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POPULATIONS AT RISK ACROSS THE LIFESPAN–CASE STUDIES

Evaluating outcomes of children's asthma self-management education through sustainable community–university partnerships

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Abstract

Objective: To evaluate the outcomes of a children's asthma management education program delivered through a community–university partnership.

Design: Quasi-experimental pretest/posttest.

Sample: Convenience sample of 50 children with asthma, grades 2–5, and their parent/caregiver from nine elementary schools in New York State.

Measurements: Child Asthma Management Self-Efficacy Survey, Child Asthma Control Test©, Parent Asthma Knowledge Test.

Intervention: Nursing students certified as *Open Airways for Schools* facilitators administered the program once weekly for 5 weeks. Parent handouts were sent home after each session. Pre/posttests for all measures were completed prior to *Open Airways* and at completion.

Results: Improved asthma management self-efficacy ($p < .001$) and improved asthma control ($p = .013$) for children with asthma were noted. Parent asthma knowledge was high pre- and posttest with no significant change. Parental knowledge regarding inhaled corticosteroids was consistently low.

Conclusions: Collaboration between universities and local school systems allows for mutually beneficial exchange of knowledge and resources to address the need for asthma self-management for children with asthma. Nursing students trained in asthma management develop expertise and provide sustainable resources for this education.

KEYWORDS

asthma, child health, disease management, partnerships, quantitative research

1 | INTRODUCTION

Disease self-management is essential to avoid adverse health events, especially for children with asthma. Nearly 10% of children aged 5–14 years have asthma, the highest rate of any age group (Centers for Disease Control [CDC], 2019). Children with uncontrolled asthma have difficulty concentrating, resulting in poor academic performance. Missing school due to asthma and prolonged hospitalizations interfere with learning ability. Fifty-four percent of children <18 years reported having one or more asthma attacks in the preceding 12 months, with 18.3 per 10,000 hospitalized for asthma compared to 13 per 10,000 for adults (CDC, 2018; 2019). Alarmingly,

nearly half of children with asthma had an average of four asthma-related missed school days per year (Sullivan et al., 2018). Although the number of children who missed school in 2014 was lower than in 2003, the total number of school days missed increased (Zahran, Bailey, Damon, Garbe, & Breysse, 2018). This underscores the need for expanded asthma education for children with an asthma diagnosis and their parents/caregivers, and also the need for a sustainable source of qualified public health educators to deliver this instruction.

Additionally, economic burden of asthma cannot be ignored. The annual costs of asthma in the U.S. is estimated to be $81.9 billion, with a per-person medical cost of $3,266 (Nurmagambetov, Kuwahara, & Garbe, 2018). Missed work and school days combined totaled $3 billion, representing 8.7 million workdays and 5.2 million school days lost.

Asthma can be managed to reduce or eliminate adverse outcomes ("Expert Panel Report-3 (EPR-3)", 2007; Global Initiative for Asthma [GINA], 2017). An ideal approach is multi-faceted, with interactions between the levels of influence within the child's social environment. Using an ecological approach, this study evaluated the outcomes of an asthma management program for children and their parents conducted by undergraduate baccalaureate nursing students enrolled in a community-engaged nursing elective through a community–university partnership.

1.1 | *Open Airways* and asthma management skills

Open Airways (*OA*) is an American Lung Association (ALA) school-based asthma education program for children aged 8–11 years (ALA, 2018). The curriculum is taught in five–six 50-min weekly sessions. Table 1 shows the specific content for each session. *OA* is recommended by the National Association of School Nurses, received a Health Education Research Award from NAEPP, and is endorsed by the CDC. *OA* is part of the Asthma Friendly Schools Initiative, providing tools for communities and schools to work together on a comprehensive approach to asthma (ALA, 2018).

The effectiveness of *OA* has been demonstrated with reductions in school absenteeism, improved academic performance, improved asthma knowledge, and sustained asthma management self-efficacy from elementary school to middle school (Greenberg et al., 2010); and improvement in asthma knowledge (Bowen, 2013, Carvalho Coelho, Cardoso, de Souza-Machado, & Souza-Machado, 2016; Greenberg et al., 2010). Modified versions of the program in teaching ten 20-min sessions were as effective as the original in improving knowledge on managing asthma triggers and symptoms and improving inhaler technique (Crane, O'Neal, Honey, & Kirkpatrick, 2015).

1.2 | Parental knowledge and asthma management

Parents of children with asthma have misperceptions and may lack basic asthma knowledge and management skills, impacting asthma outcomes for children with asthma. Many believed that children could become dependent upon asthma medication, and were unaware of asthma triggers, warning signs, and purpose and use of inhaled corticosteroids (ICS; Abu-Shaheen, Nofal, & Heena, 2016; Bhagavatheeswaran, Kasav, Singh, Mohan, & Joshi, 2016). Asthma education that included both children and parents resulted in significantly fewer school absences, emergency department visits, and hospitalizations. Parents/caregivers reported feeling better educated, knowing what triggers an asthma exacerbation, identifying

TABLE 1 *Open Airways* content

Lesson one	Basic information feelings about asthma • Helps children discuss basic facts and experiences with asthma • Children learn a relaxation exercise to help them stay calm during an asthma episode
Lesson two	Recognizing and managing asthma symptoms • Helps children identify warning signs for an asthma episode • Assists children to develop and practice a plan for managing an episode
Lesson three	Solving problems with medicines deciding how bad symptoms are • Helps children learn to use medicines properly • Assists children to identify and practice ways to decide how bad symptoms are • Practice making decisions about when medical help is needed to manage an episode
Lesson four	Finding and controlling asthma symptoms • Helps children identify things that trigger asthma symptoms • Find ways to reduce or remove asthma triggers
Lesson five	Keeping your battery charged: How to get enough energy • Helps children identify and practice six ways to stay active and solve conflicts with family, teachers, coaches, and friends about staying active
Lesson six	Doing well at school • Helps children identify signs that mean it's okay to go to school • Determine ways to make up missed schoolwork

Source: American Lung Association. (2015). *Open Airways for Schools curriculum: A school-based program for children with asthma.* Chicago, IL: Author.

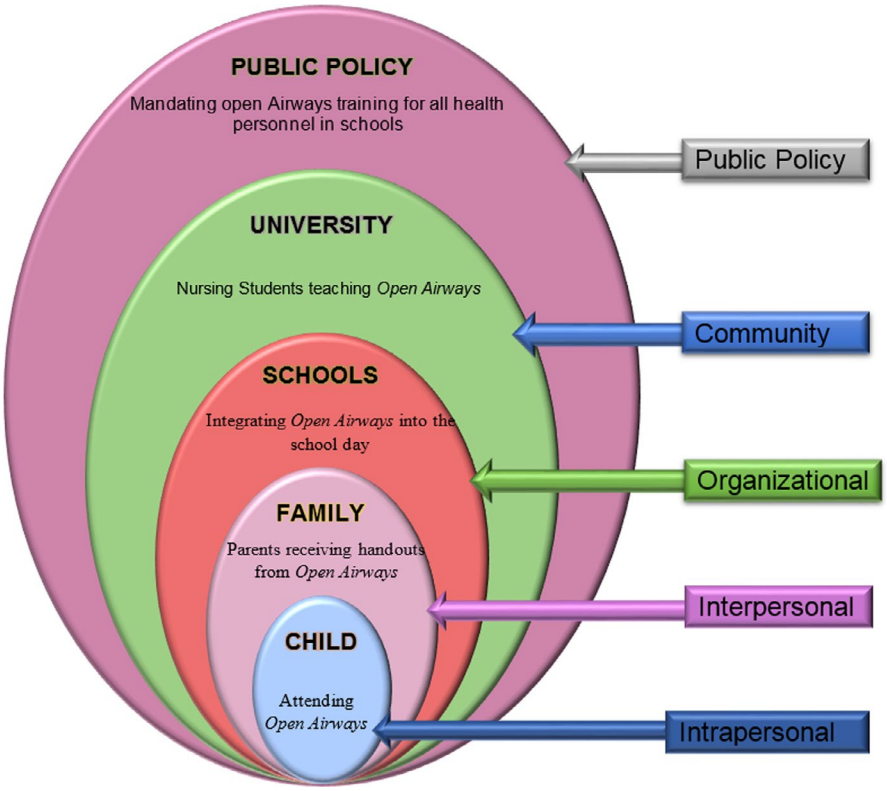

FIGURE 1 An ecological approach for asthma management [Colorfigure can be viewed at wileyonlinelibrary.com]

the signs of a severe asthma attack in their child, feeling confident about managing asthma, and feeling that the asthma was under control (Agusala, Vij, Agusala, Dasari, & Kola, 2018). Parental asthma knowledge levels have been significantly associated with their child's asthma control (Venugopal & Namboodiripad, 2016).

1.3 | Community engagement

Community engagement is the collaboration between institutions of higher education and their larger communities for mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity (Campus Compact, n.d.). Community-engaged learning combines community service with academic instruction, focusing on critical, reflective thinking and civic responsibility, meeting identified community needs (Binghamton University, 2018). Community–university relationships provide opportunities for nursing students to gain expertise in working with diverse populations and provide local schools with programing not otherwise available to their students.

Partnerships between communities and higher education impact asthma outcomes for children with asthma. Quaranta, Brown, Logvis, and Ponticiello (2012), through the use of college nursing students implementing *OA* in local elementary schools, improved asthma self-efficacy for school-age children with asthma. Asthma education delivered by nursing students through an academic partnership with an asthma clinic resulted in fewer asthma-related hospitalizations (McClure, Lutenbacher, O'Kelley, & Dietrich, 2017). Breen et al. (2019) reported a partnership between three schools of nursing, public schools, and an asthma coalition to deliver asthma education to children with asthma enrolled in those districts. These studies validate that collaborative partnerships with schools of nursing have potential to impact asthma outcomes.

1.4 | Theoretical approach

An ecological approach, through a community–university partnership, frames this study. Multiple levels of influence impact the child's ability to manage asthma: the child's individual characteristic (intrapersonal level), the family (interpersonal level), the child's school (organizational level), and schools of nursing (community level). All of these factors need to be considered to achieve the best possible outcomes for the child with asthma. See Figure 1 for ecological influences for asthma management.

Intrapersonal factors are individual knowledge, skills, attitudes, behaviors, and developmental stage (McLeroy, Bibeau, Steckler, & Glanz, 1988). School-aged children are influenced by educators, eager to learn, and more confident in their ability to achieve goals (Mcleod, 2018). High prevalence of missed school days, emergency room (ER) visits, and hospitalizations for asthma-related symptoms underscore the need for asthma education to increase knowledge, skill, and self-efficacy. Melgarejo González-Conde, Pérez-Fernández, Ruiz-Esteban, and Valverde-Molina (2019) found high asthma self-efficacy was associated with better quality of life for children with asthma. Being able to identify early warning signs and emergency symptoms, the need for trigger avoidance, and proper medication use will lead to better asthma outcomes disease ("EPR-3", 2007; GINA, 2017).

Interpersonal factors include social support systems, which for this study is the family of the child with asthma. Families influence health behaviors of individuals and are fundamental in the achievement of any goal for the child (McLeroy et al., 1988). Low asthma medication adherence was significantly associated with lower perceived social support (Sloand et al., 2019). Including the parent/caregiver in the asthma education process is crucial. Without active parent involvement, children are hindered in their ability to gain asthma control. *OA* sends home parent information after each session attended by the child with the content learned during that session (ALA, 2018).

Organizational factors, such as schools, are critical to the success of a child. Schools provide the environment and resources necessary to receive new information essential for success of the individual (McLeroy et al., 1988). Since a child is in school about 6 hr a day, schools can be instrumental with asthma management. Unfortunately, school nurses report many barriers to providing this needed asthma education, with the most salient being lack of time (Quaranta & Spencer, 2016). Working collaboratively with schools of nursing to provide asthma education to the student with asthma has the potential to eliminate this barrier.

Community factors are relationships among organizations, institutions, and informal networks (McLeroy et al., 1988). Community Engagement provides resources and expertise to local communities through partnerships with institutions of higher education. This partnership between the community and higher education has been shown to impact asthma outcomes for children with asthma, as previously discussed (Breen et al., 2019). These studies validate that collaborative partnerships with schools of nursing have potential to impact asthma outcomes.

A community-engaged nursing elective for baccalaureate undergraduate nursing students was developed to address asthma concerns in the local community. School superintendents had identified school absenteeism as a major concern, especially for their students with asthma. A sustainable partnership developed between these schools and our School of Nursing with the offering of *OA* taught by nursing students trained as *OA* facilitators.

Public policy advocacy and development include lobbying and increasing awareness about public health issues (McLeroy et al., 1988). While this study did not directly intervene at this level of influence, some examples that impact asthma outcomes can be mandating indoor air quality standards. School nurse caseloads need to be realistically determined, accounting for student acuity and community-specific health data. Use of predetermined ratios is no longer recommended (NASN, 2015). The American Academy of Pediatrics (2016) calls for a minimum of one full-time registered nurse in every school and asserts that the use of ratios for workload determination in school nursing is inadequate to fill the increasingly complex health needs of students.

To address the need for asthma education for the child with asthma and the barriers identified, this study looked at the potential of a community–university partnership with elementary schools and a School of Nursing to deliver asthma self-management education for these children and their parents. This partnership provides an on-going, sustainable supply of asthma educators to the schools and helps overcome the barrier of time confronting school nurses. Increasing asthma management skills and asthma control may translate to fewer visits to school nurse, fewer school days missed, and fewer ER visits, and hospitalizations.

The specific aim of this study was to determine whether an asthma management educational program for children with asthma taught through a community–university partnership could improve asthma self-efficacy and asthma control for the child with asthma and improve asthma knowledge for the parent of the child with asthma. The research questions posed were: (a) What are the benefits of a community–university partnership a School of Nursing for the child with asthma and (b) What are the benefits of a community–university partnership a School of Nursing for parents/caregivers of a child with asthma?

2 | METHODS

2.1 | Research design

A quasi-experimental pretest–posttest design was used. Interventions and data collection were conducted in Spring 2016. The research protocol was reviewed and approved by the Institutional Review Boards at Binghamton University. SQUIRE guidelines provided the framework for reporting the results of this study (SQUIRE, n.d.).

2.2 | Sample

A convenience sample of children with asthma in grades 2–5 from four school districts were recruited. Children younger than the suggested grade/age were attended per teacher recommendation considering maturity and cognitive level. The parent who signed consent participated in the study. All schools were within one Metropolitan Statistical Area, which contains a core urban area of 50,000 or more population (Health Resources & Services Administration, 2018). Two districts had one school participating, one district had two, and one district had five schools. Three districts were classified as suburban, and one as rural. School nurses contacted parents of children with an asthma diagnosis to determine interest in *OA*.

2.3 | Procedure

Thirty-eight baccalaureate nursing students in a research nursing elective completed online asthma education for health professionals through the Asthma and Allergy Foundation of America. They became certified as *OA* facilitators through ALA. To assure fidelity of the intervention: (a) all students received the instructor manual provided with *OA* kits, which contained the content, scripts, and activities to be used for teaching, assuring all instructors provided the

TABLE 2 School response rates for children with asthma participating in *Open Airways*

	Total school enrollment	Children with asthma	#Participating	Response rate (%)
School 1	272	6	5	83
School 2	266	5	3	60
School 3	265	5	2	40
School 4	403	14	11	79
School 5	319	7	3	43
School 6	279	15	11	73
School 7	315	7	4	57
School 8	538	10	5	50
School 9	578	21	6	29
Total	3,235	90	50	56

same content in the same manner; (b) each student had to present a session of *OA* to faculty and fellow nursing students prior to going into the schools; and (c) faculty, also certified as *OA* facilitators, supervised the nursing students during implementation to assure the content was delivered correctly.

Superintendents from each district approved the study prior to receiving Human Subject's approval. School nurses identified children with asthma and contacted their families for participation. Written parental consent and child assent was obtained. Nursing students were assigned in groups to one school exclusively and taught all sessions to the same participants. Face-to-face group sessions of *OA* were offered during or after the school day, once weekly for 5 weeks, on a day and time chosen by each individual school. Session duration was determined by each school, dependent upon the school schedule and needs; therefore, classes ranged from 25 to 70 min. All participants received the same content despite the time differences. Parent handouts were sent home after each session. Pre/posttests for child asthma management self-efficacy, parent asthma knowledge, and the Child Asthma Control Test were completed prior to the *OA* program and at completion.

2.4 | Variables and data collection instruments

The variables measured pre- and postintervention included asthma management self-efficacy, level of asthma control for the participants, and parent asthma knowledge. The Child Asthma Management Self-Efficacy Survey is part of the *OA* program. This survey consists of 12 items with a three-point Likert scale, "can do it," "might be able to do it," or "can't do it." Higher scores indicate greater self-efficacy. The Child Asthma Control Test (C-ACT© 2007 GSK. Used with permission) is a standardized tool that measures level of asthma control over the previous 4 weeks in children aged 4–11 years. The test consists of seven Likert scale items. Four items are completed by the child and three are completed by the parent. Scores ≥ 20 indicate asthma in control; scores ≤ 19 indicate asthma not in control and a health care provider should be consulted. Cronbach's α is 0.79 for those with controlled asthma and 0.83 for those with uncontrolled asthma, with test–retest reliability of 0.77 (Alzahrani & Becker, 2016). Parent Asthma Knowledge Test, modified with permission from Ho et al. (2003), includes 15 true/false items, with possible scores ranging from 15 to 30. Higher scores indicate greater asthma knowledge. Cronbach's α is 0.69.

2.5 | Data analysis

IBM SPSS Statistics 25 was used for data analysis with a priori significance level of 0.05.

Descriptive statistics were calculated to describe the sample characteristics. Frequencies and percentages were calculated for demographic data. Paired samples *t* tests were used to compare pretest and posttest scores on asthma management self-efficacy items for children attending the program and for the parent asthma knowledge questionnaire. Analysis was done for those items answered on both the pre- and posttests. Chi-square goodness of fit was used to compare asthma control (C-ACT©) before and after completing *OA*. Effect sizes for dependent sample *t* tests use eta squared values and are interpreted per the guidelines proposed by Cohen: small effect is 0.01; moderate effect is 0.06; and large effect is 0.14 (Cohen, 1988, p.284–287; Pallant, 2016, p.253). Required sample size was calculated to obtain 80% power for 95% confidence interval. A sample size of at least 11 was determined to have the power to reliably detect differences between groups.

3 | RESULTS

Fifty children with asthma (N = 50) started and completed *OA*. The sample consisted of 20 females (40%) and 30 males (60%). Mean age was 9 years. Age breakdown is as follows: 6 years (4.3%), 7 years (10.6%), 8 years (12.8%), 9 years (27.7%), 10 years (29.8%), 11 years (12.8%), and 12 years (2.1%). Three children did not provide their age. Race, ethnicity, and suburban/rural data were not collected to minimize the possibility of identification. One parent had two children in *OA*, resulting in a parent sample size of 49.

Overall response rate for children with asthma from the nine schools participating in *OA* was 56%, with a range of 40%–83%. See Table 2 for school response rates for children with asthma participation in *OA*. Response rates for completion of child and parent pretests were 100%. One hundred percent of the children completed posttests for asthma self-efficacy, 35 parents returned the asthma knowledge posttest (71% response rate), and 33 returned the postintervention C-ACT© (response rate 67%).

3.1 | Child *OA* asthma management self-efficacy pre/posttest

Not all children answered all the items on the asthma self-efficacy pre- and posttest. Only those tests with all items completed were analyzed. A significant improvement in the overall score from before attending *OA* ($M = 29.58$, $SD = 3.83$) to completion of *OA* ($M = 32.37$, $SD = 2.55$), $t(42) = -5.429$, $p < .001$ (two-tailed), was found. The mean increase in asthma management self-efficacy scores was 2.79 with a 95% confidence interval ranging from 3.82 to 5.42. The eta-squared statistic (0.41) indicated a large effect size.

Not all children answered every item for asthma management self-efficacy. Analysis was done for those items answered on both the pre- and posttest. Items which demonstrated statistically significant improvement include: (a) knowing when to take their asthma medicine ($t(47) = -3.50$, $p = .001$) with a large effect size ($\eta^2 = 0.21$); (b) knowing ahead of time when the child is going to cough or wheeze ($t(46) = -2.725$, $p = .009$) with a large effect size ($i^2 = 0.14$); (c) knowing home asthma triggers ($t(45) = -3.932$, $p < .001$) with a large effect size ($\eta^2 = 0.26$); (d) knowing school/classroom asthma triggers ($t(45) = -2.843$, $p = .007$) with large effect size ($\eta^2 = 0.16$); (e) being able to talk to the teacher about removing asthma triggers from the classroom ($t(47) = -3.725$, $p = .001$) with large effect size ($\eta^2 = 0.24$); (f) deciding when to go to school ($t(47) = -2.454$, $p = .018$) with moderate to large effect size ($\eta^2 = 0.12$).

3.2 | Child asthma control test

Analysis was based on 33 subjects with completed pre- and post C-ACTs©. Chi-square goodness of fit indicated a statistically significant difference in asthma control after completing *OA*, with 33% reporting asthma control (score of ≥20) prior to *OA* and 79.2% reporting asthma control after completing *OA*, $\chi^2(1, n = 33) = 6.19$, $p = .013$. See Table 3 for results of Chi-square test and descriptive statistics for asthma control test for children completing *OA*.

3.3 | Parent asthma knowledge test

Paired samples *t* tests were conducted on 35 subjects who returned both pre- and posttests. Not all questions were answered. No significant changes were found for parent knowledge after *OA* completion ($t(34) = -0.478$, $p = .636$). However, parents scored high prior to implementation of the program, so there might have been a ceiling effect. Maximum score was 30. Mean score prior to implementation of *OA* was 26.9 and posttest score mean was 27. While not significant, more parents were able to identify coughing as sign of asthma, when to take quick relief medication, and the need to take controller medication even if they feel normal after *OA* completion. It is notable that the question concerning inhaled steroid use was most frequently answered incorrectly. Almost half of the respondents in both the pre- and posttest indicated that inhaled steroids only need to be taken when someone is wheezing.

TABLE 3 Results of chi-square test and descriptive statistics for asthma control test for children completing *Open Airways*

Pre-*Open Airways* ACT	Post-*Open Airways* ACT < 19 (asthma not controlled)	≥20 (asthma controlled)
≤19 (asthma not controlled)	6 (66.7%)	5 (20.8%)
≥20 (asthma controlled)	3 (33.3%)	19 (79.2%)

Note: $\chi^2 = 6.19$, $df = 1$. $p < .05$. Numbers in parentheses indicate column percentages

4 | DISCUSSION

Findings support that the curriculum taught through the community–university partnership improved asthma management self-efficacy and asthma control in the participants. Power analysis validates our sample size and response rates are large enough to reliably support our findings. Significant improvement was noted for child asthma management self-efficacy and asthma control. Asthma control increased by 46%. No significant change to parent/caregiver knowledge was noted; however, both pre- and posttest scores indicated good asthma knowledge. Unfortunately, lack of knowledge concerning inhaled steroid use did not change after our intervention, which is a key treatment for maintaining asthma control.

Lack of change in parent knowledge concerning the need for inhaled steroid use in controlling asthma underscores needing a different approach to engage parents. EPR-3 (NHLBI, 2007) and GINA (2017) recommend ICS as the preferred long-term control therapy for all ages. Parents lacking this understanding for daily ICS put their child at risk for poor asthma control and exacerbations. Written handouts sent home provided this information, but we have no validation that parents received or read the information.

This partnership provides sustainable resources for providing asthma management education. The elective nursing course is established within our school and offered each semester, allowing for a continual supply of asthma educators. Through collaboration with our School of Nursing, local elementary schools are able to offer this program yearly, since 2000, without cost, overcoming the barrier of time confronting school nurses. Increasing asthma management skills and asthma control may translate to fewer visits to

school nurse, fewer school days missed, and fewer ER visits, and hospitalizations. Health care dollars can be saved from preventing these avoidable events, reducing financial burden associated with this chronic condition. Once trained as facilitators, our nursing students can continue to offer the program in communities where they reside after graduation.

An additional benefit through enrollment in this elective course is the nursing student's increased awareness of the role of population health and public health nursing. Students learn not only about asthma and how to manage this condition, but they also receive didactic education about disparities surrounding this disease. This leads to an enhanced awareness of social determinants and their impact on health, as well as respect for environmental justice, understanding the effect of where one lives on asthma outcomes. This assists these students in perceiving an expanded role outside hospital settings as a viable option for practice after graduation. This awareness, as well as the expertise gained in asthma management and confidence in ability to teach health education, transfers to all aspects of nursing. For students who decide not to engage in public health nursing, they still have this knowledge and skill to teach people in all settings to manage asthma to achieve best possible outcomes. This experience is essential to nurses in all practice settings, enhancing understanding of multiple factors that impact patient self-management of chronic disease.

Generalizability of findings may be limited. Participation was limited to schools with superintendent approval. Only those children with parent consent were able to participate. Thus, these students might not be representative of all children with asthma. We did not collect socioeconomic or family history data, which might be useful in identifying influencing factors. Data were self-reported for asthma management self-efficacy and asthma control. Question responses for asthma control are dependent upon memory, which might not reflect the actual situation.

Internal validity was limited due to lack of consistency in delivering the intervention. Each school dictated when, where, and for how long we were able to have access to the children for instruction. Therefore, not all education was given for the same duration or under the same conditions. Not all parents returned posttests, limiting our analysis of parental knowledge. Accessibility to medical care and asthma medications, which were not assessed in this study, may impact both parental knowledge and asthma outcome findings. Bias also needs to be considered as only one asthma management program was used for the intervention. However, we used the program endorsed by the NASN and CDC. In our next study, more standardization across all schools and assessment of more factors will be addressed. Use of other asthma management programs will be considered.

5 | RECOMMENDATIONS FOR FUTURE RESEARCH

This partnership between a university and community schools demonstrated a significant improvement in children's asthma management self-efficacy and asthma control. Future studies necessitate active engagement with parents, with a thoughtful approach of how to address barriers confronting parents for this type of engagement. Additionally, prospective studies need to follow children taught by nursing students to see if this collaborative partnership results in significant impacts on school absences, ER visits, and hospitalizations for asthma.

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