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A model to predict short-time asthma morbidity: what could be the explanatory factors?

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ABSTRACT

Background: There is an increase in the worldwide prevalence, morbidity and mortality of asthma. Therefore, study of the possible factors related to the burden of this disorder could help the health providers to introduce effective initiatives and reduce adverse consequences due to this condition. This study was designed to investigate any relationship between asthma morbidity with inhaler technique and other probable explanatory factors in asthmatic patients.

Methods: An observational, cross-sectional study was designed in which asthmatic patients referring to the outpatient respiratory clinic of the Shaheed Labbafinezhad hospital were entered the study using a non-probability sampling method. Their demographic, socio-economic, medical and medication history, inhaler technique (using a 10-step check list), as well as short-term morbidity index (in the past 4 weeks using the Jone's morbidity questionnaire) were determined and recorded in organized data collection forms. These data were entered the Excel and SPSS (version 17.0) worksheets and analyzed using appropriate statistical tests. A step-by-step analysis method was used in order to find out any relationship between possible explanatory factors and the morbidity index of the patients.

Results: 199 adult asthmatic patients (94 male and 105 female) with mean ± SD age of 54.29 ± 15.52 years enrolled the study. In the first step of data analysis only 5 factors out of 20 explanatory factors were eligible to be included in the multivariate analysis leading to the final predictive model. In the multivariate regression analysis, 2 out of 5 factors could remain in the final model, which were "history of systemic steroid usage" and "age" (p=0.007, r=0.32). So that, patients with a positive history of systemic steroid use and those with a younger age had higher asthma morbidity rate.

Conclusion: The observed positive relationship between history of systemic steroid usage and asthma morbidity remarks the importance of asthma control in the primary care level and highlights its role on patient's quality of life. Possible reasons leading to a higher morbidity rate in younger asthmatic patients should be evaluated in the future studies.

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Introduction

Global prevalence, morbidity, mortality and economic burden associated with asthma are growing in many countries (1-3). Literature review shows that morbidity of asthmatic patients not only is affected by direct patient care, but could also be associated with different explanatory factors such as low socio-economic status that may cause a poor primary heath-care access; inappropriate environmental conditions consisting of irritant gases, chemicals and allergen exposures; lack of attention to the inflammatory nature of the illness which follows an

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insufficient prescribing of steroids to manage the disease; over-reliance of patients on bronchodilators to relief asthma attacks; poor self-monitoring and inappropriate measurement of lungs dynamic activity using a peak flow meter; delay in seeking medical care during asthma worsening periods; poor compliance with the therapeutic regimen specially underuse of prophylactic corticosteroid inhalers and poor patient-doctor concordance (1, 4-7).

Several studies have cautiously concentrated on the reduction of the asthma morbidity and consequently on lowering the burden of the disease on the national health systems. They have also tended to determine a measure for distinguishing the extension of asthma morbidity in asthmatic patients, amongst which the "Jone's morbidity" questionnaire and the index of "quality of life" can be mentioned (8, 9).

In the Jone's morbidity questionnaire, based on the number of positive answers given to three simple questions, patient's morbidity is divided into three levels of low, intermediate and high (9).

In response to different morbidity and mortality pattern of asthma in different communities, various methods and initiatives have been designed for diagnosis, treatment and prophylaxis of asthma. These programs have had significant impacts on increasing awareness of patients and parents of asthmatic children towards asthma and its management, improving asthma knowledge and reduction of absence from school or work (10).

Despite, causing a great burden in developing countries, asthma has not been well-documented in them. On the other hand, in spite of advances in understanding the pathophysiology and treatment of asthma, reports show that morbidity and mortality attributable to the disease continue to increase (11). Interestingly, specific characteristics of study populations such as genetics, ethnicity groups, socioeconomic status, health maintenance behaviors, air quality, and obesity were recognized as likely contributors to the morbidity, mortality and burden of asthma (11, 12). Certainly, to resolve the undesirable impact of these disparities, we need to verify high risk patients to ensure that patients at higher risk are given proper care and the awareness to control their asthma as well as to diminish the effect of risk factors. Since no similar study was found to be performed in Iranian asthmatic patients, therefore we decided to design a study to investigate any relationship between asthma morbidity with probable explanatory factors.

Methods

This is an observational, cross-sectional study to determine the probable factors related to the morbidity in Iranian asthmatics living in the metropolitan city of Tehran. Study setting was the Shaheed Labbafinezhad teaching hospital affiliated to the Shahid Beheshti University of Medical Sciences, and patients referred for routine follow-up visit were included in the study, during the Spring and Autumn of the year 2009. Study population consisted of adult (age over 15 years) known asthmatic patients, from both genders who referred to the respiratory clinic for their routine follow-up and drug therapy monitoring. A non-probability sampling method was used. Patients were receiving drug therapy for their asthma and their drug regimen included at least one metered dose inhaler (MDI).

Patients' demographic information and supplementary data which could be possibly related to asthma morbidity were collected by a questionnaire. Table 1 shows 20 explanatory factors used in this study. Their possible relationship with asthma morbidity was investigated. Patients' morbidity was assessed using the Jone's questionnaire and their metered dose inhaler techniques were evaluated applying a 10-step check list (Table 2– MDI technique check list).

Short-term morbidity assessment method

The Jone's morbidity questionnaire was applied. It contains three questions as below:

During the past four weeks, have you:

1. Been in a wheezy or asthmatic condition at least once a week?

2. Had time off work or school because of your asthma?

3. Suffered from attacks of wheezing during the nights?

If answers to all 3 questions are negative, the patient's morbidity is ranked as *low*. One positive answer to any of the questions is considered as an *intermediate* morbidity level and positive answers to two or all of the questions present a *high* rate of morbidity.

Inhaler technique determination

Without giving any instruction on how to use an inhaler correctly, the inhaler technique of each patient was evaluated. Patients were given a MDI containing salbutamol and asked for inhaling two puffs of the drug to demonstrate their inhaler technique. Their performance was assessed with a 10-step check list (Table 2). One negative mark was assigned for each of the steps missed or performed inappropriately. A patient with score 10, thus, had displayed the most correct inhaler technique. Patients with an inhaler technique score less than 5 and patients with a score higher than 8 were classified as patients with poor and good inhaler techniques, respectively. Scores from 5 to 8 considered as an intermediate inhaler technique.

Statistical analysis

All of the collected data was entered into the worksheets of the Excel and SPSS (version 11.0) software. In order to identify variables eligible to be

Table 1. Preliminary tests to assess the relationships between asthma morbidity and possible explanatory factors.

No	Investigated parameter	Variable status in the study population	P-Value
1	Sex	Female=105; Male=94	0.739
2	Age (year)	Min=15 Max=84 Mean ± SD=54.24 ±15.52	0.020
3	Disease duration (year)	Min=0.2 Max=60 Mean ± SD=9.50 ± 10.13	0.838
4	Severity based on the stage of therapy	Mild*=29 Moderate and Sever**=169	0.406
5	Concomitant disease	Yes=144; No=54	0.777
6	Concomitant drugs (except NSAIDs)	Yes=173; No=26	0.866
7	NSAIDs intake (in the past 4 weeks)	Yes=105; No=93	0.811
8	History of allergy	Yes=81; No=18	0.147
9	Weight (kg)	Mean ± SD=68.99 ± 13.53	0.715
10	Height (cm)	Mean ± SD=154.51 ± 8.99	0.848
11	Smoking	Smoker=165; Non smoker=34	0.036
12	Domestic pets	Yes=35; No=164	0.932
13	Educational level	Illiterate=49 Primary-Secondary school=115 High school-College=35	0.991
14	Occupation[#]	High risk=66; Low risk=133	0.262
15	Income (self-report)	Low=87 Moderate=102 Good=10	0.504
16	Previous Inhaler Technique education	Yes=184; No=14	0.777
17	Easy access to anti-asthma drugs	Yes=82; No=113	0.101
18	Inhaler technique score	Poor=22 Intermediate=43 Good=133	0.555
19	Geographic living location[@]	High risk=142; Low risk=55	0.760
20	Systemic steroid usage (in the past 4 weeks)	Positive=108; Negative=88	0.001

*Patients on only short-acting inhaler bronchodilator (SAB); ** Patients on inhaler SAB + corticosteroids.
#High risk occupations: Animal Handlers, Nurses, Bakers and Pastry Makers, Paint Sprayers, Chemical Workers, Timber Workers, Food Processing Workers, Welders.
@ High risk group: living in the more polluted and deprived central and southern areas of the metropolitan city of Tehran.

included in the multi-variate linear regression analysis, firstly appropriate preliminary analyses including rank correlation analysis, the Mann-Whitney and Kruskal-Wallis tests were performed to find out any probable relationship between morbidity and the explanatory factors. In these analyses, factors with a $p<0.2$ were considered qualified to enter the multivariate analysis (13). Possible interactions between eligible variables were studied and no significant interaction was found. Then, in order to build the final model, relationships between these eligible explanatory factors and morbidity were assessed using a multivariate linear regression analysis. P value less than 0.05 was considered as significance level.

Results

Study sample consisted of 199 adult asthmatic patients (94 male and 105 female) with Mean ± SD age of 54.29 ± 15.52 years.

Preliminary analysis revealed that only 5 of the 20 possible explanatory factors were eligible ($p<0.2$) to enter the multivariate regression analysis (Table 2). These were

Table 2. MDI Technique-check list

Metered dose inhaler Technique	
Remove the cap	1
Shake the inhaler	2
Tilt your head back, slightly	3
Breath out	4
Place the inhaler mouthpiece in your mouth with lips around it	5
Breath in slowly through the mouth	6
Actuate the inhaler	7
Continue to breath in deeply	8
Hold the breath for 5-10 sec. or as long as you can	9
Repeat the stages 1-9 for each puff required, give 0.5-5 min. interval between puffs	10

history of systemic steroid usage ($p = 0.001$), age ($p = 0.02$), smoking ($p = 0.036$), easy access to asthma drugs ($p = 0.101$) and history of allergy ($p = 0.147$). Then, these 5 parameters were entered in a multivariate linear regression analysis to build the final model. A stepwise-forward method was used ($p \leq 0.05$).

Two factors of "history of systemic steroid usage" and "age" remained in the final model ($p=0.007$, $r=0.32$) (equation 1):

$$\text{Morbidity level} = 1.93 + \text{age}\,(-1.18 \times 10^{-2}) + (\text{steroid usage} \times 0.39) \qquad \text{equation 1.}$$

A positive relationship was observed between the history of systemic steroid usage (yes=1, no=0) in the past 4 weeks and asthma morbidity rate. In other words, patients with a positive history of systemic steroid use in the past 4 weeks had experienced higher rates of morbidity. Also, an inverse relationship was found between age and asthma morbidity rate, so that younger asthmatic patients had a higher morbidity due to asthma compared to older patients.

Discussion

From twenty independent variables investigated in this study, only two factors (age and history of steroid usage in the past four weeks) were proved to be significantly related to the asthma morbidity determined by the Jone's morbidity index.

Relationship between age and morbidity shows that an increase in patient's age, could lead to reduction in the asthma morbidity; whereas, the history of systemic steroid usage in the past four weeks had direct relationship with morbidity rate.

Previous reports explaining an inverse relationship between age and morbidity are very rare. Controversies on the relationship between age and asthma morbidity remains to be clarified by further studies. While, a study on asthmatic patients carried out in the United States, during the years 1997-2006 had revealed a result in compliance with our finding (14), however a more recently published report in 2013, covering the years 1988-2006, shows that older adults with asthma have a considerable burden of morbidity and increased mortality (15). Those findings which confirms our results, elucidate that decrease in asthma morbidity in older patients may be due to their capability to adapt with their disease and medication use. This may also be confirmed with a lesser compliance with therapeutic regimen in younger asthmatic patients (14, 16, 17).

The significant association between prednisolone rescue courses and asthma morbidity has previously been reported by a number of other studies. Studies on asthmatic patients, found that history of systemic steroid use was associated with hospitalization risk. It has been reported that asthmatics with a history of prednisolone rescue courses could have a higher risk of severe life-threatening or near-fatal asthma attacks (18-19). Perry *et al.* also showed that overuse of rescue medications and underuses of inhaled corticosteroids were prevalent amongst a rural population even though they were highly insured and had frequent health care use (20).

Yukse *et al*. showed that asthmatic patients using corticosteroids are in a higher risk of hospital admission (21). Salamzadeh *et al*. have also revealed that patients with a history of oral steroid rescue course could have a higher rate of practice appointments (22). In addition, they found that patients with a positive history of prednisolone courses had a poor asthma prescribing quality indicated by the ratio of preventers to bronchodilators. In a study in the UK, Moudgil *et al.* find a direct relationship between forced expiratory volume in the 1st second (FEV1), which was associated with increased GP attendance, and the number of prescriptions for rescue oral steroids (23).

Since a history of recent steroid usage could be a sign of poor asthma control (24), then the results obtained in this study, confirming an increased rate of morbidity in systemic steroid users seems reasonable.

In conclusion, the observed relationship between history of systemic steroid usage and asthma morbidity remarks the importance of asthma control in the primary care level and highlights its role on patient's quality of life. Possible reasons leading to a higher morbidity rate in younger asthmatic patients should be evaluated in the future studies. Physiologic as well as psychosocial needs of this age group should also be considered as a contributory factor for asthma morbidity.

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