

## Awareness and Knowledge of Children With Asthma Who Treated With Subkutan Immunotherapy

### Subkutan İmmunoterapi Uygulanan Astımlı Çocukların Farkındalık ve Bilgi Düzeyi

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#### ABSTRACT

**Objective:** Asthma is one of the most common chronic diseases of childhood. Many studies have shown that education positively affects asthma control and patients' quality of life. In this study, it was aimed to measure the awareness levels of children who have been under observation for a long time and who underwent Allergen Specific Immunotherapy (AIT).

**Methods:** Patients with asthma, asthma & allergic rhinitis and/or rhinoconjunctivitis who received subcutaneous AIT between July 2019 and December 2019 were included in our prospective case-control study. A questionnaire was applied to each patient, in which both the levels of awareness related to their disease and AIT, as well as their knowledge of the allergens and prevention measures they were sensitive to were measured. The results were examined. Age, gender, type of allergic diseases, allergen type, AIT time were evaluated statistically.

**Results:** 82 cases (48 boys and 34 girls) were included in the study. The number of patients who know the name of the disease correctly is 68 (82.9%); The number of patients who knew allergens to be sensitive was found to be 47 (57.3%). It was observed that 15%-72% of the cases had information about asthma disease. Age, gender and diseases of the patients were not statistically different.

**Conclusion:** In our study, it was observed that our children were highly aware of especially about sports and environmental protection methods. It is essential to raise awareness of patients and parents for increase treatment success and control the asthma.

**Keywords:** Asthma, awareness, immunotherapy, knowledge

#### ÖZ

**Amaç:** Astım çocukluk çađının en sık görülen kronik hastalıklarından biridir. Yapılan birçok çalışmada eğitimin, astım kontrolünü ve hastaların yaşam kalitesini olumlu yönde etkilediđi gösterilmiştir. Bu çalışmada uzun süredir izlem altında olan ve Alerjen Spesifik İmmünoterapi (AIT) programı nedeniyle sık sık bir araya gelen çocukların hem hastalıkları ve AIT ile ilişkili farkındalık düzeylerinin ölçülmesi hedeflenmiştir.

**Yöntem:** Prospektif, olgu kontrol çalışmamıza, Çocuk Alerji Polikliniđi'ne Temmuz 2019-Aralık 2019 tarihleri arasında subkutan AIT uygulanan astım, astım&alerjik rinit ve/veya rinokonjonktivitli hastalar dahil edildi. Her hastaya hem hastalıkları ve AIT ile ilişkili farkındalık düzeylerinin, hem de duyarlı oldukları alerjenler ve korunma önlemleri ile ilgili bilgilerinin ölçüldüđü bir anket uygulandı. Anket sonuçları üzerinde yaşın, cinsin, alerjik hastalık tipinin, uygulanan alerjen tipinin, AIT süresinin etkisi olup olmadığı araştırıldı.

**Bulgular:** Çalışmaya toplam 82 olgu (48 erkek ve 34 kız) alındı. Hastalığının tam olarak adını bilen olgu sayısı 68 (%82.9), duyarlı olduđu alerjeni bilen olgu sayısı ise 47 (%57.3) olarak saptandı. Olguların %15-72'sinin astım hastalığı ile ilgili bilgi sahibi olduđu görüldü. Hastalara ait yaş cinsiyet ve sahip olduđu hastalıklar arasında istatistiksel olarak anlamlı fark saptanmadı.

**Sonuç:** Araştırmamızda özellikle spor ve çevresel korunma yöntemlerini içeren konular hakkında çocuklarımızın farkındalığının yüksek olduđu görülmüştür. Astım semptomlarının azaltılması ve kontrolünün sağlanması için tedavi uygulamaları ile beraber, tedaviye uyumu arttırmak için hasta ve ailelerin bilinçlendirilmesi ve bu eğitimin devamlılıđının sağlanması esastır.

**Anahtar kelimeler:** Astım, farkındalık, immünoterapi, bilgi düzeyi

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## INTRODUCTION

Asthma is one of the most common chronic childhood diseases with a reported worldwide prevalence of between 1.4% and 21.5%<sup>(1-3)</sup>. The reported prevalence of asthma in children in Turkey is 6-15%, with one in around 10 children known to have asthma<sup>(4,5)</sup>. Allergic asthma is more common in children, and necessitates the elimination of the causative allergen and the regulation of environmental circumstances as known triggers, along with medical treatment and allergen specific immunotherapy (AIT)<sup>(6,7)</sup>. Among these, AIT is the single treatment modality that induces the development of immune tolerance and that may change the course of the disease<sup>(7)</sup>.

Allergen-specific immunotherapy involves the application of a standard allergen extract to which the patient has been established to be clinically sensitive, starting at a low dose and in gradually increasing doses so as not to cause adverse effects. This is an efficacious treatment that is directed to the etiology, and is used in allergic rhinitis, allergic asthma and allergic reactions to bee venom<sup>(8)</sup>. It has long been used successfully for the treatment of children with asthma.

Patient education, close collaboration with the patient and AIT are required for the efficacious treatment of asthma. Education has been shown to positively affect the control of asthma and the quality of life of patients in many studies performed to date<sup>(9)</sup>. In those with asthma in the pediatric age group, patient awareness of the disease and its treatment course has been observed to be low, despite the long-term follow-up and the intense use of medication<sup>(10)</sup>. Furthermore, studies of the general population, primary school teachers and parents of children with asthma have reported the level of awareness and knowledge also of those groups about asthma to be low<sup>(11-13)</sup>.

The quality of life of children and disease management may be improved through school-based asthma education programs that include also family members<sup>(14,15)</sup>. The present study measures the level of awareness of children on long-term follow-up, who were met frequently due to the AIT

program, on both their diseases and AIT, and also their level of knowledge on the allergens to which they are sensitive and the ways to protect themselves against them.

## MATERIALS and METHODS

### Patient Population

Patients with asthma, and asthma/allergic rhinitis and/or rhinoconjunctivitis who received subcutaneous AIT between July 2019 and December 2019 at the Pediatric Allergy Outpatient Clinic of the Izmir SBU Dr. Behçet Uz Child Disease and Pediatric Surgery Training and Research Hospital were included in this prospective case-control study. Asthma and allergic rhinitis diagnoses were based on international guidelines. Allergic sensitivity was detected through skin prick tests (SPT) and/or the measurement of serum-specific IgE levels. The indications and contraindications of subcutaneous AIT were evaluated considering the recommendations of the American Academy of Allergy Asthma and Immunology.

### Study Design

Sociodemographic data, such as the age and gender of the children included in the study, their age at the time of the asthma diagnosis, accompanying atopic diseases, duration of follow-up allergens to which they were sensitive, age at the start of AIT, duration of AIT, laboratory results and the content of the AIT extracts applied were recorded. All patients took part in a survey measuring their level of awareness of their disease and AIT, and also their knowledge on the allergens to which they are sensitive, along with preventative approaches. Patients who received no AIT and who dropped out of the AIT program, or whose AIT was stopped due to the onset of side effects were excluded from the study. The effects of age, gender, type of allergic disease and duration of AIT on the results of the survey were evaluated.

### Subcutaneous allergen immunotherapy

Standardized depot extracts supplied by Allergopharma (Reinbeck, Germany), including

aluminum hydroxide; and by ALK-Abellò (Madrid, Spain), including calcium phosphate and Stallergenes (Antony Cedex, France), all of which are commercially available in Turkey, were used in the study.

### Survey

The applied survey was created by Al-Harbi AS et al. (2016) (Structured Asthma Knowledge Questionnaire) after being adapted into Turkish <sup>(12)</sup>. The applied survey is presented in Table 1.

### Ethical Approval

The study was approved by the Clinical Research Ethics Board of Dr. Behçet Uz Child Diseases and Pediatric Surgery and Research Hospital (Decision date July 18, 2019, and number 2019/267-110).

### Statistical Analysis

The data were analyzed using SPSS for Windows

(Version 15.0. Chicago, SPSS Inc.). For the continuous variables, the data were expressed as mean±standard deviation or median, based on the type of distribution as normal or non-normal. Chi-square and Mann-Whitney U tests were applied for the comparison of parametric values with normal and homogeneous distribution or nonparametric variables.

## RESULTS

A total of 82 cases were included in the study (48 male; 34 female), with a mean age and mean duration of follow-up of 162.2±36.9 months and 67.7±23.9 months, respectively. The age at the start of subcutaneous AIT and the duration of follow-up for AIT were 133.3±36.9 months and 67.7±23.9 months, respectively.

An evaluation of the medical records of the patients revealed a median eosinophil count of 350/

**Table 1. Statements made to patients in the survey, and the correct answers.**

Questions	Correct answers
1. Asthma is a chronic disease that manifests with exacerbations following exposure to allergens.	True
2. Genetic and environmental factors play role in the course of asthma.	True
3. Is there a difference between asthma and chest allergies in children?	No
4. Asthma is a potentially dangerous disease.	True
5. Signs of asthma are dyspnea and night coughs.	True
6. Fever, sore throat and nasal discharge are among the symptoms of asthma.	False
7. A child with severe asthma symptoms cannot speak in sentences, cannot lie on his/her back, and changes in behavior may be seen, such as temper.	True
8. Frequent use of antibiotics prevents long-term lung damage.	False
9. An increase in respiratory system infections may cause changes in the course of asthma.	True
10. House dust, seasonal changes and sudden environmental changes, such as cold air, may lead to changes in the course of asthma.	True
11. Direct or indirect exposure to cigarette smoke may cause asthma exacerbations.	True
12. Asthma patients will have a better outcome if they visit a physician regularly.	True
13. A patient with asthma should refrain from physical activity and sports.	False
14. Patients with asthma should refrain from such foods as fish, eggs and bananas.	False
15. Physicians should inform patients about the indications of asthma and plan the patient's management of the disease, including what to avoid and what to refrain from.	True
16. A patient with asthma should be informed how to manage his/her disease.	True
17. The treatment of asthma is unnecessary in children under 6 years of age.	False
18. A patient with asthma may stop the drugs he/she uses after treatment for an exacerbation.	False
19. A patient with asthma may use the drugs of another patient without consulting a doctor.	False
20. Steam (nebulizer) is a better asthma treatment than drugs taken through a mask or tube drugs.	False
21. A patient with asthma does not need a mask when using drugs if she/he is less than 5 years old.	False
22. A patient with non-severe asthma may be treated by a primary care physician.	True
23. Asthma drugs can be addictive.	False
24. Asthma prevention drugs may have serious side effects when used to treat conditions other than exacerbations.	False
25. Special centers should be established in order to raise awareness of, and to provide for the better treatment of asthma.	True
26. Asthma may lead to absenteeism from school.	True

**Table 2. Demographic data and laboratory results of patients.**

	Patients n (%)
<b>Gender</b>	
Girl	10 (47.6%)
Boy	11 (52.4%)
<b>Diagnosis distribution</b>	
Asthma	43 (52.4%)
Asthma + Allergic Rhinitis and/or Rhinoconjunctivitis	39 (47.6%)
<b>Sensitization</b>	
House dust mites	20 (24.4%)
Pollen	30 (36.6%)
Mold	3 (3.7%)
Multiple	29 (35.4%)
<b>Content of the SKIT Used</b>	
House dust mite allergens	29 (35.4%)
Pollen allergens	42 (51.2%)
Mold allergens	3 (3.7%)
Multiple allergens	8 (8.9%)
Eosinophil count /mm <sup>3</sup> (median, min-max)	350 (29-5410)
Percentage of eosinophils (%) (median, min-max)	4.3 (0.7-22)
IgE level (IU/L) (median, min-max)	191 (5-2000)
Age of the Patient (Months, mean±SD)	162.2±36.9
Mean Age at Diagnosis (Months, mean±SD)	65.3±28.2
Duration of Follow-up (Months, mean±SD)	67.7±23.9
Age at Start of IT (Months, mean±SD)	133.3±36.9
Duration of IT (Months, mean±SD)	28.4±10.3

mm<sup>3</sup>, median eosinophil percentage of 4.3% and median total IgE level of 191 kU/L. Among the patients, 43 (52.4%) and 39 (47.6%) were followed-up for asthma and asthma & allergic rhinitis and/or rhinoconjunctivitis, respectively.

Following in vivo and in vitro allergy tests, 53 cases (64.6%) were found to be monosensitized and 29 (35.4%) to be polysensitized. The distribution of the allergens to which the patients were sensitive was as follows: 20 cases, to house dust and mite mixture (24.4%); three cases to *Alternaria alternata* (3.7%); 15 cases to meadow pollens (18.3%); and 15 cases tree mixtures (18.3%).

The extracts used in the subcutaneous AIT included a single allergen in 74 cases (91.1%) and multiple allergens in eight cases (8.9%). Subcutaneous AIT was applied in 29 cases using a house dust mite mixture (35.4%), 42 cases using meadow pollen (51.2%), three cases using *Alternaria* (3.7%) and eight cases using more than one allergen (8.9%) (Table 2).

**Table 3. Distribution of patient responses to questions.**

Questions	Correct n (%)	False n (%)	No response n (%)
1	64 (78%)	18 (22)	0 (0%)
2	75 (91.5%)	3 (3.7%)	4 (4.9%)
3	15 (18.3%)	65 (79.3%)	2 (2.4%)
4	72 (87.8%)	9 (11%)	1 (1.2%)
5	73 (89%)	8 (9.8%)	1 (1.2%)
6	37 (45.1%)	39 (47.6%)	6 (7.3%)
7	31 (37.8%)	47 (57.3%)	4 (4.9%)
8	63 (76.8%)	14 (17.1%)	5 (6.1%)
9	27 (32.9%)	49 (59.8%)	6 (7.3%)
10	73 (89%)	6 (7.3%)	3 (3.7%)
11	77 (93.9%)	2 (2.4%)	3 (3.7%)
12	75 (91.5%)	5 (6.1%)	2 (2.4%)
13	74 (90.2%)	5 (6.1%)	3 (3.7%)
14	63 (76.8%)	16 (19.5%)	3 (3.7%)
15	69 (84.1%)	10 (12.2%)	3 (3.7%)
16	73 (89%)	8 (9.8%)	1 (1.2%)
17	75 (91.5%)	5 (6.1%)	2 (2.4%)
18	12 (14.6%)	68 (82.9%)	2 (2.4%)
19	45 (54.9%)	34 (41.5%)	3 (3.7%)
20	73 (89%)	7 (8.5%)	2 (2.4%)
21	59 (72%)	22 (26.8%)	1 (1.2%)
22	61 (74.4%)	17 (20.7%)	4 (4.9%)
23	50 (61%)	28 (34.1%)	4 (4.9%)
24	55 (67.1%)	24 (29.3%)	3 (3.7%)
25	21 (25.6%)	60 (73.2%)	1 (1.2%)
26	70 (85.4%)	10 (12.2%)	2 (2.4%)

Of all patients, 68 (82.9%) were able to state the exact name of his/her disease, while 47 (57.3%) could name the exact allergen to which he/she was sensitive. The distribution of the responses given by the patients to the survey statements is shown in Table 3. Around 15-72% of the cases were found to have knowledge of asthma, while 6-68% gave incorrect responses to the statements related to the treatment and follow-up of asthma. No relationship was identified between the given responses and the age, gender and the disease of the child.

**DISCUSSION**

Asthma is a chronic repetitive disease of the respiratory tract that is frequently characterized by symptoms such as cough, dyspnea and feeling of chest tightness. It is exacerbated by many conditions, such as respiratory tract infections, exercise, allergens such as dust mites, and pollens and cigarette smoke. The patient’s knowledge of the clinical features of

their disease and the precautions to avoid, and treatments for exacerbations will aid in the control of asthma, and the prevention of acute exacerbations and complications <sup>(16,17)</sup>.

The children's level of knowledge of their disease and the allergens to which they were sensitive, and who were met frequently, was found to be higher than their knowledge of preventive measures. Some 82% of the cases knew exactly the name of their disease, although their general level of knowledge of asthma was found to vary between 15% and 72%. Sleath BL et al. <sup>(18)</sup> reported the rate of correct answers of the patients related to their diagnosis as 21%, and the level of knowledge of the patients on preventive measures, treatment and follow-up of 1-11%.

It is essential to raise the awareness of patients about their disease and drug treatments to decrease their symptoms and the need for medication, as a means of raising their quality of life. Furthermore, collaborating with the patients and their families is a fundamental aspect of treatment, and asthma management plans prepared following this approach will increase the efficacy of the asthma pharmacotherapy <sup>(19)</sup>. In the present study, however, the patients gave incorrect responses to 6-68% of the statements about the treatment and follow-up of asthma. In a study by Al-Harbi AS et al. <sup>(13)</sup>, 59.5% of patients gave correct responses to the statements. The fundamental nature of patient and family collaboration and education as a means of asthma control has been noted in many studies <sup>(19)</sup>. Raising awareness of the disease and an appropriate lifestyle can be greatly beneficial for asthma patients, being low-cost, as such information is easily accessible, thus increasing compliance. Accordingly, efforts to increasing awareness through school-based education programs, and through the web and social media, have been introduced, and many education and information programs providing instruction in drug use, emergency disease action programs and asthma lifestyle changes have been established.

Families, clinicians and school nurses should create support circles so as to ease asthma care. Complaints that asthma can interfere with daily life activities by causing school absenteeism, activity

intolerance and frequent hospital and emergency service visits and thus might have negative effects on the quality of life of both the child who has the disease and his/her caregivers <sup>(19)</sup>. Clark NM et al.'s <sup>(20)</sup> study included a total of 416 children in the study group and 419 in the control group from seven different schools, all of whom had been diagnosed with asthma. The study evaluated the efficacy of school-based family education programs related to asthma and its management. After 24 months, the children who had received focused education were found to be able to better control their symptoms at day and night, and to have better disease management associated with asthma exacerbation. Similarly, Bartholomew et al. <sup>(21)</sup> in their study of 1,730 children with asthma from 60 primary schools, reported increased knowledge of the children about the disease and better emergency action plan skills. Furthermore, less absenteeism and hospital presentations were determined in the children compared to the control group; however, no change in the general disease status was observed. It is essential to ensure adequate communication between asthma patients and healthcare workers, and to provide continuity of patient education, as such education should minimize any fears or worries patients may have about their treatment and follow-up. The information provided should be suitable for the level of education and the lifestyle of the patient to ensure compliance, and continuity in education should be ensured. These issues should also be reviewed during follow-up visits with tests of the knowledge of the patient, and any weak areas should be addressed <sup>(22,23)</sup>. The present study found the knowledge of the patients about the symptoms of asthma to be better than their knowledge of the treatment and emergency management applications, and so a hospital-based education program was planned to be implemented.

Various approaches to patient education have been devised, and the use of technology has been shown to have particularly beneficial effects on patients with asthma. Web-based asthma self-management systems and social media have been demonstrated to increase public awareness, to

improve the quality of life of people with asthma, to decrease the symptoms and exacerbations of asthma, and to improve compliance, especially in adults <sup>(24)</sup>.

Inadequate compliance with inhaled steroid treatments in patients with asthma results in poor clinical results and more applications to health services. The efficacy and safety of interventions aimed at increasing compliance with inhaled corticosteroids have been evaluated in many studies, and various applications have been developed for individuals with chronic disease, such as drug reminders, diet compliance reminders, and applications that support and ease the management of their diseases. One particular study reported findings that may support the self-management of chronic diseases involving cell phone messaging applications <sup>(25)</sup>. Therefore, identifying easier approaches to informing patients about the status of chronic diseases such as asthma, controlling for compliance with drug treatments and informing of results, and ensuring the continuation of the process might be considered part of the treatment in long-term follow-ups. In the present study, the knowledge of the children with asthma about the need for drug treatments, the management of exacerbations and the methods of drug use was observed to be inadequate. Education programs making use of verbal seminars and brochures were planned, although it has not yet been possible to assess their long-term effects. Furthermore, tested lifestyle interventions, including activities in support of nutrition, and those encouraging physical activity, yoga and massage, have been observed to increase the compliance of asthma patients to drug treatment <sup>(26)</sup>. In a study evaluating the awareness of the benefit of lifestyle changes in asthma management <sup>(27)</sup>, just a 5-10% loss of weight in obese patients with asthma was found to improve their quality of life and asthma control, while meditation applications and breathing exercises were found to decrease stress and anxiety, and to improve the respiratory rate and muscle relaxation. Improvement was reported in FEV1 from 88% to 75% ( $p < 0.001$ ), as well as a relief in symptoms from 10% to 72% ( $p < 0.01$ ) <sup>(28)</sup>. In the present study, the awareness of the children of the benefits of

sport and environmental prevention methods was found to be high, providing correct responses to the statements in these fields at a rate of 90% (Table 3).

In conclusion, activities to raise awareness in patients and their families, and to ensure the continuation of education programs, in addition to the treatment applications, should be developed so as to decrease asthma symptoms and to support disease control.

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## REFERENCES

1. Miracle V and Winston M. Take the wind out of asthma. *Nurs Manage.* 2001;32:24-30. <https://doi.org/10.1097/00006247-200104000-00013>
2. Tohidinik HR, Mallah N, Takkouche B. History of allergic rhinitis and risk of asthma; a systematic review and meta-analysis. *World Allergy Organ J.* 2019;12:100069. <https://doi.org/10.1016/j.waojou.2019.100069>
3. Enilari O, Sinha S. The Global Impact of Asthma in Adult Populations. *Ann Glob Health.* 2019;22:85. <https://doi.org/10.5334/aogh.2412>
4. Demir E, Tanaç R, Can D, Gülen F, Yenigün A, Aksakal K. Is there an increase in the prevalence of allergic diseases among schoolchildren from the Aegean region of Turkey? *Allergy Asthma Proc.* 2005;26:410-4. <https://pubmed.ncbi.nlm.nih.gov/16450577/>
5. Kurt E, Metintaş S, Başığit İ, Bulut İ, Coşkun E, Dabak S, et al. Prevalence and risk factors of allergies in Turkey (PARFAIT): Results of Children of a Multicentric-Cross Sectional Study *Ped Allergy Immunol.* 2007;18:566-74. <https://doi.org/10.1111/j.1399-3038.2007.00551.x>
6. Holgate ST. Innate and adaptive immune responses in asthma. *Nat Med.* 2012;18:673-83. <https://doi.org/10.1038/nm.2731>
7. Rottier BL, Eber E, Hedlin G, Turner S, Wooler E, Mantzourani E, et al. Monitoring asthma in childhood: management-related issues. *Eur Respir Rev.* 2015;24:194-203. <https://doi.org/10.1183/16000617.00003814>
8. Virchow JC. Allergen immunotherapy (AIT) in asthma. *Semin Immunol.* 2019;8:101334. <https://doi.org/10.1016/j.smim.2019.101334>
9. P G Gibson 1, H Powell, J Coughlan, A J Wilson, M Abramson, P Haywood, et al., Self-management education and regular practitioner review for adults with asthma, *Cochrane*

- Database of Systematic Reviews.2003;1:CD001117.  
<https://doi.org/10.1002/14651858.CD001117>
10. National Heart, Lung, and Blood Institute (US). National Asthma Education and Prevention Program. NAEPP program description. Bethesda (MD): US Department of Health and Human Services, National Institutes of Health. [Internet]. [updated 2014 September; cited 2015 Feb 19].
  11. Fadzil A, Norzila MZ. Parental asthma knowledge. *Med J Malaysia*. 2002;57:474-81.  
<https://pubmed.ncbi.nlm.nih.gov/12733173/>
  12. Al-Harbi S, Al-Harbi AS, Al-Khorayyef A, Al-Qwaiee M, Al-Shamarani A, Al-Aslani W et al. Awareness regarding childhood asthma in Saudi Arabia. *Ann Thorac Med*. 2016;11:60-5.  
<https://doi.org/10.4103/1817-1737.173194>
  13. Walter H, Sadeque-Iqbal F, Ulysse R, Castillo D, Fitzpatrick A, Singleton J. The effectiveness of school-based family asthma educational programs on the quality of life and number of asthma exacerbations of children aged five to 18 years diagnosed with asthma: a systematic review protocol. *JBI Database System Rev Implement Rep*. 2015;13:69-81.  
<https://doi.org/10.11124/jbisrir-2015-2335>
  14. Bruzzese JM, Unikel L, Gallagher R, Evans D, Colland V. Feasibility and impact of a schoolbased intervention for families of urban adolescents with asthma: results from a randomized pilot trial. *Fam Process*. 2008;47:95-113.  
<https://doi.org/10.1111/j.1545-5300.2008.00241.x>
  15. Klok T, Kaptein AA, Brand PLP. Non-adherence in children with asthma reviewed: The need for improvement of asthma care and medical education. *Pediatr Allergy Immunol*. 2015 May;26(3):197-205.  
<https://doi.org/10.1111/pai.12362>
  16. Klok T, Kaptein AA, Duiverman EJ, Brand PL. High inhaled corticosteroids adherence in childhood asthma: the role of medication beliefs. *Eur Respir J*. 2015;26:197-205.  
<https://doi.org/10.1111/pai.12362>
  17. Koster ES, Raaijmakers JA, Vijverberg SJ, Maitland-van der Zee AH. Inhaled corticosteroid adherence in paediatric patients: the PACMAN cohort study. *Pharmacoepidemiol Drug Saf*. 2011;20:1064-72.  
<https://doi.org/10.1002/pds.2228>. Epub 2011 Aug 24.
  18. Betsy L Sleath , Delesha M Carpenter, Robyn Sayner, et al. Child and caregiver involvement and shared decision-making during asthma pediatric visits. *J Asthma*. 2011 Dec;48(10):1022-31.  
<https://doi.org/10.3109/02770903.2011.626482>
  19. Walter H, Sadeque-Iqbal F, Ulysse R, Castillo D, Fitzpatrick A, Singleton J. The effectiveness of school-based family asthma educational programs on the quality of life and number of asthma exacerbations of children aged five to 18 years diagnosed with asthma: a systematic review protocol. *JBI Database System Rev Implement Rep*. 2015;13:69-81.  
<https://doi.org/10.11124/jbisrir-2015-2335>
  20. Clark NM, Brown R, Joseph CL, Anderson EW, Liu M, Valerio MA. Effects of a comprehensive school-based asthma program on symptoms, parent management, grades, and absenteeism. *Chest*. 2004;125:1674-9.  
<https://doi.org/10.1378/chest.125.5.1674>
  21. Bartholomew LK1, Sockrider M, Abramson SL, Swank PR, Czyzewski DI, Tortolero SR, et al. Partners in school asthma management: evaluation of a self-management program for children with asthma. *J Sch Health*. 2006;76:283-90.  
<https://doi.org/10.1111/j.1746-1561.2006.00113.x>
  22. Slutsky P and Stephens T.B. Developing a Comprehensive,Community-Based Asthma Education and Training Program. *Pediatric Nursing*. 2001;275:449-61.  
<https://pubmed.ncbi.nlm.nih.gov/12025308/>
  23. Fesci H, Görgülü Ü. Astım ve Yaşam. Gazi Üniversitesi Hemsirelik Yüksekokulu Dergisi. 2005:77-83.  
[http://www.hacettepehemsirelikdergisi.org/pdf/pdf\\_HHD\\_6.pdf](http://www.hacettepehemsirelikdergisi.org/pdf/pdf_HHD_6.pdf)
  24. Poowuttikul P, Seth D. New Concepts and Technological Resources in Patient Education and Asthma Self-Management. *Clin Rev Allergy Immunol*. 2020;25.  
<https://doi.org/10.1007/s12016-020-08782-w>
  25. De Jongh T, Gurol-Urganci I, Vodopivec-Jamsek V, Car J, Atun R. Mobile phone messaging for facilitating self-management of long-term illnesses. *Cochrane Database Syst Rev*. 2012;12:CD007459.  
<https://doi.org/10.1002/14651858.CD007459.pub2>
  26. Stoodley I, Williams L, Thompson C, Scott H, Wood L. Evidence for lifestyle interventions in asthma. *Breathe (Sheff)*. 2019;15:50-61.  
<https://doi.org/10.1183/20734735.0019-2019>
  27. Nyenhuis SM, Dixon AE, Ma J. Impact of Lifestyle Interventions Targeting Healthy Diet, Physical Activity, and Weight Loss on Asthma in Adults: What Is the Evidence?. *J Allergy Clin Immunol Pract*. 2018;63:751-63.  
<https://doi.org/10.1016/j.jaip.2017.10.026>
  28. Paudyal P, Jones C, Grindey C, et al. Meditation for asthma: systematic review and meta-analysis. *J Asthma*. 2018;55:771-8.  
<https://doi.org/10.1080/02770903.2017.1365887>. Epub 2017 Oct 13.