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THE EFFECTS OF AN ASTHMA ACTION PLAN AND ASTHMA SELF-EFFICACY ON
ASTHMA CONTROL

By

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A Thesis

Presented in Partial Fulfilment of Requirements for the
Degree of Master of Science in Health Sciences in the
Department of Respiratory Therapy

Under the supervision of Dr. Rachel Culbreth

In

Byrdine F. Lewis College of Nursing and Health Professions

Georgia State University

Atlanta, GA 2021

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ACCEPTANCE

This thesis, The Effects of Asthma Action Plan and Asthma Self-efficacy On Asthma Control, by Abdullah Alkhthlan was prepared under the direction of the Master's Thesis Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Master of Science in the Byrdine F. Lewis College of Nursing and Health Professions, Georgia State University. The Master's Thesis Advisory Committee, as representatives of the faculty, certify that this thesis has met all standards of excellence and scholarship as determined by the faculty.



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Abstract

Background: Asthma is one of the major chronic diseases around the world. The use of an asthma action plan has been recommended widely from various well-known health organizations as a form of self-management. Despite the widespread recommendation, the use of an asthma action plan is still questionable. **Purpose:** The purpose of this study to assess the effectiveness of asthma action plan and asthma self-efficacy on asthma control. **Methods:** The study was carried out as quantitative cross-sectional survey. The survey was carried out online and consists of three tools which are the Asthma Control Test (ACT), Asthma Impact Survey (AIS) and the Consumer Health Activation Index survey (CHAI). The subjects are divided to two groups adult asthma patients and children with asthma. **Results:** A total of two hundred and nine respondents, 139 of the respondents completed the survey (Adults group $n=77$, and Children group $n= 62$). The average mean ACT score for adults was 13.45, SD 5.3 and 18.98, SD 4.1 and p value < 0.001 . Adult patients with an asthma action plan had a mean ACT score of 12.85 SD 5.54 and those without an AAP had a mean score of 14 SD 5.2, p value 0.372. And for the children group with an AAP had a mean ACT score of 19.06, SD 3.9, and those with an AAP had a mean score of 18.55 with SD 4.97, p value = 0.737. A linear regression analysis was done to compare the ACT score and the CHAI score. No association was found between the ACT and CHAI tools in both groups with a p value of 0.827 for the adult group and p value of 0.963 for the children group. **Conclusion:** Despite the widespread recommendation of the use of an asthma action plan, we found that having an asthma action plan did not improve asthma control.

CHAPTER I

INTRODUCTION

Asthma is one of the major chronic diseases around the world. Asthma ranges from mild and not noticeable to very severe and life-threatening. Between 2011 and 2014, asthma prevalence was 8.8% among American adults and 10% among American children (Akinbami, 2016; CDC, 2012). There are 1.7 million yearly emergency room visits in the United States due to asthma exacerbations (Rui et al., 2014). The average cost of an asthma related emergency room visit in the United States is around \$1,502. Furthermore, asthma costs the U.S. economy around \$80 billion dollars per year (Nurmagambetov et al., 2018). Most asthma patients have poor control of their asthma, and that can jeopardize their work, school, quality of life, and health (FitzGerald et al., 2006; Furtado et al., 2019). The purpose of this study is to investigate whether asthma patients with asthma action plans have better control over their asthma than patients who have not received asthma action plans from their physicians. In this study, I also examine the relationships between the overall knowledge of how to use an asthma action plan, adherence to medication, and patients' overall perception of asthma control.

Poorly controlled asthma can be costly and can cause permanent damage to the airway, which is called airway remodeling (Bergeron, C., et al, 2009). Although there is no cure for asthma, self-management control of asthma has been used for years and showed significant success in managing asthma symptoms and frequency (Andrews, K. L., et al., 2014). From 2002 to 2013, the percentage of American children that have received an asthma action plan increased from 41.7% to 50.7% ($p < .001$) (Simon, A. E., et al., 2016). Despite the positive outcomes of the asthma action plan, only half of the children in the US with asthma received an asthma action plan according to 2013 study. The Global Initiative for Asthma (GINA, 2020) suggests that all patients should have an asthma action plan. Moreover, one of the four key components for asthma self-management provided by the National Heart, Lung and Blood Institute is an asthma action plan (NHLBI, 2007).

Statement of problem

Despite the fact that most asthma guidelines recommend the use of the asthma action plan, there is conflicting evidence about the benefit of the asthma action plan (Espinoza-Palma, T., 2009 and Sheares, B. J., 2015). Results from one randomized control trail showed that the asthma action plan did not provide any added benefits of asthma control compared with patients who received proper asthma education (Sheares, B. J., 2015). Because of this literature gap and insufficient evidence, we aim to investigate the association between having an asthma action plan and asthma control.

Asthma is a chronic disease that effects the life of millions of people around the world. The aim is to assess the efficacy of widely used asthma self-management tools that has been debated over the years. These findings will help us provide the most effective treatment and management for asthma patients.

Purpose of Study

The purpose of this study is to investigate whether asthma patients with asthma action plans have better control over their asthma than patients who have not received an asthma action plan by their physicians. Also, we will examine the relationship of the overall knowledge of using an asthma action plan and their control of asthma among individuals with asthma. The percentage of asthma patients with an asthma action plan will be calculated. The research questions for adult asthma patients that inform this study are:

1. What is the overall prevalence of asthma patients with an asthma action plan?
2. Is there an association between asthma action plans and hospitalization/emergency room visits among adult patients?

3. Is there an association between asthma self-efficacy and better asthma control for patients?

Also, the research questions for asthma pediatric patients completed by parents are as follows:

1. What is the overall prevalence of asthma pediatric patients with an asthma action plan?
2. What are the overall pediatric asthma patients with an asthma action plan as stated by their parents?
3. Is there an association between asthma action plans and hospitalization/emergency room visits among pediatric patients as stated by their parents?

The intended results from this study will improve our understanding of the impact of asthma action plans on asthma patients' asthma and quality of life. The ultimate goal of these results is to inform asthma control to ultimately increase awareness of asthma action plans for physicians, patients and care givers.

This study will use pre-validated asthma tools for asthma control assessment, patient quality of life tool along with demographic questions (Nathan, et al., 2004, M. Schatz et al., 2007 & Wolf et al., 2018). This study also seeks to determine if patients with an asthma action plan have better control over their symptoms, fewer ER visits, a better quality of life than patients without an asthma action plan.

Definition of Terms

GINA: The global initiative for Asthma. It is an initiative that was launched by the National Heart Lung and Blood Institute and the World Health Organization in 1993 to increase awareness about asthma.

NHLBI: The National Heart, Lung, and Blood Institute is the third largest institute of the National Institute of Health. It provides leadership in research, training, and education program for the public health.

AAP: Asthma action plan provides information and instruction on how to manage asthma.

ER: Hospital Emergency Department.

CHAPTER II

REVIEW OF THE LITERATURE

A review of the literature on asthma action plans and asthma control was conducted to inform the current study. The databases used for this research were PubMed, EBSCOhost, Science Direct, and Google scholar. The databases were accessed through online library searches at Georgia State University. Only peer-reviewed journals were selected to ensure the articles were of high quality (i.e., *Respiratory Care*, *Chest*, *Respiratory Physiology and Neurobiology*, *Respiration*, *European Respiratory Journal*, and the *American Journal of Respiratory and Critical Care Medicine*).

A wide range of articles were found. Numerous articles were assessed and examined for relevancy to our topic question “does having an asthma action plan improve asthma control” and, “do asthma patients fully understand their asthma action plans.” We used the following search terms: *asthma action plan*, *asthma self-management*, or *written asthma action plan WAAP*, “AND” *asthma control*, and the names of the previously selected journals. Additional articles were found in the cited references of the reviewed articles. In the literature review, three main aspects of asthma action plans were examined: knowledge of one’s condition and treatment, having an individualized action plan, and the effectiveness of the asthma action plan.

Effectiveness of asthma action plans

There is conflicting evidence about the effectiveness of the use of asthma action plans. Farag, H et al (2018) explored whether asthma action plans improve patients’ skills, knowledge, and asthma self-management. The researchers concluded that patients with an asthma action plan have better outcomes and fewer asthma flare-ups than those who do not (Farag, Abd El-Wahab, El-Nimr, & Saad El-Din, 2018). Rice et al (2015) found that children diagnosed with status asthmaticus who were properly educated and given asthma action plans reported using asthma controllers more often than others and that

among these children, asthma self-efficacy was significantly improved and the children were more likely to have asthma action plans than others (Rice et al., 2015). In a randomized control trial, Ducharme et al. (2011) assessed the efficacy of asthma action plan independent value. A total of 219 children were divided into two groups, a group that received an asthma action plan and a second group that received only a prescription. The researchers found that children who received asthma action plans were more likely to adhere to their prescriptions than those who did not (Ducharme et al., 2011). Gronofolah, et al (2019) investigated the effectiveness of written asthma action plans for asthma patients. The researchers assessed the patients' knowledge, exacerbations rates, frequency of rescue medication use, quality of life, and self-confidence in treating their asthma before and after using a written asthma action plan. The researchers found that having an asthma action plan improved patients' knowledge about their condition, quality of life, and asthma control confidence levels (Goronfolah et al., 2019). Other researchers found that asthma patient caregivers reported having more confidence in managing asthma and felt more capable, safe and likely to understand bronchoconstriction than caregivers without asthma action plans (Tan, Chen, Soo, Ngoh, & Tai, 2013). It is clear that asthma action plan can have a positive impact on patients' condition, asthma control, quality of life or emergency visits. However, all of these studies were done in hospitals or health care facilities and that alone can influence the results. Patient activation and willingness to participate in managing their asthma, also asthma severity could be factor that influence their decision to seek professional help. More severe and unmanageable symptoms will most likely to be present at hospital than those who have less severe or more manageable symptoms.

In addition to claims about the efficacy of asthma action plans, we have found numerous researchers questioned the efficacy of asthma action plans. Most researchers compared asthma action plans to asthma education sessions or standard asthma care, such as the giving of medication and brief asthma education and also most of them found that asthma action plans did not add any benefit to proper educational sessions. For instance, in a recent study conducted in Australia, (Harrison, Duggan, Preddy, &

Moline, 2020) found that even children with asthma action plans did not comply with them or have improved outcomes compared to asthmatic children without asthma action plans. In another randomized control trial with 91 children, Khan, Maharaj, Seerattan, and Babwah, (2014) found that providing an asthma action plan is not better than providing standard asthma care (Khan, Maharaj, Seerattan, & Babwah, 2014). In a 2017 systematic review, researchers particularly examined the effectiveness of asthma action plans when used alone and in combination with educational sessions among adults with asthma. A total of 15 randomized control trials were included in the study. The researchers concluded that there was no evidence that using an asthma action plan caused additional benefits or harm in these randomized control trials (Gatheral et al., 2017). Zhu et al (2020) conducted a study on Chinese children to assess the effectiveness of the Chinese asthma action plan that was developed in 2017. The researchers concluded that the asthma action plan did not have any greater benefits than standard asthma care (Zhu, Xiang, & Shen, 2020). Also, in 2006, Chooniedass (2006) found that only 28% of the recruited children had an asthma action plan. Furthermore, no improved asthma control was observed among children with asthma action plans (Chooniedass, 2006).

Patient Knowledge

Patient knowledge can influence the management of asthma and the efficacy of treatment (Auger, et al 2015). Auger et al. 2015 investigated if asthma readmission and caregiver's knowledge in pediatric patients can impact the patient's outcome. A total of 601 children who had been hospitalized for asthma were included in the study. The researchers found that greater asthma knowledge and decreased medication adherence were associated with asthma readmission (Auger, Kahn, Davis, & Simmons, 2015). Schuermans, et al. (2018) investigated the impact of 10-minute educational sessions on asthma control. This prospective randomized control trial included 160 adult asthma patients who had attended 10-minute asthma education sessions. After three months, the intervention group had well controlled asthma, knowledge of their medication, and knowledge of their medical device and inhalation technique

(Schuermans et al., 2018). Another study was conducted in Switzerland to assess the potential benefits of standardized asthma education for asthma control (Dürr et al 2017). The researchers assessed 223 patients for 1-year following an asthma education session. The subjects were divided into two groups, participants and non-participants. The researchers found that the education session improved patients' asthma control and perceptions of asthma care and self-management support (Dürr et al., 2017). This literature review also examined whether training asthma educators on instructing and educating asthma patients can improve their asthma outcomes. A 2020 systematic review, Babineau et al (2020) looked into whether the self-management support activities of trained asthma educators can influence patient outcomes. The study consisted of a total of 16 trails that focused on asthma training activities for educators and patient outcomes were included. The researchers concluded that SMS provided by trained educators can be beneficial in improving patients quality of life (Babineau-Therrien, Boulet, & Gagné, 2020).

Despite the widespread recommendation for the use of asthma action plans, the effectiveness of their use is still questionable (CDC, 2020; GINA, 2020; NIH, 2018). It is plausible that there are factors contributing to this confliction. Most of the reviewed studies were conducted in hospital settings, such as emergency departments and clinics. Also, most of the study designs reviewed prevented the effective assessment of the efficacy of asthma action plans in the general public. Most of these studies were single centered or most of the patients were exposed to the same experiences, such as seeing the same doctor, receiving the same care, education, or treatment, or living in the same city, which can significantly influence the results

Respiratory Therapists' role in treating asthma

Respiratory therapists are valuable in the hospital and play a huge role in the performance of medical procedures, optimal delivery of in-patient respiratory treatments, providing lung-protective

ventilation, the development and implementation of protocols to wean patients from mechanical ventilation, and the application of disease management programs for COPD (Kollef, 2017). Nonetheless, respiratory therapists' role in treating asthma is clearly valuable as well. Researchers from Duke University Medical Center found that the implementation of an asthma pathway that incorporated respiratory therapist-driven weaning of bronchodilators was associated with significant decrease in overall hospital LOS, pediatric intensive care unit LOS, and the time on continuous albuterol for pediatric asthma patients (Miller et al., 2019). While asthma disease management is administered by multidisciplinary personnel, respiratory therapists are found to be the ultimate to deliver such an intervention. Researchers from LSU, UT health and Rush university conducted a randomized control trial to assess the role of nurses, respiratory therapist or usual care provided by physician offices in administering an in-home asthma disease management. The researchers found that the respiratory therapists group had a reduced hospitalization, in-patient days, cost, quality of life and patient satisfaction than nurses and usual care provided by physician offices (Shelledy, Legrand, Gardner, & Peters, 2009).

CHAPTER III

METHODOLOGY

To address the study aims, a quantitative cross-sectional questionnaire study was conducted among individuals with asthma. The quantitative questionnaire included demographic questions and previously validated asthma control questionnaires. Demographic questions consisted of age, sex, race/ethnicity and location. Three pre-validated tools were used alongside with demographic questionnaires.

Asthma Control Test (ACT) Tool

The first tool is the Asthma Control Test (ACT)(Nathan et al., 2004). The tool consists of five questions that assess asthma control. The tool was recognized by the National Institute of Health (NIH) 2018 asthma guidelines and has been validated and found to be valid and reliable ($\alpha = 0.84$) (NIH, 2007)(Michael Schatz et al., 2007). The tool is intended for use with adolescents or adults between the age of 12 to 70 years old. The tool has a total score of 25 which interpreted as asthma is under control, a score of 15 to 19 and less is interpreted as partially controlled and a score of 14 or less indicates asthma is poorly controlled.

Asthma Impact Survey for adults and pediatrics

There are two versions of this tool one version for adults 18years and older and the other version is for pediatric patients from the age of 5 to 17 years old. This tool measures the impact of asthma on an individual's health related quality of life (HRQOL). The Asthma Impact Survey is a validated tool ($\alpha = 0.94$) (M. Schatz et al., 2007). A score of 60 and more indicates sever impact, which means asthma is severely impacting the patient's ability to function in everyday life. The patient may be experiencing asthma-related symptoms that are more severe than those of other asthma sufferers. A score of 55 to 59 indicates substantial impact which means that asthma is substantially impacting the patient's ability to function in everyday life. The patient may be experiencing asthma-related symptoms that limit his/her

performance in daily activities at home, work, or school, and participation in social activities. A score of 49 to 54 indicates some impact which means that asthma is having some impact on the patient's life but probably not enough to limit performance in daily activities or participation in social activities. And a score of 49 and less indicates little or no impact which means that asthma is having little or no impact on the patient's life.

Consumer Health Activation Index (CHAI v1) Survey Tool

The third tool is a patient health activation survey called Consumer Health Activation Index (CHAI™v1) Survey. This survey measures patients' willingness and ability to take independent actions to manage their own health. The tool is validated for patients 18 years old and older ($\alpha= 0.81$)(Wolf et al., 2018). The score ranges between 0 to 100. A score from 0 to 79 indicates low activation, 80 to 94 moderate activation and 95 to 100 indicates high activation.

Sampling Design

The study population was recruited from a Facebook asthma support group with approximately 23,000 individuals, most of which are asthma patients. The sample population was divided into two subgroups, adult asthma patients and parents of children with asthma. The sample population consists of patients ranging from 18 years to 70 years old and parents of children with asthma ranging from 1 to 17 years old. The target sample size was 100 total respondents. Based on previous power calculations of the intended computed statistics.

A post was made on the Facebook group asking members of the group for participation. Before the post was made, permission was sought from the group admins. A link for the survey was created where the questionnaire for the study was found. The link was created using the Qualtrics software (Qualtrics, Provo, UT). The link was posted on the Facebook group whereby interested participants was

able to visit the link and complete the survey. The data collection process began on 1st December 2020 to 21st April 2021.

Data Analysis

The collected data was entered into the SPSS IBM v27 software package for analysis. The data will be reviewed for any outliers or typographical errors. Descriptive statistics was computed to determine the percentage of individuals with an asthma action plan. T-tests tests were conducted to examine the association between having an asthma action plan and overall asthma control. A Chi square test was conducted to compare the association between hospitalization/emergency visits and having an asthma action plan. Predictors for having better asthma control was also computed in a regression model to compare the scores between the ACT and AIS tools.

Ethical Considerations

Permission to conduct the study was sought from the Facebook group Administrators. Prior to completing the survey, a consent form was provided to the respondents. By signing the consent form, respondents agree take part in the survey voluntarily. They also were given the opportunity to exit the survey anytime they wish. Information collected was only used for the purpose of this study and is kept confidential, out of reach of third party. This study was approved by the Georgia State University Institutional Review Board.

CHAPTER IV

RESULTS

A total of two hundred and nine respondents were recruited to complete the survey. 36.4 % of the population were males and 63.6% were females. 50.6% of the adult group age between 18 and 32 years old, 41.6% age between 33-48, and 7.8% age 49 and older. For the children group, 72.6% age 11 years old or less, 25.8% age between 12 and 17 years old and 1.6% ages between 18 and 32 years old. The respondents were asked about their race, 74% of the adult group were white, 10.4 were black or African American, 13% were Asians and 2.6 were others. For the children group 74.2% were white, 14.5% were black or African American, 9.7% were Asians and 1.6 were American Indian or Alaska Native.

Table 1. Baseline characteristics of the study population

	Adults group n = 77	Children group n = 62
Age in years (%)	18-32 (50.6) 33-48 (41.6) 49 – older (2.9)	11 or less (72.6) 12-17 (25.8) 18-32 (0.5)
Race n (%)		
White	57 (74)	46 (74.2)
Black or African American	8 (10.4)	9 (14.5)
Asian	10 (13)	6 (9.7)
Others	2(2)	1(0.5)
Gender n (%)		
Male	14 (18.2)	36 (58.1)
Female	63 (81.8)	26 (41.9)
Do you have an asthma action plan?		
Yes	38 (49.4%)	53 (85.5%)
No	39 (50.6%)	9 (14.5%)
12 months ED visits due to asthma		
Yes	35(45.5%)	30(48.4%)
No	42(54.5%)	32(51.6%)
12 months hospitalization due to asthma		
Yes	18(23.4%)	7(11.3%)
No	59(76.6%)	55(88.7%)
Do you have pets (dogs, cats, and/or birds)?		
Yes	47(61%)	36(58%)
No	30(39%)	26(42%)

Asthma control Test tool was used to measure patient's asthma control. The results are interpreted as follows. A score of 20 and more indicates that asthma is controlled, 15 to 19 means somewhat controlled and 14 and less indicates that asthma is not controlled. The ACT score was compared with a number of factors as seen in table 2. The mean ACT score for adults was 13.45, SD 5.3 and for children was 18.98, SD 4.11 and p value < 0.001.

Table 2 Analysis of the association of Asthma control test scores (ACT).

Outcomes	Adults		Children	
	n (Mean ACT)	<i>P</i> value	n (Mean ACT)	<i>P</i> value
12 months hospitalization		< 0.001		0.053
Yes	18(7.7)		7(17.00)	
No	53(15.39)		48(19.2)	
12 months ED visits		< 0.001		0.061
Yes	34(10.23)		28(17.96)	
No	37(16.4)		27(20.03)	
Do you have an asthma action plan?		0.372		0.737
Yes	34(12.85)		46(19.06)	
No	37(14.00)		9(18.5)	
Do you have pets (dogs, cats, and/or birds)?		0.564		0.220
Yes	42 (13.14)		32 (19.56)	
No	29 (13.89)		23 (18.17)	

Chi square test was performed to assess the association between having an asthma action plan and emergency visits or hospitalization in both children and adults. 7 children with an asthma action plan reported a hospitalization due to asthma in the past 12 months while no children without an asthma action plan reported 12 months hospitalization *p* value 0.313. For 12 months emergency visits, 27 out of 62 children with an asthma action plan reported an emergency visits while only 3 children without an asthma action plan reported an emergency visit *p* value 0.270. However, for adults 12 patients with an asthma action plan has an emergency visit due to asthma and 6 patients without an asthma action plan had an emergency visits *p* value 0.079. And for emergency visits 19 patients with an asthma action plan reported an emergency visit during the past 12 months, while 16 patients without an asthma action plan reported an emergency visit *p* value 0.287.

Consumer Health Activation Index tool (CHAIv1) was used in this study. CHAI v1 is a tool that captures the level of patient activation with regard to their own health. The CHAI score of 79 and less indicates low activation, 80 to 94 moderate activation and 95 to 100 indicates high activation. We compared the score to different variables to assess whether it has an impact on our results. The mean average score for adults is 75.5 and the mean average score for parents of children is 86.19 and the p value is < 0.001 . Table 3 shows the effects of CHAI score on past 12 months hospitalization, past 12 months emergency department visits and having an asthma action plan. A linear regression analysis was performed to assess the effects of CHAIv1 score on ACT score p value was 0.827 and r squared of 0.001 for adults and 0.963 and R squared 0.000 for children.

Table 3 Analysis of the association of Consumer Health Activation Index (CHAITM v1).

Outcomes	Adults		Children	
	n (Mean)	<i>P</i> value	n(Mean)	<i>P</i> value
12 months hospitalization		0.788		0.891
Yes	18(76.38)		5(86.66)	
No	43(75.19)		44(86.13)	
12 months ED visits		0.602		0.082
Yes	28(76.48)		22(88.49)	
No	33(74.74)		27(84.38)	
Do you have an asthma action plan?		0.008		0.058
Yes	29(80.05)		41(87.15)	
No	32(71.45)		8(81.25)	

Asthma Impact Survey (AIS) tool was used to determine whether asthma have an impact on patient's life, therefore higher score indicates lower quality of life. The tool categorizes the impact of asthma on patient's life based on different cut off scores. A score of ≥ 60 indicates higher impact of patient's life, 55 to 59 substantial impact, 49 to 54 some impact, ≤ 48 little or no impact. The mean impact score for adults was (58.2 and SD 9.8), and for children (57.5 and SD 10.80). Patients with an asthma action plan reported to have a mean impact score of (60.07, SD 9.68) for adults and (57.673, SD 10.7) for children. The mean impact score for adult patients who do not have an asthma action plan was (56.73, SD 9.82) and the p value was 0.162, and for children it was (56.88, SD 11.79) p value was 0.843.

Figure. 1 Association between ACT and AIS score in adults and children.

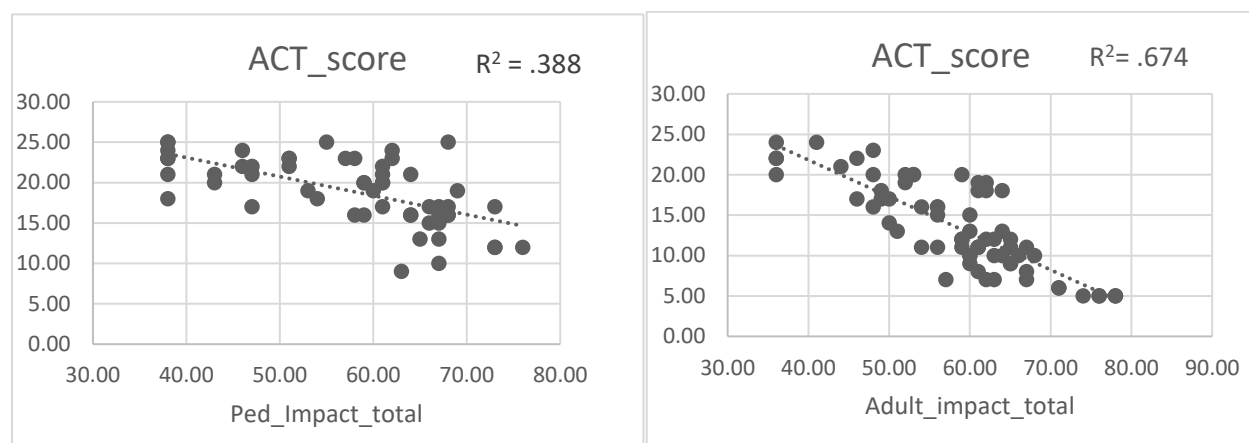


Table 4 Analysis of the association of Asthma Impact Survey.

Outcomes	Adults		Children	
	n (Mean)	<i>P</i> value	n(Mean)	<i>P</i> value
12 months hospitalization		<0.001		0.393
Yes	18(66.77)		7(60.85)	
No	50(55.2)		51(57.09)	
12 months ED visits		<0.001		0.022
Yes	32(64.96)		29(60.75)	
No	36(52.33)		29(54.34)	
Do you have an asthma action plan?		0.198		0.843
Yes	34(59.82)		49(57.67)	
No	34(56.73)		9(56.88)	

CHAPTER V

DISCUSSION

This study aimed to examine the relationship between asthma action plan, patient self-efficacy and asthma control. We found that having an asthma action plan has no effects on patient's asthma control neither in adults nor children as shown in table 2. Adults with an asthma action plan had a mean ACT score of 12.84, SD 5.54 and patients without an asthma action plan had a mean ACT score of 14.00, SD 5.2 and p value was 0.372. Also, children with an asthma action plan had a mean ACT score of 19.06, SD 3.9 and children without an asthma action plan had a mean ACT of 18.55 SD 4.9. There was a significant difference in ACT between adults and children p value < 0.001 . Almost half (49.4%) of adult patients in our sample had an asthma action plan where 85.5% of children had an asthma action plan. In the contrary, researchers in 2015 found that only 28.7% of adult asthma patients received an asthma action plan (Mirabelli, Beavers, Shepler, & Chatterjee, 2015). And in another study found that in 2013 half of children in the US received an asthma action plan (Simon, A. E., et al., 2016). We can see the trending increase in the number of patients with an asthma action plan through the years.

Multiple studies have evaluated the efficacy of asthma action plan in adults and children. Our results support these studies. The systematic review that was conducted by Gatheral. T.L. et al (2017) had similar results. 15 randomized control trails have been evaluated in the study, the researchers found that there was not any clear benefit or harm in adding asthma action plans to asthma education in terms of emergency visits or hospitalizations Gatheral. T.L. et al (2017).

Patients' self-efficacy is not found to be a potential factor of asthma control in our sample. There was not any association between higher ACT score with a higher self-efficacy score (CAHI) p value 0.827 and r squared of 0.001 for adults and 0.963 and R squared = 0.000 for children. This finding correlates with our result in table 3, where CHAI score had no impact on 12-month ED visits or 12-month hospitalization rate. Furthermore, the CHAI score had no association with the AIS score for adults (p value = 0.863 $R^2 = 0.001$) and for children as well (p value = 0.940, $R^2 = 0.000$). The CHAIv1 tool

showed a significantly higher score for adults with an asthma action plan as demonstrated in table 3 with a p value of 0.008 for adults and 0.058 for children. However, that did not lead to better asthma control score. Our finding contradicts the literature. Researchers from the State University of New York found that higher self-efficacy was associated with lower emergency visits and hospitalization (Scherer & Bruce, 2001).

Higher Asthma Impact Survey score was associated with higher hospitalization for adults and higher emergency visits in adults and children as shown in table 4. Also, there was a strong relationship between AIS and ACT ($R^2=.674$, p value <0.001 for adults and $R^2=.388$, P value <0.001 for children). For instance, higher Asthma Impact Survey score was associated with lower ACT score. Based on our analysis, asthma action plan has no effects on asthma impact score. Adults with an asthma action plan had a mean AIS score of 59.82, and those without an asthma action plan reported a mean AIS score of 56.77, p value= 0.198. And for children with an asthma action plan had a mean AIS score of 57.67, and children without an asthma action plan had a mean score of 56.88, p value= 0.843.

Limitations

This study was carried out online, therefore a more controlled environment would have led to better results. Also, most of our patients were based in the US while we had few patients from different countries, more non-US patients would have given us clearer picture on other parts of the world. The CHAIv1 tool was validated on patients who are 18 years and older, further validation is needed for younger patients. Also, the ACT tool is validated for patients who are 12 to 84 years of age, thus results obtained for younger patients might not be valid or reliable. However, our research was completed by parents of children not children themselves.

Conclusions

Despite the wide recommendation of the use of asthma action plan to control asthma, we found that asthma action plan did not provide any benefit in controlling asthma. Also, we did not find any

significant difference in asthma impact score in patients with asthma action plan and those without an asthma action plan. Further research is needed to assess the relationship between medication adherence, asthma action plan and asthma control.

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