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# BMJ Open

## Assessment of Knowledge on self-management among Asthmatic patients: A prospective cohort study

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4 **Assessment of Knowledge on self-management among Asthmatic patients: A**  
5 **prospective cohort study**  
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## Abstract

**Objectives:** Despite the many advancements in diagnosis and wide accessibility of numerous treatment options which are effective, still most of the patients have poorly controlled asthma. This can be significantly attributed to the lack of knowledge about disease management, its triggering agents and when to seek health-care provider among many other issues. The purpose of our study was to assess the knowledge of disease self-management among patients suffering from asthma.

**Setting:** A prospective cohort study design was used and ambulatory asthmatic patients were recruited through a convenient sampling method.

**Participants:** Questionnaires used enquired about 1) Patients' sociodemographic details, 2) Knowledge of disease self-management and were filled in via one-on-one interview with the patient. Asthma Self-Management Knowledge Questionnaire (ASMQ) was used and knowledge was assessed through summed ASMQ score.

**Results:** Low level of underlying disease self-management knowledge is reported when measured by asthma self-management questionnaire (ASMQ), with an average raw ASMQ score of 4.1 (max 14); which equals to transformed score of 29.34 (max 100). Of all the participants, 55% did not know that asthma cannot be cured, only 26.3% knew that one should inhale slowly while using the inhaler and approximately 87% were ignorant about the fact that getting a flu vaccine annually is the main method to prevent asthma flare-up. Overall, at baseline 83.3% of the participants showed poor knowledge with only 13.3% having adequate knowledge which after educational counseling showed improvement in the treatment group from mean ASMQ score of 4.20 to 9.77.

**Conclusions:** Low level of knowledge of asthma self-management greatly emphasizes the need

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3 to impart self-management education in structured patient care, which can ultimately enhance  
4 patient outcomes in terms of their disease comprehension, self-esteem and standards of living  
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6 apart from reducing number of hospital and emergency room visits as well as days off work.  
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11 **Keywords:** Asthma self-management, knowledge of asthma, asthma self- management education,  
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13 asthmatic patients, asthma awareness.  
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### Strengths and limitations of this study

- Strategies designed specifically targeting the deficit areas in patients' self-management knowledge can be a cost-effective approach.
- Evidence generated can attract policy makers to design and expand educational programs to meet each patient needs in achieving better disease control.
- Significance of improving patient's self-management knowledge can be manifested through asthma control, compliance, inhaler technique or quality of life.
- Multicenter study is needed so that the results can be generalizable.
- Scarcity of tools to measure the asthma self-management allowed one with very few opportunities to select ASMQ.

## INTRODUCTION

Asthma has become one of the major health concerns affecting many millions of people (Wireklint et al., 2021). It is defined as a chronic, non-communicable inflammatory disorder of the airways, that is reported to affect 334 million people worldwide with an alarming prediction of an increase of 100 million more by the year 2025 (Farzandipour et al., 2019). Considering the most leading causes of disease burden, asthma ranks 28<sup>th</sup>, causing approximately 1000 people to die every day around the globe and 16<sup>th</sup> among the leading cause of years of life lived with disability with its prevalence still rising in underdeveloped countries (Asthma, 2018).

Globally asthma is the growing contributor to increased morbidity and mortality, thus imposing a significant burden in terms of reducing productivity, not only on the patients but also on their families and health care systems (Farzandipour et al., 2019). Genetic predisposition and exposure to numerous environmental substances including dust mites, pet dander, pollens as well as stress or sedentary lifestyle collectively account for various risk factors of asthma (Subbarao *et al.*, 2009).

Despite the fact that many advancements have been made in the management of asthma including its diagnosis and treatment yet worldwide it is poorly controlled with its prevalence still increasing (Sabar *et al.*, 2018). One of the previous studies reported as low as  $\leq 1\%$  of asthmatic patients with controlled asthma (Nguyen *et al.*, 2018). Various reasons for such a low asthma control includes either health-care system related issues (unaffordability or unavailability of medications) or physicians related issues (incorrect or misdiagnosis, lack of proper diagnostic facilities, insufficient time to discuss matters with the patients, absence of reassessment of inhaler technique or lack of proper follow-up measures) or patient related issues (non-compliant behaviors due to lack of knowledge about their disease and its management) (Nguyen *et al.*, 2018). Apart from non-



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3 adherence to medication regimen, lack of proper education or routine follow-ups, incorrect use of  
4 inhalers and lack of inhaler technique assessment at patients visit besides others also play a  
5 significant role in increasing the overall prevalence of asthma in different populations (Sabar *et*  
6 *al.*, 2018). Asthma being a controllable disease requires long-term therapy and thus can be  
7 sufficiently controlled if education is provided about the disease and correct use of medications  
8 ultimately improving treatment adherence, optimizing therapeutic benefits and enhancing the  
9 patients' well-being as alarmingly increased morbidity and mortality as well as worsening of  
10 disease states is reportedly associated with non-compliance in asthma (Irfan *et al.*, 2017, Nguyen  
11 *et al.*, 2018).

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24 Patients' general knowledge about asthma includes pathophysiology of disease, purpose of  
25 treatment regimen, recognition and management of exacerbations/disease triggers and correct  
26 inhaler use and is quite different from patients' knowledge about self-management (Nguyen *et*  
27 *al.*, 2018). As self-management is defined as beliefs or confidence of an individual to uptake  
28 behaviors or to make decisions for managing their chronic conditions and it requires efficient  
29 communication about patients' condition with their family members, companions and healthcare  
30 professionals (Holley *et al.*, 2018). Asthma self-management involves actions undertaken by the  
31 patients to monitor their disease symptoms in order to avoid exacerbations (Mancuso *et al.*,  
32 2010). Asthma self-management education, when made a part of regular and planned care, not  
33 only improve patient outcomes in terms of disease comprehension, control and patients' well-  
34 being but also reduce number of hospital and emergency room visits and work absences  
35 (Farzandipour *et al.*, 2019). Variability of asthma disease (i-e change in asthma over time)  
36 implies that exacerbations can possibly occur even if a patients' asthma is well controlled.  
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54 Therefore, patients should have the knowledge about their disease management and recognition  
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3 of how and when to seek help from health professionals when confronted with exacerbations  
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5 (Nguyen *et al.*, 2018).  
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8 Despite much evidence showing the significance of asthma self-management programs in terms  
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10 of cost-effectiveness, their implementation in clinical practice is still low (Farzandipour *et al.*,  
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12 2019, Wireklint *et al.*, 2021). Extremely low knowledge of asthma self-management is reported  
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14 in several countries and requires specific educational programs that can lead to better asthma  
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16 control (Nguyen *et al.*, 2018).  
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19 As to the best of our knowledge, data regarding the asthma self- management knowledge is  
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21 lacking, therefore, the current study intended to determine the knowledge of disease self-  
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23 management among the asthmatic population.  
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## 26 **METHODOLOGY**

### 27 **Study setting and design**

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29 The study follows a prospective cohort design and is conducted at the pulmonary department  
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31 (OPD) of Pakistan Institute of Medical Sciences (PIMS), a tertiary care hospital. Eligible  
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33 participants include ambulatory asthmatic patients recruited between May to Sep 2019. The  
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35 Quasi experimental design was used consisting of a non-equivalent control group. Members of  
36  
37 the control and treatment group possess almost similar characteristics with the only difference  
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39 being that participants to control group were not randomly assigned. At baseline patients' socio-  
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41 demographic characteristics as well as knowledge of asthma self-management were assessed via a  
42  
43 face-to-face interview. Educational counseling was provided by the research scholar  
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45 (pharmacist) to the treatment group at baseline and to the control group during follow-up.  
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### 51 **Inclusion and exclusion criteria**

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54 Inclusion criteria include patients of age  $\geq 18$  years already diagnosed with asthma, already  
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3 followed up at this hospital and who were willing to give consent.  
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5 Exclusion criteria include 1) patients with cognitive disability and communication issues; 2) did  
6 not give consent; 3) having any other illness with asthma related symptoms; 4) have COPD, TB  
7 or congestive heart failure.  
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### 10 11 12 **Data collection tools** 13

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15 The data collection form was structured to obtain the patient socio-demographic details for  
16 which information was obtained from the patients' medical records and through a one-on-one  
17 interview with the patient. The Asthma Self-management questionnaire (ASMQ), a pre-  
18 validated tool was used and was filled in by the researcher.  
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24 The ASMQ is used to assess the asthmatic patients' knowledge on their disease self-  
25 management. This questionnaire contained 16 multiple choice questions including preventive  
26 measures, use of inhalers, medications and peak flow meters and can be completed in 8-10  
27 minutes through an interview (Mancuso *et al.*, 2009). Tool scores are calculated as each preferred  
28 response is given one point, then all answers are summed up to generate a raw ASMQ score  
29 ranging from 0-14 and then finally transformed between 0-100 range with more asthma self-  
30 management knowledge indicated by higher ASMQ transformed scores (Nguyen *et al.*, 2018).  
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40 Two questions related to the peak flow meters have been omitted because of their minimum use  
41 in developing countries for example, in India, patients who were prescribed peak flow meters  
42 reported to be only 2% of the total (Kotwani *et al.*, 2012). Occupational status was categorized  
43 according the ISCO categories into not working including students, housewives, currently not  
44 working or retired, blue collars workers which includes doing manual work and white-collar  
45 workers includes desk workers (Razzaq *et al.*, 2018).  
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### 54 **Data compilation and statistical analysis** 55 56 57 58 59 60

IBM SPSS Statistic version 21 was employed for data analysis. Descriptive statistics was used to summarize the mean and standard deviations of the demographics of both groups i-e Treatment and Control groups. Categorical variables were analyzed using the Chi-square test. For intra-group comparisons, Wilcoxon matched-pair test was used. A  $p$ -value of  $\leq 0.05$  was labeled statistically significant.

### Patient and public involvement

No patient involved.

## RESULTS

Approximately 265 adult asthmatic patients aged  $\geq 18$  years were approached out of which 240 gave consent to participate in the study. The majority 47.5% of the participants belonged to 36-55 years age group with 56.7% of participants being males, 15.4% had a history of allergy while 25.4% had a positive family history of the disease. **Table 1** lists some of the other characteristics.

**Table 1.** Socio-demographics of study participants

<i>Characteristics</i>	<i>Categories</i>	<i>CG</i>	<i>TG</i>	<i>p-value</i>
<i>Age</i>		39.46 $\pm$ 13.5	39.70 $\pm$ 13.99	0.892
<i>Age categories</i>	18-35	27	32	0.881
	36-55	54	60	
	>56	39	28	
<i>Gender</i>	Male	61	75	0.068
	Female	59	45	
<i>Residence</i>	Rural	75	66	0.597
	Urban	45	54	
<i>Occupation (ISO Categories)</i>	Not working	61	53	0.827
	Blue collar worker	25	22	

	White collar worker	34	45	
<b><i>Educational Status</i></b>	Illiterate	20	24	0.870
	Primary	36	40	
	Secondary	37	27	
	Graduate	27	29	
<b><i>Family history</i></b>	Disease	30	26	0.846
	Allergy	22	15	
	Both	30	35	
	None	38	44	
<b><i>Smoking status</i></b>	Ex-smokers	22	27	0.927
	Current-smokers	33	38	
	Never-Smoke	65	55	
<b><i>Disease duration Categories</i></b>	≤2	47	51	0.978
	2-5	45	34	
	>5	28	35	

Pre and post ASMQ raw and transformed score are presented in **Table 2**. Wilcoxon matched-pair test is used to calculate the p-value. A p-value of .487 in pre and post ASMQ raw and transformed scores shows non-significant changes in control group while p-value of 0.00 (i-e  $\leq 0.05$ ) in the pre and post ASMQ raw and transformed scores shows significant changes in the treatment group as a result of counseling.

**Table 2.** Pre and post ASMQ categories, ASMQ raw and transformed scores in control and treatment group

	<i>Control group</i>		<i>Treatment group</i>
<i>ASMQ Raw score</i>	<i>Pre</i>	<i>Post</i>	<i>p-value</i>
<i>Control group</i>	4.01 ± 3.32	3.89 ± 2.92	.487
<i>Intervention group</i>	4.20 ± 3.03	9.77 ± 2.58	<.001
<i>ASMQ Transformed score</i>	<i>Pre</i>	<i>Post</i>	<i>p-value</i>
<i>Control group</i>	28.69 ± 23.75	27.76 ± 20.86	.487
<i>Treatment group</i>	30 ± 21.64	69.83 ± 18.42	<.001

**Table 3.** represents responses to different question choices at baseline. Incorrect responses to questions highlight a lack of patient knowledge about the underlying disease.

**Table 3.** Frequency of false responses to questions of ASMQ at baseline

Main method to prevent asthma flare-up is to...	Take medicine before meals	46 (19.2%)
	Take steroids in pill form	33 (13.8%)
	Visit emergency room at first sign of symptoms	71 (29.6%)
Taking prescribed 2 puffs of inhaler 2 times a day...	Same as taking one puff four times a day	40 (16.7%)
	Same as taking four puffs once a day	05 (2.1%)
	Arranged in any way as long as you take a total of four puffs a day	58 (24.2%)
If you are not having asthma symptoms...	Your lungs are not sensitive to irritants	18 (7.5%)
	It's ok to skip some doses of medicine	64 (26.7%)
	You are probably cured of asthma	32 (13.3%)
Maintenance medicines...	Don't need to be taken everyday	51 (21.3%)
	Make you breathe better right after you take them	87 (36.3%)
	Can only be taken in pill form	13 (5.4%)
Rescue medicines...	Help prevent future flare-ups	74 (30.8%)
	Have no side effects	20 (8.3%)
	Do not cause you to become tolerant to medicine	11 (4.6%)
When using your inhaler, you should...	Take shallow breaths	16 (6.7%)
	Inhale quickly	113 (47%)
	Press inhaler several times while you are inhaling	22 (9.2%)
After you have used your inhaler, you should...	Take second puff as soon as after first puff	57 (23.8%)
	Keep taking puffs until you feel better	11 (4.6%)
	Wash the inhaler in a tub of water	6 (2.5%)
If having symptoms and don't know why, first thing you should do is...	Take some doses of steroid medicine	44 (18.3%)
	Call your doctor	69 (28.7%)
	Count how fast you are breathing	21 (8.8%)
Taking more rescue medicines than prescribed...	Is really not harmful	28 (11.7%)
	Is a good way to manage symptoms caused by exercise	59 (24.6%)
	May mean you can take less maintenance medicine	17 (7.1%)
For people with asthma, exercise...	Is something that should not be done regularly	19 (7.9%)
	Is only good if done for at least 30 min at a time	21 (8.8%)
	Can trigger symptoms because lungs are not taking in enough oxygen	62 (25.8%)
Asthma can be cured by...	Taking medicine daily	83 (34.6%)
	Avoiding triggers, e-g dust and cigarette smoke	42 (17.5%)
	Using a peak flow meter	7 (2.9%)
Asthma flare-ups...	Usually occur suddenly without warning	77 (32.1%)
	Cannot be triggered by strong emotions	29 (12.1%)
	Always cause wheezing	29 (12.1%)
If you are prescribed a seven-day course of steroid pills...	Don't have to avoid triggers while taking pills	19 (7.9%)
	Symptoms can't worsen while you are taking pills	50 (20.8%)
	Don't need to use peak flow meter while you are taking pills	5 (2.1%)
Which of the following help control asthma?	Reducing stress levels	46 (19.2%)
	Drinking plenty of water to stay hydrated	25 (10.4%)
	Avoiding foods with sulphites, such as dried fruit and wine	15 (6.3%)

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5 **Figure 1** shows that number of patients possessing good knowledge improved from 3 to 47 and  
6 those possessing adequate knowledge improved from 15 to 42 in the treatment group.  
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### 10 **Figure 1**

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15 **Figure 2** shows that question 7 (About hold of breath after use of an inhaler for several seconds)  
16 has the highest percentage of correct answers i.e. 47.9%. Only 32.1% of the participants knew  
17 that asthma is an incurable disease. Item 9 (About patients' increased need for maintenance  
18 medicines in case he/she is using more rescue medications than are prescribed) was frequently  
19 answered to be unknown (47.1%).  
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### 27 **Figure 2**

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31 **Figure 3** shows distribution of raw ASMQ score at baseline. 0-14 is the total possible range with  
32 higher scores resulting in higher ASMQ transformed scores and thus indicating good asthma  
33 self-management knowledge. This underlying distribution of ASMQ raw score indicates poor  
34 disease management knowledge among the study participants.  
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### 41 **Figure 3**

## 42 **DISCUSSION**

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48 The major conclusions of the current study conducted to analyze the knowledge on disease self-  
49 management among asthmatic patients illustrate a low level of knowledge with an average raw  
50 ASMQ score of 4.1 [4.1/14] that equals to 29.34 transformed score [29.34/100] at baseline (Table  
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3 Overall, at baseline 83.3% of patients have poor knowledge with only 13.3% having adequate  
4 knowledge. These results are consistent with the results from similar studies. For example, study  
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6 knowledge. These results are consistent with the results from similar studies. For example, study  
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8 conducted by Nguyen *et al* in Vietnam reported low knowledge with mean raw ASMQ score of  
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10 4.3 which equals to the transformed score of 30 (Nguyen *et al.*, 2018). Another observational study  
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12 conducted in the Kingdom of Saudi Arabia reported an average ASMQ score of 3.5 [3.5/14] (Al *et*  
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14 *al.*, 2017). The format of both of these studies was similar to that of the present study (two items  
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16 related to the peak flow meter removed) as use of peak flow meter is not common in developing  
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18 countries (Nguyen *et al.*, 2018). Apart from baseline ASMQ score, follow up ASMQ score was  
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20 also recorded in the present study suggesting the significance of educational counseling by a  
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22 pharmacist for the patient, as the mean ASMQ score got significantly increased from 4.20/14 to  
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24 9.77/14 [transformed score 69.83/100] in the treatment group as compared to no significant  
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26 increase in the control group, from 4.01/14 to 3.89/14.  
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31 Al *et al* found that patients with more than 50% correct responses were 4% while in our study this  
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33 percentage is 16.7% which is quite close to that reported by Nguyen *et al* (Al *et al.*, 2017, Nguyen  
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35 *et al.*, 2018). The number of patients with greater than 50 ASMQ scores has been significantly  
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37 increased up to 89 patients at follow-up in the treatment group. This is in agreement with the results  
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39 of an interventional study in which a full version of ASMQ was used (i-e all 16 items) reporting an  
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41 average score of 4.49/16 (transformed 28.6/100) in the intervention group at baseline and 3.91/16  
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43 (transformed score 24.4/100) in the control group and also reported an improvement in the ASMQ  
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45 average scores only in intervention group when compared to control group as a result of an  
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47 educational intervention, highlighting the fact that better ASMQ score involves better asthma  
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49 control test score (Hiral *et al.*, 2013). Significant improvement in patients asthma knowledge  
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51 resulting in increased adherence level and asthma control score after 3 months follow-up with 60%  
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3 of the patients having achieved better control and 18% well-controlled asthma has also been  
4 reported by another study emphasizing the need for effective educational programs (Kovačević et  
5 al., 2018).  
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10 Although data about the knowledge on asthma self-management is limited but on the contrary  
11 various studies have been conducted to assess the general knowledge about the diseases. For  
12 example, a study conducted in Sri Lanka reported that only 34% of the patients were  
13 knowledgeable about their disease and medications (Nguyen *et al.*, 2018). A multicenter study in  
14 China reported a low level of disease awareness among the parents of asthmatic children (Zhao *et*  
15 *al.*, 2013). Another study illustrated that 62.7% of asthmatics have poor, 12% have good and only  
16 25.3% possess adequate knowledge (Abbas *et al.*, 2019). Another study showed that although the  
17 patients have a positive attitude towards the disease, yet patients' specific disease knowledge was  
18 low (Shamkuwar *et al.*, 2016). Similarly, a lower score for knowledge apart from attitude and  
19 practices has been reported by a KAP study (Werthmann *et al.*, 2021). Another KAP study  
20 targeting caregivers of asthmatic children illustrates that different educational and management  
21 programs related to asthma have room for improvement (Beshah, 2018).  
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37 Thus, targeting patients to enhance their knowledge can improve disease outcomes and is  
38 supported by various studies, e-g cognition improvement of a patient through self-management  
39 education, ultimately enhancing patients' confidence to adopt healthy lifestyles, improving their  
40 medication adherence and quality of life has been demonstrated (Chavannesa *et al.*, 2009).  
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46 Despite the significance of inhaler therapy in the management of asthma, incorrect use of inhaler  
47 devices including the MDI (meter dose inhaler) is mostly reported (Nguyen *et al.*, 2018). This  
48 study shows that 47.9% of asthmatic patients have knowledge about holding of breath after  
49 inhaling for few seconds, while 23.8% agreed about the misconception about consecutively taking  
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3 the second puff as soon as after the first one is taken. Only 26.3% knew that they should inhale  
4 slowly while using their inhaler and 63% responded incorrectly about the correct use of inhaler.  
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6 So, there's a need for patient education through health-care providers on correct use of inhalation  
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8 technique as deficiency in health education and absence of regular follow-up visits are reported to  
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10 be the significant predictors of incorrect inhaler use which have significant association with poor  
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12 asthma control (Al-Jahdali *et al.*, 2013). Significant improvement through education at follow-ups  
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14 (p=0.000) in the inhalation technique through assessing and demonstrating the correct inhaler  
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16 technique to study participants has been reported by another study (Hiral *et al.*, 2013). Therefore,  
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18 health care providers should regularly demonstrate and re-evaluate the patients' inhaler technique  
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20 at each visit to opt out the chances for errors in the inhalation technique (Nguyen *et al.*, 2018).  
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26 Although, asthma is confirmed to be an incurable disease, yet most of the patients are ignorant about this  
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28 fact (Nguyen *et al.*, 2018). In this study, only 32.1% of participants knew that asthma cannot be cured  
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30 with 55% having the view that it can be cured by taking regular medicines and avoiding triggers. These  
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32 findings are consistent with the results from other studies. For example, misconception about asthma  
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34 being a curable disease was reported by 52% of participants through a study conducted in Vietnam and  
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36 40% by a study conducted in Saudi Arabia (Nguyen *et al.*, 2018, Donques *et al.*, 2017).  
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40 In addition, there is a lack of knowledge about control and rescue medications: for example, 36.3%  
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42 answered that breathing becomes better immediately after taking the maintenance medicines and  
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44 30.8% thought that future flare-ups can be prevented by using rescue medicines. These  
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46 misconceptions and lack of knowledge were also reported by Al *et al* stating that only 22% and  
47  
48 16.6% of the participants had correct knowledge about controller and rescue medicines and  
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50 Nguyen *et al*, in his study conducted in Vietnam, mentioning that only 15.8% and 17.1% answered  
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52 correctly about the use of maintenance and rescue medicines (Al *et al.*, 2017, Nguyen *et al.*, 2018).  
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3 In the current study, a response regarding what to do when having asthma symptoms and not  
4 knowing the cause, only 23.3% answered correctly of changing one's immediate environment.  
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7 In general, large gaps in patients' knowledge of asthma self-management have been highlighted  
8 in this study. It is hoped that study findings will help to design and expand educational programs  
9 specifically aiming at knowledge gap areas, which are still rare and this all will ultimately help the  
10 patient to achieve better control of their disease by decreasing the frequency of exacerbations and  
11 hospital readmissions which will in return improve treatment compliance, optimize therapeutic  
12 benefits and ultimately aid the patients to lead a normal healthy life.  
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16 As far as according to our knowledge, this is probably the first study in our region targeting the  
17 patients' knowledge of asthma self-management with the aim of highlighting important areas of  
18 the knowledge gap. However, it should be noted that it is a single-center study, so the results are  
19 not generalizable. The strength of our study is that as asthma is one of the ignored diseases in our  
20 country, so our study results highlighting the low level of asthma self-management knowledge  
21 helps to create a dire need for future research in this area along with emphasizes on the need for  
22 educational programs based on identified knowledge gaps. In short, various public health plans  
23 based on knowledge of medications, disease states, strategies to control the exposures to triggering  
24 agents and ensuring the correct use of inhaler techniques are needed.  
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## 44 **CONCLUSION**

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46 Assessment of patients' self-management knowledge provides room for designing specific  
47 programs aiming at the areas where knowledge deficits are evident thus providing a cost-effective  
48 approach which otherwise is impossible because of resource and time limitations. The reported  
49 low level of asthma self-management knowledge emphasizes the need for designing and  
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3 implementation of educational programs, ongoing monitoring and regular follow-ups in such a  
4 way to fit all patient needs even including the less educated ones. Moreover, regular and repeated  
5 assessment of inhaler technique if made necessary will optimize the therapeutic benefits and help  
6 to achieve better disease control.  
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### 12 **Abbreviations**

13  
14 ASMQ: Asthma self-management questionnaire; OPD: Out-patient department; TB: Tuberculosis;  
15 COPD: Chronic obstructive pulmonary disease; ISCO: International Standard Classification of  
16 Occupations; MDI: Metered dose inhaler; SPSS: Statistical package for social sciences.  
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26 Institute of Medical Sciences (PIMS), Islamabad for their kind support throughout our research  
27 period.  
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### 33 **Data Availability Statement**

34  
35 All relevant data are within the paper and its supporting information files.  
36  
37

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39  
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41 been received for the research.  
42  
43  
44

### 45 **Ethical approval and participant's consent**

46  
47 This study was approved by the Bioethics Committee of Quaid-i-Azam University, Islamabad and  
48 Institutional review board of PIMS [F.1-1/2019 (EC) PIMS]. Informed consent was also obtained  
49 from all participants after explaining them the purpose and nature of the study.  
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### 54 **Competing interests**

1  
2  
3 The authors declare that they have no competing interests.  
4

5 **Author's Contribution:** All authors (SSS, AK, RA, KUS, AB, SSs) have conceptualized and  
6 designed the study. SSS and RA collected the data. SSS, AK and KUS have contributed to the data  
7 acquisition and analysis. SSS drafted the manuscript and AK, KUS, AB and SSs have reviewed  
8 the manuscript critically. All authors read and have approved the final manuscript. The study is  
9 supervised by AK & KUS.  
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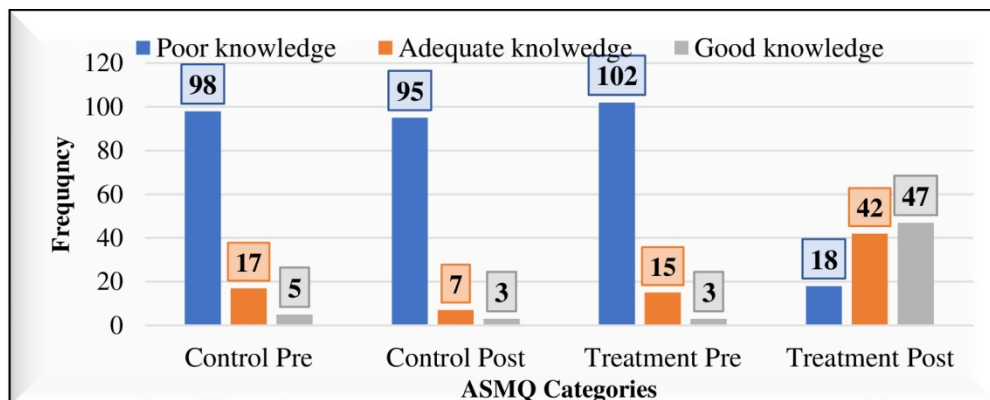
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3 **Figure Legends**  
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6 **Figure 1** Pre and Post ASMQ categories in the control and treatment group  
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8 **Figure 2** Responses to 14 items of ASMQ at baseline  
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10 **Figure 3** Distribution of raw ASMQ score at baseline. 0-14 is total possible range with higher  
11 scores resulting in higher ASMQ transformed score and thus good asthma self-management  
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For peer review only



**Figure 1.** Pre and Post ASMQ categories in the control and treatment group

Figure 1. Pre and Post ASMQ categories in the control and treatment group

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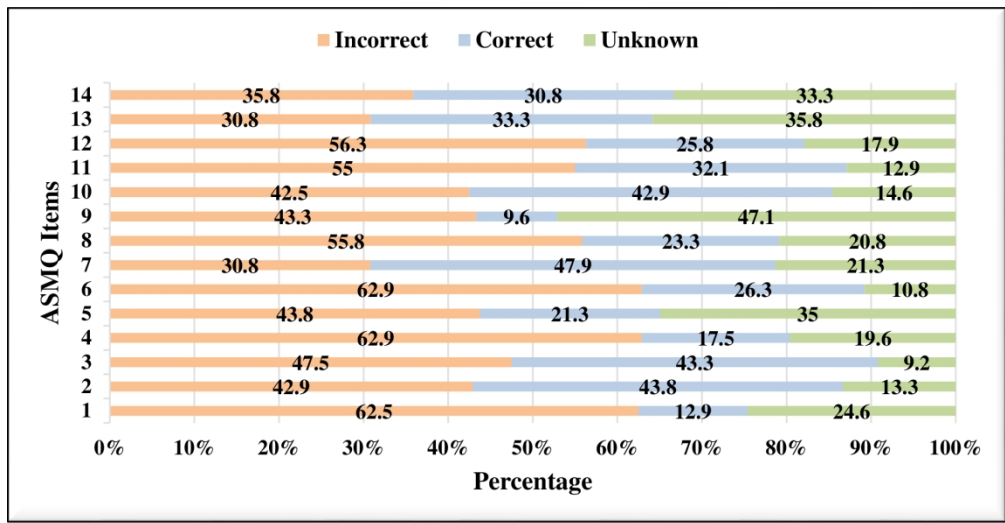
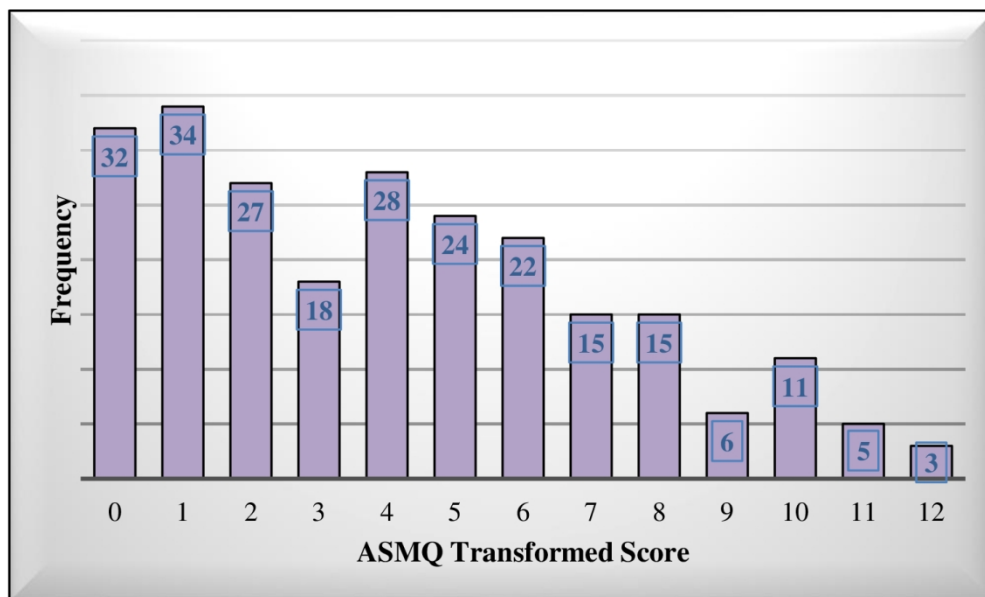


Figure 2. Responses to 14 items of ASMQ at baseline

Figure 2. Responses to 14 items of ASMQ at baseline

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**Figure 3.** Distribution of raw ASMQ score at baseline

Figure 3. Distribution of raw ASMQ score at baseline

128x84mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	6-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	7-8
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	88
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	8
Outcome data	15*	Report numbers of outcome events or summary measures over time	9

1 2 3 4 5 6 7 8	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-12
9 10 11	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
12	<b>Discussion</b>			
13 14	Key results	18	Summarise key results with reference to study objectives	12-16
15 16	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
17 18 19	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-16
20 21	Generalisability	21	Discuss the generalisability (external validity) of the study results	16-17
22	<b>Other information</b>			
23 24 25	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

# BMJ Open

## Assessment of knowledge on self-management among Asthmatic patients: The effects of an educational intervention

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<b>Primary Subject Heading</b>:	Health informatics
Secondary Subject Heading:	Public health, Respiratory medicine
Keywords:	Health informatics < BIOTECHNOLOGY & BIOINFORMATICS, PUBLIC HEALTH, RESPIRATORY MEDICINE (see Thoracic Medicine)

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4 1 **Assessment of knowledge on self-management among Asthmatic patients: The effects**  
5 2 **of an educational intervention**  
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8 4 **Shahzadi Sidra Saleem<sup>1</sup>, Amjad Khan<sup>1\*</sup>, Rubina Aman<sup>2</sup>, Shahzadi Sadia Saleem<sup>3</sup>, Ayesha**  
9 5 **Bibi<sup>1,4</sup>, Kifayat Ullah Shah<sup>1\*</sup>**  
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23 19 **Short title:** Self-management among asthmatic patients  
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## 1 **Abstract**

2 **Objectives:** Despite many advancements in diagnosis and wide accessibility of numerous  
3 treatment options which are effective, still most of the patients have poorly controlled asthma. This  
4 can be significantly attributed to the lack of knowledge about disease management, its triggering  
5 agents and when to seek the advice from health-care provider among many other issues. The  
6 purpose of our study was to assess the knowledge of disease self-management among patients  
7 suffering from asthma.

8 **Setting:** A Prospective cohort study design was used and ambulatory asthmatic patients were  
9 recruited through convenient sampling method.

10 **Participants:** Questionnaires used enquired about 1) Patients' sociodemographic details, 2)  
11 Knowledge of disease self-management and were filled in via one-on-one interview with the  
12 patient. Asthma Self-Management Knowledge Questionnaire (ASMQ) was used and knowledge  
13 was assessed through summed ASMQ score.

14 **Results:** Low level of underlying disease self-management knowledge is reported when  
15 measured by ASMQ, with an average raw ASMQ score of 4.1 (max 14); which equals to  
16 transformed score of 29.34 (max 100). Of all the participants, 55% did not know that asthma  
17 cannot be cured, only 26.3% knew that one should inhale slowly while using the inhaler and  
18 approximately 87% were ignorant about the fact that getting a flu vaccine annually is the main  
19 method to prevent asthma flare-up. Overall, at baseline 83.3% of the participants showed poor  
20 knowledge with only 13.3% having adequate knowledge which after an educational intervention  
21 showed improvement in the treatment group from mean ASMQ score of 4.20 to 9.77.

22 **Conclusions:** Low level of knowledge of asthma self-management at baseline greatly

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3 1 emphasizes the need to impart self-management education in structured patient care, which can  
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5 2 ultimately enhance patient outcomes in terms of their disease comprehension, self-esteem and  
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7 3 standards of living apart from reducing number of hospital and emergency room visits as well  
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9 4 as days off work.  
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13 5 **Keywords:** Asthma self-management, knowledge of asthma, asthma self- management education,  
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#### 54 **Strengths of this study**

- 55  
56 26 • Strategies designed specifically targeting the deficit areas in patient's self-management  
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3 1 knowledge can be a cost-effective approach.  
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- 5 2 • Evidence generated can attract policy makers to design and expand educational programs  
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7 to meet each patient needs in achieving better disease control.  
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10 4 • Significance of improving patient's self-management knowledge can be manifested  
11  
12 through asthma control, enhanced compliance, correct inhaler technique and improved  
13 5  
14 quality of life.  
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17 7 **Limitations**

- 18  
19 8 • Multicenter study is needed so that the results can be generalized.  
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21 9 • Scarcity of tools to measure the asthma self-management knowledge allowed one with  
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23 very few opportunities to select ASMQ.  
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53 25 **INTRODUCTION**

54 26  
55 27 Asthma has become one of the major health concerns affecting many millions of people (1). It  
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1 is defined as a chronic, non-communicable inflammatory disorder of the airways, that is reported  
2 to affect 334 million people worldwide with an alarming prediction of an increase of 100 million  
3 more by the year 2025 (2). Considering the most leading causes of disease burden, asthma ranks  
4 28<sup>th</sup>, causing approximately 1000 people to die every day around the globe and 16<sup>th</sup> among the  
5 leading cause of years of life lived with disability with its prevalence still rising in  
6 underdeveloped countries (3).

7 Globally, asthma is the growing contributor of increased morbidity and mortality, thus imposing a  
8 significant burden in terms of reducing productivity, not only on the patients but also on their families  
9 and health care systems (2). Genetic predisposition and exposure to numerous environmental  
10 substances including dust mites, pet dander, pollens as well as stress or sedentary lifestyle  
11 collectively accounts for various risk factors of asthma (4).

12 Despite the fact that many advancements have been made in the management of asthma including  
13 its diagnosis and treatment yet worldwide it is poorly controlled with its prevalence still increasing  
14 (5). One of the previous studies reported as low as  $\leq 1\%$  of asthmatic patients with controlled  
15 asthma (6). Various reasons for such a low asthma control includes either health-care system  
16 related issues (unaffordability or unavailability of medications) or physicians related issues  
17 (incorrect or misdiagnosis, lack of proper diagnostic facilities, insufficient time to discuss matters  
18 with the patients, absence of reassessment of inhaler technique or lack of proper follow-up  
19 measures) or patient related issues (non-compliant behaviors due to lack of knowledge about their  
20 disease and its management) (6). Apart from non-adherence to medication regimen, lack of proper  
21 education or routine follow-ups, incorrect use of inhalers and lack of inhaler technique assessment  
22 at patients visit besides others also play a significant role in increasing the overall prevalence of  
23 asthma in different populations (5). Asthma being a controllable disease requires long-term therapy

1 and thus can be sufficiently controlled if education is provided about the disease and correct use  
2 of medications ultimately improving treatment adherence, optimizing therapeutic benefits and  
3 enhancing the patients' well-being as alarmingly increased morbidity and mortality as well as  
4 worsening of disease states is reportedly associated with non-compliance in asthma (6, 7).

5 Patients' general knowledge about asthma includes pathophysiology of disease, purpose of  
6 treatment regimen, recognition and management of exacerbations/disease triggers and correct  
7 inhaler use and is quite different from patients' knowledge about self-management (6). As self-  
8 management is defined as beliefs or confidence of an individual to uptake behaviors or to make  
9 decisions for managing their chronic conditions and it requires efficient communication about  
10 patients' condition with their family members, companions and healthcare professionals (8).

11 Asthma self-management involves actions undertaken by the patients to monitor their disease  
12 symptoms in order to avoid exacerbations (9). Asthma self-management education, when made  
13 a part of regular and planned care, not only improve patient outcomes in terms of disease  
14 comprehension, control and patients' well-being but also reduce number of hospital and  
15 emergency room visits and work place absences (2). Variability of asthma disease (i-e change  
16 in asthma over time) implies that exacerbations can possibly occur even if a patient's asthma is  
17 well controlled. Therefore, patients should have the knowledge about their disease management  
18 and recognition of how and when to seek help from health professionals when confronted with  
19 exacerbations (6).

20 Despite much evidence showing the significance of asthma self-management programs in terms  
21 of cost-effectiveness, their implementation in clinical practice is still low (1, 2). Extremely low  
22 knowledge of self-management among asthmatic patients is reported in several countries and  
23 requires specific educational programs that can lead to better asthma control (6).

1 As to the best of our knowledge, data regarding the asthma self- management knowledge is  
2 lacking as no such studies have been conducted in Pakistan so far, therefore, current study intended  
3 to determine the knowledge of disease self-management among the asthmatic population and  
4 effects of an educational intervention.

## 5 **METHODOLOGY**

### 6 **Study setting and design**

7 The study follows a prospective cohort design and is conducted at the pulmonary department  
8 (OPD) of Pakistan Institute of Medical Sciences (PIMS), a tertiary care hospital. Eligible  
9 participants include ambulatory asthmatic patients recruited between May to Sep 2019. The  
10 Quasi experimental design was used consisting of non-equivalent groups. Members of the  
11 control and treatment group possess almost similar characteristics while only one of the group  
12 members experiences the treatment. At baseline patients' socio-demographic characteristics as well  
13 as knowledge of asthma self-management were assessed via a face-to-face interview.  
14 Educational material includes specifically designed pamphlets. The research scholar  
15 (pharmacist) provides the educational counselling and evaluates the inhaler technique of each  
16 treatment group patient at baseline and then at follow-up while educational counselling is  
17 provided to the control group patients at follow-up only along with evaluation of their inhaler  
18 technique by the same research scholar. Time for counselling varied according to each patients'  
19 apprehension and previous knowledge.

### 20 **Inclusion and exclusion criteria**

21 Inclusion criteria include patients of age  $\geq 18$  years diagnosed with asthma through spirometry,  
22 already followed up at this hospital and who were willing to give consent.

23 Exclusion criteria include 1) patients with cognitive disability and communication issues; 2) did

1 not give consent; 3) having any other illness with asthma related symptoms; 4) have COPD, TB  
2 or congestive heart failure.

### 3 **Data collection tools**

4 The data collection form was structured to obtain the patient socio-demographic details for  
5 which information was obtained from the patients' medical records and through a one-on-one  
6 interview with the patient. The Asthma Self-management questionnaire (ASMQ), a pre-  
7 validated tool was used and was filled in by the researcher.

8 The ASMQ is used to assess the asthmatic patients' knowledge on their disease self-  
9 management. This questionnaire contained 16 multiple choice questions including preventive  
10 measures, use of inhalers, medications and peak flow meters and can be completed in 8-10  
11 minutes through an interview (10). Tool scores are calculated as each preferred response is given  
12 one point, then all answers are summed up to generate a raw ASMQ score ranging from 0-16  
13 and then finally transformed between 0-100 range with more asthma self-management  
14 knowledge indicated by higher ASMQ transformed scores (6). Two questions related to the peak  
15 flow meters have been omitted because of their minimum use in developing countries for  
16 example, in India, patients who were prescribed peak flow meters reported to be only 2% of the  
17 total (11). After omission of these peak flow meter related two questions, generated ASMQ raw  
18 score will range from 0-14 and then will be converted into transformed score, so that it can  
19 further be categorized into poor, adequate and good knowledge categories accordingly.  
20 Occupational status was categorized according the ISCO categories into not working including  
21 students, housewives, currently not working or retired, blue collars workers which includes doing  
22 manual work and white-collar workers includes desk workers (12).

### 23 **Data compilation and statistical analysis**



1 IBM SPSS Statistic version 21 was employed for data analysis. Descriptive statistics was used  
 2 to summarize the mean and standard deviations of the demographic variables of both groups i-e  
 3 Treatment and Control. Categorical variables were analyzed using the Chi-square test. For intra-  
 4 group comparisons, Wilcoxon matched-pair test was used. A  $p$ -value of  $\leq 0.05$  was labeled  
 5 statistically significant.

### 7 Patient and public involvement

8 Patients were not involved in the design and conduct of this study.

## 10 RESULTS

11 Approximately 265 adult asthmatic patients aged  $\geq 18$  years were approached out of which 240  
 12 gave consent to participate in the study. The majority 47.5% of the participants belonged to 36-55  
 13 years age group with 56.7% of participants being males, 15.4% had a history of allergy while  
 14 25.4% had a positive family history of the disease. **Table 1** lists some of the other characteristics.

15 **Table 1.** Socio-demographics of study participants

<i>Characteristics</i>	<i>Categories</i>	<i>CG</i>	<i>TG</i>	<i>p-value</i>
<i>Age</i>		39.46 $\pm$ 13.5	39.70 $\pm$ 13.99	0.892
<i>Age categories</i>	18-35	27	32	0.881
	36-55	54	60	
	>56	39	28	
<i>Gender</i>	Male	61	75	0.068
	Female	59	45	
<i>Residence</i>	Rural	75	66	0.597
	Urban	45	54	
<i>Occupation (ISO Categories)</i>	Not working	61	53	0.827
	Blue collar worker	25	22	

	White collar worker	34	45	
<b><i>Educational Status</i></b>	Illiterate	20	24	0.870
	Primary	36	40	
	Secondary	37	27	
<b><i>Family history</i></b>	Graduate	27	29	
	Disease	30	26	0.846
	Allergy	22	15	
<b><i>Smoking status</i></b>	Both	30	35	
	None	38	44	
	Ex-smokers	22	27	0.927
	Current-smokers	33	38	
<b><i>Disease duration Categories(yrs)</i></b>	Never-Smoke	65	55	
	≤2	47	51	0.978
	2-5	45	34	
	>5	28	35	

Pre and post ASMQ raw and transformed score are presented in **Table 2**. Wilcoxon matched-pair test is used to calculate the p-value. A p-value of .487 in pre and post ASMQ raw and transformed scores shows non-significant changes in control group while p-value of 0.00 (i-e  $\leq 0.05$ ) in the pre and post ASMQ raw and transformed scores shows significant changes in the treatment group as a result of educational intervention.

1 **Table 2.** Pre and post ASMQ categories, ASMQ raw and transformed scores in control and treatment group

	<i>Control group</i>		<i>Treatment group</i>
<b><i>ASMQ Raw score</i></b>	<b><i>Pre</i></b>	<b><i>Post</i></b>	<b><i>p-value</i></b>
<b><i>Control group</i></b>	4.01 ± 3.32	3.89 ± 2.92	.487
<b><i>Intervention group</i></b>	4.20 ± 3.03	9.77 ± 2.58	<.001
<b><i>ASMQ Transformed score</i></b>	<b><i>Pre</i></b>	<b><i>Post</i></b>	<b><i>p-value</i></b>
<b><i>Control group</i></b>	28.69 ± 23.75	27.76 ± 20.86	.487
<b><i>Treatment group</i></b>	30 ± 21.64	69.83 ± 18.42	<.001

1 **Figure 1** shows that number of patients possessing good knowledge improved from 3 to 47 and  
2 those possessing adequate knowledge improved from 15 to 42 in the treatment group. Patients'  
3 knowledge was categorized on the basis of transformed score as good (>75), adequate (50-75)  
4 and poor (<50).

### Figure 1

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8 **Figure 2** shows that question 7 (About hold of breadth after use of an inhaler for several seconds)  
9 has the highest percentage of correct answers i.e. 47.9%. Only 32.1% of the participants knew  
10 that asthma is an incurable disease which emphasizes the need for patients' education about the  
11 regular uptake of medications to achieve disease control. Item 9 (About patients' increased need  
12 for maintenance medicines in case he/she is using more rescue medications than are prescribed)  
13 was frequently answered to be unknown (47.1%).

### Figure 2

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17 **Figure 3** shows distribution of raw ASMQ score at baseline. 0-14 is the total possible range with  
18 higher scores resulting in higher ASMQ transformed scores and thus indicating good asthma  
19 self-management knowledge. This underlying distribution of ASMQ raw score indicates poor  
20 disease management knowledge among the study participants.

### Figure 3

## DISCUSSION

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27 The major conclusions of the current study conducted to analyze the knowledge on disease self-  
28 management among asthmatic patients illustrate a low level of knowledge with an average raw

1 ASMQ score of 4.1 [4.1/14] that equals to 29.34 transformed score [29.34/100] at baseline (Table  
2 ).

3 Overall, at baseline 83.3% of patients have poor knowledge with only 13.3% having adequate  
4 knowledge. These results are consistent with the results from similar studies. For example, study  
5 conducted by Nguyen *et al* in Vietnam reported low knowledge with mean raw ASMQ score of  
6 4.3 which equals to the transformed score of 30 (6). Another observational study conducted in the  
7 Kingdom of Saudi Arabia reported an average ASMQ score of 3.5 [3.5/14] (13). The format of  
8 both of these studies was similar to that of the present study (two items related to the peak flow meter  
9 removed) as use of peak flow meter is not common in developing countries (6). Apart from baseline  
10 ASMQ score, follow up ASMQ score was also recorded in the present study suggesting the  
11 significance of educational intervention by a pharmacist for the patient, as the mean ASMQ score  
12 got significantly increased from 4.20/14 to 9.77/14 [transformed score 69.83/100] in the treatment  
13 group as compared to no significant increase in the control group, from 4.01/14 to 3.89/14.

14 Al *et al* found that patients with more than 50% correct responses were 4% while in our study this  
15 percentage is 16.7% which is quite close to that reported by Nguyen *et al* (6, 13). The number of  
16 patients with greater than 50 ASMQ scores has been significantly increased up to 89 patients at  
17 follow-up in the treatment group. This is in agreement with the results of an interventional study in  
18 which a full version of ASMQ was used (i-e all 16 items) reporting an average score of 4.49/16  
19 (transformed 28.6/100) in the intervention group at baseline and 3.91/16 (transformed score  
20 24.4/100) in the control group and also reported an improvement in the ASMQ average scores only  
21 in intervention group when compared to control group as a result of an educational intervention,  
22 highlighting the fact that better ASMQ score involves better asthma control test score (14).  
23 Significant improvement in patients asthma knowledge resulting in increased adherence level and

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3 1 asthma control score after 3 months follow-up with 60% of the patients having achieved better  
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5 2 control and 18% well-controlled asthma has also been reported by another study emphasizing the  
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7 3 need for effective educational programs (15).  
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10 4 Low level of knowledge is reported by various studies conducted to assess the general knowledge  
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12 5 about management of asthma, thus highlighting the dire need for educational programs. For  
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14 6 example, a study conducted in Sri Lanka reported that only 34% of the patients were  
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16 7 knowledgeable about their disease and medications (6). A multicenter study in China reported a  
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18 8 low level of disease awareness among the parents of asthmatic children (16). Another study  
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20 9 illustrated that 62.7% of asthmatics have poor, 12% have good and only 25.3% possess adequate  
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22 10 knowledge (17). Another study showed that although the patients have a positive attitude towards  
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24 11 the disease, yet patients' specific disease knowledge was low (18). Similarly, a lower score for  
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26 12 knowledge apart from attitude and practices has been reported by a KAP study (19). Another KAP  
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28 13 study targeting caregivers of asthmatic children illustrates that different educational and  
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30 14 management programs related to asthma have room for improvement (20).  
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35 15 Thus, targeting patients to enhance their knowledge can improve disease outcomes and is  
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37 16 supported by various studies, e-g cognition improvement of a patient through self-management  
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39 17 education, ultimately enhancing patients' confidence to adopt healthy lifestyles, improving their  
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41 18 medication adherence and quality of life has been demonstrated (21). Habib *et al* also demonstrated  
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43 19 in a systematic review, the significance of various patient-tailored therapies including patient  
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45 20 education that leads to their behavioral changes on long term basis ultimately causing health  
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47 21 enhancement and better disease control (22).  
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51 22 Despite the significance of inhaler therapy in the management of asthma, incorrect use of inhaler  
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53 23 devices including the pMDI (pressurized meter dose inhaler) is mostly reported (6). Assessment  
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1 of pMDI technique during this study shows that 47.9% of asthmatic patients have knowledge about  
2 holding of breath after inhaling for few seconds, while 23.8% agreed about the misconception  
3 about consecutively taking the second puff as soon as after the first one is taken. Only 26.3% knew  
4 that they should inhale slowly while using their inhaler and 63% responded incorrectly about the  
5 correct use of inhaler. So, there's a need for patient education through health-care providers on  
6 correct use of inhalation technique as deficiency in health education and absence of regular follow-  
7 up visits are reported to be the significant predictors of incorrect inhaler use which have significant  
8 association with poor asthma control (23). Significant improvement through education at follow-  
9 ups ( $p=0.000$ ) in the inhalation technique through assessing and demonstrating the correct inhaler  
10 technique to study participants has been reported by another study (14). Therefore, health care  
11 providers should regularly demonstrate and re-evaluate the patients' inhaler technique at each visit  
12 to opt out the chances for errors in the inhalation technique (6).

13 Although, asthma is confirmed to be an incurable disease, yet most of the patients are ignorant about this  
14 fact (6). In this study, only 32.1% of participants knew that asthma cannot be cured with 55% having  
15 the view that it can be cured by taking regular medicines and avoiding triggers. These findings are  
16 consistent with the results from other studies. For example, misconception about asthma being a curable  
17 disease was reported by 52% of participants through a study conducted in Vietnam and 40% by a study  
18 conducted in Saudi Arabia (6, 24). These misconceptions highlight the dire need for patient's  
19 education about the incurable nature of asthma and to clarify their concepts about the term cure  
20 that it cannot be equated with cure.

21 In addition, there is a lack of knowledge about control and rescue medications: for example, 36.3%  
22 answered that breathing becomes better immediately after taking the maintenance medicines and  
23 30.8% thought that future flare-ups can be prevented by using rescue medicines. These

1 misconceptions and lack of knowledge were also reported by Al *et al* stating that only 22% and  
2  
3 16.6% of the participants had correct knowledge about controller and rescue medicines and  
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6 2 Nguyen et al, in his study conducted in Vietnam, mentioning that only 15.8% and 17.1% answered  
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9  
10 4 correctly about the use of maintenance and rescue medicines (6, 13). In the current study, a  
11  
12 5 response regarding what to do when having asthma symptoms and not knowing the cause, only  
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14 6 23.3% answered correctly of changing one's immediate environment.

17 7 As far as according to our knowledge, this is probably the first study in our region assessing the  
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19 8 patient's self-management knowledge of asthma and effect of educational intervention specifically  
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21 9 targeting those knowledge gaps with the hope that these will ultimately help the patient to achieve  
22  
23 10 better control of their disease by decreasing the frequency of exacerbations and hospital  
24  
25 11 readmissions and will improve treatment compliance, optimize therapeutic benefits and ultimately  
26  
27 12 aid the patients to lead a normal healthy life.

31 13 Designing of such an educational program even for General Physician (GPs) is also recommended  
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33 14 by a study highlighting high educational need for conditions that are commonly encountered in  
34  
35 15 primary care such as asthma, allergies etc so that coordinated and harmonized patient care can be  
36  
37 16 provided as primary care skills and development of sustainable GPs knowledge levels are also  
38  
39 17 necessary for the success of any health care initiative (25). With the shift of modern treatment  
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41 18 goals to early detection and prevention of exacerbations, effective strategies can include either  
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43 19 broad commitments and interactive educational sessions at different levels of healthcare systems  
44  
45 20 as health centers are the first contact points of patients when referring to their disease symptoms  
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47 21 or counselling of patients during drug purchase about the proper medication use and inhalation  
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49 22 technique (26). Specifically organized educational programs for asthma control can not only  
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51 23 reduce morbidity but also enhance patient's health related quality of life and can save health-care  
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1 system resources and thus can be a cost-effective approach for under-developed countries (27).  
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3 As asthma is one of the ignored disease in our country, our study results will help to attract the  
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5 attention of countries health authorities for further research in this area along with greater  
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7 emphasizes on the need for targeted educational programs. In short, the present study tried to  
8  
9 enlighten the significance of educational intervention for conditions commonly encountered in the  
10  
11 health care settings such as asthma in front of relevant authorities so that better disease control can  
12  
13 be achieved cost-effectively in a developing country like Pakistan through reducing health related  
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15 costs and improving quality of life of asthmatic patients.  
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## 24 **CONCLUSION**

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26 Low level of asthma self-management knowledge emphasizes the need for designing and  
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28 implementation of educational programs, ongoing monitoring and regular follow-ups in such a  
29  
30 way to fit all patient needs even including the less educated ones. Assessment of patient's self-  
31  
32 management knowledge provides room for designing specific programs aiming at the areas where  
33  
34 knowledge deficits are evident thus providing a cost-effective approach which otherwise is  
35  
36 impossible because of resource and time limitations. Moreover, regular and repeated assessment  
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38 of inhaler technique, if made necessary, will optimize the therapeutic benefits and help to achieve  
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40 better disease control.  
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## 45 **Abbreviations**

46  
47 ASMQ: Asthma self-management questionnaire; OPD: Out-patient department; TB: Tuberculosis;  
48  
49 COPD: Chronic obstructive pulmonary disease; ISCO: International Standard Classification of  
50  
51 Occupations; MDI: Metered dose inhaler; SPSS: Statistical package for social sciences.  
52  
53

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6 All relevant data are within the paper and its supporting information files.

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9 been received for the research.

#### 10 **Ethical approval and participant's consent**

11 This study was approved by the Bioethics Committee of Quaid-i-Azam University, Islamabad and  
12 Institutional review board of PIMS [F.1-1/2019 (EC) PIMS]. Informed consent was also obtained  
13 from all participants after explaining them the purpose and nature of the study.

#### 14 **Competing interests**

15 The authors declare that they have no competing interests.

16 **Author's Contribution:** All authors (SSS, AK, RA, KUS, AB, SSs) have conceptualized and  
17 designed the study. SSS and RA collected the data. SSS, AK and KUS have contributed to the data  
18 acquisition and analysis. SSS drafted the manuscript and AK, KUS, AB and SSs have reviewed  
19 the manuscript critically. All authors read and have approved the final manuscript. The study is  
20 supervised by AK & KUS.

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3 **Figure Legends**  
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6 **Figure 1** Pre and Post ASMQ categories in the control and treatment group  
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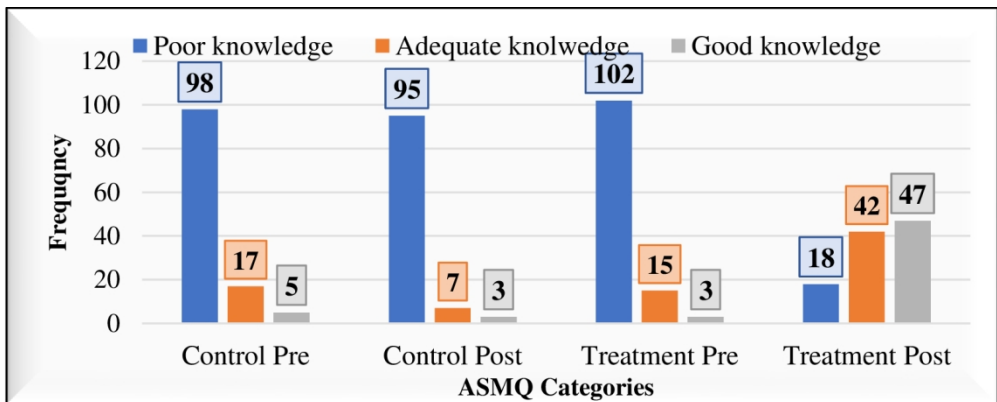
8 **Figure 2** Responses to 14 items of ASMQ at baseline  
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10 **Figure 3** Distribution of raw ASMQ score at baseline. 0-14 is total possible range with higher  
11 scores resulting in higher ASMQ transformed score and thus good asthma self-management  
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**Figure 1.** Pre and Post ASMQ categories in the control and treatment group

Figure 1. Pre and Post ASMQ categories in the control and treatment group

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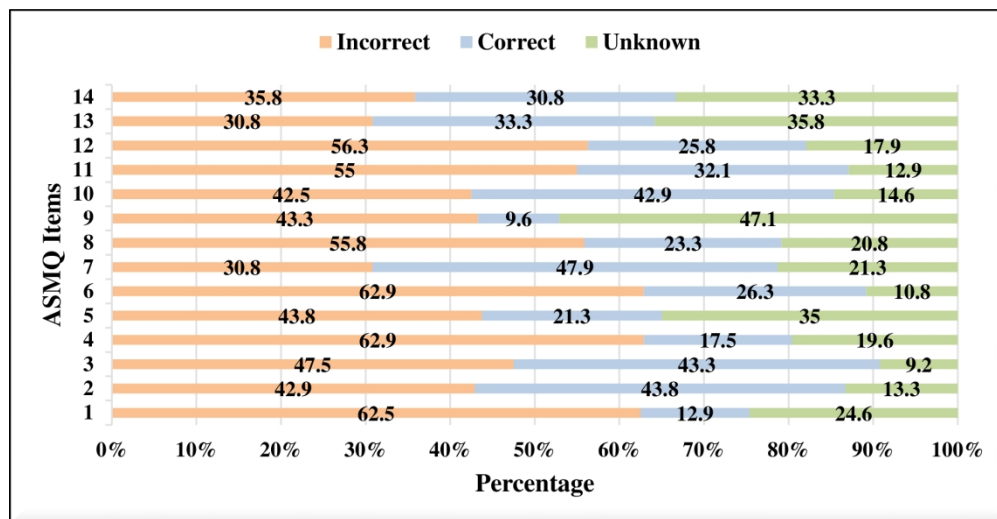
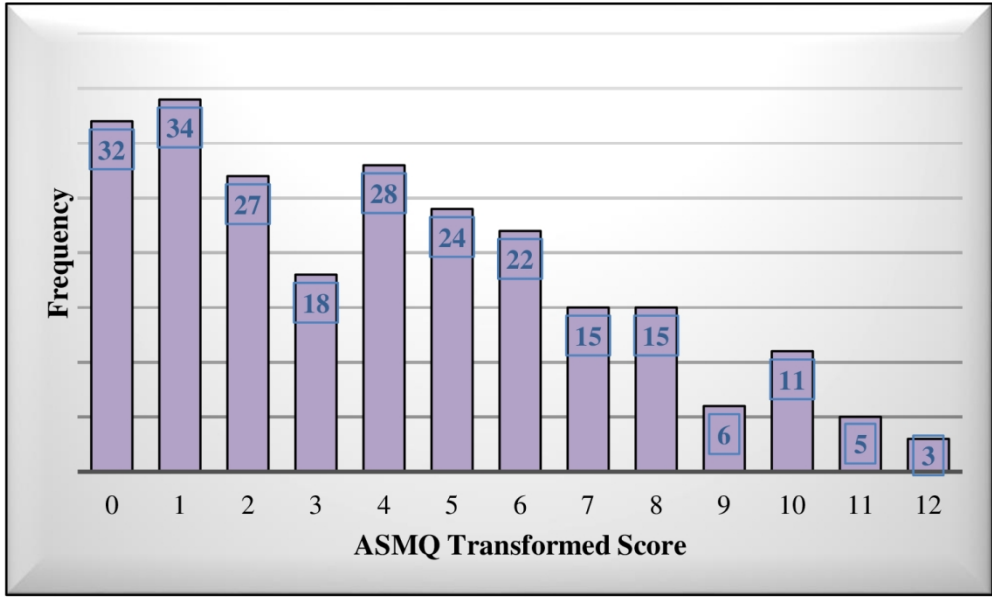


Figure 2. Responses to 14 items of ASMQ at baseline

Figure 2. Responses to 14 items of ASMQ at baseline

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**Figure 3.** Distribution of raw ASMQ score at baseline

Figure 3. Distribution of raw ASMQ score at baseline

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	6-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	7-8
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	88
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	8
Outcome data	15*	Report numbers of outcome events or summary measures over time	9

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-12
2		(b) Report category boundaries when continuous variables were categorized		
3		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		
4	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
5	<b>Discussion</b>			
6	Key results	18	Summarise key results with reference to study objectives	12-16
7	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
8	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-16
9	Generalisability	21	Discuss the generalisability (external validity) of the study results	16-17
10	<b>Other information</b>			
11	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

# BMJ Open

## Assessment of knowledge on self-management among Asthmatic patients: The effects of an educational intervention

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4 1 **Assessment of knowledge on self-management among Asthmatic patients: The effects**  
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## 1 **Abstract**

2 **Objectives:** Despite the availability of effective diagnosis and treatment strategies, asthma is still  
3 poorly controlled in majority of patients. This could be partly due to the patients' lack of  
4 knowledge about the disease management, its triggering agents and when to seek the advice from  
5 health-care provider. The purpose of our study was to assess the knowledge of disease self-  
6 management among the established asthma patients.

7 **Setting:** This was a prospective cohort study carried out among conveniently enrolled  
8 established asthmatic patients at the outpatient department of PIMS.

9 **Methods:** Via one-on-one interview with the enrolled patients, the questionnaires used enquired  
10 about 1) patients' sociodemographic details and 2) knowledge of disease self-management by  
11 using Asthma Self-Management Knowledge Questionnaire (ASMQ). The level of knowledge  
12 was assessed through summed ASMQ score.

13 **Results:** The analysis of the gathered data revealed low level of underlying disease self-  
14 management knowledge with an average raw ASMQ score of 4.1 (max 14); which equals to  
15 transformed score of 29.34 (max 100). More than half of study participants (55%) did not know  
16 that asthma cannot be cured. Only 26.3% of the participants knew that one should inhale slowly  
17 while using the inhaler, and an overwhelming majority (87%) were ignorant about the fact that  
18 getting a flu vaccine annually is the main method to prevent asthma flare-up. At baseline visit,  
19 only 13.3% had adequate knowledge of asthma self-management. The administration of  
20 educational intervention resulted in an improved level of knowledge of asthma self-management  
21 in the treatment group (mean ASMQ score from 4.20 to 9.77).

22 **Conclusions:** On the baseline visit, patients had poor knowledge about asthma self-

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3 1 management. Educational intervention had a positive impact on improving patients' knowledge  
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5 2 about disease self-management. This advocates that imparting self-management education in  
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8 3 structured patient care could result in achieving optimal asthma control and improve patients  
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10 4 health related quality of life.

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13 5 **Keywords:** Asthma self-management, knowledge of asthma, asthma self- management  
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15 6 education, asthmatic patients, asthma awareness.  
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3 1 **Strengths and limitations of this study**  
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- 5 2 • Adherence to clearly defined inclusion and exclusion criteria.  
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8 3 • Educational program resulted in significant improvement in self-management knowledge.  
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11 4 • Comparison with a parallel control group signifies the impact of an educational intervention.  
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14 5 • Participants recruited only from a single centre.  
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16 6 • Scarcity of tools to measure the asthma self-management knowledge.  
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## 1 INTRODUCTION

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Asthma has become one of the major health concerns affecting many millions of people (1). It is defined as a chronic, non-communicable inflammatory disorder of the airways, that is reported to affect 334 million people worldwide with an alarming prediction of an increase of 100 million more by the year 2025 (1, 2). Considering the most leading causes of disease burden, asthma ranks 28<sup>th</sup>, causing approximately 1000 people to die every day around the globe and 16<sup>th</sup> among the leading cause of years of life lived with disability with its prevalence still rising in underdeveloped countries (3).

10 Globally, asthma is the growing contributor of increased morbidity and mortality, thus imposing a significant burden in terms of reducing productivity, not only on the patients but also on their families and health care systems (2). Genetic predisposition and exposure to numerous environmental substances including dust mites, pet dander, pollens as well as stress or sedentary lifestyle collectively accounts as contributing factors for developing and high prevalence of poorly controlled asthma (4).

16 Despite the availability of effective diagnosis and treatment strategies, asthma is still poorly controlled in majority of patients and its incidence is on rise (5, 6). Various reasons for such a low asthma control includes either health-care system related issues (unaffordability or unavailability of medications) or physicians related issues (incorrect or misdiagnosis, lack of proper diagnostic facilities, insufficient time to discuss matters with the patients, absence of reassessment of inhaler technique or lack of proper follow-up measures) or patient related issues (non-compliant behaviors due to lack of knowledge about their disease and its management) (5). In addition to non-adherence to medication regimen, lack of proper education or routine follow-up, incorrect use of inhaler and lack of inhaler technique assessment at patient visit also play a significant role in the suboptimal

1 control of asthma (6). Being a controllable disease, asthma requires a prolonged guidelines  
2 compliant therapy along with patient education about the correct use of medications and disease  
3 self-management (5, 7).

4 The patients' general knowledge about asthma includes pathophysiology of disease, purpose of  
5 treatment regimen, recognition and management of exacerbations/disease triggers and correct  
6 inhaler use (5). On the contrary, self-management is defined as beliefs or confidence of an  
7 individual to uptake behaviors or to make decisions for managing their chronic conditions, it  
8 requires efficient communication about patients' condition with their family members,  
9 companions and healthcare professionals (8). Asthma self-management involves actions  
10 undertaken by the patients to monitor their disease symptoms and avoid exacerbations (9). The  
11 existing published literature signifies that asthma self-management is conditional on education  
12 because education improves patients understanding of their treatment rationale and monitoring  
13 and when made a part of regular and planned care, not only improves asthma control and  
14 patients' quality of life but also reduces the healthcare costs by decreasing the frequency of  
15 hospital and emergency room visits and absentees in the work places (2). Variability of asthma  
16 disease (i-e change in asthma over time) implies that exacerbations can possibly occur even if a  
17 patient's asthma is well controlled. Therefore, patients should have the knowledge about their  
18 disease management and recognition of how and when to seek help from health professionals  
19 when confronted with exacerbations (5).

20 Despite the well documented evidence of positive impact of asthma self-management programs  
21 in achieving the desired patient outcomes and reducing healthcare costs, it is still rarely  
22 implemented in the routine clinical practice (1, 2, 5) .

23 Despite the sixth most populous country in the world and harboring a high burden of asthma

1 patients, there is a scarcity of published information regarding the patients' knowledge and  
2 impact of educational intervention on knowledge about asthma self-management from Pakistan.  
3 Therefore, the current study was conducted with the objective to evaluate the knowledge of  
4 disease self-management among established asthmatic patients and the impact of an educational  
5 intervention.

## 6 **METHODOLOGY**

### 7 **Study setting and design**

8 This was a prospective cohort study carried out at the pulmonology outpatients department  
9 (OPD) of Pakistan Institute of Medical Sciences (PIMS), a tertiary care hospital located in the  
10 capital territory of Islamabad Pakistan. Those established asthmatic patients through spirometry,  
11 who were at-least 18 years old, visited the study site from May to September 2019 and were  
12 willing to participate in the study by given a written consent were included in the study. Those  
13 patients who were unable to communicate, had cognitive abnormality or any other disease with  
14 asthma related symptoms like chronic obstructive pulmonary disease, tuberculosis and heart  
15 failure were not included. The Quasi experimental design was used. The study participants were  
16 arbitrarily assigned to control and treatment groups. Both groups were roughly similar in terms  
17 of sociodemographic characteristics and asthma self-management knowledge on baseline visit.  
18 The educational intervention was administered to the treatment group. On baseline patients'  
19 socio-demographic characteristics as well as knowledge of asthma self-management were  
20 assessed via a face-to-face interview. Educational material included specifically designed  
21 pamphlets. The principal author (SSS) provided the educational counselling and evaluated the  
22 inhaler technique of each patient in the treatment group at baseline and follow-up visits. Whereas  
23 educational counselling is provided to the control group patients on follow-up visit only along

1 with evaluating their inhaler technique. Time for counselling varied according to each patients'  
2 comprehension and previous knowledge.

### 3 **Data collection tools**

4 A purpose developed data collection form was used to obtain the patients' sociodemographic  
5 characteristics from their medical records and in one-on-one interview with the patient. In order  
6 to evaluate patients' knowledge about self-management of asthma, the principal investigator  
7 administered ASMQ to the patients.

8 ASMQ contained 16 multiple choice questions about preventive measures, use of inhalers,  
9 medications and peak flow meters (10). Tool scores were calculated by giving one point to each  
10 preferred response. For generating raw ASMQ scores, all answers were summed up and  
11 transformed to a score ranging between 0-100. Higher transformed score on ASMQ signified  
12 higher knowledge about self-management of asthma (5). Two questions related to the peak flow  
13 meters were omitted because of their minimum use in developing countries, generated ASMQ  
14 raw score then ranged from 0-14 (11).

### 15 **Data compilation and statistical analysis**

16 IBM SPSS Statistic version 21 was employed for data analysis. Descriptive statistics was used  
17 to summarize the mean and standard deviations of the demographic variables of both groups i-e  
18 Treatment and Control. Categorical variables were analyzed using the Chi-square test. For intra-  
19 group comparisons, Wilcoxon matched-pair test was used. A *p*-value of  $\leq 0.05$  was labeled  
20 statistically significant.

### 21 **Patient and public involvement**

22 Patients were not involved in the design and conduct of this study.

23

## 1 RESULTS

2 Approximately 265 adult asthmatic patients aged  $\geq 18$  years were approached. Among them a  
 3 total of 240 patients gave consent to participate in the study. The majority of participants (47.5%)  
 4 belonged to the age group of 36-55 years, 56.7% were males, and 15.4% had a history of allergy  
 5 while 25.4% had a positive family history of asthma (table 1). 47.5% were categorized as not  
 6 working and 32.9% as white collar workers according to ISCO categories for occupational status  
 7 (12).

8 **Table 1.** Socio-demographics of study participants

<i>Characteristics</i>	<i>Categories</i>	<i>CG</i>	<i>TG</i>	<i>p-value</i>
<i>Age</i>		39.46 $\pm$ 13.5	39.70 $\pm$ 13.99	0.892
<i>Age categories</i>	18-35	27	32	0.881
	36-55	54	60	
	>56	39	28	
<i>Gender</i>	Male	61	75	0.068
	Female	59	45	
<i>Residence</i>	Rural	75	66	0.597
	Urban	45	54	
<i>Occupation (ISO Categories)</i>	Not working	61	53	0.827
	Blue collar worker	25	22	
	White collar worker	34	45	
<i>Educational Status</i>	Illiterate	20	24	0.870
	Primary	36	40	
	Secondary	37	27	
	Graduate	27	29	
<i>Family history</i>	Asthma	30	26	0.846
	Allergy	22	15	
	Both	30	35	
	None	38	44	
<i>Smoking status</i>	Ex-smokers	22	27	0.927

	Current-smokers	33	38	
	Never-Smoke	65	55	
<i>Disease duration Categories(yrs.)</i>	≤2	47	51	0.978
	2-5	45	34	
	>5	28	35	

Pre and post intervention ASMQ raw and transformed scores are presented in **Table 2**. No statistically significant difference in ASMQ raw and transformed scores was observed in control group (p-value=0.487). However, as a result of educational intervention, there was a statistically significant change in these scores in the treatment group (p-value <0.001).

**Table 2.** Pre and post ASMQ categories, ASMQ raw and transformed scores in control and treatment group

	<i>Control group</i>		<i>Treatment group</i>
<i>ASMQ Raw score</i>	<i>Pre</i>	<i>Post</i>	<i>p-value</i>
<i>Control group</i>	4.01 ± 3.32	3.89 ± 2.92	.487
<i>Treatment group</i>	4.20 ± 3.03	9.77 ± 2.58	<.001
<i>ASMQ Transformed score</i>	<i>Pre</i>	<i>Post</i>	<i>p-value</i>
<i>Control group</i>	28.69 ± 23.75	27.76 ± 20.86	.487
<i>Treatment group</i>	30 ± 21.64	69.83 ± 18.42	<.001

1 **Figure 1** shows that as a result of educational intervention the number of patients possessing  
2 good knowledge improved from 3 to 47 and those possessing adequate knowledge improved  
3 from 15 to 42 in the treatment group. Patients' knowledge was categorized on the basis of  
4 transformed score as good (>75), adequate (50-75) and poor (<50).

### Figure 1

8 **Figure 2** shows that question 7 (About hold of breath after use of an inhaler for several seconds)  
9 has the highest percentage of correct answers i.e 47.9%. Only 32.1% of the participants knew  
10 that asthma is an incurable disease which emphasizes the need for patients' education about the  
11 regular uptake of medications to achieve disease control. Item 9 (About patients' increased need  
12 for maintenance medicines in case he/she is using more rescue medications than are prescribed)  
13 was frequently answered to be unknown (47.1%).

### Figure 2

17 **Figure 3** shows distribution of raw ASMQ score at baseline. 0-14 is the total possible range with  
18 higher scores resulting in higher ASMQ transformed scores and thus indicating good asthma  
19 self-management knowledge. This underlying distribution of ASMQ raw score indicates poor  
20 disease management knowledge among the study participants.

### Figure 3

## 1 DISCUSSION

2  
3 To the best of our knowledge, this is probably the first study from Pakistan which assessed the  
4 patient's self-management knowledge of asthma and impact of an educational intervention. The  
5 findings of the current study signify that at baseline visit, majority of the study participants (83.3%)  
6 were poorly aware about the self-management of asthma and their knowledge was significantly  
7 improved after an educational intervention. Likewise, findings regarding the patients' poor  
8 knowledge about asthma self-management have been reported by studies conducted elsewhere.  
9 For example, a study conducted by Nguyen *et al* in Vietnam reported low knowledge with mean  
10 raw ASMQ score of 4.3 which equals to the transformed score of 30 (5). Similarly, another  
11 observational study conducted in the Kingdom of Saudi Arabia reported an average ASMQ score  
12 of 3.5 [3.5/14] (13). The format of both of these studies was similar to that of the present study  
13 (two items related to the peak flow meter removed) as use of peak flow meter is not common in  
14 developing countries (5). Likewise, a study conducted in Sri Lanka reported that only 34% of the  
15 patients were knowledgeable about their disease and medications (5).

16 A multicenter study in China reported a low level of disease awareness among the parents of  
17 asthmatic children (14). Another study illustrated that 62.7% of asthmatics have poor, 12% have  
18 good and only 25.3% possess adequate knowledge (15). Similar studies showed that although the  
19 patients have a positive attitude towards the disease, yet patients' specific disease knowledge was  
20 low (16, 17). In our study the proportion of patients (16.7%) who correctly answered more than  
21 50% questions was greater than that reported by Al *et al.*, (4%) but similar to that reported by  
22 Nguyen *et al* (16.5%) (5, 13).

23 Despite the significance of correct use of inhaler devices including the meter dose inhaler (MDI)  
24 in optimal control of asthma, there have been reports of its incorrect use (5). We found that only



1 47.9% of the current study participants had the knowledge about holding of breath after inhaling  
2 for few seconds, and 23.8% agreed with the misconception about consecutively taking the second  
3 puff as soon as after the first one is taken. Only 26.3% knew that they should inhale slowly and  
4 63% did not know about the correct use of the inhaler. So, there's a need for patient education  
5 through health-care providers on correct use of inhalation technique. Lack of health education and  
6 regular follow-up visits has previously been reported as the predictors of incorrect inhaler use and  
7 poor asthma control (18). Significant improvement through education at follow-ups ( $p=0.000$ ) in  
8 the inhalation technique through assessing and demonstrating the correct inhaler technique to study  
9 participants has been reported by another study (19). Therefore, health care providers should  
10 regularly demonstrate and re-evaluate the patients' inhaler technique at each visit to opt out the  
11 chances for errors in the inhalation technique (5).

12 Despite being an incurable disease, 55% of the current study participant were of the opinion that  
13 it can be cured thus equating control with cure. Similar findings regarding the patients'  
14 misconception that asthma is curable have been reported by studies conducted in Vietnam and  
15 Saudi Arabia (5, 20). Furthermore, there was a lack of knowledge about control and rescue  
16 medications: for example, 36.3% of the current study participants answered that breathing  
17 becomes better immediately after taking the maintenance medicines, and 30.8% thought that future  
18 flare-ups can be prevented by using rescue medicines. These misconceptions and lack of  
19 knowledge were also reported by Al *et al* stating that only 22% and 16.6% of the participants had  
20 correct knowledge about controller and rescue medicines. Similar poor knowledge about the  
21 correct use of maintenance and rescue medicines has been reported from Vietnam (5, 13). In the  
22 current study, a response regarding what to do when having asthma symptoms and not knowing  
23 the cause, only 23.3% answered correctly of changing one's immediate environment.

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3 1 Low level of patients' knowledge of asthma self-management found in the current study and  
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5 2 studies conducted elsewhere emphasize on the educational programs among asthma patients. In  
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7 3 the current study, the pharmacist administered educational intervention in the treatment group  
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9 4 significantly increased the mean ASMQ score from 4.20/14 to 9.77/14 [transformed score  
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11 5 69.83/100]. On the contrary, no significant increase in these scores was observed in the control  
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13 6 group. In the current study, educational intervention increased the number of patients with >50  
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15 7 ASMQ score up to 89 in the treatment group. This is in agreement with the results of an  
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17 8 intervention study in which a full version of ASMQ (i-e all 16 items) was used. The study reported  
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19 9 a statistically significant increase in ASMQ score in the group of patients who received an  
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21 10 educational intervention (19). Similar positive impact of an educational intervention on patients'  
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23 11 self-management knowledge of asthma, medication adherence and asthma control (60% better  
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25 12 control and 18% well-controlled) has also been reported (21).  
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27 13 Likewise positive impact of patient-tailored educational interventions on knowledge about disease  
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29 14 self-management, better disease control, treatment outcomes and patients' health related quality  
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31 15 of life has been reported by studies conducted elsewhere (18, 21-25). Especially with the shift of  
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33 16 modern treatment goals to early detection and prevention of exacerbations, effective strategies can  
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35 17 include either broad commitments and interactive educational sessions at different healthcare  
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37 18 levels and can be a cost-effective approach for under-developed countries (26, 27).  
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## 47 **CONCLUSION**

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49 21 Low level of asthma self-management knowledge and the positive impact of educational  
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51 22 intervention in the reducing the knowledge gaps emphasize the need for designing and  
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53 23 implementation of educational programs, ongoing monitoring and regular follow-ups in such a  
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55 24 way to fit all patient needs even including the less educated ones. Assessment of patient's self-  
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1 management knowledge provides room for designing specific programs aiming at the areas where  
2 knowledge deficits are evident thus providing a cost-effective approach which otherwise is  
3 impossible because of resource and time limitations. Moreover, regular and repeated assessment  
4 of inhaler technique, if made necessary, will optimize the therapeutic benefits and help to achieve  
5 better disease control.

## 6 **Abbreviations**

7 ASMQ: Asthma self-management questionnaire; OPD: Outpatient department; TB: Tuberculosis;  
8 COPD: Chronic obstructive pulmonary disease; ISCO: International Standard Classification of  
9 Occupations; MDI: Metered dose inhaler; SPSS: Statistical package for social sciences.

## 10 **Acknowledgments**

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13 Institute of Medical Sciences (PIMS), Islamabad for their kind support throughout our research  
14 period.

## 15 **Data Availability Statement**

16 All relevant data are within the paper and its supporting information files.

## 17 **Funding**

18 No specific grant from any specific agency in the public, commercial or not-for-profit sectors has  
19 been received for the research.

## 20 **Ethical approval and participant's consent**

21 This study was approved by the Bioethics Committee of Quaid-i-Azam University, Islamabad and  
22 Institutional review board of PIMS [F.1-1/2019 (EC) PIMS]. Informed consent was also obtained  
23 from all participants after explaining them the purpose and nature of the study.

1  
2  
3 1 **Competing interests**  
4

5  
6 2 The authors declare that they have no competing interests.  
7

8 3 **Author's Contribution:** All authors (SSS, AK, RA, SSs, AB, NA, SMu, SM, KUS) have  
9  
10 4 conceptualized and designed the study. SSS, RA and SSs collected the data. SSS, AK, SMu and  
11  
12 5 KUS have contributed to the data acquisition and analysis. SSS drafted the manuscript and AK,  
13  
14 6 NA, AB and SM have reviewed the manuscript critically. All authors read and have approved the  
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16 7 final manuscript. The study is supervised by AK & KUS.  
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3 **Figure Legends**  
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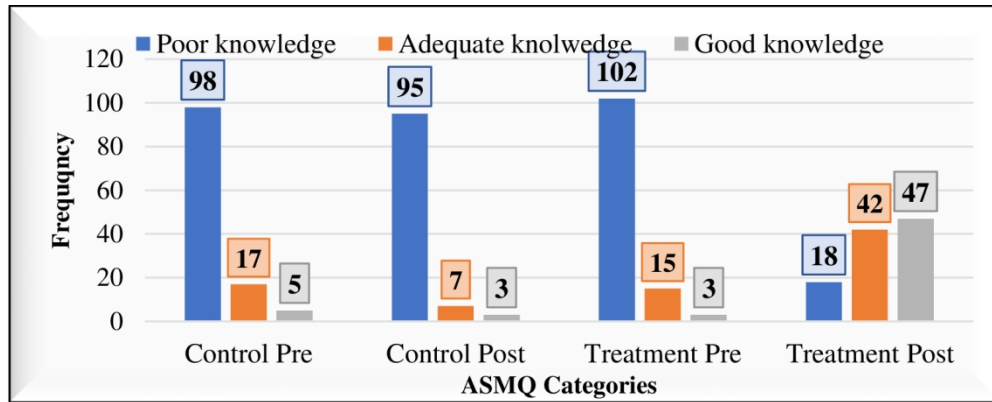
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6 **Figure 1** Pre and Post ASMQ categories in the control and treatment group  
7

8 **Figure 2** Responses to 14 items of ASMQ at baseline  
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10 **Figure 3** Distribution of raw ASMQ score at baseline. 0-14 is total possible range with higher  
11 scores resulting in higher ASMQ transformed score and thus good asthma self-management  
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For peer review only



**Figure 1.** Pre and Post ASMQ categories in the control and treatment group

Figure 1. Pre and Post ASMQ categories in the control and treatment group

140x66mm (300 x 300 DPI)



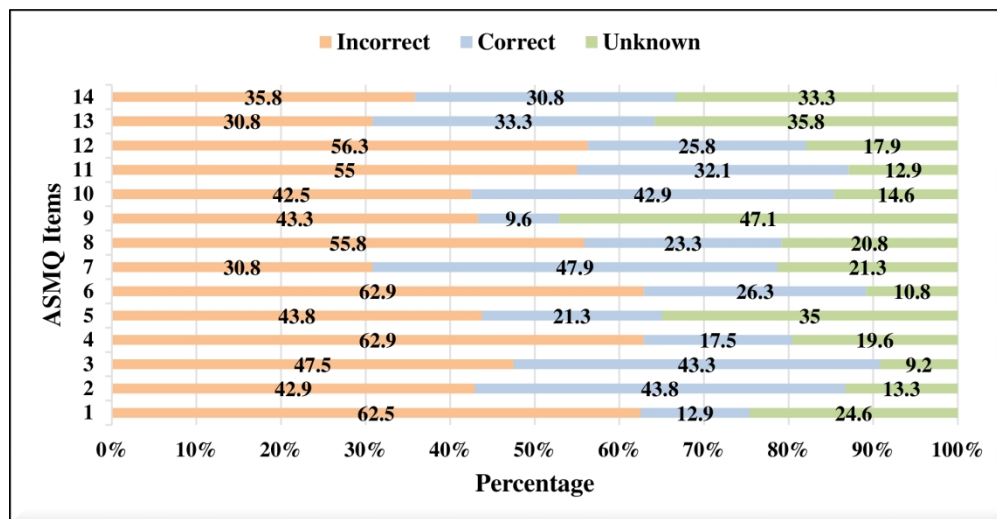
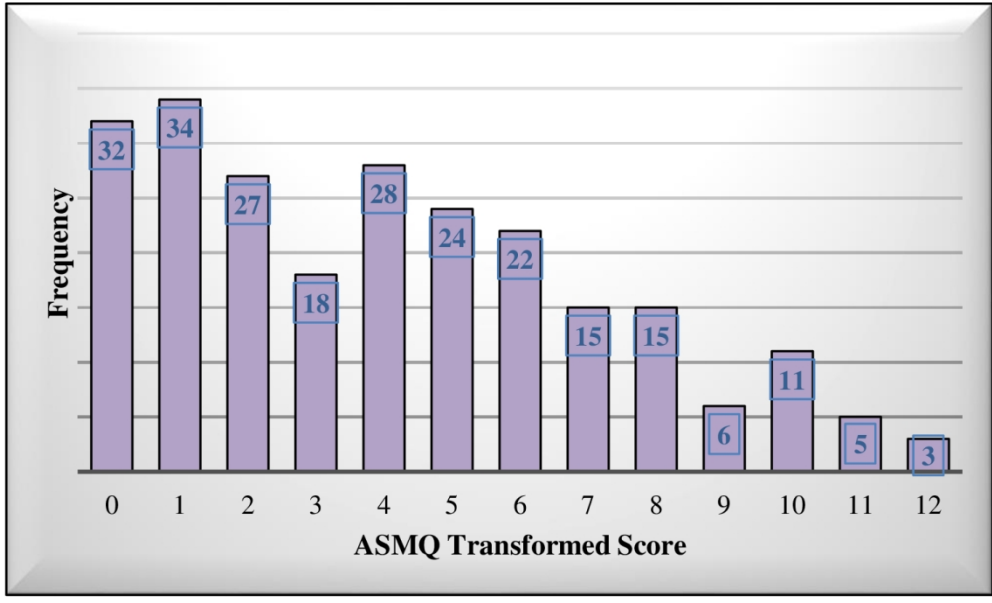


Figure 2. Responses to 14 items of ASMQ at baseline

Figure 2. Responses to 14 items of ASMQ at baseline

165x90mm (300 x 300 DPI)

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**Figure 3.** Distribution of raw ASMQ score at baseline

Figure 3. Distribution of raw ASMQ score at baseline

128x84mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	6-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	7-8
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	88
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	8
Outcome data	15*	Report numbers of outcome events or summary measures over time	9

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-12
2		(b) Report category boundaries when continuous variables were categorized		
3		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		
4	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
5	<b>Discussion</b>			
6	Key results	18	Summarise key results with reference to study objectives	12-16
7	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
8	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-16
9	Generalisability	21	Discuss the generalisability (external validity) of the study results	16-17
10	<b>Other information</b>			
11	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

# BMJ Open

## Impact of Pharmacist-led educational intervention on knowledge of self-management among Asthmatic patients: A prospective cohort study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2021-058861.R3
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4 1 **Impact of Pharmacist-led educational intervention on knowledge of self-**  
5 2 **management among Asthmatic patients: A prospective cohort study**  
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## 1 **Abstract**

2 **Objectives:** Poor control of asthma in the majority of patients could be partly due to their lack of  
3 knowledge concerning disease management, its triggering agents, and when to seek advice from  
4 the health-care provider. This study aims to assess the impact of pharmacist-led educational  
5 intervention on knowledge of self-management among asthmatic patients.

6 **Design:** A pre-post cohort study.

7 **Setting:** Outpatient department of a tertiary care hospital affiliated with Quaid-i-Azam  
8 University, Pakistan.

9 **Participants:** Approximately 265 adult asthmatic patients selected through a spirometry  
10 process, aged  $\geq 18$  years were approached. 240 patients gave consent to participate in the study  
11 and were divided into control and treatment groups.

12 **Interventions:** The educational intervention consisted of individual patient counselling using  
13 educational material with time varied according to each patient's comprehension and previous  
14 knowledge.

15 **Primary and secondary outcome measures:** Assessment consisted of a 14-item Asthma Self-  
16 Management Knowledge Questionnaire (ASMQ) quantifying a patient's self-management  
17 knowledge through an ASMQ score and its change following an educational intervention.

18 **Results:** Disease self-management knowledge was low with an average raw ASMQ score of 4.1  
19 (max 14); which equates to a transformed score of 29.34 (max 100) and the proportion of patients  
20 who correctly answered more than 50% of questions were 16.7% preintervention. More than  
21 half of the participants (55%) did not know that asthma cannot be cured. The administration of



1 educational intervention protocols resulted in significantly improved level of knowledge of  
2 asthma self-management ( $<.001$ ) in the treatment group (mean ASMQ score improved from 4.20  
3 to 9.77).

4 **Conclusion:** On baseline visit, patients possessed a poor knowledge about asthma self-  
5 management. Educational intervention protocols had a positive impact on improving patients'  
6 knowledge about disease self-management. This would suggest that education and self-  
7 management skills should be seen as an integral component of asthma management and should  
8 be incorporated in structured patient care to achieve optimal asthma control.

9 **Keywords:** Asthma self-management, knowledge of asthma, asthma self-management  
10 education, asthmatic patients, pharmacist-led educational intervention.

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3 1 **Strengths and limitations of this study**  
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- 5 2 • Adherence to clearly defined inclusion and exclusion criteria.  
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8 3 • A cohort study using a parallel control group for comparison.  
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11 4 • An appropriate sample size consisting of representative asthmatic patients.  
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14 5 • Participants were recruited only from a single center.  
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16 6 • Scarcity of tools to measure the asthma self-management knowledge.  
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## 1 INTRODUCTION

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3 Asthma has over many years become one of the major health concerns affecting millions of  
4 people (1) and is defined as a chronic, non-communicable inflammatory disorder of the airways  
5 which affects 334 million people worldwide with an alarming prediction of an increase of 100  
6 million more by the year 2025 (1, 2). Considering the most leading causes of disease which  
7 burdens society, asthma ranks 28<sup>th</sup>, causing approximately 1000 people to die every day around  
8 the globe. In addition, it ranks 16<sup>th</sup> among the leading causes of years of life lived with a  
9 disability and its prevalence is still rising in underdeveloped countries (3).

10 Globally, asthma is becoming a growing contributor of increased morbidity and mortality and  
11 thus imposing a significant burden in terms of reducing productivity, not only of the patients  
12 but also on their families and health care systems (2). Genetic predisposition and exposure to  
13 numerous environmental substances including dust mites, pet dander, pollens as well as stress  
14 or sedentary lifestyle collectively accounts as contributing factors for developing and high  
15 prevalence of poorly controlled asthma (4).

16 Despite the availability of effective diagnostic and treatment strategies, asthma is still poorly  
17 controlled in the majority of patients and its incidence is on the rise (5, 6). Various reasons for  
18 such a low asthma control includes either health-care system related issues (unaffordability or  
19 unavailability of medications) or physicians related issues (incorrect or misdiagnosis, lack of  
20 proper diagnostic facilities, insufficient time to discuss matters with the patients, absence of  
21 reassessment of inhaler technique or lack of proper follow-up measures) or patient related issues  
22 (non-compliant behaviors due to lack of knowledge about their disease and its management) (5).

23 In addition to non-adherence to the proper medication regimen, lack of proper education or routine  
24 follow-up, incorrect use of inhaler and lack of inhaler technique assessment during the patient

1 visit also play a significant role in the suboptimal control of asthma (6). Being a controllable  
2 disease, asthma requires a prolonged guidelines compliant therapy along with patient education  
3 about the correct use of the prescribed medications and disease self-management (5, 7).

4 The patients' general knowledge about asthma includes that of the pathophysiology of the  
5 disease, the purpose of the specific treatment regimen, recognition and management of  
6 exacerbations/disease triggers and especially, correct use of the inhaler (5). Self-management  
7 is defined as the ability of an individual to apply the appropriate guidelines or make informed  
8 decisions for managing their chronic conditions. This requires the efficient communication  
9 about patients' condition with their family members, companions and healthcare professionals  
10 (8). Asthma self-management furthermore involves actions undertaken by the patients to  
11 monitor their disease symptoms and avoid exacerbations (9). The existing published literature  
12 signifies that asthma self-management is conditional on the education received by the patients  
13 since this improves their understanding of their treatment rationale and monitoring thereof and  
14 when made a part of their regular and planned care, not only improves asthma control and their  
15 quality of life but also reduces the healthcare costs by decreasing the frequency of hospital and  
16 emergency room visits and absenteeism from the work places (2). Variability of asthma disease  
17 (change in asthma over time) implies that exacerbations can possibly occur even if a patient's  
18 asthma is well controlled. Therefore, patients should have the knowledge about their disease  
19 management and recognition of factors to indicate when to seek help from health professionals  
20 when confronted with such exacerbations (5).

21 Despite well documented evidence of the positive impact of asthma self-management programs  
22 in achieving the desired patient outcomes and reducing healthcare costs, it is unfortunately rarely  
23 implemented in routine clinical practice (1, 2, 5).

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3 1 Despite being the sixth most populous country in the world and harboring a high burden of  
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5 2 asthma patients, there remains a scarcity of published information regarding the patients'  
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7 3 knowledge and impact of the educational intervention about asthma self-management in  
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9 4 Pakistan. Therefore, the current study was conducted with the objective to evaluate the  
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11 5 knowledge of disease self-management among established asthmatic patients and the impact of  
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13 6 an educational intervention might illustrate to address this finding.  
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## 17 **METHODOLOGY**

### 19 **Study setting and design**

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22 9 The cohort study was carried out at the pulmonology outpatient's department (OPD) of the  
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24 10 Pakistan Institute of Medical Sciences (PIMS), a tertiary care hospital located in the capital  
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26 11 territory of Islamabad Pakistan. All asthmatic patients were selected through a spirometry  
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28 12 process and were at least 18 years old. These patients visited the study site from May to  
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30 13 September 2019 and were willing participants by giving their written consent. Those patients  
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32 14 who were unable to communicate adequately, had a cognitive abnormality or any other disease  
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34 15 with asthma related symptoms such as chronic obstructive pulmonary disease, tuberculosis or a  
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36 16 weak heart, were excluded. The Quasi experimental design was used. Participants in the study  
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38 17 group were arbitrarily assigned to control and treatment groups. Both groups were roughly  
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40 18 similar in terms of sociodemographic characteristics and asthma self-management knowledge  
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42 19 resulting from a baseline visit. The educational intervention was provided to the treatment  
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44 20 group. The baseline patients' socio-demographic characteristics as well as knowledge of asthma  
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46 21 self-management were assessed via a face-to-face interview. Educational material included  
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48 22 specifically designed pamphlets. The principal author (SSS) provided educational counselling  
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50 23 and evaluated the inhaler technique of each patient in the treatment group at baseline and follow-  
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1 up visits. All educational counselling was provided to the control group patients on follow-up  
2 visits only along with evaluating their inhaler technique. Time allocated for counselling varied  
3 according to each patients' comprehension and previous knowledge of their condition.

#### 4 **Data collection tools**

5 A purpose developed data collection form was used to obtain the patients' sociodemographic  
6 characteristics from their medical records and in one-on-one interviews with the patient. In order  
7 to evaluate a patients' knowledge about what self-management of asthma meant, the principal  
8 investigator administered ASMQ forms to the patients.

9 The ASMQ contained 16 multiple choice questions about preventive measures, use of inhalers,  
10 medications and peak flow meters (10). Tool scores were calculated by giving one point to each  
11 preferred response. For generating raw ASMQ scores, all answers were summed up and  
12 transformed to a score ranging between 0-100. Higher transformed scores on ASMQ signified a  
13 higher knowledge about self-management of asthma (5). Two questions related to the peak flow  
14 meters were omitted due to their minimum use in developing countries. This process generated  
15 an ASMQ raw score which ranged from 0-14 (11).

#### 16 **Data compilation and statistical analysis**

17 IBM SPSS Statistic version 21 was employed for data analysis. Descriptive statistics was used  
18 to summarize the mean and standard deviations of the demographic variables of both groups  
19 viz., Treatment and Control. Categorical variables were analyzed using the Chi-square test. For  
20 intra-group comparisons, the Wilcoxon matched-pair test was used. A *p*-value of  $\leq 0.05$  was  
21 labeled statistically significant.

#### 22 **Patient and public involvement**

23 Patients were not involved in the design and conduction of this study.

## 1 RESULTS

2 Approximately 265 adult asthmatic patients aged  $\geq 18$  years were initially approached. Among  
 3 them a total of 240 patients gave their consent to participate in the study. The majority of  
 4 participants (47.5%) belonged to the age group of 36-55 years of which 56.7% were males, and  
 5 15.4% had a history of an allergy while 25.4% had a positive family history of asthma (Table  
 6 1). 47.5% of the study group were categorized as not working and 32.9% as white collar workers  
 7 according to the ISCO categories for occupational status (12).

8 **Table 1.** Socio-demographics of study participants

<i>Characteristics</i>	<i>Categories</i>	<i>CG</i>	<i>TG</i>	<i>p-value</i>
<i>Age</i>		39.46 $\pm$ 13.5	39.70 $\pm$ 13.99	0.892
<i>Age categories</i>	18-35	27	32	0.881
	36-55	54	60	
	>56	39	28	
<i>Gender</i>	Male	61	75	0.068
	Female	59	45	
<i>Residence</i>	Rural	75	66	0.597
	Urban	45	54	
<i>Occupation (ISO Categories)</i>	Not working	61	53	0.827
	Blue collar worker	25	22	
	White collar worker	34	45	
<i>Educational Status</i>	Illiterate	20	24	0.870
	Primary	36	40	
	Secondary	37	27	
	Graduate	27	29	
<i>Family history</i>	Asthma	30	26	0.846
	Allergy	22	15	
	Both	30	35	
	None	38	44	
<i>Smoking status</i>	Ex-smokers	22	27	0.927

	Current-smokers	33	38	
	Never-Smoke	65	55	
<i>Disease duration Categories(yrs.)</i>	≤2	47	51	0.978
	2-5	45	34	
	>5	28	35	

Pre and post intervention ASMQ raw and transformed scores are presented in **Table 2**. No statistically significant difference in the ASMQ raw and transformed scores was observed in control group (p-value=0.487). However, as a result of educational intervention, there was a statistically significant change in these scores in the treatment group (p-value <0.001).

**Table 2.** Pre and post ASMQ categories, ASMQ raw and transformed scores in control and treatment group

	<i>Control group</i>		<i>Treatment group</i>
<i>ASMQ Raw score</i>	<i>Pre</i>	<i>Post</i>	<i>p-value</i>
<i>Control group</i>	4.01 ± 3.32	3.89 ± 2.92	.487
<i>Treatment group</i>	4.20 ± 3.03	9.77 ± 2.58	<.001
<i>ASMQ Transformed score</i>	<i>Pre</i>	<i>Post</i>	<i>p-value</i>
<i>Control group</i>	28.69 ± 23.75	27.76 ± 20.86	.487
<i>Treatment group</i>	30 ± 21.64	69.83 ± 18.42	<.001



1 **Figure 1** illustrates that as a result of the educational intervention, the number of patients  
2 possessing a good knowledge improved from 3 to 47 and those possessing adequate knowledge  
3 improved from 15 to 42 in the treatment group. Patients' knowledge was categorized on the  
4 basis of a transformed score as: good (>75), adequate (50-75) and poor (<50).

### Figure 1

8 **Figure 2** illustrates that question 7 (the holding of breath after use of an inhaler for several  
9 seconds) has the highest percentage of correct answers i.e 47.9%. Only 32.1% of the participants  
10 knew that asthma is an incurable disease which emphasizes the need for a comprehensive  
11 patients' education about the regular uptake of medications to achieve disease control. Item 9  
12 (patients' increased need for maintenance medicines in case he/she is using more rescue  
13 medications than are prescribed) was frequently answered to be unknown (47.1%).

### Figure 2

17 **Figure 3** illustrates the distribution of the raw ASMQ score at baseline. 0-14 is the total possible  
18 range with higher scores resulting in higher ASMQ transformed scores and thus indicating a  
19 better asthma self-management knowledge. This underlying distribution of ASMQ raw scores  
20 indicates a poor disease management knowledge among the study participants.

### Figure 3

## 1 DISCUSSION

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To the best of our knowledge, this is probably the first study conducted in Pakistan to assess the patient's self-management knowledge of their asthma condition and the impact of an educational intervention might have to manage this condition. The findings of the current study signify that at the baseline visit the majority of the study participants (83.3%) were poorly educated about the self-management of asthma and their knowledge was significantly improved after an educational intervention. Likewise, findings regarding the patients' poor knowledge about asthma self-management have been reported by studies conducted elsewhere. For example, a study conducted by Nguyen *et al* in Vietnam reported a poor knowledge with a mean raw ASMQ score of 4.3 which equates to the transformed score of 30 (5). Similarly, another observational study conducted in the Kingdom of Saudi Arabia reported an average ASMQ score of 3.5 [3.5/14] (13). The format of both of these studies was similar to that of the present study after the two items related to the peak flow meter were similarly removed (5). Likewise, a study conducted in Sri Lanka reported that only 34% of the patients were knowledgeable about their disease and medications (5). A multicenter study in China reported a low level of disease awareness among the parents of asthmatic children (14). Another study illustrated that 62.7% of asthmatics have poor, 12% have good and only 25.3% possess an adequate knowledge of their condition (15). Similar studies showed that although the patients have a positive attitude towards the disease, their specific disease knowledge was low (16, 17). In our study the proportion of patients (16.7%) who correctly answered more than 50% of the questions was greater than that reported by Al *et al.*, (4%) but similar to that reported by Nguyen *et al* (16.5%) (5, 13). Despite the significance of the correct use of inhaler devices, including the meter dose inhaler (MDI) in optimal control of asthma, there have been reports of its incorrect use (5). We found that

1 only 47.9% of the participants in the current study had the correct knowledge about the holding of  
2 breath after inhaling for several seconds, and 23.8% agreed with the misconception about  
3 consecutively taking the second puff as soon as possible after the first. Only 26.3% knew that they  
4 should inhale slowly and 63% did not know about the correct use of the inhaler. This strongly  
5 suggests that there is a need for patient education through health-care providers on the correct  
6 procedure of the inhalation technique. Lack of health education and regular follow-up visits has  
7 previously been reported as the predictors of incorrect inhaler use and poor asthma control (18).  
8 Significant improvement through education at follow-ups ( $p=0.000$ ) in the inhalation technique  
9 through assessing and demonstrating the correct inhaler technique has been reported by another  
10 study (19). Therefore, health care providers should regularly demonstrate and re-evaluate the  
11 patients' inhaler technique at each visit to prevent or reduce the chances for errors in the inhalation  
12 technique (5).

13 Despite being an incurable disease, 55% of the current study group were of the opinion that it can  
14 be cured thus equating control with cure. Similar findings regarding the patients' misconception  
15 that asthma is curable have been reported by studies conducted in Vietnam and Saudi Arabia (5,  
16 20). Furthermore, there was a lack of knowledge about control and rescue medications: for  
17 example, 36.3% of the current study participants answered that breathing becomes better  
18 immediately after taking the maintenance medicines, and 30.8% thought that future flare-ups can  
19 be prevented by using rescue medicines. These misconceptions and lack of knowledge were also  
20 reported by Al *et al* stating that only 22% and 16.6% of the participants had correct knowledge  
21 about controller and rescue medicines. Similar poor knowledge about the correct use of  
22 maintenance and rescue medicines has been reported from Vietnam (5, 13). In the current study, a  
23 response regarding what to do when manifesting asthma symptoms and not knowing their cause,

1 only 23.3% answered correctly to change one's immediate environment.

2 The low level of patients' knowledge of asthma self-management found in the current study and  
3 studies conducted elsewhere, emphasize the importance of educational programs among asthma  
4 patients. In the current study, the pharmacist administered educational intervention in the treatment  
5 group significantly increased the mean ASMQ score from 4.20/14 to 9.77/14 [transformed score  
6 69.83/100]. On the other hand, no significant increase in these scores was observed in the control  
7 group. In the current study, educational intervention increased the number of patients with >50  
8 ASMQ score up to 89 in the treatment group. This is in agreement with the results of an  
9 intervention study in which a full version of ASMQ (all 16 items) was used. The study reported a  
10 statistically significant increase in the ASMQ score for the group of patients who received an  
11 educational intervention (19). A similar positive impact of an educational intervention on patients'  
12 self-management knowledge of asthma, medication adherence and asthma control (60% better  
13 control and 18% well-controlled) has also been reported (21).

14 Likewise, the positive impact of patient-tailored educational interventions on knowledge about  
15 disease self-management, better disease control, treatment outcomes and patients' health related  
16 quality of life has been reported by studies conducted elsewhere (18, 21-25). This specifically  
17 applies to the shift of modern treatment goals to early detection and prevention of exacerbations,  
18 effective strategies including either broad commitments and interactive educational sessions at  
19 different healthcare levels and a cost-effective approach for under-developed countries (26, 27).

## 21 **CONCLUSION**

22 The low level of asthma self-management knowledge and positive impact of educational  
23 intervention in reducing current knowledge gaps, emphasize the need for designing and  
24 implementation of educational programs, ongoing monitoring and regular follow-ups in such a

1 way to fit all patient needs especially including the less educated ones. Assessment of patient's  
2 self-management knowledge provides room for designing specific programs aimed at the areas  
3 where knowledge deficits are evident thus providing a cost-effective approach which otherwise is  
4 impossible because of resource and time limitations. Moreover, regular and repeated assessment  
5 of inhaler technique, if made necessary, will optimize the therapeutic benefits and help to achieve  
6 better disease control.

### 7 **Abbreviations**

8 ASMQ: Asthma self-management questionnaire; OPD: Outpatient department; TB: Tuberculosis;  
9 COPD: Chronic obstructive pulmonary disease; ISCO: International Standard Classification of  
10 Occupations; MDI: Metered dose inhaler; SPSS: Statistical package for social sciences.

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### 16 **Data Availability Statement**

17 All relevant data are within the paper and its supporting information files.

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20 been received for the research.

### 21 **Ethical approval and participant's consent**

22 This study was approved by the Bioethics Committee of Quaid-i-Azam University, Islamabad and  
23 Institutional review board of PIMS [F.1-1/2019 (EC) PIMS]. Informed consent was also obtained

1 from all participants after explaining them the purpose and nature of the study.

## 2 **Competing interests**

3 The authors declare that they have no competing interests.

4 **Author's Contribution:** All authors (SSS, Amjad Khan, RA, SSs, AB, NA, SMu, SM, IRG, SAR,  
5 AK, KUS) have conceptualized and designed the study. SSS, RA and SSs collected the data. SSS,  
6 Amjad Khan, SMu and KUS have contributed to the data acquisition and analysis. SSS drafted the  
7 manuscript and Amjad Khan, NA, AB, SM, SAR and AK have reviewed the manuscript critically.  
8 IRG attended to the English language used in the manuscript. All authors read and have approved  
9 the final manuscript. The study is supervised by Amjad Khan & KUS.

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3 **Figure Legends**  
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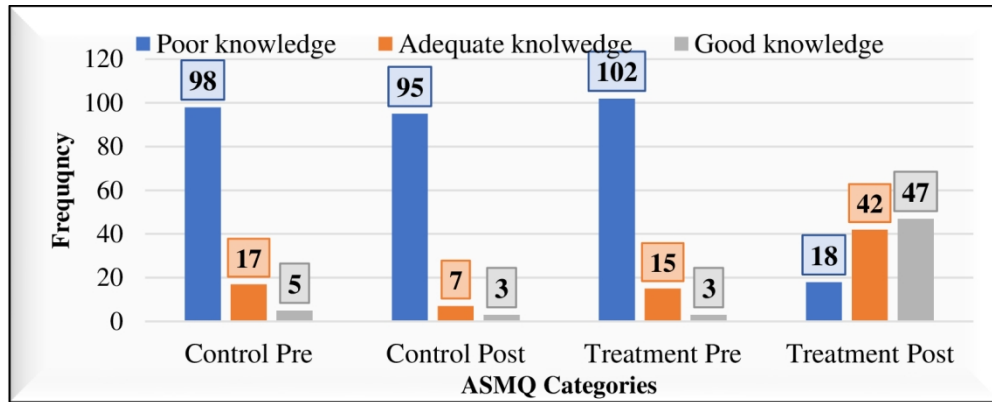
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6 **Figure 1** Pre and Post ASMQ categories in the control and treatment group  
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8 **Figure 2** Responses to 14 items of ASMQ at baseline  
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10 **Figure 3** Distribution of raw ASMQ score at baseline. 0-14 is total possible range with higher  
11 scores resulting in higher ASMQ transformed score and thus good asthma self-management  
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For peer review only



**Figure 1.** Pre and Post ASMQ categories in the control and treatment group

Figure 1. Pre and Post ASMQ categories in the control and treatment group

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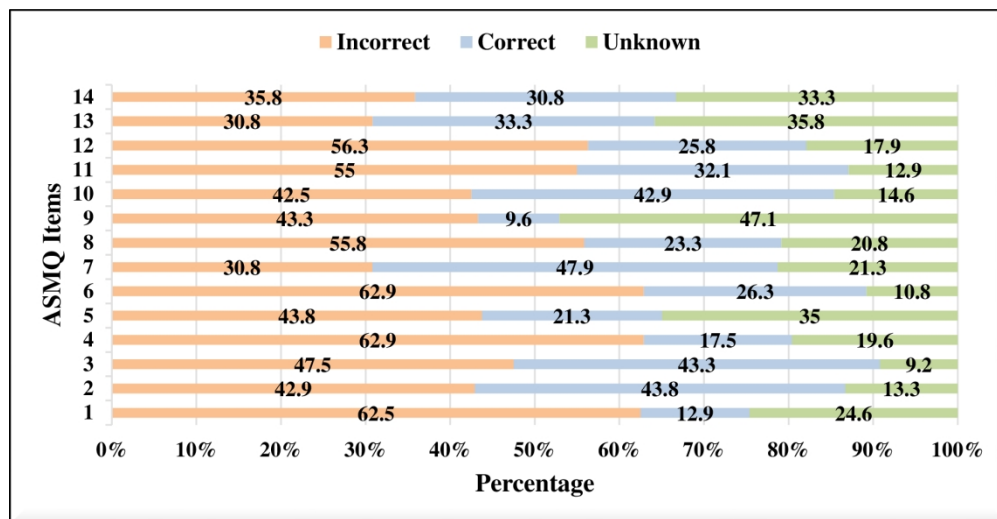


Figure 2. Responses to 14 items of ASMQ at baseline

Figure 2. Responses to 14 items of ASMQ at baseline

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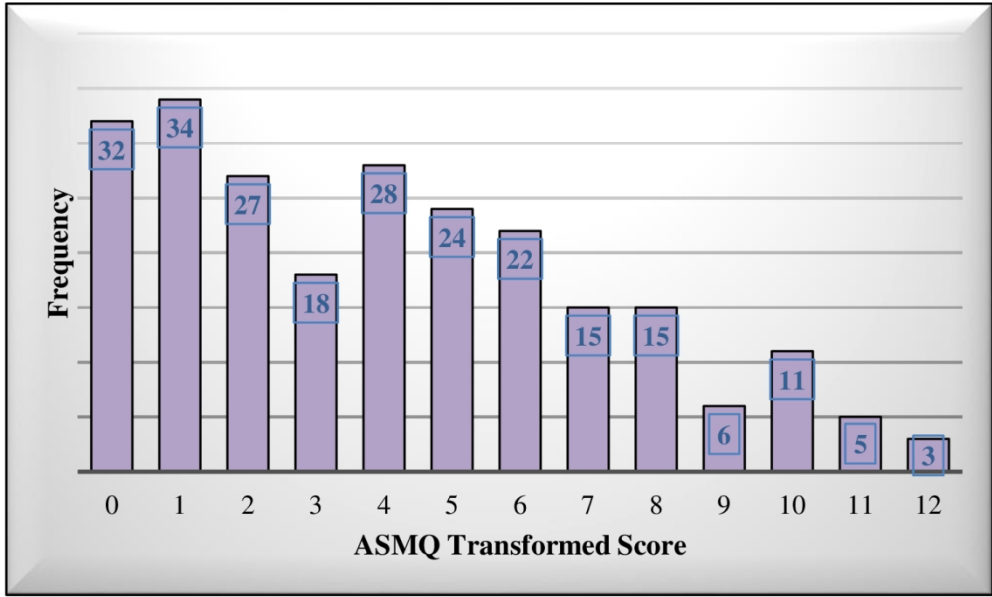


Figure 3. Distribution of raw ASMQ score at baseline

Figure 3. Distribution of raw ASMQ score at baseline

128x84mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	6-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses	7-8
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	88
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	8
Outcome data	15*	Report numbers of outcome events or summary measures over time	9

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-12
2			(b) Report category boundaries when continuous variables were categorized	
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
4	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
5	<b>Discussion</b>			
6	Key results	18	Summarise key results with reference to study objectives	12-16
7	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
8	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-16
9	Generalisability	21	Discuss the generalisability (external validity) of the study results	16-17
10	<b>Other information</b>			
11	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

22 \*Give information separately for exposed and unexposed groups.

23 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.