J MEDICINE 2026; 27: 102-113

Original Article

Evaluation of the Knowledge, Attitude and Practice of Asthma among the University Students in Bangladesh: A Cross-Sectional Study

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Abstract

Background: *Asthma is a common long-term lung disease, and university students are a key group for messages about how to prevent and manage it on their own.*

Methods: *From April 2024 to August 2025, an online survey was conducted among 1,325 undergraduate and graduate students (538 male and 787 female) from 19 universities with a structured questionnaire consisting of 48 questions (15 about knowledge, 8 about attitude, and 10 about practice). Knowledge is rated from 0 to 15, with 0 being bad and 15 being good. 5-point Likert scales with set cut-offs are used to analyse attitude (8–40) and practice (10–50) scores. Welch's t-test/ANOVA or Mann–Whitney U are used to compare groups. Pearson correlation is used to examine relationships between KAP dimensions, and SEM is used to examine predictors (two-sided p<0.05).*

Results: *The mean (±SD) scores are 12.02±3.41 for knowledge, 31.12±8.22 for attitude, and 43.12±8.95 for practice. Overall, 89.7% have good knowledge, 69.9% have a good attitude, and 88.0% have proactive practice towards asthma. There is a positive relationship between the KAP domains, with the strongest link between knowledge and practice (r=0.428, p<0.001). In analyses with more than one variable, being older is linked to having less knowledge, while being in a higher academic year and being interested in a free inhaler-technique workshop are linked to having more knowledge. Knowledge is also linked to both attitude and practice.*

Conclusion: *Most Bangladeshi university students have a good understanding of asthma and how to deal with it. Skills-based campus programs, especially those that teach people how to use inhalers, may help fill in the gaps and improve asthma self-management.*

Keywords: *Knowledge, Attitude and Practice Analysis of Asthma, Asthma in Bangladesh, Asthma Management, Survey on Asthma.*

DOI: *https://doi.org/10.3329/jom.v27i2.92270*

Received: *25-01-2025* ***Accepted:*** *06-05-2026*

Introduction

Asthma is a common and complicated long-term airway problem that causes inconsistent expiratory airflow limitation that can change over time and with treatment. It also causes different respiratory symptoms, such as wheezing, shortness of breath, chest tightness, and cough. Chronic airway inflammation and bronchial hyper responsiveness are two other common pathobiological features, along with bronchoconstriction that happens from time to time. Some patients may also have too much mucus and changes in their airways, which can cause airflow obstruction that comes and goes or stays.[1] Asthma is still a major non communicable disease that causes a lot of pain and deaths that could be avoided all over the world, even though there are better medicines and management options based on research. The World Health Organization says that asthma affected 262 million people and killed 455,000 people in 2019. In low- and middle-income countries, the disease was especially bad because it is often misdiagnosed, people can't easily get the medicines they need, and long-term care is poorly organized.[2]

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According to studies on the global burden of disease, asthma is a major cause of disability and healthcare use around the world.[3]

According to international guidelines, asthma-related illness and mortality can be significantly decreased with prompt diagnosis, evidence-based anti-inflammatory treatment, and continued support for self-management. In order to achieve long-term control and reduce the risk of flare-ups, the Global Initiative for Asthma (GINA) recommends that the first line of treatment be inhaled corticosteroid (ICS) therapy. Depending on the degree of symptom control and the likelihood of further flare-ups, the treatment plan should be modified. People usually don't follow their controller therapy, don't understand asthma, can't get the inhaled medication and wait too long for care because Asthma control is still not good in many places.[4] Even when drugs are prescribed, it is very important to use the inhaler correctly so that the drugs work and the patient become better. Consistent evidence shows that inhaler mistakes happen often across all types of devices and don't go away over time. These mistakes include failing to exhale before inhaling, inhaling insufficiently, and failing to hold your breath after inhaling. These errors can worsen symptoms and increase the chance of an exacerbation or an unplanned doctor's visit. Therefore, patient education needs to be not only bound in theory but also more focused on practical training, like how to use an inhaler.[5]

There is a lot of evidence that supported self-management works. This usually includes teaching patients, helping them learn new skills, regular evaluations by professionals, and a written, personalized asthma action plan. A comprehensive systematic meta-review revealed that supported self-management can enhance asthma control and decrease unscheduled care across various populations and healthcare environments.[6] Consequently, evidence from Cochrane reviews endorses the implementation of tailored written asthma action plans as a crucial element of adult asthma management to facilitate early recognition of deterioration and appropriate response. Self-management technique is still not widely used, even though it has benefits. This is especially true in places where resources are limited.[7] Routine clinical records often underestimate the true community burden of asthma for population health planning because they do not fully capture symptom variability, exacerbations, environmental exposures, and treatment behaviors.[8] From ISAAC (International Study of Asthma and Allergies in Childhood) to more recent GAN (Global Asthma Network) initiatives, standardized cross-sectional surveys have been crucial to asthma epidemiology and surveillance because they enable comparable estimates across countries and time periods.[9, 10]

Asthma is still a big health problem in Bangladesh, but there isn't enough information about how common it is or how people act when they have it. A recent study of the whole population found that the national rate of asthma has been stable at about 7% for more than ten years. This means we need more up-to-date information to help us figure out how to stop and control the disease.[11] Recent data highlight that a lot of young adults in educational environments were reported with asthma. For instance, a study of university students in Bangladesh found that 13.3% of them had asthma.[12] University students are an important group for public health campaigns because they are easy to reach through school programs, their risks change over time, and their behaviors make it harder to stop, find, and manage asthma over the long term.

The present study assesses the knowledge, attitudes, and practices (KAP) levels towards asthma of Bangladeshi university students and identifies factors associated with preventive practices to inform targeted health education and asthma control strategies. The results will help create focused educational programs and health promotion measures that aim to manage the asthma. The goal is to gather evidence-based information that may be used to shape future public health programs and teaching efforts that are specifically designed for university students.

Materials and Methods

Study Design and Participants

From April 2024 to August 2025, a descriptive cross-sectional study was carried out to investigate the knowledge, attitude, and practices (KAP) regarding asthma among the university students in Bangladesh. Undergraduate and postgraduate students from the Pharmacy department, as well as different departments of Stamford University Bangladesh, University of Dhaka, Jahangirnagar University, Bangladesh University of Professionals, University of Asia Pacific, Jagannath University, Sonargaon University, United International University, BRAC University, Notre Dame University Bangladesh, Independent University Bangladesh, Daffodil International University, Shanto-Mariam University of Creative Technology, Green University of Bangladesh, North South University, Sher-E-Bangla Agricultural University, ASA University Bangladesh, Pabna University

of Science and Technology and Shahjalal University of Science and Technology were included. The students of the study were well-versed about the aim of the study before answering the queries, and it was also made clear to the participants before the answering session that those who were unwilling to join in the study should feel free to withdraw. The technical terms were clarified in detail for a better understanding of the participants. No multi-response answers for single response questions were considered for data analysis.

Sample Size

The survey was carried out on a total 1325 students, including 538 male students and 787 female students from 19 university students. Data were collected via Google Forms.

Questionnaire

The questionnaire was categorized according to patient-completed asthma knowledge questionnaire (PAKQ),[13] The Knowledge, Attitude, and Self-Efficacy Asthma Questionnaire,[14] Assessing Patient Knowledge of Asthma Using a Newly Validated Tool,[15] Development and validation of an asthma knowledge questionnaire for use in Brazil,[16] and 2020 Focused Updates to the Asthma Management Guidelines.[17] The final questionnaire had 48 questions in four groups: 15 questions were on basic information, 15 questions were on knowledge, 8 questions were on attitude, and 10 questions were on practice. For the purpose of statistical analysis, scores are designed based on the number of options for each item. Correct responses are awarded 1 point and incorrect or unclear answers get 0 points in knowledge dimension. The cut-off value for knowledge dimension is set at: 0-7 for poor level of knowledge and 8-15 for good level of knowledge. In the attitude and practice dimensions, a five-point Likert scale is primarily used. The scale ranged from very positive (5 points) to very negative (1 point) to measure the level of positivity. The cut-off value for attitude dimension is set at: 8–19 for negative attitude, 20–30 for neutral attitude, and 31–40 for positive attitude. Similarly, the cut-off value for practice dimension is set at: 10– 20 for inactive practice, 21–30 for moderate practice, and 31–50 for proactive practice.

Statistical Analysis

RStudio IDE (Posit), version 2025.05.0 is used for the statistical analysis. Descriptive analysis of the general characteristics of the participants and the KAP scores are performed as follows: continuous variables in normal distribution (KAP scores) are presented by mean ± standard deviation (SD). Continuous variables that followed a normal distribution are compared using Welch's t-test or ANOVA, while those that does not are compared using the Mann-Whitney U test. Categorical variables including the demographic characteristics and answers to different question are described by n (%). Pearson's correlation analysis is used to evaluate the relationship between Knowledge, Attitude, and Practice dimensions, with $|r|<0.40$ is weak; $0.40 \leq |r| 0.60$ is moderate; $|r| \geq 0.60$ is strong. Structural equation modelling (SEM) is used to investigate path relationships between KAP and basic information. Two-sided $p < 0.05$ is considered statistically significant.

Results

The questionnaire was distributed among 538 males (40.60%) and 787 females (59.40%) students. Their mean (±SD) KAP scores are 12.02 ± 8.22, 31.12 ± 8.22, and 43.12 ± 8.95, respectively. Gender is significantly connected to attitude score ($p < 0.001$) and practice scores ($p < 0.001$), with higher scores of female respondents. Age group is associated with attitude scores ($p < 0.001$) and practice scores ($p < 0.001$). Education level shows significant association with knowledge ($p < 0.001$), and practice scores ($p < 0.001$). Current living arrangements are significantly associated with knowledge scores ($p < 0.001$), attitude scores ($p < 0.001$), and practice scores ($p < 0.001$) as well. Family living places have a significant correlation with knowledge scores ($p < 0.001$), and practice scores ($p < 0.001$). Smoking status is significantly linked knowledge scores ($p < 0.001$), attitude scores ($p < 0.001$), and practice scores ($p < 0.001$). Family history of asthma also have a significant knowledge score ($p < 0.001$), attitude score ($p < 0.001$), and practice score ($p < 0.001$) as well. Doctor diagnosis asthma shows significant association with knowledge score ($p < 0.001$), attitude score ($p < 0.001$), and practice score ($p = 0.003$). Training on correct inhaler technique is associated with knowledge score ($p < 0.001$), attitude score ($p < 0.001$), and practice score ($p < 0.001$). Interested in free inhaler-technique workshop have a significant knowledge ($p < 0.001$) and practice score ($p < 0.001$) (Table 1).

The knowledge, attitude and practice histogram (Figure I) shows that 136 (10.3%) respondents had poor knowledge, and 1189 (89.7%) respondents had good knowledge about asthma. Regarding attitude towards asthma, 132 (10%) respondents were negative, 266 (20.1%) were neutral, and 927 (69.9%) respondents were positive attitude. Among all the respondents, 48 (3.6%) had an inactive practice, 111 (8.4%) had a moderate practice, and 1166 (88%) had a proactive practice towards asthma.

Table I: Demographic Information (N = 1325)

Variables & Parameters	N (%)	Knowledge Score		Attitude Score		Practice Score	
		Means ± SD	*p*-value	Means ± SD	*p*-value	Means ± SD	*p*-value
Total	1325 (100)	12.02 ± 3.41	-	31.12 ± 8.22	-	43.12 ± 8.95	-
Gender							
Male	538 (40.60)	11.75 ± 4.00	0.024	29.77 ± 7.59	<0.001	40.98 ± 10.21	<0.001
Female	787 (59.40)	12.21 ± 2.93		32.04 ± 8.50		44.59 ± 7.63	
Age Group (Years)							
18 – 21	460 (34.72)	11.96 ± 3.36	0.67	29.74 ± 9.32	<0.001	44.40 ± 8.07	<0.001
22 – 24	656 (49.51)	12.01 ± 3.44		31.75 ± 8.14		41.72 ± 10.17	
25 or above	209 (15.77)	12.21 ± 3.42		32.18 ± 4.77		44.73 ± 5.26	
Education Level							
1st Year Students	244 (18.42)	10.40 ± 4.40	<0.001	29.89 ± 7.59	0.008	41.52 ± 10.61	<0.001
2nd Years Students	289 (21.81)	13.33 ± 1.80		31.70 ± 11.04		47.31 ± 3.21	
3rd Year Students	222 (16.75)	12.54 ± 2.48		31.92 ± 8.06		42.22 ± 10.68	
4th Year Students	312 (23.55)	11.91 ± 2.59		30.36 ± 7.32		40.98 ± 9.50	
Masters	258 (19.47)	11.78 ± 4.45		31.87 ± 5.71		43.31 ± 7.65	
Current Living Arrangements							
With Parents	784 (59.17)	12.23 ± 3.19	<0.001	32.21 ± 7.57	<0.001	43.19 ± 8.58	<0.001
With Relatives	78 (5.89)	13.08 ± 2.83		37.31 ± 3.75		47.08 ± 5.62	
Hostel/Mess/Shared Accommodation							
419 (31.62)	11.37 ± 3.58		27.77 ± 9.01		41.72 ± 10.06		
Others	44 (3.32)	12.68 ± 5.12		32.55 ± 4.32		48.36 ± 2.70	
Family Living Places							
Urban	825 (62.26)	12.79 ± 3.12	<0.001	31.12 ± 9.25	0.03	42.87 ± 9.31	<0.001
Semi-Urban	297 (22.42)	11.71 ± 3.25		31.92 ± 5.97		44.73 ± 5.83	
Rural	203 (15.32)	9.36 ± 3.36		29.94 ± 6.23		41.79 ± 10.75	
Smoking Status							
Never	1199 (90.49)	11.91 ± 3.41	<0.001	31.57 ± 7.93	<0.001	43.78 ± 8.21	<0.001
Ex-smoker	13 (0.98)	15.00 ± 0.00		32.00 ± 0.00		39.00 ± 0.00	
Occasionally	68 (5.13)	13.75 ± 2.04		24.29 ± 9.39		34.34 ± 14.54	
Current Smoker	45 (3.40)	11.56 ± 4.28		29.16 ± 10.14		40.02 ± 10.28	
Family History of Asthma							
Yes	484 (36.53)	12.71 ± 2.66	<0.001	29.32 ± 10.45	<0.001	41.46 ± 9.71	<0.001
No	816 (61.58)	11.69 ± 3.73		32.30 ± 6.39		44.23 ± 8.36	
Not Sure	25 (1.89)	9.64 ± 2.83		27.36 ± 3.64		39.04 ± 5.75	
Doctor-Diagnosed Asthma							
Yes	264 (19.92)	12.90 ± 2.81	<0.001	31.28 ± 6.71	<0.001	41.52 ± 7.92	0.003
No	999 (75.40)	11.75 ± 3.56		31.37 ± 8.54		43.46 ± 9.09	
Not Sure	62 (4.68)	12.63 ± 2.46		26.40 ± 7.34		44.55 ± 9.94	
Training on correct Inhaler Technique		Yes	403 (30.42)	12.72 ± 3.24	<0.001	29.90 ± 8.23	<0.001
40.18 ± 11.12	<0.001						
No	861 (64.98)	11.97 ± 3.14		31.91 ± 8.09		44.67 ± 7.18	
Not Sure	61 (4.60)	8.11 ± 5.14		28.02 ± 8.39		40.82 ± 10.02	
Interested in Free Inhaler-technique workshop							
Yes	1072 (80.91)	12.69 ± 2.67	<0.001	31.43 ± 8.58	0.015	43.75 ± 8.53	<0.001
No	103 (7.77)	7.10 ± 3.96		30.05 ± 6.49		36.86 ± 12.65	
Not Sure	150 (11.32)	10.67 ± 4.44		29.61 ± 6.17		42.91 ± 6.96	

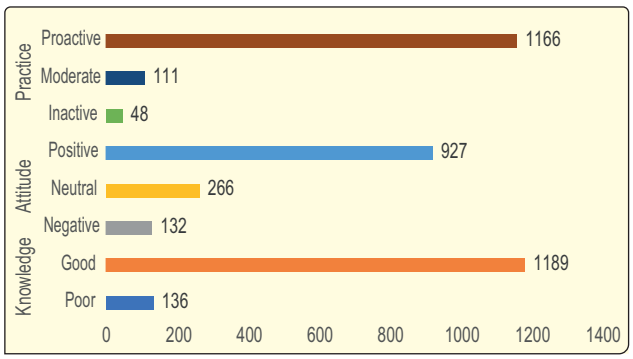

Figure I: Knowledge, attitude, and practice (KAP) histogram. K (15 questions, 0 – 15 points with 0 – 7 as poor level of knowledge and 8 – 15 as good level of knowledge); A (8 questions with 8–19 for negative attitude, 20–30 for neutral attitude, and 31–40 for positive attitude); P (10 questions with 10–20 for inactive practice, 21–30 for moderate practice, and 31–50 for proactive practice).

Most of the items had a high overall knowledge score. The highest percentages of correct answers were for knowing that common triggers and symptoms of asthma include dust, smoke, pollen, odors, cold air, and viral infections (95.9%) and that common symptoms include wheeze, shortness of breath, chest tightness, and cough (93.2%). Most of the people who took part (89.3%) also knew that asthma is a long-term condition and (87.4%) knew how important it is to use an inhaler correctly. But there were significant knowledge gaps in a few areas, mostly because people answered "Not sure." The question with the fewest correct answers was about spirometry as a diagnostic test (62.9% correct; 33.4% not sure). People also didn't know much about how to tell the difference between inhaler types and signs of poor control. For example, they didn't know that controller/preventer inhalers reduce inflammation (68.2% correct), written asthma action plans reduce severe attacks (68.3% correct), or that using reliever inhalers often means poor asthma control (67.2% correct) (Table 2).

Most of the respondents (82.1%) who answered the question about their attitude towards asthma think that controller medications are safe when taken as directed, that proper inhaler technique is important (78.2%), and that universities

Table 2. Distribution of questions answered for the knowledge dimension, n (%)

Qs. No.	Question	Correct	Incorrect	Unclear
K1	Asthma is a chronic disease that affects the airways (breathing tubes).	1183 (89.28)	56 (4.23)	86 (6.49)
K2	Asthma symptoms can come and go and may worsen with triggers.	1067 (80.53)	62 (4.68)	196 (14.79)
K3	Common asthma symptoms include wheezing, shortness of breath, chest tightness, and cough.	1235 (93.21)	24 (1.81)	66 (4.98)
K4	Dust, smoke, pollen, strong odors, cold air, and viral infections . can trigger asthma	1270 (95.85)	6 (0.45)	49 (3.70)
K5	Spirometry is a useful test to help diagnose asthma.	834 (62.94)	49 (3.70)	442 (33.36)
K6	A "reliever" inhaler is used for quick relief during sudden asthma symptoms.	1143 (86.26)	98 (7.40)	84 (6.34)
K7	A "controller/preventer" inhaler helps reduce inflammation and prevent future attacks.	904 (68.23)	79 (5.96)	342 (25.81)
K8	Using the correct inhaler technique is important for effective treatment.	1158 (87.40)	25 (1.89)	142 (10.72)
K9	Frequent need for a reliever inhaler can be a sign of poor asthma control.	890 (67.17)	105 (7.92)	330 (24.91)
K10	Night-time cough or wheeze may indicate uncontrolled asthma.	1037 (78.26)	57 (4.30)	231 (17.43)
K11	Asthma cannot always be permanently cured, but it can be well controlled with proper treatment.	1139 (85.96)	37 (2.79)	149 (11.25)
K12	Second-hand smoke can worsen asthma symptoms.	1083 (81.74)	43 (3.25)	199 (15.02)
K13	A written asthma action plan can help reduce severe attacks.	905 (68.30)	68 (5.13)	352 (26.57)
K14	People with asthma can usually exercise safely if their asthma is well controlled.	998 (75.32)	104 (7.85)	223 (16.83)
K15	Seeking early medical care for recurrent wheeze or prolonged cough is important.	1084 (81.81)	55 (4.15)	186 (14.04)

should teach more about asthma (80.5%). The same number of people also said it was important to help sick friends see a doctor and to support ways to keep people from getting sick. There is room for improvement in certainty and consistent risk perception, especially when it comes to how serious something is and how important it is to manage it over the long term. This is because a large number of people were unsure or disagreed on some issues, even though most people were generally positive (Table 3).

Everything went as planned during the practice sessions. Avoiding known respiratory triggers (73.5% of respondents), keeping living rooms free of dust (75.0% of respondents), and avoiding cigarette smoke and the smells that come with it (76.0% of respondents) were the three behaviours that were most likely to be "Always." Participants said that they usually followed a number of safety rules, such as spraying with a steady stream and limiting their exposure to the substance when it became hard to breathe. Because only 52.7% of people said they often check pollution and air quality alerts before working out, exercise is the activity that people like the least. This shows that even though people are more aware of environmental threats, they still aren't ready to understand information about them (Table 4).

Table 3. Distribution of questions answered for attitude dimension, n (%)

QS. No.	Question	Very Positive (%)	Positive (%)	Neutral (%)	Negative (%)	Very Negative (%)
A1	Asthma is a serious condition that requires proper long-term management.	454 (34.26)	493 (37.21)	136 (10.26)	24 (1.81)	218 (16.45)
A2	Avoiding triggers is important even if symptoms are mild.	335 (25.28)	564 (42.57)	245 (18.49)	54 (4.08)	127 (9.58)
A3	Inhaled controller medicines are safe when used as prescribed.	472 (35.62)	616 (46.49)	99 (7.47)	18 (1.36)	120 (9.06)
A4	Correct inhaler technique is essential for good asthma control.	558 (42.11)	478 (36.08)	132 (9.96)	42 (3.17)	115 (8.68)
A5	We Should Encourage a friend with asthma symptoms to consult a healthcare professional.	555 (41.89)	538 (40.60)	87 (6.57)	31 (2.34)	114 (8.60)
A6	Regular follow-up is important for people with asthma.	533 (40.23)	466 (35.17)	162 (12.23)	43 (3.25)	121 (9.13)
A7	I feel confident I could help someone having breathing difficulty by seeking prompt assistance.	310 (23.40)	592 (44.68)	265 (20.00)	31 (2.34)	127 (9.58)
A8	Universities should provide more education about asthma and respiratory health.	566 (42.72)	500 (37.74)	107 (8.08)	50 (3.77)	102 (7.70)

Table 4: Distribution of question answered for practice dimension, n (%)

QS. No.	Question	Very Positive (%)	Positive (%)	Neutral (%)	Negative (%)	Very Negative (%)
P1	Avoid cigarette smoke and smoky environments.	1007 (76.00)	108 (8.15)	88 (6.64)	74 (5.58)	48 (3.62)
P2	Use a mask or other protection when exposed to dust or heavy air pollution.	858 (64.75)	156 (11.77)	175 (13.21)	81 (6.11)	55 (4.15)
P3	Keep living area clean to reduce dust accumulation.	994 (75.02)	144 (10.87)	120 (9.06)	24 (1.81)	43 (3.25)
P4	Ensure good ventilation when using cleaning sprays or strong chemicals.	946 (71.40)	108 (8.15)	108 (8.15)	49 (3.70)	114 (8.60)
P5	Try to avoid known respiratory triggers (dust, smoke, strong perfume/odor).	974 (73.51)	130 (9.81)	92 (6.94)	44 (3.32)	85 (6.42)
P6	Check air quality or pollution advisories before prolonged outdoor activities.	698 (52.68)	287 (21.66)	155 (11.70)	80 (6.04)	105 (7.92)
P7	In cold weather, cover nose and mouth if experience breathing sensitivity.	862 (65.06)	161 (12.15)	179 (13.51)	63 (4.75)	60 (4.53)
P8	If have persistent cough, wheeze, or shortness of	868 (65.51)	164 (12.38)	177 (13.36)	56 (4.23)	60 (4.53)
P9	Avoid intense exercise when I am having active breathing symptoms.	831 (62.72)	237 (17.89)	124 (9.36)	54 (4.08)	79 (5.96)
P10	Share accurate information about asthma with friends/family when relevant.	851 (64.23)	178 (13.43)	129 (9.74)	94 (7.09)	73 (5.51)

Table V: Results of Pearson's correlation analysis

	Knowledge	Attitude	Practice
Knowledge	1		
Attitude	0.191 ($p < 0.001$)	1	
Practice	0.428 ($p < 0.001$)	0.349 ($p < 0.001$)	1

Pearson's correlation analysis (Table 5) showed significant positive relationships among all knowledge, attitude, and practice (KAP) dimensions. The strongest connection showed between knowledge and practice (r = 0.428, $p < 0.001$) which indicating that higher asthma knowledge was completely aligned with more practice. Comparatively significant strong relation was presented between practice and attitude (r = 0.349, $p < 0.001$) and attitude and knowledge (r = 0.191, $p < 0.001$).

Moreover, SEM (Table 6 and Figure 2) showed that older students had lower knowledge scores than those aged 18–21 (age 22–24: β = -0.33, 95% CI -0.39 to -0.26; age ≥25: β = -0.24, -0.34 to -0.15; both p<0.001). Conversely, Knowledge was elevated in all subsequent academic years compared to the first year (2nd year: β = 0.47; 3rd year: β = 0.37; 4th year: β = 0.45; Masters: β = 0.36; all p<0.001). Living in a hostel, mess, or shared accommodation was linked to lower Knowledge (β = -0.17, -0.23 to -0.12; p<0.001).

Table VI: Multivariable linear regression analysis of factors associated with KAP scores

Predictor	β (95% CI)	*p*-value
Knowledge		
Gender (Female)	0.04 (-0.02, 0.09)	0.223
Age (22–24)	-0.33 (-0.39, -0.26)	<0.001
Age (≥25)	-0.24 (-0.34, -0.15)	<0.001
Education level (2nd year students)	0.47 (0.41, 0.53)	<0.001
Education level (3rd year students)	0.37 (0.31, 0.44)	<0.001
Education level (4th year students)	0.45 (0.36, 0.54)	<0.001
Education level (Masters students)	0.36 (0.25, 0.47)	<0.001
Living arrangement (Hostel/Mess/Shared)	-0.17 (-0.23, -0.12)	<0.001
Living arrangement (With relatives)	0.07 (0.01, 0.13)	0.013
Living arrangement (Other)	0.07 (0.03, 0.12)	0.002
Family living place (Semi-urban)	-0.11 (-0.16, -0.05)	<0.001
Family living place (Rural)	-0.24 (-0.30, -0.18)	<0.001
Smoking status (Occasionally)	0.03 (-0.02, 0.07)	0.251
Smoking status (Current smoker)	-0.02 (-0.08, 0.05)	0.62
Smoking status (Ex-smoker)	0.08 (0.05, 0.10)	<0.001
Family history of asthma (Yes)	-0.04 (-0.10, 0.01)	0.133
Family history of asthma (Not sure)	-0.06 (-0.12, 0.00)	0.064
Any doctor-diagnosed allergic condition (Yes)	-0.09 (-0.14, -0.03)	0.001
Doctor-diagnosed asthma (Yes)	0.01 (-0.05, 0.06)	0.803
Doctor-diagnosed asthma (Not sure)	-0.03 (-0.10, 0.04)	0.394
Any home/environment exposure (Yes)	0.02 (-0.03, 0.06)	0.496
Inhaler-technique training (Yes)	0.08 (0.03, 0.12)	0.001
Inhaler-technique training (Not sure)	0.08 (0.01, 0.15)	0.031
Workshop interest (Yes)	0.62 (0.52, 0.71)	<0.001
Workshop interest (Not sure)	0.46 (0.37, 0.55)	<0.001
Attitude		
Knowledge	0.25 (0.18, 0.32)	<0.001
Gender (Female)	0.19 (0.13, 0.26)	<0.001
Age (22–24)	0.30 (0.18, 0.41)	<0.001
Age (≥25)	0.35 (0.25, 0.45)	<0.001
Education level (2nd year students)	-0.09 (-0.18, 0.00)	0.045
Education level (3rd year students)	-0.13 (-0.23, -0.02)	0.015

Table VI: Multivariable linear regression analysis of factors associated with KAP scores *(Cont'd)*

Predictor	β (95% CI)	*p*-value
Education level (4th year students)	-0.24 (-0.38, -0.10)	<0.001
Education level (Masters students)	-0.15 (-0.28, -0.02)	0.026
Living arrangement (Hostel/Mess/Shared)	-0.18 (-0.25, -0.11)	<0.001
Living arrangement (With relatives)	0.11 (0.05, 0.16)	<0.001
Living arrangement (Other)	-0.02 (-0.05, 0.02)	0.338
Family living place (Semi-urban)	0.23 (0.17, 0.30)	<0.001
Family living place (Rural)	0.16 (0.10, 0.22)	<0.001
Smoking status (Occasionally)	-0.15 (-0.23, -0.08)	<0.001
Smoking status (Current smoker)	-0.09 (-0.16, -0.03)	0.007
Smoking status (Ex-smoker)	"0.14 ("0.18, -0.11)	<0.001
Family history of asthma (Yes)	"0.27 ("0.34, -0.19)	<0.001
Family history of asthma (Not sure)	-0.16 (-0.21, -0.11)	<0.001
Any doctor-diagnosed allergic condition (Yes)	0.06 (0.01, 0.11)	0.012
Doctor-diagnosed asthma (Yes)	-0.02 (-0.07, 0.03)	0.422
Doctor-diagnosed asthma (Not sure)	0.00 (-0.07, 0.07)	0.941
Any home/environment exposure (Yes)	0.06 (0.01, 0.10)	0.012
Inhaler-technique training (Yes)	-0.13 (-0.19, -0.07)	<0.001
Inhaler-technique training (Not sure)	-0.02 (-0.11, 0.06)	0.582
Workshop interest (Yes)	-0.03 (-0.10, 0.04)	0.413
Workshop interest (Not sure)	-0.04 (-0.12, 0.04)	0.319
Practice		
Knowledge	0.42 (0.35, 0.49)	<0.001
Attitude	0.13 (0.07, 0.20)	<0.001
Gender (Female)	0.25 (0.18, 0.31)	<0.001
Age (22–24)	-0.10 (-0.18, -0.02)	0.016
Age (≥25)	0.01 (-0.08, 0.09)	0.900
Education level (2nd year students)	0.16 (0.09, 0.22)	<0.001
Education level (3rd year students)	-0.07 (-0.14, 0.00)	0.051
Education level (4th year students)	0.04 (-0.07, 0.15)	0.493
Education level (Masters students)	0.08 ("0.02, 0.18)	0.097
Living arrangement (Hostel/Mess/Shared)	-0.05 (-0.11, 0.00)	0.051
Living arrangement (With relatives)	0.10 (0.04, 0.15)	<0.001
Living arrangement (Other)	0.17 (0.13, 0.21)	<0.001
Family living place (Semi-urban)	0.01 (-0.05, 0.07)	0.730
Family living place (Rural)	0.00 (-0.06, 0.07)	0.908
Smoking status (Occasionally)	0.08 (0.01, 0.14)	0.021
Smoking status (Current smoker)	0.05 (-0.03, 0.13)	0.194
Smoking status (Ex-smoker)	-0.03 (-0.14, 0.08)	0.620
Family history of asthma (Yes)	0.11 (0.06, 0.16)	<0.001
Family history of asthma (Not sure)	"0.07 (-0.15, 0.00)	0.054
Any doctor-diagnosed allergic condition (Yes)	-0.03 (-0.08, 0.02)	0.205
Doctor-diagnosed asthma (Yes)	0.01 (-0.03, 0.05)	0.654
Doctor-diagnosed asthma (Not sure)	-0.06 (-0.13, 0.01)	0.091
Any home/environment exposure (Yes)	0.12 (0.08, 0.17)	<0.001
Inhaler-technique training (Yes)	-0.22 (-0.27, -0.17)	<0.001
Inhaler-technique training (Not sure)	-0.23 (-0.31, -0.16)	<0.001
Workshop interest (Yes)	0.09 (0.03, 0.15)	0.002
Workshop interest (Not sure)	0.11 (0.03, 0.18)	0.004

β= standardized regression coefficient; CI = confidence interval. Statistical significance: $p < 0.05$ (*), $p < 0.01$ (**), $p < 0.001$ (***)

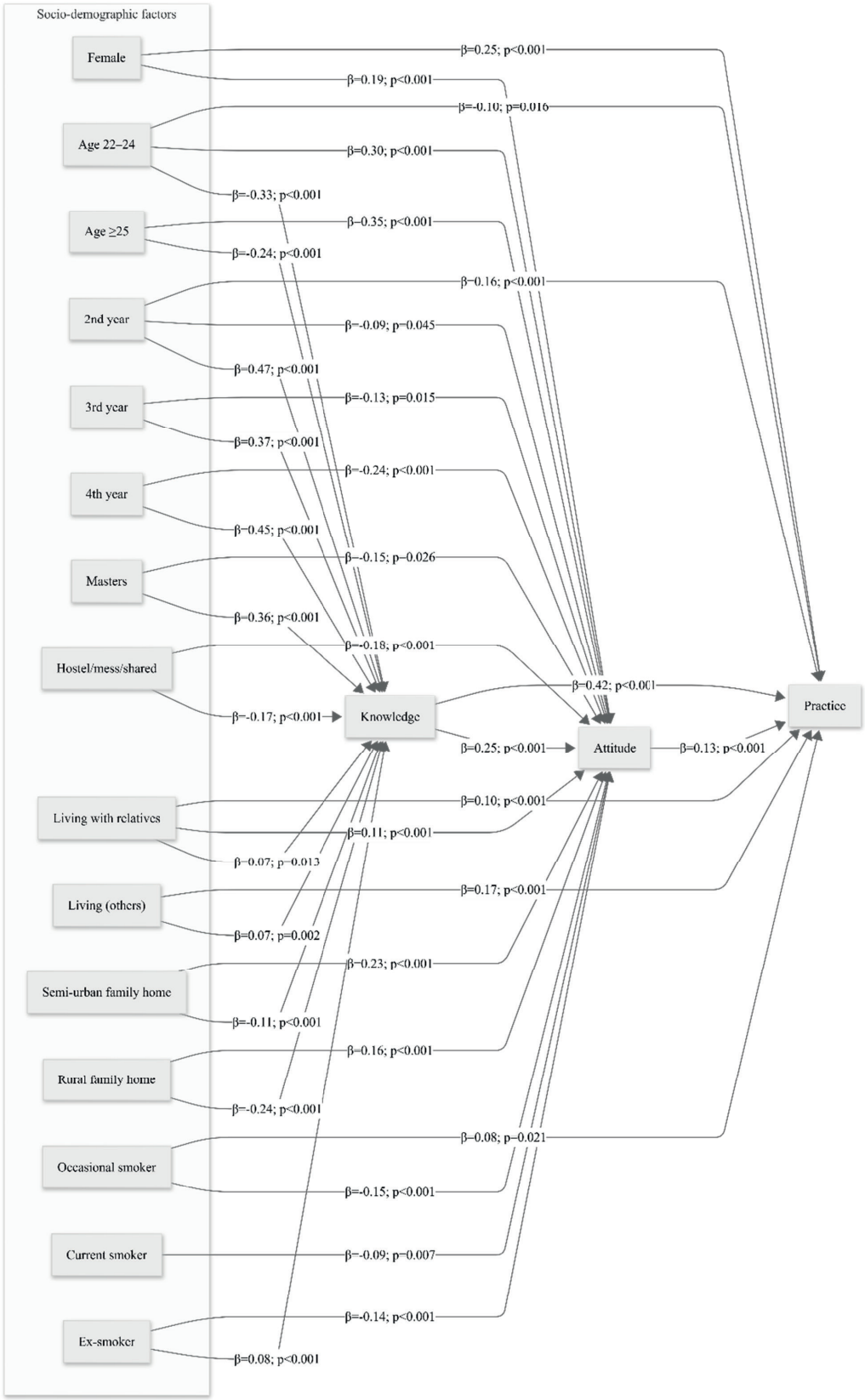

Figure 2: Illustration of Structural Equation Model (SEM) analysis**.**

On the other hand, living with relatives (β = 0.07, 0.01 to -0.13; p=0.013) or in other arrangements (β = 0.07, 0.03 to -0.12; p=0.002) showed small positive links. Students from semi-urban (β = -0.11, -0.16 to -0.05) and rural family homes (β = -0.24, -0.30 to -0.18) exhibited lower Knowledge compared to their urban counterparts (both p<0.001). Among health-related predictors, any doctor-diagnosed allergic condition was negatively associated with Knowledge (β = -0.09, -0.14 to -0.03; p=0.001), while prior inhaler-technique training was positively associated (Yes: β = 0.08, 0.03 to 0.12; p=0.001; Not sure: β = 0.08, 0.01 to 0.15; p=0.031). The most significant positive correlations with Knowledge were found in the willingness to participate in a complimentary inhaler-technique workshop (Yes: β = 0.62, 0.52 to 0.71; Not sure: β = 0.46, 0.37 to 0.55; both p<0.001).

In addition, Knowledge was a significant independent predictor of a more positive attitude (β = 0.25, 0.18 to 0.32; p<0.001). Females exhibited a more favorable attitude compared to males (β = 0.19, 0.13 to 0.26; p<0.001). Attitude was significantly elevated in the age groups 22–24 (β = 0.30, 0.18 to 0.41) and ≥25 (β = 0.35, 0.25 to 0.45; both p<0.001) compared to the age group 18–21. However, Attitude was slightly lower in higher academic years compared to the first year (2nd year: β = -0.09, p=0.045; 3rd year: β = -0.13, p=0.015; 4th year: β = -0.24, p<0.001; Masters: β = -0.15, p=0.026). Living in a hostel, mess, or shared accommodation was linked to a lower Attitude (β =-0.18, -0.25 to -0.11; p<0.001), while living with relatives was linked to a higher Attitude (β = 0.11, 0.05 to 0.16; p<0.001). Students from semi-urban (β = 0.23, 0.17 to 0.30) and rural family backgrounds (β = 0.16, 0.10 to 0.22) exhibited a more favorable Attitude compared to their urban counterparts (both p<0.001). Smoking (whether current, occasional, or former) and a family history of asthma (Yes/Not sure) were both linked to a lower Attitude (all p≤0.007). Furthermore, any doctor-diagnosed allergic condition (β = 0.06, 0.01 to 0.11; p=0.012) and exposure at home or in the environment (β = 0.06, 0.01 to 0.10; p=0.012) were positively correlated with Attitude, while inhaler-technique training (Yes) exhibited an inverse correlation (β = -0.13, -0.19 to -0.07; p<0.001).

Practice was most significantly correlated with Knowledge (β = 0.42, 0.35 to 0.49; p<0.001), alongside a separate independent effect from Attitude (β = 0.13, 0.07 to 0.20; p<0.001). Female students indicated greater Practice than their male counterparts (β = 0.25, 0.18 to 0.31; p<0.001). In comparison to ages 18–21, Practice was marginally reduced in ages 22–24 (β = -0.10, -0.18 to -0.02; p=0.016), whereas no association was found for ages ≥25 (p=0.900). Second-year students practiced more than first-year students (β = 0.16, 0.09 to 0.22; p<0.001). Living with relatives (β = 0.10, 0.04 to 0.15; p<0.001) or in alternative arrangements (β = 0.17, 0.13 to 0.21; p<0.001) exhibited a positive correlation with Practice. There was a small positive link between occasional smoking and Practice (β = 0.08, 0.01 to 0.14; p=0.021), but there was no link between current or former smoking and Practice. People with a family history of asthma (Yes: β = 0.11, 0.06 to 0.16; p<0.001) and those who had been exposed to asthma in their home or environment (β = 0.12, 0.08 to 0.17; p<0.001) were also more likely to practice. Inhaler-technique training (Yes and Not sure) was negatively correlated with Practice (Yes:β = "0.22, -0.27 to -0.17; Not sure: β = -0.23, -0.31 to -0.16; both p<0.001). Interest in a complimentary inhaler technique workshop (Yes/Not sure) exhibited a positive correlation with Practice (β = 0.09, p=0.002; β = 0.11, p=0.004).

Discussion

This study presents that university students in Bangladesh have a lot of knowledge about asthma, have a good attitude, and used to do what they can to keep it from happening. Even though there are some things people don't know about asthma that could be fixed through practical education, it's clear that most people understand that it is a long-term respiratory illness. The mean (±SD) scores for knowledge, attitude, and practice (KAP) (N = 1325) are 12.02±8.22, 31.12±8.22, and 43.12±8.95, respectively. 89.7% of respondents have good knowledge, 69.9% respondents have positive attitude, and 88.0% respondents have extremely proactive. It is really inspiring because asthma is always a major global non-infectious disease, and a lot of asthma deaths happen in low- and middle-income countries, where there still have problems with diagnosis, proper care, and access to effective long-term management.[2] At the same time, the item-level pattern in our dataset shows that "general awareness" doesn't always turn into guideline-relevant, actionable understanding. There was a lot of confusion about spirometry as a diagnostic test (62.9% correct; 33.4% "not sure"), written asthma action plans, the roles of controllers and preventers in lowering airway inflammation, and the fact that using relievers too often means poor control. These certain gaps are clinically important because current asthma guidelines stress the need for objective assessment (including spirometry) when necessary, consistent controller therapy when needed, and self-management backed by a written action plan and regular review.[1,4] The results indicate a transition from predominantly informational messaging to skill-based education that emphasizes "what to do" (monitoring, step-up/step-down decisions according to action plans, and proper inhaler usage) alongside "what asthma is."

The connections between KAP domains show how important it is to design interventions that work together. Pearson's

correlation analysis shows that knowledge, attitude, and practice are all strongly linked, with the strongest link being between knowledge and practice ($r=0.428$, $p<0.001$), follows by attitude and practice ($r=0.349$) and knowledge and attitude ($r=0.191$). In the SEM framework, knowledge is a strong predictor of attitude ($\beta=0.25$, 95% CI 0.18 to 0.32; $p<0.001$). This pattern fits with KAP theory, but research on implementation shows that education alone is often not enough unless it is combined with supported self-management elements (structured review, reinforcement, and practical tools). These can lower the need for unscheduled care and improve asthma outcomes in a variety of situations.[6] People are still using inhalers in wrong technique, and it hasn't gotten much better over the years, so it's very important to focus on it.[5] This shows that people need to see it demonstrated and checked again and again instead of just once. Our data shows that people who have already had training in how to use an inhaler are more likely to know how to use one ($\beta=0.08$; $p=0.001$), and people who are interested in a free inhaler-technique workshop are also more likely to know how to use one ($\beta=0.62$; $p<0.001$). This shows that skill-building programs on campus are possible and that students want them.

Patterns in equity-relevant subgroups provide additional insights for targeted programming. Students between the ages of 18 and 21 know more than students who are older. Knowledge improve from the first year to the second year; however, students residing in hostels, messes, or shared accommodations, and hailing from semi-urban or rural family backgrounds, exhibit lower levels of knowledge. In multivariable analysis, female respondents exhibit superior attitude scores ($\beta=0.19$; $p<0.001$), indicating that male students may require more tailored approaches to engagement. These gradients probably show differences in how easy it is to get health information, how people have interacted with the health system in the past, and how they live, all of which can affect their exposure to triggers and chances to get care. In Bangladesh, where urban air pollution is always bad for respiratory health, combining asthma health promotion with practical ways to follow WHO air quality guidelines to lower exposure may make messages about preventing asthma and controlling symptoms even stronger.[18]

Finally, the student profile here is mostly good, which is a good sign compared to reports from clinical populations in Bangladesh that show patients in tertiary-care settings don't know much about or use inhalers correctly. But it shouldn't ensure the safety of people too, because the gaps are directly related to the skills needed to stop flare-ups breathing problem and keep control on asthma.[19] In general, these results highlight the idea of starting asthma programs at universities that teach students how to read and understand action plans, how to use an inhaler, and how to get in touch with other students who are more likely to have asthma. These programs should also have ways for students to be sent to and followed up on that follow the most up-to-date asthma management guidelines.

Conclusion

In Conclusion, this study presents that university students in Bangladesh know a lot about asthma and have a positive attitude about it. On the contrary, they do to fight it is what other young people who know a lot about it do. But there are still big gaps in the parts that are important for keeping an eye on and improving your health over time. "General awareness" may not always lead to decisions that follow the rules when symptoms get worse. They don't know how to present if someone has asthma, the basic differences between controller and relief therapy, how to read asthma action plans correctly, or how to discuss about asthma correctly. The results support the idea that asthma programs on campus would be much better with skills-based support. This would include regular checks and changes to inhaler technique, finding and keeping track of symptoms, and sharing techniques for making action plans that make treatment easier. We need to work harder to make sure that the measuring tool is easy to use for both students and non-students. Whenever possible, it should be a top priority to include objective evaluations of asthma status and treatment. It should be find out the ways of well and affordable university programs that can teach how to take care of their own health, use their inhalers correctly, and get clinically significant results like better symptom control and fewer flare-ups.

Compliance with ethics requirements

The Ethical Review Committee of the Faculty of Science, Stamford University Bangladesh approved the study protocol (SUB/SF/EC-0701/19).

Acknowledgment

The authors are grateful to the Department of Pharmacy, Stamford University Bangladesh, Dhaka-1217 for providing all supports to carry out of this research.

Conflict of interest

The authors reported no potential conflict of interest.

Funding

No funding sources

Author's contribution

All the authors contributed to the paper's conception, design, and submission.

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