

# Effect of Implementing Bronchial Asthma Care Bundle on Adolescents' Adherence, Asthma Control and Hospital Readmission

<sup>1</sup>Rehab Abd El Aziz El Sayed Abd El Aziz, <sup>2</sup>Ahlam Mohamed Ismail Aly

<sup>1</sup>lecturer of Pediatric Nursing, Faculty of Nursing, Mansoura University, Egypt.

<sup>2</sup> Assistant Professor of Pediatrics, Qena Faculty of Medicine, South Valley University, Egypt.

*Corresponding author E-mail (rehababelazizelsayed@yahoo.com)*

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**Abstract:** Asthma is a chronic illness affecting children and adolescents, the purpose of asthma management focuses on treating the symptoms, asthma control and decrease hospital admission. So, healthcare professionals should dedicate more their effort to educate the asthmatic adolescents about treatment plan.

**Aim:** this study was aimed to evaluate the effect of implementing bronchial asthma care bundle on adolescents' adherence, asthma control and hospital readmission.

**Research design:** A quasi experimental research design using the two groups (study and control).

**Setting:** This study was carried out in the in-patient ward at Mansoura Government Hospital for Chest diseases, Egypt.

**Sample:** Composed of 126 adolescents with asthma who were admitted to the previous setting, after fulfilling inclusion criteria. They were divided randomly to 2 identical groups, study and control.

**Tools:** 4 tools were used. 1, structured interview questionnaire sheet. 2, Performance observation checklists. 3, Asthma Morisky Medication Adherence Scale. 4, Asthma Control Test.

**Results:** the present study revealed that, there were high statistically significant differences between study and control groups ( $p < 0.001$ ) after intervention regarding studied adolescent's knowledge and practice. Also, near half of them (49.2% & 58.7%) in study group had high adherence compared with less than one quarter (20.6% & 17.5%) of adolescents in control group, after intervention post 30 and 60 days. In addition, less than two third of them (52.4% & 63.5%) in study group had well asthma control compared to more than one quarter of adolescents (27.0% & 30.2%) in control group after 30 and 60 days. Also, more than two third (69.8% & 65.1%) of adolescents in study group had not hospital readmission after 30 and 60 days after intervention compared to around one quarter (22.2% & 28.6%) of adolescents in control group. There high statistical significant differences between both groups after intervention.

**Conclusions:** the study concluded that, bronchial asthma care bundle affected positively on adolescent's knowledge, practice, adolescent's adherence, asthma control and hospital readmission.

**Recommendation:** it was suggested further implementation of bronchial asthma care bundle intervention in other emergency departments and hospitals.

**Keywords:** Adherence, Adolescents, Asthma care bundle, Asthma control, Bronchial asthma, Hospital readmission.

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## 1. INTRODUCTION

Bronchial asthma is a chronic respiratory disease characterized by recurrent attacks of dyspnea, chest tightness, wheeze and cough that vary in severity and frequency from one individual to another [1,2]. It's induced by long term of the airway passages inflammation due to the hypersensitivity of the nerve endings in the airways leading to epithelial fragility, airway cell hyperplasia, increase mucus secretion, enlarged mucus glands, increased airway muscle mass and increase wall thickening, which causing airways obstruction[3]. The causes of asthma attack aren't totally understood, however

some predisposing factors embrace environmental factors such as [virus infections, allergens, pollutants or other irritants]. Genetic factors such as [family history of asthma] [4]. The mechanisms are multifaceted, therefore it's clear that both genes and environmental factors determine asthma attack vulnerability [5].

Bronchial asthma is the commonest chronic inflammatory illnesses of childhood in the United States, with a prevalence of 9.5%. Asthma is that the third leading reason behind hospitalization among children at any time. Adolescents are at significantly high risk for poor bronchial asthma outcomes, with asthma death rates double as high for eleven to seventeen years more than 0–10 years old [6]. Over 1,000,000 children (1 in 11) in the United Kingdom (UK) are thought to be living with bronchial asthma, although the number of children experiencing asthmatic symptoms could also be larger. Several countries report high prevalence rates of childhood bronchial asthma, prevalence among six to seven-year-olds stood at [16.7% and 21.5 %] for girls and boys respectively, and at "19.8% and 23.3%" in children 13 to 14 years of age [7,8]. While, in Egypt, the overall prevalence of bronchial asthma among school children was 7.7% [8% in urban areas and 7% in rural areas] [9].

The treatment of bronchial asthma and well asthma control are affected by patient's knowledge, educational level, adherence to treatment regimes, behavioral changes, doctor's experience and confidence and the accessibility of health care services. The purpose of asthma attack treatment are to realize and maintain control of clinical manifestations of asthma for long periods. Once their asthma attack is controlled, patients are higher able to prevent attacks, avoid manifestations, and maintain physical activity. However, despite the availability of clinical practice guidelines and treatment choices, asthma attacks are partly controlled for several patients and poorer asthma control is related to higher costs and increased resources use. Also, many gaps still exist between the care suggested by guidelines which really provided and there's an inadequate concentrate on self-management [10].

Adolescence is a critical stage of growth and development during which responsibility and progress of self-care techniques will be achieved. In learning skills of asthma self management, adolescent bronchial asthma education should take into consideration teach problem-solving skills, developmental concerns and increase personal responsibility [11]. On average, adolescent outcomes are poor than those of younger patients. The poor outcomes discovered for adolescents could also be associated with the various developmental, psychological, emotional and social changes adolescents characteristically undergo throughout these stage. Several adolescents with asthma, especially those with a lot of severe disease, suffer from anxiety, depression and low self-esteem [10,12]. As well as adolescents' adherence for medication is usually poor [13].

A care bundle is a structured method of rising the method of intervention resulting in an improvement in patient outcomes. It's a straight forward, small set of evidence-based practical actions or interventions, that once performed reliably, improve patient outcomes [14]. The bronchial asthma care bundle is planned to be used primarily for patients discharged from emergency departments once after acute asthma attack, however also will appropriate to be used in admissions inpatient wards wherever circumstances allow. The bundle can be applied to both children and adults. It's including five elements were selected to improve the care outcomes: Inhaler technique should be assessed, medications review, a written asthma action plan (AAP) should be provided and self-management, prevention of triggering factors and scheduled follow up [15,16].

Medication adherence is a patient's medication taking behavior associated with the intention of the health recommendation he/she has been given. Particularly in patients suffering from chronic illness like bronchial asthma. It is very important for better outcomes of treatment in several situations such as maintenance of medication concentrations in the blood to control symptoms of diseases [17,18]. Non adherence to medication may occur due to forgetfulness, lack of motivation, poor communication, emotional disturbance, family dynamics, financial constraints, inadequate health attainment, poor patient knowledge, belief about the illness and its severity and treatment. These barriers can be prevented through appropriate counseling by the nurses [17].

Asthma control refers to the degree to that bronchial asthma symptoms can be determined and later on improved with management. It's the main aim of treatment using asthma management guidelines. Well-controlled asthma consists of decreased daytime and night-time symptoms, minimized long-term morbidity and reduced risk of life-threatening bronchial asthma attacks [1]. Bronchial asthma control increases with age among children; Most bronchial asthma self

management interventions include improving knowledge about asthma and promoting asthma control; in contrast to self management, looking once oneself in a healthful state, self management encourages associate alliance between the doctor or healthcare provider and the patient for the aim of managing bronchial asthma [19].

The pediatric nurse practitioner (PNP) play very important role in the management course of asthmatic children who admitted to the hospital, asthmatic children were assessed by 4 individuals groups [ doctors, nurses, families and intern residents]. Specifically the role of PNP as a health educator, individuals from each group noted the strong ability of the PNP to provide correct and effective knowledge that meets the child and their family's needs. Once evaluating PNPs as a members of the bronchial asthma management team for children with asthma. The adolescents who received bronchial asthma education and care from pediatric nurses had lower lengths of hospital stay when hospitalized, also the costs related to the hospitalization were also considerably less [20].

Therefore, The aim of this study was to evaluate the effect of implementing bronchial asthma care bundle on adolescents' adherence, asthma control and hospital readmission

### 1.1. Significant of the study

Bronchial asthma is the commonest chronic disease throughout childhood and adolescence world-wide, it's prevalence has been increasing over the last years, round the world is approximately 5-10%. It's the primary cause for absence from school and 3<sup>rd</sup> cause for hospitalization of children under the age of fifteen years. The public and economic health care costs associated with hospital and emergency department (ED) readmission of asthmatic children are several [21,22]. Additionally to the individual and social impacts of childhood bronchial asthma, will increases in ED visits 640 000, and 157 000 hospitalizations for children each year and 10.5 millions missed school days, as a result of asthma attacks in children have emphasized the necessity to understand the development of childhood bronchial asthma and to know it's key determinants. Bronchial asthma prevalence, morbidity and mortality rates seem to be higher in adolescents more than in younger children. Adolescents with symptomatic bronchial asthma have a lot of physical and emotional symptoms and activities limitations, negative behaviors, lower perceived well-being and a lot of acute recurrent asthma attack [22,23]. So, when adolescents has good knowledge and practice about bronchial asthma care bundle, they could be have high medication adherence and able to prevent and mange asthma better, the present study will be the first study in Egypt which implementing the bronchial asthma care bundle for asthmatic adolescents. Hopefully, this study would be improve adolescents' adherence for treatment, asthma control and decrease hospital readmission.

### 1.2. Aim of study

The aim of this study was to evaluate the effect of implementing bronchial asthma care bundle on adolescents' adherence, asthma control and hospital readmission.

### 1.3. Research hypotheses.

*It was hypothesized that:*

H<sub>1</sub>: There will be a significant improvement in knowledge and practice scores of adolescents after implementation of bronchial asthma care bundle.

H<sub>2</sub>: Bronchial asthma care bundle intervention will improve adolescent's adherence for treatment.

H<sub>3</sub>: Bronchial asthma care bundle intervention will enhance asthma control scores.

H<sub>4</sub>: There will be a significant decrease in adolescent's hospital readmission after 30 and 60 days post discharge from hospital.

H<sub>5</sub>: There will be a relationship between gender and adolescents' medication adherence, asthma control, knowledge and practice in study group after intervention.

H<sub>6</sub>: There will be a relationship between the asthma control level and adolescents' hospital and ED readmission in study group after intervention.

## 2. SUBJECT AND METHODS

### 2.1. Research design:

A quasi experimental research design using the two groups ( study and control), pre & post tests were utilized for both groups.

### 2.2. Setting:

This study was carried out in the in-patient ward at Mansoura Government Hospital for Chest diseases, Egypt.

### 2.3. Sampling:

#### 2.3.1. Sample size

Based on data from literature, considering that the level of significance = 5%, Power = 80%, Type of test = two-sided, then the formula of calculating sample size is  $n = [(Z_{\alpha/2} + Z_{\beta})^2 \times \{2(SD)^2\}] / (\mu_1 - \mu_2)^2$ . According to the formula the sample size required is 63 adolescent in each group (study & control).

**Where,**

n = sample size required in each group,

$\mu_1 - \mu_2$  = clinically significant difference

SD = standard deviation

$Z_{\alpha/2}$ : This depends on level of significance, for 5% this is 1.96

$Z_{\beta}$ : This depends on power, for 80% this is 0.84

Based on the above mentioned statistical formula, the sample composed of 126 adolescents with bronchial asthma who were admitted to the previous setting. They were divided randomly to 2 identical groups, the study group (63) who receive bronchial asthma care bundle, and the control group (63) who receive routine care based on the policy of hospitals. Study sample was selected after fulfilling the inclusion criteria

#### ***Inclusion criteria***

- 1- Age from 10-19 years.
- 2- Both sexes.
- 3-They had confirmed diagnosis for bronchial asthma.
- 4- All degrees of bronchial asthma [ mild, moderate and sever].

#### ***Exclusion criteria***

- 1- Free from other chronic illness.
- 2- Free from thoracic congenital anomalies.
- 3- Previously attended or currently attending an asthma health education program.

**2.4. Tools.** The following tools were used for data collection:

#### **Tool I- A structured interview questionnaire sheet:**

The tool was developed by the researchers to collect data about adolescents' characteristics, history and knowledge, after reviewing related literatures [24,4,25]. This tool was written in an Arabic language to suit the level of adolescents understanding. It was divided into four parts:

**Part 1. Socio-demographic characteristics of adolescent.** Gender, age, residence, educational grade level, and family income.

**Part 2. Medical history.** Family history of asthma, sibling with asthma, smoking, duration of bronchial asthma, severity of asthma and medications used.

**Part 3. Bronchial asthma clinical history.** School absenteeism due to asthma in previous 30 days, acute asthma symptoms at school, daytime and nighttime symptoms and days with activity restrictions in previous 30 days.

**Part 4. Adolescent's knowledge about asthma and bronchial asthma care bundle.**

Using **Asthma Knowledge Questionnaire (AKQ)**. This questionnaire was adopted from (AlMotlaq & Sellick, 2011) [25]. It was used to assess adolescent's level of knowledge about asthma. It consisted of 36 questions, twenty four questions "23 true or false and 1 open-ended question" about bronchial asthma. It included definition, general knowledge about bronchial asthma, predisposing or triggers factors, symptoms, asthma treatment, prevention of asthma attacks. In addition, 12 true/false questions about bronchial asthma care bundle, it included definition of asthma care bundle and its components (inhaler drugs technique, medication, triggers factors, prevention of triggers factors, written action plan and follow up schedule and important of it).

#### *Scoring system*

Correct answer scored '1' mark and incorrect answer scored '0', the total score was obtained through adding up all questions' marks. Its total scores range (0 - 36 marks) equal 100%, with a higher percent indicate greater knowledge. Then, adolescents were categorized into three groups according to their knowledge level; good if total score  $\geq 70\%$ , average if total score  $50\% < 70\%$  and poor if score  $< 50\%$  (HPD and Subasinghe, 2016) [26].

#### **Tool II- Performance observation checklists:**

This tool was adopted from Wilkinson et al, (2016) and Bowden & Greenberg, (2012) [27,28]., It including 58 questions, it consisted of three practically checklists about nebulizer administration 24 questions, inhaler drugs administration 26 questions and breathing and coughing exercise 8 questions. The observation checklists were used to assess actual adolescent practices related to bronchial asthma.

#### *Scoring system*

The scoring system for the observation checklists were developed; scored one for each correct answer (done) and zero for incorrect answer or missing statement (not done), the total score was computed out of (58 marks). Adolescents were grouped in to 2 categories according to the level of their practices, satisfactory practice when the total score was 60% and more and unsatisfactory when the total score was less than 60% (Matthews et al, 2013) [29].

#### **Tool III- Asthma Morisky Medication Adherence Scale (MMAS-8):**

This scale was adopted from (Morisky et al., 1986) [30], it was a structured self-report measure of medication taking behavior questionnaire, consisted of eight questions, items one to seven were (yes) or (no) questions, whereas item eight using a five -point Likert response choices.

#### *Scoring system*

Every "No" answer scored (1) and every "Yes" answer scored (0), except for question five, in which every answer 'Yes' scored (1) and every 'No' scored (0), for question eight, when a children selects answer 'zero', the mark is (one) and when they select answer 'four', the mark is (zero). Answers (1, 2, 3) were scored (0.25, 0.5, 0.75 respectively). Total scores will range from zero to eight and have been categorized into 3 levels of adherence: high adherence (score = 8), medium adherence (score of 6 to < 8), and low adherence (score < 6).

#### **Tool IV- Asthma Control Test (ACT):**

It was developed by (Nathan et al, 2004) [31], it is a simple five questions tool that was self-administered by the patient and provides a numerical score for each question, from 1-5 ranging from poor control to well control, it was used to help healthcare provider determine if asthma symptoms are well controlled or poor control.

#### *Scoring system*

Total score was 25 marks, if score range from 20 - 25 indicate that, bronchial asthma was well controlled, while, score is 19 or less, indicate that bronchial asthma was not well controlled (partly). if score is 15 or less, indicate bronchial asthma might be very poorly controlled and the children must be contact healthcare provider.

#### 2.4.1. Validity and reliability of tools

Tools 1 and 2 were reviewed by a panel of five experts in the pediatric nursing and medicine before introducing it to the participants to ensure its validity and their comments were considered. The reliability of knowledge was tested giving Cronbach's  $\alpha$  coefficient of 0.812, practice was tested giving Cronbach's  $\alpha$  coefficient of 0.847, medication adherence scale was tested by (Morisky et al., 1986) [30], giving Cronbach's  $\alpha$  coefficient of 0.80 and asthma control was tested by (Nathan et al, 2004) [31], giving Cronbach's  $\alpha$  coefficient of 0.83.

#### 2.5. Ethical considerations

A permission was gained from the director of hospital and the head of the department after explaining the usefulness of the study, tools, duration and oral consent approval was gained from the mothers and their adolescents after explaining the usefulness of the study and the duration of the study. They were assured about the confidentiality of the collected data. The researcher informed the mothers about their right to withdraw of their adolescents from the study at any time and their rights to reject or accept their adolescents' participation in the study.

#### 2.6. Pilot study

It was done on ten percent of the studied adolescents (n=13 adolescents) to evaluate the feasibility, applicability and clarity of the tools, also to determine the time required to answer these tools and some modifications were done. Adolescents in the pilot were not included in the study.

#### 2.7. Field of work

The field of work was started and completed through the period from the beginning of November 2016 to the end of May 2017. The researcher was available in the study setting 3 days per week from 9 A.m. to 12 p.m. Each adolescent in study and control groups was individually interviewed without the adolescents sharing in the classroom using the previously mentioned study tools. The questionnaires and the answers were marked by the adolescent after researcher was explained how they were answered it; 20 minutes was needed to complete the questionnaire. The study subjects were divided into two groups, the study (bronchial asthma care bundle) group and control (routine asthma care) group. The researcher collected data about adolescent's socio-demographic characteristics and medical history in both groups one time before implementation of intervention stages. All questionnaires were translated by researcher to Arabic language. Collection of data was carried out in 3 stages, it was started at admission of adolescents in the in-patient departments till discharge; including assessment stage once before starting asthma care bundle intervention 'pre test', implementation stage for intervention and evaluation stage post 30 days and 60 days follow up after completion of the intervention, to evaluate intervention outcomes 'post test'. The reasons for selecting these intervals to assess the point of maximum benefits from intervention after a short period of time (30 days), adolescents were assumed to follow the training method by observation stages. Also, the second post test (60 days later) was aimed to evaluate adolescent's ability to retain the acquired knowledge and practices over a brief period of time and evaluating the results of intervention.

**1. Assessment stage.** Assessment of adolescent's knowledge in both groups about asthma and bronchial asthma care bundle, practical checklists including (nebulizer, inhaler administration and breathing and coughing exercises), asthma medication adherence and asthma control. Also bronchial asthma clinical history such as "school absenteeism due to asthma, acute asthma symptoms at school, daytime and nighttime symptoms and days with activity restrictions in previous 30 days" (pre-test), using the above tools.

#### 2. Implementation stage.

**\*For adolescents in study group.** Implementation of the bronchial asthma care bundle intervention individually for each adolescent, it was given in three sessions (two theoretical and one practical); each session time from 45- 60 minutes, researchers designed the educational booklet about bronchial asthma care bundle after reviewing related literatures and was given to all adolescents in study group. Sessions one and two were theoretical including, introduction and implementation of bronchial asthma care bundle, it was translated into Arabic language by the researchers, it consisted of five elements [TAPES]:

**T-Technique of inhaler drugs and medication:** the researcher was explained how to correct use inhaler drugs administration. In addition, explain the importance of medication adherence to control asthma symptoms and recurrent attacks, the researcher was instructed of adolescent about how take medication, prepare it's dose correctly, side effects and when increase or decrease the dose.

**AP- A written Action Plan:** The researcher was explained all information about bronchial asthma for adolescents, self management and how to carry out steps of action plan to control asthma symptoms, decrease recurrent of hospitalization and how they identify worsening symptoms to rapid go to ED.

**E- Environmental triggering factors:** Bronchial asthma have triggers factors, which should be well recognized to decrease exposure of adolescent to it and decrease asthma attacks. Trigger factors including smoking, dust, pets, non steroidal anti-inflammatory drugs, occupational causes and others factors, the researcher was instruct the adolescents to avoid expose to this factors.

**S - Subsequent care (follow up):** The researcher was explained follow up schedule and importance of regular follow up for adolescents to improve management outcome and control asthma symptoms.

Third practical session include practical demonstration of inhaler technique and medication administration such as nebulizer and inhaler drugs and breathing and coughing exercises then re-demonstration by adolescents for this procedures. Many teaching methods were used such as lectures, practical demonstration and re-demonstration, also teaching media in the form of power point, educational handout about asthma care bundle elements and video were used.

The researcher was invited the adolescent's parents to attend the intervention sessions but some of them accept invitation and researcher educate them about intervention to help their adolescents at home if they needed, without parents interference during their adolescent answer of the questionnaires.

**\*For adolescents in control group.** They were received routine care for asthmatic patient according to hospital policy.

**3. Evaluations stage.** Comparison between the study and control group's results was done to evaluate the effect of the bronchial asthma care bundle intervention on adolescent's adherence, asthma control, and hospital readmission after 30 and 60 days later during follow up, while adolescent's knowledge and practices were evaluated immediately and after 30 days after intervention. Also others intervention outcomes such as " school absenteeism due to asthma, acute asthma symptoms at school, daytime and nighttime symptoms and days with activity restrictions were evaluated after 30 days" and length of hospital stay (post test) using previous tools. If adolescents unable to attend according to schedule follow up visits, the researcher ask of them through telephone call to attain post test.

## 2.8. Limitation

The researcher was overloaded with educating adolescent's mothers about bronchial asthma care bundle stages because the same mothers and adolescents are not present at the same time.

## 2.9. Data analysis

All statistical analyses were performed using SPSS for windows version 20.0 (SPSS, Chicago, IL). Continuous data were expressed in mean  $\pm$  standard deviation (SD) while categorical data were expressed in number and percentage. Chi-square test was used for comparison of variables with categorical data while the independent sample t test was used for comparison of continuous data. Statistical significance was set at  $p < 0.05$ .

## 3. RESULTS

The socio-demographic characteristics of studied adolescents and their medical history **Table (1)**; it is obvious that, the mean age of adolescents were  $(14.3 \pm 2.9$  &  $14.5 \pm 2.7)$  respectively in study and control groups and more than half of them (54.0% & 55.6%) respectively were females and males in both groups, also more than half (55.6% and 63.5% respectively) of them in both groups were from rural areas. In relation to adolescent's medical history, it is clear from this table that, less than two third (60.3% & 54.0%) respectively in both groups have positive family history of asthma and the majority of them (90.5% & 87.3%) respectively in both groups were exposed to passive smoking. In addition, less

than half (44.4% & 34.9%) respectively of them in both groups suffered from asthma since  $\geq 3$  years. Less than half of them (49.2% & 42.9%) respectively in both groups have moderate asthma.

**Figure (1)** shows adolescents' knowledge about bronchial asthma care bundle, this figure reveals that, less than two third of adolescent (63.5% & 52.4%) respectively in both groups have poor knowledge before implementing bronchial asthma care bundle intervention, while immediately after intervention, less than two third (63.5%) of them in study group and (58.7%) of them post 30 days had good knowledge compared with minority of children in control group. There were high statistical significant differences between both groups after intervention ( $p < 0.001$ ).

**Figure (2)** presents the adolescents' practice regarding bronchial asthma care bundle; it was clear from this figure that, more than three quarter (79.4%) of adolescent in study group and more than two third (69.8%) of adolescent in control group have unsatisfactory practice before intervention, while after intervention, less than three quarter (71.4% & 69.8%) respectively of adolescents had satisfactory practice post immediately and after 30 days in study group compared with about one third (31.7%) of adolescent in control group. There were highly statistical significant differences between both groups after intervention ( $p < 0.001$ ).

**Figure(3)** shows adolescents' medication adherence, it is clear from this figure that, less than half (47.6%) of adolescents in study group and more than half (58.7%) of adolescent in control group had low adherence before intervention, while post 30 days, approximately half of studied adolescents (49.2%) and after 60 days, more than half of them (58.7%) in study group had high adherence compared with less than one quarter (23.8%) of studied adolescents in control group after intervention, there were high statistical significant differences between both groups after intervention ( $p < 0.001$ ).

It is obvious from **Figure (4)** that more than half of studied adolescents (54.0% & 55.6%) respectively in study and control groups had poor asthma control before intervention, while after 30 days, more than half of studied adolescents (52.4%) and after 60 days, about two third of them (63.5%) in study group had well asthma control compared with more than one quarter of studied adolescents (27.0% & 30.2%) respectively in control group after intervention. There were high statistical significance differences between both groups after intervention ( $p < 0.001$ ).

**Table (2)** illustrates outcomes of bronchial asthma care bundle according to school absenteeism, recurrence of asthma symptoms at school and length of hospital stay, it was clear from this table that, there were no statistical significant differences between both groups before intervention. While after intervention, less than two third (61.9%) of adolescents in study group had not absence from school post 30 days, compared with more than one quarter (30.2%) of adolescents in control group, also the mean length of hospital stay was  $3.4 \pm 0.5$  in study group compared with  $6.3 \pm 1.2$  in control group after intervention. there were high statistical significant differences between both groups ( $p < 0.001$ ).

**Table (3)** presents outcomes of bronchial asthma care bundle according to hospital and ED readmission, it is obvious that, no statistically significance difference between both groups before intervention, while more than two third (69.8% & 65.1%) respectively of adolescents in study group had not hospital readmission after 30 and 60 days after intervention compared with around one quarter (22.2% & 28.6%) respectively of adolescents in control group. Concerning ED readmission, less than two third (61.9% & 63.5%) respectively of adolescent in study group had not ED readmission after 30 and 60 days compared with more than one quarter (27.0% & 31.7%) respectively of adolescents in control group. There were highly statistical significance differences between both groups after intervention ( $p < 0.001$ ).

**Table (4)** shows correlation between adolescents' gender and their medication adherence, asthma control, knowledge and practice in study group after intervention post 30 days. It's clear from this table that, there were a relationship between the studied adolescents' gender and their medication adherence, asthma control, knowledge and practice in study group after intervention, the female significantly more frequent than in males. This relation was highly statistical significant ( $p < 0.001$ ).

Correlation between adolescents' age and their medication adherence, asthma control, knowledge and practice in study group after intervention post 30 days **Table (5)**, it is obvious that. There were a strong relationship between the studied adolescents' age and their medication adherence, asthma control, knowledge and practice in study group after intervention post 30 days, it was significantly more frequent in adolescent's age 17 – 19 years. This relation was statistical significant ( $p < 0.001$ ).

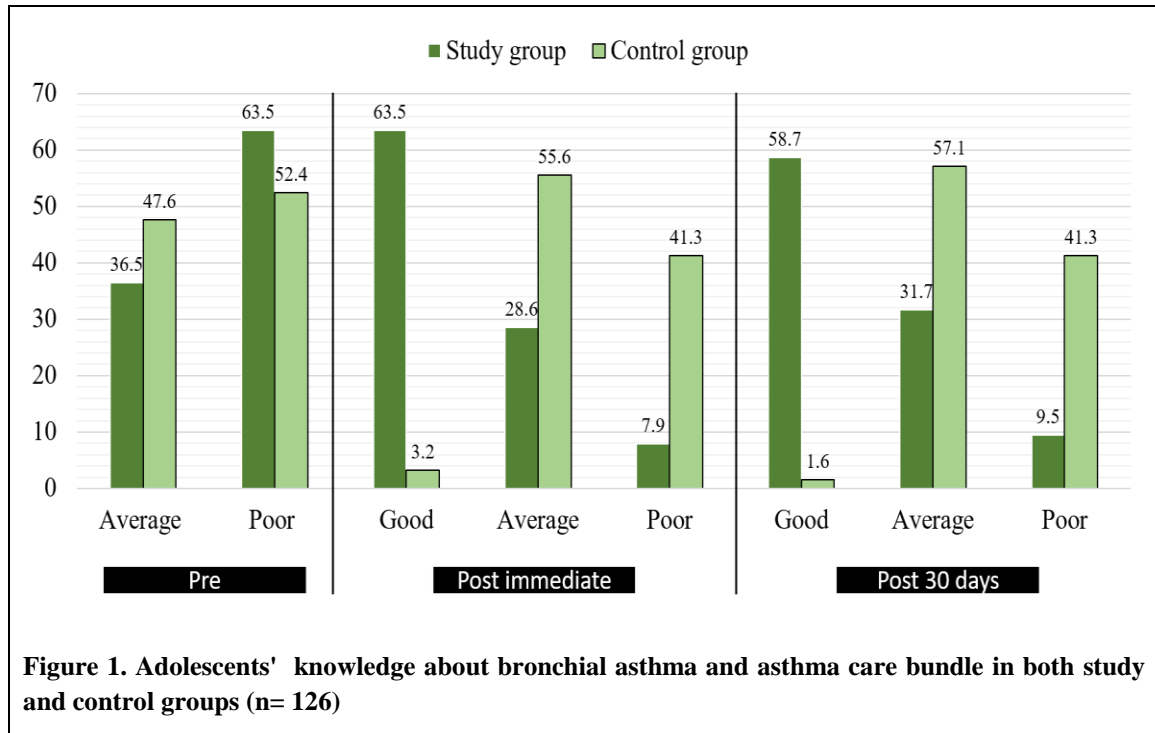


**Table (6)** demonstrates the correlation between asthma control and adolescents' hospital and ED readmission in study group after intervention post 30 days and 60 days. It is clear from this table that, there were positive relationship between the asthma control level and adolescents' hospital and ED readmission after intervention, adolescents with well control asthma had not hospital and ED readmission in post 30 and 60 days. There were a highly statistical significance differences(  $p < 0.001$ ).

**Table 1. Socio-demographic characteristics of the adolescents and their medical history in both study and control groups (n= 126 )**

Variables	Study (n=63)		Control (n=63)		Chi square test	
	No	%	No	%	X <sup>2</sup>	P
<b>Gender</b>						
Male	29	46.0	35	<b>55.6</b>	1.143	0.285
Female	34	<b>54.0</b>	28	44.4		
<b>Age (years)</b>						
Early (10 –<15)	30	<b>47.6</b>	28	<b>44.4</b>	0.334	0.846
Middle (15- <17)	18	28.6	21	33.3		
Late (17 – 19)	15	23.8	14	22.3		
<b>Mean ±SD</b>	14.3 ±2.9		14.5 ±2.7		0.353	0.725
<b>Residence</b>						
Rural	35	<b>55.6</b>	40	<b>63.5</b>	0.824	0.364
Urban	28	44.4	23	36.5		
<b>Educational Grade Level</b>						
Primary	8	12.7	10	15.9	1.333	0.721
Preparatory	24	<b>38.1</b>	18	28.6		
Secondary	19	30.2	21	<b>33.3</b>		
University	12	19.0	14	22.2		
<b>Family income</b>						
Average	13	20.6	11	17.5	0.325	0.852
Median	39	<b>61.9</b>	42	<b>66.7</b>		
Minimum	11	17.5	10	15.8		
<b>Family history of asthma</b>						
Yes	38	<b>60.3</b>	34	<b>54.0</b>	0.519	0.471
No	25	39.7	29	46.0		
<b>Sibling with asthma</b>						
Yes	13	20.6	20	31.7	2.012	0.156
No	50	<b>79.4</b>	43	<b>68.3</b>		
<b>Smoking</b>						
Active	6	9.5	8	12.7	0.321	0.571
Passive	57	<b>90.5</b>	55	<b>87.3</b>		
<b>Duration of asthma</b>						
6 – <12 months	7	11.1	11	17.5	2.781	0.427
1 – <2 years	12	19.0	17	27.0		
2 – <3 years	16	25.4	13	20.6		
≥3 years	28	<b>44.4</b>	22	<b>34.9</b>		
<b>Severity of asthma</b>						
Mild	13	20.6	19	30.1	1.512	0.570
Moderate	31	<b>49.2</b>	27	<b>42.9</b>		
Severe	19	30.2	17	27.0		
<b>Medications used</b>						
Nebulizer at home	13	20.6	10	15.9	1.214	0.876
Antibiotic	16	25.4	19	<b>30.2</b>		
Cough remedies	19	<b>30.2</b>	16	25.4		
Inhalers on demand	7	11.1	9	14.2		
Inhalers regular	8	12.7	9	14.3		

**Figure 1. Adolescents' knowledge about bronchial asthma and asthma care bundle in both study and control groups (n= 126)**



**Figure 2. Adolescents' practice regarding asthma care bundle in both study and control groups (n= 126)**

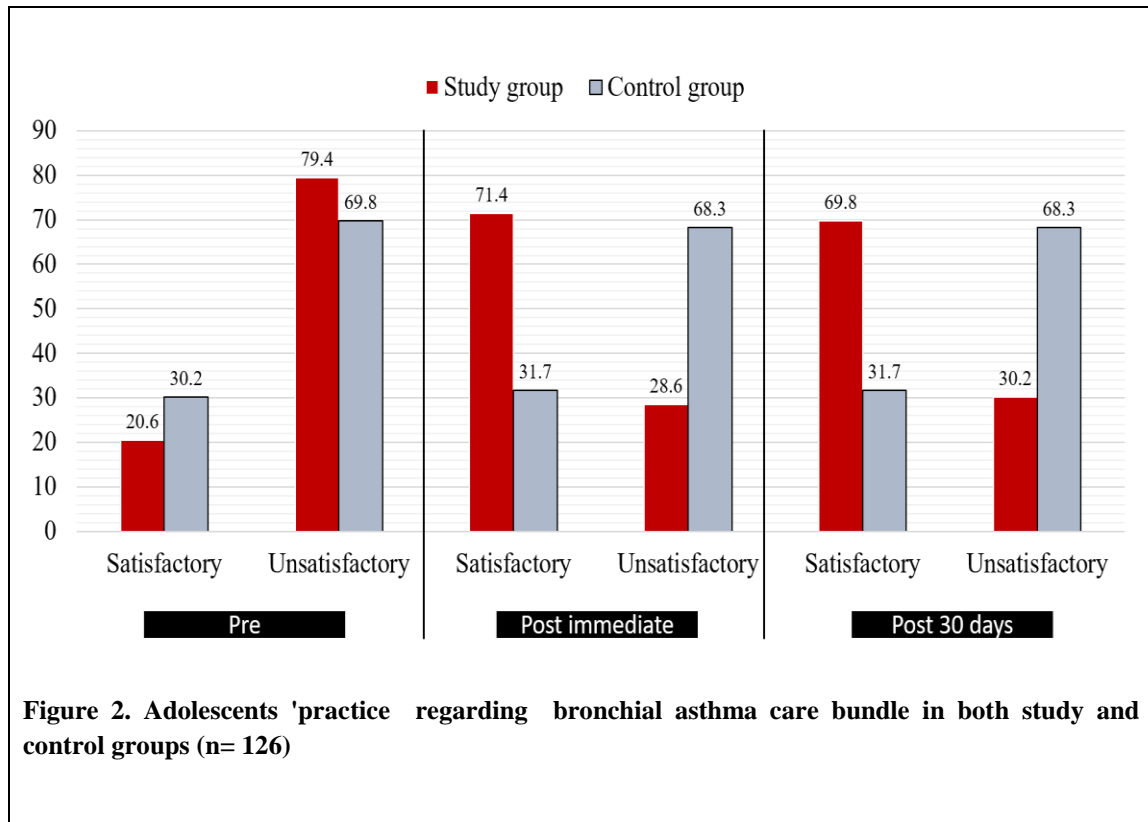


Figure 3. Adolescents' medication adherence in both study and control groups (n= 126)

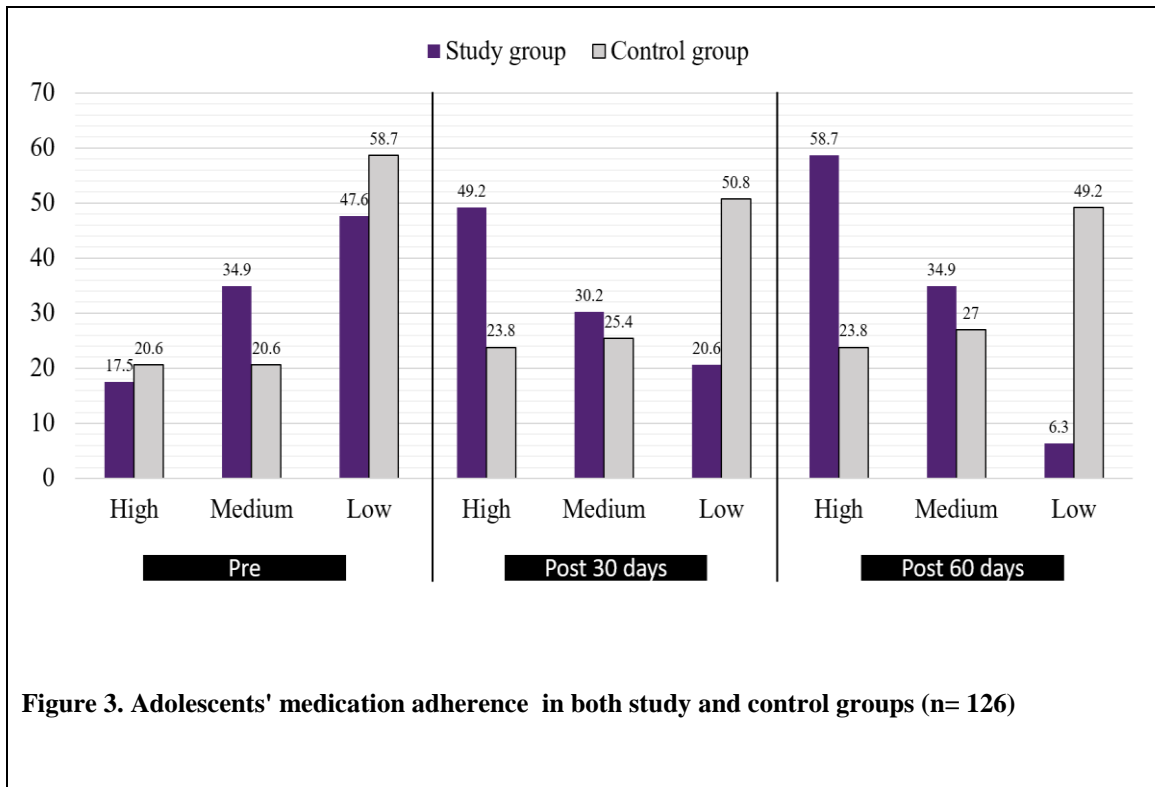
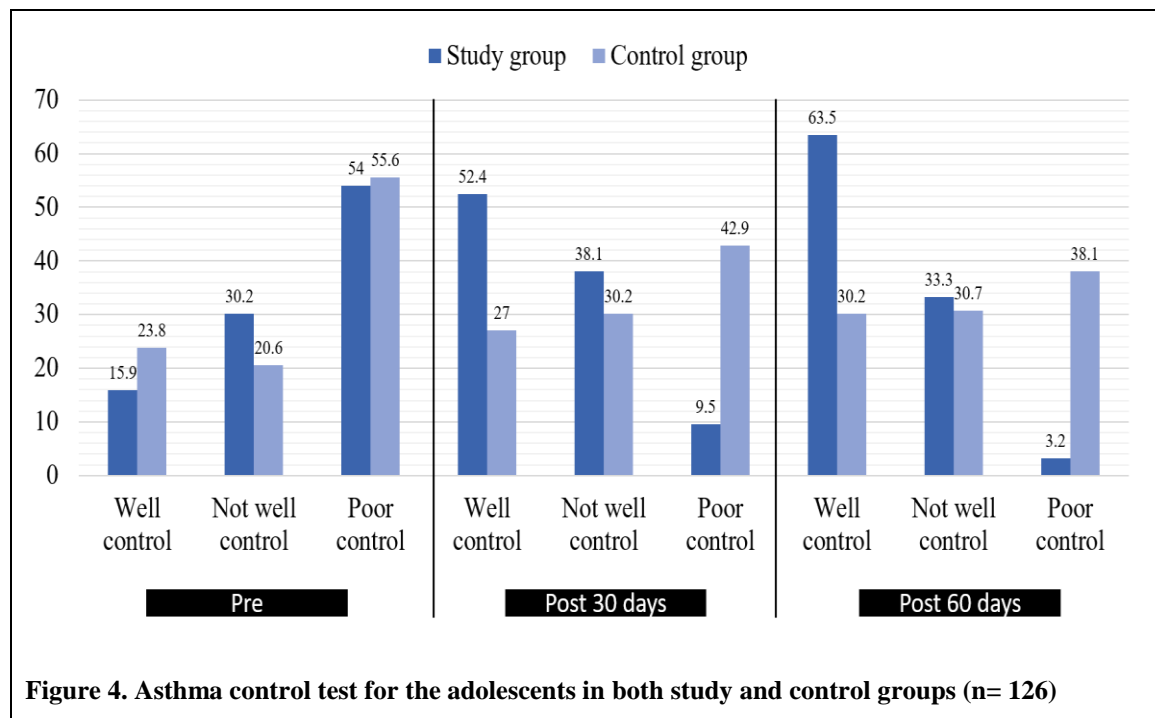


Figure 4. Asthma control test for the adolescents in both study and control groups (n= 126)



**Table 2. Outcomes of bronchial asthma care bundle according to school absenteeism, recurrence of asthma symptoms and length of hospital stay in both groups (n=126)**

Variables	Study (n=63)		Control (n=63)		Chi square test	
	No	%	No	%	X <sup>2</sup>	P
<b>Pre</b>						
- School absenteeism due to asthma in previous 30 days						
No absence	23	36.5	18	28.6		
<5 days	10	15.9	7	11.1		
5 – 10 days	19	30.2	20	31.7		
>10 days	11	17.5	18	28.6	2.854	0.415
- Acute asthma symptoms at school in previous 30 days						
Yes	40	63.5	39	61.9		
No	23	36.5	24	38.1	0.034	0.854
-Daytime symptoms in previous 30 days						
Yes	45	71.4	43	68.3		
No	18	28.6	20	31.7	0.151	0.698
-Nighttime symptoms in previous 30 days						
Yes	49	77.8	46	73.0		
No	14	22.2	17	27.0	0.385	0.535
- Days with activity restrictions in previous 30 days						
Yes	39	61.9	42	66.7		
No	24	38.1	21	33.3	0.311	0.577
<b>Post 30 days</b>						
-School absenteeism due to asthma						
No absence	39	<b>61.9</b>	19	<b>30.2</b>		
<5 days	7	11.1	9	14.3		
5 – 10 days	13	20.6	20	31.7		
>10 days	4	6.3	15	23.8	15.000	**0.002
-Acute asthma symptoms at school						
Yes	20	31.7	40	63.5		
No	43	68.3	23	36.5	12.727	**<0.001
-Daytime symptoms						
Yes	23	36.5	47	74.6		
No	40	63.5	16	25.4	18.514	**<0.001
-Night time symptoms						
Yes	30	47.6	48	76.2		
No	33	52.4	15	23.8	10.904	**<0.001
- Days with activity restrictions						
Yes	19	30.2	39	61.9		
No	44	69.8	24	38.1	12.779	**<0.001
-Mean length of hospital stay (days)	3.4 ±0.5		6.3 ±1.2		17.260*	**<0.001

\* t value, Student`s t test

\* Statistical significant (p<0.05). \*\* High statistical significant (p<0.001)

**Table 3. Outcomes of bronchial asthma care bundle, according to hospital and ED readmission in both groups (n=126)**

Variables	Study (n=63)		Control (n=63)		Chi square test	
	No	%	No	%	X <sup>2</sup>	P
<b>Pre</b>						
<b>Hospital readmission in past 30 day</b>						
No	11	17.5	13	20.6		
One	41	65.1	36	57.1		
Two	10	15.9	12	19.0		
Three or more	1	1.6	2	3.2	1.006	0.799
<b>Hospital readmission in past 60 day</b>						
No	20	31.7	18	28.6		
One	30	47.6	29	46.0		
Two	11	17.5	13	20.6		
Three or more	2	3.2	3	4.8	0.489	0.921
<b>ED readmission in past 30 day</b>						
No	18	28.6	16	25.4		
One	32	50.8	34	54.0		
Two	8	12.7	7	11.1		
Three or more	5	7.9	6	9.5	2.365	0.500
<b>ED readmission in past 60 day</b>						
No	22	34.9	21	33.3		
One	30	47.6	31	49.2		
Two	7	11.1	6	9.5		
Three or more	4	6.3	5	7.9	0.228	0.973
<b>Post</b>						
<b>Hospital readmission in past 30 day</b>						
No	44	<b>69.8</b>	14	<b>22.2</b>		
One	15	23.8	36	57.1		
Two	4	6.3	11	17.5		
Three or more	0	0.0	2	3.2	29.431	**<0.001
<b>Hospital readmission in past 60 day</b>						
No	41	<b>65.1</b>	18	<b>28.6</b>		
One	20	31.7	27	42.9		
Two	2	3.2	17	26.9		
Three or more	0	0.0	1	1.6	22.851	**<0.001
<b>ED readmission in past 30 days</b>						
No	39	<b>61.9</b>	17	<b>27.0</b>		
One	19	30.2	35	55.6		
Two	5	7.9	6	9.5		
Three or more	0	0.0	5	7.9	18.475	**<0.001
<b>ED readmission in past 60 day</b>						
No	40	<b>63.5</b>	20	<b>31.7</b>		
One	21	33.3	33	52.4		
Two	2	3.2	7	11.1		
Three or more	0	0.0	3	4.8	15.111	*0.002

\* Statistical significant (p<0.05).

\*\* High statistical significant (p<0.001)

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**Table 4. Correlation between adolescents' gender and their medication adherence , asthma control, knowledge and practice in study group after intervention post 30 days (n= 63)**

Variables	Male (n=29)		Female (n=34)		Chi square test	
	No	%	No	%	X <sup>2</sup>	P
<b>Adolescents' medication adherence</b>						
High adherence (=8)	9	<b>31.0</b>	22	<b>64.7</b>		
Medium adherence (6- <8)	9	31.0	10	29.4		**
Low adherence (<6)	11	37.9	2	5.9	11.410	0.003
<b>Asthma control</b>						
Well control	8	<b>27.6</b>	25	<b>73.5</b>		
Partly control	16	55.2	8	23.5		**
Poor control	5	17.2	1	2.9	13.781	<0.001
<b>Knowledge</b>						
Good	10	<b>34.5</b>	27	<b>79.4</b>		
Average	15	51.7	5	14.7		**
Poor	4	13.8	2	5.9	13.164	0.0013
<b>Practice</b>						
Satisfactory	15	<b>51.7</b>	29	<b>85.3</b>		**
Unsatisfactory	14	48.3	5	14.7	8.374	0.004

\*\* High statistical significant (p<0.001)

**Table 5. Correlation between adolescents' age and their medication adherence , asthma control, knowledge and practice in study group after intervention post 30 days (n= 63)**

Variables	10 – <15 (n=30)		15 – <17 (n=18)		17 – 19 (n=15)		Chi square test	
	No	%	No	%	No	%	X <sup>2</sup>	P
<b>Adolescents' medication adherence</b>								
High adherence (=8)	14	<b>46.6</b>	4	22.2	13	<b>86.7</b>		
Medium adherence (6- <8)	8	26.7	9	50.0	2	13.3		**
Low adherence (<6)	8	26.7	5	27.8	0	0.0	14.929	0.005
<b>Asthma control</b>								
Well control	16	<b>53.3</b>	5	27.8	12	<b>80</b>		
Partly control	10	33.3	11	61.1	3	20		*
Poor control	4	13.3	2	11.1	0	0.0	10.174	0.038
<b>Knowledge</b>								
Good	17	<b>56.7</b>	6	33.3	14	<b>93.3</b>		
Average	9	30.0	10	55.6	1	6.7		*
Poor	4	13.3	2	11.1	0	0.0	13.205	0.010
<b>Practice</b>								
Satisfactory	20	<b>67.7</b>	9	50.0	15	<b>100</b>		**
unsatisfactory	10	33.3	9	50.0	0	0.0	9.985	0.007

\* Statistical significant (p<0.05). \*\* High statistical significant (p<0.001)

**Table 6. Correlation between asthma control and adolescents' hospital readmission in study group after intervention post 30 days and 60 days (n= 63)**

Variables	Well control (n=33)		Partly control (n=24)		Poor control (n=6)		Chi square test	
	No	%	No	%	No	%	X <sup>2</sup>	P
<b>Hospital readmission in past 30 day</b>								
No	11	8	3	12.5	0	0.0		
One	41	24	14	58.3	3	50		
Two	10	1	7	29.2	2	33.3		**
Three or more	1	0	0	0	1	16.7	19.683	0.003
<b>Hospital readmission in past 60 day</b>								
No	20	14	5	20.8	1	16.7		
One	30	18	11	45.8	1	16.7		
Two	11	1	8	33.3	2	33.3		**
Three or more	2	0	0	0	2	33.3	31.335	<0.001
<b>ED readmission in past 30 days</b>								
No	18	13	4	16.4	1	16.7		
One	32	20	11	45.8	1	16.7		
Two	8	0	7	29.2	1	16.7		**
Three or more	5	0	2	8.3	3	50	30.349	<0.001
<b>ED readmission in past 60 day</b>								
No	22	17	5	20.8	0	0.0		
One	30	16	13	54.2	1	16.7		
Two	7	0	6	25.0	1	16.7		**
Three or more	4	0	0	0	4	66.6	53.49	<0.001

\*\* High statistical significant (p<0.001)

#### 4. DISCUSSION

Bronchial asthma is a chronic disease and consequently the goal of management concentrates on treating the signs and symptoms accurately, maintaining pulmonary function, stable levels of physical activities and preventing exacerbations. In the last years, healthcare providers was dedicated more focused on education of patients, an important aspect in the management of bronchial asthma [32]. Adolescence offer a novel window of opportunity to give behavioral interventions to improve long-term bronchial asthma outcomes. Despite the challenges of uncertainty, complacency, sense of invincibility, and opportunities exist, success in changing health habits during adolescence may carry throughout the adult lifetime [6,33]. The aim of this study was to evaluate the effect of implementing bronchial asthma care bundle on adolescents' adherence, asthma control and hospital readmission.

Regarding socio-demographic characteristics of studied adolescents and their medical history (Table 1) the present study showed that, the mean age were (14.3 ±2.9 & 14.5 ±2.7) respectively in study and control groups. This result was in congruent with harris et al, (2015) [1], who studied school-based self management interventions for asthma in children and adolescents: a mixed methods systematic review and reported that, examines outcome measures, inclusion criteria will cover populations (children five to 18 years of age). Also this result was agreement with Alreshidi, (2015) [34], who studied The Impact of a School-Based, Nurse-Delivered Asthma Health Education Program on Quality of Life, Knowledge and Attitudes of Saudi Children with Asthma and reported that, the majority of participants age were over 9 years old.

Regarding to residence , the present study showed that, more than half of studied adolescents in both groups were from rural areas . This result was in an disagreement with Duncan et al, ( 2012) [35]. who studied efficacy of a parent–youth

teamwork intervention to promote adherence in pediatric asthma and reported that, less than half of studied subject were from rural area. Regarding family history of asthma and smoking history, the finding of the present study showed that, the majority of studied adolescents in both groups were exposed to passive smoking, and less than two third of studied children respectively in both groups have positive family history of asthma this result could be attributed to smoking and genetics factors were considered very important predisposing factors for asthma in children. This results was in line with **Al Dhduh et al, (2015) [36]**. who studied prevalence and severity of allergic diseases among Egyptian pediatric in Different Egyptian Areas and showed that, the prevalence of "passive smoking" and family history among asthmatics students were more than half of them.

Concerning duration of asthma the finding of the present study reported that, less than half of studied adolescent had asthma since three years and more. This result was in agreement with **HPD and Subasinghe, (2016) [26]**. who stated that, more than half of studied subject had asthma since more than three years. Regarding medication used the present study found that, more than one quarter in both groups were used Cough remedies and antibiotic respectively for asthma treatment. This results was in an disagreement with **Al Dhduh et al., (2015) [36]**. who reported that, around half of them used Cough remedies, antibiotic and more than one quarter were used inhaler medications. This because the asthma medication were many methods and it were used according to patient status and severity of asthma attack.

Concerning adolescents' knowledge (**Figure1**), the present study showed that, less than two third of adolescents in both groups have poor knowledge before intervention, while immediately and post 30 days after intervention, less than two third of adolescents in study group had good knowledge compared with minority of adolescents in control group. There were highly statistical significance differences between both groups after intervention ( $p < 0.001$ ). This may be due to implementing bronchial asthma care bundle intervention had positive impact on adolescents' knowledge and increased their awareness. This result was in agreement with **Alreshidi, (2015) [34]**., who found that, the level of children's knowledge in the control group did not changed through the 3 intervention phases, compared with children in intervention group, their knowledge was increased significantly after implementing the intervention program ( $p < 0.001$ ). This results confirm that the asthma educational intervention program had a significant effect on children's knowledge resulting in maintained, improved knowledge and awareness about the bronchial asthma. Hence the hypothesis 1 was supported by this result.

Regarding adolescents' practice (**Figure 2**), the results of the present study revealed that, more than three quarter of adolescents in study group and more than two third in control group have unsatisfactory practice before intervention, while after intervention, less than three quarter of adolescents had satisfactory practice post immediately and after 30 days in study group compared with about one third of adolescent in control group. There were highly statistical significant differences between both groups after intervention ( $p < 0.001$ ), this result could be attributed to decrease adolescent's knowledge before asthma care bundle intervention and their knowledge was improved as well as their practice was improved after intervention, also decrease of home interventions level in the adolescent may be due to their low of autonomy to implement the suitable accurate of interventions. This result was in the same line with **Santana et al, (2005) [37]**., who studied Educational interventions for children with asthma: an analytical review of the literature and stated that, majority of studied subject have improvement in correct implementation of the management plan, correct use of inhalers and increase acquired self-management skills after educational intervention. Hence the hypothesis 1 was supported by this result.

Regarding the adolescents' medication adherence (**Figure3**), the finding of the present study revealed that, less than half of studied adolescents in study group and more than half of adolescents in control group had low adherence before intervention, while post 30 and 60days, approximately half and more than half of studied adolescents in study group had high adherence compared with less than one quarter of adolescents in control group after intervention. there were high statistical significance differences between both groups after intervention. This could attributed to direct implementing asthma care bundle for adolescents and explain important of medications administration in prevent of recurrence asthma attack and the correct inhaler drugs administration could increase adolescent's adherence for medication. This results of the present study was in harmony with **Halterman et al,( 2011) [38]**, they studied "a pilot study to enhance preventive asthma care among urban adolescents with asthma" and reported that, positive outcomes of pilot study included ( improve knowledge, quality of life, proper use of medications; symptoms; medication adherence; asthma control, lung function and health care outcomes) after intervention. Hence the hypothesis 2 was supported by this result.



Findings of this study pointed out that, more than half of studied adolescents in both groups had poor asthma control before intervention, while after 30 days, more than half of studied adolescents and after 60 days about two third of them in study group had well asthma control compared with more than one quarter of adolescents in control group after intervention. There were highly statistical significance differences between both groups after intervention (**Figure 4**). This may be due to health education may lead to improve knowledge level and home management care, and all of this achieve well asthma control. this results was in accordance with **Zarei et al, (2013) [39]**, they studied "the effect of educational and modifying intervention on asthma control among adolescents: a randomized clinical trial" and reported that, a statistical significance differences between the amount of change in asthma control of the both groups was revealed, while, a poor asthma control was found in the control group post intervention. Also this study was disagree with **Jonsson, M. (2015) [40]**, Who studied Asthma care for children and adolescents and showed that, only a small proportion of adolescents had controlled asthma. Most adolescents were not well or partly controlled. Hence the hypothesis 3 was supported by this result.

Concerning outcomes of bronchial asthma care bundle according to school absenteeism, recurrence of asthma symptoms and length of hospital stay (**Table 2**), the present study revealed that, there were highly statistical significance differences between both groups after intervention ( $p < 0.001$ ). This results was in the same line with, **Cicutto et al., (2013) [41]**, they studied " a randomized controlled trial of a public health nurse delivered asthma program to elementary schools in Canada" and reported that, there significant difference between intervention and control groups, with high score of quality of life; symptom control and decrease of school absenteeism in the intervention group ( $P < 0.001$ ). As regard length of hospital stay, the finding of the present study found that, mean length of hospital stay was  $3.4 \pm 0.5$  in study group compared with  $6.3 \pm 1.2$  in control group after intervention. there were high statistical significant differences between both groups ( $p < 0.001$ ). this result was in consistent with **Nkoy et al., (2015) [42]**, they "studied improving pediatric asthma care and outcomes across multiple hospitals" and reported that, a highly statistical significant decrease in length of stay ( $P < 0.001$ ) and cost after implementation an evidence-based intervention model at primary children's hospital.

The finding of outcomes of asthma care according to hospital and ED readmission (**Table 3**). The finding of the present study found that, more than two third of adolescents in study group had not hospital readmission after 30 and 60 days after intervention compared with around one quarter of adolescents in control group. Also, less than two third of adolescents in study group had not ED readmission after 30 and 60 days after intervention, compared with more than one quarter of adolescents in control group. There statistically significant differences between both groups after intervention. This may be due to implementing of bronchial asthma care bundle intervention for adolescents in study group resulting in improve adolescent's knowledge about asthma care bundle elements and practice for nebulizer, inhaler medication and breathing and coughing exercise and the researcher was explained the importance of apply this elements at home so that, hospital readmission were decreased. This result was in the same line with **Lee, & McCullough, (2016) [43]**, who studied "the effectiveness of interventions to address childhood asthma: a scan of the literature and current approaches" and reported that, the interventions result in significantly reduce the number of hospitalizations, ED visit and unscheduled visits for seek health care after educational programs as a whole. Hence the hypothesis 4 was supported by this result.

Correlation between adolescents' gender and their medication adherence, asthma control, knowledge and practice in study group after intervention post 30 days (**Table 4**), the results of this study concluded that, the high medication adherence, well asthma control, good knowledge and satisfactory practice were significantly more frequent in females than in males. This relation was statistical significant. This may be due to the females in this age were feel of responsibility and they were liked to meet their peers in schools so that, they had high adherence for treatment to decrease asthma attacks, also may be due to the boys were denied asthma symptoms due to poor communication with their family members in this age. This result was in agreement with **Chan et al., (2016) [44]**, they studied "factors associated with medication adherence in school-aged children with asthma" and stated that, females sex were significant associated with high medication adherence. Hence the hypothesis 5 was supported by this result.

Regarding Correlation between adolescents' age and their medication adherence, asthma control, knowledge and practice in study group after intervention post 30 days (**Table 5**), the findings of the present study revealed that, the high medication adherence, well asthma control, good knowledge and satisfactory practice were significantly more frequent in majority of adolescent's who their age 17 – 19 years, this may attributed to late adolescents have more awareness and

more liable to learn and remember the asthma intervention so that, they had good knowledge, satisfactory practice and high adherence score. This led to well control of asthma symptoms. This finding was disagreed with, **Chan et al., (2016) [44]**, who stated that, there was a similar non-significant trend between age of the children and adherence, with low adherence in older children.

In relation to the correlation between asthma control and adolescents' hospital and ED readmission in study group after intervention post 30 days and 60 days (**Table 6**). The finding of the present study revealed that, there was a strong relationship between the asthma control level and adolescents' hospital readmission after intervention, adolescents with well control asthma had not hospital and ED readmission post 30 and 60 days more than adolescents had not well control asthma. There were highly statistically significant differences ( $p < 0.001$ ). This may be attributed to, adolescent who had well control of asthma this mean decrease day and night symptoms of asthma and not absenteeism from school all of this decrease hospital and ED readmission. This finding was consistent with **Britto et al., (2014) [10]**, they reported that a corresponding proportion of patients had a high score of 25 marks on the asthma control test, the mean proportion of patients with asthma-related ED visits or hospitalizations was stable. Hence the hypothesis 6 was supported by this result.

Finally, by evaluating the effect of implementing bronchial asthma care bundle on adolescents' adherence, asthma control and hospital readmission, an improvement was observed among adolescent's adherence for medication, well asthma control and hospital readmission, as well as reduce of hospital stay and school days absenteeism. So that, implementing bronchial asthma care bundle considered very important in management of asthmatics adolescents.

## 5. CONCLUSION

The study concluded that, bronchial asthma care bundle affected positively on adolescent's knowledge, practice, adolescent's medication adherence, asthma control and decrease hospital readmission. Also, decrease school absenteeism and reduce length of hospital stay. There was positive relationship between the asthma control level and adolescents' hospital and ED readmission after intervention, as well as the females had good knowledge, satisfactory practice, high adherence and asthma control more than males. This result supports the proposed study.

## 6. RECOMMENDATION

The results of the present study were recommended further implementation of asthma care bundle intervention in other emergency departments and hospitals. Provision of asthma care bundle intervention to all asthmatic children. Asthma care bundle should be implemented in the school and hospitals health program. Replication of the asthma care bundle intervention program for nurses in outpatient and in the inpatient wards. Educational intervention program about asthma care bundle are recommended to mothers of children with asthma. Future research to study the correlation between other demographic characteristics of adolescents and their adherence and asthma control.

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