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School-Based Interprofessional Asthma Self-Management Education Program for Middle School Students: A Feasibility Trial

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Abstract

Background: Asthma is the most common chronic disease among school-aged children under 18 years of age and is a major cause of morbidity, loss of school days, and increased hospitalizations. Asthma disproportionately affects low-income, minority youth in Alabama. The benefits of improving asthma control and self-management have significance for improving health, preventing disease, and reducing health disparities by addressing social, behavioral, environmental, economic, and medical determinants of health.

Objectives: This collaborative community partnership between the Mobile County Public School System, University of South Alabama (USA), and USA Children's and Women's Hospital involved nursing students, respiratory therapy students, and medical residents from three colleges and the hospital. The research question was whether a school-based asthma self-management education program presented by an interprofessional team was feasible for teens with asthma in a medically underserved area (MUA).

Methods: Middle school students with a diagnosis of asthma participated in this institutional review board–approved study. Asthma assessments, one-on-one coaching, and group education were done over five sessions, using *Power*

Breathing for teens curriculum. Instruments were the Childhood Asthma Control Test (ACT), the Asthma Responsibility Questionnaire (ARQ), the Self-Efficacy Scale, the Pediatric Asthma Quality of Life Questionnaire (PAQLQ), peak flow monitoring, and spirometry.

Results: Eighteen students with moderate to severe persistent asthma completed the program with reduced asthma symptoms and increased asthma control, medication knowledge/skills, self-efficacy, and asthma responsibility.

Conclusions: Adolescents with asthma need education in medication management, spacer use, peak flow, trigger avoidance, and coaching to take on the responsibility of asthma care. This multidimensional, interprofessional approach can strengthen asthma self-management in a middle school medically underserved community population.

Keywords

School-based health promotion, interprofessional education, community engagement, school health services, asthma self-management education

Asthma is a chronic health condition that demonstrates a high burden on approximately 8.4% of children in the United States, with 60.3% of children diagnosed with asthma categorized as having persistent asthma.^{1,2} Children with asthma use the emergency department more often, compared with children without asthma,

and incur increased hospitalizations, which result in increased health care expenditures.³ It has been documented that almost half of children in the United States with asthma have missed 1 or more days of school owing to asthma-related issues.⁴ There are often barriers to obtaining asthma-related health care, such as not being able to afford medications or to see a primary care

doctor, as well as a scarcity of asthma specialists, especially for those with no or partial year health insurance coverage.⁵

More specifically, asthma is the number one chronic illness of schoolchildren in Alabama with higher disparities in minority and poor communities (Alabama School Nurse Survey, Unpublished report to the Alabama Board of Nursing).^{6,7} Lifetime asthma prevalence is significantly higher for Black (19.4%), other non-Hispanic (25.6%), and multiracial (32.1%) children in Alabama. Lifetime asthma reported for middle school students in Alabama was 22.5%, and more middle school students (13.6%) also reported having had an asthma episode or attack in the last year compared with high school students (9.5%), demonstrating that the most vulnerable students are middle school.⁶ Mobile County in Alabama has a significant number of MUAs, which further exacerbates asthma-related health disparities. As a result, new models using community partnerships for health care and asthma-related education are needed.

This study targeted adolescents in MUAs areas with an intervention that has the potential to improve self-management, quality of life, and overall asthma control. Effective asthma control and self-management have significance for improving school achievement with lifelong benefits. Asthma symptoms compromise breathing and account for significant school absences, emergency department visits, and hospitalizations. Middle school students were selected because they are at a pivotal time to transition to self-care and asthma responsibility. Young teens also have key adaptive needs in their transition to adolescence and can benefit from educational support.

ADAPTATION AS HOLISTIC APPROACH TO CARE

The theoretical basis for this work was the Roy adaptation model, which builds on stress-adaptation theory and relates to clinical practice approaches.^{8,9} The model was used to address the multiple domains of adolescent development, which impact the development of asthma control and self-management. Four adaptive modes or domains in individuals are physiological mode, self-concept mode, role function mode, and interdependence mode.¹⁰ These domains are described in a middle range theory relating the conceptual elements to practice with persons with chronic illness.¹¹ Key concepts in the model are the stimuli creating the need for

adaptation, adaptive processes, and outcomes indicating adaptation in multiple domains. Figure 1 shows the application of the model for adolescents with asthma. Teens with asthma have focal stimuli of asthma symptoms, severity, and control; contextual stimuli of meaning of illness, personal resources, and level of asthma responsibility; and residual stimuli of their developmental stage and school setting. Processes of adapting include asthma education, medication regimen adherence, and collaboration/participation with others. Outcomes are improved functional ability, a sense of normalcy, self-management, and role consistency (Figure 1). These combine to describe an adaptive process with numerous inputs and outcomes that can be significant for the young adolescent as she or he transitions to adulthood with a chronic illness. These components were addressed in the design and implementation of the school-based program.

INTERPROFESSIONAL COLLABORATION AND COMMUNITY EDUCATION APPROACHES

Asthma education programs are seen as the cornerstone of effective asthma management.¹² The National Asthma Education and Prevention Program developed the Expert Panel Report 3 (EPR-3) guidelines for the diagnosis and management of asthma, which provide a list of four components of asthma management. One focuses solely on education for providers and patients and families within the home and community setting.¹³ Several research studies have cited positive outcomes through the use of community-based asthma education programs.^{12,14–17} As a result of the education provided within these studies, several outcomes demonstrated improvements, such as enhanced knowledge; better controlled asthma; fewer emergency department visits, hospitalizations, and school absences; increased health promotion behaviors and quality of life; and improved communication with and access to health care providers.^{12,14–17}

The connection with the community illustrated in these studies can also be applied to the school setting. The effective use of a community partnership to address asthma is illustrated in a series of studies by investigators in Connecticut and Colorado, where asthma management programs in schools were found to be highly effective. A randomized, controlled trial of a public health nurse-delivered asthma

Figure 1. Middle range theory of adapting in chronic illness of asthma

program to elementary schools revealed at 1 year less urgent care use, less absenteeism, improved inhaler technique, and a higher quality of life.¹⁸ Other studies have likewise found improvements in asthma control, health promotion behaviors, absenteeism, and school performance.^{16,17,19} In a review on establishing school-based programs for children with asthma, in 2014 Cicutto et al.²⁰ concluded that models of asthma care that place community schools at the center are effective and may provide a strategy for managing other chronic illnesses.²⁰

Furthermore, interprofessional collaboration to address the health needs of a community is supported by the Institute of Medicine report on the *Future of Nursing* and the World Health Organization report *Framework for Action on Interprofessional Education & Collaborative Practice*.^{21,22} Nursing students bring a holistic view of persons that can enrich the interprofessional dialog. Respiratory therapy students working with a population of teens with asthma bring excellent skills in respiratory assessment and interpretation of spirometry data. Respiratory therapists and prescribers involved in asthma care not only bring an appreciation for

the EPR-3 standards of care, but also recognize the critical role that self-management brings to medication adherence and effectiveness.¹³ Moreover, resident physicians can serve as a liaison between inpatient care, primary providers, and families.

The impact of using community partnerships to address the problem of high asthma burden can be seen in the literature. However, combining an interprofessional team with a community partnership in a school setting to provide education on asthma related topics is a novel approach. An initiative was developed to include collaboration between the Mobile County Public School System (MCPSS), the USA College of Nursing and College of Allied Health faculty, USA College of Medicine, resident physicians, and hospital staff from USA Children's and Women's Hospital (USACWH).

The MCPSS administration provided their approval and support for the project, and the school nurse acted as a liaison between the school administration, student participants, and the faculty from the USA College of Nursing and College of Allied Health. Each of the interprofessional providers contributed to the Asthma Self-Management Education

(ASME) program through assessments, education on asthma self-management, and maintaining communication with parents and teen participants. The nursing students, respiratory therapy students, and residents provided one-on-one education and coaching to the teen participants. Additionally, the hospital staff coordinated efforts with the team to ensure continuity of care for teens with asthma throughout the USA Healthsystem. The partnership's goal was to implement a school-based ASME intervention to address health disparities, reduce asthma symptoms, and improve asthma control and self-management in this vulnerable population.

PURPOSE AND OBJECTIVES

The purpose of this community partnership was to evaluate the feasibility and effectiveness of an interprofessional team collaborating with the MCPSS to implement an ASME program. The program was based on the *Power Breathing Program* for teens and included many clinical and social parameters: asthma symptom control, improved self-management of asthma, and enhanced self-concept, responsibility, interdependence, and quality of life.²³ Specific objectives of this study were to:

- a. Develop and pilot an interprofessional assessment and ASME intervention program for middle school students with asthma,
- b. Pilot the feasibility of collaborating with community partners within the MCPSS and USACWH to implement a school-based ASME program,
- c. Determine the effect the ASME program would have on the middle school student's ability to adapt during the transition to adolescence within multiple domains (physiological, self-concept, role function, and interdependence), and
- d. Discover the ability of the ASME program to impact breathing function and asthma control in the group of middle school students with asthma.

METHODS

Target Community and Study Design

Owing to asthma placing a greater burden on minority middle school students in poorer communities, a specific community was targeted. A middle school located within the

MCPSS was selected from a geographic information system plot of school districts in designated MUAs (Figure 2). The middle school chosen serves urban, suburban, and rural areas of the county and the school population includes predominantly minority, Medicaid recipients; is located in a MUA of Mobile County; and has a high asthma prevalence. A convenience sample of middle school students and their parents were chosen by self-selection (voluntary participation). Middle school students were recruited by two methods: (1) students with asthma by diagnosis or respiratory symptoms suggestive of asthma whom were referred by the school nurse, and (2) parents could self-refer their middle school student in response to flyers distributed to children attending the school. Approval of the study was granted by the USA Institutional Review Board, the director of research for the MCPSS, the supervisor of health and social services for the MCPSS, and by the administration of the target community school where the ASME program was held. Parental consent and teen assent were obtained. All participants met inclusion criteria for the study: middle school teens of any ethnic origin with asthma listed in school records; able to understand and speak English; and attended sixth-, seventh-, or eighth-grade classes at the targeted middle school. Data from the two cohorts of middle school students are reported from Spring 2016 and Fall 2016 with a total of 18 students completing all activities. This research was designed as a quasi-experimental study, as well as a program evaluation study.

Establishing the Community Partnership

The initial step in forming the community partnership was to collaborate within the academic environment to create the interprofessional team of USA College of Nursing and College of Allied Health faculty with students from both disciplines. This team collaborated to create the ASME program and was later responsible for implementing the program at the pilot school. The academic faculty also reached out to USACWH for further partnership. The hospital was currently working on implementing a Home Management Asthma Plan of Care project within the hospital setting and through the collaboration with the pediatric in-service specialist, the concepts of that project were embedded within the ASME program and the specialist was highly involved in the development and implementation of the ASME program at the pilot school.

Figure 2. Medically underserved areas in Mobile County with corresponding middle schools identified

GIS Mapping by Sam Stutsman, University of South Alabama Department of Geography

After the framework of the ASME program was developed, the team made contact with the MCPSS to add another community partnership to the ASME collaborative. The decision to collaborate with a school system was made due to the previously discussed high asthma burden in middle school students and the success of previous studies that occurred in a school-based setting.^{6,18,21} Initial discussions were first held with the MCPSS administration (supervisor of health and social services and the director of research) on the possibility for setting up the ASME program within a middle school. The director of research for the MCPSS was instrumental in guiding the team on aspects of performing a research study in

a school-based environment and the supervisor of health and social services for the MCPSS was vital in helping the team further enhance the ASME program and to make connections with the school nurse at the pilot school.

Once approval was obtained, the pilot school was chosen, and communication started with the middle school's administrative and health care staff. Several planning meetings occurred with the school principal, school nurse, and parent program manager, who welcomed the program. The school nurse helped to refer several at-risk middle school students with asthma, attended the parent/student orientation to provide a "familiar face," and offered support each week

during the implementation phase of the program. The parent program manager worked with the team to help coordinate equipment, reserve space within the school, and to help disseminate the recruitment flyers to parents. Support letters were obtained from MCPSS administration, USACWH, and from the academic institution and the letters were submitted with the institutional review board proposal. The community partnership formation process took around 6 months and has now been in existence since Fall 2015.

During the second cohort in Fall 2016, additional members from USACWH were added. Resident physicians participated as a way to connect with the community and they were very helpful in working with the team in developing asthma action plans (AAPs) based on information from the middle school student's primary providers. The academic faculty have since met with the MCPSS administration to provide feedback on the collaboration and present results of the ASME program. Finally, USA faculty collaborated with the pediatric in-service specialist from USACWH to compile the outcome data, run the data analysis, and prepare the manuscript for the study. The partnership moving forward has a broader focus because the ASME program will be expanded to include more schools within the MCPSS.

Implementing the ASME Program

As stated, an interprofessional team of students, faculty, staff, and resident physicians implemented an assessment and ASME program within a middle school in a MUA. The first step in implementing the program was to train the team of interprofessional students on the concepts of teamwork, training on instruments and equipment, and planning for the parent/adolescents orientation. Interprofessional students as they relate to this study are defined as students from multiple professional groups who come together to learn from each other and to collaborate.²⁴ The use of an interprofessional team of students was part of the purpose of this research, because faculty wanted to engage students to work together and take ownership in the project. Faculty from multiple disciplines who are certified asthma educators ensured that the students were adequately trained before implementation and were supervised during the asthma education sessions. After recruitment, there was an orientation meeting conducted

for the participants and their parents by the interprofessional team. Students (and their parents) completed a signed consent/assent and filled out baseline questionnaires before beginning the study.

Instruments

Baseline questionnaires were completed to gather key information that could be compared with the results achieved after students completed the ASME program. Baseline questionnaires included the Self-Efficacy Scales,²⁵ ARQ, PAQLQ, and Childhood ACT.^{26–28}

Self-efficacy scale. The Self-Efficacy Scale helps to discover the degree of confidence that the teen perceives of having over his or her environment to achieve certain objectives or to overcome perceived obstacles.²⁵ A student's level of confidence or personal mastery is important in that it affects the level of motivation to change behaviors. The Self-Efficacy Scale consists of 23 questions, includes reversed worded questions, and is based on a 5-point Likert scale with 1 (strongly disagree), 2 (agree), 3 (neutral), 4 (agree), and 5 (strongly agree). The scale is further divided into two subscales, the general self-efficacy and the social self-efficacy subscales. To obtain a score, all reverse worded questions are flipped, and a score is totaled.

Asthma responsibility scale. The ARQ determines the perceptions of shared responsibility in asthma management between the teen and their parents or caregivers.²⁶ The 10 statements included within the ARQ are scored on a scale of 1 to 5, with a score of 1 meaning that parents take full responsibility all of the time, 2 indicating the parent takes responsibility most of the time, 3 describes when the parent and child share responsibility, 4 meaning the child assumes responsibility most of the time, and 5 indicates that the child takes responsibility all of the time. The scores for each statement are added and a mean is calculated to determine the teen's level of responsibility in his or her asthma management.

Pediatric asthma quality of life questionnaire (PAQLQ). The PAQLQ can be used for children ages 7 to 17 years old and measures the physical, emotional, and social problems that are most troublesome to children with asthma.²⁷ The tool includes 23 questions divided into the three domains of symptoms, activity limitation, and emotional function. First, children

are asked to select three activities within the activity domain and rate how much asthma bothers them while completing those three activities on a 7-point scale that ranges from 1 (extremely bothered) to 7 (being not bothered at all). Then the children answer the remaining 20 items, which ask how often they have been bothered by asthma symptoms and how those symptoms have made them feel during the previous week using the same 7-point scale. The overall PAQLQ score is calculated using a mean of all answers.

Childhood ACT. The Childhood ACT determines the perception of asthma control based on both the child's and caregiver's responses.²⁸ The Childhood ACT has four questions for the child to complete and it uses facial pictures to help depict severity of symptoms. This is followed by three questions for the parent to answer based on frequency of symptoms. The Childhood ACT, which is developed for children between 4 and 11 years of age was used instead of the Youth or Adult ACT, which is aimed at those above the age of 12 because more sixth graders (11-year-olds) were initially recruited into the ASME and the interprofessional team was concerned about low literacy levels in the recruitment population. It was felt that the children's responses would be more accurate with use of the Childhood ACT because it used facial pictures instead of just wording. The Childhood ACT overall score is calculated by adding up the scores for each of the seven questions and ranges from 0 to 27. Scores of 19 or less are indicative of asthma symptoms that are poorly controlled.

Assessment of asthma severity, control, and self-management. The baseline asthma history was gathered and an assessment of breathing function and asthma control was completed using spirometry and peak expiratory flow (PEF) rates. All of this information was used to categorize the severity of asthma for each middle school student according to the EPR-3 guidelines.¹³ Based on the EPR-3 guidelines, the level of severity is determined by the assessment of both impairment and risk. The severity of asthma symptoms fall in to one of four categories: intermittent, mild persistent, moderate persistent, or severe persistent asthma symptoms. Intermittent asthma symptoms are characterized as having asthma symptoms and use of a short-acting beta agonist (SABA) no more than 2 times a week, no more than two night-time awakenings per month, and a normal forced expiratory

volume in 1 second (FEV₁) for weight and age. Mild persistent severity includes asthma symptoms and use of SABA two or more times a week, night time awakenings of more than three to four per month, minor limitation of daily activities, and a FEV₁ of greater than 80% of predicted for age, weight, and race. Moderate to severe persistent asthma is categorized as having daily asthma symptoms, night-time awakenings of one or more per week, daily use of a SABA, and a 5% decrease in the predicted FEV₁ for age, weight, and race.¹³ Risk is determined by the number of asthma exacerbations requiring treatment with oral steroids.

The health records of each middle school student were reviewed for the presence of an individualized AAP. The AAP aids in self-recognition and self-management of asthma symptoms based on identified symptoms.¹³ The AAP is divided into three zones: green, yellow, and red, and is individualized based on predicted PEF. The green zone is indicative of the lack of any asthma symptoms and 80% or greater personal best predicted PEF. The yellow zone indicates that asthma symptoms are worsening and the personal best PEF reading is within 50% to 80% of personal best, whereas the red zone is considered an emergency and prompt medical attention is needed if symptoms do not return to the yellow or green zone after two doses of a SABA.

The ASME program was implemented over a span of five sessions that incorporated an established educational program, the *Power Breathing Program* curriculum.²³ For each session, the middle school students arrived to the science laboratory where they completed a quick activity (called "bellringers") to help them prepare and focus for the upcoming educational session. This process mimicked what the students were used to doing daily in the pilot school setting and was suggested by the school staff. After the bellringer activity, the middle school students were provided with an interactive educational session based on the topics covered in the *Power Breathing Program* curriculum. These included symptom management, trigger avoidance, medication technique and adherence, and communication with health care providers, including the school nurse.

The middle school students then met individually with a nursing student and respiratory therapy student dyad to receive assessment and need-specific education. Each

participant kept a diary of their asthma control to include PEF measures (weekly), medication use, school absences and reason, and visits to emergency department, urgent care, or hospitalizations, and received assessment and education as part of their session visits. The nursing and respiratory therapy students logged the information from these diaries and discussed any concerns with the middle school student. The nursing and respiratory therapy students also asked participants for self-reported feelings, coping strategies, adherence, symptom management, and school absences. The middle school students were coached individually in the use of spacers, PEF, and the use of their individualized AAP. Finally, a physician resident reviewed the medication regimen provided as part of the home management plan of care/AAP by the student's primary care provider. Resident physicians reviewed this plan to determine consistency with national guidelines and followed up by completing an AAP for any student that did not originally have an AAP from their primary care provider.

Students completed other sessions at home. Home activities included videos and a home review using the Asthma Home Environmental Checklist.²⁹

Communication via multiple modalities (email, phone, texts) connected parents, teen participants, the interprofessional student team, and the school nurse for reinforcement and enhanced collaboration. A final closing event was held in the community setting, outside school time on a Saturday. Results for the program were reported to the middle school students and their parents, final surveys were completed, and an *Asthma Blues* CD was given to those who completed the program.³⁰

RESULTS

Data Analysis

Data collected were exported to the Statistical Package for the Social Sciences (SPSS) Version 23 for analysis (SPSS, Inc, Chicago, IL). Frequency and descriptive statistics were used to compare the differences of the pretest and post-test results of the degree of asthma control, asthma responsibility, self-efficacy, and quality of life to determine the effectiveness of the ASME program. Paired sample *t*-tests were used to compare the means of the pre-intervention and post-intervention

groups and the data were analyzed to determine if the average difference was statistically significant. The sample size was too small ($n = 18$) to have a confidence level in the statistical findings. Therefore, reporting for the quantitative section is primarily reported as descriptive statistics.

Demographics. Thirty-six middle school teens were recruited, sixteen of whom were excluded owing to their inability to attend all educational sessions of the ASME program and two because of incomplete data collected for data analysis (Table 1). The final sample included 18 middle school students, of which 44% ($n = 8$) were male and 56% ($n = 10$) were female. Race/ethnicity were self-reported as primarily Black 56% ($n = 10$), Hispanic 1% ($n = 1$), and White 39% ($n = 7$). Participants ranged in ages from 11 to 14 years old with a mean age of 12.8 (SD 1.1) and were primarily in the eighth grade ($n = 9$ [50%]), with the remainder in the sixth grade ($n = 5$ [28%]) and seventh grade ($n = 4$ [22%]). Based on school records, 50% of teens ($n = 9$) had a controller medication and 100% ($n = 18$) had a reliever medication prescribed to them by their primary care physician.

Asthma Symptoms. Before participation in the ASME program, all of the participants were identified as having moderate to severe persistent asthma according to EPR-3 guidelines based on participant PEF and forced expiratory

Table 1. Demographics

	Group 1 (n)	Group 2 (n)	Total, n (%)
Gender			
Male	5	3	8 (44)
Female	4	6	10 (56)
Age (y)			
11	0	1	1 (0.06)
12	2	3	5 (28)
13	4	4	8 (44)
14	3	4	4 (22)
Grade			
6	2	3	5 (28)
7	0	4	4 (22)
8	7	2	9 (50)
Race/Ethnicity			
White	1	6	7 (39)
Hispanic	1	0	1 (0.06)
Black	7	3	10 (56)
Medications			
Reliever	9	9	18
Controller	5	4	9 (50)

Figure 3. Peak flow

volume (FEV₁ percent of predicted results).¹³ A paired-sample *t* test was calculated to compare the mean PEF of all participants before starting the ASME program to the mean PEF after completion of the program (Figure 3). The mean PEF for the pre-program group was 322.86 (*SD* = 37.28) and the mean PEF of the post-completion group was 369.86 (*SD* = 25.30; *p* < .05). Based on each participant's individualized AAP, the PEF reading showed that 62% of the teen participants were in the yellow zone before the intervention as compared with a 100% being in the green zone after the intervention.

Assessments of teen participant's asthma knowledge were validated by the nursing student and respiratory therapy students in the following four skills: using a metered dose inhaler (MDI), using an MDI with a spacer, properly recording PEF readings, and tracking symptoms in a weekly asthma diary. There was an increase in asthma knowledge in all of the four skills areas over the intervention period: technique of using an MDI, use MDI with a spacer, recording of correct PEF readings, and tracking of daily symptoms on a weekly asthma diary, all at four-fold or greater levels (Table 2).

Respiratory assessments were completed by the nursing student and respiratory therapy students to compare any changes in the participant's asthma symptoms throughout the program. The Childhood ACT was administered to the participants to determine their perception of asthma control.

Table 2. Assessment of Student's Asthma Knowledge and Skills

Demonstration of Four Basic Skills (<i>n</i> = 18)	Preprogram, <i>n</i> (%)	Postprogram, <i>n</i> (%)	<i>p</i> Value
Correct use of MDI	3 (17)	15 (83)	≤ .000*
Correct technique using a spacer with MDI	1 (0.05)	17 (94)	≤ .000*
Correct technique using a peak flow meter	2 (11)	16 (89)	≤ .000*
Correct technique in recording peak flow reading and tracking symptoms on asthma diary	2 (11)	16 (89)	≤ .000*

Abbreviation: MDI, metered dose inhaler.

Based on results, there was an improvement in symptoms from a mean score of 18.45 (*SD* = 1.30; poorly controlled) to a mean score of 19.69 (*SD* = 1.16; controlled) after completion of the ASME program (Figure 4).

Asthma Responsibility, Self-Efficacy, and Quality of Life. The ARQ was administered to middle school participants before and after completion of the ASME program to determine their perceptions concerning shared responsibility in their asthma management. By the end of the program,

Figure 4. Asthma control test

participants' responsibility for asthma self-management began to shift from mostly a shared responsibility between the parent and teen with a mean score of 3.36 ($SD = 0.99$), toward a positive direction of the teen beginning to assume more responsibility for asthma self-management with a mean score of 3.48 ($SD = 0.92$) after the program (Figure 5).

The Self-Efficacy Scale was implemented to determine the degree of confidence that the teen perceives of having over his or her environment to achieve certain objectives or to overcome perceived obstacles. Scores were totaled for each question after flipping all reverse worded questions. A paired-sample t test was calculated to compare the mean scores for the self-efficacy scale in both subscales. The results revealed an increase in scores for both the general and social self-efficacy components of the self-efficacy scale. Pre-program mean scores for general self-efficacy were 3.70 ($SD = 0.83$) and after the program were 3.90 ($SD = 0.73$); the mean scores for the social self-efficacy component were 3.54 ($SD = 0.71$) before the program and 3.70 ($SD = 0.76$) after completion of the ASME program (Figure 6).

The PAQLQ contains 23 items that are subdivided into three domains: asthma symptoms, emotions, and activities. The results of the PAQLQ before the program revealed a broad range of self-reported activities the teen participants engaged in regularly including playing at recess, skipping rope, swimming, walking, and riding a bicycle. Cohort 2 participated

in more sports—football, baseball, track, and running. Less exertive activities included studying, singing, getting up in the morning, talking, sleeping, and playing with pets.

The degree of bother was described by the teens to be higher during the activities that require more exertion than those that require less exertion. For example, the teens reported a mean score of 4.78 ($SD = 1.34$) or somewhat bothered in the activity domain as compared with a mean score of 5.5 ($SD = 1.21$), bothered a bit to hardly bothered in the emotional domain. Overall the teen's reported they were bothered by their asthma symptoms with a mean score of 5.35 ($SD = 1.28$; bothered a bit). Well-controlled asthma should make it possible to engage in most sports, so these participants may have been self-limiting engagement or limited by level of asthma control. For some participants, asthma did produce some bother in quieter activities such as sleeping, singing, or studying. The participants noted occasional bother on common day-to-day symptoms (coughing, shortness of breath, dyspnea, ability to take a deep breath), emotions (frustrated), and activities (keeping up with others and being tired).

DISCUSSION

The ASME program was initiated to address the public health concern of the prevalence of childhood asthma, specifically among adolescent middle school students. Adolescents

Figure 5. Asthma responsibility

Figure 6. Self-efficacy scale

are entering the stage of growth and development where they are concrete thinkers and are beginning to establish their independence. As this age group continues with growth and development into adulthood, improved self-management skills and asthma knowledge are essential to promoting health and preventing poor asthma-related outcomes. The evaluation of the ASME program was designed to explore the effectiveness of this intervention to improve adolescent asthma health

outcomes, increase asthma knowledge, and provide a foundation for successful asthma self-management skills.

The objective to develop and pilot an interprofessional assessment and ASME intervention program for middle school students with asthma was met. However, the sustainability of school-based interventions beyond programs such as the interprofessional ASME program presents a continued challenge. Sustainability requires an approach that emphasizes

the development of a community network of stakeholders that understand and support the efforts of an ASME by maximizing resources.³¹ Schools often lack the resources to deliver the interventions without assistance from outside groups; therefore, the community partnership approach of the ASME program including nursing and respiratory therapy students, resident physicians, and faculty proved beneficial and was found to meet the second objective of determining the feasibility of collaborating with community partners within a school system. Similar studies have demonstrated a lack of resources within schools to address asthma and that community partnerships help fill these gaps and are effective and cost efficient owing to the low costs associated with conducting a school-based ASME program.^{14,21} Community partnerships using ASME programs have also been found to improve self-management of asthma symptoms and level of control to prevent asthma exacerbations; therefore, ASME programs provide a cost savings by lessening associated health care costs for treating children with asthma.^{12,14} The nursing and respiratory therapy students and resident physicians, after receiving rigorous training based on the current EPR-3 guidelines and on the *Power Breathing Program* for teens program, effectively delivered the program to medically underserved, middle school teens with asthma. The ASME program was also beneficial to the students and resident physicians because it reinforced their asthma knowledge and confidence in teaching adolescent patients about health issues, enhanced communication and collaboration skills, and assisted in developing an appreciation of social responsibility.

The third and fourth objectives of determining the effect of an ASME program on the middle school student's ability to adapt during the transition to adolescence within multiple domains and its ability to impact breathing function and asthma control in the group of middle school students with asthma go hand in hand. The increase in PEF readings are important in that it demonstrates better asthma control, but it is also a concrete number that the adolescent can see and then make adjustments to medications to better control their asthma symptoms before symptoms occur. The PEF can change before asthma symptoms are evident; therefore, by adjusting medications based on PEF readings, it can prevent the adolescent from experiencing symptoms before they begin.

Other effective community-based asthma education programs have also demonstrated a similar impact on asthma control, asthma knowledge, and a reduction of symptoms, which correlate very well with this study.^{12,14,16}

Although not statistically significant, an increase in asthma responsibility demonstrated a positive shift from total parental control of asthma condition and medications to the adolescent beginning to take more responsibility for their asthma symptoms and medications. These findings were further authenticated by the increase in asthma self-management skill attainment, which suggests that participants developed an increased capacity to care for their asthma. As all areas measured for asthma self-management indicated improvement, the education provided was effective in this area. Ensuring that the adolescent population increases in independence, health promotion activities, and their ability to self-manage their asthma symptoms is vitally important.^{16,21,32} Positive shifts in general and social self-efficacy confirm that the teen participants felt more confident in all aspects of their lives. Adaptation that occurs in all four adaptive modes has the greatest potential in creating holistic change and being integrated into a child's overall life. Growing in self-management of this chronic condition, the child/youth gains the ability to improve across physiologic, self-concept, role function, and interdependence modes, which best supports the long-term adaptation.

The physical and psychosocial measures were deliberately chosen for their relationship to the adaptive modes of the Roy adaptation model. Physiological mode adaptation can be measured with PEF and ACT. General Self-efficacy corresponds with the self-concept adaptive mode and social self-efficacy corresponds with the role function adaptive mode. Change in interdependence mode corresponds with the shift in asthma responsibility. An overall positive change in all four adaptive domains or modes was achieved through this program. Continued validation of the interrelated concepts and the methods most effective in meeting objectives is needed. Expansion of the program to improve asthma self-management in middle school students is warranted. An interprofessional collaborative model, coupled with a community partnership, is highly effective in building on the strengths and contributions of each profession to this holistic and integrated care model.

The experience of middle school students during the implementation of the ASME program was perceived to be positive. During each session, students were engaged, asked appropriate questions, and shared related experiences to the subject matter. Students enjoyed the interactive discussions, individual coaching, and active participation. The middle school students reported that the games and scenarios were their favorite activity of the program and they enthusiastically competed in all activities to demonstrate their knowledge attainment. In addition, the school nurse at the middle school expressed the desire to continue the implementation of the ASME program and potentially expand the implementation of the program to all middle school children of the MCPSS.

Significance

Collaborative studies have found that school-based ASME programs are effective. For instance, a randomized controlled trial of an asthma program in elementary schools revealed a decrease in urgent care use and absenteeism, improved inhaler technique, and a higher quality of life.¹⁹ Likewise, other studies demonstrate improvements in absenteeism and school performance.^{33–35} According to the national EPR-3 guidelines, “proven school-based programs should be considered for implementation because of their potential to reach large numbers of children who have asthma.”¹³ Children are used to receiving instruction at school and school-based programs facilitate a welcoming learning environment for students who are affected by asthma.¹³

Responding to the needs of teens with asthma requires a comprehensive, coordinated, and systematic approach; therefore, the potential significance of this study is that it adds to the existing body of knowledge that school-based programs using a collaborative team approach are feasible and effective. This study demonstrates that an ASME program can be successfully implemented in a school environment with multiple community partners and can translate into improved outcomes for children with asthma. Collaboration with community partners beyond the university is essential to providing care by reaching individuals, families, and populations where they live and work. Partnerships developed as a part of this study are expanding owing to their effectiveness in improving health outcomes of children with asthma, and

this project also supports the mission of the Alabama Asthma Coalition to improve the quality of life for those living with asthma in Alabama through education, advocacy, surveillance, and partnerships. Future efforts include a partnership with the Alabama Asthma Coalition to establish a consistent framework for increasing asthma awareness and to improve asthma management and outcomes of school-aged children in Alabama.

LIMITATIONS

Limitations of the study were its small sample size and the ability to obtain data from the participants. Data for all dependent variables could not be obtained for the entire sample group owing to the participant’s competing academic responsibilities. The ASME program was conducted during school hours and some participants were required to complete testing in their academic courses during times when data were collected from the ASME group. Other limitations include the quasi-experimental design in a single school in which random assignment of participants to control and experimental groups was not possible; therefore, possible pretest and post-test response shift bias was not emended. Another important issue to consider is that use of a pretest and post-test design allows the measure of the degree of change before and after completion of the ASME program and denotes that data are only collected from those participants who complete the program, not from the entire group of participants. This limitation could be important because the lack of information gathered from participants who did not complete the program does not allow for any examination of attrition. Specific limitations in use of the PAQLQ were noted as there was no pretest-to-post-test determination. It has potential for future longitudinal applications, because control should contribute to improved quality of life experiences.

LESSONS LEARNED

This study was designed to determine the feasibility of conducting an ASME program with middle school students. The feasibility of the program was demonstrated by improvement trends in all dependent variables, including asthma control. The participant’s one-on-one interaction with nursing students, respiratory therapy students, and the

resident physician yielded enhanced participation by the teen participants and the nursing students, respiratory therapy students, and resident physicians interacted positively with teens and with each other during the sessions and reported an authentic opportunity to collaborate. Future efforts will be to expand the program while streamlining the program to enhance effectiveness.

Barriers were encountered in recruitment and logistics of asthma education sessions. All sessions were held in the school during school hours. The school had limited classrooms for sessions to be conducted and teen participants had competing academic projects that prevented some students from participating in all activities. Finally, reaching parents has been a challenge in school-based interventions. Given the competing demands for parents' time, parent attendance in asthma interventions is often poor, resulting in the exclusion of parents from assessments of their child's asthma condition, their knowledge of asthma and control, and their degree of responsibility in the child's asthma care. However, continued efforts are in progress to encourage parental engagement. Overall community outcomes of the program have been shared with the partners and the program is continuing to expand.

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