ORIGINAL ARTICLE

Predictors of Asthma Control among Libyan Adolescents with Persistent Asthma

Nadya Mohamed Elfeturi Elarusy[1,2], Shamsul Bahri Mohd Tamrin[3], Lye Munn Sann[1], Siti Irma Fadhillah Binti Ismail[4]

[1] Department of Community Health, Faculty of Medicine Sciences, Universiti Putra Malaysia, 43400 Serdang Selangor, Malaysia
[2] Department of Community Health, Faculty of Medicine, University of Zawia, Libya
[3] Department of Environmental & Occupational Health, Faculty of Medicine Sciences, Universiti Putra Malaysia. 43400 Serdang Selangor, Malaysia
[4] Department of Psychiatry, Faculty of Medicine and Health Science, Universiti Putra Malaysia, 43400 Serdang Selangor, Malaysia

ABSTRACT

Introduction: Among adolescents, asthma is an important public health burden that is associated with high morbidity and mortality. Poor asthma control is likely in this age group. Our aim was to identify the predictors of well controlled asthma among adolescents with persistent asthma in Northwest of Libya. **Methods:** A sample of 92 adolescents with persistent asthma were recruited from the respiratory clinic in Sabratha Teaching Hospital, and completed questionnaires measuring demographic and clinical characteristics, asthma knowledge, self-efficacy, and asthma control. Logistic regression analysis was carried out, taking the asthma control as the dependent variable. **Results:** Twenty-four percent of participants had well controlled asthma. In a bivariate analysis, well controlled asthma was significantly associated with adolescents having mild persistent asthma, not having allergic rhinitis, using preventive inhalers regularly, reporting higher level asthma knowledge, and higher self-efficacy. However, in multiple logistic model, only self-efficacy was an independent predictor of asthma control, with higher self-efficacy associated with well-controlled asthma (Adjusted OR= 1.107, 95% CI: 1.012 – 1.210, p= 0.026). **Conclusion:** Identifying and targeting modifiable predictors of well controlled asthma could improve asthma control. In adolescents with asthma, enhancing self-confidence of adolescents to undertake health behaviour modification seems to be an important step toward a better asthma control.
Malaysian Journal of Medicine and Health Sciences (2023) 19(1):224-231. doi:10.47836/mjmhs19.1.30

Keywords: Asthma, Asthma control, Predictors, Adolescents, Libya

Corresponding Author:
Nadya Mohamed Elfeturi Elarusy, PhD
Email: nadyaelfeturi@gmail.com
Tel: +21891-7826446

INTRODUCTION

Asthma is a global public health problem with respect to its high prevalence. About 334 million people suffer from asthma around the world, and current trends suggest that an additional 100 million may have asthma by 2025 (1). Compared to adults, the prevalence of asthma is higher in children below 18 years old. The global prevalence of asthma for 6-7 years of age, adolescents aged 13-14 years, and adults was 12, 14.1%, and 8.6% respectively (2, 3). In Libya, the prevalence of wheezing experience in the past 12 months among adult asthmatic patients based on the modified International Study of Asthma and Allergies questionnaire was 17.6% which is comparable to the prevalence in other part of the world, while the prevalence of asthma after confirmation by pulmonary function tests was 6.9% (4). Unfortunately, based on literature research, no published studies have examined the prevalence of asthma in children and adolescents, as well as the level of asthma control among all age groups in Libya. However, in neighbouring countries such as Tunisia, which is located at the border of Libya in the northwest, although the prevalence among children and adolescents was low is 3.5% [95% CI: 2.9% to 4.2%], but only 7.6% [95% CI: 4.8 -11.8%] of children were considered to be controlled. This likely reflects unsatisfactory asthma control in Tunisia (5).

Asthma control is a primary goal of asthma management. It includes assessment of symptoms, use of reliever medication, and frequency of asthma exacerbations (6). Despite the availability of effective therapies and established guidelines for asthma management, the

global level of control is still suboptimal (7-9). In a global survey called Asthma Insights and Management Survey conducted in 20 countries in North America, Europe, Latin America, and Asia-Pacific region from 2009-2011 to determine the level of asthma control based on the Global Initiative for Asthma guidelines (GINA) among 10,302 adults and adolescents with asthma, results showed poor levels of asthma control, where the global median of well controlled asthma was 9% ranging from 0% to 29% (9).

In adolescents, poor control and poor understanding of asthma are likely (10-12). Possible reasons for poor control include adolescents being less confident in using the preventive inhaler medication to prevent asthma exacerbation and control their symptom (13, 14), express difficulty to remember taking their medication because of their other priorities, and denial of their asthma symptoms (15, 16, 14). Moreover, during the period of adolescence, issue with emerging independence may contribute to poor asthma control and higher mortality rates, as parents become less able to manage asthma among their teenage children (17, 10).

Poor asthma control among this age group is associated with high morbidity and mortality (17, 18, 11). Akinbami et al. (17) showed a higher asthma mortality rate among adolescents by approximately 1.5 times compared with younger children. The other effects of poor asthma control may include impaired health related quality of life especially physical and emotional well-being, emergency hospitalizations, and school absenteeism (19). Furthermore, poor asthma control in adolescence can lead to ineffective management in adulthood and increase the risk of fixed airflow obstruction (20).
Exploring modifiable factors associated with asthma control is an essential step to enhance control in adolescents and reduce the negative impact of the disease on daily life. However, in Libya, such information on these factors had not been previously reported. Therefore, the objective of the current study was to identify the factors that predict well controlled asthma among adolescents with persistent asthma in Northwest of Libya.

MATERIALS AND METHODS

Study Design

This study was based on a cross-sectional data collected in the autumn of 2017 in the Northwest of Libya. We used baseline data of patients who participated in a randomized controlled trial to evaluate the effectiveness of an asthma educational intervention on asthma control. The total required sample size was calculated by applying the formula for two sample problem to test Hypothesis for the difference between two population proportions (21). Considering the power of 0.8, a total number of 92 asthmatic adolescents who met the criteria of participation in the study were recruited, and asked to answer the questionnaires. It was carried out among adolescents with persistent asthma at Sabratha Teaching Hospital, a public hospital that have respiratory clinic with professionally qualified doctors and nurses working there, and offers free medication for all asthma patients. The pediatric and medical general practitioners working in the emergency departments of this hospital and respiratory specialists were informed about the objectives of this study and eligibility criteria in order to facilitate recruiting patients to participate. Inclusion criteria included adolescents aged 12-18 years, with persistent asthma assessed by physicians and specified by the National Heart, Lung, and Blood Institute guidelines for at least one year (22). Adolescents with other underlying lung pathology or other chronic illness were excluded. The consent was taken from all eligible adolescents who agreed to participate and their parents.

Study Instruments

The data were collected using an Arabic questionnaire consisting of five sections; socio-demographic characteristics, medical history characteristics of participants, Asthma Control Questionnaire (ACQ), Asthma Knowledge Questionnaire, and Asthma Self-Efficacy Scale. The socio-demographic characteristics included the information about age, gender, mother and father educational level, and family income. The medical history characteristics of participants included the information about exposure to tobacco smoke, and use of preventive inhaler, severity of asthma, and comorbidities (presence of allergic rhinitis and obesity).

Asthma control was the outcome variable. It was measured with the 5-item version of ACQ-5 developed by Juniper et al (23). It is a short and simple instrument that has been validated for use in clinical trials and epidemiological surveys to identifying well-controlled asthma and poorly controlled asthma, and to facilitate comparison of results across studies (24, 25). The five questions were included in ACQ asking about frequency of awakening at night by symptoms, severity of symptoms when waking in the morning, limitations of daily activities, shortness of breath, and wheezing. It is 7-point Likert scale ranging from 0 to 6, where 0 represents excellent control and 6 represents extremely poor asthma control. The overall score is the mean of five responses. The ACQ-5 cut-off score less than one provided optimum balance of sensitivity (73.3%) and specificity (71.3%) for detecting well controlled asthma using GINA criteria as gold standard of asthma control. In the other words, if the patient has an ACQ-5 score of one or more, the patient is considered as poorly controlled asthma (25). The ACQ is a commonly standardized validated instrument used for evaluating asthma control, and translated to the other languages (26). The Arabic version of ACQ has been validated in a retrospective study among Lebanese asthmatic participants aged 7-16 years, and the internal consistency was excellent (α = 0.959) (27). Cronbach alpha ACQ of the in the current

study was 0.89.

Asthma knowledge was assessed with a modified version of the Newcastle Asthma Knowledge Questionnaire (NAKQ). The psychometric properties of NAKQ are well constructed, with evidence of adequate concurrent and discriminate validity, and high degree of reproducibility (28, 29). This questionnaire contains 25 true/false questions; each correct response is worth 1 point. The total scores range between 0 and 25, with higher scores indicating greater knowledge.

The self-efficacy was assessed using the Asthma Self-Efficacy Scale. It was composed of 14 items, assessing patient self-confidence in asthma prevention and the strength of beliefs pertaining to manage serious breathing problem. It is a 5-point Likert scale from 1 (the lowest score) to 5 (the highest score). Total scores range between 14 and 70, with higher scores indicating higher self-efficacy. The authors reported good reliability for Asthma Self Efficacy Scale ($\alpha = 0.87$) (30).

Both the modified version of NAKQ and Asthma Self-Efficacy Scale were translated from English to Arabic version according to the WHO process of translation and adaptation of instruments (31). Content validity was investigated by a team of experts composed from one asthma specialist and two pediatric consultants, and their comment were applied. The translated version of both questionnaires were tested on a sample of 105 asthmatic adolescents who were not included in this study. The modified Arabic version of NAKQ proved to be reliable in this study, with a Cronbach alpha of 86. While the Cronbach alpha of Asthma Self-Efficacy scale in the current study was 0.84. The exploratory factor analysis for the knowledge questionnaire yielded one factor, with a total explained variance of 65.72%. Whereas the factor analysis for Asthma Self-Efficacy scale yielded two factors, with a total explained variance of 61.46%.

Data Analysis

Data were analyzed using Statistical Package for Social Science (SPSS version 22). Before conducting data analysis, the data entering was checked for data entry error, missing data, and outliers. The data were examined for normality using Shapiro-Wilk test, skewness values, and visual inspection of the histograms and Q-Q plots. The alpha level of significance was set at value of ≤ 0.05 for all analysis. Descriptive statistics were summarized using means and standard deviations for continuous variables, and numbers and percentages for categorical variables. The asthma control is measured by Asthma Control Questionnaire with cut-off point < 1.00 for detecting well-controlled asthma. In order to determine the association between asthma control level and socio-demographic, medical, asthma knowledge and self-efficacy variables, the comparison between well-controlled asthma and not well-controlled asthma groups were performed by Chi-square test for categorical variables, and independent t-test for knowledge and self-efficacy variables. For 2x2 table that may contain a cell with expected counts<5, Fisher's exact test was used instead of Chi-square test. Variables which were associated with asthma control at level $p \leq 0.15$ were included in multiple logistic regressions (32). In order to reduce extremely large confidence intervals in logistic regression, the use of preventive inhalers variable was collapsed to the two categories. Participants were categorized as regularly using preventive inhalers if they used them "every day" or "most of days". Adolescents who never used preventive inhalers or used them sometimes were categorized as "irregular use of preventive inhalers" (32).

Ethical Consideration

This study was approved by the Ethics Committee for Research Involving Human Subjects University Putra Malaysia (Ref No: UPM/TNCPI/RMC/1.4.18.2 JKEUPM Ref No: (FPSK-027)2017. Moreover, the permission from Sabratha Teaching Hospital was obtained prior to carrying out this study.

RESULTS

A total of 92 asthmatic adolescents enrolled in the study. Table I summarizes the descriptive statistics of the study variables. The median age of participants was 14 years and ranging from 12 to 17 years old. Approximately 56.5% were male. Majority of participants' fathers (54.3%) and participants' mothers (53.4%) had university education and above. Most of the participants had mild persistent asthma (73.9%), had allergic rhinitis (66.3%). Majority of them were normal weight (82.6%), but only17.4% were overweight or obese. Almost a third of participants were exposed to smoking at their homes. Regarding preventive asthma medication, only 51.1% used them regularly. Moreover, approximately three quarters of participants had poorly controlled asthma and just 23.9% had well-controlled asthma.

As shown in Table II, significantly higher proportions of adolescents with mild persistent asthma (29.4%) and not having allergic rhinitis (38.7%) had well-controlled asthma while among adolescents who had more severe asthma and allergic rhinitis only 8.3% ($p= 0.037$) and 16.3% ($p= 0.018$) respectively were well-controlled. Regarding the use of preventive inhalers, 16.3% participants reported not taking any preventive inhalers, 32.6% participants took the preventive inhalers as needed, and most of them asthma was poorly controlled ($p= 0.013$). Adolescents with well controlled asthma reported better asthma knowledge (mean difference= 3.26, 95% CI= 1.30 – 5.25, $p= 0.001$), and higher self-efficacy (mean difference= 6.63, 95% CI= 3.06 - 10.20, $p<0.001$) as compared to adolescents with uncontrolled asthma.

In multiple logistic model, results indicated that the

Table I: Characteristics of the study variables. (n= 92)

Variables		Frequency (%)
Age median (SD)	14 years (1.70)	
Gender		
Male		52(56.5%)
Female		40(43.5%)
Educational level of father		
≤ Secondary education		42(45.7%)
≥ University education		50(54.3)
Educational level of mother		
≤ Secondary education		41(44.6%)
≥ University education		51(53.4)
Family income (Libyan dinar) monthly		
400 – 800 LYD		17(18.5%)
800 -1500 LYD		51(55.4%)
> 1500 LYD		24(26.1%)
Severity of asthma		
Mild persistent asthma		68(73.9%)
Moderate persistent asthma		24(26.1%)
Use of preventive inhalers		
Every day		24(26.1%)
Most days		23(25%)
Some days		30(32.6%)
Never		15(16.3%)
Had Allergic Rhinitis		
Yes		61(66.3%)
No		31(33.7%)
Body Mass Index (BMI)		
Normal		76(82.6%)
Overweight		13(14.1%)
Obesity		3(3.3%)
Expose to smoking at home		
Yes		29(31.5%)
No		63(68.5)
Asthma control test		
Uncontrolled		70(76.1%)
Controlled		22(23.9%)
Asthma knowledge Mean(SD)	13.83(4.28)	
Self-efficacy Mean(SD)	44.96(7.84)	

five-predictor model was a statistically significant (χ^2 = 27.045, p<0.001). It accounted between 25.5% and 38.2% of the variance of asthma control, and correctly predicted 82.6% of cases. As displayed in table III, only self-efficacy was found to be significant as an independent predictor of asthma control, with higher self-efficacy associated with well-controlled asthma (Adjusted OR= 1.107, 95% CI: 1.012 – 1.210, p= 0.026). On the other hand, severity of asthma, allergic rhinitis, use of preventive inhalers, and asthma knowledge were not significant in this model.

DISCUSSION

This study was the first research in Libya to assess the level of control in asthmatic patients. In this study over three-quarters of the participants was poorly controlled similar to other studies that indicated control of asthma was suboptimal in different regions of the world (9).

The above result highlighted the gap between the levels of asthma control among Libyan adolescents and level of control recommended by international guidelines, and provided opportunity to address factors adversely effecting asthma control. Therefore the predictors of asthma control were identified. The multiple logistic regression models unfortunately showed that only self-efficacy was significant. However, the multiple logistic regression model indicated that the OR for asthma knowledge, regular use of preventive inhalers, allergic rhinitis as comorbidities, and severity of asthma variables were all in the right direction, but were not significant most likely due to the lack of statistical power.

One of the most important predictors that greatly influenced the level of asthma control was the self-efficacy of participants to manage asthma. This is consistent with the results of studies which revealed a significant correlation between higher self-efficacy and better asthma control (33, 16, 34). Rhee et al (12) examined cognitive factors that predict asthma control among 373 asthmatic adolescents in USA; the results showed that higher self-efficacy predicted better asthma control (P= 0.004) and fewer missed doses of controller medication (P= 0.006). Similarly, in mixed study by van der Meer and colleagues reported that adolescents with poorly controlled asthma had limited self-efficacy, as compared to adolescents with well controlled asthma, and they accepted symptoms of asthma as part of their daily lives (15).

Multiple logistic regression analysis confirmed the finding that higher self-efficacy was the only statistically significant predictor for well-controlled asthma, with each one unit increase in asthma self-efficacy scale increasing the odds of well-controlled asthma by 1.107 times. However, asthma knowledge, allergic rhinitis, and use of preventive inhalers did not remain significant in this analysis. This finding is contrast to what other previous studies were reported. For instance, Yawn et al (35) and Harris at el. (36) reported that inadequate knowledge about the disease's management and recognition of asthma symptoms in asthmatic adolescents was associated with poor control. Stanford and colleagues conducted a cross-sectional survey study that included 2429 asthmatic patients below 18 years old to assess factors that influence asthma control (37). They found that patients with irregular use of preventive inhalers were more likely to have inadequate control (adjusted OR =1.41, 95% CI 1.05-1.91). Vandenplas et al (38) examined the effect of allergic rhinitis on asthma control among 1173 patients with asthma aged 12 years or above. The risk of suboptimal control was increased among patients who had allergic rhinitis by two times

Table II: Results of analysis of potential predictors of asthma control

Variables	Well-controlled asthma (n= 22)	Uncontrolled asthma (n= 70)	Test Statistic	P value
Age (Median)	13 years	14 years	U= 689	0.450
Gender				
Male	13(25%)	39(75%)	$\chi^2 = 0.078$	0.780
Female	9(22.5%)	31(77.5%)		
Educational level of father				
≤ Secondary education	10(23.8%)	32(76.2)	$\chi^2 = 0.000$	0.983
≥ University education	12(24%)	38(76%)		
Educational level of mother				
≤ Secondary education	7(17.1%)	34(82.9%)	$\chi^2 = 1.902$	0.168
≥ University education	15(29.4%)	36(70.6%)		
Family income (LYD)				
400 – 800 LYD	3(18.8%)	13(81.2%)	FET = 0.727	0.715
800 -1500 LYD	12(23.5%)	39(76.5%)		
> 1500 LYD	7(28%)	18(72%)		
Severity of asthma				
Mild persistent	20(29.4%)	48(70.6%)	FET = 5.057	0.030*
Moderate persistent	2(8.3%)	22(91.7%)		
Use of preventive inhalers				
Never	1(6.7%)	14(93.3%)	FET= 9.889	0.016*
Some days	4(13.3)	26(86.7%)		
Most days	6(26.1%)	17(73.9%)		
Every day	11(45.8%)	13(54.2%)		
Had Allergic Rhinitis				
Yes	10(16.4%)	51(83.6%)	$\chi^2 = 0.5.626$	0.018*
No	12(38.7%)	19(61.3%)		
Body Mass Index (BMI)				
Normal	18(23.7%)	58(76.3%)	FET = 3.161	0.170
Over weight	2(15.4%)	2(84.6%)		
Obesity	2(66.7%)	1(33.3%)		
Expose to smoking at home				
Yes	5(17.2%)	24(82.8%)	$\chi^2 = 1.036$	0.309
No	17(27%)	46(73%)		
Asthma knowledge Mean(SD)	16.32(4.93)	13.04(3.77)	t = 3.249	0.001*
Self-efficacy Mean(SD)	50.00(8.46)	43.37(6.98)	t = 3.687	<0.001*

*Significant result at P<0.05. FET =Fisher's Exact Test. Over weight: BMI ≥85th percentile.
Obesity: BMI ≥95th percentile

Table III: Multiple logistic model on predictors of well asthma control (n=92)

Variables	B	S.E.	Wald	Adjusted OR (95%CI)	P value
Moderate persistent asthma	-1.554	0.895	3.012	0.211 (0.037- 1.223)	0.083
Absence of allergic rhinitis	1.025	0.588	3.031	2.78 (0.879-8.827)	0.082
Regular use of preventive inhalers	0.898	0.623	2.083	2.456 (0.725-8.320)	0.149
asthma knowledge	0.131	0.074	3.106	1.140 (0.985-1.319)	0.078
self-efficacy	0.101	0.045	4.975	1.107 (1.012-1.210)	0.026*

*Significant result at P<0.05.

(AOR=2.00, 95% CI 1.35-2.97; P = 0.002) after adjusting age, gender, and smoking habits variables. Rege and colleagues conducted national survey on 795 asthmatic patients aged 6-17 years to evaluate asthma control and asthma severity (39). They found that moderate to severe persistent asthma was associated with greater odds of poor asthma control (OR= 15.35; p= 0.003). The study by Dalcin et al (40) on 275 patients aged 11 years and above, revealed that a diagnosis of severe persistent asthma had higher odds of uncontrolled asthma (OR= 5.3; p<0.0001). Possible reasons for the difference between the results of this study and these previous

studies might be the larger sample sizes, and research design of earlier studies that were cross-sectional studies and included many age groups.

This study has several limitations. First, the generalizability might be limited because this research was undertaken in one public hospital only in Northwest of Libya. Hence, it might not provide adequate representation for all asthma care, especially general practice. Moreover, recruiting small number of participants with moderate asthma and lack of recruitment of severe asthmatic adolescents limited generalizability of findings to mild asthmatic adolescents. Yet another limitation is that the regular use of controller medications was measured at baseline by adolescent self-report which may influence bias. Future research should reassess the relationship between asthma control and objective measures of using preventive inhaler medications (for example, metered dose count device).

CONCLUSION

The results of the current study demonstrated that the majority of the participants had poor asthma control, and the level of self-efficacy was shown to be a strong predictor for asthma control. These findings suggest that in general there is a need for conducting an educational intervention that is designed to enhance self-confidence of asthmatic adolescents to undertake health behaviour and improving their level of asthma control.

ACKNOWLEDGEMENTS

The authors would like to thank the medical staff of Sabratha Teaching Hospital for their fruitful cooperation during this study. The authors would also like to thank all patients for their cooperation and willing to participate in the study, which would never be possible to carry out without their contribution.

REFERENCES

1. Adeloye D, Chan KY, Rudan I, Campbell H. An estimate of asthma prevalence in Africa: a systematic analysis. Croatian medical journal. 2013;54(6):519-31. doi: 10.3325/cmj.2013.54.519
2. Lai CK, Beasley R, Crane J, Foliaki S, Shah J, Weiland S, ISAAC Phase Three Study Group. Global variation in the prevalence and severity of asthma symptoms: phase three of the International Study of Asthma and Allergies in Childhood (ISAAC). Thorax. 2009;64(6):476-83. doi:10.1136/thx.2008.106609
3. To T, Stanojevic S, Moores G, Gershon AS, Bateman ED, Cruz AA, et al. Global asthma prevalence in adults: Findings from the cross-sectional world health survey. BMC public health. 2012;12(1):1-8. doi:10.1186/1471-2458-12-204
4. Iesa MA, Awooda HA, Konozy EH, Musa OA. Wheezing alone is not enough to validate asthma diagnosis among Libyan adults: A questionnaire-based study reinforced with pulmonary function test. Sudan Medical Monitor. 2017;12(1):25-29. doi: 10.4103/summ.summ_12_17
5. Nafti S, Taright S, El Ftouh M, Yassine N, Benkheder A, Bouacha H, et al. Prevalence of asthma in North Africa: the Asthma Insights and Reality in the Maghreb (AIRMAG) study. Respiratory medicine. 2009;103:S2-11. doi:10.1016/S0954-6111(09)70022-8
6. Reddel HK, Bateman ED, Becker A, Boulet LP, Cruz AA, Drazen JM, et al. A summary of the new GINA strategy: A roadmap to asthma control. European Respiratory Journal. 2015;46(3):622-39. doi: 10.1183/13993003.00853-2015
7. Demoly P, Paggiaro P, Plaza V, Bolge SC, Kannan H, Sohier B, et al. Prevalence of asthma control among adults in France, Germany, Italy, Spain and the UK. European Respiratory Review. 2009;18(112):105-112. doi: 10.1183/09059180.00001209
8. Thompson PJ, Salvi S, Lin J, Cho YJ, Eng P, Abdul Manap R, et al. Insights, attitudes and perceptions about asthma and its treatment: Findings from a multinational survey of patients from 8 Asia-Pacific countries and Hong Kong. Respirology. 2013;18(6):957-967. doi:10.1111/resp.12137
9. Nathan RA, Thompson PJ, Price D, Fabbri LM, Salvi S, Gonz6lez-Dнaz S, et al. Taking aim at asthma around the world: global results of the asthma insight and management survey in the Asia-Pacific region, Latin America, Europe, Canada, and the United States. The Journal of Allergy and Clinical Immunology: In Practice. 2015;3(5):734-42. doi:10.1016/j.jaip.2015.04.013
10. Sadof M, Kaslovsky R. Adolescent asthma: a developmental approach. Current opinion in pediatrics. 2011;23(4):373-8. doi: 10.1097/MOP.0b013e32834837cb
11. Asher I, Pearce N. Global burden of asthma among children. The international journal of tuberculosis and lung disease. 2014;18(11):1269-78. doi: 10.5588/ijtld.14.0170
12. Rhee H, Wicks MN, Dolgoff JS, Love TM, Harrington D. Cognitive factors predict medication adherence and asthma control in urban adolescents with asthma. Patient preference and adherence. 2018;12:929-937. doi: 10.2147/PPA.S162925
13. Ayala GX, Yeatts K, Carpenter DM. Brief report: Factors associated with asthma management self-efficacy among 7th and 8th grade students. Journal of paediatric psychology. 2009;34(8):862-868. doi:10.1093/jpepsy/jsn134
14. Naimi DR, Freedman T, Ginsburg KR, Bogen D, Apter AJ. Adolescents and Asthma: Why Bother with Our Meds?. Journal of Allergy and Clinical Immunology. 2009;123(6):1335-1341. doi:10.1016/j.jaci.2009.02.022
15. Van der Meer V, Van Stel HF, Detmar SB, Otten W,

Sterk PJ, Sont JK. Internet-based self-management offers an opportunity to achieve better asthma control in adolescents. Chest. 2007;132(1):112-119. doi:10.1378/chest.06-2787
16. Rhee H, Belyea MJ, Ciurzynski S, Brasch J. Barriers to asthma self-management in adolescents: Relationships to psychosocial factors. Pediatric pulmonology. 2009;44(2):183-91. doi:10.1002/ppul.20972
17. Akinbami LJ, Moorman JE, Garbe PL, Sondik EJ. Status of childhood asthma in the United States, 1980–2007. Pediatrics. 2009;123(3):S131-45. doi:10.1542/peds.2008-2233C
18. Hennessy-Harstad E. Asthma and adolescents: review of strategies to improve control. The Journal of School Nursing. 2013;29(1):39-51. doi:10.1177/1059840512454546
19. Braido F. Failure in asthma control: reasons and consequences. Scientifica. 2013; 2013:1-15. doi:10.1155/2013/549252
20. Fehrenbach H, Wagner C, Wegmann M. Airway remodelling in asthma: what really matters. Cell and tissue research. 2017;367(3):551-569. doi:10.1007/s00441-016-2566-8
21. Lemeshow, S., Hosmer, D. W., Klar, J., Lwanga, S. K., & World Health Organization. (1990). Adequacy of sample size in health studies. West Sussex P019 1 UD, England: John Wiley & Sons
22. National Heart, Lung, and Blood Institute. National Asthma Education and Prevention Program. (2007). Expert panel report 3: Guidelines for the diagnosis and management of asthma. Retrieved from:https://www.nhlbi.nih.gov/files/docs/guidelines/asthgdln.pdf
23. Juniper EF, O'Byrne PM, Guyatt GH, Ferrie PJ, King DR. Development and validation of a questionnaire to measure asthma control. European respiratory journal. 1999;14(4):902-7. doi: 10.1034/j.1399-3003.1999.14d29.x
24. Juniper EF, O'Byrine PM, Roberts JN. Measuring asthma control in group studies: do we need airway calibre and rescue β2-agonist use?. Respiratory medicine. 2001;95(5):319-323. doi:10.1053/rmed.2001.1034
25. O'Byrne PM, Reddel HK, Eriksson G, Llstlund O, Peterson S, Sears MR, Jenkins C, Humbert M, Buhl R, Harrison TW, Quirce S. Measuring asthma control: a comparison of three classification systems. European Respiratory Journal. 2010;36(2):269-76. doi: 10.1183/09031936.00124009
26. Rhee H, Love T, Mammen J. Comparing asthma control questionnaire (ACQ) and national asthma education and prevention program (NAEPP) asthma control criteria. Annals of Allergy, Asthma & Immunology. 2019;122(1):58-64. doi:10.1016/j.anai.2018.09.448
27. Hallit S, Raherison C, Waked M, Salameh P. Validation of asthma control questionnaire and risk factors affecting uncontrolled asthma among the Lebanese children's population. Respiratory medicine. 2017;122:51-57. doi:10.1016/j.rmed.2016.11.018
28. Fitzclarence CA, Henry RL. Validation of an asthma knowledge questionnaire. Journal of paediatrics and child health. 1990;26(4):200-4. doi:10.1111/j.1440-1754.1990.tb02429.x
29. Espinosa L, AM SS. The Spanish version of the Newcastle Asthma Knowledge Questionnaire for parents of children with asthma (NAKQ). Transcultural adaptation and reliability analysis. In Anales De Pediatria (Barcelona, Spain: 2003) 2009:70 (3): 209-217. doi: 10.1016/j.anpedi.2008.10.013
30. Bursch B, Schwankovsky L, Gilbert J, Zeiger R. Construction and validation of four childhood asthma self-management scales: parent barriers, child and parent self-efficacy, and parent belief in treatment efficacy. Journal of Asthma. 1999;36(1):115-28. doi:10.3109/02770909909065155
31. World Health Organization. (2013). Process of translation and adaptation of instruments. Retrieved from http://www.who. int/substance_abuse/research_tools/translation/en/.
32. Tabachnick BG, Fidell LS. Using multivariate statistics, 6th (ed.), 2013, Boston, MA.
33. Lavoie KL, Bouchard A, Joseph M, Campbell TS, Favreau H, Bacon SL. Association of asthma self-efficacy to asthma control and quality of life. Annals of Behavioral Medicine. 2008;36(1):100-6. doi:10.1007/s12160-008-9053-8
34. Wood MR, Price JH, Dake JA, Telljohann SK, Khuder SA. African American parents'/guardians' health literacy and self-efficacy and their child's level of asthma control. Journal of pediatric nursing. 2010;25(5):418-27. doi:10.1016/j.pedn.2009.05.003
35. Yawn BP, Rank MA, Bertram SL, Wollan PC. Obesity, low levels of physical activity and smoking present opportunities for primary care asthma interventions: an analysis of baseline data from The Asthma Tools Study. NPJ primary care respiratory medicine. 2015;25(1):1-7. doi:10.1038/npjpcrm.2015.58
36. Harris K, Mosler G, Williams SA, Whitehouse A, Raine R, Grigg J. Asthma control in London secondary school children. Journal of Asthma. 2017;54(10):1033-40. doi:10.1080/02770903.2017.1299757
37. 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). Journal of Asthma. 2010;47(3):257-62. doi:10.3109/02770900903584019
38. Vandenplas O, Dramaix M, Joos G, Louis R, Michils A, Verleden G, Vincken W, Vints AM, Herbots E, Bachert C. The impact of concomitant rhinitis on

asthma-related quality of life and asthma control. Allergy. 2010; 65(10):1290-7. doi:10.1111/j.1398-9995.2010.02365.x

39. Rege S, Kavati A, Ortiz B, Mosnaim G, Cabana MD, Murphy K, Aparasu RR. Documentation of asthma control and severity in pediatrics: analysis of national office-based visits. Journal of Asthma. 2020;57(2):205-16. doi:10.1080/02770903.2018.1554069
40. Dalcin PD, Menegotto DM, Zanonato A, Franciscatto L, Soliman F, Figueiredo MD, Pereira RP. Factors associated with uncontrolled asthma in Porto Alegre, Brazil. Brazilian Journal of Medical and Biological Research. 2009;42(11):1097-103. doi: 10.1590/S0100-879X2009005000035