

**SPIROMETRIC STUDY IN BRONCHIAL ASTHMA PATIENTS OF DIFFERENT AGE GROUPS****K.SIVANANDHAN*¹, NALINI SIVANANDHAN² AND M.PALANISWAMY¹**¹Department of Microbiology, Karpagam Academy of Higher Education, Coimbatore, Tamil Nadu, India²Asthma Research and Treatment Centre, Shanthi Nursing Home Campus, 133, Palladam Road, Pollachi, Coimbatore, Tamil Nadu, India**ABSTRACT**

Spirometric study was conducted for 83 bronchial asthma patients (43 males and 40 females) who attended the Asthma Research Centre, Pollachi to know the influence of height, age and gender of the patient, duration of suffering, Immunoglobulin E level and smoking upon spirometric values FEV1 and FEV1%. The patients were divided into six groups, depending upon their age (from 10 years to 60 years). The test was conducted using Helios – 702 electronic spirometer as per the guidelines of American Thoracic Society (ATS) statement on standardization of spirometry 1994 Update (1995). For an analysis of the spirometric results it was observed that the decline in spirometric values was more marked in shorter patients; the duration of illness had little effect up to 30 years of age; the duration of suffering and smoking caused a great decline after 40 years of age; gender and Immunoglobulin E level had insignificant influence upon spirometric values.

KEYWORDS: Bronchial asthma – Spirometric study – Total Immunoglobulin E – Forced Expiratory Volume in one second.

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INTRODUCTION

Asthma, a chronic recurrent inflammatory disease of the airways, is usually episodic in nature and reversible, either spontaneously or with treatment in early stages. However, in chronic conditions, airflow limitation occurs as a result of varying degrees of airway hyperresponsiveness, airway edema and bronchial constriction. Pulmonary Function Test (PFT) is a non-invasive test, used to detect airflow restriction and lung volume limitation. Any pathological alteration in the structure of the lung tissue affects spirometric values. The lung function, as measured by FEV₁, increases steadily in childhood, reaching a peak at the age of 16, at which point it remains relatively stable until the age of 35 when it begins to decline.¹ Asthmatic subjects had approximately twice the rate of decline in FEV₁ than that occurred in non-asthmatic subjects (Lange 1998).² The major determinants of Forced Expiratory Volume (FEV) are age, gender (Covar 2004),³ duration of disease,⁴ more prominent eosinophilic airway inflammation (Covar 2004),³ asthma exacerbations⁵ and smoking.⁴ In this study an attempt has been made to determine the effect of height of patients, ageing, duration of suffering, smoking and total Immunoglobulin 'E' level upon the spirometric values of FEV₁ and FEV₁% of asthmatic patients of different age groups.

MATERIALS AND METHODS

Sample Selection

Eighty - three patients (both male and female) suffering from bronchial asthma belonging were selected for the study. Patients belonged to both urban and rural areas and duration of disease was varied for these patients. The patients were divided into six groups based on their age as follows: Group A: 10 years and below, Group B: 11 to 20 years, Group C: 21 to 30 years, Group D: 31 to 40 years, Group E: 41 to 50 years and Group F: 51 to 60 years.

Case History

All patients were thoroughly examined and detailed reports about the history of wheezing and treatment history were entered in case sheets. In history of wheezing, parameters such as duration of suffering, whether it was diurnal or nocturnal, the number of attacks, potential allergen exposure history etc. were noted down. In treatment history, intake of medications including use of inhaler, rotahaler and nebulizer were noted down.

Various Parameters Considered

1. Height and weight of the subjects were measured, as specified before (Crapo *et al.*, 1999).⁶
2. Spirometric Parameters
3. The total immunoglobulin 'E' level in serum was estimated in all patients by ELISA method. It is intended as an aid to diagnose atopy.

Spirometric Test

The simple Forced Vital Capacity (FVC) maneuver was performed using Helio-702 electronic spirometer which was pre-calibrated. As per the guidelines of the American Thoracic Society (ATS)⁷ statement on standardization of spirometry 1994 Update (1995), Spirograms which were free from artifacts and which had a good start with satisfactory exhalation were considered for study. The bronchodilator test was done using 200 µg of metered dose of Salbutamol inhaler and Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV₁), FEV₁ in percentage (FEV₁%) were recorded for analysis (NAEPP – 2002).⁸

ELISA test

IgE ELISA was performed as per instructions from Manufacturer (Omega Diagnostics, UK). Briefly, the number of strips required for the assay was assembled. 100 µl of each standard and positive control were dispensed. 20 µl of each sample to be tested was dispensed into the respective wells and 80 µl of sample diluent was added to into each sample well to make a 1/5 dilution. Assay plate was tapped rapidly to mix the well contents and then incubated for 60 minutes at room temperature. After 60 minutes, well contents were decanted and the wells were washed 3 times manually with wash buffer. 100 µl of Conjugate was then dispensed into each well and incubated for 30 minutes at room temperature. After 30 minutes, the well contents were discarded and washed 4 times carefully. It was ensured that the wells were empty but did not dry out. Then, 100 µl of TMB Substrate was rapidly added into each well and incubated for 10 minutes after which 100 µl of Stop Solution was added to each well. Optical density (OD) was read at 450nm in a microplate reader (Robonic) within 10 minutes.

RESULTS AND DISCUSSION

Group A (Age 10 years and below)

In this age group, boys with the low height of 120 – 125 cms (boys with ID No. 45, 78, and 133) were having very low FEV₁ value when compared to the other boys with more than 125 cms in height.]

Table I

Spirometry Results (Age below 10 years) R – Rural U – Urban IgE - Immunoglobulin E Sm – Smoker N.Sm – Nonsmoker FEV1 – Forced Expiratory Volume in 1- second Ht – Height Pre Bro – Pre Bronchodilator Post Bro – Post Bronchodilator

S. No	ID No.	Age	Sex	AREA: R/U	Ht, in cms	S/NS	Duration of Suffering , yrs	Total IgE, IU/ml	SPIROMETRY VALUES				Predicted Normal Value of FEV1 (L)
									FEV ₁ (L)		FEV1 %		
									Pre- Bro	Post- Bro	Pre- Bro	Post- Bro	
1	45	8	M	U	120	NS	3	1707	0.56	0.61	44	48	1.28
2	131	8	M	U	127	NS	5	160	1.01	1.15	72	82	1.4
3	46	9	M	R	143	NS	7	1437	1.71	1.74	93	95	1.84
4	48	9	M	U	127	NS	4	1455	1.09	1.12	78	80	1.4
5	71	9	M	U	136	NS	5	1624	1.16	1.18	72	73	1.62
6	79	9	M	U	138	NS	3½	352	1.14	1.28	68	76	1.68
7	110	9	M	U	138	NS	8	316	1.41	1.56	84	93	1.68
8	133	9	M	R	119	NS	-	968	0.98	0.98	78	78	1.26
9	47	10	M	R	132	NS	3	638	1.31	1.45	87	96	1.51
10	78	10	M	R	125	NS	6	809	0.86	0.93	63	68	1.36

Though the boy with ID No. 46, who was 143 cms in height, was suffering from bronchial asthma for 7 years, and his total immunoglobulin 'E' level was 1437 IU/ml, his FEV1 and FEV1% were only slightly reduced. Thus, the analysis of the results showed that in Group A – consisting of only males (Aged 10 years and below) - with the increase in height of patients, there was less decline in FEV1 and FEV1% values. In contrast, the duration of illness and total Immunoglobulin 'E' level had very little impact on FEV1 and FEV1% values. The

findings are in accordance with the study report of Stanley (2004)⁹ which says that 'recent studies have shown that male sex is a risk factor for asthma progression from childhood to early adulthood'.

Group B (Age 11 to 20 years)

On analysis it was noted that in persons with ID Nos. 27, 80, 34, who were taller than the average height of 152.5cms, there was no decline in spirometric values of FEV1 and FEV1% which was more than 100%.

Table II

Spirometry Results (Age 11 – 20 Years)

S. No	ID No.	Age	Sex	AREA: R/U	Ht, in cms	S/NS	Duration of Suffering , yrs	Total IgE, IU/ml	SPIROMETRY VALUES				Predicted Normal Value of FEV1 (L)
									FEV ₁ (L)		FEV1 %		
									Pre- Bro	Post- Bro	Pre- Bro	Post- Bro	
1	27	12	M	U	157	NS	2	86	11	2.5	100	104	2.4
2	122	12	M	R	141	NS	10	393	1.64	2.02	93	114	1.77
3	195	12	F	U	152	NS	1	1357	1.82	1.94	86	92	2.12
4	92	13	M	R	148	NS	1½	780	1.87	1.86	93	92	2.02
5	97	13	F	U	149	NS	11	1192	1.67	1.72	82	85	2.03
6	80	14	M	R	161	NS	1	1198	2.72	2.8	105	108	2.59
7	88	14	F	R	131	NS	12	1403	1.06	1.47	72	100	1.47
8	108	14	M	R	159	NS	3	764	1.95	1.98	78	80	2.49
9	109	14	M	R	155	NS	3	609	1.5	1.6	65	69	2.31
10	201	14	F	R	153	NS	12	1109	1.46	1.67	68	78	2.15
11	34	15	F	R	153	NS	4	1195	2.28	2.37	106	110	2.15
12	125	15	F	R	146	NS	1	1154	1.66	1.69	86	87	1.94
14	33	16	F	R	157	NS	7	1107	1.9	2.47	83	108	2.28
15	72	16	M	R	162	NS	4	353	2.01	2.07	76	78	2.64
16	70	17	M	R	167	NS	2	919	2.69	2.64	93	90	2.9

There was a marked decline in FEV1 and FEV1% values in patients who were below the average height with long duration of suffering from bronchial asthma as in the case of persons with ID Nos. 97, 88 and 201. The total immunoglobulin 'E' level was although more than 1000 IU/ml in patients with ID Nos. 34 and 80, who were above the average height, the FEV1 and FEV1% values were not affected. It was, in general, noticed that the decline in FEV1 and FEV1% values

were more marked in shorter persons and those suffering from bronchial asthma for a long time.

Group C (Age 21 to 30 years)

The FEV1 and FEV1% values were reduced in all patients before the administration of bronchodilator drug but they increased after bronchodilator (Asthalin inhaler 200µg metered dose) administration.

Table III
Spirometry Results (Age 21 – 30 Years)

S. No	ID No.	Age	Sex	AREA: R/U	Ht, in cms	S/NS	Duration of Suffering , yrs	Total IgE, IU/ml	SPIROMETRY VALUES				Predicted Normal Value of FEV1 (L)
									FEV ₁ (L)		FEV1 %		
									Pre- Bro	Post- Bro	Pre- Bro	Post- Bro	
1	146	22	M	R	184	NS	4	310	3.38	3.46	101	103	3.35
2	165	23	M	R	172	NS	5	950	1.26	3	35	83	3.6
3	38	25	M	R	169	NS	15	1500	3.32	3.28	97	95	3.44
4	31	27	M	U	124	NS	26	460	2.76	2.59	77	72	3.58
5	69	27	F	R	150	NS	3	1665	1.97	2.04	88	91	2.25
6	84	28	F	R	157	NS	15	469	2	2.07	81	84	2.47
7	41	29	F	U	173	NS	25	1208	1.3	1.9	44	64	2.98
8	59	29	F	U	151	NS	1	1123	1.98	2.09	88	93	2.24
9	61	29	F	R	144	NS	3	495	1.51	1.73	75	86	2.01
10	75	29	M	R	171	NS	12	485	1.59	2.23	46	65	3.42
11	95	29	F	U	153	NS	12	193	1.65	1.76	71	76	2.31
12	115	29	F	R	162	NS	2 mon	835	2.32	2.41	89	92	2.61
13	59	29	F	U	151	NS	1	1123	1.98	2.09	88	93	2.24
14	55	30	F	R	139	NS	1	1210	1.16	1.28	64	70	1.82

It was inferred that in this age group of 21 to 30 years, the FEV₁ and FEV₁% values were not declined in taller patients (more than the average height of 156 cms) if their duration of suffering from bronchial asthma was below 5 years. If the duration of suffering was more than 10 years, then there was a marked decline in FEV₁ and FEV₁% values although their heights were more than the average height. Further, in this group, the gender, age and total immunoglobulin E level showed very insignificant influence in causing decline in FEV₁ and FEV₁% values.

Group D (Age 31 to 40 years)

In this age group, there were 16 patients: 5 males and 11 females. 2 persons were current smokers and 14

persons were non-smokers. As for patients with ID Nos. 123, 36, 44, 112 and 42 who were shorter than the average height of 159 cms, their FEV₁ and FEV₁% values were declined markedly. And as for patients with ID Nos. 62, 64, 65, 52 and 96 who were having either average height or above it, their FEV₁% values were above 80%. More years of suffering caused a marked decline in FEV₁ and a FEV₁% as in the case of patients with ID Nos. 128, 105, 185, 44, 42 and 143. Smoking also caused a marked decline in FEV₁ and FEV₁% values in patients with ID No. 128 and 194. This finding is in line with the results of Lange (1998),² Thomson(2005),¹⁰ and Althuis(1999).¹¹

Table IV
Spirometry Results (Age 31 – 40 Years)

S. No	ID No.	Age	Sex	AREA: R/U	Ht, in cms	S/NS	Duration of Suffering , yrs	Total IgE, IU/ml	SPIROMETRY VALUES				Predicted Normal Value of FEV1 (L)
									FEV ₁ (L)		FEV1 %		
									Pre- Bro	Post- Bro	Pre- Bro	Post- Bro	
1	64	31	F	U	162	NS	8	104	2.15	2.44	84	95	2.57
2	123	31	F	U	155	NS	3	361	1.27	1.41	54	60	2.34
3	185	31	M	R	173	NS	13	290	1.41	1.67	41	49	3.44
4	36	32	F	R	154	NS	7	1100	1.12	1.51	49	66	2.28
5	52	32	F	U	156	NS	2	145	2.88	2.72	123	116	2.35
6	96	32	F	U	157	NS	15	1046	2.05	2.12	86	89	2.38
7	98	33	F	U	144	NS	1½	938	1.63	1.72	85	90	1.92
8	105	34	F	U	160	NS	22	135	1.57	1.93	64	79	2.44
9	44	35	F	R	147	NS	12	1305	1.02	1.66	52	59	1.98
10	128	35	M	R	175	S	30	353	2.02	2.12	59	62	3.42
11	194	35	M	R	168	S	3	1521	1.9	1.98	60	63	3.16
12	42	37	F	R	151	NS	12	120	0.98	0.98	47	47	2.07
13	65	37	M	R	158	NS	10	1292	2.46	2.39	89	87	2.75
14	143	37	M	U	176	NS	10	2296	0.8	0.83	24	24	3.4
15	112	38	F	R	150	NS	6	182	1.36	1.38	67	68	2.02
16	62	39	F	U	161	NS	3	390	2.37	2.67	100	113	2.37

Group E (Age 41 to 50 years)

Total patients in this group were 13. Among them were 6 males and 7 females. Excepting in the patients with ID No. 39, 66 and 142 who were suffering from bronchial asthma for 40 years, 15 years and 15 years respectively, the post-bronchodilator values of FEV₁ and FEV₁% were reduced. In the rest of the patients, the post-bronchodilator values of FEV₁ and FEV₁%

were increased. The patient with the ID No. 104, who was although 170 cms in height, was suffering from bronchial asthma for 15 years and since he was a smoker, his pre and post bronchodilator values of FEV₁ and FEV₁% were very much declined. His FEV₁ w and FEV₁% were only 34 and 39%, the lowest of all patients.

Table V
Spirometry Results (Age 41 – 50)

S. No.	ID No.	Age	Sex	AREA: R/U	Ht in Cms	S/NS	Duration of Suffering , yrs	Total IgE IU/ml	SPIROMETRY VALUES				Predicted Normal Value of FEV ₁ (L)
									FEV ₁ (L)		FEV ₁ %		
									Pre- Bro	Post- Bro	Pre- Bro	Post- Bro	
1	39	42	F	R	152	NS	40	1027	1.06	0.92	53	46	2
2	54	42	M	R	171	NS	25	203	2.29	2.44	74	79	3.1
3	221	44	M	U	155	NS	6	237	1.63	1.82	66	74	2.46
4	94	45	F	U	147	NS	7	1053	1.66	1.7	94	96	1.77
5	227	45	F	R	147	NS	2	540	1.03	1.11	58	63	1.77
6	135	46	M	U	169	NS	10	510	1.8	2.36	61	81	2.93
7	111	47	F	U	148	NS	1½	333	1.49	1.63	85	93	1.76
8	149	47	F	U	163	NS	8	854	0.77	0.97	34	43	2.26
9	175	47	M	U	168	NS	6	91	1.63	1.76	57	61	2.87
10	101	48	F	R	142	NS	10	238	1.02	1.08	66	70	1.54
11	104	49	M	R	170	S	15	427	0.99	1.12	34	39	2.89
12	142	49	M	R	167	NS	15	281	2.54	2.29	91	82	2.78
13	66	50	F	R	154	NS	15	21	0.99	0.98	52	52	1.9

Hence, it was found out that in the asthmatic patients, the duration of suffering and smoking caused accelerated decline in FEV₁ and FEV₁% values as in the case of patients with ID Nos. 42, 66, 149, 104 and 101. The study report of Soriano (2009)¹² as presented in 'The natural history of chronic air flow obstruction revisited' is also in line with our findings. It was inferred that in patients between 41 to 50 years of age, the height of the patient has got little influence on the decline of FEV₁ and FEV₁% values. The study report of Zeiger (1998)¹³ strongly supports the findings of this study. Smoking in these asthmatic patients caused accelerated decline in FEV₁ and FEV₁% values as in the case of the patient with ID No. 104. In the study conducted by Sarojini (2014)¹⁴ there was decline in

spirometric value in women exposed to even passive smoking.

Group F (Age 51 to 60 years)

Total patients examined were 15. Among them there were 9 males and 6 females. One patient with ID No. 187, who was 145cms in height, and another with ID No. 117, who was 174 cm in height, were suffering from bronchial asthma for 30 years and their pre and post-bronchodilator FEV₁ and FEV₁% values were markedly reduced. The FEV₁ and FEV₁% values were declined in the patient with the ID No. 208 who was 149cms in height that was well below the average height, though he was suffering from bronchial asthma for only 5 months.

Table VI
Spirometry Results (Age 51 – 60)

S. No	ID No.	Age	Sex	AREA: R/U	Ht, in cms	S/NS	Duration of Suffering, yrs	Total IgE, IU/ml	SPIROMETRY VALUES				Predicted Normal Value of FEV ₁ (L)
									FEV ₁ (L)		FEV ₁ %		
									Pre- Bro	Post- Bro	Pre- Bro	Post- Bro	
1	228	51	F	R	162	NS	10	255	1.55	1.59	72	74	2.15
2	187	52	F	R	145	NS	30	1265	0.65	0.73	42	47	1.55
3	208	53	M	U	149	NS	5 mon	443	1.24	1.2	61	59	2.02
4	77	54	M	R	172	NS	15	469	1.46	1.6	51	56	2.84
5	93	55	F	U	145	NS	20	295	1.2	1.27	81	85	1.49
6	117	55	M	R	174	NS	30	269	1.54	1.66	53	57	2.89
7	120	55	M	U	161	NS	5	172	2.12	2.28	88	95	2.41
8	73	57	F	R	155	NS	10	144	0.76	0.76	43	43	1.78
9	51	58	F	U	153	NS	10	1229	1.2	1.46	71	86	1.69
10	100	58	M	R	165	NS	5	314	0.63	0.68	25	27	2.48
11	161	58	M	U	167	NS	3	347	2.52	2.5	98	98	2.56
12	188	58	F	R	156	NS	20	1242	1.22	1.35	68	75	1.8
13	35	59	M	R	171	NS	6	141	2.12	2.51	50	60	2.68
14	74	60	M	R	161	NS	20	1387	0.76	1.19	33	52	2.29
15	129	60	M	R	171	NS	7	619	1.99	2	75	75	2.65

The pre and post - bronchodilator FEV₁ and FEV₁% values were also significantly declined in patients with ID Nos. 188, 74, 77 and 73 who were suffering from bronchial asthma for 10 to 20 years. Among 15 patients, only in 4 patients with ID Nos. 51, 93, 120 and 161, the post bronchodilator value of FEV₁% exceeded 80% and in all other 11 patients, the post- bronchodilator value of FEV₁% was below 80%. The marked reduction in spirometric value was in line with the perception that asthma is a chronic, eosinophilic inflammatory disease where tissue injury and repair may lead to irreversible fibrotic changes in the air ways leading to decline in

pulmonary functions. The spirometric values FEV₁ and FEV₁% were reduced before the administration of bronchodilator drug in all patients and increased after the administration of the same. These findings were thus in line with the perception that asthma is characterized by the presence of reversible airflow obstruction. The marked decline in FEV₁ and FEV₁% values in patients suffering from asthma for a long duration may be due to at least three mutually independent mechanisms by which one can reach a low level of FEV₁ in later adult life. They are reduced growth, premature and accelerated decline in lung function.

Table VI
Forced Expiratory Volume in 1 second (FEV1) and FEV1 in percentage (FEV1%):
Pre and Post bronchodilator mean values compared with predicted normal values.

S.No	Age groups	No. of patients	Mean±SEM				Predicted Normal value, FEV1(L)
			FEV1		FEV1%		
			Pre-Broncho	Post-Broncho	Pre-Broncho	Post-Broncho	
1	< 10 years	10	1.1±0.1	1.2±0.1**	73.9±4.4	78.9±4.7**	1.5
2	11 to 20 years	15	1.9±0.12	2±0.11	85.7±3.3	93±3.5*	2.2
3	21 to 30 years	13	2±0.20	2.3±0.18	73.5±5.8	82.6±3.4*	2.8
4	31 to 40 years	16	1.7±0.15	1.8±0.14**	67.8±6.3	72.9±6.1**	2.6
5	41 to 50 years	13	1.5±0.15	1.6±0.16	63.5±5.2	67.6±5.2	2.3
6	51 to 60 years	15	1.4±0.15	1.5±0.15**	60.7±5.35	65.9±5.22**	2.2

** $p < 0.005$, * $p < 0.05$, SEM – Standard Error of Mean, FEV1 (L) – Litres of Air

A case control study was performed in the Busselton cohort by Peat and co-workers (1987).¹⁵ Asthmatic subjects had a greater rate of decline in FEV1 values, than did a non-asthmatic subject. The other study done by Lange (1998)² showed that asthmatic subjects had approximately twice the rate of decline in FEV1 values than that occurred in non-asthmatic subjects. Conflicting results have been reported regarding the influence of bronchial asthma on the rate of decline of lung function. Anyhow, the results of previous studies of the decline in FEV1 values in people with asthma are consistent with the present findings. In the present study, although the number of smokers participated was very low, there was a definite accelerated decline

in FEV1 and FEV1% values of lung function tests. Thompson and Spears (2005)¹⁰ have reported that smoking and asthma are associated with poor symptom control and impaired therapeutic responses to anti-asthma drug. Higher levels of smoking are seen in patients with asthma who attend emergency departments with exacerbations (Silverman 2003).¹⁶ But, Ulrik (1992),¹⁷ in their 10 year follow up of 180 asthmatic patients, reported that there was no relation between the rate of decline in lung function and the number of cigarettes smoked. Compared with the asthmatic non-smokers, smokers with asthma have worse symptom control (Althuis 1999)¹¹ and an increased mortality rate (Marquette 1992).¹⁸

Table.VII
Relationship of asthma in adults to decline in FEV1

Author	Subjects	Follow – up	FEV1 decline
Peat <i>et al.</i> , (1987)	92 asthmatics could not assess smoking indefinitely	18 Yrs	Asthma 15 ml > Non –asthma
Buist and Vollmer (1987)	35 adult asthmatics 2 cohorts	9 – 11 Yrs	Employee's asthma > decline then non – asthma only among non- smokers screening asthma > decline than non-asthmatics only among smokers
Lange <i>et al.</i> , (1998)	1095 asthmatics	15 Yrs	Asthma 14 ml /Yr > non-asthma
Fletcher <i>et al.</i> , (1976)	17 male smokers with asthma	8 Yrs	Asthma 22 ml/ 1Yr > non-smokers
Schachter <i>et al.</i> , (1984)	Adult smokers; no adjustment for age, gender of smoking	6 Yrs	Asthma 18 ml > non-smokers

In the present study, there was marked decline in FEV1 and FEV1% values in patients above 50 years of age. But, Peat (1987)¹⁵ did not find any influence of age on the functional decline over several years in asthma, whereas Ulrik (1992)¹⁹ reported steeper decline in FEV1 values with ageing. Ageing, unlike the duration of disease, may lower the intensity of the events of re-modeling that characterize chronic asthma.

CONCLUSION

Therefore, it was clearly evident from the present study that asthma patients showed marked decline in all lung functions when compared to the predicted values of that age group, and further the spirometric values of FEV1 and FEV1% were influenced by the height of the patient, ageing, duration of suffering and smoking.

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Smoking in asthmatics aggravated the symptoms and accelerated the decline in lung functions.

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