


RESEARCH ARTICLE

# A cross-sectional study to assess knowledge, attitudes, and risk perceptions of doctor of pharmacy students regarding asthma

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## Keywords

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## Abstract

**Background:** Asthma is a chronic respiratory condition that affects a significant number of individuals worldwide. Effective management of asthma relies on the knowledge and competence of healthcare professionals. This study aimed to evaluate knowledge, attitudes, and risk perceptions regarding asthma among pharmacy students. **Methods:** This cross-sectional study was conducted in 2023 among students enrolled in the final year of pharmacy at different universities in Islamabad and Rawalpindi. A self-constructed and face-validated questionnaire was utilised for data collection, which lasted four months. The chi-square test and independent sample t-test were applied to establish associations. **Results:** Out of 302 students, 55.3% were female. The mean age of students was  $23.1 \pm 1.3$  years. Only 19.5% of participants had good knowledge, while 56% strongly agreed that educational skills are vital for becoming competent asthma educators, and 18.5% strongly believed they could manage asthma patients. Around 54% of the students were able to perceive age and a lack of patient knowledge as risk factors. **Conclusion:** The majority of students had moderate knowledge about asthma and mixed attitudes towards asthma management. Perceptions of asthma risks were adequate.

## Introduction

Identified as a global health issue by the World Health Organisation (WHO, 2024), asthma is characterised by episodes of recurring wheezing, dyspnea, coughing, and increased bronchial responsiveness. The intensity and frequency of these attacks vary from person to person (Federico *et al.*, 2020).

Globally, 300 million people have been diagnosed with asthma, and this number is predicted to rise to 400 million by 2025. Asthma is believed to cause about one out of every 250 deaths worldwide (Azzi *et al.*, 2023). In Pakistan, 15 million children and around 7.7 million adults suffer from asthma. The prevalence of asthma among the general population of Pakistan is estimated to be 4.3% (Khan, 2022), and asthma has also been recognised as the leading cause of ambulatory visits

and hospitalisations among children (Kazi *et al.*, 2022). Since there is no cure for asthma, clinical episodes can be avoided and controlled through appropriate management (Neto *et al.*, 2020).

Pharmacists worldwide and in Pakistan are seeing their roles evolve: they are now involved in patient care and no longer just dispense medications. Community pharmacists are uniquely positioned to offer the interventions needed for a more thorough and efficient management of chronic diseases like asthma (Abubakar & Atif, 2021; Bridgeman & Wilken, 2021). Several factors determine the degree of asthma control. These include patients' attitudes and lifestyles, as well as healthcare workers' and patients' asthma knowledge and management skills (Zeru *et al.*, 2020).

International guidelines from the British Thoracic Society (BTS) and the Global Initiative for Asthma (GINA) have long emphasised the importance of self-management as an essential part of asthma care (GINA, 2024). It has been reported that pharmacists do not engage in activities that promote self-management among asthmatics (Wang *et al.*, 2020). They have a keen ability to educate patients about asthma and address their concerns, as asthma is a chronic condition requiring self-monitoring, frequent assessments, and specialised instruments. Numerous studies have demonstrated that in asthma, clinical severity and quality of life are considerably improved by pharmacist interventions (Fletcher *et al.*, 2020; Jia *et al.*, 2020; Khmour *et al.*, 2020; Paoletti *et al.*, 2020; Amorha *et al.*, 2021; Caminati *et al.*, 2021; Rahayu *et al.*, 2021; Rodrigues *et al.*, 2021; Sudeshika *et al.*, 2021). Pharmacists often fail to follow standard asthma knowledge, attitudes, and behaviour guidelines. Previous literature has demonstrated poor compliance with international asthma standards among practising physicians and pharmacists (Mathioudakis *et al.*, 2021).

In the Pakistani pharmacy curriculum, the management of diseases like asthma is taught in the fourth and final year making it crucial to assess pharmacy students' knowledge and attitudes towards asthma. Without adequate knowledge, graduating pharmacy students may lack competence in asthma management and empathy towards patients (Taqi *et al.*, 2021).

The literature review revealed only two studies conducted in India and Nigeria assessing asthma awareness among pharmacy students (Amorha *et al.*, 2018; Maheshwari *et al.*, 2022). This study aimed to evaluate pharmacy students' knowledge, attitude, and perceived risks related to asthma management, aligning with recent asthma guidelines in Pakistan. To the authors' knowledge, this assessment is the first in the national context. Identifying gaps in future pharmacists' asthma-related knowledge is crucial for developing targeted educational interventions and improving pharmacist-led care for asthma patients in the country (Serhal *et al.*, 2022).

## Methods

### Study design and setting

This cross-sectional study was conducted from February 2023 to May 2023 among final-year pharmacy students from five private sector universities in Islamabad and Rawalpindi. The results were reported according to the STROBE checklist.

### Inclusion and exclusion criteria

Only final-year Doctor of Pharmacy (Pharm.D.) students from private universities were included in the study because they are expected to serve the community as healthcare providers upon graduation, making their knowledge, attitudes, and risk perceptions about asthma particularly relevant to society. Students from the first to the fourth year of the Pharm.D. programme in different registered and unregistered universities in Islamabad and Rawalpindi were excluded.

### Sample size calculation

Rawalpindi and Islamabad comprise ten public and private universities fully recognised by the Pakistan Pharmacy Council (PPC). PPC data shows that 1235 final-year pharmacy students are enrolled in these universities (PCP, 2024). The minimum sample size was calculated using Yamane's formula, considering an error of 0.05 (Louangrath & Louanglath, 2017).

$$n = \frac{N}{1+N(e)^2} \quad n = \frac{1235}{1+1235(0.05)^2} = 302$$

### Data collection procedure

All participating pharmacy institutes permitted data collection. After providing written informed consent, 302 students were enrolled using the convenience sampling technique. To maintain anonymity, the pharmacy institutes were coded with the first letter of their names (A, H, M, S, and R). Students were invited to complete the survey during their break time, and the questionnaires were collected after 20 minutes.

The study focused on private sector universities due to the investigators' affiliations and the ease of obtaining timely data collection permission. Among the private institutes in the twin cities, data collection sites were selected based on ease of access for the research team members who collected data.

### Study instrument development

A structured questionnaire was developed based on a literature review, drawing inspiration from similar global studies (Chokhani *et al.*, 2021; Azzi *et al.*, 2022; Said *et al.*, 2022; Saleem *et al.*, 2022). Face validation of the questionnaire was performed by two pharmacists and two public health specialists. A pilot study was conducted among 32 final-year students from various institutes in Rawalpindi and Islamabad, and the recommended changes were incorporated into the questionnaire. Reliability was assessed using Cronbach's alpha, yielding a value of 0.73. The data from the pilot study were not included in the final dataset.

The questionnaire consisted of four sections. The first part collected demographic characteristics, including age, gender, residence (hosteller or non-hosteller), location (rural or urban), and the student's institution. The second part assessed asthma knowledge through 15 questions related to the diagnosis, treatment, and prevention of asthma. The third section evaluated attitudes with five questions addressing competency in treating asthma, the impact of attitudes and self-efficacy on patient compliance, control of respiratory function in asthma care, and independent asthma management. The fourth part included five questions to evaluate risk perceptions, focusing on the use of antimicrobials and inhalers in asthma management, patient self-efficacy, the impact of patient knowledge on asthma management, and the progression of asthma with age.

### Scoring

The total knowledge score for each student was calculated, with a maximum possible score of 15. Knowledge scores were then categorised based on Bloom's criteria: good ( $\geq 80\%$ ), moderate (60%–79%), and poor (score  $< 60\%$ ) (Alzahrani *et al.*, 2022). Attitudes and perceptions were rated on a 5-point Likert scale from strongly agree to strongly disagree.

### Statistical analysis

Data entry and analysis were performed using SPSS version 23. Two researchers created the variables based on the questionnaires and entered the data. Two other team members then cross-checked the data entry. Means and standard deviations were calculated for students' age and knowledge scores. The results were presented in tables. The chi-square test assessed differences in knowledge, attitudes, and risk perceptions related to asthma among students across genders and institutions. Independent sample t-tests were applied to compare knowledge scores across genders and institutions. A  $p$ -value of less than 0.05 was considered statistically significant.

### Ethical considerations

Ethical clearance for this study was granted by the Ethical Committee of Abasyn University, Islamabad Campus (letter no. AUIC/PD/02/23/EA02). Additional ethical clearance was obtained from the universities where data collection took place. Students were informed that their participation was voluntary, with no monetary benefits or penalties for withdrawing. All participants provided written informed consent. The study adhered to the ethical principles outlined in the Declaration of Helsinki (as revised in 2013) and Good Clinical Research Practice (World Medical Association, 1974; Barton, 2007). The

data were treated as confidential and anonymous throughout the study.

## Results

### Sociodemographic characteristics

The sample consisted of 302 Pharm.D. students from five different educational institutes in Rawalpindi and Islamabad. The participation rates among A, H, M, S, and R were 45%, 90%, 54%, 71%, and 51%, respectively. The majority of participants were female (55.3%), around 60% were non-hostellers, and 252 lived in urban areas. The maximum participation among all the study subjects was from H University, accounting for more than 25% of the sample. Table I provides details about students' sociodemographic profiles.

**Table I: Sociodemographic profiles of the participants**

Variables	No.	(%)	Mean $\pm$ SD	Range
Age (years)	-	-	23.1 $\pm$ 1.3	20-34
<b>Gender</b>				
Male	135	(44.7)		
Female	167	(55.3)		
<b>Residence</b>				
Non-hosteller	188	(62.3)		
Hosteller	114	(37.7)		
<b>Location</b>				
Urban	252	(83.0)		
Rural	50	(16.0)		
<b>Institutions</b>				
A	45	(14.9)		
H	81	(26.8)		
M	41	(13.6)		
S	71	(23.5)		
R	64	(21.2)		

### Pharmacy students' knowledge of asthma

Overall, 19.5% of participants had poor asthma knowledge, while the majority (61.4%) had moderate knowledge, and only 19.5% had good knowledge. Most students (94%) claimed to know the typical symptoms of asthma, while less than 25% were able to identify that asthma occurrence is age-dependent (Table II).

Stratification by gender showed that female pharmacy students had better knowledge of asthma being a non-communicable disease ( $p = 0.00$ ), age-dependent ( $p = 0.04$ ), and associated with IgE antibodies ( $p = 0.00$ ). Also, female pharmacy students exhibited superior understanding of the role of mast cells in allergic reactions ( $p = 0.03$ ), prevention strategies ( $p = 0.03$ ), and FEV1 decrease in asthma ( $p = 0.03$ ). The assessment of

knowledge scores across institutions revealed significant differences in most knowledge-related questions. However, similarity was observed across institutions in questions related to asthma and COPD being the same

disease ( $p = 0.50$ ), long-term asthma control drugs ( $p = 0.07$ ), prevention strategies ( $p = 0.28$ ), and the use of peak flow metres ( $p = 0.78$ ).

**Table II: Knowledge regarding asthma management**

Questions	Yes n (%)	No n (%)	Don't know n (%)	Correct answers %	Gender <i>p</i> -value* % correct answers	Institutions <i>p</i> -value* % correct answers
1. Do you know the typical symptoms of asthma?	284 (94.0)	17 (5.6)	1 (0.3)	94.0	0.12 M=91.1 F=96.4	0.02 A=97.8 H=90.1 M=100 S=87.3 R=100
2. Are asthma and COPD (coronary obstructive pulmonary disease) the same disease?	32 (10.6)	268 (88.7)	2 (0.7)	88.7	0.16 M=85.9 F=91.1	0.50 A=91.1 H=91.4 M=95.1 S=85.9 R=82.8
3. Can the signs and symptoms of asthma be misunderstood with TB?	187 (61.9)	98 (32.5)	17 (5.6)	61.9	0.55 M=63.7 F=60.5	0.01 A=55.6 H=55.6 M=60.9 S=66.2 R=70.3
4. Inflammation of the airways needs to reach a certain threshold to result in symptoms.	214 (70.9)	57 (18.9)	31 (10.3)	70.9	0.75 M=68.8 F=72.5	0.02 A=62.2 H=77.8 M=60.9 S=83.1 R=60.9
5. Is Asthma communicable?	97 (32.1)	199 (65.9)	6 (2.0)	65.9	0.00 M=50.4 F=78.4	0.00 A=33.3 H=30.9 M=82.9 S=78.9 R=64.1
6. Is the occurrence of asthma independent of age?	218 (72.2)	71 (23.5)	13 (4.3)	23.5	0.04 M=27.4 F=77.3	0.00 A=42.2 H=17.3 M=82.9 S=15.5 R=31.3
7. Is IgE associated with asthma?	223 (73.8)	37 (12.3)	42 (13.9)	73.8	0.00 M=64.4 F=81.4	0.00 A=77.8 H=82.7 M=48.8 S=85.9 R=62.5
8. Are the mast cells involved in triggering allergic reactions after allergic reactions?	259 (85.8)	29 (9.6)	14 (4.6)	85.8	0.03 M=80 F=90.4	0.00 A=66.7 H=93.8 M=100 S=90.1 R=75
9. Are ICS (Inhaled Corticosteroids) and LAB2 (Long-Acting Beta 2 Agonist) the first line of therapy for asthma?	166 (55.0)	119 (39.4)	17 (5.6)	55.0	0.46 M=54.8 F=55.1	0.00 A=80 H=56.8 M=63.4 S=21.1 R=67.2

Questions	Yes n (%)	No n (%)	Don't know n (%)	Correct answers %	Gender <i>p</i> -value* % correct answers	Institutions <i>p</i> -value* % correct answers
10. Does long-term asthma control include Beclomethasone, salmeterol and albuterol?	239 (79.1)	41 (13.6)	22 (7.3)	79.1	0.06 M=70.4 F=82.6	0.07 A=66.7 H=85.2 M=90.2 S=78.9 R=73.4
11. Can avoiding a particular allergen reduce the occurrence of asthma?	233 (77.2)	45 (14.9)	24 (7.9)	77.2	0.03 M=70.4 F=82.6	0.28 A=71.1 H=77.8 M=87.8 S=81.7 R=68.7
12. Do you know GINA no longer recommends SABA treatment alone without ICS even with mild intermittent asthma?	128 (42.4)	72 (23.8)	102 (33.8)	42.4	0.10 M=47.4 F=38.3	0.00 A=55.6 H=41.9 M=12.2 S=35.2 R=60.9
13. Can GINA guidelines implementation manage the prevalence of asthma?	145 (48.0)	45 (14.9)	112 (37.1)	48.0	0.25 M=47.4 F=48.5	0.00 A=57.8 H=48.1 M=17.1 S=54.9 R=53.1
14. Does FEV1 (Forced Expiratory Volume) decrease in asthma?	200 (66.2)	51 (16.9)	51 (16.9)	66.2	0.01 M=65.9 F=66.5	0.03 A=60 H=69.1 M=51.2 S=71.8 R=70.3
15. Do you know how and when to use peak flow meter?	175 (57.9)	74 (24.5)	53 (17.5)	57.9	0.27 M=54.8 F=60.5	0.78 A=57.8 H=62.9 M=65.9 S=52.1 R=53.1

\*chi-square test

As shown in Table III, most male (60%) and female (62.2%) students had moderate asthma knowledge. Only 22 out of 135 males and 37 out of 167 females showed good asthma knowledge. When categorised by institutions, most pharmacy students from all five

educational institutes had moderate asthma knowledge. The assessment of knowledge scores across genders and institutions revealed significant differences between genders ( $p = 0.01$ ), as shown in Table IV.

**Table III: Knowledge categorisation across gender and institutions**

Variables	Knowledge score category			Total
	Poor (n)	Moderate (n)	Good (n)	
<b>Gender</b>				
Male	32	81	22	135
Female	26	104	37	167
<b>Institutions</b>				
A	10	23	12	45
H	13	48	20	81
M	11	27	3	41
S	9	50	12	71
R	15	37	12	64
<b>Total</b>	<b>58</b>	<b>185</b>	<b>59</b>	<b>302</b>

**Table IV: Knowledge score differences across genders and institutions**

Variables	Knowledge score		p-value*
	Mean	SD	
<b>Gender</b>			
Male	9.58	2.34	0.01
Female	10.27	1.79	
<b>Institutions</b>			0.56
A	10.11	2.36	
H	10.19	2.19	
M	9.54	1.59	
S	9.89	1.82	
R	9.92	2.27	

\* independent sample t-test

**Students' attitudes towards asthma management**

The assessment of attitudes towards asthma management revealed that around 56% of the students strongly agreed that learning education skills is necessary to become a competent asthma educator, 21.2% strongly believed that attitudes and self-efficacy have a more significant impact on patient compliance than knowledge, 17.5% strongly agreed that controlling respiratory function is too complicated in asthma care, around 25% strongly agreed that patient behaviours have more influence on asthma management outcomes

than pharmacist efforts, and only 18.5% strongly believed that they could manage asthma patients. When assessing attitudes across genders, no significant difference was visible in attitude-related questions, except for the question on the complexity of controlling respiratory function ( $p = 0.01$ ). The assessment of students' attitudes across institutions revealed significant differences in most attitude-related questions, except for the belief that patient behaviours have more impact on asthma management outcomes than the pharmacist's efforts ( $p = 0.28$ ) (Table V).

**Table V: Students' attitudes regarding asthma**

Questions	Strongly agree n(%)	Agree n(%)	Neutral n(%)	Disagree n(%)	Strongly disagree n(%)	Gender p-value*	Institution p-value*
1. To become a competent asthma educator, it is necessary to learn education skills	169 (56.0)	111 (36.8)	5 (1.7)	12 (4.0)	5 (1.7)	0.08	0.00
2. Attitude and self-efficacy rather than knowledge have more impact on compliance	64 (21.2)	144 (47.7)	51 (16.9)	30 (9.9)	13 (4.3)	0.92	0.03
3. Control of respiration function is too complicated in asthma care	53 (17.5)	131 (43.4)	83 (27.5)	30 (9.9)	5 (1.7)	0.01	0.04
4. Outcomes of asthma management greatly depend on patient behaviour rather than pharmacist efforts	74 (24.5)	128 (42.4)	59 (19.5)	30 (9.9)	11 (3.6)	0.97	0.28
5. Do you consider yourself able to manage asthma patients?	56 (18.5)	158 (52.3)	62 (20.5)	17 (5.6)	9 (3.0)	0.14	0.03

\*chi-square test

**Risk perceptions regarding asthma management**

The majority of participants demonstrated adequate risk perception regarding asthma management. More than 25% recognised that antibiotics are ineffective against asthmatic airway inflammation, 54.6% agreed that asthma worsens with age, 51% agreed that asthma can be self-monitored, 56% recognised the importance of regular inhaler technique use, and 54% perceived

patients' lack of knowledge as a risk in management asthma. Gender-based analysis revealed no significant differences in risk perception, except for the question related to the role of antibiotics in asthmatic airway inflammation ( $p = 0.00$ ). Across institutions, significant differences were observed in perceptions of antibiotic efficacy in asthmatic airway inflammation ( $p = 0.00$ ) and the effect of age on asthma ( $p = 0.01$ ) (Table VI).

**Table VI: Students' risk perceptions regarding asthma management**

Questions	Strongly agree n(%)	Agree n(%)	Neutral n(%)	Disagree n(%)	Strongly disagree n(%)	Gender p-value*	Institution p-value*
1. Antibiotics help against asthmatic inflammation in the airways	45 (14.9)	107 (35.4)	45 (14.9)	76 (25.2)	29 (9.6)	0.00	0.00
2. Asthma worsens with age	45 (14.9)	165 (54.6)	47 (15.6)	33 (10.9)	12 (4.0)	0.12	0.01
3. Asthma can be self-monitored by patients	32 (10.6)	154 (51.0)	70 (23.2)	37 (12.3)	9 (3.0)	0.47	0.41
4. It is necessary to use inhaler technique on regular basis	59 (19.5)	169 (56.0)	38 (12.6)	25 (8.3)	11 (3.6)	0.50	0.25
5. Patients have lack of knowledge related to asthma	47 (15.6)	163 (54.0)	60 (19.9)	24 (7.9)	8 (2.6)	0.22	0.99

\*chi-square test

## Discussion

This study involved 302 final-year pharmacy students from five educational institutes in Rawalpindi and Islamabad. Overall, 19.1% of participants had poor knowledge of asthma, while the majority (61.4%) had moderate knowledge. Students' attitudes towards asthma management were mixed, although the majority could perceive the associated risks.

A similar study conducted among students from six pharmacy institutes in Southern Nigeria yielded contrasting results. The Nigerian study reported that around 50% of the Nigerian students had good knowledge and attitudes, aligning with the present findings only in the perceived risks of asthma management. It also identified the perceived barriers to pharmacist-led asthma care, an aspect not explored in this study. The more encouraging results in Nigeria could be attributed to the government's SIWES programme, which exposes pharmacy students to occupational health and industrial experience (Amorha *et al.*, 2018). Another study among pharmacy students in India reported notably better knowledge (61.13%), attitudes (72.7%), and practices (63.8%) scores. It also assessed awareness among postgraduate pharmacy students (Maheshwari *et al.*, 2022). The better asthma awareness among Indian pharmacy students, compared to their Pakistani counterparts, can be attributed to a curriculum that focuses more on practical training (Arakawa *et al.*, 2020).

As research related to the assessment of asthma awareness among pharmacy students is limited, studies conducted among other target populations, such as practising pharmacists and physicians, were used for the comparison. It is well established that asthma-related mortality and morbidity can be controlled when all stakeholders are aware of asthma management (Adabla *et al.*, 2023).

Poor knowledge and practices among pharmacists have been recognised as barriers to effective asthma management (Taqi *et al.*, 2021). A study conducted among pharmacists in Egypt revealed similar findings, with a majority displaying poor knowledge (28.5%) (Said *et al.*, 2022). However, contrary to the present study, most participants (80.2%) exhibited positive attitudes towards asthma care. The Egyptian study also reported that female pharmacists had more positive attitudes towards asthma care, while the present study found no differences in attitudes across genders.

In Jordan, a study among community pharmacists reported different results, with 57.5% demonstrating high knowledge and 55.5% displaying better attitudes towards asthma care (Jarab *et al.*, 2024). Conversely, research in Nigeria among community pharmacists, aligning more closely with this study's findings, showed that only 34.8% had good knowledge and merely 11.2% exhibited good practices related to asthma treatment (Amorha *et al.*, 2020).

A study conducted in the Aseer region of Saudi Arabia regarding asthma revealed that general practitioners had suboptimal knowledge and attitudes regarding the management of acute asthma (Assiri *et al.*, 2021). Similarly, assessments of asthma awareness among physicians in Lebanon, Myanmar, Malaysia, Morocco, Nepal, and Saudi Arabia also revealed inadequate knowledge and attitudes regarding inhaler use in asthma (Chokhani *et al.*, 2021; Almutairi *et al.*, 2022).

Appropriate risk perceptions related to asthma management among pharmacists are vital for improved asthma control in the community, as evidence-based counselling provided by pharmacists leads to improved patient outcomes. An American study established that patient outcomes in asthma are affected by the extent of self-monitoring (Bridgeman & Wilken, 2021). Similarly, in the present study, most pharmacy students indicated that asthma could be effectively self-

monitored. They also recognised the importance of appropriate inhaler use, as pharmacists' poor knowledge of this technique contributes to poor patient outcomes (Jia et al., 2020).

Educational interventions inculcating appropriate asthma-related knowledge, attitudes, and risk perceptions among future pharmacists are crucial for overcoming barriers to pharmacist-led asthma care. Improving pharmacists' knowledge would subsequently elevate the confidence of asthmatic patients in pharmacist-led care. Therefore, efforts should be directed towards addressing this issue.

### **Strengths and limitations of the study**

The study highlighted knowledge, attitude, and risk perceptions related to asthma among pharmacy students, marking the first such investigation conducted in Pakistan. A pilot study was conducted to validate the study instrument, adding to the study's robustness. Another strength is the inclusion of data from multiple pharmacy institutes in the twin cities rather than limiting it to a single centre. However, the study has limitations. The non-random sampling technique used may preclude the generalisability of the results. Additionally, the data were collected only from private-sector pharmacy institutes, as the authors could not obtain timely permission from public-sector universities.

### **Recommendations**

The existing pharmacy curriculum should be evaluated, and comprehensive modules on asthma should be incorporated. This revision will ensure that students have a solid understanding of the topic and its related issues, enabling them to provide better care and counselling to patients.

Policymakers should also create opportunities for pharmacy students to gain hands-on experience in asthma counselling, testing, and management through internships or rotations in asthma clinics or hospitals. Such practical experience would help address knowledge gaps and mixed attitudes towards asthma care.

### **Conclusion**

This study revealed that the majority of final-year pharmacy students in Pakistan had moderate knowledge of asthma and mixed attitudes towards its management. Their perceptions of asthma risks were adequate.

### **Conflict of interest**

The authors declare no conflict of interest.

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