RESULTS

The results of our study are illustrated in the following tables (table1- 21) and figures (figure1-23)**.** This study was conducted on 60 randomly selected children, aged from 2 to 12 years, 40 patients suffering from bronchial asthma and 20 healthy age and sex matched children taken as a control group. All of our patients were in the acute asthma attack. The study was conducted at Benha University Children Hospital over the period from May 2010 to April 2011.

Table (1): Comparison between the two studied groups according to demographic data.

	Cases (n = 40)		Control (n = 20)		Test of sig.
	No.	%	No.	%	
Sex					
Male	22	55.0	9	45.0	$\chi^2 = 0.534$
Female	18	45.0	11	55.0	p = 0.465
Age(years)					
Range	3.0 – 12.0		2.0 – 12.0		Z = 0.863
Mean ± SD	6.88 ± 3.01		6.23 ± 3.04		p = 0.388
Median	6.0		5.50		
Residence					
Urban	30	75.0	13	65.0	$\chi^2 = 0.657$
Rural	10	25.0	7	35.0	p = 0.418
Parent education					
Not educated	8	20.0	6	30.0	$\chi^2 = 0.745$
Educated	32	80.0	14	70.0	p = 0.388
Family size					
≤ 5	17	42.5	12	60.0	$\chi^2 = 1.635$
> 5	23	57.5	8	40.0	p = 0.201
Range	3.0 – 8.0		3.0 – 8.0		Z = 1.398
Mean	5.85 ± 1.21		5.30 ± 1.63		p = 0.162
Median	6.0		5.0		

χ^2: Chi square test
Z : Z for Mann Whitney test

This table shows that male patients constiuted55% while female patients constituted 45% of the cases with age ranging from 3-12 years with mean age (6.88 ± 3.01). Patients from rural areas constituted 25% and those from urban side constituted 75% of the cases, most of our patients were for educated parents constituting 80% of cases with 57.5 % of asthmatics were belonging to family size more than 5.

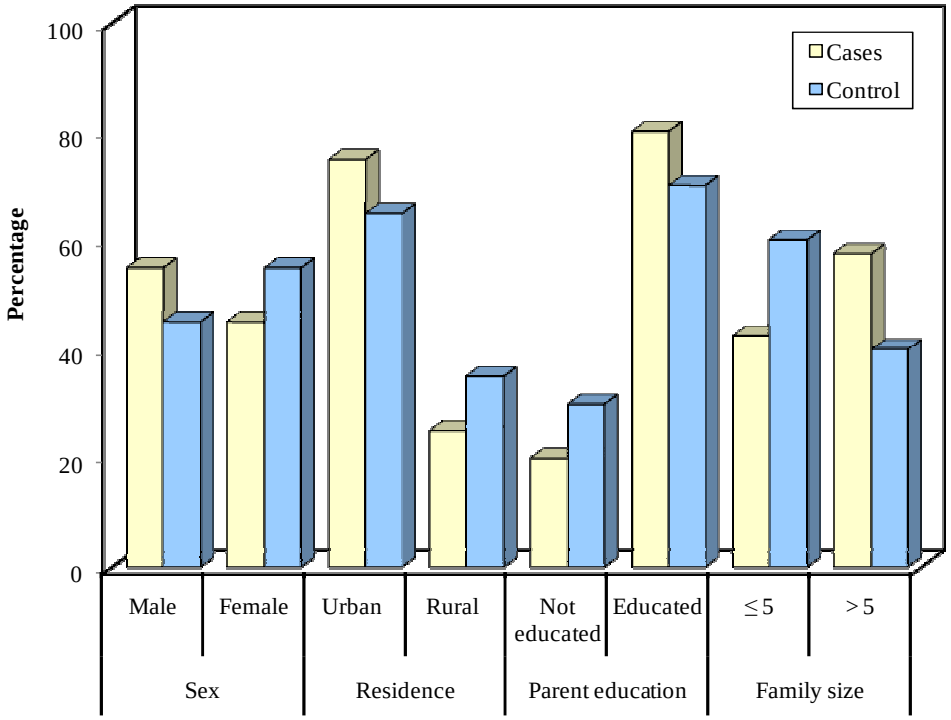

Figure (1): Comparison between the two studied groups according to demographic data.

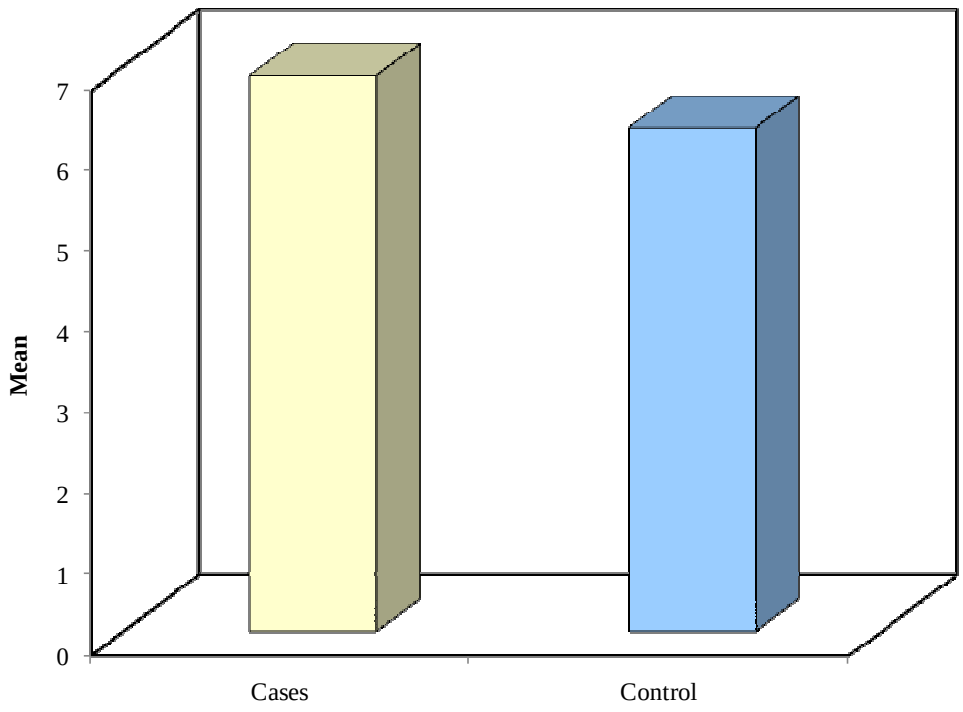

Figure (2): Comparison between the two studied groups according to age.

Table (2): Distribution of the studied asthmatics according to age at onset and duration of asthma (n = 40).

variables	No.	%
Age at onset (years)		
Less than 3 years (early onset)	14	35.0
≥ 3 years	26	65.0
Range	2.0 – 5.0	
Mean ± SD	3.31 ± 1.11	
Median	3.0	
Duration of asthma (years)		
< 5	28	70.0
≥ 5	12	30.0
Range	1.0 – 10.0	
Mean ± SD	3.56 ± 2.55	
Median	2.50	

This table shows that**,** most of our patients had their first attack of asthma at or above 3 years of age (65% of cases) with mean duration **(**3.56 ± 2.55**).**

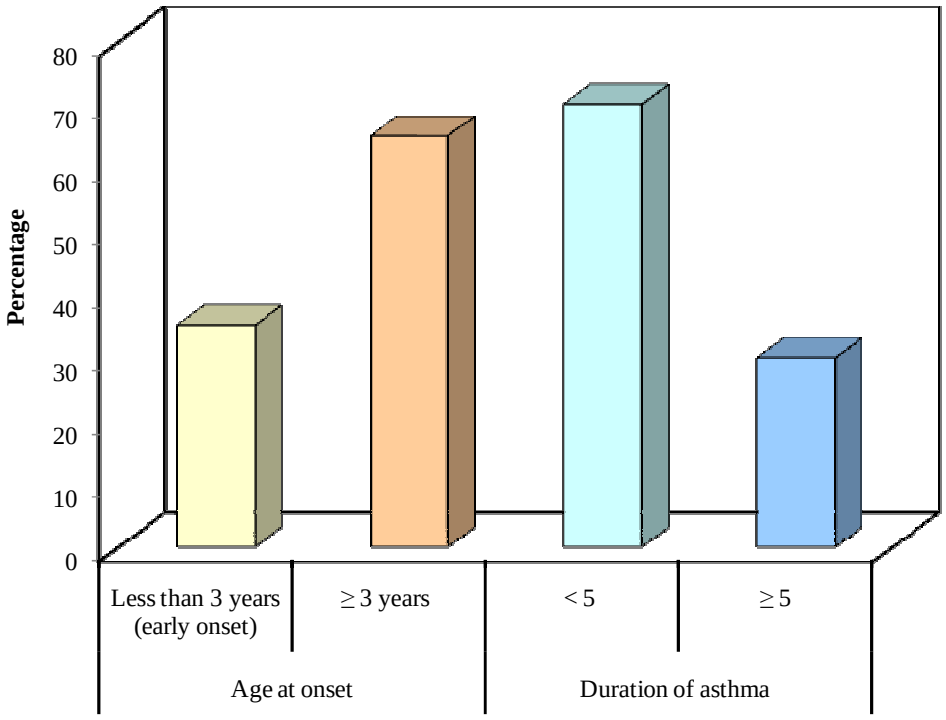

Figure (3): Distribution of the studied asthmatics according to age at onset and duration of asthma (n=40).

Table (3): Comparison between the two studied groups according to family history of atopy and personal history of associated atopy.

	Cases (n = 40)		Control (n = 20)		Test of sig.
	No.	%	No.	%	
Family history of atopy					
-ve	17	42.5	20	100.0	FEp <0.001
+ve	23	57.5	0	0.0	
Associated atopy					
+ve atopy	**6**	**15.0**	**0**	**0.0**	FEp = 0.165
Skin allergy	2	5.0	0	0.0	
Allergic rhinitis	2	5.0	0	0.0	-
Skin allergy + rhinitis	2	5.0	0	0.0	

This table shows that, 15% of our cases have associated atopy in the form of skin allergy and/ or allergic rhinitis with positive family history of atopy in 57.5% of the cases.

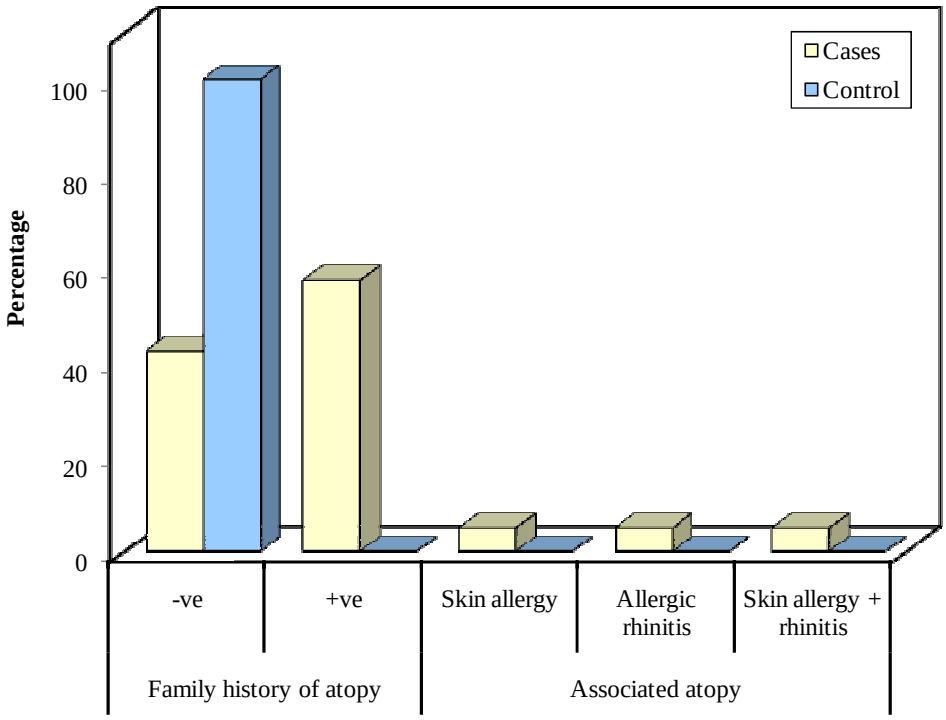

Figure (4): Comparison between the two studied groups according to family history of atopy and personal history of associated atopy.

Table (4): Classification of asthmatic patients according to asthma grade and the level of control.

	Cases (n = 40)	
	No.	**%**
Asthma grade		
Mild persistent	3	7.5
Moderate	21	52.5
Severe	16	40.0
Level of control		
Uncontrolled	30	75.0
Controlled	10	25.0

This table shows that, most of our patients with moderate asthma presenting 52.5%, 40% with severe asthma and 7.5% with mild persistent asthma. Also, 75% of our patients had uncontrolled bronchial asthma.

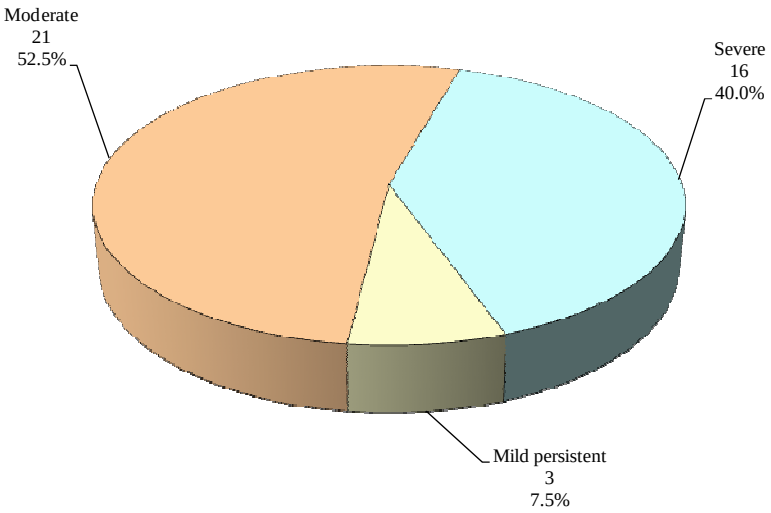

Figure (5): Classification of asthmatic patients according to asthma grade.

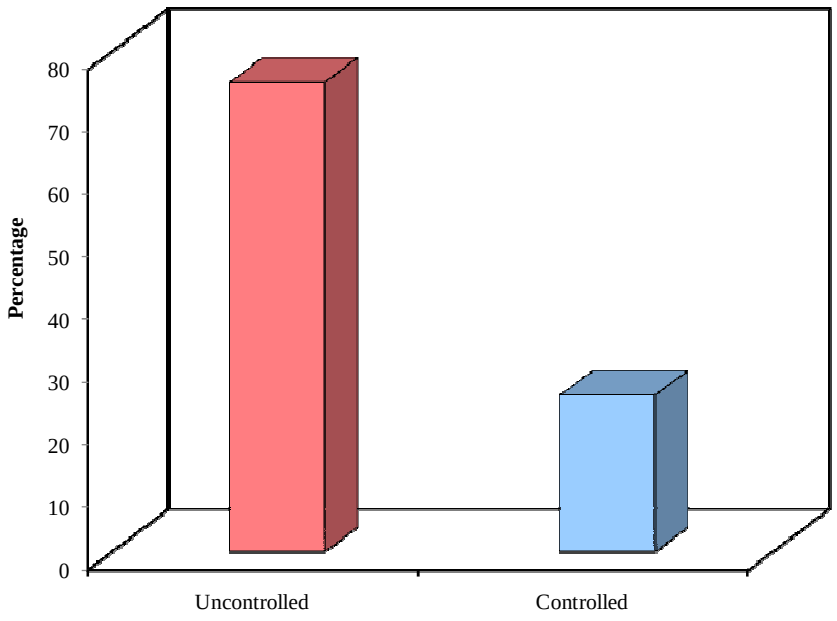

Figure (6): Classification of asthmatic patients according to the level of control.

Table (5): Distribution of asthmatic patients according to sex and asthma grade.

	Sex				MCp
	Male (n = 22)		Female (n = 18)		
	No.	%	No.	%	
Asthma grade					
Intermittent	0	0.0	0	0.0	0.203
Mild persistent	2	9.1	1	5.6	
Moderate	14	63.6	7	38.9	
Severe	6	27.3	10	55.6	

MCp: p value for Monte Carlo test

This table shows that, (63.6%) of male patients with moderate asthma while (55.6%) of female patients with severe asthma.

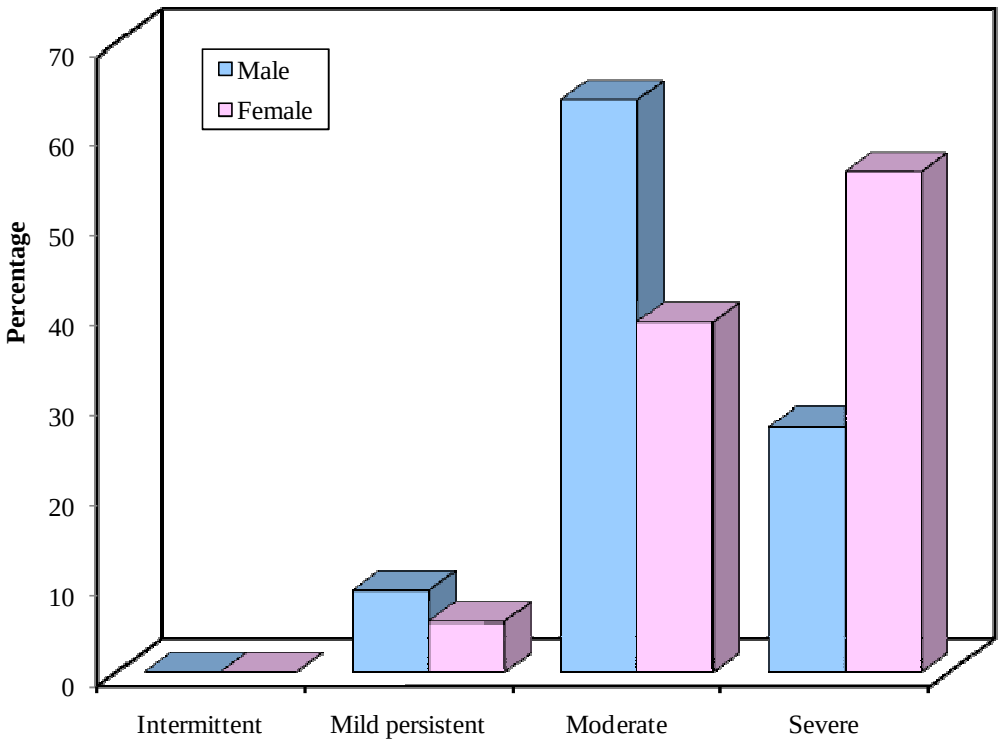

Figure (7): Distribution of asthmatic patients according to sex and asthma grade.

Table (6): Comparison between the two studied groups according esinophilic count.

	Cases (n = 40)		Control (n = 20)		Test of sig.
	No.	%	No.	%	
Esinophils					
Normal	12	30.0	20	100.0	FEp <0.001*
Increased	28	70.0	0	0.0	

Normal esinophilic count <450 /cmm

MCp: p value for Monte Carlo test

FEp : p value for Fisher Exact test

* : Statistically significant at $p \leq 0.05$

This table shows that, there is significant elevation of esinophils in 70% of cases.

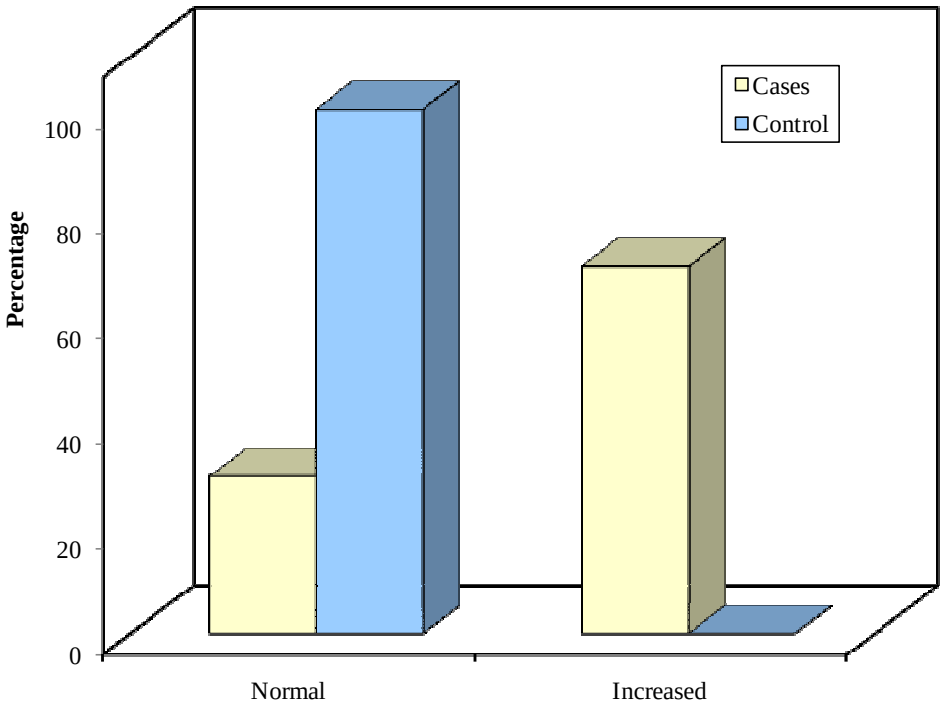

Figure (8): Comparison between the two studied groups according esinophilic count.

Table (7): Relation between asthma grade and esinophilic count.

	Asthma grade						Control	
	Mild persistent (n = 3)		Moderate (n = 21)		Severe (n = 16)			
	No.	%	No.	%	No.	%	No.	%
Esinophils								
Normal	2	66.7	7	33.3	3	18.8	20	100.0
Increased	1	33.3	14	66.7	13	81.3	0	0.0
FEp_1			0.533		0.155		0.130	
FEp_2					0.461		<0.001*	
FEp_3							<0.001*	

FEp_1 : p value for Fisher Exact test between mild persistent and other types of severity of attack

FEp_2 : p value for Fisher Exact test between moderate, severe and control

FEp_3 : p value for Fisher Exact test between severe and control

* : Statistically significant at $p \leq 0.05$

This table shows that, the number of esinophils is increasing with increasing the severity of asthma. The differences are significant in moderate and severe asthma in comparison to control children.

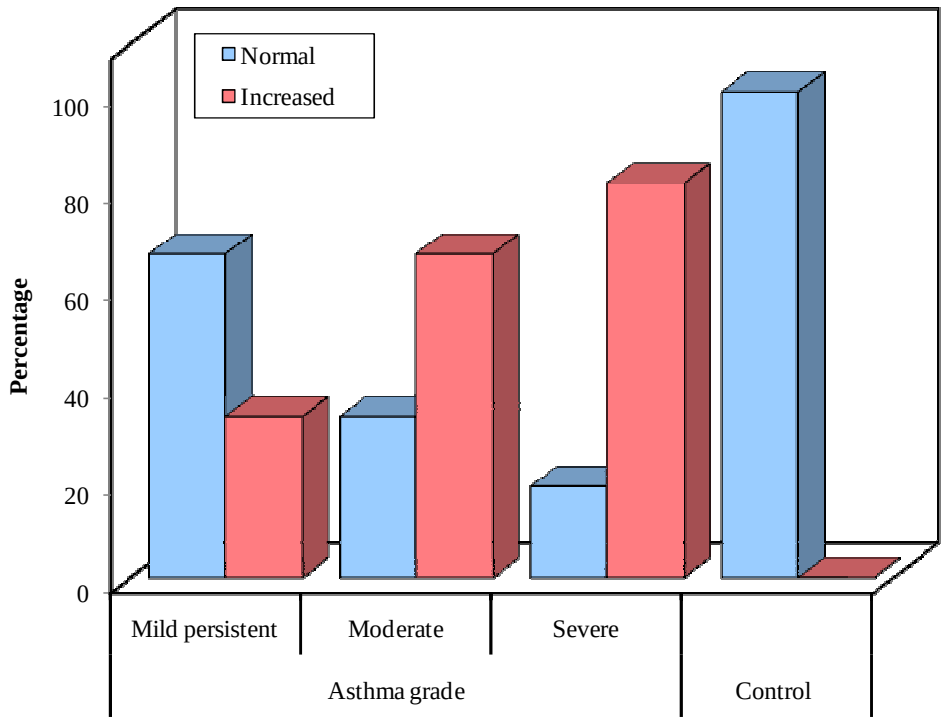

Figure (9): Relation between asthma grade and esinophilic count.

Table (8): Results of oxygen saturation in asthmatics according to severity of asthma exacerbation and control children.

	Asthma exacerbation			Control
	Mild	**Moderate**	**Severe**	
Oxygen saturation				
Range	95.0 – 96.0	92.0 – 96.0	88.0 – 94.0	98.0 – 100.0
Mean ± SD	95.67 ± 0.58	94.33 ± 1.28	90.25 ± 1.57	98.90 ± 0.72
Median	96.0	95.0	90.0	99.0
p_1		0.076	<0.001*	<0.001*
p_2			<0.001*	<0.001*
p_3				<0.001*

p_1 : p value of LSD test between mild persistent with other types of severity of attack

p_2 : p value of LSD test between moderate with severe and control

p_3 : p value of LSD test between sever and control

This table shows that, the more the severity of the asthma attack, the more the reduction of oxygen saturation.

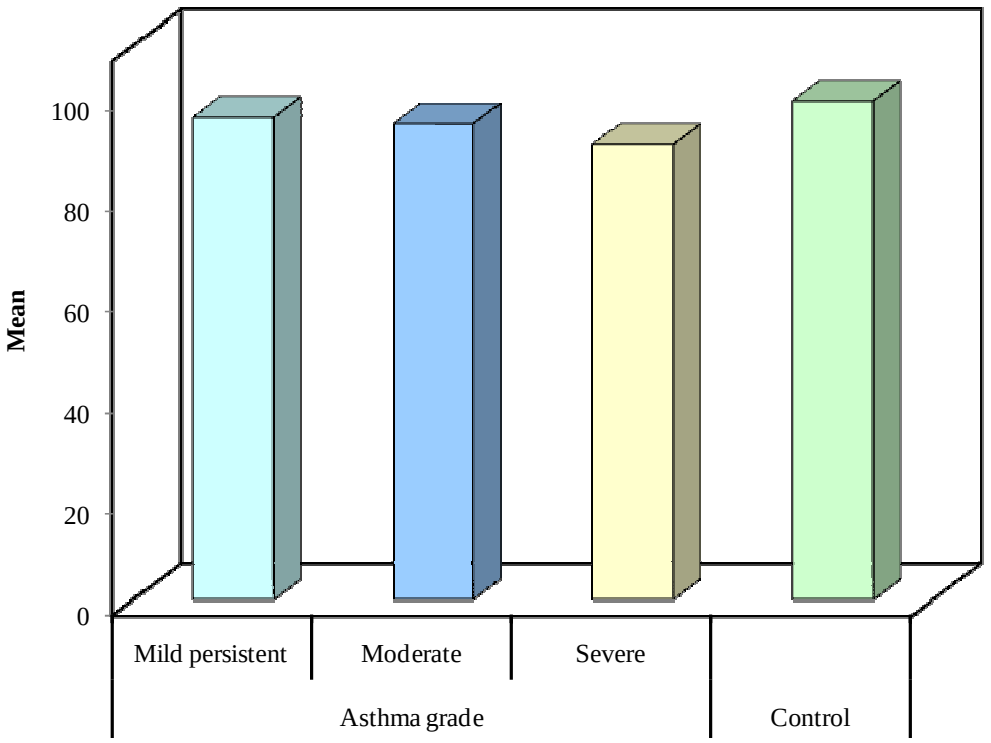

Figure (10): Results of oxygen saturation in asthmatics according to severity of asthma exacerbation and control children.

Table (9): Comparison between the two studied groups according to serum C3 and C4 levels.

	Cases (n = 40)		Control (n = 20)		Test of sig.
	No.	%	No.	%	
C3					
Normal	10	25.0	20	100.0	FEp <0.001*
Increased	30	75.0	0	0.0	
Range (mg/dl)	92.0 – 225.0		97.0 – 175.0		Z = 3.866* p <0.001
Mean ± SD	179.08 ± 44.04		123.70 ± 22.17		
Median	197.50		115.50		
C4					
Normal	18	45.0	20	100.0	FEp <0.001*
Increased	22	55.0	0	0.0	
Range (mg/dl)	23.10 – 69.30		16.20 – 39.20		Z = 3.584* p <0.001
Mean ± SD	42.70 ± 15.58		27.31 ± 6.89		
Median	42.95		26.75		

Z : Z for Mann Whitney test
FEp : p value for Fisher Exact test
* : Statistically significant at $p \leq 0.05$

Normal values: C3 (90-180mg/dl) and C4 (10-40mg/dl) ***(Baudne et al., 1996)***.

This table shows that, there is significant elevation of C3, C4 in our asthmatic children than control children.

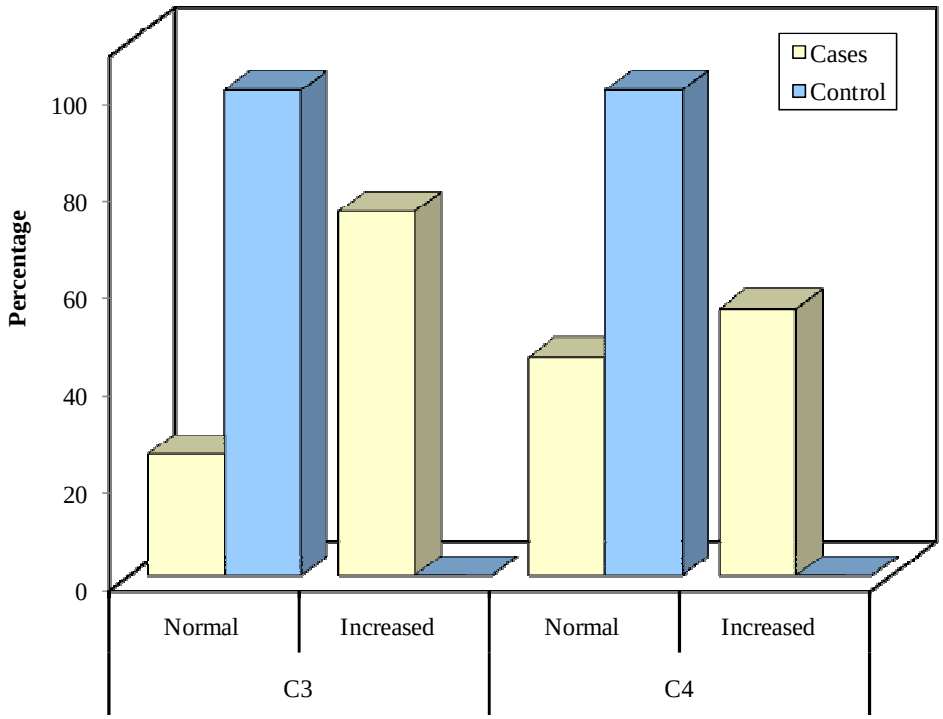

Figure (11): Comparison between the two studied groups according to serum C3 and C4 levels.

Table (10): Relation between C3 and C4 with family size in asthmatic group (n=40).

	C3				C4			
	Normal (n = 10)		Increase (n = 30)		Normal (n = 18)		Increase (n = 22)	
	No.	%	No.	%	No.	%	No.	%
Family size								
≤ 5	3	30.0	14	46.7	5	27.8	12	54.5
> 5	7	70.0	16	53.3	13	72.2	10	45.5
FEp	0.471				0.116			
Range	5.0 – 8.0		3.0 – 8.0		4.0 – 8.0		3.0 – 8.0	
Mean ± SD	6.40 ± 1.26		5.67 ± 1.15		6.17 ± 1.15		5.59 ± 1.22	
Median	6.0		6.0		6.0		5.0	
Z (p)	1.453 (0.146)				1.461 (0.144)			
r (p)	-0.246 (0.127)				-0.202 (0.212)			

FEp : p value for Fisher Exact test
Z : Z for Mann Whitney test
r: Pearson coefficient

This table shows that, there is no relation between the family size and the level of C3 and C4.

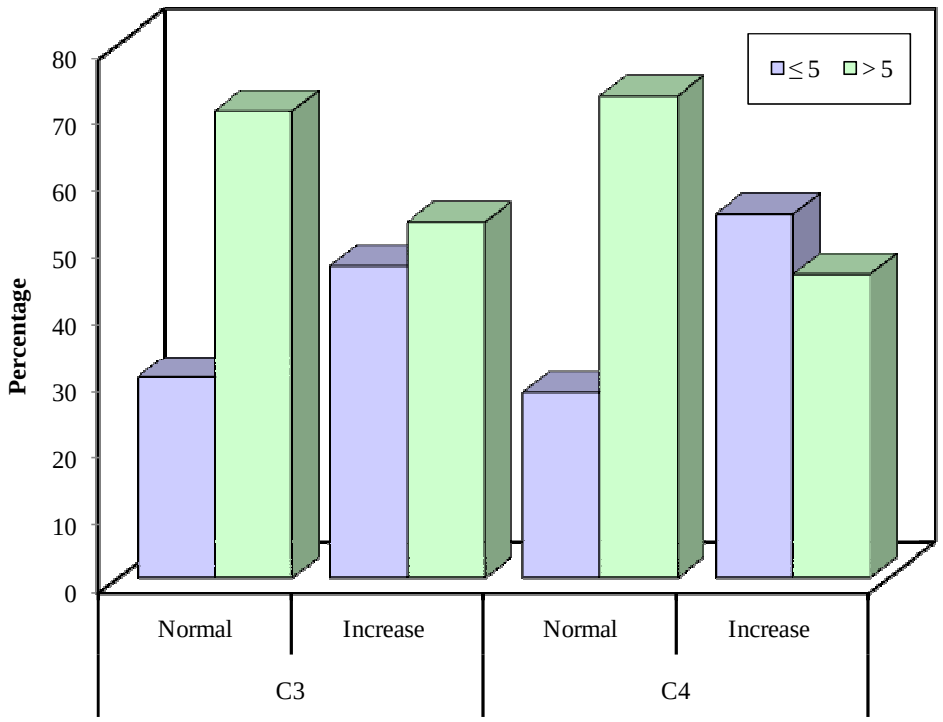

Figure (12): Relation between C3 and C4 with family size in asthmatic group (n=40).

Table (11): Relation between C3 and C4 with age in asthmatic group.

Age	C3		C4	
	Normal (n = 10)	**Increase (n = 30)**	**Normal (n = 18)**	**Increase (n = 22)**
Range	3.0 – 12.0	3.0 – 12.0	3.0 – 12.0	3.0 – 12.0
Mean ± SD	6.40 ± 2.99	7.03 ± 3.05	6.22 ± 2.78	7.41 ± 3.14
Median	5.0	6.0	5.0	6.50
Z (p)	0.650 (0.516)		1.325 (0.185)	
r (p)	0.196 (0.226)		0.285 (0.074)	

Z : Z for Mann Whitney test
r: Pearson coefficient

This table shows that, there was no relation between changes in the level of C3, C4 and the age in cases group.

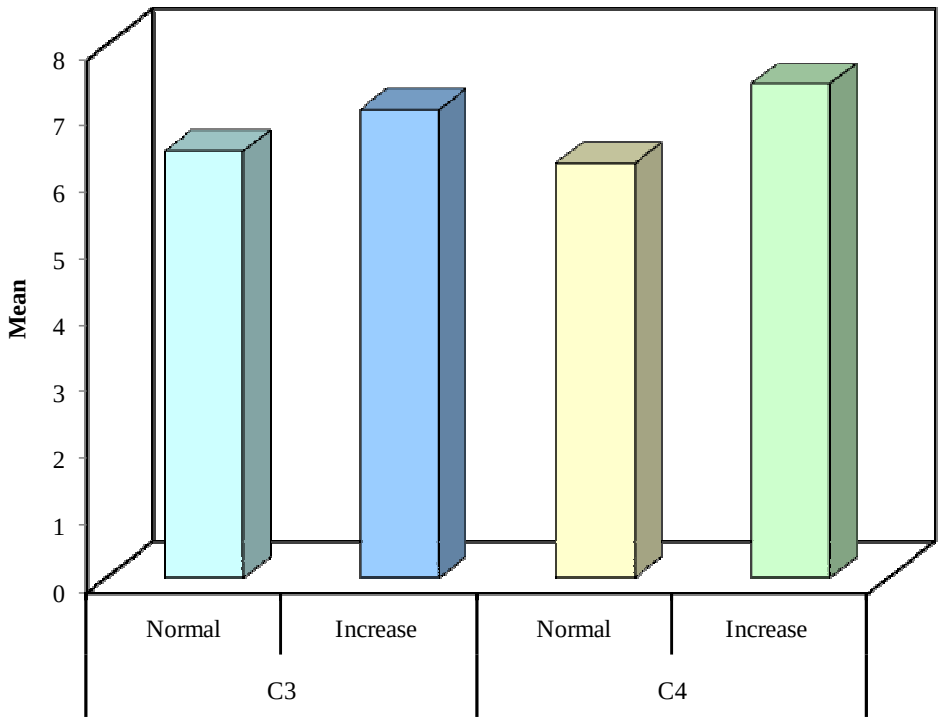

Figure (13): Relation between C3 and C4 with age in asthmatic group.

Table (12): Serum levels of C3, C4 in relation to sex in asthmatic group.

	Sex				Test of sig.
	Male		Female		
	No.	%	No.	%	
C3					
Normal	8	36.4	2	11.1	FEp = 0.082
Increased	14	63.6	16	88.9	
Range (mg/dl)	92.0 – 219.0		96.0 – 225.0		Z = 1.836 p = 0.066
Mean ± SD	167.05 ± 47.96		193.87 ± 34.54		
Median	190.50		203.0		
C4					
Normal	12	54.5	6	33.3	χ^2 = 1.800 p = 0.180
Increased	10	45.5	12	66.7	
Range (mg/dl)	23.10 – 69.30		24.10 – 67.30		Z = 1.767 p = 0.077
Mean ± SD	38.93 ± 15.23		47.30 ± 15.15		
Median	33.35		49.65		

Z : Z for Mann Whitney test
FEp : p value for Fisher Exact test

This table shows that, there is no relation between sex and serum levels of C3 and C4.

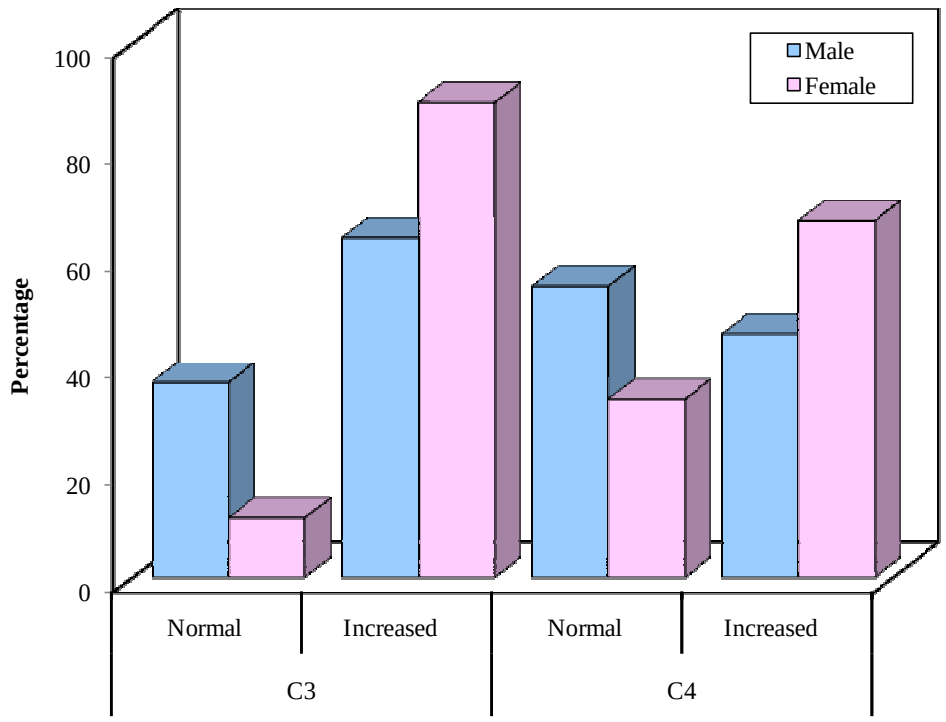

Figure (14): Serum levels of C3, C4 in relation to sex in asthmatic group.

Table (13): Serum levels of C3, C4 in asthmatic group according to residence.

	Residence				Test of sig.
	Urban		Rural		
	No.	%	No.	%	
C3					
Normal	6	20.0	4	40.0	FEp = 0.232
Increased	24	80.0	6	60.0	
Range (mg/dl)	94.0 – 225.0		92.0 – 204.0		Z = 2.437 p = 0.015*
Mean ± SD	186.20 ± 41.04		157.70 ± 47.97		
Median	203.0		187.50		
C4					
Normal	8	26.7	10	100.0	FEp <0.001*
Increased	22	73.3	0	0.0	
Range (mg/dl)	23.10 – 69.30		24.10 – 35.60		Z = 2.983 p = 0.003*
Mean ± SD	47.35 ± 15.22		28.73 ± 4.04		
Median	48.90		28.10		

Z : Z for Mann Whitney test
FEp : p value for Fisher Exact test
* : Statistically significant at $p \leq 0.05$

This table shows that, there is significant relation between residence and serum levels of C3 and C4 as we find increased serum levels of C3 and C4 in 80% and 73.3% of urban cases respectively.

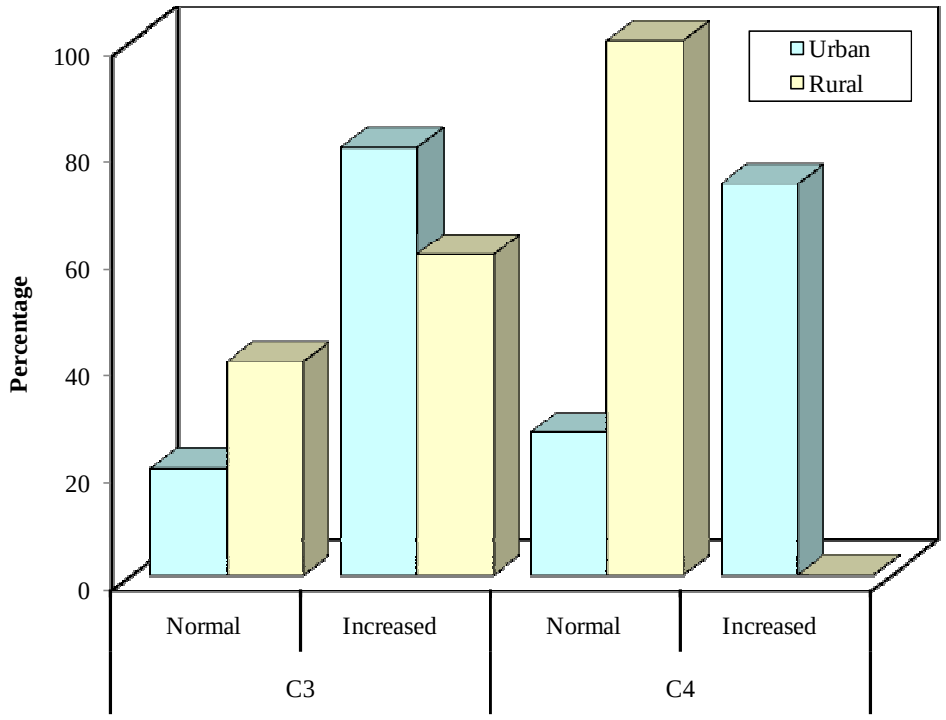

Figure (15): Serum levels of C3, C4 in asthmatic group according to residence.

Table (14): Serum levels of C3 and C4 according to duration of asthma.

	C3				C4			
	Normal (n = 10)		Increase (n = 30)		Normal (n = 18)		Increase (n = 22)	
	No.	%	No.	%	No.	%	No.	%
Duration of asthma (yrs)								
< 5	8	80.0	20	66.7	15	83.3	13	59.1
≥ 5	2	20.0	10	33.3	3	16.7	9	40.9
FEp	0.693				0.165			
Range	1.0 – 8.0		1.0 – 10.0		1.0 – 8.0		1.0 – 10.0	
Mean ± SD	2.95 ± 2.54		3.77 ± 2.56		2.78 ± 2.15		4.20 ± 2.72	
Median	2.25		2.75		2.0		3.50	
Z (p)	0.995 (0.320)				1.732 (0.083)			
r (p)	0.239 (0.137)				0.375* (0.017)			

FEp : p value for Fisher Exact test
Z : Z for Mann Whitney test
r: Pearson coefficient
* : Statistically significant at $p \leq 0.05$

This table shows that, there is no significant relation between the level of C3 and the duration of asthma while, there is significant relation between asthma duration andC4 levels.

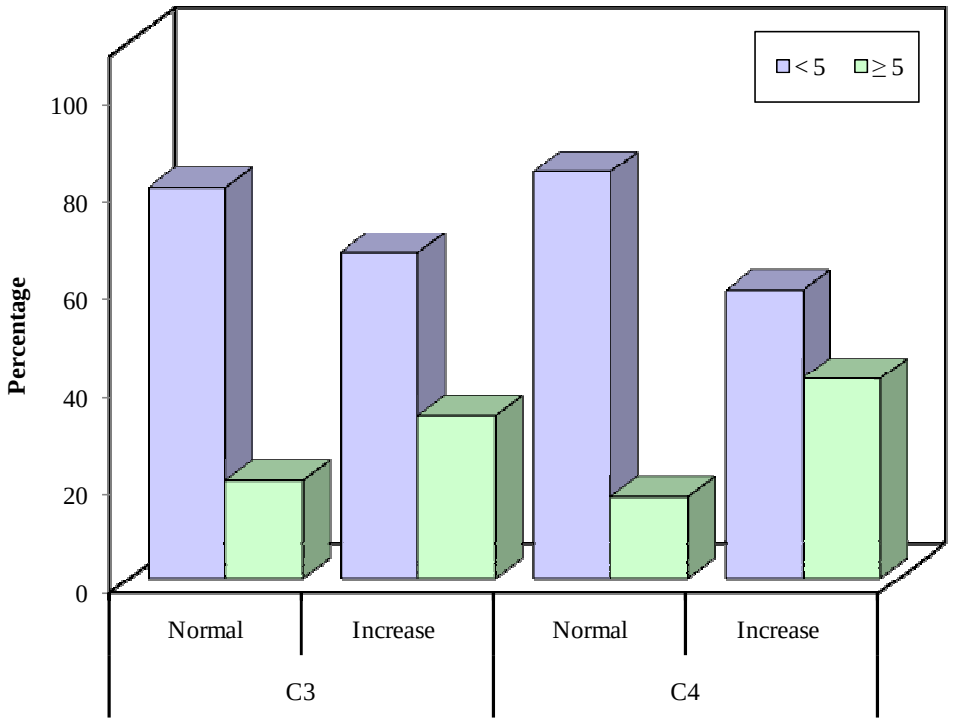

Figure (16): Serum levels of C3 and C4 according to duration of asthma.

Table (15): Levels of C3 and C4 with different durations of asthma in patient group.

	Duration			
	1 - <2 (n = 10)	**2 - <4 (n = 15)**	**4 - <6 (n = 5)**	**6 – 10 (n = 10)**
C3				
Range	92.0 – 215.0	94.0 – 223.0	193.0 – 225.0	104.0 – 219.0
Mean ± SD	159.70 ± 50.10	175.53 ± 44.71	207.0 ± 11.55	189.80 ± 41.55
Median	189.0	190.0	205.0	207.50
χ^2 (p)	7.803* (0.050)			
p_1		0.345	0.027*	0.031*
p_2			0.067	0.141
p_3				0.854
C4				
Range	23.10 – 64.20	23.20 – 69.10	32.20 – 63.70	27.20 – 69.30
Mean ± SD	37.65 ± 12.76	37.80 ± 15.78	53.34 ± 14.11	49.77 ± 15.05
Median	34.85	31.10	62.40	55.35
χ^2 (p)	7.630 (0.054)			
p_1		0.760	0.086	0.076
p_2			0.073	0.030*
p_3				0.327

χ^2: Chi square for Kruskal Wallis test

p_1 : p value for Mann Whitney test between mild persistent and other types of severity of attack

p_2 : p value for Mann Whitney test between moderate, severe and control

p_3 : p value for Mann Whitney test between severe and control

* : Statistically significant at $p \leq 0.05$

This table shows the different serum levels of C3 and C4 with the different durations of asthma in studied group.

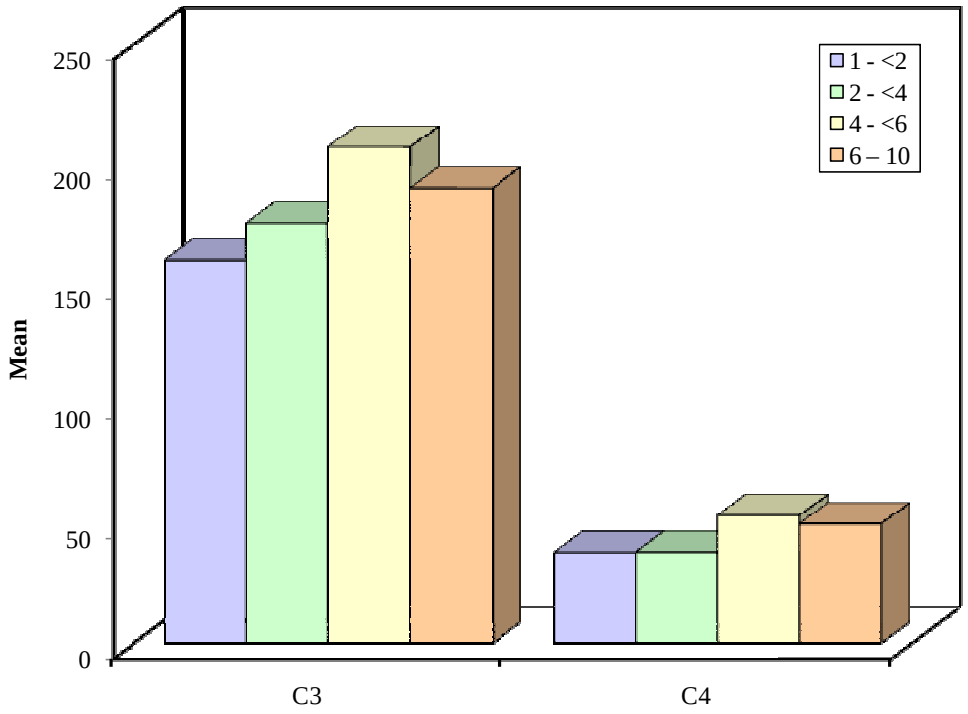

Figure (17): Levels of C3 and C4 with different durations of asthma in patient group.

Table (16): Levels of C3 and C4 in relation to asthma grade in asthmatic patients and control groups.

	Asthma grade						Control	
	Mild persistent (n = 3)		Moderate persistent (n = 21)		Severe persistent (n = 16)			
	No.	%	No.	%	No.	%	No.	%
C3								
Normal	3	100.0	7	33.3	0	0.0	20	100.0
Increased	0	0.0	14	66.7	16	100.0	0	0.0
FEp_1			0.059		0.001*		-	
FEp_2					0.012*		<0.001*	
FEp_3							<0.001*	
Range	92.0 – 98.0		94.0 – 206.0		201.0 – 225.0		97.0 – 175.0	
Mean ± SD	95.33 ± 3.06		166.67 ± 41.34		211.06 ± 7.36		123.70 ± 22.17	
Median	96.0		189.0		210.50		115.50	
p_1			0.010*		0.007*		0.008	
p_2					<0.001*		0.003	
p_3							<0.001*	
C4								
Normal	3	100.0	15	71.4	0	0.0	20	100.0
Increased	0	0.0	6	28.6	16	100.0	0	0.0
FEp_1			0.546		0.001*		-	
FEp_2					<0.001*		<0.001*	
FEp_3							<0.001*	
Range	24.90 – 30.20		23.10 – 60.20		45.20 – 69.30		16.20 – 39.20	
Mean ± SD	27.30 ± 2.69		32.97 ± 9.87		58.35 ± 7.69		27.31 ± 6.89	
Median	26.80		30.20		58.25		26.75	
p_1			0.541		0.007*		1.000	
p_2					<0.001*		0.074	
p_3							<0.001*	

FEp_1 : p value for Fisher Exact test between mild persistent and other grades of asthma
FEp_2 : p value for Fisher Exact test between moderate, severe and control
FEp_3 : p value for Fisher Exact test between severe and control
p_1 : p value for Mann Whitney test between mild persistent and other groups (control, moderate persistent and severe persistent asthma
p_2 : p value for Mann Whitney test between moderate persistent, severe persistent and control groups
p_3 : p value for Mann Whitney test between severe persistent and control groups
* : Statistically significant at $p \leq 0.05$

This table shows that**,** there are significant relations between the level of C3, C4 and the asthma grades i.e. all of asthmatic children with mild persistent asthma have normal C3, C4 levels, while, all the patients with severe asthma have increased level of C3, C4 however, patients with moderate asthma C3, C4 were increased only in 66.7% and 28.6% respectively.

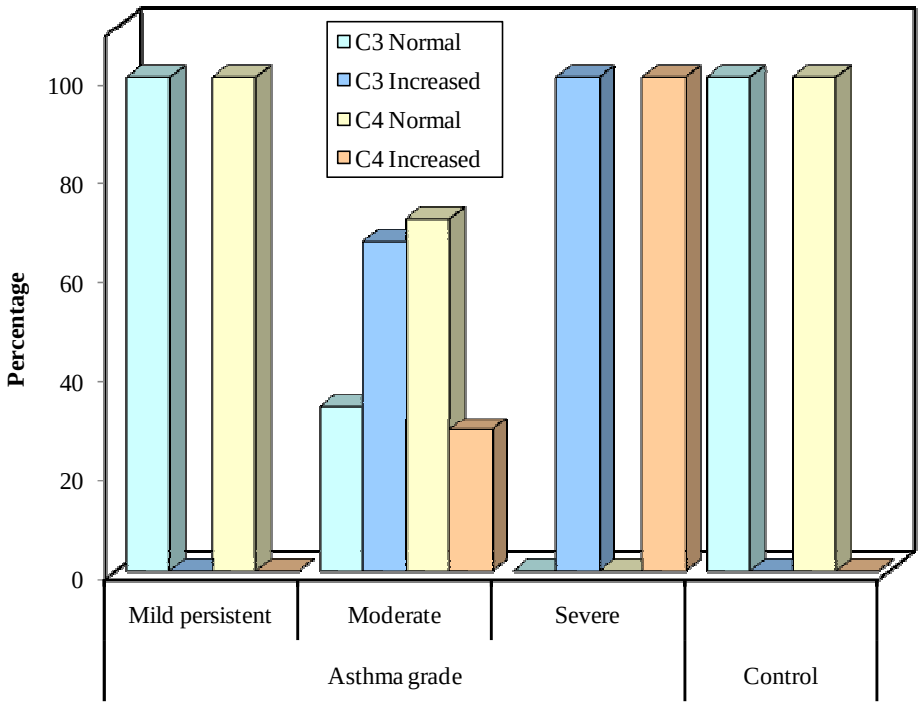

Figure (18): Levels of C3 and C4 in relation to asthma grade in asthmatic patients and control groups.

Table (17): Correlation between C3 and C4 with oxygen saturation and esinophils.

	C3		C4	
	r	**p**	**r**	**p**
Oxygen saturation	-0.604*	<0.001	-0.735*	<0.001
Esinophils	0.692*	<0.001	0.399*	0.011

r: Pearson coefficient
* : Statistically significant at $p \leq 0.05$

This table shows that, there is negative correlation between serum levels of C3, C4 and oxygen saturation. On the other hand there is positive correlation between serum levels of C3, C4 and esinophilic count.

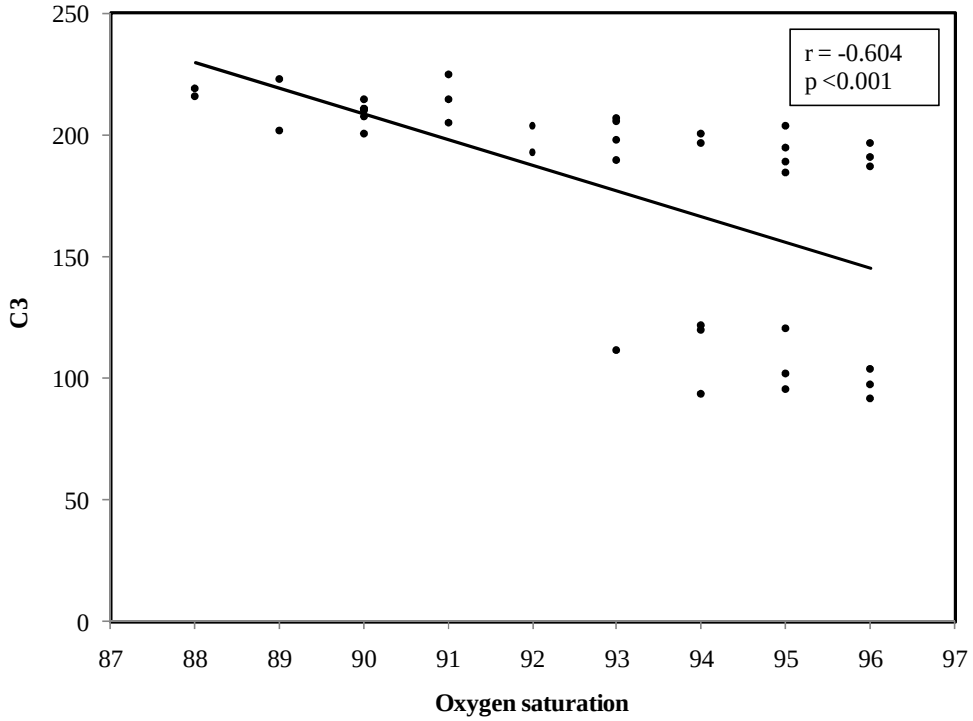

Figure (19): Correlation between C3 and oxygen saturation

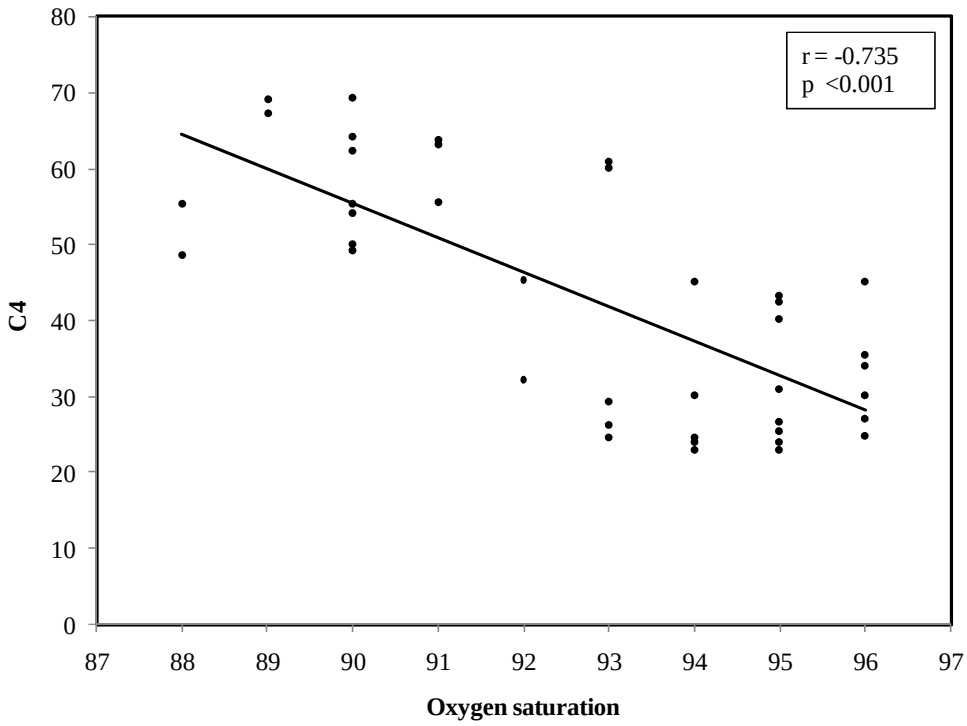

Figure (20): Correlation between C4 and oxygen saturation

Table (18): Distribution of the studied cases according to used medications.

	No.	%
Used medication		
3+5	5	12.5
1+2+5	1	2.5
1+5	6	15.0
2+4	1	2.5
1+6	2	5.0
1+4	10	25.0
1+2+4	1	2.5
3+4	1	2.5
2+3+5	8	20.0
3+5+6	1	2.5
1+4+6	4	10.0

1= Inhaled short acting bronchodilators
2= Theophylline
3= Systemic short acting bronchodilators "SABA"
4= Inhaled corticosteroids **"ICS"**
5= Systemic corticosteroids "SC"
6= Others (sustained release theophylline - leukotriens modifiers- mast cell stabilizers- LABA)

This table shows that, 25% used Inhaled short acting bronchodilators+ Inhaled corticosteroids , 20% of patients used Theophylline +Systemic short acting bronchodilator+ Systemic corticosteroids **,**15% used Inhaled short acting bronchodilators+ Systemic corticosteroids,12.5% used Systemic short acting bronchodilators+ Systemic corticosteroids ,10% used Inhaled short acting bronchodilators + Inhaled corticosteroids + Others and the remaining small proportions used different drug combinations as showed above.

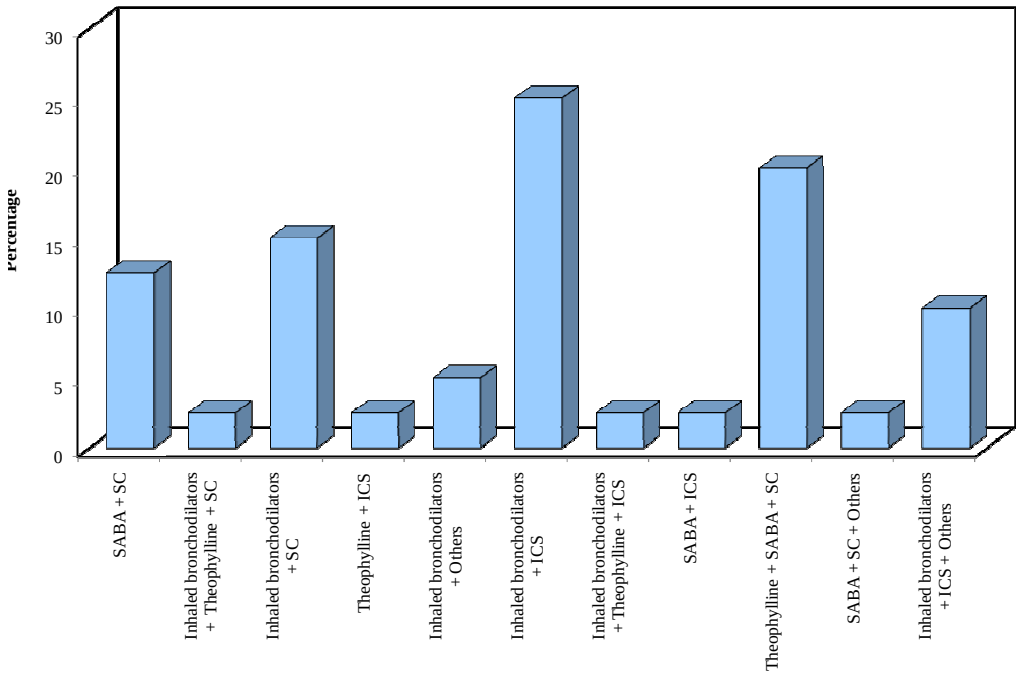

Figure (21): Distribution of the studied cases according to used medications.

Table (19): Relation between level of control and used medications in cases group.

	Level of control			
	Uncontrolled (n = 30)		Controlled (n = 10)	
	No.	%	No.	%
Used medication				
3+5	5	16.7	0	0.0
1+2+5	1	3.3	0	0.0
1+5	6	20.0	0	0.0
2+4	1	3.3	0	0.0
1+6	2	6.7	0	0.0
1+4	4	13.3	6	60.0
1+2+4	1	3.3	0	0.0
3+4	1	3.3	0	0.0
2+3+5	8	26.7	0	0.0
3+5+6	1	3.3	0	0.0
1+4+6	0	0.0	4	40.0

1= Inhaled short acting bronchodilators
2= Theophylline
3= Systemic short acting bronchodilators
4= Inhaled corticosteroids
5= Systemic corticosteroids
6= others (sustained release theophylline- - leukotriens modifiers- mast cell stabilizers-LABA)

This table shows that, 60% of controlled cases were on inhaled bronchodilators and inhaled corticosteroid therapy and 26.7% of uncontrolled cases were using oral theophylline, oral short acting bronchodilators and systemic corticosteroids. Also, we found that the addition of leukotrien modifiers and mast cell stabilizers to inhaled corticosteroid, inhaled bronchodilators provided good control.

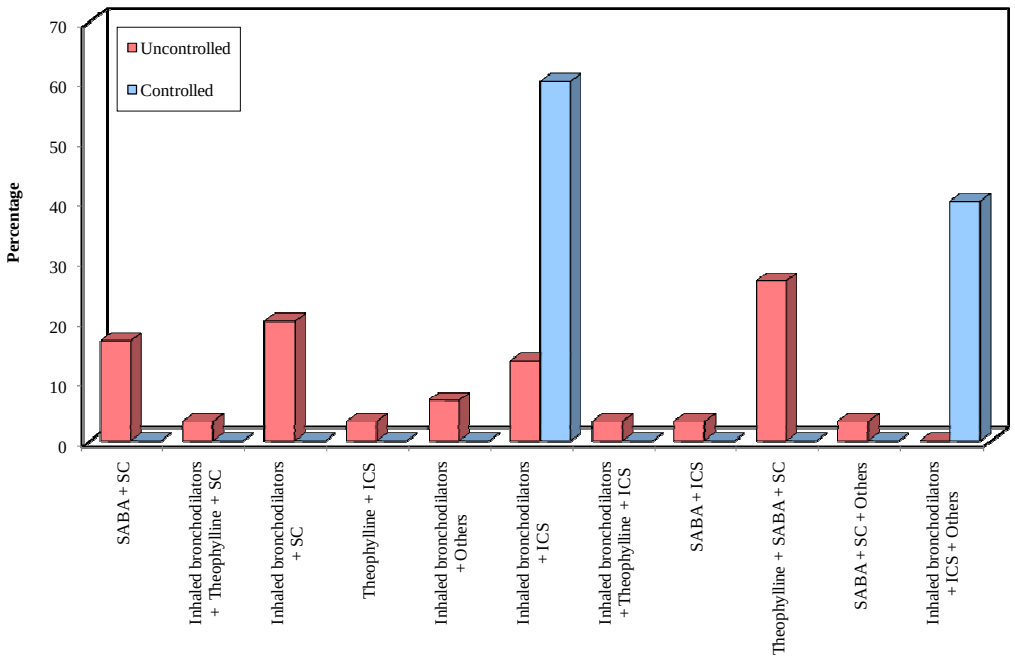

Figure (22):Relation between level of control and used medications in cases group.

Table (20): Serum levels of C3 and C4 in relation to level of asthma control in patients group.

	Level of control				Control	
	Uncontrolled (n = 30)		Controlled (n = 10)			
	No.	%	No.	%	No.	%
C3						
Normal	0	0.0	10	100.0	20	100.0
Increased	30	100.0	0	0.0	0	0.0
FEp_1			<0.001*		<0.001*	
FEp_2					-	
Range	185.0 – 225.0		92.0 – 122.0		97.0 – 175.0	
Mean ± SD	203.40 ± 10.84		106.10 ± 11.72		123.70 ± 22.17	
Median	204.0		103.0		115.50	
p_1			<0.001*		0.019*	
p_2					<0.001*	
C4						
Normal	8	26.7	10	100.0	20	100.0
Increased	22	73.3	0	0.0	0	0.0
FEp_1			<0.001*		<0.001*	
FEp_2					-	
Range	23.20 – 69.30		23.10 – 30.20		16.20 – 39.20	
Mean ± SD	48.21 ± 14.09		26.15 ± 2.45		27.31 ± 6.89	
Median	48.90		25.25		26.75	
p_1			<0.001*		0.676	
p_2					<0.001*	

p_1 : p value for Mann Whitney test between Uncontrolled with controlled and control group
p_2 : p value for Mann Whitney test between controlled and control group
FEp_1 : p value for Fisher Exact test Uncontrolled between controlled and control group
FEp_2 : p value for Fisher Exact test Uncontrolled controlled and control group
* : Statistically significant at $p \leq 0.05$

This table shows significant relation between the level of control of asthma and serum levels of C3, C4 i.e. C3 level was increased in 100% of the uncontrolled group and was normal in the controlled group, while C4 level was increased 73.3% of uncontrolled group and normal in controlled group (mean C3 level was 203.4 ±10.8 and the mean C4 level was 48.2±14.09 in uncontrolled cases in comparison to 106.1±11.72 and 26.15±2.4 for C3 and C4 respectively in controlled cases).

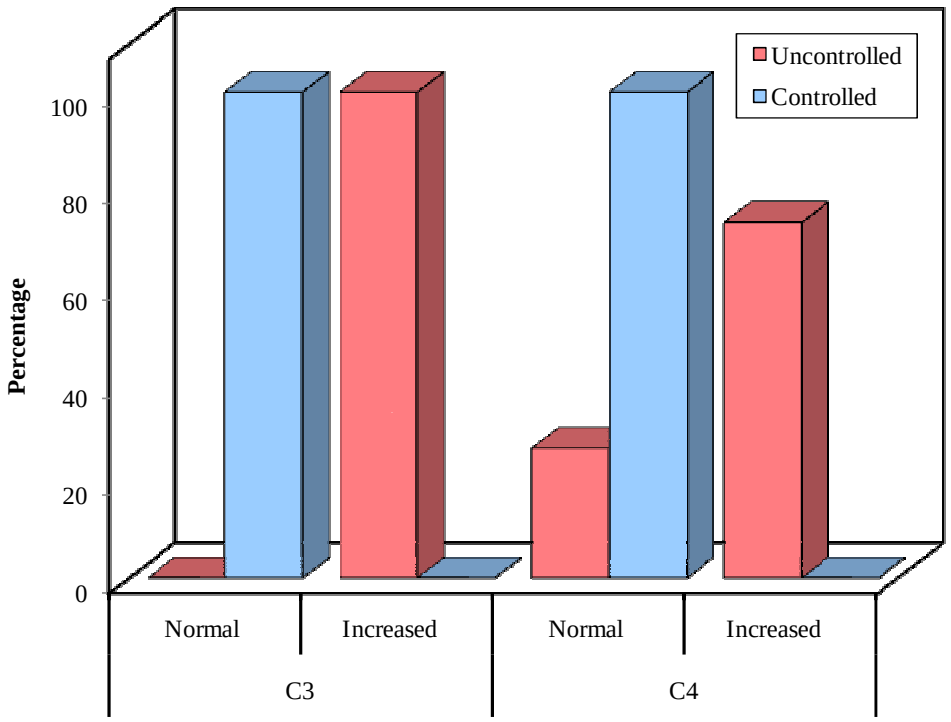

Figure (23): Serum levels of C3 and C4 in relation to level of asthma control in patients group.