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ORIGINAL ARTICLE

Medication adherence in adolescent asthma patients

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ABSTRACT

Objective: One of the most important reasons for the lack of asthma control in adolescents is non-adherence to treatment. This study aimed to investigate the level of adherence to treatment and the factors affecting it in adolescent patients with asthma.

Material and Methods: Adolescents diagnosed with asthma for at least three months and prescribed regular controller therapy were included in the study. The Morisky 8-item Medication Adherence Questionnaire (MMAS-8) was used to assess adherence. In cases of non-adherence, the reasons were investigated. The asthma control test (ACT) was used to evaluate asthma control.

Results: The study included 312 adolescents with asthma, aged between 10 and 18 years. It was observed that 57.1% of the patients were non-compliant with asthma treatment. The most common reason for non-adherence was "conscious non-adherence" (60%). The most frequently reported reasons for non-adherence were "I forget to take my medication" (27%) and "I don't take my medication when other people are around because I don't want my disease to be known" (25.8%). A strong positive linear relationship was found between ACT and MMAS-8 scores ($r=0.72$, $p<0.001$).

Conclusion: This study showed that more than half of the adolescent asthma patients were non-compliant with asthma treatment. It was determined that adolescents generally exhibited "conscious non-compliance," forgot to take their medication, and did not use their medication appropriately because they concealed their illness from others. Understanding the feelings of adolescent patients and addressing their concerns as part of asthma education may help increase compliance rates.

Keywords: Adherence, adolescents, asthma, asthma control.

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INTRODUCTION

Asthma is a chronic respiratory disease characterized by inflammation and narrowing of the airways and is commonly observed in childhood. It can significantly impact the quality of life of children and requires regular treatment to control the symptoms.[1]

"The extent to which a person's behavior taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health-care provider" is how the World Health Organization (WHO) defines adherence.[2] The most important step in asthma control and the reduction of asthma-related morbidity and mortality is "medication adherence." However, adherence to asthma medication in children remains a significant challenge. Adherence to asthma medications in children requires active participation in the treatment plan by both children and their families.[3] Unfortunately, the literature indicates low adherence to asthma medications in children, which adversely affects disease control.[4]

Adolescence is defined as a period that begins with sexual and psychosocial maturation along with rapid biological development, during which the individual gains independence and social productivity.[5] Adolescents experience physical and psychosocial changes that affect their health. Due to these changes, reluctance to seek medical help, denial of symptoms, lack of knowledge about asthma, decreased compliance with treatment, and inadequate asthma control leading to morbidity are common in adolescents.[6,7] Low adherence rates to inhaled corticosteroids (ICS), particularly in adolescent asthma patients, have been associated with increased mortality rates.[8] Therefore, studies focusing on the characteristics of drug use for chronic diseases, such as asthma, in adolescents are of great importance. In the literature, studies on medication adherence of children with asthma mainly cover the age group of 6–18 years and not only adolescents. However, adolescence is a very special period of life both physiologically and mentally. In this period, the individual leaves the family control and starts to make his/her own decisions. Therefore, asthma medication adherence studies including young children may not give accurate results for adolescent patients. In this study, we aimed to obtain more accurate results than similar studies in the literature by including only adolescent asthma patients. In addition, a medication adherence study including adolescent asthma patients has not been conducted in our country before.

Our clinical observations suggest that many adolescent asthma patients in Türkiye do not take their medication regularly. Adolescents with low adherence to asthma medication may have poorer control of their disease. In our country, studies on treatment non-adherence in asthma are limited. The aim of this study was to evaluate the rates of treatment non-adherence in adolescent asthma patients and to investigate the reasons for treatment non-adherence.

MATERIAL AND METHODS

This cross-sectional study was conducted at the pediatric allergy and immunology outpatient clinic of Ordu Training and Research Hospital in 2024. Approval was obtained from the Non-Interventional Research Ethics Committee, and permission was obtained from the Provincial Health Directorate (E-14647249-000-0987876). This study was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained separately from participating adolescents and their parents.

The inclusion criteria were "being diagnosed with asthma for at least three months" and "being between the ages of 10–18 years." Exclusion criteria were "being outside the specified age range," "being diagnosed with asthma within the last three months," or "not being recommended to use regular controller medication (inhaled corticosteroid or combination of inhaled corticosteroid and long-acting beta agonist) as asthma medication."

Adolescence is defined by WHO as "10–19 years of age".[9] Therefore, this age group was included in this study. To emphasize the differences in physical, mental, and social development, adolescence was divided into three main groups: "early stage (10–13 years)," "middle stage (14–17 years)," and "late stage (18 years)".[10]

According to the Global Initiative for Asthma (GINA) guidelines, asthma was diagnosed by demonstrating reversible airway obstruction in patients with recurrent cough, wheezing, and dyspnea unexplained by other causes. Reversible airway obstruction was defined as a ≥12% or ≥200 ml increase in the volume at 1st second of forced expiration (FEV1) after 400 µg of inhaled salbutamol.[11]

Pulmonary function tests were performed on all patients. All study groups were tested using inhalant allergens. Histamine (10 mg/ml) was used as a positive control, and isotonic saline (0.9%) was used as a negative control for the skin prick test. Results in which the diameter of the edema with allergen was ≥3 mm more than that of the negative control were considered positive. All pulmonary function tests and skin prick tests were performed by the same person.

The sociodemographic and clinical characteristics of the patients were recorded. In addition, the number of outpatient and emergency department visits with an asthma-related complaint in the previous year, the number of hospitalizations due to asthma, the number of systemic steroid courses taken, and the number of asthma medications recommended in the last three months were recorded both by asking the patients and by examining the hospital records. The data required for the study were obtained from both the adolescent and the parents. If the answers given were contradictory, hospital records were analyzed. If necessary, pharmacy records were requested and analyzed. The answers provided by the child and the parents and the hospital records were compared, cross-validated, and the most accurate data were recorded.

Asthma Control Test

Asthma control was assessed using the Turkish version of the Asthma Control Test (ACT). An ACT score of ≥20 was considered "under control," and <20 was considered "not under control".[12]

Morisky 8-Material Medication Adherence Questionnaire

One of the scales that can be used to evaluate treatment compliance, which is an important factor in the management of chronic respiratory diseases, is MMAS-8. A validity and reliability study of the Turkish version of the scale has been conducted, and it has been stated that

it can be used safely in adolescent patients diagnosed with asthma.[13] Therefore, the MMAS-8 was used to assess patients' adherence to treatment in the last three months.

In the compliance test, where a maximum score of eight points can be obtained, patients who scored 8 points were considered to have high compliance, patients who scored 6 or 7 points were considered to have moderate compliance, and patients who scored less than 6 points were considered to have low compliance.[13] For statistical analyses, subjects with high compliance were grouped as "Compliant," and those with moderate and low compliance were grouped as "Non-compliant."

Non-adherent patients were asked why they did not use the controller medication. The reported reasons for treatment non-adherence were categorized as recommended in the WHO report on adherence to long-term treatments: "irregular non-adherence," "conscious non-adherence," and "involuntary non-adherence".[1]

Statistical Analysis

Statistical analyses were performed using SPSS Statistics version 29.0.1 software. The conformity of the variables to a normal distribution was examined visually (histogram and probability graphs) and analytically (Kolmogorov-Smirnov/Shapiro-Wilk tests). Descriptive statistics are presented as mean and standard deviation for normally distributed variables and as median for non-normally distributed variables. For the comparison of quantitative variables, Student's t-test was used if the distribution of the data was normal; otherwise, the Mann-Whitney test was applied. The chi-square test was used to compare qualitative variables. Statistical significance was set at $p<0.05$.

RESULTS

The study included 312 adolescents with asthma, 171 of whom were male (54.8%), aged between 10 and 18 years. The median age of the patients was 14 years (minimum–maximum: 10–17). When patients were classified according to the three adolescent age groups, 150 (48.1%) were in early adolescence, 126 (40.4%) in middle adolescence, and 36 (11.5%) in late adolescence. All participants were attending school in an age-appropriate manner, had similar socioeconomic status, and lived in the geographical area where the study was conducted.

The median time since asthma diagnosis was 12 months (minimum–maximum: 3–163 months). When asthma status in the previous year was evaluated, 29.8% of the patients had at least one emergency department visit due to asthma. In the previous year, 9.3% of the patients had a history of hospitalization for asthma. The sociodemographic and clinical characteristics of the patients are shown in Table 1.

At the time of asthma diagnosis and during follow-up, 130 (41.7%) participants stated that they had received training on asthma treatment. Of these, 52 (16.7%) received training on asthma treatment from the nurse in charge, 98 (31.4%) received asthma training with a demo device, and 50 (16%) had a written asthma action plan (A demo device refers to an example of the asthma medication form that the patient will use, such as a turbohaler, aeroliser, or discus.).

Table 1: Sociodemographic and clinical characteristics of the patients

Age, median (min–max)	14 (10–17)
Gender (F/M), n (%)	141(45.2)/171 (54.8)
Age of mother*	40.4 (7.3)
Age of father*	43.5 (8.4)
Mother's education level, n (%)	
Primary education and below	37 (11.9)
High school	247 (79.2)
University and above	28 (9)
Father's education level, n (%)	
Primary education and below	30 (9.6)
High school	215 (68.9)
University and above	67 (21.5)
Family history of asthma (present/absent), n (%)	56 (17.9)/256 (82.1)
Atopy n (%)	
Yes	52 (16.7)
No	260 (83.3)
Concomitant chronic disease n (%)	
Yes	23 (7.4)
No	289 (92.6)
Recommended controller treatment for asthma, n (%)	
ICS	93 (29.8)
LTRA	20 (6.4)
ICS + LABA	113 (36.2)
ICS + LTRA	33 (10.6)
ICS + LABA+ LTRA	53 (17)
Time elapsed after diagnosis of asthma (months)**	12 (6–16)
Hospitalization due to asthma in the last year (present/absent), n (%)	29 (9.3)/283 (90.7)
Has experienced an asthma attack in the last three months (yes/no), n (%)	92 (29.5)/220 (70.5)
Asthma control test score, n (%)	
≥20	149 (47.8)
<20	163 (52.2)
FEV1, n (%)	
<80%	45 (14.4)
≥80%	246 (78.8)
Not cooperative	21 (6.7)

*: Mean, standard deviation; **: Median, interquartile range; LABA: Long-acting beta agonist; ICS: Inhaled corticosteroid; LTRA: Leukotriene receptor antagonist; FEV1: Volume expired in the 1st second of forced expiration; ACT: Asthma control test.

Table 2: Medication adherence characteristics of the patients in the study

Level of adherence according to Morisky 8-substance medication adherence questionnaire, n (%)	134 (42.9)
Exact compliance	93 (29.8)
Partial compliance	85 (27.3)
Low compliance	
Reasons for non-compliance, n (%)	38 (28.6)
Irregular mismatch	79 (60)
Conscious non-compliance	61 (12.4)
Involuntary disharmony	
Reasons for treatment non-adherence reported by patients, n (%)	48 (27)
I forget to take my medicine	46 (25.8)
I do not use it in the presence of other people because I do not want other people to know about my illness	
I don't take my medicine because I have no complaints	26 (14.6)
I don't think I have asthma	22 (12.4)
I don't want to specify or other	14 (7.9)
I was not informed that I should take my medication regularly	12 (6.7)
I was not informed about my illness	10 (5.6)

The parents of the children included in the study were asked about the control of their child's use of asthma medication. It was found that only the mother controlled the use of medication in 52 cases, only the father controlled the use of medication in 18 cases, and both parents controlled the use of medication in 8 cases. At least one of the parents of 78 (25%) adolescents controlled their child's medication use. Adherence to asthma medication was found to be higher in patients whose medication use was controlled by their parents compared to those whose medication use was not controlled ($p<0.05$).

According to the MMAS-8-item medication adherence questionnaire, 42.9% of patients were found to be fully compliant with their asthma medications. The most common reason for non-adherence was found to be "conscious non-adherence" (60%). The most common reasons for non-adherence were "I forget to take my medication" (27%) and "I do not use it when other people are around because I do not want my disease to be known" (25.8%) (Table 2). A strong positive linear relationship was found between ACT scores and MMAS-8 scores ($r=0.72$, $p<0.001$).

While no statistically significant difference was found between the groups of patients with "treatment non-adherence" and "good treatment adherence" in terms of age, gender, and educational status, a significant difference was found in terms of asthma control test score, duration of asthma follow-up, adolescent age group, use of chronic medication for non-asthma reasons, and outpatient clinic visits for asthma (Table 3).

When the factors affecting treatment non-adherence were analyzed by multivariate logistic regression analysis, it was found that treatment adherence was negatively affected by an asthma follow-up period longer than 1 year, not being followed up in a pediatric allergy-immunology clinic, being a late adolescent, and chronic drug use for a reason other than asthma (Table 4).

DISCUSSION

In this study, it was found that more than half (57.1%) of the adolescent asthma patients were non-compliant with asthma treatment. It was determined that adolescents generally exhibited "conscious non-compliance," forgot to take their medication, and did not use their medication appropriately because they concealed their illness from their environment. Prolonged asthma follow-up and chronic medication use for reasons other than asthma negatively affected treatment adherence. In addition, the results of our study show that the responsibility for asthma medication use is largely left to adolescents themselves.

Adolescence was divided into three stages: early, middle, and late. Early adolescence refers to the age range of 10 to 14 years. The most important feature of this period is the effort to adapt and cope with the biological changes that occur during puberty. The period between the ages of 15–17 is defined as middle adolescence. During this period, adolescents believe that they are omnipotent and may engage in risky behaviors. Late adolescence, between the ages of 18–21, is a stage where an identity has been formed with the characteristics acquired since the beginning of puberty.[10]

In general, adolescents have low adherence to asthma medications.[2] The low adherence rates in adolescents with asthma may be attributed to the many developmental, psychosocial, and environmental changes experienced during adolescence. For example, early adolescence is a time when cognitive functioning changes from concrete to abstract thinking, transforming a simple perception of asthma into more sophisticated knowledge of the condition.[14] Furthermore, "increased interest in peer acceptance" and "desire for autonomy from parents" are key characteristics of adolescents. Therefore, adolescents may hide their asthma symptoms and/or discontinue their medication to avoid embarrassment and/

Table 3: Characteristics of patients with good treatment adherence and patients with treatment non-adherence

Characteristics of patients	Good treatment adherence	Poor treatment adherence	p
Gender (male/female), n (%)	63/71 (47/53)	78/100 (43.8/56.2)	0.5
Age (years), Mean± SD	13.5 (2.3)	13.6 (2.2)	0.3
Education, n (%)			0.2
Primary and high school	107 (79.9)	133 (77.5)	
University	27 (20.1)	40 (22.5)	
Asthma control test score, Mean± SD	22.1 (3.1)	16.1 (4.7)	**<0.001**
Have you had an asthma attack in the last 3 months?			**<0.001**
Yes	10	82	
No	124	96	
Have you been hospitalized in the last 1 year?			**<0.001**
Yes	4	25	
No	130	153	
Duration of asthma follow-up, n (%)			**<0.001**
>1 year	52 (38.8)	35 (19.7)	
<1 year	82 (61.2)	143 (80.3)	
Adolescent group, n (%)			**<0.001**
Early stage	64 (47.8)	86 (48.3)	
Middle stage	52 (38.8)	74 (41.6)	
Late stage	18 (13.4)	18 (10.1)	
Is there chronic medication use for reasons other than asthma?, n (%)			**0.007**
Yes	10 (7.5)	32 (18)	
No	124 (92.5)	146 (82)	
Outpatient clinic for asthma, n (%)			**<0.001**
Pediatrics	42 (31.3)	106 (59.6)	
Pediatric allergy immunology	92 (68.7)	72 (40.4)	

SD: Standard deviation.

Table 4: Factors affecting treatment non-adherence (According to multivariate logistic regression analysis results)

Factors	OO	95% CI	p
Male gender	1.4	0.8-2.5	0.1
Asthma follow-up period longer than 1 year	3.7	2-6.7	**<0.001**
Not being followed up in a pediatric allergy-immunology clinic	3.5	2-5.9	**<0.001**
Being a late adolescent	3.7	2.1-6.5	**<0.001**
Parents do not have a university degree	1.4	0.8-2.4	0.1
Chronic medication use for a reason other than asthma	6.4	2.5-16.7	**<0.001**

OO: Likelihood ratio; CI: Confidence interval.

or appear different from their peers.[2] With the potential impact of these factors, it has been shown that adolescents with asthma have a higher rate of asthma attacks, hospitalization, and mortality than younger children.[15] For these reasons, studies involving adolescent asthma patients are of great importance to reduce mortality and morbidity by increasing medication adherence.

Treatment non-adherence is a common problem in patients with asthma. In asthma, adherence to treatment tends to be poor, with rates of <50% in children and 30–70% in adults, depending on the country, age, sex, and ethnicity.[16] In our country, there are few studies on treatment non-adherence in asthma, including children, and no study has included only adolescents. Therefore, it was not possible to compare some of our results with the literature. In a study conducted in our country that included pediatric and adolescent asthma patients, 22.8% of the patients were non-compliant with treatment.[17] In our study, the rate of non-compliance with asthma medication was 57.1%. The higher rate found in our study compared with other studies in our country may be related to the fact that our study included only adolescents.

In children with asthma up to adolescence, parents may contribute to increasing compliance rates as a controlling mechanism for their child's medication use. In a study conducted in the United States of America, the rates of leaving the responsibility of controlling medication use to the patient in children and adolescents with asthma were investigated. It was shown that the rates were 20% at the age of 7 years, 50% at the age of 11 years, 75% at the age of 15 years, and 100% by the age of 19 years. In adolescents, medication use is largely left to the individual's own responsibility.[18] Supporting this, our study showed that only 25% of the adolescents were controlled by their parents. Our findings showed that 75% of the adolescents were responsible for their own medication use and did not undergo any parental control. These results indicate that in our country, the responsibility for asthma medication use is left to adolescents themselves. It is very important for parents to share this responsibility with their children and control their medication use. At this point, it is important that physicians who diagnose and follow up on treatment should warn not only the adolescent but also the parents about compliance. It may be necessary to educate both adolescents and parents, first together and then separately, emphasizing that both have different responsibilities.

Takkinsatian et al.[19] found that the most common cause of medication non-adherence in adolescent asthma patients was deliberate non-adherence. Similarly, in our study, the most common cause of non-adherence was deliberate non-adherence. Among non-adherent patients, 25.8% stated that they did not use their medication when others were present because they did not want their disease to be known, and 27% stated that they forgot to take their medication. Adolescence is a crucial stage of life marked by distressing emotions.[2] These results may be related to the intense psychosocial changes experienced during adolescence. It may be insufficient for physicians to provide only technical training on asthma medication. Understanding the emotions of adolescent patients and responding to their concerns and reservations as part of asthma education may contribute to increasing compliance rates.

Asthma management aims to optimally control asthma, as recommended by guidelines. However, studies have found that only half of the adolescents with asthma are well controlled.[20] Although there may be many reasons for the low rate of good control in adolescent patients with asthma, the most important factor is the low compliance rate with asthma medications.[2] In our study, similar to the literature, only 47.8% of patients had well-controlled asthma. Additionally, the finding of a strong positive linear relationship between the ACT scores and MMAS-8 scores of the patients and the statistical difference between the ACT scores of the well-controlled and uncontrolled groups indicate that medication adherence and asthma control are directly related. A high MMAS-8 score indicates that the patient's treatment compliance is high. Patients with high treatment compliance have higher ACT scores. Our results showed that the asthma control rate increased as the rate of medication adherence increased in adolescent patients with asthma.

Late adolescence is a period in which the influence of the family on the adolescent decreases, and it differs from other adolescent stages in this respect. In this period, when the influence of the family is very low, adolescents may neglect their responsibilities and voluntarily abandon their treatment. Therefore, more attention should be focused on adolescents in this age group.

Adolescents with asthma experience physical and psychosocial changes that affect their health. Inadequate asthma control, leading to reluctance to seek medical help, denial of symptoms, lack of knowledge about asthma, decreased adherence to treatment, and increased morbidity, is common in adolescents. Asthma may affect adolescents' peer relations, identity development, body image, and psychological adjustment, causing problems such as embarrassment, not carrying inhalers, and using their medication less in front of their peers.[7,21]

Takkinsatian et al.[19] examined children and adolescents with a diagnosis of asthma and found that providing education significantly increased patient compliance. In contrast, only 41.7% of patients in our study received asthma training. However, most of the training sessions were conducted without the use of a demo device and without a written asthma action plan. Intensive outpatient clinics in our country may have insufficient time for education. Trained and experienced nurses can provide more detailed asthma education using a demo device.

In addition, in our study, continuing asthma follow-up in an outpatient clinic other than a pediatric allergy outpatient clinic was found to be a risk factor for low medication adherence. This may indicate that regular follow-up of patients in pediatric allergy clinics specializing in asthma and with good social and technical facilities may be a source of motivation for compliance. In pediatric allergy and immunology clinics, adolescent asthma patients can be followed up more effectively with both pulmonary function tests and skin prick tests, and their belief in and motivation for treatment can be maintained at a higher level.

In our study, it was shown that asthma medication adherence decreased if the duration of asthma follow-up was longer than 1 year and if there was chronic medication use for a non-asthma reason. In the initial period of diagnosis and treatment, both parents and adolescents have high motivation towards the treatment of the disease. However, if the disease process is prolonged, for example after 1 year, both parents and adolescents may lose motivation, leading to a decrease in the rate of compliance with treatment. The presence of another chronic disease and the use of medication for this reason may cause fatigue and psychological boredom in the adolescent, resulting in decreased belief in asthma treatment and reduced compliance. Renewing education and motivating both the adolescent patient and parents about medication compliance during each outpatient clinic visit may help increase adherence.

This study has some limitations, including its cross-sectional design and the fact that it was based on the statements of parents and patients. However, the fact that this was a real-life study conducted with a large patient population is a significant strength. The study covers winter and spring, which may introduce seasonal differences in asthma control, representing another limitation. The most important feature of our study is that it is the first and only study on this subject conducted in our country.

CONCLUSION

In conclusion, this study showed that more than half of the adolescent asthma patients were non-compliant with their medications, and those who were non-compliant had worse asthma control. Prolonged duration of asthma follow-up, use of multiple medications due to chronic diseases, and late adolescence are risk factors for medication non-adherence. A closer follow-up of patients with these conditions in terms of adherence, more frequent outpatient clinic visits, and increased education may improve medication compliance. Additionally, parents should not completely leave the responsibility of medication use to their children. Sharing this responsibility, providing timely warnings, and motivating their children can also help increase adherence.

This study focused on medication compliance in adolescent asthma patients for the first time in our country. We believe that the data obtained from this study will contribute to efforts aimed at increasing the medication compliance of adolescent asthma patients. Furthermore, there is a need for nationwide, multicenter, prospective studies on this subject.

Statement

Ethics Committee Approval: The Ordu University Non-Interventional Scientific Research Ethics Committee granted approval for this study (date: 04.04.2024, number: E-14647249-000-0987876).

Author Contributions: Concept – MÖ, SD; Design – MÖ, SD; Supervision – MÖ, SD; Resource – MÖ, SD; Materials – MÖ; Data Collection and/or Processing – MÖ; Analysis and/or Interpretation – MÖ, SD; Literature Search – MÖ, SD; Writing – MÖ, SD; Critical Reviews – MÖ, SD.

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REFERENCES

1. Reddel HK, Bacharier LB, Bateman ED, Brightling CE, Brusselle GG, Buhl R, et al. Global initiative for asthma strategy 2021: Executive summary and rationale for key changes. J Allergy Clin Immunol Pract 2022;10:S1–18.
2. Ciprandi G, Licari A, Castagnoli R, Ciprandi R, Marseglia GL. Asthma control in adolescents: The importance of assessing adherence. Acta Biomed 2022;93:e2022264.
3. Bender BG, Bender SE. Patient-identified barriers to asthma treatment adherence: Responses to interviews, focus groups, and questionnaires. Immunol Allergy Clin North Am 2005;25:107–30.
4. McQuaid EL, Vasquez J, Canino G, Fritz GK, Ortega AN, Colon A, et al. Beliefs and barriers to medication use in parents of Latino children with asthma. Pediatr Pulmonol 2009;44:892–8.
5. Landeo-Gutierrez J, Celedón JC. Chronic stress and asthma in adolescents. Ann Allergy Asthma Immunol 2020;125:393–8.
6. Towns SJ, van Asperen PP. Diagnosis and management of asthma in adolescents. Clin Respir J 2009;3:69–76.
7. Bitsko MJ, Everhart RS, Rubin BK. The adolescent with asthma. Paediatr Respir Rev 2014;15:146–53.
8. Kaplan A, Price D. Treatment adherence in adolescents with asthma. J Asthma Allergy 2020;13:39–49.
9. World Health Organization. Adolescent health. Available at: https://www.who.int/maternal_child_adolescent/adolescence/en/. Accessed Jan 27, 2025.
10. Orben A, Tomova L, Blakemore SJ. The effects of social deprivation on adolescent development and mental health. Lancet Child Adolesc Health 2020;4:634–40.
11. Global Initiative For Asthma. 2024 GINA main report. Available at: https://ginasthma.org/2024-report/. Accessed Jan 27, 2025.
12. Uysal MA, Mungan D, Yorgancioglu A, Yildiz F, Akgun M, Gemicioglu B, et al. The validation of the Turkish version of Asthma Control Test. Qual Life Res 2013;22:1773–9. Erratum in: Qual Life Res 2013;22:1781–2.
13. Oğuzülgen IK, Köktürk N, Işikdoğan Z. Turkish validation study of morisky 8-item medication adherence questionnaire (MMAS-8) in patients with asthma and chronic obstructive pulmonary disease. Tuberk Toraks [Article in Turkish] 2014;62:101–7.
14. De Simoni A, Horne R, Fleming L, Bush A, Griffiths C. What do adolescents with asthma really think about adherence to inhalers? Insights from a qualitative analysis of a UK online forum. BMJ Open 2017;7:e015245.
15. Vazquez-Ortiz M, Angier E, Blumchen K, Comberiati P, Duca B, DunnGalvin A, et al. Understanding the challenges faced by adolescents and young adults with allergic conditions: A systematic review. Allergy 2020;75:1850–80.
16. Engelkes M, Janssens HM, de Jongste JC, Sturkenboom MC, Verhamme KM. Medication adherence and the risk of severe asthma exacerbations: A systematic review. Eur Respir J 2015;45:396–407.
17. Capanoglu M, Dibek Misirlioglu E, Toyran M, Civelek E, Kocabas CN. Evaluation of inhaler technique, adherence to therapy and their effect on disease control among children with asthma using metered dose or dry powder inhalers. J Asthma 2015;52:838–45.
18. Orrell-Valente JK, Jarlsberg LG, Hill LG, Cabana MD. At what age do children start taking daily asthma medicines on their own? Pediatrics 2008;122:e1186–92.
19. Takkinsatian P, Chantaratin S, Sirisakpanit S, Srisuwatchari W, Pacharn P, Jirapongsananuruk O, et al. Psychosocial factors and lack of asthma knowledge undermine child and adolescent adherence to inhaled corticosteroid. J Asthma 2022;59:2234–45.
20. Tosca MA, Marseglia GL, Ciprandi G; "ControL'Asma" Study Group. The real-world "ControL'Asma" study: A nationwide taskforce on asthma control in children and adolescents. Allergol Immunopathol (Madr) 2021;49:32–9.
21. Sadof M, Kaslovsky R. Adolescent asthma: A developmental approach. Curr Opin Pediatr 2011;23:373–8.