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Research Article

PHARMACIST KNOWLEDGE IN THE TREATMENT AND THERAPEUTIC EDUCATION OF ASTHMA

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ABSTRACT

Introduction

Asthma is a chronic lung disease that affects the airways characterized by swelling, increased mucus in the airways and squeezing of the muscles surrounding the airways. In Lebanon, pharmacists play an integral role in optimizing patient's health-related quality of life and achieving positive clinical outcomes. Studies emphasize that the pharmacist intervention in asthma management can improve the treatment effectiveness.

Objective

Evaluation of knowledge of asthma and its therapeutic education by Lebanese pharmacists.

Method

A descriptive, cross-sectional survey was carried out from the 1st of September till 15th November 2022, using a random sample of Lebanese graduated pharmacists from different districts. The final self-assessment questionnaire included 60 questions. Statistical analyses were performed using the Statistical Package for Social Science (SPSS) version 26.

Results

Out of 56 pharmacist participants, 78.6% were females and 67.9% worked in community pharmacies. The mean score of knowledge and practice of education was 20.32 (± 4.6008) out of 32. Eighty-seven (87%) percent of participants knew that asthma is characterized by wheezing with dry cough and chest pain mainly exacerbated at night. In addition, 41.1% considered that inhaled corticosteroids (ICS) are the first line treatment, 91.1% considered that ICS+ short-acting β2 agonist or ICS + long-acting β2 agonist is the maintenance treatment in mild to moderate asthma and, 78.6% knew that immunotherapy is the last line therapy of asthma. On the other hand, 91.1% reported that oropharyngeal candidiasis is the main side effect of ICS. Concerning the pharmacist's role in patient education, 83.9% strongly agreed on advising the patients to rinse their mouth after ICS use. In addition, 44.6% strongly agreed pharmaceutical care improves management and treatment of asthma.

Conclusion

This cross-sectional study showed that the majority of pharmacists involved had a wide gap in the knowledge of asthma and in their role in treatment and therapeutic education.

Keywords: Asthma, Pharmacist role, Asthma management, Inhaled corticosteroids, Bronchodilators

INTRODUCTION

Asthma is a common Non-Communicable Disease (NCD) that significantly affects people's quality of life. It ranks 16th in disability and 28th in disease burden globally [1]. Currently, 300 million people have asthma, with an estimated additional 100 million affected by 2025. Prevalence, severity, and mortality rates vary geographically, with high-income countries having high prevalence and low-to middle-income countries experiencing more asthma-related deaths. While asthma is more common in children, it leads to greater morbidity and mortality in adults [2]. Childhood asthma is more prevalent in boys, while adult asthma is more common in women, suggesting a role of sex hormones [3]. Asthma is influenced by various factors such as gender, early pulmonary infections, rhinitis, smoking (active and passive), and obesity [4].

Concerns have been raised about asthma patients being at a higher risk of severe acute respiratory syndrome coronavirus -2 (SARS-

CoV-2) infection and disease severity during the COVID-19 pandemic. However, asthma itself is not an independent risk factor for both [5].

The prevalence of adult asthma in Lebanon falls within the range reported in neighboring countries. The future prevalence of asthma is expected to increase due to factors like urbanization and pollution, an aging population, adoption of a Western lifestyle, and the economic crisis [6,7].

Pharmacists play an important role in the management of NCDs, where they are uniquely positioned to improve outcomes in asthma patients given their clinical expertise in patient management and their ability to educate patients on asthma medications, provide training on inhalation technique, address patients' concerns around the potential side effects of medications, and improve adherence to treatment [8,9]. This study aims to evaluate the knowledge of the Lebanese pharmacists in the treatment and therapeutic education of patients with asthma. The determination of pharmacist's role in asthma management is primarily linked to the knowledge of the disease, its nature, pathogenesis, symptoms, therapeutic strategy, and the required monitoring. For this reason, the initial part includes primarily an assessment of knowledge which, in turn, contributes to the optimization of the pharmacist role and its impact on health outcome.

MATERIALS AND METHODS

Study design and participants

A descriptive, cross-sectional pilot survey was conducted from 01st September to 15th November 2022 to assess the knowledge and practices of Lebanese pharmacists regarding asthma management. The study utilized a random sample of Lebanese graduated pharmacists from various districts, although it should be noted that the sample may not be fully representative of the entire Lebanese pharmacist population.

All licensed pharmacists working in different domains were eligible to participate in an online questionnaire administered through Google Forms. The questionnaire was designed to be validated and reaches out to pharmacists practicing in Lebanon. Eligible participants included both male and female licensed-pharmacists with at least one year of experience in any pharmaceutical field. The study ensured anonymity, confidentiality, and privacy of the respondents.

Questionnaire

1. Gender
   - Male
   - Female
2. Age in years
   - 20-24
   - 25-29
   - 30-39
   - >40
3. Place of residence
   - Beirut
   - Bekaa
   - Mount Lebanon
   - North Lebanon
   - South Lebanon
   - Baalbek
   - Akkar
4. Highest degree of education
   - Bachelor degree
   - Master degree
   - PhD
   - PharmD
   - Others_____
5. Education completed in
   - Lebanon
   - Out-side Lebanon
6. If in Lebanon, specify which university
   - Lebanese university
   - BAU
   - LIU
   - LAU
   - USJ
   - Others____
7. Field of work
   - Community pharmacy
   - Hospital pharmacy
   - Clinical pharmacy
   - Pharmaceutical industry
   - Research study
   - Pharmaceutical Company
   - Others_____
8. Work position
   - Owner of a pharmacy
   - Employee in a pharmacy
   - Medical representative
   - Others____
9. Years of experience
   - 1-4
   - 5-9
   - >10
10. Weekly working hours
    - 1 hours-20 hours
    - 20 hours-40 hours
    - >40 hours
11. Number of daily patients
    - <10
    - 10-50
    - 50-100
    - >100
12. How many asthma prescriptions do you receive per month?
    - 2
    - 2-5
    - >5

Questions related to pharmacist general knowledge about asthma

13. What is asthma?
    - Infectious disease
    - Inflammatory disease
    - Physiological disease
    - Autoimmune disease
14. What do you think causes and triggers asthma?
    - Genetic
    - Air pollution
    - Smoking
    - Allergies to things such as pollen, dust, etc.
    - Bacteria and viruses
    - All of the above
15. What type of inflammation do you think is triggered in asthma
    - Type 1 inflammation
    - Type 2 inflammation
16. What are the triggers of asthma attacks
    - Upper respiratory tract infections
    - Tobacco smoke
    - Particulate pollution, stress, allergens
    - All of the above
    - None of the above
17. What do you think Asthma depends on
    - Genetic factors
    - Non- genetic factors
    - Both
18. Do you think that Men are more affected by Asthma than women
    - True
    - False

Questions related to pharmacist knowledge about symptoms and complications

19. What are the main symptoms of asthma?
    - Wheezing with dry cough and chest pain

mainly exacerbated at night
- Wheezing with wet cough and chest pain mainly exacerbated in the morning

20. What does asthma in adults include?
- Childhood asthma persisting in adulthood
- Asthma starting in childhood, disappearing and then reappearing in adulthood
- Asthma starting in adulthood
- All of the above

21. What do you think is the Onset of asthma?
- At any age
- Mainly adulthood
- Mainly childhood

22. What do you think that mainly exacerbate asthma?
- Respiratory viruses such as COVID-19 infection
- Exercise
- Lifestyle
- Atypical bacteria
- All of the above

23. What Asthma complications include?
- Permanent narrowing of bronchial tubes
- Higher risk of obesity
- All of the above
- None of the above

24. What Persistent asthma complications on long term include?
- Airway remodeling
- Superimposed infections as pneumonia
- Chronic bronchitis
- Emphysema
- Respiratory failure
- All of the above
- None of the above

Questions related to asthma diagnosis and treatment

25. What do you think is the main test used to diagnose asthma?
- FEV1
- Bronchial provocation test
- Allergen testing

26. What does FEV1 measures
- Peak expiratory flow
- Forced expiratory volume in one second

27. As a pharmacist what do you think is the first line treatment of asthma?
- Montelukast
- Immunotherapy
- Inhaled corticosteroids
- Bronchodilators

28. What is the controller medication every adult must use according to GINA guidelines?
- SABA
- ICS

29. Which reliever lowers the risk of severe exacerbations according to GINA?
- Controller and preferred reliever: ICS-formoterol
- Controller: ICS, Reliever: SABA

30. What is the preferred treatment for intermittent asthma and asthma symptoms in children?
- SABA
- ICS
- LABA
- Montelukast
- None of the above

31. What is the preferred treatment from age 5 to 12 years in step 4 according to GINA?
- Low dose ICS+LABA
- Medium dose ICS+LAMA
- SABA+ICS

32. In what age Omalizumab is FDA approved for children?
- >12 years
- > 3years
- 5-12 years

33. As a pharmacist what do you recommend in case of asthma attacks?
- Inhaled bronchodilators
- Oral bronchodilators
- Inhaled corticosteroids
- Oral mucolytics

34. What do you think as a pharmacist the maintenance treatment in mild to moderate asthma?
- ICS +SABA (on demand), ICS+LABA
- Oral corticosteroids
- Monoclonal antibodies

35. What is the last line therapy for asthma?
- Immunotherapy
- Oral corticosteroids
- Oral bronchodilators

36. As a pharmacist what do you do when you deliver an inhalation device for the first time?
- Explain to the patient how to use it
- Check the use of the device
- Just give advices about the proper use of the device

37. What is the first advice to give to the patient upon delivering inhaled corticosteroids inhalation device?
- Oral candidiasis
- Mouth ulcers
- Bad breath

38. What is the main side effect of inhaled corticosteroids?
- Vaginal candidiasis
- Oropharyngeal candidiasis
- Voice hoarseness

39. As a pharmacist LABA must be administered?
- They should always be administered with inhaled oral corticosteroids every 12 hours
- They can be given alone

40. From which age Montelukast is shown to be clinically beneficial?
- 5 years
- 2 years
- 14 years

41. How Montelukast must be administered?
- 1 hour after meal in the morning once daily
- 2 hours after meal in the morning or evening
- 1 hour before or 2 hours after a meal in the evening

42. What is recommended in the treatment in allergic cases of severe asthma not controlled with conventional treatments of optimal doses of ICS and appropriate treatment beta 2 agonist prolonged action
- Montelukast
- Humanized monoclonal antibodies (omalizumab, mepolizumab, dupilumab)
- Oral corticosteroids

Questions related to pharmacist role and education

43. Patients should rinse their mouth after the use of inhaled corticosteroids
- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

44. Do you inform the patient about the side effects on ICS?
- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

45. Do you teach the patients the proper use of the device?
- Strongly agree
- Agree
- Neutral

- Disagree
- Strongly disagree

46. Patients are advised/required to stop smoking
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
47. Low dose ICS reduces asthma hospitalizations and death
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
48. Did you use asthma guidelines in the pharmacy?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
49. Bronchial thermoplasty may be helpful in asthmatics with airway remodeling
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
50. Asthmatics do not appear to be at increased risk of developing severe COVID-19
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
51. The risk of COVID-19 related mortality appeared to be lower in people with asthma than in people without asthma
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
52. Are you one of the pharmacists who tried to call the doctor to give the alternative in case of absence of the inhalation puff he prescribed because of the medicine crisis that Lebanon is going through?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
53. Do you think that calling the doctor to replace the inhalation puff because of its expensive cost especially during the deteriorating economic situation in Lebanon can help the patient in keeping with treatment?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
54. Education of your asthmatic patient about the warning signs of asthma attacks and the factors triggering asthma attack is important in increasing patient confidence in your pharmacy
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
55. Are you from the pharmacists who asked the asthmatic patient to verify the proper use of inhaler in front of you for better compliance?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
56. Are you from the pharmacists who asked the asthmatic patient to verify the proper use of inhaler in front of you for better compliance?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
57. Does asthma cause growth delay in children?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
58. Does asthma increase risk of depression in adults
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree
59. Do you think pharmaceutical care improves management and treatment of asthma?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
60. Based on this survey, do you see yourself able to deal with asthma patients?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree

Data collection

The survey link was disseminated to pharmacists via multiple social media platforms, including WhatsApp, Facebook, Instagram, LinkedIn, and Telegram. The survey was estimated to take approximately 5 minutes-7 minutes to complete and there were 3 reminders sent to the pharmacists. Participants were provided with information about the study objectives, the study-investigators, and were assured that their responses would remain private, anonymous, and confidential.

The final self-assessment questionnaire comprised of 60 questions, all presented in English. These questions were primarily sourced from Global Initiative for Asthma (GINA) 2022 guidelines. The questionnaire was divided into three sections:

The first section focused on demographic data, gathering information on participants' characteristics such as age, educational level (if BS, PharmD, Masters or PhD) working field, position, and years of experience. This section aimed to identify the knowledge and roles of pharmacists across different demographics.

The second section evaluated the general knowledge of pharmacists regarding asthma, including its nature, pathogenesis, symptoms, and complications.

The third section consisted of questions specifically designed to assess the pharmacist's knowledge about asthma treatment and their ability to effectively manage and follow up with asthma patients.

By adhering to the STROBE guidelines, this study aimed to enhance the transparency and quality of reporting in observational research, ensuring that all relevant information regarding the study design and participant selection process is provided.

Data analysis

The statistical analysis was performed using the Statistical Package for Social Science (SPSS) version 26. The descriptive statistics were computed for quantitative variables (mean ± standard deviation, SD) and categorical variables (frequency and percentage). Moreover, the variables that showed a p-value <0.2 were included in the forward multivariate linear regression model. In all cases, a p-value of 0.05 was considered statistically significant.

Descriptive statistics were performed to represent the participants' characteristics and their level of knowledge in the treatment and therapeutic education of asthma and were expressed as percentages, means and SD, or prevalence and 95% Confidence Interval (CI) when applicable. Moreover, the associations between the knowledge in the treatment and therapeutic education of asthma and the participants' characteristics were compared with the chi-square tests and expressed as prevalence and 95% CI. The Fisher Exact test was also used when expected count was lower than 5. As for the multivariable analysis, a logistic regression was conducted.

Factors that had a p-value<0.2 in the bivariate analysis were included in the model. The Forward LR method of entry was used. Adjusted odds ratio (aORs) and their 95% CIs were used to quantify the associations between variables and knowledge and the role of pharmacists in the treatment and therapeutic education of asthma.

RESULTS

Study process and termination

A total of 56 pharmacists participated in the study, 44 of them were females (78.6%), corresponding to a very low response rate despite the large number of pharmacists who received the survey on one hand, and all the reminders sent on the other hand. More than half of the participants were females (78.6%). Nineteen participants (33.9%) had a "Doctor of Pharmacy" (Pharm-D) degree, and all of them had a pharmacy diploma from a Lebanese University. The detailed baseline participants demographics and characteristics are shown in Table 1

Table 1: Demographic data of studied participants

Questions		Frequency (%)
Gender	Males	12 (21.4%)
	Females	44 (78.6%)
Age (years)	20 years-24 years	2 (3.6%)
	25 years-29 years	35 (62.5%)
	30 years-39 years	10 (17.9%)
	>40 years	9 (16.1%)
Place of residence	Beirut	9 (16.1%)
	Bekaa	2 (3.6%)
	Mount Lebanon	25 (44.6%)
	North Lebanon	3 (5.4%)
	South Lebanon	17 (30.4%)
	Baalbek	0 (0%)
	Akkar	0 (0%)
Highest degree of education	Bachelor	18 (32.1%)
	Master	17 (30.4%)
	PharmD	19 (33.9%)
	PhD	2 (3.6%)
Education completed in	Lebanon	56 (100%)
If in Lebanon specify which university	LU	40 (71.4%)
	BAU	4 (7.1%)
	LIU	6 (10.7%)
	LAU	0 (0%)
	USJ	1 (1.8%)
Field of work	Community pharmacy	44 (78.6%)
	Hospital pharmacy	5 (8.9%)
	Clinical pharmacy	1 (1.8%)
	Pharmaceutical industry	0 (0%)
	Research study	2 (3.6%)
	Pharmaceutical company	0 (0%)
Work position	Owner of a pharmacy	7 (12.5%)
	Employee in a pharmacy	38 (67.9%)

	Others	10(17.8%)
	Medical representative	1 (1.8%)
Years of experience	1 years-4 years	42 (75%)
	5 years-9 years	6 (10.7%)
	>10 years	8 (14.3%)
Weekly working hours	1 hours-20 hours	17 (30.4%)
	20 hours-40 hours	23 (41.1%)
	>40 hours	16 (28.6)
Number of daily patients	<10	6 (10.7%)
	10-50	22 (39.3%)
	50-100	20 (35.7%)
	>100	8 (14.3%)
Number of asthma prescriptions received per month	2	11 (19.6%)
	2-5	25 (44.6%)
	>5	18 (32.1%)
	none	2(3.7%)

Evaluation of knowledge of pharmacists regarding asthma

In the context of the nature of the disease, 44 participants (78.6%) correctly answered that it is an inflammatory disease. However, only 20 participants (35.7%) were aware that asthma is triggered by type 2 inflammation. Among participants, 49 (87.5%) truly answered that asthma is characterized by wheezing with dry cough and chest pain mainly exacerbated at night, also most of the participants 73.2% said that asthma is mainly exacerbated by all of the considered factors (respiratory viruses, atypical bacteria, exercise and life style). Furthermore, the vast majority of pharmacists (48 (85.7%)) answered that all of the mentioned asthma complications (airway remodeling, superimposed infections as pneumonia, emphysema and chronic bronchitis) can persist on long term (Table 2).

Table 2: Answers evaluating pharmacists' knowledge on definition, pathogenesis, symptoms, and complications of asthma

	Correct answers n (%)*
What is asthma	44 (78.6%)
What do you think causes and triggers asthma?	53 (94.6%)
What type of inflammation do you think is triggered in asthma?	20 (35.7%)
What are the triggers of asthma attack?	49 (87.5%)
What do you think Asthma depends on	47 (83.9%)
Do you think that men are more affected by Asthma than women?	39 (69.6%)
Asthma symptoms are mainly characterized by?	49 (87.5%)
What does asthma in adults include?	28 (50%)
What do you think the onset of asthma is	24 (42.9%)
What do you think that mainly exacerbate asthma?	41 (37.2%)
What asthma complications include?	17 (30.4%)
What Persistent asthma complications on long term include?	48 (85.7%)
*The results are given in frequency (n) and percentages (%)	

Evaluation of pharmacist's role in treatment and therapeutic education

Regarding first-line treatment of asthma, only 23 (41.1%) participants answered correctly ICS, while 29 (51.8%) participants answered that bronchodilators are the first-line treatment of asthma (Figure 1 and Table 3).

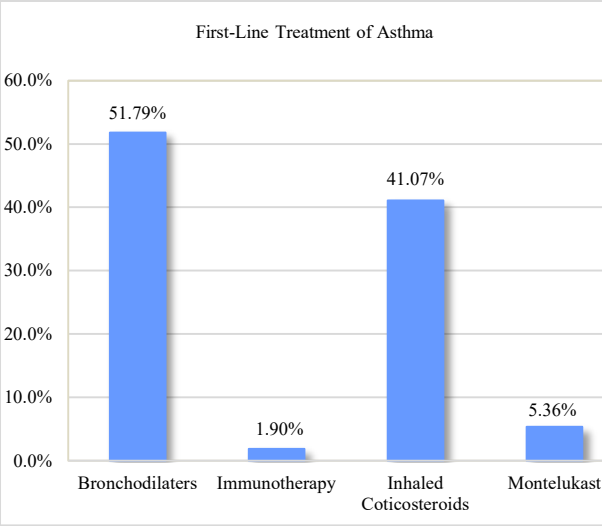

Figure 1: Answers of participants regarding the first-line treatment according to GINA 2022

In addition, 58.9% considered that Short-Acting Beta-Agonist (SABA) the controller for asthma according to GINA guidelines which is not correct, and only 41.1% of the participants answered correctly that ICS is the controller medication of asthma. However, with respect to the preferred reliever that lowers the risk of asthma exacerbations, only 48.2% answered correctly ICS-formoterol. With respect to the last line therapy of asthma, 78.6% of the responders reported immunotherapy is the last line which is correct.

The pharmacist's knowledge in patient education was represented in the Likert scale questions in which the pharmacists who strongly agreed to the asked questions are represented by 47 pharmacists (83.9%) on advising the patients to rinse their mouth after the use of ICS, and 36 (64.3%) to inform the patients about the side effects of ICS. Moreover, 40 participants (71.4%) to teach the patients about the proper use of the device, the same number also to advise to stop smoking (Table 4). 44.6% strongly agreed that the pharmaceutical care improves management and treatment of asthma.

On the other side, pharmacists who agree to the questions are represented by 30 (53.6%) who answered that low dose ICS reduces asthma hospitalization and death, 27 (48.2%) said to use asthma guidelines in the pharmacy and also 22 (39.3%) voted that asking the patient to verify the proper use of inhaler is important for better compliance. In addition, 34 pharmacists (60.7%) agree that they are able to deal with asthmatic patients. Finally, the pharmacists mostly disagreed some questions are represented by 22 pharmacists (39.3%) for that asthma can causes growth delay in children; therefore, they do not relate them; by 18 (32.1%) participants who also disagreed that asthma maybe at increased risk of developing COVID-19, and by 17 (30.4%) who disagree that the risk of COVID-19 mortality appeared to be lower in people with asthma than those without asthma.

Table 3: Answers evaluating the pharmacist knowledge in the treatment and therapeutic education

	Correct answers n (%)*
What do you think is the main test to diagnose asthma?	37 (66.1%)
What does FEV1 measures?	51 (91.1%)
As a pharmacist what do you think is the first line treatment of Asthma?	23 (41.1%)
What is the controller medication every adult must use according to GINA?	23 (41.1%)
Which reliever lower the risk of severe exacerbations according to GINA?	27 (48.2%)
What is the preferred treatment for intermittent asthma and asthma symptoms in children?	24 (42.9%)
What is the preferred treatment from age 5 to 12 years in step 4 according to GINA?	16 (28.6%)
In what age omalizumab is FDA approved for children?	16 (28.6%)
As a pharmacist, what do you recommend in case of asthma attacks?	37 (66.1%)
What do you think as a pharmacist, the maintenance treatment in mild to moderate asthma?	51 (91.1%)
What is the last line therapy for asthma?	44 (78.6%)
As a pharmacist, what do you do when you deliver an inhalation device for the first time?	46 (82.1%)
What is the first advice to give to the patient upon delivering ICS inhalation device and why?	50 (89.3%)
What is the main side effect of inhaled corticosteroids?	51 (91.1%)
As a pharmacist how LABA must be administered?	36 (64.3%)
From which age montelukast is shown to be clinically beneficial?	28 (50%)
How montelukast must be administered?	36 (64.3%)
What is recommended in the treatment in allergic cases of severe asthma not controlled with conventional treatments of optimal doses of ICS and appropriate treatment beta 2 agonist prolonged action?	25 (44.6%)
*The results are given in frequency (n) and percentages (%)	

Table 4: Likert scale questions related to patient's education

Opinion	Strongly agree	agree	Neutral	Disagree	Strongly disagree
Patients should rinse their mouth after the use of inhaled corticosteroids	47 (83.9%)	8 (14.3%)	1 (1.8%)	-	-
Do you inform the patients about the side effects of inhaled corticosteroids	36 (63.4%)	14 (25%)	4 (7.1%)	2 (3.6%)	-
Do you teach the patient the proper use of the device	40 (71.4%)	12 (21.4%)	3 (5.4%)	-	1 (1.8)
Patients are advised/required to stop smoking	40 (71.4%)	12 (21.4%)	3 (5.4%)	1(1.8%)	-
Low dose ICS reduces asthma hospitalizations and death	17 (30.4%)	30 (53.6%)	7 (12.5%)	2 (3.6%)	-
Do you use asthma guidelines in the pharmacy?	18 (32.1%)	27 (48.2%)	7 (12.5%)	3 (5.4%)	1 (1.8%)
Bronchial thermoplasty may be helpful in asthmatics with the airway remodeling	11 (19.6%)	21(37.5%)	23 (41.1%)	1 (1.8%)	-
Asthmatics do not appear to be at increased risk of developing covid-19	10 (17.9%)	9 (16.1%)	12 (21.4%)	18 (32.1)	7 (12.5%)
The risk of covid-19 related mortality appeared to be lower in people with asthma than in people without asthma	5 (8.9%)	7 (12.5%)	14 (25%)	17 (30.4%)	13 (23.2%)
Are you one of the pharmacists who tried to call the doctor to give the alternative in case of absence of the inhalation puff he prescribed because of the medicine crisis that Lebanon is going through?	23 (41.1%)	21 (37.5%)	10 (17.9%)	1 (1.8%)	1 (1.8%)
Do you think that calling the doctor to replace the inhalation puff because of its expensive cost especially during the deteriorating economic situation in Lebanon can help the patient in keeping with treatment?	29 (51.8%)	20 (35.7%)	5 (8.9%)	2 (3.6%)	-
Education of your asthmatic patient about the warning signs of asthma attacks and the factors triggering asthma attack is important in increasing patient confidence in your pharmacy	34 (60.7%)	16 (28.6%)	6 (10.7%)	-	-
Are you from the pharmacists who asked the asthmatic patient to verify the proper use of inhaler in front of you for better compliance?	21 (37.5%)	22 (39.3%)	9 (16.1%)	4 (7.1%)	-
Does asthma cause growth delay in children?	7 (12.5%)	8 (14.3%)	17 (30.4%)	22 (39.3%)	2 (3.6%)
Does asthma increase the risk of depression in adults	7(12.5%)	14 (25%)	27 (48.2%)	8 (14.3%)	-
Do you think pharmaceutical care improves management and treatment of asthma	25 (44.6%)	24 (42.9%)	7 (12.5%)	-	-
Based on this survey, do you see yourself able to deal with asthma patients	13 (23.2%)	34 (60.7%)	8 (14.3%)	1 (1.8%)	-
The results are given in frequency (n) and percentages (%)					

Bivariate and multivariate analysis

The mean knowledge score was 20.32 (± 4.6008) out of 32. Bivariate and multivariate analyses were done to explore the factors which might affect the designed score. Based on the test results, only years of experience affected the level of knowledge and the role in treatment and therapeutic education (p-value=0.009).

Regarding the multivariate analysis, logistic regression was done; factors with p-value less than 0.2 were: Gender p-value=0.16; Age p-value 0.18; Highest degree of education p-value0.17 and Years of experience p-value 0.009). Omnibus tests of model coefficients were not-significant (p-value=0.099) which means none of the entered factors influence the score of knowledge.

DISCUSSION

This is the first study done to evaluate the Lebanese pharmacist's knowledge in the treatment and therapeutic education based on pharmacist-filled survey. Pharmacists have a crucial role in planning and leading medication safety through developing specific protocols for following-up asthma complications, preventing drug-induced adverse effects, and providing essential advices hat improve the quality of life of asthmatics [10]. Based on the sample participated in our study, results showed that few pharmacists had the minimum required knowledge which allows them to be able to manage asthmatic patients. Findings showed that 44.8% of participants had a score over 22, while the remaining were below this score, which indicates that most of the pharmacists (more than half) had a gap in knowledge related to asthma management. It is worth mentioning that the score used in this study cannot be compared to any score of other studies, since all scores used to assess the impact of pharmaceutical care were based on patients-filled surveys, which is not the case of our study.

To illustrate, an asthma medication knowledge questionnaire and a standardized inhaler checklist were developed and showed that a short-term training program was effective in training pharmacists to effectively advise patients with asthma about disease management and medication [11].

External validity

The prosperity of the role of pharmacist in asthma treatment highly depends on the pharmacist knowledge about the definition, pathogenesis, symptoms and complications of the disease.

According to the international forum of allergy and rhinology, the pharmacist should be aware that asthma is an inflammatory disease of the airways and lung tissue of mainly type 2 inflammation 12 and according to the 1991, 1997 and 2007, National Institutes of Health Asthma (NIH) guidelines define asthma as: "chronic inflammatory disease of the airways in which many cells and cellular elements play a role especially mast cells, eosinophils, T lymphocytes, macrophages, neutrophils, epithelial cells" of mainly type 2 inflammation [12]. Although our study showed a very good knowledge on the definition of asthma (78.6% correct answers). The majority of participants did not identify that the type of inflammation is type 2.

Data from the American Lung Association showed that among adults over the age of 18, women were 62% more likely than men to develop asthma. Overall prevalence in women (97.3/1,000) was 35%, higher than in men (71.9/1,000)

In addition, a National Health Interview Survey conducted in 2009 in the United States estimated that asthma prevalence was lower in girls of 15 years old than in men, while the pattern shifts in the young adult of 15 years-35 years with a higher prevalence in women (6.3% in men and 9.6% in women). This difference persists in adults older than 35 years (5.6 versus 10.1% in men and women, respectively). Similar results have been shown in European studies evaluating the prevalence of asthma by age [13]. Although, in our study 69.6% denied that men are more affected than women.

With respect to the most common symptoms symbolizing asthma presence, data collected from 4918 survey responders showed that dry cough was the most common symptoms of asthma (58.9%), followed by wheezing (39.1%) and then by shortness of breath and chest tightness [14].

On the other hand, onset of a study in 2010 was conducted in the United States on asthmatic patients residing there have showed that an estimated 87% of adults with active asthma reported that the onset of asthma occurred in childhood 15, where in our study only 42.9% of the responders answered the same [15].

Regarding asthma diagnosis test, the majority (66.1%) of the respondents answered that FEV1 can be the main test to identify patients with asthma. Therefore, according to a study by Macy *et al*. who found that 62% of asthmatics were identified with FEV1 reversibility [16].

For the therapeutic strategy of asthma, the participants showed a relatively variable level of knowledge with respect to the first and last line therapy. Only 23 pharmacists knew that ICS is the first-line treatment. On the other hand, an acceptable number of participants (44 pharmacists) were aware that immunotherapy is the last line therapy for asthma. The variability of the involved Lebanese pharmacist's knowledge can be confirmed by comparing the answers to the British Thoracic Society/Scottish Intercollegiate guidelines network guidelines who also recommend ICS therapy in all patients once the diagnosis of asthma is confirmed. This knowledge variability is also compared to the systemic review and meta-analysis of randomized controlled trials which consider that ICS doses that achieve at least 80%-90% of the maximal achievable clinical effect in moderate to severe asthma are approximately 200 mcg/day [17]. Moreover, 98 studies in addition to the European Academy of Allergy and Clinical Immunonology's (EAACI) Guidelines on Allergen Immunotherapy (AIT) for allergic asthma who confirmed the efficacy of immunotherapy in reducing symptoms on long-term [18].

According to GINA guidelines, the preferred controller medication in asthmatic patients is ICS and not SABA as most of our participants answered (58.9%) [19]. Furthermore, GINA guidelines suggests the use of ICS-formoterol as controller-reliever, this is the preferred approach recommended by GINA for adults and adolescents, based on strong evidence that it reduces the risk of severe exacerbations compared with regimens with SABA as reliever, In our study, only 48.2% of the participants answered the same which indicates that most of the pharmacist do not follow GINA guidelines updates [19].

There was a debate about omalizumab, at which age it is FDA approved, the majority of the pharmacists (64.3%) reported that it is FDA approved in ages >12 years old, while according to GINA guidelines omalizumab is FDA approved from 5 years-12 years old [7]. Good pharmacists' knowledge was revealed in the management of asthma attacks, where 66.1% of the responders answered that inhaled bronchodilators are the best choice in asthma attacks and this is was adopted by GINA guidelines [7].

Regarding inhalation device information, most of the participants answered correctly especially those who said to explain to the patient how to use it and they are 46 pharmacists. These results are similar to several studies, one of them conducted in Enugu state, Nigeria (May 2017-July 2017) by a cross-sectional study where more than half (71%) from 116 registered community pharmacists claimed to educate patients on correct inhaler techniques [20,21].

According to the National Library of medicine, Montelukast is FDA approved for the treatment of chronic asthma and prevention of exercise-induced bronchoconstriction, also it can be taken without regard to food or meals at night and is clinically beneficial from 2 years old [23,24].

In our study, the pharmacist's role in asthmatic patient education was assessed within the Likert questions, in which a variable level of contribution was identified within the participants. The education of patients by pharmacists is one of the most important issues should be taken into consideration to improve the quality of life of the patient, therefore most of the pharmacists agreed to use asthma guidelines in the pharmacy in order to be up to date and for better management of the disease [25]. These results are confirmed by a study connected in Hamilton, Toronto, Ontario, Canada where a randomized controlled method is done including volunteer community pharmacists who received either an asthma education program (AEP; intervention group) or a delayed AEP (control group) [26].

The ideal goal of this study was to show the importance and the advanced role the pharmacist can play in managing asthma patients and how improvement he/she can imply if proper knowledge is acquired. The majority of participants strongly agreed/ agreed that the pharmaceutical care improves treatment and management of asthma. This was proved by a comprehensive review of 25 studies that found that pharmacist's interventions improved asthma outcomes (e.g., asthma severity), reduced healthcare utilization of community pharmacies, and improved asthma symptoms. It also reduced healthcare utilization in outpatient clinics as a result of patient education, medication administration, and patient self-management monitoring components [9].

CONCLUSION

This study is the first of its kind that aims to evaluate the knowledge of the Lebanese pharmacists in the treatment and therapeutic education of patients with asthma through the evaluation of their asthma knowledge. Previous studies focused on patients' perspectives, but this study collected information directly from pharmacists through surveys. The majority of pharmacists demonstrated a satisfactory level of knowledge about asthma and their role in its treatment and education. However, there was a notable lack of awareness regarding asthma's therapeutic strategy, monitoring adverse effects, and promoting necessary lifestyle modifications. While most pharmacists agreed that pharmaceutical care improves asthma treatment, only a minority felt confident in dealing with asthma patients. Recommendations include implementing legislation to ensure continuous education and knowledge updates for pharmacists, as well as promoting collaboration between clinical and community pharmacists to enhance their familiarity with various medical conditions.

LIMITATIONS

There were some limitations in our study. The major one was the small sample size in which only 56 pharmacists participated in the survey, and this could have affected the significance of multivariate logistic regression test done. Further investigation is needed to explore the confounding factors in the multivariate analysis and to be able to identify those that directly affect the role of pharmacists in asthma management. In addition, a larger sample of pharmacists is needed to be incorporated in a largescale study to avoid the effect of sample size on the significance of tests.

The low participation may be linked to the online-based survey filling due to the possible technical obstacles. In addition, the online based survey was an obstacle to discuss with the pharmacists any clarifications they had. It is essential to consider the information and selection biases present in the study on the knowledge and role of Lebanese pharmacists in treating asthmatic patients. While the findings offer valuable insights, caution should be exercised in generalizing the results to the broader population of Lebanese pharmacists. Future research with larger sample sizes, longer durations, and more rigorous sampling methods would help mitigate these biases and provide more robust evidence on this topic.

Recommendations

The pharmacist plays a crucial role in managing asthma by undertaking various responsibilities. These include raising awareness among patients about asthma triggers and providing strategies to identify and avoid them, promoting medication adherence through patient counseling, and screening patients at risk of developing asthma or exacerbations. Pharmacists also educate patients about asthma management strategies and proper inhaler techniques, and recommend personalized treatments based on disease severity, phenotype, and control. They should be familiar with common asthma signs, such as wheezing, dry cough, and shortness of breath during physical activity, to assess exacerbations and disease progression. As primary healthcare professionals, pharmacists need to be aware of patients' medical history to ensure medication safety. Lifestyle modifications, such as smoking cessation and avoiding asthma triggers like allergens, pollution, and respiratory infections, should be emphasized. Pharmacists should also advise patients to rinse their mouth after using ICS to prevent oral candidiasis and teach proper inhaler techniques for bronchodilators and corticosteroids. Ensuring medication adherence and monitoring respiratory rates and asthma control levels are essential. Additionally, pharmacists must inform patients about appropriate actions during asthma attacks, including sitting upright, using inhalers every 60 seconds up to 10 puffs, and calling an ambulance if there's no improvement after 10 puffs.

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