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Adherence to inhaler technique among children with asthma

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Abstract

Purpose: The purpose of the review was to gather evidence about the adherence to inhaler techniques among children with asthma.

Study design: A systematic review.

Method: A structured literature search was done using various electronic database MEDLINE; PubMed and Procast.

Result: Total 25 studies were shortlisted, from which 15 of them with proper methodology were reviewed and reported. Studies included Randomized control trail, experimental studies, observation study, cross sectional study, prospective observational study, Randomized controlled OUTERSPACE trial. Studies reported that adherence to asthma controller therapy showed that the adherence is based on the parenteral perception and positive approach towards the inhaler therapy and many of them showed that the poor adherence. And the Electronic device monitoring is a way that helping the caregivers and children using video directly observed therapy (DOT), electronic monitoring with a digital smart spacer support, connected inhaler system (CIS), comprising clip- on inhaler sensors, a patient-facing app and a healthcare professional (HCP) dashboard, electronic monitoring devices, electronic monitoring device with audio-visual reminder showed improvement in adherence to inhaler techniques among the children and caregivers.

Keywords: Adherence, inhaler technique, asthma, children

Introduction

Asthma is "a chronic inflammatory disorder of airways associated with increased airway hyper responsiveness, recurrent episodes of wheezing, breathlessness, chest tightness, and coughing. (Global Strategy for Asthma Management and Prevention Guidelines) in 2022 ^[1]. Asthma may causes coughing that worsens with viral infection, and also occurs with asleep or is triggered by exercise or cold air and a whistling or wheezing sound when breathing out and Shortness of breath, Chest congestion or tightness, and Trouble sleeping due to shortness of breath, and Trouble breathing that hampers play or exercise, Fatigue, which can be due to poor sleep ^[2].

Asthma is one of the most common chronic childhood illness currently, affecting an estimated 6.1 million population. childhood asthma is the most common cause for the emergency visit, hospitalization, and missed school days. The childhood asthma divided into two one is recurrent wheeze which is triggered by a viral infection, resolves in the early school age and second one is chronic asthma is associated with allergy which will be persist later in childhood or often in adulthood.

Management of children with asthma by four components, Regular assessment and monitoring, patient education, control of factor contributing asthma and principles of asthma pharmacotherapy which includes the four steps. step 1 will be the SABA and step 2 will be low dose of inhaled corticosteroids(ICS), step 3 is medium dose of ICS and step 4 will be the medium dose of ICS and with LABA (long acting- β 2 agonist) or LTRA (leukotrience receptor antagonist) ^[2].

The average medication adherence to inhaled corticosteroids therapy in children documented to be around 50%. Quality of life among children with asthma is affected due to limited activities. The children may missed school days, inability to carry out normal activities, or perceived poor health status and also linked with depression. Children with more severe symptoms are less to have high academic achievement than children with fewer symptoms or those who are without asthma ^[5].

The aim of the present study was to carry out a rapid systematic review on adherence to inhaler techniques, in asthma management.

Research title

Adherence to inhaler technique among children with asthma.

Objective

The purpose of the review was to gather evidence about the adherence to inhaler techniques among children with asthma.

Methods

Rapid systematic review

The methodological protocol for this rapid review followed the literature search was carried out in Oct-Dec 2021. All the published studies (English language) which utilized as adherence to inhaler technique were included regardless of the age of the participants. For the purposes of this review, any study which is related adherence to inhaler therapy. Three different databases i.e. MEDLINE; PubMed and Procast were rigorously searched using the following subject headings and keywords.

- Asthma Controller Therapy And Adherence
- Inhaler Techniques And Adherence
- Electronic Monitor And Adherence

Asthma Controller Therapy and Adheren CE

A prospective observational study at the King Khalid Hospital in Majmaah, Saudi Arabia between January and April 2020; Adherence to Asthma Controller Therapy Among Children in Majmaah City, Saudi Arabia. The aim of this study was to assess the adherence to asthma controller therapy and the factors that might influence the level of adherence among asthmatic children. The study was conducted among children aged 1-14 years with a diagnosis of asthma. The data was collected using a pre-tested questionnaire which contained four validated items, and the respondents were the parents of the affected children analysed 152 asthmatic children to evaluate their adherence to asthma controller therapy. The result showed that majority of the children were males (60%). In that they found that the majority of the children had poor adherence to asthma medication (83.6%) while the remaining had good adherence (16.4%) [1].

A study was conducted on High inhaled corticosteroids adherence in childhood asthma: The study aim is to assess the adherence in young asthmatic children over a 3-month period, including the role of parental illness and medication perceptions as determinants of adherence. The sample were recruited between age group of 2–6-yr-old children with asthma, using inhaled corticosteroids (ICS), followed-up at pediatric asthma clinic (where patients are being extensively trained in self-management, and are followed-up closely). Adherence was measured electronically using a SmartInhaler1 and calculated as a percentage of the prescribed dose. The result showed that the Median (interquartile range) adherence, measured over 3 months in 93 children, was 92 (76–97) %, and most children had well controlled asthma. 94% of parents expressed that giving ICS to their child would protect him/her from becoming worse. Adherence was significantly associated with asthma control and with parental perceptions about medication. The study

showed that the high adherence rate associated with parental perceptions about ICS [2].

A pilot study was conducted on Enhancing Medication Adherence among Inner-City Children with Asthma: Results from Pilot Studies. The goal of these study was to pilot test an intervention that used social learning strategies (e.g., goal-setting, monitoring, feedback, reinforcement, and enhanced self-efficacy). Participants were 15 children with asthma, aged 7–12 years, who had been prescribed at least one daily inhaled steroid. The children and their mothers lived in inner-city Baltimore and all were African-American. Participants received up to five visits in their home by a nurse. Electronic monitors were installed on the children's MDI to provide immediate feedback on medication adherence to the families and validate medication use. The study was conducted over a 4 weeks period. The study result showed that the underutilization decreased by enhancing the home based intervention [3].

A study was done on Adherence to inhaled corticosteroids in children with asthma and their parents the purpose of this study was to identify factors that were associated with adherence to ICSs in children with asthma and their parents in a multi-ethnic population in Amsterdam, the Netherlands. The sample were recruited 232, aged between 7-17 years, with pediatrician diagnosed asthma. The data collection done questionnaires examining socio-demographics, asthma control, knowledge of asthma and other determinants of adherence. Adherence to ICSs was assessed by self-report and pharmacy record data. The study showed that the positive subjective view of parents and self-efficacy were inversely associated with poorer adherence [4].

Inhaler techniques and adherence

A study was conducted on Evaluation of inhaler technique, adherence to therapy and their effect on disease control among children with asthma using metered dose or dry powder inhalers. The objective of the study is to assess problems about correct use of inhaler devices, adherence to inhaler corticosteroid treatment and the effects of these problems on the control of asthma. This was assessed using a questionnaire. A 107 patients and their families were interviewed as a sample. Metered dose inhaler (MDI) with spacer was used by 119 (69.5%) patients and 52 (30.5%) used dry powder inhalers (DPIs). The devices were used correctly by 68.1% of patients using MDI and 34.6% of patients using DPI ($p < 0.001$). The most common improper step was "breathe in from the spacer 5-6 times or 10 s" for MDI (24.4%) and "exhale to residual volume" for DPI (51.9%). Frequency of correct use was higher in patients trained 3 times ($p < 0.001$) Partial or poor adherence was showed 22.8% of patients. Patients with mothers who had lower educational status had higher frequency of incorrect use of inhaler device ($p = 0.007$) [5].

A Study was conducted on Inhaler device, administration technique, and adherence to inhaled corticosteroids in patients with asthma. The aim of this study is to compare inhaled corticosteroid (ICS) inhaler type with user technique and ICS medication adherence among adults with asthma. The sample recruited 270 adults into two groups based on the ICS device type: metered-dose inhaler (MDI) or dry powder inhaler (DPI). Inhaler technique was assessed using standardized checklists. Medication adherence was evaluated using the Medication Adherence Report Scale (MARS). The result showed no difference in technique

scores between the groups ($p=0.46$), but better ICS adherence among DPI users ($p=0.001$). And the DPI use associated with higher rates of adherence but not with inhaler technique after adjusting for potential confounders [6].

A cross sectional study was done in medicine, outpatient department of a tertiary care referral hospital, at Rajshahi, in 2021. The population age above 18 years. 400 sample were selected using random sampling techniques. Face to face interview was done with structured questionnaire. Adherence was assessed using cronbach's alpha of the TAI (test of adherence scale 10 point scale) Patients are considered as good, intermediate, and poor adherents if they score 50, 46–49, and ≤ 45 respectively. Result showed that the majority of the patients (86%) reported poor adherence to their inhalation therapy. 8% of them reported good adherence (TAI score 50) and 6% showed moderate adherence (TAI score 46-49). Rural residency, less schooling, middle income, co morbidity, using longer than 5 years as identified as precipitating factor for non-adherence [7]. A prospective observational study was done in Saudi Arabia 2020. to evaluate their adherence to asthma controller therapy. The sample between the age of 1-14 years, 52 sample were selected using convenience sampling. the subjects were assessed the adherence using the Paediatric Inhaler Adherence Questionnaire (PIAQ). The subjects demographic data collection was done through the pre-test questionnaire in the Out Patient department and the data collection done through the phone call after visit to assess the adherence. The result revealed that the assessment of adherence to asthma controller therapy was performed by using total mean score for adherence to medication therapy was 5.16 (SD: 2.30) Nearly 60% were males. Asthma was most prevalent in the age group of 6-10 years (40.1%), followed by the age group of two to five years (32.9%), the majority of the patients had poor adherence to asthma medication (83.6%) while the remaining showed good adherence (16.4%) [8].

Electronic monitor and adherence

A study was conducted on Feasibility of video observed therapy to support controller inhaler use among children in West Baltimore in February 2020 and was prematurely terminated on March 13, 2020. This study is to assess feasibility of a novel video directly observed therapy (DOT)-based digital asthma program intended to support correct inhaled corticosteroid (ICS) use among children. The sample was recruited between age group 2 to 18 years with sub-optimally controlled asthma and prescribed ICS were recruited during outpatient the program was delivered via the emocha mobile application (emocha Mobile Health Inc., Baltimore, MD). The emocha platform supports video capture of ICS doses and encrypted transmission to a secure server for remote viewing on a web portal (video DOT). The study showed that the platform also supports delivery of the following intervention components: daily automatic and customizable dose reminders; two-way in-app chat function to facilitate nurse feedback as well as on-demand nurse support; and a progress tracker screen to visualize adherence over time. The study showed that the participants experienced the program as long, but easy to use; benefits included building routines, skill, and independence [9].

A Protocol of the 76 Conducted on Can electronic monitoring with a digital smart spacer support personalized

medication adherence and inhaler technique education in patients with asthma. The aim of this study is to assess the feasibility of undertaking a definitive randomized controlled trial of personalized, smart spacer data-driven education and explore clinical benefits. The sample recruited with asthma ≥ 18 years using inhaled corticosteroids, long-acting beta-agonists, short-acting beta-agonists administered with a pressurized-metered- dose-inhaler and spacer ($n=40$) will use a smart spacer for 1 month. Patient are divided into control group (routine care) versus intervention group (personalized education), the Asthma Control Questionnaire (ACQ), Work Productivity and Activity Impairment (WPAI) questionnaire and Test of Adherence to Inhalers (TAI) are administered and fractional exhaled nitric oxide (FeNO) is assessed. The outcome is the overall feasibility of a definitive trial assessed by patient recruitment speed, participation and drop-out rate. Secondary outcomes are patient and healthcare provider satisfaction and exploratory clinical outcomes are adherence, inhaler technique, TAI score, FeNO, lung function, ACQ and WPAI [10].

A randomised controlled trial of the effect of a connected inhaler system on medication adherence in uncontrolled asthmatic patients This study evaluated the effect of different elements of a connected inhaler system (CIS), comprising clip-on inhaler sensors, a patient-facing app and a healthcare professional (HCP) dashboard, on adherence to asthma maintenance therapy. The sample were recruited 437 adult. open-label, parallel-group, 6-month, randomised controlled trial in adults with uncontrolled asthma (asthma control test (ACT) score less than 20) on fixed-dose inhaled corticosteroids/long-acting β -agonist maintenance. Subjects received fluticasone furoate/vilanterol ELLIPTA dry-powder inhalers for maintenance and salbutamol/albuterol metered-dose inhalers for rescue, with a sensor attached to each inhaler. The result shows that ACT scores improved in all study arms with no significant differences between groups. A CIS can improve adherence to maintenance medication and reduce rescue medication use in patients with uncontrolled asthma [11].

An observational study was conducted on adherence to home nebulizer therapy among children with asthma; the study is to assess the rate of adherence to home nebulizer treatment in pediatric patients in China. The CARE study was a 12-week, multicenter, prospective, observational study across 12 tertiary hospitals in China. Sample were recruited aged between 0–14years, clinically diagnosed with asthma and prescribed home nebulizer inhaled corticosteroid (ICS) therapy for ≥ 3 months. Children were attended onsite visits at 0, 4, 8 and 12weeks to assess asthma control, severity and treatment adherence (recorded by electronic monitoring devices and caregivers).the study shows that adherence reported by electronic monitoring devices was 69.9%, and median caregiver-reported adherence was 77.9%. The proportion of patients with well-controlled asthma increased from 12.0% at baseline to 77.5% at visit 4. Increased time between asthma diagnosis and study enrolment was a significant predictor for better adherence and asthma control. Adherence to home nebulization, a widely used treatment for asthma, was high among Chinese pediatric patients. Asthma control improved with increasing treatment duration. These results suggest that home nebulization of ICS is an effective and recommendable long-term treatment for pediatric patients with asthma [12].

A study was conducted on Assessing adherence to inhaled therapies in asthma and the emergence of electronic monitoring devices Hetal Dhruve. The aim of this study to assess the Infrequent use of inhaled corticosteroids (ICS) and/or over-reliance of short-acting β -agonists (SABA) using the electronic monitoring devices (EMDs). The data collection done using patient- reported questionnaires or prescription refill records. In Electronic monitoring of inhaler devices allow for monitoring of use, as well as recording of and feedback on inhaler technique for some devices. Most electronic monitoring devices (EMDs) are paired with a smartphone application, allowing patients to set reminders and display both preventer and reliever use over time. This devices allows identification of intentional and unintentional ICS non-adherence as well as frequency of SABA use. This allows identification of intentional and unintentional ICS non- adherence as well as frequency of SABA use. This information assists clinicians in distinguishing difficult-to-control from severe asthma. Although additional evidence is required to assess the impact of EMDs on clinical outcome measures such as exacerbation rate, the introduction of EMDs into the asthma armoury is a significant step forward in asthma care with the potential to improve asthma-related outcomes ^[13].

A pilot study was conducted on Enhancing Medication Adherence among Inner-City Children with Asthma: Results from Pilot Studies. The goal of these study was to pilot test an intervention that used social learning strategies (e.g., goal-setting, monitoring, feedback, reinforcement, and enhanced self-efficacy). Participants were 15 children with asthma, aged 7–12 years, who had been prescribed at least one daily inhaled steroid. The children and their mothers lived in inner-city Baltimore and all were African-American. Participants received up to five visits in their home by a nurse. Electronic monitors were installed on the children's MDI to provide immediate feedback on medication adherence to the families and validate medication use. The study was conducted over a 4 weeks period. The study result showed that the underutilization decreased by enhancing the home based intervention ^[14].

A randomized control trial was conducted on the effect of an electronic monitoring device with audiovisual reminder function on adherence to inhaled corticosteroids and school attendance in children with asthma: in Auckland, New Zealand between May 10, 2010, and Feb 26, 2012. This study aimed to investigate the use of an inhaler with audiovisual reminders leads to improved adherence and asthma outcomes in school-aged children who presented to the emergency department with an asthma exacerbation. Patients aged 6–15 years who attended the regional emergency department with an asthma exacerbation and were on regular inhaled corticosteroids. The sample were recruited randomly assigned intervention (220) and control group (110) to receive an electronic monitoring device for use with their preventer inhaler with the audiovisual reminder functions either enabled to support adherence to inhaled corticosteroids (intervention group) or disabled (control group). Participants were followed up every 2 months for 6 months. The primary outcomes were adherence to preventive inhaled corticosteroids and number of days absent from school for any reason. Asthma control was assessed as a secondary outcome. Median percentage adherence was 84% (10th percentile 54%, 90th percentile 96%) in the intervention group, compared with 30% (8%,

68%) in the control group ^[15].

Result

In this systematic review focused on the asthma controller therapy, inhaler techniques, electronic device monitor and adherence. There was poor adherence to Asthma controller therapy based on the parenteral perception towards the inhaler therapy. Adherence to Inhaler techniques showed that majority of the children were performing inappropriate techniques (breath in spacer 4-6 times or 10 times). There was a positive improvement in adherence to inhaler technique using a various Electronic device.

Discussion

The present study adds information to the existing information on adherence to inhaler technique among children with asthma. The studies used in this review of 15 studies. In this review discussed on adherence to asthma controller therapy, adherence to inhaler technique and adherence to electronic device.

Conclusion

In this systematic review focused on the Adherence to inhaler techniques among children with asthma. The Asthma controller therapy and Electronic device monitoring is crucial for asthma control. This study is provides birds eye view on the adherence to inhaler techniques. There are 15 studies were analyzed scientifically related adherence to inhaler techniques. Since the majority of the participants demonstration exhibited incorrect inhaler techniques. The study was assed using inhaler checklist, adherence tool and questionnaire was used as it is a feasible, valid and reliable instrument for assessing the inhaler techniques in any type of device. And the techniques of inhaler also demonstrated poor adherence and the electronic device monitoring will improve the inhaler techniques in children.

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