

Adherence in young children with asthma

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Purpose of review

To discuss the unique challenges of managing asthma in young children and to review the literature over the past year with regard to regimen adherence in this relatively understudied population.

Recent findings

Young children and their families face unique challenges in dealing with asthma and these have the potential to affect regimen adherence. They include the time and effort required by asthma-management activities (e.g. nebulizer use), dependency on parents for asthma care, and the limited ability of children to communicate about their symptoms. Five published studies were found for the past year. They covered three areas: adherence assessment (e.g. electronic monitoring versus diary cards), device impact on adherence (e.g. influence of the novelty of medication-delivery device), and adherence interventions (e.g. parental education regarding symptoms).

Summary

Research suggests that several components need to be considered when designing interventions to improve adherence for young children with asthma: to consider the strain in the caregiver role when developing the treatment regimen, to provide devices that parents and children can use, to monitor adherence with electronic monitoring, and to address parents' concerns and perceptions about treating prodromal symptoms of an asthma exacerbation. Because many parents are hesitant to treat cough symptoms, an additional training component may need to be added to address this concern.

Keywords

adherence, asthma, children, pediatric

Introduction

Young children represent an important proportion of those with childhood asthma. Children with asthma are typically first diagnosed as young children, with 50–80% diagnosed by the age of 5 years [1]. Additionally, appropriate diagnosis at this age and early treatment may prevent airway remodeling [2]. Finally, children under 5 years of age represent a disproportionately high percentage of the overall cost of inpatient care for children with asthma [3]. Consequently, regimen adherence with this population deserves consideration, both in clinical work and research.

Unique challenges for asthma in young children

Young children and their families face unique challenges in dealing with asthma and its care. These challenges have the potential to affect regimen adherence. They include the amount of time and effort required by asthma-management activities, dependency on parents for asthma care, and the limited ability of young children to communicate about their symptoms.

The typical asthma-management plan for infant and preschool children can be more difficult than that for older children. Metered-dose inhalers (MDIs) may be awkward for some young children and parents to use, as they require holding a spacer and inhaler device up to the child's mouth and also specific cleaning techniques to reduce electrostatic charges which may reduce drug delivery [4]. The alternative to using an MDI is to use a nebulizer, which many parents prefer, although MDIs can provide easier administration and similar drug delivery [4]. Nebulizers are bulky and can be hard to transport, making it difficult for parents to give medication treatments when they are not at home. Additionally, nebulizers must be disassembled, rinsed, and dried after each use. After six to eight uses, nebulizers should be deep-cleaned with a water and vinegar solution [5[•]]. If a child is taking a corticosteroid twice a day and albuterol as needed one to three times daily, for example, a parent should be rinsing the nebulizer up to five times a day and deep-cleaning every day and a half. This process can take a significant amount of time, particularly compared to that needed to rinse and wash a MDI spacer or to simply put away medication when no cleaning is required. Nebulizers are also more time-consuming because of the treatment duration. Instead of a quick puff from an inhaler, a nebulizer treatment takes about 13 ± 8 min [6^{••}]. Not only must a parent find time for these treatments in a

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Abbreviations

MDI metered-dose inhaler
pMDI pressurized metered-dose inhaler

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busy day, but parents also often need to provide quiet activities to help their child sit still during these long and sometimes awkward treatments. For families with a single parent, multiple children, or a busy, chaotic family environment, some of these time-consuming treatments may be skipped [7]. Finally, especially for the youngest children, a mask may be required during a nebulizer treatment, something that some children may find frightening or confining [8]. Adherence to nebulizer use in young children ranges from 33 to 71% [9].

Asthma management in young children is highly dependent on parents. First, most of a young child's time is spent with family, as these children have not yet begun school [10]. Second, young children are unable to plan their own treatment (e.g. realizing that they will need a bronchodilator before playing outside) and cannot have the primary responsibility for avoiding triggers (e.g. keeping their room dust-free) [10]. Asthma educators have indicated that out of 38 asthma self-management skills, 3-year-olds can perform only 42% of them and then only with adult assistance; 5-year-olds can perform 11% independently, but need adult assistance (18%) or supervision (47%) for the other skills; and 7-year-olds can perform 32% of the tasks independently and 58% with adult supervision [10]. In addition to not being able to take responsibility for asthma care tasks, younger children are also unable to communicate health information sufficiently. For example, younger children are less able to notice and express small changes in symptoms; thus, parents must learn to observe small cues of an asthma exacerbation in their child [11]. Accordingly, any treatment plan or asthma education for very young children should be directed primarily at parents.

Because asthma management is so dependent on parents, parenting stress and parenting effectiveness can be significantly related to adherence. Parenting stress can be a particularly salient factor in young children with asthma, as most of these children are within a year or two of diagnosis, so parents are still adjusting to the diagnosis and management of asthma [10]. This adjustment period requires parents to assimilate the asthma regimen into other routines [12]. Mothers also report experiencing stress due to sleep disturbances caused by nighttime asthma symptoms and to cancellation of family activities due to asthma exacerbations [10]. The more unpredictable disease symptoms are, the greater the strain on the family [13], and an increase in symptoms is highly correlated with a decrease in parental quality of life [14]. A parent experiencing strain in the caregiver role may be more likely to feel less confident and less knowledgeable about their child's asthma care, and these constructs have been linked to poor adherence [15]. Conversely, it can be hypothesized that better adherence can lead to better symptom control, thereby reducing strain and stress for the family.

Review of recent studies of adherence in young children

In preparation for this review, a systematic literature search on adherence in young children with asthma was conducted using the PubMed and PsychInfo databases. Very few studies examining adherence in young children with asthma have been published in the past year; in fact, only five articles were identified. However, the number of studies published in 2005 might represent a considerable increase compared to past years. Specifically, in the previous 10 years, about four or five articles were published annually on young children with asthma. Only a handful of these articles dealt with adherence issues. Prior to 1995, even fewer articles were published on young children with asthma. The five adherence studies that were found can be grouped into three topic areas: adherence assessment, impact of devices on adherence, and adherence interventions.

Adherence assessment

Electronic monitoring is a relatively new assessment technique that provides an important, objective measure of medication use. Butz and colleagues [6^{••}] compared self-report (i.e. diary records) of nebulizer use to electronic monitoring to evaluate the sensitivity, specificity and agreement between these two measures. This study included 157 children between the ages of 2 and 8 years (mean, 4.6 years). Most of the children used the nebulizer for albuterol (95%), while 27% used it for a controller medication. Both types of medication were monitored for 12 weeks using electronic monitoring and diary card recordings. Electronic monitoring was conducted by a device which connected to the nebulizer electrical plug and recorded the date, time, and total length of each nebulizer use event. The diary card was a simple preprinted checklist on which the parent recorded the number of times the nebulizer was used each day. Parents returned completed cards every 2 weeks via mail.

Electronic monitoring and diary cards were compared as to whether the nebulizer was used at all each day, resulting in a binary coding of yes or no for 8221 days of nebulizer use across all participants. The concordance between diary and electronic monitoring was high, at 84.7%, and the κ coefficient was 0.61, which is considered a good strength of agreement. Over-reporting of nebulizer use on diary cards occurred on 15% of days. The primary drawback of diary data appeared to be a decreasing return rate for diary cards: first 3 weeks, 75%; second 3 weeks, 62%; third 3 weeks, 57%; and fourth 3 weeks, 44%. This declining return rate is consistent with previous research on diaries for peak-flow meter readings [16].

The data suggest that electronic monitoring of nebulizer use is a viable and preferred measure for long-term assessment. However, diary card data may be a useful

and accurate way to measure days of nebulizer use over a short amount of time (i.e. 2–3 weeks). Additionally, electronic monitoring could not provide any information on the type of drug used in the nebulizer, unless a separate nebulizer device was used for each drug within a family. Diary records provide a more practical solution for recording the specific drug used.

The main weakness of this study was the binary method of comparing the two data sources (nebulizer use versus non-use). This method reduces the ability to determine validity of diary card use for gathering more detailed information. For example, using binary data precludes examination of adherence to each dose of a twice-daily medication regimen. Thus, although this study provides preliminary data comparing diary cards and electronic monitoring, more detailed comparisons need to be made before the validity and utility of diary cards for nebulizer use can be fully established.

Impact of devices on adherence

Recognizing the difficulty some parents have in getting their young child to comply with inhaler devices, Chaney and colleagues [17•] ran a pilot study to determine the usability and adherence of children using the Funhaler (InfaMed, Australia). The Funhaler is a low-volume spacer with a toy module attached, so that when the child uses good inhalation techniques a disk spins and the spacer whistles. Thirty-eight children, ages 1.5–6 years (mean, 3 years), were given a Funhaler for 2 weeks, and their parents completed questionnaires about attitudes toward spacers and frequency of medication use both before and after having the Funhaler. Parents reported that using the Funhaler significantly increased the chance that the child had been medicated the previous day, the chance that the child used appropriate technique, and the success of the parent in medicating their child. Results also indicated that children had fewer behavioral problems (i.e. struggling, screaming when putting the mask on) while using the Funhaler. This study suggests that using a spacer device designed to be similar to a toy has the potential to significantly increase both parent and child adherence. However, the study relied solely upon self-report data for adherence measurement and did not have a control group. Thus, increased adherence could be due to the novelty of the device or parent's desire to show good adherence as part of study demands. Further, because the study only spanned 2 weeks, the novelty of the device likely would have decreased across time, perhaps leading to lower adherence ratings.

Iqbal and colleagues [18•] also evaluated a new medication-delivery device, the HaloLite Paediatric Nebulizer. This nebulizer uses the patient's breathing pattern to time the delivery of the medication. The end of treatment is indicated by a buzzer, and the nebulizer also logs

the date, time, and length of treatment. Adherence and satisfaction while using the HaloLite was compared in a crossover trial design to adherence and satisfaction with a pressurized metered-dose inhaler (pMDI) with a valved holding chamber. A data logger was attached to the pMDI so electronic adherence data could be measured for both devices. Twelve children between the ages of 11 and 36 months were included.

Adherence to the regimen (twice-daily budesonide) was low for both groups (HaloLite, 68%; pMDI, 71%). Device compliance was calculated as percentage of the number of optimal treatments out of all treatments. For the pMDI, optimal treatment required shaking the pMDI before actuation and inhalation of greater than 400 ml within 15 s of actuation. For the HaloLite, optimal treatment required use of the nebulizer until a buzzer sounded, indicating that the dose had been delivered (about 40 s). Device compliance was significantly better with the pMDI (51%; HaloLite, 30%). All parents found the pMDI easier to use and would switch to it over the HaloLite. This study, unlike the Chaney *et al.* [17•] study, did not find a link between satisfaction with a device and better adherence.

Adherence interventions

In a study designed to reduce asthma exacerbations in young children, Colland and colleagues [19] developed an educational intervention to teach parents how to recognize and treat the prodromal symptoms of asthma. Twenty-nine families of children between the ages of 4 and 11 years (mean, 6.5 years) were randomly assigned to one of two groups, control or experimental. Both groups received asthma education, and participants in the experimental group worked with the asthma educator to determine the prodromal signs of their own child. The experimental group families also were advised to double their child's inhaled corticosteroid dose for 1 week when any of these signs occurred. In the year following the intervention, prodromal signs were recognized in only 48% of the exacerbations in the experimental group, and prodromal signs were treated adequately with inhaled corticosteroid in 25% of the cases and not treated at all in 25% of the cases. Additionally, lung functioning and number of exacerbations did not differ between the control and experimentation groups. In post-hoc questioning, many families in the experimental group stated that they were uncomfortable treating many prodromal signs, particularly coughing, preferring instead to see if the signs cleared up on their own. In conclusion, this intervention was generally unsuccessful at getting parents to react to early signs of asthma and also at preventing asthma exacerbations or improving lung functioning.

In a similar intervention, Butz and colleagues [5•] developed a home-based intervention, targeting symptom

identification and treatment. Over the 6 month intervention, 221 families of young children (mean age, 4.5 years) were assigned to either a standard asthma education group (three home visits) or to a group receiving both standard education and symptom identification and treatment training (six home visits). This structure is a weakness of the study, such that degree of contact (i.e. number of home visits) differs as a function of treatment type. Thus, significant differences may be the result of increased contact rather than the symptom-identification component. Additionally, data were gathered using self-report, so that actual use or objective adherence could not be determined. In both groups, symptom perception, nebulizer-use technique, and self-management skills (e.g. preventative asthma doctor visits, giving asthma medication when child is wheezing) improved significantly from pre- to post-intervention. The only significant difference between the two education groups was that parents receiving symptom identification training were significantly more likely to use asthma medications to treat cough symptoms (83.9 versus 74.7%). However, these data suggest that about 20% of parents are not treating cough symptoms, which is a similar proportion to that found by Colland and colleagues [19].

Conclusion

In reviewing the studies published recently on adherence in young children, the available research suggests that the following components may be important to consider when designing interventions to improve adherence for young children: (1) consider the strain in the caregiver role when developing the treatment regimen; (2) provide asthma devices that both parents and children like to use; (3) monitor adherence with electronic monitoring in order to most accurately determine if the intervention is successful across time; and (4) address parents' concerns and perceptions about treating early or prodromal symptoms of an asthma exacerbation. Because many parents are hesitant to treat cough symptoms, an additional training component may need to be added to address this concern specifically.

Despite the unique and important challenges for this population, little research is being done with young children with asthma. However, although there are currently fewer published studies with this population relative to older children with asthma, the area appears to be growing. Future research on young children with asthma would benefit by continuing the research areas reviewed in this article and by improving the studies by using stronger methodological design and more electronic monitoring.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (p. 138).

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