

Hematological profiles among asthmatic patients in southwest ethiopia: a comparative Cross-sectional study

Abstract

Background: Asthma is a disease affecting the airways that carry air to and from the lungs. Eosinophils and neutrophils play major roles in pathogenesis of inflammatory disease. However the relation between peripheral blood cell counts of other major leukocyte, hemoglobin, and erythrocyte sedimentation rate in asthmatic patients is less clear.

Objective: The aim of this study was to determine hematological profile among asthmatic patients attending Jimma University specialized hospital, from March 1 to April 30, 2016

Methodology: Facility based comparative cross-sectional study was conducted. A total of 120 asthmatic patients and 120 apparently healthy individuals were recruited in this study. Socio-demographic and clinical data were collected using questionnaire based interview. Four mL of blood sample was collected from each study participants for hematological analysis. Complete blood count was done using Sysmex hematology analyzer, KX-21 (Sysmex Corporation, Japan). Differential leukocyte count was done by examination of thin blood films stained with Wright stain under oil immersion objective. Erythrocyte sedimentation rate was determined using Westergren's method. Data was analyzed using SPSS Version 20 software. P-value < 0.05 was considered as statistically associated.

Result: The mean comparison of hematological parameters indicated absolute and relative counts of neutrophil, eosinophil and basophil white blood cell and erythrocyte sedimentation rate were significantly high in asthmatic patients compared to control group. On the other hand, absolute and relative counts of monocyte and lymphocyte were significantly low in asthmatic patients.

Conclusion and recommendation: In this study, there was a statistical significant variation in many hematological parameters among asthmatic patients compared with control group. Therefore, hematological parameters showed significant mean difference should be considered for proper management of asthma.

Keywords: asthmatic patients, hematological profile, Hb, ESR, RBC, WBC

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Introduction

Hematological parameters are measurable blood indices that can be used as markers in the diagnosis and monitoring of certain physiological and pathological abnormalities. Hematological parameters can be affected by disease conditions affecting hematopoietic physiology and due to immunological response. For example, allergic diseases may affect the hematological parameters including eosinophils and neutrophils.¹⁻³ Allergy is a disorder of the immune system in a form of hypersensitivity in response to allergens. Asthma, allergic rhinitis and eczema are common allergic diseases. Asthma affects the airways that carry air to and from lungs. The inside walls of airways of asthmatic patients can be swollen or inflamed. This swelling or inflammation makes the airways extremely sensitive to irritations and increases susceptibility to allergic reaction. As inflammation causes the airways to become narrower, less air can pass through them, results tissue hypoxia and/or hypoxemia.^{4,5}

Asthma is a public health problem in all countries regardless of the level of development that 235 million people currently suffer from

asthma.⁶ Most asthma related deaths occur in low and lower middle income countries. Asthma is under diagnosed and under treated. It creates substantial burden to individuals and families, often restricts individuals' activities for a lifetime.⁶⁻⁸ The burden of asthma varies from region to region depending upon environmental and genetic factors. Regarding race and ethnicity, asthma prevalence was higher among black persons.^{9,10} Asthma was reported in 1.2-6.3% adults in most countries,^{11,12} the highest prevalence (>20%) was generally observed in Latin America and in English-speaking countries of Australasia, Europe, North America and South Africa. The lowest prevalence (<5%) was observed in the Indian subcontinent, Asia-Pacific, Eastern Mediterranean, and Northern and Eastern Europe. In Africa, the prevalence was mostly observed between 10-20%¹¹⁻¹⁴ while the burden of asthma is increasing through time in the world.¹⁰

Typical changes due to asthma include an increase in eosinophil and thickening of the lamina reticular, chronically the airways' smooth muscle may increase in size along with an increase in the numbers of mucous glands. Eosinophils, basophils and neutrophils play major roles in pathogenesis of allergic diseases.¹⁵ However, the relation

between peripheral blood cell counts of other types of leukocyte groups, hemoglobin (Hb) concentration, erythrocyte sedimentation rate (ESR) among asthmatic patients is less clear. In spite of this, no previous study was done on the hematological profile of asthmatic patients in Ethiopia. Therefore this study was aimed to determine the hematological profile among asthmatic patients compared with apparently healthy individuals.

Methods and materials

Study area and population

A facility based comparative cross-sectional study was done from March 1 to April 30, 2016. The study was conducted in Jimma University Specialized Hospital (JUSH). JUSH is found in Jimma Town, 350 Km southwest of Addis Ababa, capital city of Ethiopia. Currently it is the only teaching and referral hospital in the southwestern part of the country, providing services for catchment population of about 15 million people. There were 533 asthmatic patients with regular follow-up in JUSH from whom 302 were female. A total of 240 study participants, 120 asthmatic patients and 120 apparently healthy individuals, were recruited in this study. All asthmatic patients attending JUSH during the study period were included consecutively. Asthmatic patients who had self reported and/or known disease other than asthma were excluded. Pregnant women were not included in this study. Control groups were students, Jimma University and JUSH staffs, patients’ relatives or guardians and HIV voluntary counseling and testing service users.

Data collection techniques and instruments

Socio-demographic and related data were collected using questionnaire based interview. Four mL of venous blood sample was collected from each study participant using ethylene diamine tetra acetic acid (EDTA) containing vacutainer test tube in the morning. Blood samples were taken to JUSH hematology laboratory and run for complete blood count within two hours of sample collection. Hb parameters, red blood cell (RBC) parameters, platelet count and total white blood cell (WBC) count were determined by Sysmex hematology analyzer, KX-21 (Sysmex Corporation, Japan). From the same sample thin blood films were prepared for the assessment of differential count. Differential leukocyte count was done by examination of thin blood films stained with Wright stain under the oil immersion objective. Leftover EDTA anti coagulated blood samples were diluted with 3.1 g/L tri-sodium citrate in 1:4 ratio, 1 part of citrate to 4 parts of blood. Tri-sodium citrate diluted blood samples were used to determine ESR value using westergren’s method.

Table 1 Socio-demographic and clinical variables of asthmatic patients in JUSH, Jimma, South West Ethiopia, 2016

Variables	Asthmatic patients	Control group
	No (%)	No (%)
Sex		
Male	36 (30.0)	39 (32.5)
Female	84 (70.0)	81 (67.5)
Age in year		
21-30	25 (20.8)	27 (22.5)
31-40	46 (38.3)	47 (39.2)
41-50	21 (17.5)	22 (18.3)

Data processing and analysis

All the data were entered, cleaned and analyzed by using SPSS version-20 software. Descriptive statistics was used for simple frequency of variables. Unpaired T-test was done for mean comparison of hematological parameters. P value less than 0.05 was considered as statistically significant.

To assure the quality of the data, training was given for the data collectors to minimize technical and observer biases. Questioner was translated to local language, Amiharic and Oromifa. Standard operating procedures were followed during specimen collection and all other laboratory procedures. Low, normal and high control reagents were used for the hematology analyzer.

Ethical approval was obtained from Jimma university ethical review committee. Permission was taken from JUSH medical director. Prior to data collection, written informed consent was obtained from each study participant. All the laboratory test results were reported for clinician.

This study was the first in our country, particularly in the study area that will serve as a baseline for further studies. On the other hand, this study was a cross-sectional study that did not indicate hematological parameters at the baseline (the time of initial diagnosis) among asthmatic patients and changes through time. Moreover, laboratory based screening of co-infections were not done, which might have an effect on hematological profile could be another limitation.

Result

A total of 120 asthmatic patients and 120 control groups were included in this study. The mean age of asthmatic study participants was 42.8 (±13.5) ranged from 22 to 80 years old. Majority of asthmatic study participants, 38.3 % (n=46), were within the age group of 31–40 years old. Duration of asthmatic study participants live with asthma ranged from 1 year to 20 years. Maximum variation of socio-demographic characteristics comparable with study group was considered (Table 1).

The mean and standard deviation of all hematological parameters of asthmatic study participants were presented on Table 2.

In this study, all WBC parameters except total WBC count, platelet count and ESR value in asthmatic patients had significant mean difference compared with control group. Absolute and relative counts of neutrophil, eosinophil and basophil were significantly high in asthmatic patients (Table 3).

Table Continued

Variables	Asthmatic patients	Control group
	No (%)	No (%)
51-60	15 (12.5)	14 (11.7)
61-70	8 (6.7)	7 (5.8)
71-80	5 (4.2)	3 (2.5)
Residence		
urban	81 (67.5)	83 (69.2)
rural	39 (32.5)	37 (30.8)
Family size		
< 4	63 (52.5)	68 (56.7)
5-8	51 (42.5)	48 (40.0)
>8	6 (5.0)	4 (3.3)
Educational status		
Illiterate	46 (38.3)	41 (34.2)
Primary	45 (37.5)	43 (35.8)
Secondary	18 (15.0)	21 (17.5)
Higher level	11 (9.2)	15 (12.5)
Occupation		
Private	38 (31.7)	29 (30.8)
Employer	71 (59.1)	76 (56.7)
No job (including students)	11 (9.2)	22 (12.5)
Marital Status		
Never married, single	6 (5.0)	13 (10.9)
Married, live together	106 (88.3)	103 (85.8)
Widowed	8 (6.7)	4 (3.3)
Duration of patients live with asthma in year		
<5 years	49 (40.8)	
6-10 years	45 (37.5)	
11-15 years	20 (16.7)	
16-20 years	6 (5.0)	

Table 2 Mean and median of hematological parameters distribution in different sex groups of asthmatic patients in JUSH, Jimma, southwest Ethiopia, 2016

Variables/parameters	Male (n=36)		Female (n=84)		Total (n=120)	
	mean	St. Deviation	mean	St. Deviation	mean	Median
RBCs parameter						
RBC count (10 ¹² /L)	4.8	0.44	4.68	0.83	4.72	4.76
MCV (fl)	88.19	3.74	86.84	3.37	87.25	87
HCT (%)	42.5	3.89	41.84	3.15	42.04	41.5
Hb parameters						
Hb g/dL	14.29	1.44	13.92	2.13	14.04	14
MCH (pg)	29.7	1.47	29.68	1.67	29.69	29.6
MCHC (g/dL)	33.53	1.19	33.62	1.62	33.59	33.8
WBC absolute counts (10⁹/L)						

Table Continued

Variables/parameters	Male (n=36)		Female (n=84)		Total (n=120)	
	mean	St. Deviation	mean	St. Deviation	mean	Median
Total WBC count	7.36	2.54	6.64	2.47	6.85	6.5
Neutrophils	4.73	2.07	3.94	3.89	4.17	3.36
Lymphocyte	1.84	0.56	2.27	1.03	2.14	1.95
Monocyte	0.17	0.07	0.17	0.15	0.17	0.14
Eosinophil	0.48	0.14	0.49	0.31	0.49	0.42
Basophiles	0.17	0.06	0.15	0.16	0.16	0.13
WBC Differential count (%)						
Neutrophils	61.54	11.87	55.19	29.1	57.09	56.6
Lymphocyte	26.68	8.58	35.47	11.58	32.84	32
Monocyte	2.71	1.92	2.6	1.71	2.63	2.2
Eosinophil	6.95	2.32	7.67	3.36	7.45	6.5
Basophiles	2.49	1.15	2.36	1.69	2.4	2
Platelet count (106/L)	258.83	85.08	250.17	62.2	252.77	250
ESR (mm/hr)	28.86	28.32	30.03	17.22	29.68	23

BMI, body mass index; St. Deviation, standard deviation; RBC, red blood cell; MCV, mean cell volume; Hb, hemoglobin; MCH, mean cell hemoglobin; MCHC, mean cell hemoglobin concentration; ESR, erythrocyte sedimentation rate; WBC, white blood cell

Table 3 Comparisons of Mean values of hematological parameters of asthmatic patients and apparently healthy individuals in JUSH, Jimma, South west Ethiopia, 2016

Hematological parameters	Asthmatic patients (mean ± SD)	Control group (mean ± SD)	P-value
RBC parameters			
RBC count (10 ¹² /L)	4.83±.35	4.72±.74	0.142
MCV(fl)	87.74±4.01	87.25±3.52	0.32
HCT (%)	42.45±2.91	42.04±3.38	0.314
Hb parameters			
Hb (g/dL)	14.04±1.95	13.18±.91	0.101
MCH (pg)	29.69±1.61	28.77±1.17	0.061
MCHC (g/dL)	33.59±1.51	32.77±.71	0.054
WBC absolute counts (10⁹/L)			
Total WBC count	6.85±2.51	6.72±1.30	0.614
Neutrophils	4.17±3.46	3.49±.87	0.038
Lymphocyte	2.14±.94	2.47±.63	0.041
Monocyte	0.17±.13	0.45±.21	0.013
Eosinophil	0.49±.27	0.27±.15	0.001
Basophiles	0.16±.13	0.04±.05	0.001
WBC differential counts (%)			
Neutrophils	57.09±25.31	51.92±7.72	0.033
Lymphocyte	32.84±11.47	36.95±7.18	0.002
Monocyte	2.63±1.77	6.66±2.66	0.001
Eosinophil	7.45±3.09	3.95±1.95	<0.001
Basophiles	2.40±1.55	0.58±0.74	0.001
Platelet count (10 ⁹ /L)	252.77±77.23	275.62±60.48	0.071
ESR (mm/hr)	29.68±21.05	5.98±5.02	<0.001

RBC, red blood cell; MCV, mean cell volume; Hb, Hemoglobin; MCH, mean cell hemoglobin; MCHC, mean cell hemoglobin concentration; WBC, white blood cell; ESR, Erythrocyte sedimentation rate; SD, standard deviation; CI, Confidence interval

Discussion

A total of 240 study participants were included in this study. Comparison of mean values indicated, many hematological parameters had significant mean difference between the two groups. Accordingly, ESR value, platelet count, and relative and absolute count of neutrophil, eosinophil and basophile had significantly high mean value in asthmatic patients compared to control groups. On the other hand, the mean values of relative and absolute count of lymphocyte and monocyte were significantly lower in asthmatic patients compared to control groups.

Mean RBC count and Hb concentration in our study were higher in asthmatic patients compared to control group but there were no significant mean difference. An increase in RBC count and Hb concentration among asthmatic patients might be due to the fact that increased erythropoietin production. Erythropoietin is the principal stimulator of erythropoiesis and is induced under hypoxic conditions.¹⁶

In this study, there was slightly higher total WBC count among asthmatic patients compared to the control group but there was no significant mean difference among the groups. Another similar study done in Assam Medical College and Hospital reported significant difference on WBC count.¹⁷ The difference might be due to the difference in method and study population. For example in our study, study participants were out patients while study done in Assam Medical College and Hospital, Dibrugarh study participants were inpatients. The other reason might be emanated from laboratory methods as total leukocyte count was done manually using Turk's diluting fluid and Neubauer's chamber while in this study total WBC was done using hematological auto-analyzer.

Absolute counts of neutrophil ($P=0.038$), eosinophil ($P=0.001$) and basophile ($P=0.001$) were significantly higher in asthmatic patients as compared to the control groups in this study. The increase in eosinophil count in our study was consistent with similar studies, which reported circulating eosinophils were elevated in asthmatic patients.^{17,18} This might be due to the fact that circulating eosinophils are elevated in patients with allergic conditions. It has been reported that eosinophils recruitment is being induced by exotaxin and the involvement of IL-4 and IL-13 in allergic reactions.¹⁹⁻²¹

The current study showed mean lymphocyte ($P=0.041$) and monocyte ($P=0.013$) count were significantly low in asthmatic patients compared to the control group. This finding was supported by other similar study.¹⁷ This might be due to the fact that neutrophil influx and the subsequent neutrophil activation involve IL-8 mediation, which results the activation of innate immune mechanisms rather than acquired immunity.²² Low monocyte count in asthmatic patients in this study was supported by other study reported evidence for activation of alveolar macrophages, but not peripheral blood monocytes, among asthmatic patients.²³ This might be due to monocytes migration from the bone marrow to the inflamed tissue through the peripheral blood system and mature into macrophages, the functional cell of the lineage. Then, monocytes can produce a complex repertoire of cytokines and can actively participate in the pathogenesis of inflammatory diseases.²⁴

The current study indicated mean ESR value ($P<0.001$) was significantly high in asthmatic patients as compared to apparently healthy individuals. This finding was supported by a study done dermatology and ENT of Assam Medical College and Hospital, Dibrugarh.¹⁷ The increased of ESR in this study might be due to the

mediators of IL-1 and Tumor necrosis factor produced by mast cell, basophile, and macrophage and then, these mediators stimulate the liver to produce acute phase proteins, such as fibrinogen. On the other hand increasing level of fibrinogen will increase positive charge and rouleaux formation will be found. This rouleaux formation increases the ESR among asthmatic patients.²⁵

Mean platelet count in this study was lower in asthmatic patients compared to the control group but the difference was not significant. Other studies reported that there was significantly high platelet cell count in asthmatic patients who were allergic, hospitalized and ambulatory patients in the Department of Allergology and Internal Diseases at the Medical University of Bialystok.²⁶ The same study reported that there was no significant difference on platelet count among non-allergic asthmatic patients compared with healthy groups.²⁶ The difference might be due to selection of study groups in our study that all asthmatic, allergic and non-allergic asthmatic patients were considered as study groups.

Conclusion

Hematological parameters that showed significant mean difference between asthmatic patients and apparently healthy individuals should be considered for proper management and monitoring of asthmatic patients. In addition to this, these hematological parameters might be used as an additional input for the diagnosis of asthma. It might be very important to have other studies on newly diagnosed asthmatic patients and longitudinal studies as well.

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Conflict of interest

The authors declare that there is no conflict of interest.

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