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ORIGINAL RESEARCH

Asthma Treatment Outcome and Factors Associated with Uncontrolled Asthma Among Adult Patients with Asthma in Addis Ababa, Ethiopia

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Background: Asthma is a major public health challenge in the world resulting in significant health and economic burden. The modifiable and non-modifiable risk factors could have considerable impact on asthma control and medical care.

Objective: This study is intended to evaluate the treatment outcome and identify risk factors for poor asthma control among patients with asthma in Addis Ababa, Ethiopia.

Methods: A multicentre cross-sectional study using interview and chart review was conducted among patients with asthma attending ambulatory care of two large public hospitals in Addis Ababa, Ethiopia, between March and June 2018. The Global Initiative for Asthma Guideline was used to determine treatment outcomes. The variables of interest were described using descriptive statistics such as frequencies, percentages, mean, and standard deviations. Multivariable logistic regression was used to determine factors associated with uncontrolled asthma. All statistical significance level was determined at $p < 0.05$.

Results: A total of 230 patients with asthma were interviewed. More than half (65.2%) of patients were females, and their mean age was 54 ± 15.1 years. Overall, 50.4% of the patients had uncontrolled asthma status. More than two number of trigger factors (AOR = 1.88; 95% CI: 1.09–2.01), cold weather (AOR = 2.11; 95% CI: 1.51–2.42), exacerbations of asthma in the last 12 months (AOR = 2.01; 95% CI: 1.39–2.32), moderate persistent asthma (AOR = 3.47; 95% CI: 1.75–5.13), severe persistent asthma (AOR = 2.90; 95% CI: 2.56–3.98), patients on Salbutamol puff with Beclomethasone (AOR = 2.92; 95% CI: 2.50–3.45) and patients on Salbutamol puff with Beclomethasone and Prednisolone (AOR = 5.76; 95% CI: 4.02–6.02) use were significantly associated with uncontrolled asthma.

Conclusion: More than half of patients with asthma had uncontrolled asthma treatment outcome. This indicates the need to give due attention to asthma patients with uncontrolled status, particularly to those with identified risk factors. Health care providers should work in creating patient awareness on appropriate use of their prescribed medications, avoidance of asthma triggering factors for decreasing the progression of the disease and better asthma control.

Keywords: asthma, treatment outcome, uncontrolled asthma, severity, exacerbations and trigger factors

Introduction

Asthma is a heterogeneous respiratory disease, usually characterized by chronic airway inflammation with variable air flow limitation.[1] It is triggered by dusty environment, cold weather, upper respiratory tract infection, household pests, tobacco smoke and strong smell features.[2] Asthma is a major cause of morbidity and mortality globally, resulting in a significant health and economic burden to 358 million individuals with asthma in 2015.[3,4] During that same year, about 400,000 people died from asthma, with significantly higher mortality occurring in the low- and middle-income countries.[4] It has been documented that if not controlled properly, asthma can affect daily activities and lead to significant physical and socio-economic burden

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with health-related cost.[1] Patients with uncontrolled asthma status use the health care service frequently which in turn results in the loss of significant productivity. Compared to those with well-controlled asthma, people with uncontrolled asthma bear the largest disease burden and financial burden.[1,5,6] Among the factors reported to aggravate uncontrolled asthma are moderate persistent asthma, severe persistent asthma, exacerbation of asthma, being elderly, persistent exposure to trigger factors, poor knowledge towards asthma care and negative attitude towards inhaled corticosteroids.[1,7–9] Only few studies have, however, been conducted in Ethiopia to assess the prevalence of asthma. Two studies from the northern part of Ethiopia reported prevalence rates of 10.4%[10] and 29.6%.[11] Furthermore, few other studies are available that have reported high levels of uncontrolled asthma with mean prevalence as high as 71.7%.[12]

Yet the above mentioned studies have not addressed important variables such as number of trigger factors and type of trigger factors which are thought to be of paramount importance to improve health status of patients with uncontrolled asthma. This study was therefore conducted to assess the treatment outcome and identify risk factors for poor asthma control among adult patients with asthma attending treatment in two hospitals in Addis Ababa, Ethiopia.

Methods

Study Area and Setting

Addis Ababa, the largest city and political and commercial capital of Ethiopia, has 38 hospitals (13 public and 25 private) and 98 health centers.[13] From among these, two public hospitals were selected for this hospital-based cross-sectional study which was conducted from 1 March to 30 June 2018. These two hospitals, ie, St. Paul's Hospital Millennium Medical College (St. Paul's Hospital) and Menelik II Referral Hospital (Menelik II Hospital) were selected for the study due to the high number of patients at follow-up care. St. Paul's Hospital is one of the largest public teaching hospitals established in 1961 GC. The hospital has 404 beds and serves around 333,752 patients per year, both ambulatory care and hospitalized patients. There were 2692 patients seen in the chest clinic in 2017. Menelik II Hospital was established in 1910 and has 352 beds. The hospital sees more than 206,919 patients every year, with 143 of them requiring asthma treatment follow-up.

Study Population

All patients with asthma attending ambulatory care of St. Paul's Hospital and Menelik II Hospital were included for the study based on eligibility criteria. The inclusion criteria were being on anti-asthmatic medications at least for 3 months and age of 18 years or older. Patients with lower and upper respiratory tract infection, chronic obstructive pulmonary disease, emphysema, pulmonary hypertension, and congestive heart failure and patients with incomplete chart information were excluded.

Sample Size and Sampling Techniques

The sample size was calculated using a single population proportion formula.[14] Considering 53.3% as proportion (p) of uncontrolled asthma (9), with 95% confidence interval and 5% marginal error (d), the sample size was calculated to be 383. However, the study population was less than 10,000. Hence, the corrected sample size, using the correction formula was 223. Considering a 5% contingency. The final sample size was calculated to be 234. Participants were recruited from each study settings based on the patient load of the hospitals: 171 from St. Paul's Hospital and 63 from Menelik II Hospital were allocated proportionally. A consecutive sampling technique was employed to obtain the required number of participants from each hospital.

Data Collection Procedures and Tools

A structured questionnaire was adopted from the Global Initiative for Asthma guidelines (GINA),[1] and by review of other relevant literature[7,15–18] that was used for interviewing selected patients. The pretested structured data collection tool consisted of two parts: (i) information on basic socio-demographic characteristics and (ii) information on asthma symptom control and severity. In addition, patient charts were reviewed to collect information on asthma diagnosis, duration of asthma, comorbidity, concurrent medication(s) and anti-asthmatic medication(s) pattern.

Statistical Analysis

Data were entered into Epi-Data Version 3.1 and then exported to SPSS Version 23.0 for analysis. Descriptive statistics (mean, standard deviation, percentages and frequencies) was used to summarize the data. Multivariable logistic regression analysis was employed to identify factors associated with uncontrolled asthma. A *p*-value of 0.05 or less was considered statistically significant. Asthma treatment outcome was defined based on GINA asthma control tool.[1] For this study, the outcome factors were divided into two categories: well-controlled and partially controlled asthma were designated "controlled", whereas uncontrolled asthma was considered "uncontrolled".

Data Quality Control

The questionnaire was pre-tested on 5% of the total study participants in the same population outside the study setting in a referral hospital in Addis Ababa for two weeks before the actual data collection time to detect problems and make required revisions. Two-day training was given to all data collectors and the first author closely monitored the data collection process. Furthermore, the first author checked collected data for clarity, consistency and completeness on a daily basis.

Operational Definitions

Asthma Treatment Outcome

According to management, asthma severity and control were assessed based on GINA asthma symptom control assessment tool (GINA Score). This tool is used to classify treatment outcome status based on daytime symptoms, nighttime symptoms, limitation in activities and rescue medication use.[1]

Well Controlled

It is entitled to an outcome in which patient's response to asthma symptom control assessment tool (GINA Score) like daytime symptoms, nighttime symptoms, limitation in activities and rescue medications used to be none in the past four weeks.[1]

Partially Controlled

This stands for asthma symptom control assessment tool (GINA Score) if the study participant's answer is about one or two "yes"responses.[1]

Uncontrolled

This stands for asthma symptom control assessment tool (GINA Score) in which sample of study participant's answer is about three or four "yes"responses.[1]

Treatment Outcome

Patients' response to therapeutic regimen they had been prescribed during clinical follow-up visits was based on the current clinical subjective findings reported by each study participant. Thus, based on GINA score, the overall outcome could be defined into two categories which are controlled and uncontrolled considering GINA score report controlled and uncontrolled asthma. Accordingly, partially controlled and well controlled participants were considered as "controlled" asthma status.[7]

Results

Socio-Demographic and Clinical Characteristics of Patients

A total of 230 participated in the study with a response rate of 98.3%. The mean ±SD age of participants was 54.3 ±15.1 years. The majority of patients were female (65.2%), married (56.5%), and never smokers (85.7%). The mean duration of illness from a clinical diagnosis with asthma was 12 ± 9.2 years. About half (47.4%) of the study participants reported that they had at least one time history of asthma exacerbations in the last 12 months and 92 (40%) had moderate persistent asthma as shown in Table 1.

Triggering Factors for Asthma Exacerbations Patients with Asthma

More than three-fourths (84.8%) of patients reported one or more triggering factors, where cold weather 106 (46.1%) and bad or strong smell 95 (41.3%) were the two leading triggering factors for asthma exacerbations (Table 2).

Anti-Asthmatic Medication Pattern and Concurrent Medication Used by Patients with Asthma

Treatment with anti-asthmatic medications was found as alone or combination therapy. Salbutamol puff monotherapy accounted for 54 (23.5%) of the study participants' treatment, while 100 (43.5%) of the patients were using Salbutamol puff + Beclomethasone inhaler. More than one-third (35.2%) of asthma patients had concurrent medications (Table 3).

Asthma Treatment Outcome

Over half (50.4%) of patients had uncontrolled asthma, while only (22.6%) had well-controlled asthma treatment outcome (Table 4).

Risk Factors for Uncontrolled Asthma

Patients with more than two number of trigger factors (AOR = 1.88; 95% CI: 1.09–2.01), who had cold weather as triggering factor (AOR = 2.11; 95% CI: 1.51–2.42), with asthma exacerbations in the last 12 months (AOR = 2.01; 95% CI: 1.39–2.32), with moderate persistent asthma (AOR = 3.47; 95% CI: 1.75–5.13) and severe persistent asthma (AOR = 2.90; 95% CI: 2.56–3.98) were more likely to have uncontrolled asthma status than their counterparts. Patients who had been on Salbutamol puff with Beclomethasone and Salbutamol puff with Beclomethasone and Prednisolone use were about 2.92 and 5.76 times more likely to have uncontrolled asthma status than other anti-asthmatic medications (AOR = 2.92; 95% CI: 2.50–3.45 and AOR = 5.76; 95% CI: 4.02–6.02, respectively) (Table 5).

Discussion

This study was conducted to assess the treatment outcome of asthma patients and identify factors associated with uncontrolled asthma among patients with asthma in Ethiopia. The study showed that more than half of the patients had uncontrolled asthma, and several factors such as more than two number of trigger factors, cold weather, exacerbations in the last 12 months, and moderate persistent or severe persistent severity of asthma and medication could contribute to the poor treatment outcomes.

Our study revealed that 50.4% of patients had uncontrolled asthma which is comparable to studies conducted in 11 European countries (45%),[19] Vietnam (46%),[20] Italy (51.3%),[16] and Ethiopia (53.3%).[7] This similarity might be due to the use of the same simple screening tool to classify asthma symptom control. This finding was greater than the result reported in China (17.2%)[21] and Saudi Arabia (23.3%).[22] The differences in the level seen might be due to the diagnosis of asthma being made by respiratory physicians, lung function tests done to the patients and the high educational status of study participants in those studies.[21,22] In addition to this, the fact that most study participants in those studies have taken health education about asthma disease such as device use technique and behavior-related education by their physician and asthma educator might contribute towards the discrepancy.[22] However, it was lower than the findings in a study done in South Eastern Nigeria (82.9%)[23] and Jimma, Ethiopia (64.5%).[15] The difference might be explained in part by the fact that patients were found to overestimate their uncontrolled status.[23] Compared to the finding from Jimma, Ethiopia, the lower monthly income status of the participants in that study might have led to decreased medication affordability, especially the ICS, which may account towards the difference.[15,23]

An asthma standard of management care not only includes the pharmacological treatment but also comprises effective management of triggers as well as risk factors to achieve sustained asthma control.[24] Effective and proper utilization of optimized asthma management with anti-asthmatic medication can significantly reduce asthma-related exacerbation.[25] Asthma exacerbations in the last 12 months were found to have a significant association with uncontrolled asthma, which was consistent with findings from other studies.[7,16,17] This might be due to the fact that patients with uncontrolled asthma

Table 1 Socio-Demographic and Clinical Characteristics of Patients with Asthma at Ambulatory Care in Two Public Hospitals of Addis Ababa, Ethiopia

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	80	34.8
Female	150	65.2
Age category (in years)		
18–34	24	10.4
35–64	138	60.0
≥65	68	29.6
Marital status		
Single	24	10.4
Married	130	56.5
Divorced	25	10.9
Widowed	51	22.2
Residence		
Addis Ababa	193	83.6
Out of Addis Ababa	37	16.1
Education		
No formal education[a]	84	36.5
Primary education	68	29.6
Secondary education and above	78	33.9
Occupation		
Employed	153	66.5
Unemployed	77	33.5
Access of care		
Free of payment[b]	136	59.1
Out-of-pocket	94	40.9
Use of biomass fuel		
No	139	60.4
Yes	91	39.6
Smoking status		
Never-smoker	197	85.7
Current-smoker	6	2.6
Ex-smoker	27	11.7
Duration of asthma (in years)		
<12	148	64.3
≥12	82	35.7
Severity of asthma		
Mild intermittent	50	21.7
Mild persistent	49	21.3
Moderate persistent	92	40.0
Severe persistent	39	17.0
Exacerbations in last 12 months		
Yes	109	47.4
Comorbidities		
Yes	81	35.2

Notes: [a]Include illiterates and able to read and write due to informal education like religious teaching. [b]Include insurance and institutional linkage.

frequently visit hospital which might increase their chance of acquiring additional disease and exposed to various triggering factors, which in turn result in exacerbations of the symptom.[1] In this study moderate and severe persistent asthma was revealed as factors for uncontrolled asthma similar to the study done in Brazil[26] and Jimma, Ethiopia.[15] In

Table 2 Trigger Factors for Asthma Exacerbations in Patients with Asthma at Ambulatory Care in Public Hospitals of Addis Ababa, Ethiopia

Characteristics	Frequency (n)	Percentage (%)
Number of triggering factor		
No	35	15.2
One trigger	128	55.7
Two or more triggers	67	29.1
Type of triggering factors[a]		
Cold weather	106	46.1
Bad or strong smell	95	41.3
Dust	61	26.5
Smoke	32	13.9
Others (fumes, pollen and irritants)	14	6.1

Note: [a]More than one triggering factor is possible.

Table 3 Anti-Asthmatic Medication Pattern and Concurrent Medication Used by Patients with Asthma at Ambulatory Care in Public Hospitals of Addis Ababa, Ethiopia

Variables	Frequency (n)	Percentage (%)
Types of anti-asthmatic medications		
Salbutamol puff use		
Salbutamol puff PRN[a]	54	23.5
Salbutamol puff PRN[a] + Beclomethasone puff BID[b]	100	43.5
Salbutamol puff PRN[a] + Prednisolone	21	9.1
Salbutamol puff PRN[a] + Beclomethasone puff BID[b]+ Prednisolone	55	23.9
Concurrent medication[c]		
Yes	81	35.2

Notes: [a]As needed; [b]Two times/day; [c]Metformin, aspirin, hydrochlorothiazide, and insulin; +: plus.

Table 4 Asthma Treatment Outcome Among Patients with Asthma at Ambulatory Care in Two Public Hospitals of Addis Ababa, Ethiopia

Variables	Frequency (n)	Percentage (%)
Asthma treatment outcome		
Well controlled	52	22.6
Partially controlled	62	27.0
Uncontrolled	116	50.4

view of this, it has been documented that patients with moderate and severe persistent asthma were more likely to have uncontrolled asthma.[1,15,26]

This study revealed that from pharmaco-therapeutic related factors, patients on Salbutamol puff with Beclomethasone and Salbutamol puff with Beclomethasone and Prednisolone use were found to have uncontrolled asthma status. The reasons for the observed association might be poor inhaler technique, fear of side effect or dependency and overall high specific concern towards the controller medications which consequently may have led to low adherence to the use of controller medications.[1] This study finding evidently calls for more research into the use of these groups of medications both among the providers and patients.

Our study has some limitations. This study being a cross-sectional study does not allow a temporal link to be established between the independent and dependent variables. In addition, the spirometric assessment technique which would have allowed for better measurement of the asthma control level was not used. In spite of these limitations, the

Table 5 Multivariable Logistic Regression Analysis Result of Factors Associated with Uncontrolled Asthma Among Patients with Asthma at Ambulatory Care in Public Hospitals of Addis Ababa, Ethiopia

	Uncontrolled Asthma			
Characteristics	**Yes; n (%)**	**No; n (%)**	**COR (95% CI)**	**AOR (95% CI)**
Gender				
Male	32 (13.9)	48 (20.9)	1.00	1.00
Female	84 (36.5)	66 (28.7)	1.91 (1.36–2.46)*	1.73 (0.76–1.26)
Cold weather				
No	51 (22.2)	73 (31.7)	1.00	1.00
Yes	65 (28.3)	41 (17.8)	2.26 (1.75–2.77)*	2.11 (1.51–2.42)*
Number of triggers				
No	12 (5.2)	23 (10)	1.00	1.00
One	69 (30)	59 (25.7)	2.24 (1.48–3.00)*	2.05 (0.98–1.75)
Two or more	35 (15.2)	32 (13.9)	2.09 (1.26–2.92)	1.88 (1.09–2.01)*
Exacerbations in last 12 months				
No	50 (21.7)	71 (30.9)	1.00	1.00
Yes	66 (28.7)	43 (18.7)	2.18 (1.67–2.69)*	2.01 (1.39–2.32)*
Comorbidity				
No	78 (33.9)	71 (30.9)	1.00	1.00
Yes	38 (16.5)	43 (18.7)	0.80 (0.63–0.94)	0.65 (0.58–1.31)
Duration of asthma				
<12 years	73 (31.7)	75 (32.6)	1.00	1.00
>12 years	43 (18.7)	39 (17.0)	1.13 (0.61–1.65)	1.02 (0.52–1.94)
Severity of asthma				
Mild intermittent	14 (6.1)	36 (15.7)	1.00	1.00
Mild persistent	23 (10.0)	26 (11.3)	2.27 (1.44–3.10)*	1.95 (0.93–2.35)
Moderate persistent	56 (24.3)	36 (15.7)	4.00 (2.04–5.96)*	3.47 (1.75–5.13)*
Severe persistent	23 (10.0)	16 (6.9)	3.69 (2.80–4.58)*	2.90 (2.56–3.98)*
Type of anti-asthmatic medications				
Sal puff[a]	14 (6.1)	40 (17.4)	1.00	1.00
Sal puff[a] + Beclo[b]	54 (23.5)	46 (20.0)	3.35 (2.62–4.08)*	2.92 (2.50 −3.45)*
Sal puff[a] + Pred[c]	7 (3.0)	14 (6.1)	1.25 (0.24–2.26)	0.73 (0.58–1.75)
Sal puff[a]+ Beclo[b]+ Pred[c]	41 (17.8)	14 (6.1)	6.40 (5.54–7.26)*	5.76 (4.02–6.02)*

Notes: *Significant association $p < 0.05$. [a]Salbutamol; [b]Beclomethasone, [c]Prednisolone; +: plus.

study used different assessment tools which helped in acquiring the required data for status of asthma treatment outcome and clinical and behavioral related characteristics of the study.

Conclusions

The finding of the study indicated that high rates of uncontrolled asthma, more than two number of trigger factors, cold weather, exacerbations in the last 12 months, moderate and severe persistent severity of asthma and salbutamol use alongside controller medications were found to be significant predictors of uncontrolled asthma levels. It is therefore recommended that health care providers should work in creating patient awareness towards their condition including the avoidance of asthma triggering factors and the appropriate use of their medications. Furthermore, additional studies need to be conducted to prospectively assess the reason for the development of uncontrolled asthma including those on controller medications.

Abbreviations

GINA, Global Initiative for Asthma Guideline; ICS, Inhaled Corticosteroids.

Data Sharing Statement

Data used in this analysis are available from the corresponding author on reasonable request.

Ethical Consideration

The study was done in accordance with the principles of the Declaration of Helsinki. The study protocol was reviewed and approved by the Ethical Review Committee of the School of Pharmacy, Addis Ababa University (ERB/SOP/10/10/2018) and SPHMMC (PM23/192), respectively. In addition, the respective heads of the two hospitals permitted the study to be conducted in their hospitals. Informed consent was obtained from each study participant including for the publication of their anonymous responses. All participants' personal information was kept anonymous, and confidentiality was secured throughout the study period.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests.

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