



School and Community-based Nurse-led Asthma Interventions for School-aged Children and Their Parents: A Systematic Literature Review

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ABSTRACT

Problem: Asthma is one of the most prevalent chronic diseases in the world. Lack of asthma knowledge can lead to asthma exacerbations, more emergency room visits, school absences, and decreased quality of life. This systematic review examines the effectiveness of educational intervention programs on asthma management for school-aged children and their parents beyond inpatient clinic settings.

Eligibility Criteria: Educational asthma interventions for school-aged children and their parents with comparison with usual asthma care and the outcome related to asthma management. Studies included were peer-reviewed and published in English within the last five years.

Sample: The eight study articles were identified in ProQuest, Medline, CINAHL, and PubMed databases.

Results: The review demonstrated that educational asthma interventions for children and their parents significantly improved knowledge and skills related to asthma self-management.

Conclusions: School and community-based asthma educational intervention programs are key components for good management of asthma condition. Well-planned asthma education programs are valuable and should go beyond inpatient clinic settings for promoting and maintaining health for children with asthma and their parents.

Implications: School nurses are well-positioned to assume a more prominent role in asthma care to improve child health and academic outcomes. School nurses have an opportunity to establish a trusting relationship that is foundational for collaborating with parents and students for better asthma management.

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Introduction

Asthma is one of the most prevalent chronic diseases in the world (Harris et al., 2015). The Center for Disease Control (CDC) reported about 6.2 million children in the United States have asthma and 3.3 million children experienced an exacerbation of asthma symptoms based on 2016 National Health Interview Survey (NHIS) data (Centers for Disease Control and Prevention, 2018). Uncontrolled asthma often leads to premature death (Asthma and Allergy Foundation of America [AAFA], 2015). In 2016, 3518 people died of asthma related causes (CDC, 2018). Many asthma exacerbation deaths can be prevented with proper asthma management (AAFA, 2015). When asthma symptoms are not effectively managed, children can experience numerous asthma exacerbations and nocturnal coughing which results in school absences, restriction from school activities, emergency room (ER) visits, and

hospitalizations (Francisco, Rood, Nevel, Foreman, & Homan, 2017; Isik & Isik, 2017). Children living with asthma are at increased risk of disability, emotional problems, and lower academic achievement (Cicutto et al., 2013; Nurmagametov, Kuwahara, & Garbe, 2018).

Asthma affects the lives of the parents or guardians as well as children (Heyduck, Bengel, Farin-Glattacker, & Glattacker, 2015). During an asthma episode, parents may need to stay at home with their child thereby missing work (Engelke, Swanson, & Guttu, 2014; Suwannakeeree, Deerojanawong, & Prapphal, 2016). Parents must not only worry about controlling their child's asthma, but also the financial burden and stress the chronic illness adds to the family situation. Parents' knowledge about asthma severity and asthma management determines help seeking behaviors to manage their child's asthma (Archibald, Caine, Ali, Hartling, & Scott, 2015). Parents' beliefs about asthma management, medication routines and adverse side effects, impact asthma-related decisions and results in consequences for the individual, the family, and in turn are likely to affect quality of life and academic performance (Engelke et al., 2014; Heyduck et al., 2015). Therefore, it is crucial that most child health asthma education programs include parents and focus on

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both the parents' and children's skillset and learning levels with the aim of developing successful asthma management strategies (Kieckhefer et al., 2014; Suwannakeeree et al., 2016). School nurses can implement nurse-led asthma education programs to develop successful asthma management strategies based on the National Asthma Education and Prevention Program (NAEPP) guidelines and National Association School Nurses (NASN) Framework recommendations for students and their parents (NASN, 2016).

Exploring different strategies beyond the inpatient clinic setting is key for successful asthma management. School nurses have an integral role in understanding the meaning parents assign to the asthma management to achieve better outcomes for children with asthma (Lemanske et al., 2016). Listening to the parents' experiences and understanding of asthma can lead to increased cooperation between parents and nurses and enhance asthma management. Parents may adopt a more positive approach when nurses value the parents' knowledge and involve them in establishing asthma management strategies for their children (Engelke et al., 2014). School nurses are in an advantageous position to manage asthma while creating a safe, healthy, and ready to learn environment for all students (Friend & Morrison, 2015; Maughan, Duff, & Wright, 2016).

The National Asthma Education and Prevention Program (NAEPP) guidelines emphasize that an effective asthma management plan should educate school-aged children and their parents about the disease (National Institutes of Health [NIH], 2012). The NIH (2012) suggested increasing asthma education programs for self-management beyond primary health clinics to schools and community settings. School nurses are proponents of asthma education and can be resources for students and their parents by communicating and accessing available community resources such as the Environmental Protection Agency (EPA) for indoor air quality (NIH, 2012). The purpose of this systematic review is to explore school- and community-based educational intervention programs for school-aged children and their parents and to examine the effectiveness of the programs in asthma management. This review may ramp up school nurses' efforts to deliver asthma educational programs for their respective school communities. The systematic literature review aims to synthesize primary, peer-reviewed experimental and quasi-experimental studies.

Method

This systematic review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009). The studies population, intervention, comparison, and outcomes (PICO) elements are the PRISMA guidelines, and while identifying the eligibility of potential study articles, the PICO elements were employed to schematize the process for verifying eligible articles for this systematic review (Joanna Briggs Institute, 2011). In regard of PICO methodology, the target population is school-aged children between 5 and 18 years old and their parents, the intervention is educational asthma interventions for children and/or their parents, the selected studies should have comparisons with the usual asthma care and educational asthma intervention, and the outcome interest should be related to asthma knowledge and skills needed to manage asthma; thus, lessening emergency room visits, hospitalizations, unscheduled physician visits, and missed school/work days.

Study Selection and Search Strategy

The literature review was conducted after a consultation with the University librarian. The databases searched for this review were ProQuest Nursing and Allied Health, Medline with full text (EBSCO), Cumulative Index of Nursing and Allied Health Literature (CINAHL) Complete, and PubMed Remote. The combinations of MeSH search terms were "asthma," "students," "parents," "asthma management," "educational intervention,"

and "school." The search was limited to human subjects, published between 2013 and 2018 in English, and peer-reviewed. We searched the articles published in the past five years to include current information and to eliminate overlap from an earlier review that examined school- and community-based educational intervention programs for school-aged children and/or their parents. There are few systematic reviews on school health services that address the needs of students with chronic diseases and asthma programs effects on quality of life (Leroy, Wallin, & Lee, 2016; Walter et al., 2015). To our knowledge, there is no systematic review of nurse-led interventions for promoting asthma management. The aforementioned PICO elements formulated for the inclusion criteria. Excluded criteria were a) study intervention programs not focused on asthma, b) asthma interventions for only adults (not related to their children), and c) non-experimental studies, qualitative studies, and dissertations.

Data Extraction

The search strategy resulted in a total of 845 articles. The CINAHL search resulted in 19 citations, ProQuest resulted in 792, Medline located 14, and PubMed resulted in 20 citations. The one researcher reviewed each abstract for inclusion. A stepwise progression of choosing and evaluating articles for synthesis was followed. Seven hundred and seventeen articles were excluded for the following reasons: not original research studies; i.e., guidelines, reviews, policy briefs, and commentaries (n = 487); not experimental studies (n = 126); duplicated items (n = 104). Primarily, 128 abstracts met screening criteria for a full, complete review. One reviewer performed full-text review with confirmation of the appropriateness to include into the review by other reviewers. After the full review, 120 articles were excluded for the following reasons: interventions were not school- or community-based interventions (n = 111), children were less than five years of age or older than 18 (n = 7), or the outcomes measured were not related to asthma management (n = 2). Consequently, eight articles were identified, and reference lists of retrieved articles were examined; however, the hand search did not uncover additional eligible articles. (See Table 1.)

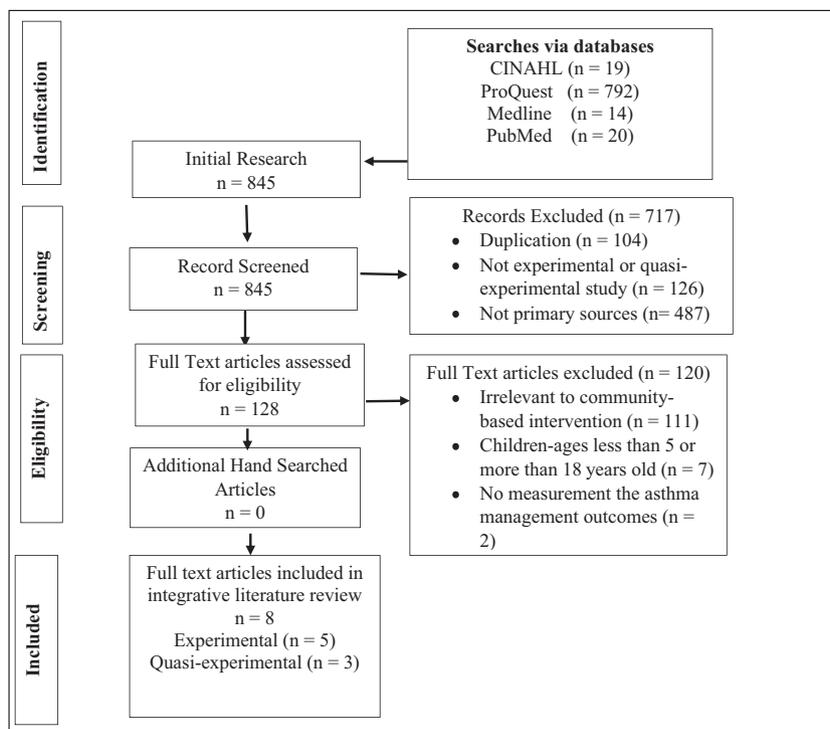
Quality Appraisal

The John Hopkins Nursing Evidence-Based Practice (JHNEBP) rating scale was used to assess the methodological strength of the evidence (Newhouse, Dearholt, Poe, Pugh, & White, 2005). In this systematic review, the data obtained from experimental studies/randomized controlled trials (RCT) were rated as a Level I study, and the data obtained from quasi-experimental studies were rated as Level II based on JHNEBP rating scale and confirmed by the all three reviewers (Newhouse et al., 2005). Random sequence generation, allocation concealment, blinding of participants, blinding of outcome assessment, incomplete outcome data, selective reporting, and other sources of bias were examined based on the Cochrane Collaboration's tool used for assessing risk of bias (Higgins & Green, 2011).

Results

There were five Level I studies and three Level II studies. The five studies were conducted in the United States, one study was conducted in Iran, another was conducted in Netherland, and the last was conducted in India. All eight selected studies were examined for potential bias by using Cochrane Collaboration's tool. Random sequence generation and allocation concealment were stated in all eight studies. Fiks et al. (2015) and Horner, Brown, Brown, and Rew (2016) study was double blinded. Kintner et al. (2015) and van Bragt et al. (2015) study were single blinded. The other four studies did not mention blinding (Grover et al., 2016; Payrooveh, Kashaninia, Mahdaviani, & Rezasoltani, 2014; Raspberry et al., 2014; Suwannakeeree et al., 2016). All studies have complete outcome data for each main outcome. However, one

Table 1
Flowchart of search and screening process.



study did not show a significant result due to inadequate sample size (van Bragt et al., 2015). All studies reported the selective outcomes. Other source of bias was not found in the studies. All studies included in the systematic review were compiled into a data extraction matrix that included author/year, the study purpose/question, sample size/country, method & measurement tool, and findings (Table 2).

The eight studies combined represented a total of 1108 school-aged participants, ranging from six to 18 years of age. Sample sizes ranged from 24 (Grover et al., 2016) to 456 (Rasberry et al., 2014). Six studies used a child-parent dyad as the unit for the sample (Fiks et al., 2015; Grover et al., 2016; Horner et al., 2016; Kintner et al., 2015; Payroovee et al., 2014; Suwannakeeree et al., 2016), and parents sample size represented a total of 381. Two studies used only children as the sample (Rasberry et al., 2014; Van Bragt et al., 2014). Suwannakeeree et al. (2016) included five teachers, 47 students with asthma, and 14 parents. The intervention programs were primarily conducted in school settings. Local church community halls and public conference rooms were also used in addition to school settings for asthma intervention programs. Fiks et al. (2015) used electronic health records linked to patient portals to enable mutual goal settings with children and the parents for asthma management. Grover et al. (2016) recruited children and their parents from an outpatient clinic. Horner et al. (2016) delivered two modes of an educational intervention for second through fifth-grade students and their parents. The intervention components are listed in Table 3. Socioeconomic status was not consistently documented, but three articles mentioned most of the participants had a lower socioeconomic level (Horner et al., 2016; Rasberry et al., 2014; Suwannakeeree et al., 2016). All the studies clearly stated they used the reliable measurement tools for measuring the outcomes.

Level I Studies

Fiks et al. (2015) expressed that the reason for asthma office visits can vary, and asthma status can change between visits; further, limited time for office visits may not be enough to recognize parents' concerns and knowledge of asthma management behaviors. The study aimed to

assess the feasibility, suitability, and effectiveness of the MyAsthma electronic health record linked to patient portals, supporting shared decision making for children with asthma. MyAsthma tracks parents' concerns and goals, asthma treatment for the children, children's asthma symptoms, medication adherence, and it also provides decisional support for parents on the asthma management. Shared Decision Making (SDM) includes active participation of healthcare professionals and parents in management choices, information exchange, communication preferences, and mutual agreement of the purpose of an asthma management plan. The SDM method is related to increased knowledge, improved awareness of condition risk, and enhanced agreement of choices with subjective values. Stata version 13 (Stata Corp) were used for the analysis, but there was not an information which test(s) was used to analyze the data. The intervention group parents reported fewer ER visits, asthma specialist visits, and hospitalizations over a six-month period compared to the control group. The intervention group parents also reported that the children had fewer asthma exacerbations and their own knowledge of the asthma disease process had increased. The study results showed missed work and school days significantly decreased ($p = .001$) in the intervention group compared to usual care group.

Grover et al. (2016) designed a study to develop, apply, and assess the effectiveness of a culturally relevant asthma education intervention program for children with asthma and their parents in India. The key principles for the intervention were meaningful learning, art therapy, problem-based learning, and goal setting. Power point presentations, children's workbooks, age-appropriate graphically appealing activities, and open-ended communications were used for the intervention. At baseline, there was no difference between the usual and intervention group. Repeated measure ANOVA demonstrated a statistically significant improvement in the dependent variables, including asthma control ($p < .01$), asthma knowledge ($p < .001$), inhaler technique ($p < .001$), and quality of life ($p < .001$) in the intervention group compared to the usual care group. At the beginning of the study, none of the participants had a written asthma action plan in either group. All participants in the intervention group had a written asthma action plan ($n = 24$) at the end of the study. The study findings indicated that an intensive,

Table 2
Studies included in the literature review.

Author/Year	Purpose/Question	Sample/Country	Method & Measurement Tool	Findings
Level I Studies				
Fiks et al. (2015)	To assess the feasibility, suitability, and effect of MyAsthma an electronic health record linked patient portal supporting shared decision making for children with asthma.	Convenience sampling 60 families, 30 in intervention and 30 in control group. USA.	Randomized Controlled Trial & Integrated Therapeutics Group Child Asthma Short Form to measure asthma-related quality of life, Parent Patient Activation Measure, and the Asthma Control Tool (ACT).	Intervention group reported fewer ER visits, asthma specialist visits, and hospitalization over six months compared to control group. The children had a less frequency of asthma exacerbations. Parents' knowledge has been increased about asthma, and they missed fewer days of work due to asthma compared to usual care group ($p = .001$). Significant improvement in the dependent variables including asthma control ($p < .01$), asthma knowledge ($p < .001$), written asthma action plan, medication use ($p < .001$), and quality of life in the intervention group compared to usual care group.
Grover et al. (2016)	To progress, apply, and assess the effectiveness of culturally applicable asthma education intervention program for children with asthma and their parents.	Convenience sampling 40 parent-child pairs 24 pair in intervention and 16 pair in control group. India	Randomized Controlled Trial & Paediatric Asthma Caregiver Quality of Life (PACQL).	Participants in the two intervention groups resulted in fewer doctor visits ($p = .048$) for asthma symptoms, ER visits ($p < .001$), and severity of asthma ($p = .004$) than the attention-control groups.
Horner et al. (2016)	To examine the impacts of two methods of providing an asthma education program in two different settings; a school setting and a community setting on condition outcomes and asthma self-management in elementary students in the countryside.	Stratified sampling 33 elementary school in 5 rural school districts 238 s through fifth grade students. USA	Randomized Controlled Trial & Asthma Inventory for Children and Severity of Chronic Asthma Scale.	Asthma episode management ($p = .006$) and risk-reduction/prevention behavior were significant ($p < .001$), and health advancement behaviors remained same. HRQL improvement seen in both groups (intervention group 33% and enhanced usual care 57%).
Kintner et al. (2015)	To explore the efficacy of the SHARP program for fourth and fifth-grade students and their parents on increasing active asthma self-care behaviors.	Convenience sampling 205 students ages between 9 and 12 years and their parents. USA	Cluster Randomized Controlled Trial & Asthma Health Behaviors (AHB) Survey and General Health History Survey.	
van Bragt et al. (2015)	To explore the efficiency of the individualized self-management care on health-related quality of life (HRQL) in elementary school-aged children with asthma compared to enriched usual care.	33 children; 18 in the enhanced usual care, and 15 in the intervention group. Dutch	Cluster-Randomized Controlled Trial & Paediatric Asthma Quality of Life Questionnaire with standardized activities (PAQLQ(s))	
Level II Studies				
Payroovee et al. (2014)	To evaluate the effect of family empowerment on the quality of life of school-aged children with asthma.	Convenience sampling 45 children ages between 7 and 11 years old and their parents. Iran	Two group, Quasi-experimental study & Paediatric Asthma Quality of Life Questionnaire with standardized activities (PAQLQ(s)).	Family-based asthma-empowerment interventions support children with asthma and their parents to gain knowledge and skills about asthma disease and asthma management effectively ($p < .001$).
Raspberry et al. (2014)	To explore whether students in the asthma program demonstrated better asthma control than students in a comparison school district, and students in the asthma program demonstrate signs of progress in asthma control between the starting point and follow-up.	2 school district, 5 schools, 456 students. USA	Two group, Quasi-experimental, cross-sectional design & Asthma Control Questionnaire (ACQ).	Students with asthma in the intervention school district demonstrated significantly superior asthma management than students with asthma in the comparison district ($p = .0085$). Students with poorly-controlled asthma at baseline demonstrated that they had significantly greater FEV1 scores at follow-up.
Suwannakeeree et al. (2016)	To evaluate the efficiency of school-based asthma instructive interventions on asthma outcomes and asthma management in school-aged children.	47 students ages between 7 and 15 years old, 14 parents, and 5 teachers. USA	Repeated quasi-experimental study & International Study of Asthma and Allergies in Childhood (ISAACS) questionnaires and Paediatric Asthma Caregiver's Quality of Life Questionnaire (PACQL).	Asthma management level was improved among children and their parents. They reported lessening ER visits ($p = .002$), hospitalization rates, nighttime asthma symptoms ($p = .02$), and school absenteeism ($p = .01$) at six month's post-intervention time. Teachers' asthma knowledge significantly increased.

culturally appropriate, multi-component, individualized intervention program was effective. Goal setting procedures with parents and children helped to achieve goals and enhance the self-efficacy of children and parents to effectively manage asthma.

Horner et al. (2016) stated that rural area populations encounter considerable obstacles related to asthma care, including lower financial status, more uninsured residents, and fewer healthcare professionals to meet population needs. Healthcare services usually are not as available, and patients are required to travel longer distances and spend more time to access and receive care. The study aimed to examine the impact of two methods of providing an asthma education program in two different settings (a) the school setting and (b) the community setting. Two modes of delivering a nurse-led asthma intervention program included an asthma class in school and an asthma day camp held on

Saturdays. The latent growth curve modeling in SAS 9.3 were used for each group data analyzing. The asthma day camp intervention demonstrated more significant results with fewer ER visits ($p < .001$) and hospitalization ($p = .13$) compared to asthma class in school and compared to both attention control groups. Moreover, the asthma class in the school setting demonstrated a significant decrease in asthma severity ($p = .004$) and unscheduled doctor visits ($p = .048$) compared to the asthma day camp and both attention control groups. However, the findings supported that participants in the both intervention groups resulted in better selected health outcome variables, including fewer doctor visits for asthma symptoms, fewer ER visits, and improved asthma symptoms compared to the attention-control groups. Moreover, students' asthma self-management performance improved significantly over time for all the students in the study.

Table 3
Intervention components.

Author & Year	Intervention Components
Fiks et al., 2015	MyAsthma an electronic health record linked patient portal supporting shared decision making for children with asthma
Grover et al., 2016	Culturally relevant asthma education intervention program <ul style="list-style-type: none"> • mutual goal choices for asthma control, • information exchange, • communication, • enriching the subjects' knowledge of asthma
Horner et al., 2016	Asthma class in school and an asthma day camp <ul style="list-style-type: none"> • meaningful learning, • age appropriate art therapy, • problem-based learning, • goal setting, • open-ended communications
Kintner et al., 2015	The Staying Healthy–Asthma Responsible & Prepared (SHARP) <ul style="list-style-type: none"> • asthma disease and its pathophysiology, • learning symptoms, • severity, • medications, • risk reduction/prevention behaviors, • assessing the study participants' understandings of asthma management
Payroovee et al., 2014	Family-based empowerment interventions <ul style="list-style-type: none"> • support children with asthma and their parents to gain knowledge and skills about asthma disease and asthma management effectively
Raspberry et al., 2014	All-inclusive model <ul style="list-style-type: none"> • identification of students with asthma, • asthma education for students with asthma, • case management for students with asthma, • consisted of joint education for students with asthma, • educating the school staff, making home visits, • training parents of students with asthma, • asthma training for staff • connecting the students with community-based healthcare professions
Suwannakeeree et al., 2016	School-based asthma instructive interventions <ul style="list-style-type: none"> • asthma education, • practical trainings on metered dose inhaler performances, • training how to use and read of a peak flow meter • breathing exercises, • using asthma diaries, • self-management plans
van Bragt et al., 2015	Individualized self-management <ul style="list-style-type: none"> • training how to use and read of a peak flow meter • address the necessities of each child

Kintner et al. (2015) suggested state achievement tests are used to measure academic outcomes; therefore, school superintendents/principals may be hesitant to adopt non-academic programs. For that reason, the Staying Healthy–Asthma Responsible and Prepared (SHARP) program is designed to improve academic performance by incorporating better self-management asthma techniques within the school curriculum

(Kintner et al., 2015). SHARP is designed for middle and high school students to educate them as well as community populations, including parents, family members, teachers, and peers about asthma and self-management. Kintner et al. (2015) explored the effectiveness of the SHARP program for fourth and fifth-grade students and their parents. Within SHARP, successful self-care behaviors were a goal, and it is categorized as asthma episode management, risk-reduction/prevention, and health advancement activities. The school intervention module entailed ten 50-minute sessions. The community intervention module is a 90-minute session incorporated into an asthma health fair for parents and students with a collaborative information and sharing exhibition. Various statistic tests were used for analyzing the data including inferential and descriptive statistic, the R Amelia package were completed to justification for missing data, and sensitivity analysis was used to check outcomes. The study findings demonstrated statistically significant improvement in asthma episode management ($p = .006$). The risk-reduction/prevention behaviors were significantly improved ($p < .001$), while health advancement behaviors remained the same.

van Bragt et al. (2015) used a cluster randomized controlled trial with a nine month follow-up to explore the effectiveness of individualized self-management care on health-related quality of life (HRQL) in a Netherland elementary school-aged children with asthma compared to enriched usual care. The individualized self-management program addressed the unique needs of each child. Enriched usual care entailed an evaluation of symptoms, medication adherence, and experience managing asthma triggers. A multi-level analysis technique was used for the study. At the end of the study improvement was seen on HRQL in both groups. The improvement in both groups could have been a result of either the enhanced usual care for the control group, the inadequate sample size, or Hawthorne effect meaning that the adjustment of actions by participants increased self-management.

The three studies used a randomized control group design (Fiks et al., 2015; Grover et al., 2016; Horner et al., 2016), and the two studies used a cluster randomized controlled trial (Kintner et al., 2015; van Bragt et al., 2015). All study participants were randomly assigned to an intervention or control group. Nurses led the asthma intervention programs in the three studies. The participants' asthma severity ranged from mild (55%) to moderate (37%) and severe (8%) (Kintner et al., 2015). Fiks et al. (2015) and van Bragt et al. (2015) determined the participants' asthma severity ranged from moderate to severe persistent asthma. Grover et al. (2016) determined the study subjects' asthma severity as mild to moderate persistent asthma. Horner et al. (2016) did not specify the asthma severity level of the participants. The aforementioned studies were conducted to implement educational intervention programs for successful asthma management behaviors and reduce asthma exacerbations, unscheduled doctor visits, missed school days, and restricted daily activities. The study findings were consistent, and four studies demonstrated that the study subjects' asthma knowledge increased and their ability to manage asthma improved (Fiks et al., 2015; Grover et al., 2016; Horner et al., 2016; Kintner et al., 2015). Furthermore, risk reduction/prevention behaviors were significant (Kintner et al., 2015) and ER visits, asthma specialist visits, and hospitalization rates decreased (Fiks et al., 2015; Horner et al., 2016). There were fewer work and school missed days (Fiks et al., 2015), and greater reports of medication adherence, quality of life, written asthma action plans, asthma goals, and self-efficacy on asthma management (Grover et al., 2016).

Level II Studies

There were three quasi-experimental design studies in the Level II category. Payroovee et al. (2014) stated that when children are younger, parents usually take care of children and manage the asthma for the children. As the child with asthma matures, managing asthma can become the responsibility of the child under the supervision of parents. The purpose of the study was to evaluate the effect of family empowerment on

the quality of life of school-aged (7–11 years old) children. The study was a two-group quasi-experimental design with an experimental and control group. The findings indicated that educational family-based empowerment interventions could help children with asthma and their parents gain knowledge and skills about asthma disease processes and asthma management effectively ($p < .001$). This intervention was a nurse-led, family-based empowerment intervention. Children received a colorful booklet and parents received a practical asthma guide card and educational pamphlet at the end of the intervention. All questions asked by parents or children were answered during the intervention.

Rasberry et al. (2014) used a quasi-experimental, cross-sectional design to explore (a) whether students in the asthma program demonstrated better asthma control than students in a comparison school district and (b) whether students in the asthma program demonstrated signs of progress in asthma control between the starting point and follow-up. The study used the all-inclusive model which consisted of joint education for students with asthma, educating the school staff, making home visits, training parents of students with asthma, and connecting the students with community-based healthcare professionals. One-way ANOVA and post-hoc analyses were used. McNemar's chi-square test and *t*-test were used for post-hoc analyses. Students with asthma in the intervention school district demonstrated statistically significant asthma management than students with asthma in the comparison district ($p = .0085$). Students with poorly-controlled asthma at baseline demonstrated that they had significantly greater peak expiratory flow rate scores at follow-up. The study findings indicated that the comprehensive school-based asthma management programs led to improvement in asthma management for students, particularly those with poorly controlled asthma. Rasberry et al. (2014) expressed that school-based asthma management programs are essential to help the students with asthma to make certain they have knowledge and skills to manage asthma and sustain asthma management.

Suwannakeeree et al. (2016) used one group in a repeated measure quasi-experimental study. The study aimed to evaluate the efficiency of school-based asthma instructive interventions on asthma outcomes and asthma management. Gaining knowledge of asthma among parents has been demonstrated to reduce asthma exacerbations and increase asthma management in school-aged children. The intervention consisted of training the school teachers/staff and the parents on asthma knowledge and educating the children to make them aware of asthma severity, occurrences, and management. The SPSS package was used for descriptive and compared *t*-test to analyze the data. The study results indicated that asthma management behaviors were abysmal in the pre-test before the intervention. However, significant progress on asthma management behaviors were identified at three and six month's post-intervention time. The participants' knowledge of asthma significantly increased with the intervention. Teachers' knowledge of asthma was greater than other participants which was believed to help the students in school manage their asthma symptoms. The pulmonary functions did not change the participants who already had normal range pulmonary function levels. However, 18 children had pulmonary functions less than 80% at the beginning of the program. Their pulmonary function levels improved significantly at six month's post-intervention time ($p = .01$). Asthma management also improved for children and their parents. The research study resulted in fewer ER visits ($p = .002$), reduced nighttime asthma symptoms ($p = .02$), and less school absenteeism ($p = .01$) at six month's post-intervention time. The study findings indicated that asthma self-management should be examined periodically from time to time to ensure and maintain good asthma management.

All three Level II studies were quasi-experimental design. Rasberry et al. (2014) and Suwannakeeree et al. (2016) study populations were from low socio-economic populations, and the studies were conducted in the United States. Payroovee et al. (2014) did not specify the socio-economic level of participants, and the study was conducted in Iran. The purpose of these studies was to increase intervention programs beyond

inpatient clinic settings to increase successful asthma management behaviors and decrease undesired conditions. All Level II study results demonstrated that the subjects gained knowledge and skills to manage asthma (Payroovee et al., 2014; Rasberry et al., 2014; Suwannakeeree et al., 2016). Moreover, ER visits, hospitalization rates, nighttime asthma symptoms, and school absenteeism were reduced (Suwannakeeree et al., 2016), and greater FEV1 scores were observed in one study (Rasberry et al., 2014).

Discussion

Lack of asthma knowledge, underestimating the severity of the asthma symptoms, and having limited access to healthcare facilities can lead to asthma exacerbations, more ER visits, unscheduled doctor visits, school absences, poor quality of life, and death (AAFA, 2015; Suwannakeeree et al., 2016). Several studies indicated that the factors associated with poor asthma management in children were related to a lack of asthma knowledge on the part of the children and their parents (Fiks et al., 2015; Grover et al., 2016; Horner et al., 2016; Payroovee et al., 2014; Suwannakeeree et al., 2016). Poor asthma management can reflect a lack of knowledge, including underestimation of the asthma severity or overestimation of the degree of asthma symptoms.

The National Heart, Lung, and Blood Institute (NHLBI) and the NAEP rigorously stress educating children with asthma and their parents in asthma management (NIH, 2012; van Bragt et al., 2015). A successful asthma self-management requires knowledge of asthma including the facts and symptoms of asthma, triggers, and right technique of medication use (Horner et al., 2016; Payroovee et al., 2014). Nurses can play an integral role in empowering children and their parents to improve asthma management through education, advising, and direct care (van Bragt et al., 2015). School- and community-based asthma education programs should be developed by interdisciplinary professionals to address the mental, psychological, behavioral, and social features of living with asthma (Kintner et al., 2015). School-aged children are capable of learning how to manage their asthma through proper age-appropriate education and support (Payroovee et al., 2014). School nurses can plan intervention that are age-appropriate, hands-on, problem-based that enhance learning. When children learn how to manage the asthma symptoms, they are more confident in managing their condition under the supervision. Keeping school-aged children responsible for asthma management is important for healthy development that supports a sense of control and ability over the asthma condition (Payroovee et al., 2014; van Bragt et al., 2015). Families are important as the first responders, and they need effective interventions that support their knowledge and skills to manage asthma (Fiks et al., 2015; Grover et al., 2016; Horner et al., 2016; Kintner et al., 2015; Payroovee et al., 2014; Suwannakeeree et al., 2016). Asthma education programs are likely to strengthen the empowerment of the children and their parents in managing asthma.

The synthesis of the review demonstrated that there is a necessity to use present applicable, student-friendly educational interventions focusing on asthma control approaches that meet the students' and parents' needs. Asthma educational intervention programs beyond inpatient clinic settings can improve asthma knowledge and skills, asthma management, school attendance, and quality of life for children with asthma and their parents. School- and community-based asthma intervention programs enable access to healthcare and better asthma management for all populations, including rural and low socio-economic populations (Kintner et al., 2015; Suwannakeeree et al., 2016). The intervention programs must be culturally relevant as well as age-appropriate and designed to meet both children and parents' needs for optimum effectiveness (Grover et al., 2016). In sum, effective asthma management at school can increase school attendance and school performance, while reducing ER visits, hospitalization rates, and unplanned doctor visits (Fiks et al., 2015; Grover et al., 2016; Horner et al., 2016; Kintner et al., 2015; Rasberry et al., 2014; Suwannakeeree et al., 2016).

All studies reported the sample size, design, inclusion/exclusion criteria, intervention components, intervention duration, pretest and posttests timeline, measurement tools, statistical analyzing, and results. Overall, the systematic literature review demonstrated that educational asthma interventions significantly improved knowledge and skills of self-management behaviors in studies' participants. Evidence exists in the literature that asthma educational interventions are effective beyond the doctor offices and hospital settings. Knowledge can be increased and sustained over time; however, the practice should be repeated for maintenance based on the synthesis found in this systematic review. School nurses can plan small presentations and health fairs for students and their parents and at the same time use case management methods to follow students' progress. Moreover, follow-up periods can be advantageous to include as well as periodic course revision (Suwannakeeree et al., 2016).

Strengths & Limitations

There were several limitations in this review. Articles published only in English were searched and retrieved. There may be some articles relevant to this systematic review which were not included due to searching four databases or human filter. Family households were not identified such as single mother or father, grandparent as a primary caregiver, or foster family. On the other hand, despite these limitations, the implications for nurses are remarkable and equivalent to NIH (2012) and NAEPP guidelines and recommendations related to educating school-aged children and their parents in an effort to improve knowledge and skills to manage asthma.

Implications for School Nurses

School nurses are in a good position to manage chronic diseases, and to create a safe, healthy, ready to learn environment for all students (Friend & Morrison, 2015; Maughan et al., 2016). School nurses are well-positioned to support students in managing chronic conditions such as asthma (Rasberry et al., 2014). Educating about asthma self-management takes considerable time and dedication on the part of the nurse, child and family member. School nurses must assume a more prominent role in asthma care to improve child health and academic outcomes. It is essential that nurses assess students for sufficient sleep, nutrition, and involvement in appropriate school activities to promote and maintain the students with asthma health and well-being (Kintner et al., 2015).

School nurses have an opportunity to establish a trusting relationship that is foundational for collaborating with parents and students for better asthma management. Such strategies will result in better attendance and improved school performance (American Academy of Pediatrics (AAP), 2014). National Association of School Nurses (NASN) Framework for 21st Century School Nursing Practice highlights individual-centered care and posits that school-based asthma intervention programs can be developed using the framework for achieving the desired outcomes of the student with asthma population (Cowell, 2015; NASN, 2016). The Center for Disease Control and Prevention (2015) recommends coordinated care for the students, families, and the communities to increase asthma management and in turn reduce school absenteeism. School nurses can plan asthma care coordination interventions that connect the school, the family, and community-based healthcare professionals for managing asthma successfully (AAP, 2014). The best interventions not only provide education, but also support students in gaining access to needed clinical care, ensure students use the right medications, offer care coordination, and collaborate directly with students' parents to increase knowledge and sustain improved asthma management (Rasberry et al., 2014).

Conclusion

School- and community-based asthma educational intervention programs are key components of asthma management. Well-planned asthma education programs are valuable and should go beyond inpatient clinic settings for promoting and maintaining health for children with asthma and their parents. The systematic review indicated that community-based, particularly school-based asthma educational interventions, resulted in greater improvements in asthma management knowledge and skills, and fewer undesired outcomes such as ER visits, hospitalizations, unscheduled doctor visits, missed school and work days. School-based programs may be one of the best options to deliver asthma educational interventions for students, parents, and the school community. Principals, school administrators, teachers, and school staff can join with nurses, who work in school and community settings to implement effective asthma management programs. More research studies to inform practice are warranted.

CRediT authorship contribution statement

Elif Isik: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing - original draft, Writing - review & editing.
Nina M. Fredland: Conceptualization, Formal analysis, Investigation, Validation, Visualization, Supervision, Writing - review & editing.
Wyona M. Freysteinson: Methodology, Resources, Software, Data curation, Supervision, Writing - review & editing.

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