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Asthma Triggers and Control among Adults in an Egyptian Setting

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Abstract

Background: Uncontrolled asthma prevails among asthmatics despite advances in disease management. Epidemiology of asthma and allergies in childhood had gained a considerable research interest. However, adult onset asthma in the Egypt has not been fully characterized.

Objective(s): We aimed to assess the morbidity and factors associated with uncontrolled asthma in a sample of asthmatic adult using standard asthma medications.

Methods: A cross-sectional study was conducted at the chest outpatient clinics at the major health insurance hospital in Alexandria. A total of 320 asthmatic adults above 18 years were randomly selected and enrolled in the study. Participants were interviewed using standardized predesigned questionnaire.

Results: Asthmatic patients comprised 62.5% females and 37.5% males with mean age of 45.3 ± 12.1. Two thirds of the patient had mild persistent (30.3%) and moderately persistent asthma (30.6%). Moderately controlled asthma was the most frequent (82.5%). Asthma had mild to moderated impact on exercise (30.3%), patient productivity (51.1%) and interruption of daily activity (54.7%). All patients reported never receiving an asthma action plan. Patients with uncontrolled asthma had higher rates of health care use. The overall patient adherence to treatment was mostly low (78.4%) although the satisfaction with health care was generally accepted (87.8%). Several demographics and comorbid conditions were identified as independent factors associated with sever and uncontrolled asthma notably male gender, smoking, working, low income and presence of co-morbidities.

Conclusion: Moderately controlled asthma is prevalent in patients using standard asthma medications in Egypt. There is a need for improving asthma care in asthmatic adult patients. This will require comprehensive evaluation of asthma control and medication use, implementation of treatment plans, control of environmental factors and addressing comorbid conditions.

Keywords

Adult onset asthma; Triggers; Control; Egypt

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Abbreviations

AAP: Asthma Action Plan; BMI: Body Mass Index; CI: Confidence Interval; ED: Emergency Department; GER: Gastroesophageal Reflux; HCP: Health Care Provider; ICS: Inhaled Corticosteroids; ICU: Intensive Care Unit; LABA: Long Acting Beta$_2$ Agonist; MDI: Metered Dose Inhaler; OR: Odds Ratio; PFM: Peak Flow Meter; SABA: Short Acting Beta$_2$ Agonist; GINA: Global Initiative for Asthma; BTS/SIGN: The British Thoracic Society/Scottish Intercollegiate Guideline Network

Introduction

Asthma is a common, chronic respiratory disease affecting 1-18% of the country wise population worldwide [1,2]. It manifests by variable symptoms of wheeze, shortness of breath, chest tightness and/or cough resulting from airway inflammation, hyper responsiveness to direct/ indirect stimuli and narrowing. Asthma attacks can be caused by a range of risk factors and irritants collectively referred to as asthma 'triggers'. These include exercise, allergen or irritant exposure, change in weather, pollutants/ occupational exposures, viral respiratory infections, medications in addition to other factors such as emotional stress and comorbid medical conditions [3]. Symptoms and airflow limitation may resolve spontaneously or in response to medication, and may sometimes be absent for weeks or months at a time [4]. On the other hand, patients can experience episodic flare-ups (exacerbations) of asthma that may be life-threatening and carry a significant burden on patients and the community. By time, airway inflammation, hyper responsiveness and narrowing persist even with symptoms amelioration and improvement of lung functions by treatment [5,6].

Despite advances in therapeutic standards and promotion of preventive management, asthma-related morbidity remains high, continuing to have a significant effect on health resource utilization and patients' quality of life [7].

The aim of the present study was to characterize asthma among adults in an Egyptian setting by assessing morbidity and addressing different demographic factors associated with disease severity and control.

Methods

Case definition

Cases with asthma are diagnosed based on GINA Guidelines for making a diagnosis of asthma [8] including history of variable symptoms and evidence of variable expiratory air flow limitation. Asthmatics were asked to give flow meter measurements to assess the FEV and PEF.

Study setting and design

A cross sectional descriptive study was carried out at the chest disease department of Gamal Abdel-Nasser hospital, the biggest health insurance hospital that pools patient from all Alexandria city. The study population involved asthmatics adults who were registered and attending the outpatient clinic at the study setting. A total of 320 asthmatic adults were randomly selected and enrolled in the study.

Data collection

A pre-designed structured interview questionnaire was used to collect data about patients' sociodemographics: age, sex, marital status, occupation, residence, educational level, crowding index (number of individuals per room), family income, housing conditions, ….etch, habits/addiction: physical exercise, smoking, substance abuse, alcohol intake....etc., clinical history of cough, wheezes, dyspnea, orthopnea, expectoration..etc., asthma triggers (factors causing more severe asthma symptoms and exacerbations on patients having asthma): contact, inhalants, ingested …..etc., interference with daily activities, sick leaves/ absenteeism, medications used, allergy and atopy including: allergic rhinitis/ hay fever, allergic conjunctivitis, contact dermatitis, eczema. All asthmatics were subjected to general and systemic examination and assessment of body mass index (BMI) (9), and waste circumference [10].

Asthma severity has been categorized as mild intermittent, mild persistent, moderate persistent and severe persistent based on asthma severity classification [11,12]. Bronchial asthma control was assessed and asthma symptoms control were classified into controlled, partially controlled or uncontrolled according to GINA guidelines [11]. Asthmatic adherence to self- management guidelines was assessed using Morisky 8-Item Medication Adherence Questionnaire [13] a score >2 was considered low adherence, 1 or 2 for medium adherence and a score of 0 means high adherence.

Asthmatic satisfaction with received health care was assessed using the Short Form Patient Satisfaction Questionnaire 18-PSQ [14]. The patients are asked to indicate how they feel about the medical care they received in general with no reference to specific time frame or visit. Responses to each item are given on a 5-point scale ranging from strongly agree (1) to strongly disagree (5). The Score range was 18-90 and was scaled as 18-<23 Good, 24-< 35 Accepted, 36-<59 Fair and 60-90 Poor.

The smoking index was calculated using the following formula [15]:

Number of cigarettes per day X number of years of smoking X 365

Smokers are categorized as light smoker (smokes less than 10 cigarettes per day), moderate smokers (smokes 10-20 cigarettes per day) and heavy smokers (smokes more than 20 cigarettes per day).

Statistical analysis

Data were collected, revised, coded and fed to statistical software SPSS (Statistical Package for the Social Sciences) Version16.0 (SPSS, Chicago, IL, USA). All statistical analysis was done using two tailed tests and alpha error of 0.05 P value. The means with standard deviation and percent were used to describe the scale and categorical data, respectively. For categorical data, Pearson's Chi square test, Fishers exact test, and Mont Carlo exact test, were used for several independent groups. Ordinal logistic regression was used for multivariate analysis of factor associated with asthma severity and control.

Ethical statement

The study was approved by the institutional review board and the ethics committee of the High Institute of Public Health affiliated to Alexandria University, Egypt. The research was conducted in accordance with the ethical guidelines of the Declaration of Helsinki 2013 and the International Conference on Harmonization Guidelines for Good Clinical Practice. All participants were invited to sign an informed written consent after explaining the aim and concerns of the study. Data sheets were coded to ensure anonymity and confidentiality of patient's data.

Results

The enrolled patients were more female (62.5%), aging 35 -<65 years (with mean age of 45.3 ± 12.1), university (50%) & secondary school (44%) graduates, married (75.6%), of lower Egypt origin (99.4%), urban residents (98.4%) with 1 -<2 crowding index (69.1%) and full time workers (91.6%) with 500 -<2000 LE monthly income. Other features are detailed in Table 1.

Table 2 presented the patient's habits and asthma triggers. Though 75.3% of them never smoked cigarettes, 79.4% were side smokers. Hubble-bubble was smoked by 10% of the patients. Physical exercise was not practiced or occasionally done by 56.2% and 36.2% of the patients respectively. The most frequent asthma triggers reported by asthmatics were seasonal variation (80.3%), dust (76.2%), strong odors/perfumes (60.0%), flu (53.8%), emotion/stress (45.0%), smoke (tobacco, incense, coal, wood) (25.0%), GER (20.3%), and mold/ moisture (19.7%).

Asthma control, activity affection and clinical picture in the last 6 months prior to the study were illustrated in Table 3. Moderately controlled asthma was the most frequent (82.5%) one. Asthma impact on exercise was seen to be nil (48.8%) and mild (30.3%). Likewise, asthma affected patient productivity mildly (51.1%) and moderately (22.9%); only 11.6% got disabled by it. The daily activity was mildly, moderately and severely interrupted in 28.8%, 54.7% and 13.1% of participants.

The overall prevalence of asthma symptoms (cough, wheezy, chest tightness) in a frequency of >1 time a week in daytime was shown in two thirds (60.9%) the studied patients. A similar percentage (65.5%) experienced asthma symptoms once a week in nighttime. Likewise, sleep disturbance occurring <1 time and >2 times a week were respectively informed by 44.4% and 48.8% of all. For the treatment of asthma flare ups, 59.7% of the asthmatics were admitted at hospitals 1-2 times, 53.5% visited the emergency department 1-2 times, and 10% were admitted at the ICU. High BMI correlated positively with the number of hospital admissions (r= 0.23 P<0.0001) while high risk waist circumference correlated positively with the number of hospital and ICU admissions (r=0.114 P=0.043) and (r=0.115 P=0.006) respectively. About 50.9% and 43.1% of patients respectively received 1-5 and >5 times asthma treatment at private health facilities. Meanwhile, 52.5%, 25.6% and 16.6% of the participants had asthma-associated sickness leave for 1-2 weeks, <1 week and >2 weeks respectively. Retrospective inquiry about asthma management prior to the enrollment in the study revealed that most of the patients (90.6%) did not undergo investigations for asthma. Two thirds of the patients (49.4%) adopted changes of their life style to control asthma triggers and stop smoking (62.8%). Nebulizer was used by 70% of the patients and the most frequent medication used was inhaled corticosteroid and SABA (72.5%). Relievers and was used by almost all of the patients (99.4%) whereas controllers and preventers were used less frequently (89.8% and 73.8% respectively).

Most of the studied patients (80.9%) were seeking medical advice for asthma in health insurance clinic/ or hospitals and only 7.2% used to visit also private clinic/ hospital for asthma management. However,

Table 1: Socio-Demographic features of studied patients.

	Participants (n=320)	
	No.	**%**
Age (years)		
20-	73	22.8
35-	106	33.1
50-	130	40.6
65+	11	3.4
Mean ± SD	45.3 ± 12.1	
Gender		
Male	120	37.5
Female	200	62.5
Residence		
Urban	315	98.4
Rural	5	1.6
Ethnicity		
Lower Egypt	318	99.4
Nubian	2	0.6
Marital status		
single	48	15
married	242	75.6
widowed	21	6.6
divorced	9	2.8
Education		
read and write	13	4.1
preparatory	5	1.6
secondary	142	44.4
university education	160	50
Working status		
Working (full time employment)	293	91.6
Retired	27	8.4
Crowding index		
< 1	57	17.8
1- <2	221	69.1
2--3	42	13.1
Income		
100- (very low)	18	5.6
500- (low)	151	47.2
1000- (enough)	144	45
2000+ (enough and saving)	7	2.2
Family history		
Irrelevant	29	9.1
Bronchial Asthma	174	54.4
Allergic rhinitis/hay fever/ conjunctivitis/ urticarial/eczema	111	34.7
Bronchial Asthma and allergy	6	100
Duration of asthma		
Do not know	215	67.6
1-	51	16
10-	37	11.6
20-	12	3.8
30+	3	0.9
Co-morbidities		
None	46	14.5
COPD	2	0.6
TB	2	0.6
Obesity	57	17.9
Hypertension	125	39.3
IHD/CHD	39	12.3
DM type 1	3	0.9
DM type 2	55	17.3
Hyperlipidemia	57	17.9
Rheumatic disorder	8	2.5
Others	45	14.2
BMI		
Normal weight (18-)	3	0.9
Over weight (25-)	95	29.7
Obese (> 30)	22	69.4
Waist circumference[c]		
Average	22	7.9
High risk	256	92.1

Table 2: Habits and asthma triggers of the enrolled participants.

	Participants (n=320)	
	N	**%**
Smoking Never	241	75.3
Current smoker	35	10.9
Ex-smoker	44	13.8
Passive smoker	254	79.4
Smoking index Light <10 per day	33	10.3
Moderate 10-20 per day	33	10.3
Heavy> 20 per day	15	4.7
Age at start smoking		
<20 years	21	6.6
20-30 years	49	15.3
>30 years	6	1.9
Duration of quitting smoking		
< 1 year	11	3.4
5-	15	4.7
10-	8	2.5
20+	3	3.2
Smoking other than cigarettes		
Hubble bubble (Shisha, Goza)	32	10
Regular exercise		
Nil	180	56.2
occasional	116	36.2
1-2 times a month	16	5
1-2 times a week	8	2.5
Asthma symptoms related to work		
Do you feel that your asthma symptoms are related to your occupation	10	3.1
Have you ever changed occupation because of asthma symptoms before	6	1.9
Are there other people at work with symptoms similar to yours	24	7.5
Do you feel your asthma symptoms at home after work	10	3.1
Asthma triggering factors		
Do not know	1	0.3
Dust	244	76.2
Flu	172	53.8
Pollen	1	0.3
Exercise/Effort	40	12.5
Smoke (tobacco, incense, coal, wood)	80	25
Strong odor/ perfumes	192	60
Animals (cats, dogs)	4	1.2
Food (eggs, strawberry, chocolate…etc)	44	13.8
Pests (rodents, cockroaches)	1	0.3
Mold /moisture	63	19.7
Emotion / Stress	144	45
Season (Fall, Winter, Spring, Summer)	257	80.3
Gastro-esophageal reflux (GER)	65	20.3
Drugs (NSAID, ...)	2	0.6

Note: No history of alcohol intake or substance abuse was traced.

Table 3: Asthma flare-up and control months prior to the study.

	Participants (n=320)	
	No.	**%**
Asthma severity		
Mild intermittent	125	39.1
Mild persistent	97	30.3
Moderate persistent	98	30.6
Asthma control		
Poorly controlled	31	9.7
Moderately controlled	264	82.5
Well controlled	25	7.8
Exercise affection by asthma		
None	156	48.8
Mild	97	30.3
Moderate (must take ICS before)	34	10.6
Sever and stopped	33	10.3
Working activity affected by asthma		
Retired	22	6.9
None	24	7.5
Mild	163	51.1
Moderate	73	22.9
disabled by asthma	37	11.6
Daily activity interruption due to asthma		
Nil	11	3.4
Mild	92	28.8
Moderate	175	54.7
Sever and totally stopped	42	13.1
Additional Activity/work		
None	15	4.7
little interrupted	208	65
moderately un interrupted	97	30.3
Frequency of daytime symptoms (cough, wheezy, chest tightness) in last 6 months		
< 2 times a month	58	18.1
< 1 time a week	63	19.7
> 1 time a week	195	60.9
continual with limited activities	4	1.2
Frequency of night time symptoms (cough, wheezy, chest tightness) in last 6 months		
<2 times a month	49	15.3
> 2 times a month	57	17.8
> 1 time a week	210	65.6
Frequent	4	1.2
Sleep disturbance by night time symptoms in last 6 months		
Nil	21	6.6
<1 time a week	142	44.4
>2 times a week	156	48.8
Every night	1	0.3
Times of observation at emergency department in last 6 months		
Zero	78	24.4
1 to 2	171	53.4
3 to 4	71	22.2
Times of hospital admission in last 6 months		
Zero	126	39.4
1 to 2	191	59.7
3 to 5	3	0.9
Times of admission at ICU in last 6 months		
Zero	277	86.6
1	32	10
2	9	2.8
3	2	0.6
Times of treatment at private clinic/ hospital in last 6 months		
Zero	19	5.9
1-5 times	163	50.9
> 5 times	138	43.1
Sickness leave due to asthma in last 6 months		
None	17	5.3
< 1 week	82	25.6
1-2 weeks	168	52.5
> 15 days	53	16.6
Days lost from work due to asthma in last 6 months		
None	18	5.6
< 1 week	60	18.8
1-2 weeks	138	43.1
> 15 days	104	32.5
Patient specified best/maximum flow meter result		
<300 (150-250) liter	127	39.7
>300 (300-550) liter	193	60.3

almost all of the participants (93.8%) used to have one main HCP who usually checks for their asthma. None of the studied patients (0.0%) has a written plan from their treating doctor or know how to self-manage their asthma. The majority of them (83.8%) control their asthma symptoms symptomatically. Almost all patients (98.4%) did not how to prevent their asthma from getting more sever while one thirds (34.7%) were knowledgeable what to do when asthma becomes worse. The inhaler was properly used by most of the patients (96.2%). However, only 19.7% used to rinse their mouth after the intake of preventers. None of the studied participant has or has ever used a flow meter (0.0%) (Table 4).

A negligible number of the patients (n=11; 3.4%) stated that they can easily communicate with HCP for advice on having breathing problem. The overall patient adherence to treatment was mostly low (78.4%) and to small extent medium (20.0%). Treatment-, patient- and disease-related categorized causes of non-adherence was noted by 52.2%, 44.4%, and 0.2% of patients. Forgetfulness (73.5%), fears from side effects (23.8%), medication costs (76.8%), difficulties with inhalers (51.1%) & its side effects (19.7%) and stigmatization (100%) were its main factors. HCP-related non adherence factors were recalled by 1.1% of participants. The score of HCP-asthmatic communication and satisfaction based on the PSQ-18 was mainly accepted (87.8%) (Table 5).

Results of bivariate analysis are displayed in Table 6. Adult asthmatic patients aging 30 years or more and those having co-morbidities were at 2.3 and 2.5 times more risk of having sever asthma (OR=2.34; 95% CI 1.14-4.8), (OR=2.52; 95% CI=1.2-5.3) respectively. Females had 67% lower risk of severe asthma compare to males (OR=0.33; 95% CI 0.18-0.61). Control of asthma triggers and being not working or retired and were in favour of milder asthma (OR=0.41; 95% CI=0.26-0.66) and (OR=0.49; 95% CI=0.30-0.79) respectively (Table 7). Cessation of smoking, being retired, free of co-morbidities, or having higher income were predictors for achieving better asthma control (Table 8).

Discussion

In the current study, asthmatic women pre-dominated male one although female gender predicted low asthma severity and better control. This could be linked to less physical activity and non-smoking. In fact, sex affects the development of asthma in a

Table 4: Heath seeking behaviour, asthma monitoring and management among the enrolled asthmatic patients.

	Participants (n=320)	
	No.	**%**
Where to seek medical advice for asthma		
Health insurance clinic/ hospital	259	80.9
Private clinic/ hospital	23	7.2
Both	38	11.9
have one main HCP who usually checks asthma		
No	20	6.2
Yes	300	93.8
Has have a written plan from treating doctor	0	0.0
Know how to control asthma symptoms		
No	52	16.2
Yes, by symptoms	263	83.8
Know how to self-manage asthma symptoms	0	0.0
Know how to prevent asthma symptoms from getting severe		
No	315	98.4
Yes	5	1.6
Know what to do when asthma becomes worse		
No	209	65.3
Yes	111	34.7
Can easily communicate with HCP for advice on having breathing problem		
No	309	96.6
Yes	11	3.4
Investigations done for asthma		
Nil	290	90.6
Spirometery	1	0.3
CBC	26	8.1
others	3	0.9
Change of life style		
Control of asthma triggers	190	59.4
Quitting Smoking	59	62.8
Medications		
Inhaled Corticosteroids (ICS)	182	57.6
ICS+ inhaled SABAs	229	72.5
oral LABA	67	21.2
oral CS	40	12.7
Anti-histaminic	147	46.5
Other Bronchodilators including inhaled LABA	218	69.0
Nebulizer	222	70.3
Relievers	318	99.4
None	10	3.1
once per day	6	1.9
twice per day	304	95.0
Preventer	236	73.8
None	84	26.2
once per day	75	23.4
twice per day	161	50.3
Controllers	287	89.7
None	33	10.3
once per day	240	75.0
twice per day	45	14.1
3+ times per day	2	0.6
Has/use a peak flow meter	0	0.0
Rinse mouth after preventer		
NA	148	46.2
No	109	34.1
Yes	63	19.7
Proper use of inhaler (demonstration)		
NA	4	1.2
No	8	2.5
Yes	308	96.2

Table 5: Patient adherence to treatment (Morisky/Mosbey score), and patient-HCP communication satisfaction score.

	Participants (n=320)	
	No.	**%**
Level of Adherence		
Low adherence (>2)	251	78.4
Medium adherence (1or 2)	64	20
High adherence (0)	5	1.6
Causes of non-adherence		
Patient –related factors	**157**	**43.3**
Misunderstanding or lack of instruction	1	0.7
Fears from side effects	36	23.8
Unexpressed/un-discussed fears or concerns	1	0.7
Dislike treatment	6	4
Cultural issues	2	1.3
Forgetfulness	111	73.5
Religious issues~	1	0.7
Treatment-related factors	**192**	**52.8**
Difficulties with inhaler devices	1	51
Side effects	39	19.7
Cost of medication	152	76.8
Dislike of medication	6	3
Disease-related factors	**1**	**0.27**
Stigmatization	1	100
Health professional-related factors	**13**	**3.6**
Dissatisfaction with health-care Professional	12	92.4
Poor supervision, training or follow-up	1	7.6
Satisfaction score		
Good (24-35)	2	0.6
Accepted (36-59)	281	87.8
Poor (60-90)	37	11.6

Note: ~ Fasting in Ramadan for Muslims.

time-dependent manner. Until age 13-14 years, the incidence and prevalence of asthma are greater among boys than among girls [16]. On studying asthma through puberty, de Marco et al, have shown a greater incidence of asthma among adolescent and young adult females due to smaller airway caliber and a greater proportion of males with remission of asthma [17].

Almost all participants were urban residents as the study setting is serving urban districts in Alexandria. Urban environmental exposures contribute to increasing asthma prevalence [16,17]. Moreover, Alexandria is a coastal city and has a humid climate where exposure to indoor biological contaminants in the urban environment prevails.

Obesity looked a big challenge in the asthmatic population. In the present study, the majority of the studied asthmatic patients were obese and overweight although this was not linked to asthma severity or its control. Abdominal obesity was a major finding in the current study as well. Developing asthma due to abdominal obesity is also a main concern as the muscles are tighter and the airway is narrower resulting in breathing at low lung volume, Most of the studied patients had high risk waist circumference measurements which

Table 6: Factors associated with asthma severity and control.

	Asthma Severity				**Asthma Control**			
	Mild Intermittent	Mild Persistent	Moderate Persistent	P	Poorly Controlled	Moderately Controlled	Well Controlled	P
	No. (%)	No. (%)	No. (%)		No. (%)	No. (%)	No. (%)	
Age (years)								
<30	27 (61.4)	11 (25.0)	6 (13.6)	**0.002**	2 (4.5)	37 (84.1)	5 (11.4)	0.34~
>30	98 (35.5)	86 (31.2)	92 (33.3)		29 (10.5)	227 (82.2)	20 (7.2)	
Gender								
Male	25 (20.8)	39 (32.5)	56 (46.7)	**0.0001**	22 (18.3)	96 (80.0)	2 (1.7)	**0.0001**
Female	100 (50.0)	59 (29.0)	42 (21.0)		9 (4.5)	168 (84.0)	23 (11.5)	
Residence								
Urban	121 (38.4)	97 (30.8)	97 (30.8)	0.19~	31 (9.8)	263 (83.5)	21 (6.7)	**0.0001~**
Rural	4 (80.0)	0 (0.0)	1 (20.0)		0 (0.0)	1 (20.0)	4 (80.0)	
Marital status								
Married	81 (33.5)	77 (31.8)	84 (34.7)	**0.001**	26 (10.7)	200 (82.6)	16 (6.6)	0.2
Not married	44 (56.4)	20 (25.6)	14 (17.9)		5 (6.4)	64 (82.1)	9 (11.5)	
Education								
Low literacy	4 (22.2)	8 (44.4)	6 (33.3)	0.24	2 (11.1)	16 (88.9)	0 (0.0)	0.63~
High literacy	121 (40.1)	89 (29.5)	92 (30.5)		29 (9.6)	248 (82.1)	25 (8.3)	
Working status								
Working (full time employment)	106 (36.2)	95 (32.4)	92 (31.4)	**0.001**	30 (10.2)	245 (83.6)	18 (6.1)	**0.005~**
Retired	19 (70.4)	2 (7.4)	6 (22.2)		1 (3.7)	19 (70.4)	7 (25.9)	
Crowding index								
<2	121 (39.0)	95 (30.6)	94 (30.3)	0.67~	28 (9.0)	257 (82.9)	25 (8.1)	0.121~
>2	4 (40.0)	2 (20.0)	4 (40.0)		3 (30.0)	7 (70.0)	0 (0.0)	
Income								
Low	60 (35.5)	61 (36.1)	48 (28.4)	0.058	15 (8.9)	146 (86.4)	8 (4.7)	0.71
High	65 (43.0)	36 (23.8)	50 (33.1)		16 (10.6)	118 (78.1)	17 (11.3)	
Co-morbidities								
None	33 (71.7)	6 (13.0)	7 (15.2)	**0.0001**	0 (0.0)	38 (82.6)	8 (17.4)	**0.002~**
Yes	92 (33.6)	91 (33.2)	91 (33.2)		31 (11.3)	226 (82.5)	17 (6.2)	
BMI								
Normal weight (18-)	1 (33.3)	0 (0.0)	2 (66.7)	0.108~	0 (0.0)	2 (66.7)	1 (33.3)	0.46~
Over weight (25-)	40 (42.1)	34 (35.8)	21 (22.1)		8 (8.4)	79 (83.2)	8 (8.4)	
Obese (>30)	84 (37.8)	63 (28.4)	75 (33.8)		23 (10.4)	183 (82.4)	16 (7.2)	
Waist circumference[c]								
Average	45 (51.7)	27 (31.0)	15 (17.2)	**0.003**	6 (6.9)	71 (81.6)	10 (11.5)	0.22
High risk	80 (34.8)	68 (29.6)	82 (35.7)		25 (10.9)	190 (82.6)	15 (6.5)	
Smoking								
Never	106 (44.0)	77 (32.0)	58 (24.1)	**0.0001**	8 (3.3)	210 (87.1)	23 (9.5)	**0.0001~**
Current smoker	7 (20.0)	8 (22.9)	20 (57.1)		12 (34.3)	23 (65.7)	0 (0.0)	
Ex-smoker	12 (27.3)	12 (27.3)	20 (45.5)		11 (25.0)	31 (70.5)	2 (4.5)	
Passive Smoking								
No	46 (69.7)	8 (12.1)	12 (18.2)	**0.0001**	3 (4.5)	49 (74.2)	14 (21.2)	**0.0001**
Yes	79 (31.1)	89 (35.0)	86 (33.9)		28 (11.0)	215 (84.6)	11 (4.3)	
Smoking other than cigarettes								
No	119 (41.3)	80 (27.8)	89 (30.9)	**0.008**	29 (10.1)	234 (81.2)	25 (8.7)	0.16~
Hubble bubble (Shisha, Goza)	6 (18.8)	17 (53.1)	9 (28.1)		2 (6.2)	30 (93.8)	0 (0.0)	
Quitting smoking								
No	6 (17.1)	21 (60.0)	8 (22.9)	**0.0001**	1 (2.9)	34 (97.1)	0 (0.0)	**0.0001~**
Yes	18 (30.5)	10 (16.9)	31 (52.5)		22 (37.3)	34 (57.6)	3 (3.2)	
Control of asthma triggers								
No	18 (13.8)	60 (46.2)	52 (40.0)	**0.0001**	16 (12.3)	111 (85.4)	3 (2.3)	**0.005**
Yes	107 (56.3)	37 (19.5)	46 (24.2)		15 (7.9)	153 (80.5)	22 (11.6)	

Table 7: Multiple ordinal logistic regression analysis for predictors of asthma severity.

Risk factor	OR	SE	z	P>z	95% C.I	
					LL	UL
Age> 30 years	**2.34**	0.86	2.32	**0.020**	**1.14**	**4.80**
Gender/ Female	**0.33**	0.10	-3.57	**0.0001**	**0.18**	**0.61**
Not working/ retired	**0.49**	0.12	-2.90	**0.004**	**0.30**	**0.79**
Co-morbidity	**2.52**	0.94	2.47	**0.014**	**1.21**	**5.25**
Income> 1000 LE	0.61	0.16	-1.92	0.055	0.37	1.01
Avoiding triggers~	**0.41**	0.10	-3.64	**0.0001**	**0.26**	**0.66**

Note: ~Avoiding asthma exacerbating factors

Table 8: Multiple ordinal logistic regression analysis for predictors of asthma control.

Risk factor	OR	SE	z	P>z	95% C.I	
					LL	UL
Age> 30 years	0.62	0.31	-0.96	0.338	0.228	1.66
Gender/Female	2.3	1.13	1.7	0.087	0.884	6.03
Not working/retired	**2.6**	0.71	3.45	**0.001**	**1.5**	**4.42**
Co-Morbidity	**0.26**	0.13	-2.75	**0.006**	**0.1**	**0.68**
Income> 1000 LE	**2.22**	0.78	2.28	**0.023**	**1.11**	**4.43**
High risk Waist c	0.84	0.45	-0.33	0.745	0.28	2.44
Smoking	0.95	0.37	-0.13	0.893	0.44	2.04
Quitting smoking	**0.54**	0.12	-2.66	**0.008**	**0.34**	**0.85**
Avoiding of triggers	1.07	0.38	0.21	0.830	0.54	2.14

was significantly associated with moderate persistent asthma state [18-21]. Meanwhile, obesity was also associated with the co-morbid hypertension, hyperlipidemia and type 2 diabetes mellitus in one third, one fifth and one fifth of the studied asthmatics respectively. Similarly, Nystad et al., [22] reported in their study that the risk of asthma increased steadily with body mass index. In men, the risk of asthma increased by 10% with each unit of increased body mass index between 25 and 30. The similar value for women was 7%. Overweight or obese persons reported asthma more often than did thinner persons after adjustment for smoking, education, and physical activity. Moreover, in their cross-sectional survey, Forte et al., [23] tried to investigate both the prevalence of obesity and its relationships with asthma severity and control in a group of 272 patients with confirmed asthma diagnosis attending at an outpatient allergy clinic in Brazil. They concluded that obesity is of high prevalence in asthmatic patients and is strongly linked to female gender. Yet, it has not any significant linkage to asthma severity and control. The association of the categorized BMI with incident asthma as well as the impact of gender on that association was also studied in a meta-analysis of 7 prospective epidemiological studies connoting 333,102 done by Beuther and Sutherland [24]. In comparison with normal weight, overweight and obesity conferred increased odds of incident asthma in men and women, suggesting asthma incidence could be reduced by interventions targeting overweight and obesity. Studying the association between obesity and asthma control and hospitalization revealed that higher BMI and high risk waist circumference was significantly related with high more frequent admissions to hospital and ICU. Likewise, Shore et al., [25] found that people with obesity are also more likely to be hospitalized for asthma. Thomson at al., [26] in their study stated that 75% of patients treated for asthma in the emergency room are either overweight or obese. In a 12-year follow up study for prognosis of adult-onset asthma, Tuomisto found that uncontrolled asthma was predicted by elevated body-mass index at baseline [27]. However, BMI and high risk waist circumference did not appear as significant predictors of asthma severity and control among the studied population.

Direct and passive smoking appeared as a prominent factor in the current study although the vast majority of the studied asthmatics never smoked. This is not surprising as the majority (two thirds) of the study population were females. Women in Egypt smoke much less than men. According to the Global Adult Tobacco Survey (GATS), men (38.1% [95%CI 36.8-39.4]) are much more likely than women (0.6% [95% CI 0.4-0.9]) to use tobacco and this reflects the reserved society that prohibits such practices among women [28]. However, this doesn't preclude the risk of smoking. In Egypt women can expose to second hand smoking or passive smoking either indoor or in work places. The number of passive smokers in the present study amounted to 80%. A study conducted by Radon et al., in Germany found that the chronic bronchitis and asthma were significantly higher in subjects reporting involuntary tobacco smoke exposure in the workplace with a daily exposure of >8 h. The control of such exposure might reduce the risk of respiratory symptoms independently of exposure to other airborne contaminants [29]. Gilliland at al., [30] and Janson [31] found that lifetime environmental tobacco smoke exposure, especially at work, is associated with respiratory symptoms/diseases, asthma, impairment of lung function and increased bronchial responsiveness. The consequence of workplace exposure seems to be more serious than domestic exposure. In Italy, Simoni et al., [32] reported that women exposure to both husband and workplace tobacco smoke resulted in a significant risk factor for dyspnoea, shortness of breath, wheeze, asthma, bronchitis/emphysema, and rhino-conjunctivitis. Exposure only at work yielded higher adjusted odds ratios for all health conditions, except for rhino-conjunctivitis. This has also been affirmed by Ulrik and Lange [33]. Nonetheless, conflicting results of increased, decreased or even no association between smoking and asthma have been shown by other inconsistent studies [27,29-34]. Elimination of exposure to smoking at workplace has been proposed to decrease the occurrence of shortness of breath at rest and rhino-conjunctivitis [32]. We were not able to evaluate the effect of life style modification by smoking cessation on asthma severity and control in the present study the as the number of asthmatic who quitted was very low.

In the present study, a wide range of asthma triggers that aggravate asthma has been mentioned by the recruited asthmatics. A complex of 3-6 asthma triggers has been found to flare asthma symptoms per each of the studied patients. Gastro esophageal reflux (GER) and asthma occur together frequently [35,36]. The condition is a self-propagating where reflux aggravates asthma that in turn induces further reflux. The estimated prevalence of GER in asthmatics adults is between 60-80% [37,38]. This is 3-4 folds higher than the present findings.

Alexandria is a costal and temperate urban city in Egypt. Cities are polluted and pollution exposure is linked to a greater risk for asthma [39]. The association between urbanization as well as the rural and urban environment and development of asthma has been investigated in the studies of Asher [40] and Jie at al., [39]. They recorded that the main risk factors for developing asthma in urban areas are atopy and allergy to house dust mites, followed by allergens from animal dander, mold growth, fuel combustion and environmental tobacco smoke. Teifoori et al tried to identify the main allergen sensitizers by molecular diagnosis and Component Resolved Diagnosis (CRD), in a group of 202 adult Iranian asthmatic patients treated at Loghman Hakim Hospital and Pasteur Institute of Teheran in the period of 2011-2012. Pollen and cockroach were the most relevant allergen sources in the asthmatic population. Forty-five percent of all patients could be considered atopic individuals. Eighty-two percent of atopic patients were sensitized to pollen allergens. While 35% of the atopic population was sensitized to cockroach [41]. Price et al, found that an asthmatic may be sensitive to a complex of 6-15 asthma triggers. As trigger burden increased, behavioral changes to manage trigger exposure had significantly increased the impact on daily life and job choice. Participants reporting a high trigger burden were more likely to report uncontrolled asthma and experienced on average more severe asthma attacks, hospitalizations, and more missed days at work during a lifetime than those with a low trigger burden [42]. Triggers and strategies for controlling modifiable triggers should be more focused while educating asthma management to asthmatic patient. Adoption of some environmental health strategies like decreased exposure to dust, use of anti-mite bed sheets, avoidance of pets at home and vaccination against influenza may have a preventive effect on asthma progression [43-45].

Asthma genetic element was evident in the high family history of asthma (54.4%) and other allergic conditions including rhinitis, conjunctivitis, hay fever, eczema & urticaria (37.7%) among the studied asthmatic patients. This raise the suspicion of high prevalence of atopy among the studied patients although atopy was not immunological investigated in the present study and despite the low co-presence other allergies (6%), the role of atopy in asthma development couldn't be excluded. The factor of allergens recall and denial by asthmatics should be taken into consideration.

About 10% of adults suffer an attack of asthma, and up to 5% of these have severe disease that responds poorly to treatment [46]. In the United States, Peters et al., found that uncontrolled asthma is highly prevalent (55%) [47]. In the present study, one third of the asthmatic population had moderate persistent asthma that was poorly controlled in about 9.7%. However none had suffered from severe persistent asthma. Despite nationally promoted treatment standards and improved therapeutic agents, asthma-related morbidity remains high, continuing to have high health care use and a significant effect on patients' quality of life. In six month period prior to the carrying out the present study, asthma caused approximately 3500 missed work days for 320 adult participants, 1700 physician office visits, 500 asthma-related visits to emergency departments, 300 hospital admissions, and 56 admissions at the ICU with an overall estimated cost of 380.000 EGP.

Multivariable analysis of the demographics and comorbid conditions identified several independent factors associated with sever and uncontrolled asthma. These accorded in part with results of REACT study conducted in USA [47]. Literacy did not appear associated with better asthma control as the majority of the study population was educated. This also reflects equity in access to health care regardless the level of education. Nevertheless higher income was a predictor of controlled asthma as this category of asthmatics always seeks paid health service and medications of better quality. This confirms results a conducted in Egypt where higher prevalence and severity found in the lower socioeconomic group which could be contributed by high crowding index and cockroaches that thrive in unhygienic housing conditions [48]. The fact that more than half of patients reported taking preventers twice per day reflects poorly controlled asthma and an effort to relieve symptoms.

Non adherence to medications in asthma is common among adults with rates ranging from 30% to 70% notably due to use of multiple medications, long treatment durations and periods of symptom remission [49-51]. In the present study, poor adherences were mainly of non-persistence and non-conforming types [52] and were attributed primarily to treatment-related factors including cost of medications. In fact, some patients were using the ICS (Furadil® inhaler) less frequently as prescribed as it was paid in part by the patients and only 50% of its cost is covered by the health insurance. Occurrence of treatment side effects was also a barrier to adherence particularly that one third of patients had co-morbid hypertension or diabetes which are aggravated by long-term use of corticosteroid. In a study conducted by the group of Kankaanranta, Patients with both systemic inflammations, treated with higher dose of inhaled corticosteroid (ICS) and have comorbidities showed poorest outcome of asthma [53]. Forgetfulness is one of the major non-intentional reasons for non-adherence [52]. One third of the participants reported forgetfulness as a cause for poor adherence to medications and this was positively correlated with older ages ($r=0.166$ $P=0.003$) suggesting age related memory loss. Providers and health system factors were not barriers to adherence and the satisfaction score was generally accepted. All participant patients had never received a written management plan, a factor that could influence adherence. Written asthma action plans have been associated with decreased emergency department visits, fewer hospitalizations, and improved lung function [54]. Action plan completed in discussion with the patient may contribute to improving adherence by reducing confusion about medications, and reminding patients about when and how to use them, teach the patient how to self-manage asthma symptoms, how to prevent asthma symptoms from getting severe, what to do when asthma becomes worse and to easily communicate with HCP for advice on having breathing problem.

Conclusion and Recommandations

Despite management in accordance with established guidelines, a significant proportion of asthmatics have uncontrolled disease. The present findings support the need for a more comprehensive ongoing assessment of asthma severity and control particularly medication use with comparative assessments over time to achieve optimal asthma control. Identifying specific barriers for each patient and

adopting suitable techniques to overcome them will be necessary to improve medication adherence. Also, to set up feasible patient-HCPs communication plan for exchanging data and ensuring adherence to the HCP instructions and prescribed medications dosage and schedule. Control of environmental factors and addressing co-morbid conditions (GERD, DM, hypertension, obesity) as interventions may result in improved asthma control.

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Authors Contributions

Hassan M Farag: Study concept and design; development of the study questionnaire and tools, interpretation of data; critical revision of the manuscript for important intellectual content, supervision of the study implementation, and technical support.

Ekram W Abd El-Wahab: Study design, development of the study questionnaire and tools, statistical analysis, drafting of the manuscript; interpretation of data, critical revision of the manuscript for important intellectual content; supervision of the study implementation and technical support.

Nessrin A El-Nimr: Study design, interpretation of data, and critical revision of the manuscript for important intellectual content.

Hoda A Saad El-Dein: Recruitment of study cases, executing the study plan, data collection.

Quick Look

- The prevalence of uncontrolled asthma is high in the community outpatient clinic setting
- Demographic and co-morbid factors can interfere with asthma control
- Improvements in health care, asthma management and avoidance of triggers can help reduce asthma severity and burden

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