Impact of online therapeutic education on asthma control in youth: an emergency department study

Éducation thérapeutique du patient asthmatique aux urgences: intérêt chez l'adolescent et l'adulte jeune

Fatma Hebaieb, Rayène Arfaoui, Rania Hmaïssi, Sofiène Gzara, Sonia Aissa

Service d'Urgence, Hôpital Mahmoud El Matri Ariana / Faculté de Médecine de Tunis, Université Tunis El Manar

Abstract

Background: Asthma is a widespread chronic respiratory disease. It affects all age groups, mainly youth. Its management aims to prevent exacerbations and ensure normal daily-life activity. Current international recommendations attach particular importance to the therapeutic education to improve asthma control and reduce emergency room visits.
Aim: To assess the impact of online therapeutic education for youth asthmatics initiated in the emergency department on the level of asthma's control.
Methods: Descriptive-evaluative study conducted over six months including asthmatics aged 14 to 35 years old living in Ariana. Asthma control was evaluated according to the 2019 Global Initiative for Asthma recommendations with a reassessment at three months after online therapeutic education.
Results: N=75; 18% of patients were adolescents, sex-ratio = 0.56. University education was noted in 73% of cases and high socio-economic status in 48% of subjects. 55% of participants had no basic knowledge of the asthma's pathophysiology. Moderate classification of the last exacerbation was noted in 71% of patients and humidity was the most common exacerbation trigger (76%).
A significant improvement in asthma control was observed after therapeutic education ($p<0.001$) with a positive correlation with female gender ($p=0.048$), basic knowledge of asthma's pathophysiology ($p=0.001$) and mild classification of the last exacerbation ($p=0.039$). Male gender and humidity as exacerbation trigger were independent factors negatively influencing control outcome after therapeutic education.
Conclusion: The emergency department is the referral unit of the management of asthmatics with acute events. This represents an important opportunity to share educational messages that have proven effective using an online model.
Keywords: Asthma-Education-Adolescent-Young adult-emergency

Résumé

Introduction : L'asthme est une pathologie respiratoire chronique très répandue qui touche principalement les jeunes. Sa prise en charge vise à prévenir la survenue d'exacerbation et assurer une activité quotidienne normale.

Objectif : Evaluer l'impact de l'éducation thérapeutique en ligne initiée aux urgences sur le niveau de contrôle de l'asthme.

Méthodes : Etude prospective menée sur six mois. Inclusion des asthmatiques âgés de 14 à 35 ans. Le niveau de contrôle de l'asthme était évalué selon les recommandations de la GINA avec une réévaluation à trois mois après éducation thérapeutique en ligne.

Résultats : N=75, 18% adolescents, âge moyen=24 ans et sex-ratio=0,56. Un niveau d'étude supérieur était noté dans 73% des cas et un bon niveau socio-économique dans 48%. 55% n'avaient aucune connaissance des mécanismes physiopathologiques. La dernière exacerbation a été classée modérée dans 71%. L'humidité était le facteur d'exacerbation le plus fréquent (76%).

Une amélioration significative du contrôle de l'asthme a été observée après l'éducation thérapeutique ($p<0,001$) avec une corrélation positive avec : genre féminin ($p=0,048$), bonne connaissance des mécanismes physiopathologiques ($p=0,001$) et classification légère de la dernière exacerbation ($p=0,039$). Le sexe masculin et le déclenchement de l'exacerbation par l'humidité étaient des facteurs indépendants influençant négativement l'évolution du contrôle après l'éducation thérapeutique.

Conclusion : Le service d'accueil des urgences est un lieu de consultation fréquent pour les patients asthmatiques. Transmettre des messages éducatifs à partir des urgences et émettre un programme d'éducation thérapeutique en ligne a fait preuve de son efficacité.
Mots-clés : Asthme-Éducation-Adolescent-Adulte jeune-Urgences.

Correspondance
Fatma Hebaieb
Service d'Urgence, Hôpital Mahmoud El Matri Ariana / Faculté de Médecine de Tunis, Université Tunis El Manar
Email: fatma.hebaieb@fmt.utm.tn

INTRODUCTION

Asthma is a chronic respiratory condition that is widely spread throughout the world. Its prevalence is increasing in different age groups especially in youth (1,2). It constitutes the most frequent chronic disease in childhood (1). It often limits the daily activity of patients, reduces their quality of life and represents a heavy burden for individuals and their families with high direct and indirect costs (3,4). Asthma control is a relatively recent concept that evolves beyond the usual notion of disease severity. It may be described as controlling the residual manifestations of asthma under treatment, thus providing a dynamic concept to facilitate therapeutic decisions.

To improve the asthma outcome, facilitate symptom control and reduce emergency department (ED) visits, other therapies and non-drug strategies have been considered. Global Initiative for Asthma (GINA) insist on the value of educational strategies and personalized action plan (3). Therapeutic education in asthma aims to guarantee the best possible quality of life by offering patients autonomy with the acquisition and maintenance of necessary skills to use their treatment optimally and manage their chronic disease (3).

Our study was interested to assess the impact of online therapeutic education provided by ED team on the level of asthma control in adolescents and young adults and to describe the influence of the different personal factors on the effectiveness of the education program

METHODS

Study design and setting

Prospective, descriptive-evaluative study conducted over a six-month period from January to June 2020, in a polyvalent ED in Ariana governorate.

Study population

Patients aged 14 to 35 years old with known asthma living in Ariana who presented successively to our ED for exacerbation or answering the online questionnaire during the study's period. Through social networks (Outlook, Instagram and mainly Facebook), known asthmatics, living in Ariana, had responded to the form shared online, as well as to the interrogation made by telephone. The diagnosis of known asthma was based on a combination of clinical and paraclinical arguments, mainly spirometry. As a non-inclusion criterion, we decided on asthma of primary diagnosis in the ED. Exclusion criteria were patients followed for mental illness for risk of misunderstanding or interpretation of therapeutic education and patients lost to follow-up during the study.

Study protocol

Personal history

Patient demographics, including socioeconomic status and education level, known asthma history and background therapy, comorbidities, risk factors for poor asthma outcomes, and exacerbation triggers were recorded. The socio-economic status was based on the most used indicators: education, occupation and income (5).

Clinical evaluation

The emergency physician noted the classification of asthma exacerbation severity into 3 classes: mild, moderate, and severe based on the current international recommendations. It should be noted that, in view of the first wave of SARS-COV2 epidemic, peak expiratory flow was not considered in the classification of exacerbation in patients consulting the ED. The level of asthma control was assessed according to the 2019 GINA recommendations (3). Optimal control of asthma meets the following criteria: no or minimal daytime symptoms, no night waking due to asthma, no or minimal activity limitation, no or minimal medication use, no exacerbation and normal lung function (3).

Well controlled asthma is defined as all criteria met, partly controlled asthma as one or two criteria per week, and uncontrolled asthma as three or more criteria per week.

For patients who filed the online form, they were called and provided the information necessary to classify the severity of the last asthma exacerbation and assess their asthma control.

Therapeutic education program

After completing the questionnaire (in the ED/online), patients were contacted by email and telephone, for possible correction or clarification of received answers. One or more video messages were sent to them containing a clear explanation of the use of the inhalation device. These messages varied depending on the inhalation

system that was prescribed for each case. Thus, each patient received a different email containing one or more explanatory video clips.

Therefore, 3 video clips were filmed with a Samsung NX 1000 digital camera:

- Video 1 explaining the handling of a metered dose inhaler

- Video 2 explaining the handling of a dry powder inhaler system like Diskus

- Video 3 detailing the handling of a dry powder inhaler system type aerosolizer.

Patients had to confirm that they had received and studied the manuals provided. A second phone call was then made.

Three months later, a third telephone call was necessary to evaluate the condition of each included patient, the questionnaire is thus completed by the investigator. The verification of post-education asthma control level was in September 2020.

Attached is the internet link of the video sequences filmed: https://www.youtube.com/user/22rayene/videos.

Statistical analysis

The Mac Nemar test was used to compare frequencies of paired groups and in case of invalidity, we resorted to the binominal distribution properties. A p value < 0.05 was considered significant in all statistic tests.

We have classified the investigated cases according to the results of our analysis into groups: Group 1: Patients who had maintained good control or became well controlled after the education program, Group 2: Patients who had improved asthma control without becoming well controlled and those who failed to improve their asthma control 3 months after the education program.

To identify risk factors independently related to the event, we conducted a multivariate analysis in logistic regression stepwise descending. The multivariate analysis allowed the calculation of adjusted Odds Ratios, measuring the role of each factor.

Ethical considerations

The local ethics committee of Mahmoud El Matri in Ariana approved the study protocol on December 3, 2019 with the IRB registration number 42/2019. The patients had to sign an informed consent, based on complete, precise, properly conveyed and understood information, before being included. The confidentiality of patients' medical and personal data was respected.

RESULTS

Personal history and clinical evaluation

Seventy-five patients were enrolled. Figure1 illustrates the flow diagram for study participants. They had an average age of 24 years and showed a female predominance (64%). Fifty-five patients (73%) had university education among them were 16 health care professionals (21%), including physicians, dentists, pharmacists, and paramedical staff. Twelve patients had controlled asthma (16%), forty-one patients had partly controlled asthma (55%) and twenty-two patients had uncontrolled asthma (29%). Moderate classification of the last exacerbation was noted in 71%. Humidity was the most common exacerbation trigger (76%).

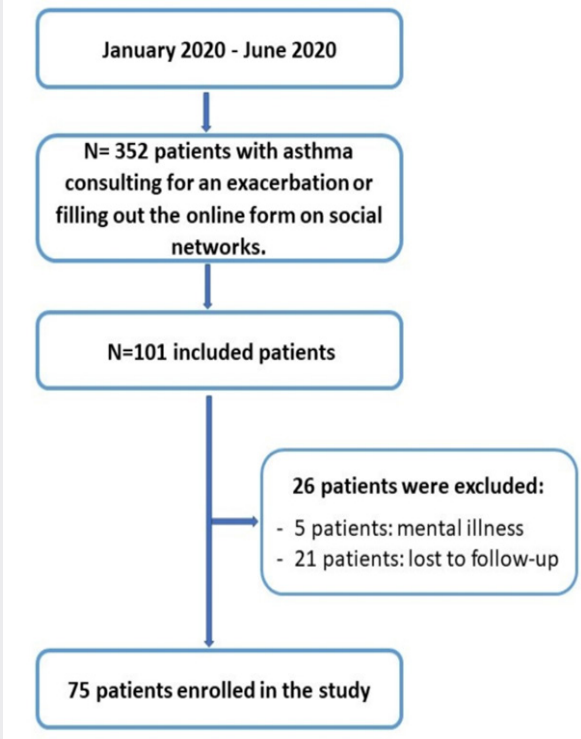

Figure 1. Flow diagram for study participants.

Table 1 shows the characteristics of patients prior to the therapeutic education.

Table 1. Personal history and clinical evaluation

Characteristic of population		Results
Age, years		24,3 ± 10
Age groups	Adolescent	14 (19%)
	Young adult	61 (81%)
Sex-ratio (M/F)		0,56
Socioeconomic status	High socioeconomic status	36 (48%)
	Middle socioeconomic status	35 (47%)
	Low socioeconomic status	4 (5%)
Family stability (adolescent)	Married parents	12 (86%)
	Divorced parents	2 (14%)
Marital status (young adults)	Single	47 (77%)
	Married	13 (21%)
	Divorced	1 (2%)
Education level	Primary education	2 (3%)
	Secondary education	18 (24%)
	University education	55 (73%)
Basic knowledge of the asthma's pathophysiology		41 (55%)
Tobacco, active smoker		26 (31%)
Controller medications for asthma: types of inhalers	Metered dose inhalers	71 (95%)
	Dry powder inhalers	4 (5%)
Comorbidities	Infant asthma	25 (33%)
	Gastroesophageal reflux	15 (20%)
	Pulmonary tuberculosis	1 (1%)
	Atopic terrain	57 (76%)
Prior asthma-related events	ED visit once a year	42 (56%)
	ED visits ≥ twice a year	23 (31%)
	Hospitalization for asthma exacerbation	6 (8%)
	ICU stay for severe asthma exacerbation	1 (1%)
Severity of last asthma exacerbation	Mild	9 (12%)
	Moderate	53 (71%)
	Severe	13 (17%)
Circumstances of asthma exacerbation	Exposure to environmental allergens	53 (71%)
	Humidity	57 (76%)
	Season change	56 (75%)
	Cold air	38 (51%)
	Environmental change	45 (60%)
	Presence of animals	23 (31%)
	Exercise	33 (44%)
	Hearty meal	9 (12%)
Asthma control on initial examination based on GINA 2019	Well controlled asthma	12 (16%)
	Partly controlled asthma	41 (55%)
	Uncontrolled asthma	22 (29%)

GINA: Global Initiative for Asthma

Asthma control

Asthma control was compared before and 3 months after therapeutic education. The figure 2 and table 2 illustrate the distribution of patients according to changes in level of control before and 3 months after the education program.

The percentage of patients with uncontrolled or partly controlled asthma had decreased from 84% to 31%. That of patients with well controlled asthma had improved from 16% before therapeutic education to 69% after (p<0.001). No deterioration in asthma control was observed after the therapeutic education program.

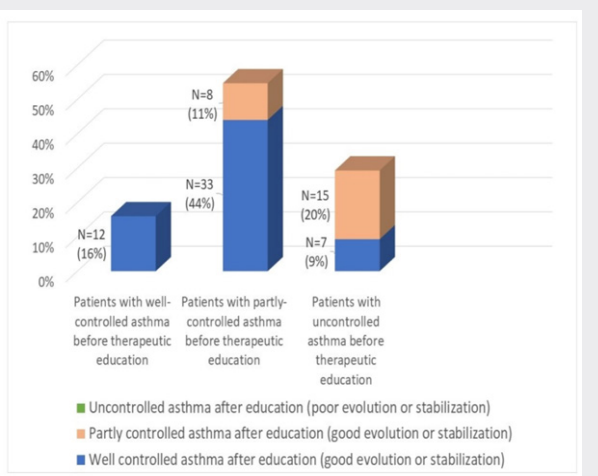

Figure 2. Evolution of asthma control before and 3 months after therapeutic education.

Table 2. Asthma control level before and 3 months after therapeutic education

Characteristic of population	Well controlled asthma		Partly controlled asthma		Uncontrolled asthma	
	N	%	N	%	N	%
Prior to therapeutic education	12	16	41	55	22	29
3 months after therapeutic education	52	69	23	31	0	0

p<0,001
Mc Nemar Test: p<0,001

Factors that affect the evolution of asthma control after the education program

Female gender, basic knowledge of the mechanisms of asthma's physiopathology, humidity, and inhalation of allergens as exacerbation-triggers factors, and mild classification of the last exacerbation were significantly associated with the evolution of asthma control after therapeutic education. Table 3 presents a summary of the analysis of factors that may influence the outcome of asthma control after the education program.

Adolescents' family stability, young adults' marital status, types of inhalers, comorbidities and prior asthma-related events did not influence the evolution of asthma control after education program.

Multivariate regression analysis revealed that humidity (OR=10.68; 95% confidence interval, 1.32 - 86.05; p=0.008) and gender (OR=2.69; 95% confidence interval, 0.976 - 7.42; p=0.048) were

factors independently related to improvement in asthma control with therapy education.

After calculating the adjusted Odds Ratios, it can be concluded that:

• Factors that improved the level of control after this program were:

- Female gender (p=0.048; OR=2.69)

- Basic knowledge of the mechanisms of bronchial obstruction (p<0.001; OR=73.3)

- Mild classification of last exacerbation (p=0.008; OR=3.35)

• Factors negatively influencing the evolution of post education asthma control were:

- Humidity as exacerbation trigger (p=0.008; OR=10.68)

- Exacerbation of asthma after exposure to environmental allergens (p=0.039; OR=3.84).

Table 3. Factors that affect the evolution of asthma control after the education program

a		Group 1* (n=52)		Group 2† (n=23)		p-value
		N	%	N	%	
Age	Adolescent	10	19	4	17	0,56
	Young adult	42	81	19	83	
Gender	Female	37	71	11	48	0,048
	Male	15	29	12	52	
Socio-economic status	High	26	50	10	43,5	0,14
	Middle	25	48	10	43,5	
	Low	1	2	3	13	
Education level	Primary	1	2	1	4	0,788
	Secondary	12	23	6	26	
	University	39	75	16	70	
Tobacco, active smoker	Yes	15	29	12	52	0,093
Basic knowledge of the asthma's pathophysiology	Yes	40	77	1	4	0,001
Humidity as trigger for an exacerbation	Yes	35	67	22	96	0,008
Exacerbation of asthma after exposure to environmental allergens	Yes	33	63	20	87	0,039
Classification of the last exacerbation	Mild	9	17	0	0	0,008
	Moderate	37	71	16	70	
	Severe	6	12	7	30	

* Group 1: patients who had maintained good asthma control or became well controlled after the education program.

†Group 2: Patients who had improved asthma control without becoming well controlled and those who failed to improve their asthma control 3 months after the education program

DISCUSSION

Our study shows that therapeutic education is an efficient approach to optimize asthma control in adolescents and young adults. Sixty-nine percent of patients had well-controlled asthma after the education program compared to 16% at the beginning of the study. None of included patients had poor control after the therapeutic education, while 29% were uncontrolled prior to it.

Gender, presence of basic knowledge of the asthma's pathophysiology, exacerbation-inducing factors as humidity or inhalation of allergens and mild classification of the last exacerbation were significantly associated with well evolution of asthma control after therapeutic education.

According to GINA, asthma control is assessed by the patient's ability to manage asthma symptoms, to reduce or remove them by treatment. Disease control has two main areas of action: symptom control and risk factors for future poor outcome, particularly asthma flare-ups (3). Asthma control remains poor, worldwide (6-12). Many studies have analyzed the impact of the education program on asthma control (13-17). Boulet and al (14) reported that in the year following the therapeutic education program for enrolled patients, the number of unscheduled medical visits related to respiratory problems decreased significantly (from 137 to 33 visits; p=0.002). There was an observable rise in the proportion of patients with well-controlled asthma which increased from 52 before the therapeutic education program to 90 one year later (p<0.001) (14). In the comparative study of Arikan and al, one hour of education for children with uncontrolled asthma in the presence of their parents did not improve asthma control at 1 and 3 months, although the Asthma Control Test score was higher in the education group compared to the control group (15). This study is in the only case found in the literature that did not report a significant impact of therapeutic education program. However, they found a significant difference between the two groups regarding school absenteeism: 0.1±3 for the first group vs 2±4 for the second (p=0.006) (15). Ali and al in 2019 reported that therapeutic education had a positive impact on the level of asthma control: the number of cases with well-controlled disease increased from 28 patients (32%) to 44 patients (50%) after therapeutic education (p=0.0043) (16). The visits to the EDs decreased after education (42 visits before education versus 20 visits after the education program; p=0.0002); the number of ED visits per patient per year decreased to 0.86 before and 0.44 after education (p<0.01) (16). The Gallefoss and al study (17) evaluated the life's quality of 78 asthma patients compared therapeutic education program group to a control group,

reported a statistically significant decrease in daytime symptoms, nighttime events, limitation of activity due to asthma per week and consequently a better control (17). Our study confirmed the importance of therapeutic education and its impact on asthma control. The percentage of our patients with poor or partial control decreased from 84% before therapy education to 31% afterwards. The proportion of patients with well-controlled asthma increased from 16% to 69% (p<0.001). In addition, we aimed to assess the impact of different personal factors on the effect of the education program on asthma control. Tada and al noted that therapeutic compliance was better in older subjects compared to younger subjects (18) and recent literature reported that asthma control was more difficult in adolescents (18,19). Gemicioglu and al found that asthma control and adherence were similar in elderly and newly diagnosed young asthma patients, although the follow-up rate was lower in younger patients (20). In our study, there was no evidence of an impact of age on the evolution of asthma control after the education program. Selberg and al in 2019 evaluated the difference in both genders concerning asthma control and didn't find a statistically significant difference (21). In our study, female gender was an independent factor related to good asthma control with an OR of 2.69. This is a unique finding that wasn't reported in the literature. Analyses studying patients' knowledge of their asthma disease prove the positive impact of this knowledge on the evolution of asthma (22,23). Indeed, good education of asthma and its mechanism leads to a 25% reduction in work absenteeism, 36% fewer EDs visits, 40% fewer hospitalizations and fewer night wakings due to asthma (23). Our study reflects patients' lack of knowledge of asthma: only 54.7% of patients had a minimal pathophysiological awareness. Although the level of education did not influence the evolution of asthma control after therapeutic education, basic knowledge of the asthma's pathophysiology was significantly involved in the disease control (p<0.001).

Scientific analyses assessing the impact of asthma exacerbation triggers on the evolution of asthma control after therapeutic education are exceptional. In our study, patients with humidity and allergens inhalation as exacerbation triggers have more difficult asthma control even after therapeutic education.

Humidity had an independent negative influence on the evolution of asthma control after education and this result wasn't reported in the literature. The classification of the last exacerbation was also significantly involved in the good evolution of asthma control after therapeutic education (p=0.008). No article reported a similar result.

Our data and literature findings indicate poor asthma control despite available medical resources. They confirm the useful role of therapeutic education in the asthma management. Online therapeutic education has been found effective, with a significant impact on controlling this disease. It is available, repeated, and unlimited. A new concept, appreciated by our young study population, that under certain circumstances may be necessary or even indispensable such as the first wave of COVID19 pandemic.

Limitations

- Although we insisted to our best ability on understanding the usage steps of inhaler and on asking clarifying questions, we did not have the opportunity to check this in a face-to-face, as the therapeutic education was done by correspondence during the COVID pandemic19.

- Selection biases were related to self-selection of patients on social networks and to the proportion of health professionals representing 21% of our sample.

CONCLUSION

Therapeutic education should be an integral part of asthma treatment in adolescents and youth. Our study highlighted the contribution of ED in therapeutic education and preventive approach. Additional efforts are needed for males' therapeutic education and a special emphasis should be placed to avoid humid environments among asthmatics. The establishment of a national platform of asthma school in Tunisia, multidisciplinary, accessible, free, and available from the ED presentation is therefore essential.

REFERENCES

1. Vos T, Lim SS, Abbafati C, Abbas KM, Abbasi M, Abbasifard M, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet 2020;396(10258):1204–22. DOI:10.1016/S0140-6736(20)30925-9
2. Bourdin A, Doble A, Godard P. The Asthma Insights and Reality in the Maghreb (AIRMAG) study: perspectives and lessons. Respiratory Medicine 2009;103:S38–48. DOI:10.1016/S0954-6111(09)70026-5
3. Global Initiative for Asthma. Global strategy for asthma management and prevention (2019 update) [Internet]. GINA [cited 2022 Aug 15]; [201 pages]. Available from: https://ginasthma.org/wp-content/uploads/2019/06/GINA-2019-main-report-June-2019-wms.pdf
4. Bahadori K, Doyle-Waters MM, Marra C, Lynd L, Alasaly K, Swiston J, et al. Economic burden of asthma: a systematic review. BMC Pulm Med 2009;9(1):24. DOI:10.1186/1471-2466-9-24
5. Galobardes B, Morabia A, Bernstein M. Statut socio-économique : un facteur de risque indépendant. Medecine Et Hygiene 2000;58:1910–3.
6. Aissa I, Gharsalli H, Khattab A, Driss L, Ghedira H. Etat de contrôle de

l'asthme en Tunisie. Tunis Med 2010;88(2): 97–101.

7. Price D, Fletcher M, van der Molen T. Asthma control and management in 8,000 European patients: the REcognise Asthma and LInk to Symptoms and Experience (REALISE) survey. NPJ Prim Care Respir Med 2014;24(1):14009. DOI:10.1038/npjpcrm.2014.9
8. Mjid M, Belloumi N, Hedhli A, Toujani S, Ouahchi Y, Cherif J, et al. Facteurs influençant le contrôle de l'asthme chez l'adulte tunisien. Rev Fr Allergol 2017;57(6):408–12. DOI:10.1016/j.reval.2017.03.003
9. Thakur N, Martin M, Castellanos E, Oh SS, Roth LA, Eng C, et al. Socioeconomic status and asthma control in African American youth in SAGE II. J Asthma 2014 Sep;51(7):720–8. DOI:10.3109/02770903.2014.905593
10. BinSaeed AA. Asthma control among adults in Saudi Arabia. Study of determinants. Saudi Med J 2015;36(5):599–604. DOI:10.15537/smj.2015.5.10929
11. Stanford RH, Gilsenan AW, Ziemiecki R, Zhou X, Lincourt WR, Ortega H. Predictors of Uncontrolled Asthma in Adult and Pediatric Patients: Analysis of the Asthma Control Characteristics and Prevalence Survey Studies (ACCESS). J Asthma 2010 ;47(3):257–62. DOI:10.3109/02770900903584019
12. Gebremariam TH, Binegdie AB, Mitiku AS, Ashagrie AW, Gebrehiwot KG, Huluka DK, et al. Level of asthma control and risk factors for poor asthma control among clinic patients seen at a Referral Hospital in Addis Ababa, Ethiopia. BMC Res Notes 2017;10(1):558. DOI:10.1186/s13104-017-2887-z
13. Thiam K, Dia Kane Y, Diatta A, Ndiaye EHM, Cissé MF, Mbaye FBR, et al. Évaluation de l'impact de l'école de l'asthme chez les asthmatiques suivis au service de pneumo-phtisiologue du CHNU de Fann. Rev Mal Respir 2019;36:A180. DOI:10.1016/j.rmr.2018.10.394
14. Boulet LP, Boulay MÈ, Gauthier G, Battisti L, Chabot V, Beauchesne MF, et al. Benefits of an asthma education program provided at primary care sites on asthma outcomes. Respir Med 2015 ;109(8):991–1000. DOI:10.1016/j.rmed.2015.05.004
15. Arıkan-Ayyıldız Z, Işık S, Çağlayan-Sözmen Ş, Anal Ö, Karaman Ö, Uzuner N. Efficacy of asthma education program on asthma control in children with uncontrolled asthma. TurkJPediatr 2016;58(4):383. DOI:10.24953/turkjped.2016.04.006
16. Ali A, Pena SG, Huggins C, Lugo F, Khaja M, Diaz-Fuentes G. Impact of Group Asthma Education on Asthma Control and Emergency Room Visits in an Underserved New York Community. Can Respir J 2019;2019:1–7. DOI:10.1155/2019/5165189
17. Gallefoss F, Bakke PS, Rsgaard PK. Quality of Life Assessment after Patient Education in a Randomized Controlled Study on Asthma and Chronic Obstructive Pulmonary Disease. Am J Respir Crit Care Med 1999 ;159(3):812–7. DOI:10.1164/ajrccm.159.3.9804047
18. Tada M, Kuraki T, Taooka Y, Fuchita H, Karino F, Miura K, et al. Comparison of clinical management of young and elderly asthmatics by respiratory specialists and general practitioners. J Asthma 2015;52(2):162–9. DOI:10.3109/02770903.2014.928311
19. Jalloul W, Benjelloun H, Zaghba N, Yassine N. L'asthme chez l'adolescent. Rev Malad Respir Actual 2021;13(1):71. DOI:10.1016/j.rmra.2020.11.137
20. Gemicioglu B, Bayram H, Cimrin A, Abadoglu O, Cilli A, Uzaslan E, et al. Asthma control and adherence in newly diagnosed young and elderly adult patients with asthma in Turkey. J Asthma. 2019;56(5):553–61. DO: 10.1080/02770903.2018.1471707
21. Selberg S, Hedman L, Jansson S, Backman H, Stridsman C. Asthma control and acute healthcare visits among young adults with asthma—A population-based study. J Adv Nurs 2019;75(12):3525–34. DOI:10.1111/jan.14174
22. Sin MK, Kang DH, Weaver M. Relationships of asthma knowledge, self-management, and social support in African American adolescents with asthma. Int J Nurs Stud 2005;42(3):307–13. DOI:10.1016/j.ijnurstu.2004.06.01
23. FitzGerald JM, Gibson PG. Asthma exacerbations. 4: Prevention. Thorax. 2006;61(11):992–9. DOI:10.1136/thx.2005.045195