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Abstract

Asthma is the most prevalent chronic illness in childhood affecting 7 million youth. Many youth with asthma face another risk factor in obesity. Obesity, in turn, increases disorders such as asthma. Studies have recommended that asthma programs also address weight management in youth. Taking this into consideration, the I Can Control Asthma and Nutrition Now (ICAN) program is an innovative school-based program composed of (1) nutrition and weight management education, (2) asthma education, and (3) monthly reenforcement visits. This pilot study tested the initial effectiveness of the ICAN pilot program on a variety of asthma and nutrition outcomes in 25 urban minority students with asthma. Over the course of the pilot program, significant increases in asthma knowledge, asthma self-efficacy, asthma quality of life, asthma self-care, nutrition knowledge, nutrition self-efficacy, and asthma control were observed. The ICAN program has demonstrated promising preliminary results in improving nutrition and asthma health outcomes with urban minority high school students.

Keywords

asthma, nutrition, obesity, high school

Introduction

Asthma is the most prevalent chronic illness in childhood, affecting 7.1 million individuals under the age of 17 (Akinbami, Morrmann, & Liu, 2011). Currently, 9.6% of all children below the age of 18 have asthma. Children in poverty have a higher asthma prevalence rate of 13.5% (Centers for Disease Control and Prevention [CDC], 2011). Racial and ethnic disparities in children with asthma are also concerns. Non-Hispanic Blacks (14.6%) and multi-racial children (13.6%) experience asthma at higher rates than White children (8.2%; Moorman, Zahran, Truman, & Molla, 2011). Annually, 14.4 million school days are missed due to asthma, averaging 4.1 school days for those who experience an asthma attack (American Lung Association, 2010; CDC, 2011). In addition, hospitalization and death rates due to asthma for African Americans are nearly three times those of Whites.

Many children with asthma face another risk factor, obesity. Childhood obesity has tripled in the last three decades (Ogden, Carroll, Kit, & Flegal, 2012). Within the last decade increases in body mass index (BMI) have been

associated with increases in the incidence, prevalence, and severity of asthma (Black, Smith, Porter, Jacobson, & Koebnick, 2012; Chen, Weiss, Heyman, Cooper, & Lustig, 2011). Michelson, Williams, Benjamin, and Barnato (2009) also suggest obesity-induced inflammation may contribute to greater asthma severity. Previous studies have recommended that intervention programs concomitantly address asthma and weight management in children (Kwon et al., 2006; Luder, Melnik, & DiMaio, 1998). However, current school asthma education programs do not address healthy nutrition and weight management, which may be due to the

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recent recognition of the relationship between these two conditions.

It is only in the last decade that schools have been identified as a resource for initiatives and services related to weight and health. Registered dietitians are not routinely employed by school districts. However, the need for nutrition services through school-based health centers to address weight has been identified. The interdisciplinary collaboration of nursing and dietetic professionals to address the common problems with these students is a unique feature of the I Can Control Asthma and Nutrition Now (ICAN) program.

Asthma and Obesity

In the United States, obesity has increased threefold for youth in the last four decades (Ogden et al., 2012). During the same time, youth asthma prevalence has also increased (Akinbami et al., 2011). One of the first studies to examine these conditions together, conducted by Gennuso, Epstein, Paluch, and Cerny (1998), reported that in a sample ($n = 171$) of predominantly Hispanic (78%) youth, 45.9% of those with asthma were overweight or obese compared with 30.2% of those without asthma who were overweight or obese ($p = .04$). It was unclear whether exercise-induced asthma symptoms lead to increased exercise avoidance and subsequently obesity; or whether obesity caused increased asthma symptoms with exercise or both. Black, Smith, Porter, Jacobson, and Koebnick (2012) confirmed this finding and also reported that increasing BMI was associated with significantly increased incidence of current asthma. In a study that analyzed National Health and Nutrition Examination (NHANES) data, from 77 million youth, asthma severity increased with both elevated BMI and an inflammatory marker. These findings may support a link between obesity-induced inflammation and increased asthma severity (Michelson, Williams, Benjamin, & Barnato, 2009). Increasingly data from large cross-sectional and prospective studies support the theory that obesity is a risk factor for asthma in youth. Initial research suggests obesity precedes asthma (Shore & Johnston, 2006).

Current asthma management guidelines (Expert Panel 3) emphasize the importance of asthma control and introduce new approaches, including education, for monitoring asthma (National Asthma Education and Prevention Program [NAEPP], 2007). Overall, asthma education programs developed over the past 20 years have demonstrated significant benefits from self-management behaviors, health outcomes, and quality of life (QOL) for children with asthma (Blandon Vijil, del Rio Navarra, Eslava, & Monge, 2004; Bruzzese, Unikel, Gallagher, Evans, & Collard, 2008; Srof, Tobaas, & Velsor-Friedrich, 2011; Velsor-Friedrich, Pigott, & Louloudes, 2004). However, none of these established programs devote substantial content to nutrition and healthy

weight management. Since increases in BMI are associated with an increase in the incidence, prevalence, and severity of asthma, it is critical that future asthma education and management programs include this content in order to support positive asthma health outcomes.

School-Based Health Care

Schools are an ideal setting for obesity prevention programs (Foster et al., 2008; Story, 1999) and are advocated as the logical environment for health education, health services, and development of supportive networks. They have the advantage of reaching low-income children with limited access to resources. Optimal programs include a combination of family- and school-based programs (Ritchie, Crawford, Hoelscher, & Sothorn, 2006). The present research project used this ideal setting for implementing a multicomponent program that includes education coupled with coping skills training (CST) related to nutrition in students with asthma at risk for obesity. Behavioral counseling was included in the monthly visits. Family support was encouraged with an evening session that highlighted the ICAN program to parents and siblings.

Theoretical Framework

Orem's self-care deficit theory (SCDT) was the guiding framework for the present research (Orem, 2001). The basic premise of this theory is that individuals engage in continuous communication and interchange among themselves and their environment to live and function. There are three inter-related theoretical frameworks that form the general SCDT: (a) the theory of self-care, (b) the theory of self-care deficit, and (c) the theory of nursing systems. The theory of self-care states that individuals have an ability (self-care agency) to take deliberate action to maintain life, health, and well-being (Orem, 2001). The components of self-care agency, which are considered important to asthma management include coping, asthma knowledge, asthma self-efficacy, nutrition knowledge, and nutrition self-efficacy pertinent to dietary behaviors and healthy weight. Health-deviation, self-care requisites are associated with alterations in health status. In this study, asthma and obesity are considered health-deviation requisites that require specialized actions. The theory of nursing system describes the development, implementation, and evaluation of a plan of the nurse/dietitian system in conjunction with the patient to complete requirements for human functioning and development. In this study, self-care agency and self-care were explored as they relate to urban low-income minority youth with asthma. The ICAN intervention in this study is classified as supportive and educational. Figure 1 depicts the relationship among the theoretical model, study variables, and operational measures for this study.

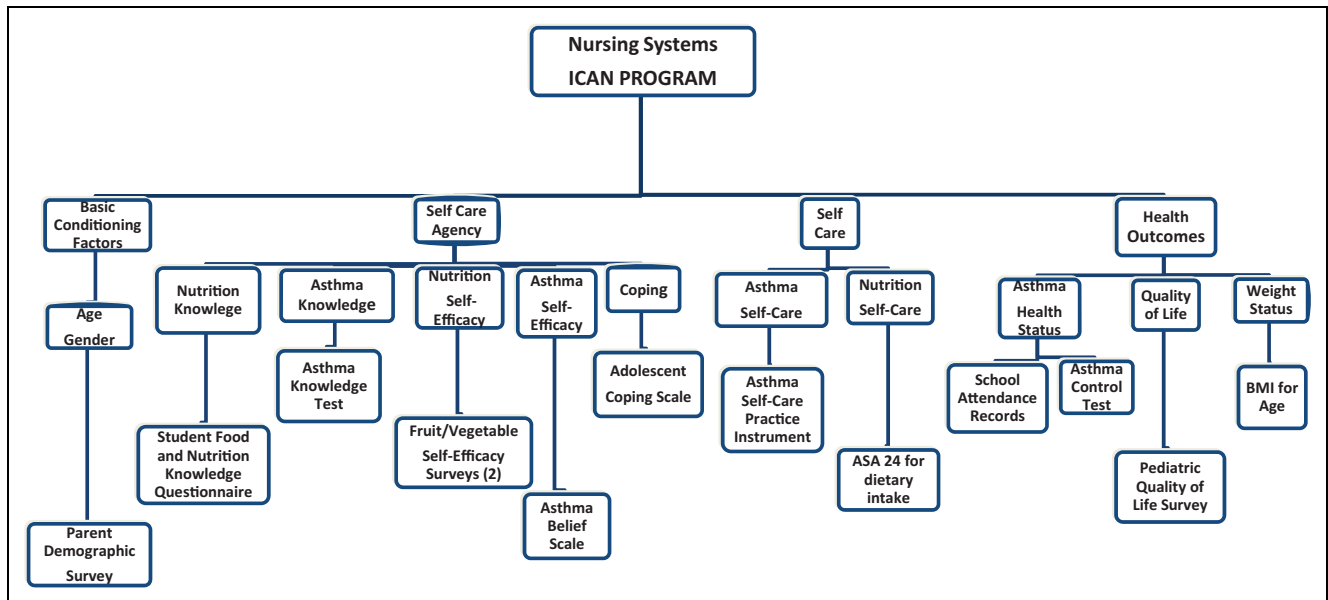


Figure 1. Theoretical model, study variables and operational measures.

Summary

Minority youth are at risk for poor control of asthma, a potentially life-threatening disease, due to social and environmental stressors, coupled with the risk for the comorbidity of obesity. Although prior studies have demonstrated the significant impact of asthma education/management programs in the school-aged population, there are no programs that target nutrition and weight management for those with asthma. This study addressed this need by implementing a school-based program to improve nutrition knowledge, dietary behaviors, and asthma outcomes among adolescents at risk for obesity. The combination of asthma and nutrition education with CST and registered nurse (RN)/dietetic intern (DI) reinforcements can lay the groundwork for a transition from parent-managed care to self-care. If this intervention is successful in program delivery and outcomes, then future research will be conducted in a larger sample for extended periods.

Study Purpose and Aims

The I Can Control Asthma and Nutrition Now (ICAN) program is an innovative school-based program implemented by a multidisciplinary team to improve the health status of youth with asthma who are at risk of unhealthy weight, based on demographic characteristics, through education and behavioral approaches. The overall purpose of this pilot study was to evaluate the initial effectiveness of the ICAN program in minority youth with asthma. The aims and hypothesis of this preliminary investigation are summarized below:

Aim 1

The present research aims to determine the effectiveness of the ICAN program on nutrition knowledge and dietary behaviors, specifically increased intake of fruits and vegetables, decreased intake of sugar-sweetened beverages, decreased screen time, and increased breakfast consumption. Minority high school students with persistent asthma who are at risk for high BMI based on minority status receiving the ICAN program should have significant improvements in nutrition knowledge and targeted dietary behaviors.

Aim 2

In addition, the present research aims to determine the effectiveness of the ICAN program on asthma self-care, asthma-related QOL, asthma knowledge, coping, asthma health outcomes, and weight status.

Minority high school students with persistent asthma who are at risk for high BMI receiving the ICAN program should have significant improvements in asthma self-care, asthma-related QOL, asthma knowledge, coping, and weight status at two posttest periods compared to baseline.

Method

Study Design and Institutional Review Board Approval

The present research is a prospective intervention trial using pre-post test comparisons of one treatment group. The study was approved by the Loyola Institutional Review Board (IRB).

Table 1. Sample Characteristics at Baseline

Gender	Male 43.5%	Female 56.5%
	Mean	SD
Age	15.92	1.38
	Median	
Combined family income	\$30,000–\$39,000	
	Yes	No
Control of asthma (ACT)	66%	44%
Overweight/obese	36%	43%
Taking asthma meds	72%	20%
Asthma action plan	52%	40%
ER visit in past year	12%	84%
Hospital overnight in the past year	4%	92%
Secondhand smoke exposure	28%	68%
Flu vaccine in the past year	43.5%	56.5%
Recommended fruit intake ^a	17%	83%
Recommended vegetable intake	7%	93%
Recommended dairy intake	0%	100%
Recommended grain intake	67%	33%
Recommended meat or protein	38%	62%

Note. ACT = Asthma Control Test; ER = emergency room.

^a Based on recommendations of the Dietary Guidelines for Americans.

Recruitment

From two urban high schools, all students with asthma were invited to participate in the ICAN program. Recruitment strategies included announcements at parent meetings, electronic newsletters, daily announcements in school, packets distributed to students with asthma by school staff, flyers in the school, and distribution of information in the cafeteria for the first 3 weeks of the school year.

Screening and Enrollment

Inclusion criteria included (a) diagnosis of asthma by a physician, (b) asthma classification of mild, moderate, or severe persistent, (c) prescription medication for asthma, (d) enrollment in the 9th–12th grades at the participating school, and (e) ability to read and write English at the fourth grade level. Asthma diagnosis was ascertained by review of the student school record that included a physical examination report. Asthma severity was determined by parental report on the demographic survey. Exclusion criteria included (a) other chronic diseases such as diabetes, cancer, heart disease, psychological disorders, or chronic kidney disease or (b) current participation in another clinical trial. Obesity was not considered a chronic disease.

If a parent or student expressed interest in the study, the parent was contacted for screening and enrollment. Parent consents and student assents were obtained either at the school or at home. Permission to contact the student's primary care or clinic physician was included in the consent/assent. Initially 84 students were identified as potential participants based on an asthma diagnosis in school records. Of these, 52 were screened for study

participation based on interest. Of these, 26 students were enrolled in the ICAN pilot study. Most students who declined to enroll did so due to time conflicts with other school activities such as poetry club, choir practice, counseling sessions, or academic advising. During the first 4 weeks of the program, two students dropped from the study and one additional student was enrolled, leaving a final sample size of 25.

Participants and Setting

Twenty-five students (56.5% female and 43.5% male) completed the ICAN study at two high schools in the Chicago area. The average age was 15.92 (standard deviation [*SD*] = 1.38) years, and the students were African American (92%), Hispanic (4%), or mixed-race (4%). Of these participants, 44% were not in control of their asthma and 36% were overweight or obese. Detailed information regarding use of asthma medication, asthma action plan, and hospital visits is presented in Table 1.

ICAN Intervention Program

The ICAN program was developed as an adaptation of an intervention that was used in a randomized control trial with urban minority students with asthma (Velsor-Friedrich et al., 2012). The Teen Educational Asthma Management Program is composed of three elements: (1) asthma education; (2) CST; and (3) nurse practitioner-reinforcement visits (Velsor-Friedrich et al., 2012). In this study, 60% of the students ($n = 137$) were either overweight or obese. Due to the concerns of the increasing prevalence of both youth asthma and obesity, the authors added a nutrition component to the intervention so that it could address these comorbidities. The ICAN program is thus composed of four elements: (1) asthma education, (2) nutrition education synthesized with CST, targeting obesity prevention and management, (3) reinforcement visits with a registered nurse (RN) and dietetic intern, and (4) a family information meeting. To evaluate effectiveness, the original study protocol included treatment and control groups. However, the groups were found to be nonequivalent in relation to weight status. The protocol was adjusted to provide intervention delivery to both groups with evaluation of pre- and posttest outcomes.

The two asthma educational sessions covered content as described in the current asthma management protocols using the DVD game: *Quest for the Code* (Starlight Children's Foundation, 2011). *Quest for the Code*, an interactive, three-dimensional video that combines asthma education with rich graphics and top celebrities, was viewed by the students in groups during lunch periods. The second session included a review, discussion about the group's asthma symptoms, medications, management, and additional content from the "Fight Asthma Now" program developed by the Respiratory Health Association.

Planet Health is a school-based program developed by researchers from the Harvard School of Public Health. Target behaviors recommended in the evidence-based protocol of the Expert Committee regarding child and adolescent overweight and obesity provide the framework for this school-based obesity prevention program (Barlow and the Expert Committee, 2007; Carter, Weicha, Peterson, Nobrega, & Gortmaker, 2007). These included limiting the intake of sugar-sweetened beverages, encouraging the intake of fruits and vegetables, eating breakfast daily, limiting screen time, and lowering saturated fat content. The five weekly ICAN nutrition education sessions used resources from the Planet Health program. Each session included a focused nutrition lesson followed by introduction of a coping skill. Then interactive exercises were completed with students allowing them the opportunity to practice the coping skill with a nutrition scenario.

The CST strategies were used to reinforce nutrition information. CST is a cognitive behavioral strategy that teaches students personal and social coping skills to assist in making health-related decisions. It has been used successfully in youth with cardiac disease and diabetes (Grey, Boland, Davidson, Li, & Tamborlane, 2000; Grey et al., 2009; Srof et al., 2011). Beneficial effects of CST in a randomized pilot intervention of parents were lower BMI and percentage body fat, and improvements in stress management compared to those in the control group (Berry, Meikus, Savoye, & Grey, 2007). Specific coping skills included problem solving, clear communication, stress management, conflict resolution, and contingency management. A typical scenario involved using problem solving to select a beverage at a convenience store. Sessions included group problem-solving and role-play activities, which allowed opportunities to increase perceived competence and foster peer support for improved health choices.

In addition to the ICAN sessions offered at the school during lunch periods, electronic modules were developed and offered using Loyola Blackboard course software. These interactive modules encouraged students to seek resources and make decisions related to the target behaviors using existing Internet resources. Responses were posted to the Blackboard system, which allowed researchers to evaluate and provide feedback to the possible solutions as requested in the posted threads.

After a baseline data collection period, the ICAN intervention started with two asthma education sessions delivered by a nurse and then five nutrition and coping skill sessions delivered by a dietitian. All program delivery was completed during the student's lunch period. To maximizing time for program delivery, a healthy lunch was provided to students. Each session was approximately 45–60 min. Attendance records were maintained and one makeup session was held and attended by all students who missed any other session. A new blackboard module was posted weekly. The blackboard sessions were interactive and included scenarios using popular foods and products. An orientation to supplemental

blackboard modules was provided at the end of the first nutrition education session. Research assistants guided the participants in a hands-on practice session using computers that included use of their passwords to ensure access. Students were asked to complete the blackboard modules from home. Only 8% of students completed any of these. Students cited lack of time, school, and work demands as reasons.

After the core education sessions were completed, each student met with an RN and dietetic intern monthly for individualized reinforcement sessions about asthma and nutrition management for 2 months during lunch periods. These sessions provided individualized guidance to the student related to his or her specific goals for nutrition and asthma self-management. These included problem solving related to recent experiences with asthma or nutrition issues and additional asthma or nutrition education. The ICAN educational session covered an 8-week period including the makeup session. This was followed by two reinforcement visits. The total program length spanned 14 weeks.

Interventionists for program delivery and data collection were RNs, a dietitian, and dietetic interns. During the monthly reinforcement visits, the RN assessed the student's asthma health including current asthma medications, symptoms, emergency department, and/or hospitalizations visits. Students were asked to demonstrate inhaler and peak flow meter skills discussed in the asthma educational component. For the monthly reinforcement visits with the dietetic intern, students were asked to establish a behavioral goal. The dietetic intern reviewed progress on behavioral change, provided additional materials from Planet Health, established goals for the next month, provided additional family support materials, and discussed other relevant issues.

In order to gain family support for these behavior changes, two strategies were implemented. A family session was offered at each school and parent newsletters were sent home. At each family session, approximately 50% of families were represented with at least the ICAN participant and one parent. For approximately 25% of the families, a second parent and/or sibling also attended. A stepped compensation approach was used to maintain students in the study and to encourage data completion at all time periods. After completion of baseline data, students received a \$10 gift card. This amount was increased by \$5 at each data collection point. By the completion of the study, each participant received a total of \$70 value in gift cards. In addition, if a family came to the evening session, they received a \$20 gift card.

Outcome Measures and Instruments

Basic conditioning factors. The Parent Asthma Questionnaire (17 items) was used to measure basic conditioning factors such as age, gender, ethnicity, parents' highest level of education, family income, asthma symptoms, asthma-related hospital visits, and asthma medications. The survey was developed by the primary investigators and used in previous studies.

Self-care agency measures. Self-care agency was measured using the following five instruments: (1) Adolescent Coping scale (ACS), (2) Asthma Knowledge Test (AKT), (3) Asthma Self-Belief scale (ABS), (4) Student Food Knowledge Questionnaire (SFNQ), and (5) the Nutrition Self-Efficacy: Eating Fruits and Vegetables (E), and Nutrition Self-Efficacy: Eating, Asking and Preparing Fruits and Vegetables (EAP) surveys.

The ACS (short form) was used to assess coping abilities. The ACS is an 18-item, self-report inventory that examines the extent to which adolescents cope in different circumstances on a scale of 1 (not at all) to 5 (very much). Items are rated using a 5-point Likert-type scale. Reliability for this measure was acceptable at baseline ($\alpha = .75$), first posttest ($\alpha = .83$), and second posttest ($\alpha = .89$; Velsor-Friedrich et al., 2012).

The AKT (Tell us about your asthma) was used to assess asthma knowledge. This 25-item test measures knowledge specific to asthma with an overall score of 0 – 25 correct responses obtained (Talabere, 1990; Talabere & Velsor-Friedrich, 1995). Previous research demonstrates this measure is reliable ($\alpha = .80$; Velsor-Friedrich et al., 2012).

The ABS was used to measure self-care capabilities related to self-efficacy or beliefs regarding level of confidence in managing asthma (Velsor-Friedrich, Pigott, Srof, & Froman, 2004). The construct focuses on one's perceived ability to manage illness. The 15 items are rated on a 5-point scale from "I can do this" to "I cannot do this," with high scores indicating greater self-efficacy. Reliability for this measure was not acceptable at baseline ($\alpha = .62$) but was at the first posttest ($\alpha = .78$) and second posttest ($\alpha = .75$).

The SFNQ was adapted from a longer version of the US Department of Agriculture (USDA) Team Nutrition SFNQ to assess nutrition knowledge. Specific items were adapted from national surveys including the CDC Youth Risk Behavioral Surveillance Survey and the USDA Diet and Health Knowledge Survey for adults. Content validity was established by experts in nutrition and education (Murimi, Colvin, Liner, & Guin, 2006). The survey used for the ICAN project included 17 items that asked about food and the certain connections between food components to health.

Two surveys, Nutrition Self-Efficacy: Eating Fruits and Vegetables (E) and Nutrition Self-Efficacy: EAP, were used to assess diet-related self-care agency. The first nutrition self-efficacy survey included 14 items about requesting and preparing fruits and vegetables. Reliability for this measure was acceptable at baseline ($\alpha = .83$) and second posttest ($\alpha = .85$). The second nutrition self-efficacy survey included 17 items asking about one's ability to eat more fruits and vegetables at different meals or times of the day. The surveys have been adapted from validate tools and used to assess school-based interventions (Baranowski et al., 2000; Reynolds, Yaroch, Franklin, & Maloy, 2002a, 2002b). Reliability for this measure was acceptable at baseline ($\alpha = .88$), first posttest ($\alpha = .89$), and second posttest ($\alpha = .93$).

Self-care measures. Self-care was measured using the following measures: (1) the Asthma Self-Care Practice Instrument, (2) Pediatric Asthma Quality of Life, (3) asthma health outcomes, (4) nutrition self-care behaviors including consumption of fruits and vegetables, breakfast, sugar-sweetened beverages, and screen time, and (5) nutrition health outcomes.

The Asthma Self-Care Practice Instrument was used to assess asthma self-care (Fitzpatrick & Frey, 1993). This 21-item scale measures asthma self-care practices on a range of 0% to 100% of the time. Content validity was established by a panel of physician and nurse experts in pediatric asthma. Reliabilities for this measure were acceptable at baseline ($\alpha = .85$), first posttest ($\alpha = .83$), and second posttest ($\alpha = .89$). Total scale α s in the previous studies ranged from .87 to .89 in previous studies (Velsor-Friedrich et al., 2012).

Health outcome measures. Asthma health outcome was measured with the Asthma Control Test. It is a 5-item instrument that measures the frequency and severity of asthma symptoms over the past 4 weeks (Nathan, Sorknes, & Kosinski, 2004). It is recognized by the National Institutes of Health and is clinically validated by specialist assessment and spirometry (Nathan et al., 2004). In addition, information related to asthma symptoms, asthma-related emergency department visits/hospitalizations and school absences were collected at baseline and both posttest periods.

Pediatric Asthma Quality of Life Questionnaire is a 23-item, 7-point tool measuring both physiological and emotional impairments experienced by those aged 7 to 17 years (Juniper et al., 1996). Construct validity demonstrated strong relationships with control of asthma and medication requirements. Cross-sectional correlations reveal strong relationships between asthma control and QOL. The correlation coefficient was .92 and the test-retest reliability for this measure was high.

Nutrition self-care behaviors were measured using the Automated Self-Administered 24-hour Recall (ASA24). This new web-based method of recording diet intake was developed by the National Cancer Institute (ASA24, 2009; Subar et al., 2010). It is based on the USDA's Automated Multiple-Pass Method that has been validated for selected nutrients (Moshfegh et al., 2008; Thompson, 2010). The tool has acceptable face validity for calories, nutrients, and food group estimates consistent with data from the NHANES (ASA24, 2009). Students completed the 24-hour dietary recall using this computer-assisted method in the classroom during the three data collection time periods.

Nutrition health outcomes were assessed using the BMI which was calculated based on measurements of the student's height and weight according to defined procedures specific to children in school settings. This included use of a scale and stadiometer, removal of shoes, outer apparel,

accessories, and care regarding confidentiality (Ikeda & Crawford, 2000). Weight status was assessed using CDC growth charts and protocol (CDC, 2009). Data were collected at baseline, week 8 (first posttest), and 14 (second posttest). Students completed all of the instruments in a group setting over a period of two 45-minute sessions during lunch periods. These were distinct dates that were not included as part of the ICAN educational sessions. Other than ASA24, students completed paper surveys by hand.

Data Analysis

Data entry, cleaning, screening of the data, and descriptive statistic summary were completed by research associates who were trained and supervised by the team statistician. The data were entered and analyzed using SPSS 17.

Results

Descriptive Statistics

Descriptive statistics for baseline sample characteristics are presented in Table 1. As expected, a majority of students did not meet recommendations of the Dietary Guidelines for Americans (USDA, 2010) for fruit, vegetable, dairy, grain, and meat/protein food groups at baseline. None of the students consumed the recommended servings of the five food groups based on the Dietary Guidelines. Four students (16.7%) met the recommended intake for three food groups. Approximately 20% students did not meet any of the recommended intakes for any of the food groups. In addition, 44% were not in control of their asthma and 36% were obese or overweight.

Correlations Among Study Outcomes

Initially, correlation analyses were conducted to examine the relations among study variables at each time point. This analysis was conducted to provide the initial rationale for considering nutrition and asthma outcomes together (see Table 2). Results indicated that at baseline, nutrition self-efficacy (EAP) was positively associated with asthma self-efficacy ($r = .42, p < .05$) and nutrition self-efficacy (E; $r = .62, p < .01$) but was negatively associated with asthma knowledge ($r = -.42, p < .05$). At baseline, asthma self-efficacy was also positively associated with asthma self-care ($r = .61, p < .01$) and asthma QOL ($r = .42, p < .05$). Nutrition self-efficacy (E) was negatively associated with sugar-sweetened beverage intake ($r = -.51, p < .05$) and screen time was positively associated with fruit intake ($r = .54, p < .05$).

At the first posttest, nutrition self-efficacy (EAP) was positively associated with asthma self-care ($r = .46, p < .05$), asthma self-efficacy was positively associated with asthma self-care ($r = .52, p < .05$), asthma knowledge was negatively associated with sugar-sweetened beverage intake ($r = -.72, p < .01$), and fruit intake was positively

associated with vegetable intake ($r = .59, p < .05$). However, asthma self-efficacy was negatively associated with vegetable intake ($r = -.48, p < .05$).

At the conclusion of the study (the second posttest), coping was positively associated with fruit intake ($r = -.71, p < .01$), nutrition self-efficacy (EAP) was positively associated with asthma self-efficacy ($r = .49, p < .05$) and asthma self-care ($r = .52, p < .05$), nutrition knowledge was positively associated with asthma self-care ($r = .48, p < .05$) and asthma QOL ($r = .49, p < .05$). In addition, asthma self-care was positively associated with asthma QOL ($r = .44, p < .05$) and vegetable intake ($r = .48, p < .05$) and nutrition self-efficacy was negatively associated with sugar-sweetened beverage intake ($r = -.66, p < .05$).

Taken together, these initial correlational findings suggest that there is an important connection between nutrition and asthma. More specifically, proper nutrition self-efficacy and knowledge is associated with increased self-care and QOL for those with asthma. These correlational effects do not, however, provide evidence that nutrition and asthma outcomes improved over the course of the ICAN study. As such, additional analyses were conducted to shed light on positive change in outcomes over time.

ICAN Intervention Effectiveness

Inferential tests examining change over time using contrasts in repeated-measures analysis of variance (ANOVA) were conducted to determine potential effectiveness of the ICAN program. Repeated-measures ANOVA allows for examination of omnibus differences in study outcomes over the course of the study. Therefore, overall mean differences over time were first examined and, if significant, contrasts examining specific mean differences (i.e., improvement in study outcomes) from baseline to each time point were carried out. Means for study outcomes at each time point are presented in Table 3. Results indicated significant mean differences over the course of the study for asthma self-efficacy, $F(2, 42) = 19.53, p < .001$, nutrition knowledge, $F(2, 44) = 11.93, p < .001$, nutrition self-efficacy (EAP), $F(2, 42) = 27.67, p < .001$, asthma self-care, $F(2, 42) = 3.21, p = .05$, and asthma QOL, $F(2, 44) = 3.37, p < .05$.

Contrasts in repeated-measures ANOVA were conducted to examine the nature of the mean differences over the course of the study—specifically to determine whether outcomes improved at the first and second posttest. Change from the first to second posttest was not examined (a) because there was no theoretical rationale for expecting such a change and (b) to control for the number of statistical analyses (limiting type I error rate).

As hypothesized, results indicated a significant increase in asthma self-efficacy from baseline to the first posttest, mean difference = .42, $SE = .08, p < .001$, and from baseline to the second posttest, mean difference = .50, $SE = .10, p < .001$.

Table 2. Correlations Among Study Outcome Variables at Baseline, First Posttest, and Second Posttest

Outcome	1	2	3	4	5	6	7	8	9	10	11	12
1) BL_Coping	1											
2) BL_AstKnow	-.13	1										
3) BL_AstSelf-eff	.02	-.18	1									
4) BL_NutKnow	-.04	.39	.10	1								
5) BL_Nut SE(EAP)	.17	-.42*	.42*	.30	1							
6) BL_Nut SE (E)	.01	-.31	.16	.25	.62**	1						
7) BL_AstSelf-care	.14	-.15	.61**	.23	.38	-.03	1					
8) BL_AstQOL	-.32	.27	.42*	.30	-.16	-.12	.18	1				
9) BL_FruitIntake	.03	-.02	.10	.27	.34	-.07	.27	-.12	1			
10) BL_VegIntake	.04	-.02	-.23	.30	-.15	-.15	-.20	.18	.01	1		
11) BL_SSB	.27	.23	.15	.20	-.21	-.51*	.37	-.16	.37	.12	1	
12) BL_ScreenTime	-.15	-.17	.00	-.13	.24	.09	.17	-.31	.54*	-.18	.24	1

Note. SSB = sugar-sweetened beverage intake.

Asterisks denote significant correlation, * $p < .05$. ** $p < .01$. *** $p < .001$.

Outcome	1	2	3	4	5	6	7	8	9	10	11	12
1) T1_Coping	1											
2) T1_AstKnow	.16	1										
3) T1_AstSelf-eff	-.14	.34	1									
4) T1_NutKnow	.00	-.34	.10	1								
5) T1_Nut SE(EAP)	-.23	.33	.31	-.24	1							
6) T1_Nut SE (E)	.04	.17	.25	.30	.54	1						
7) T1_AstSelfcare	-.32	.07	.52*	-.03	.46*	.25	1					
8) T1_AstQOL	-.25	-.19	-.30	.16	.26	-.15	-.02	1				
9) T1_FruitIntake	.06	-.24	.03	.32	-.32	-.30	-.13	-.22	1			
10) T1_VegIntake	.40	-.25	-.48*	.15	-.25	-.36	-.10	.11	.36	1		
11) T1_SSB	-.09	-.72**	.02	.59**	-.43	.03	-.15	-.03	.59*	.19	1	
12) T1_ScreenTime	.29	-.09	.27	-.35	-.54	-.46	.26	.42	-.18	.36	-.70	1

Asterisks denote significant correlation, * $p < .05$. ** $p < .01$. *** $p < .001$.

Outcome	1	2	3	4	5	6	7	8	9	10	11	12
1) T2_Coping	1											
2) T2_AstKnow	.13	1										
3) T2_AstSelf-efficacy	-.08	.05	1									
4) T2_NutKnow	.40	.36	.24	1								
5) T2_Nut SE(EAP)	.37	-.01	.49*	.24	1							
6) T2_Nut SE (E)	.16	.14	.24	.18	.65**	1						
7) T2_AstSelfcare	.07	.14	.52*	.48*	.32	.18	1					
8) T2_AstQOL	.00	.16	-.04	.49*	-.20	-.33	.44*	1				
9) T2_FruitIntake	.71**	.18	.00	.43	.38	.33	.16	.23	1			
10) T2_VegIntake	.14	-.08	.39	.32	.33	.03	.48*	.13	-.04	1		
11) T2_SSB	-.43	.00	.55	.02	-.09	-.66*	.42	.28	-.49	.27	1	
12) T2_ScreenTime	-.20	-.16	.26	.09	-.12	-.33	.06	-.04	-.32	.22	.05	1

Asterisks denote significant correlation, * $p < .05$. ** $p < .01$. *** $p < .001$.

Similar results were found with nutrition knowledge from baseline to the first posttest, mean difference = .149, $SE = .70$, $p < .05$, and from baseline to the second posttest, mean difference = 3.22, $SE = .61$, $p < .001$; with nutrition self-efficacy (EAP) from baseline to the first posttest, mean difference = 1.34, $SE = .24$, $p < .001$, and from baseline to the second posttest, mean difference = .15, $SE = .08$, $p = .05$; with asthma self-care from baseline to the first posttest, mean difference = 7.26, $SE = 3.53$, $p = .05$, and from

baseline to the second posttest, mean difference = 8.47, $SE = 4.20$, $p = .05$; with asthma QOL from baseline to the second posttest, mean difference = .58, $SE = .24$, $p < .05$. Perhaps most importantly, a chi-square analysis indicated the percentage of students who were in control of their asthma had improved from 56% at baseline to 76% at the second posttest, $\chi^2(1) = 5.25$, $p < .05$.

Contrary to hypotheses, no significant mean differences were observed in asthma knowledge, $F(2, 44) =$

Table 3. Descriptive Statistics for Study Outcomes at Baseline, First Posttest, and Second Posttest

	Baseline	1st Posttest	2nd Posttest
Outcome variable	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Coping	3.54 (0.47)	3.33 (0.48)	4.86 (2.73)
Asthma knowledge	22.56 (1.76)	21.52 (3.93)	23.09 (1.59)
Asthma self-efficacy	4.04 (0.47)	4.43 (0.46)	4.51 (0.38)
Nutrition knowledge	13.32 (3.76)	15.09 (3.12)	16.83 (2.33)
Nutrition self-efficacy (EAP)	2.43 (0.36)	3.72 (1.16)	2.55 (0.39)
Nutrition self-efficacy (E)	3.85 (0.80)	4.07 (0.84)	4.18 (0.80)
Asthma self-care (%)	59.49 (16.97)	67.03 (16.70)	68.11 (17.92)
Asthma quality of life	5.15 (0.99)	5.46 (1.11)	5.77 (0.97)
Fruit intake (cups)	1.13 (1.74)	0.88(1.04)	1.19 (1.34)
Vegetable intake (cups)	1.14 (0.79)	1.07 (0.85)	0.83 (0.96)
Breakfast (%)	64%	72%	68%
Sugar-sweetened beverage intake (oz)	14.52 (18.29)	13.88 (12.58)	8.00 (8.22)
TV screen time (hours)	1.59 (1.18)	2.43 (2.30)	1.73 (1.58)
Asthma control test (ACT)	3.78 (0.92)	3.94 (0.68)	4.07 (0.84)

Note. Means reflect total sample means and SDs and do not account for missing data omitted in analysis when full data were not present at each time point.

2.43, $p = .09$, asthma coping, $F(2, 44) = 1.27$, $p = .29$, fruit intake, $F(2, 30) = 0.79$, $p = .46$, vegetable intake, $F(2, 30) = 1.22$, $p = .31$, sugar-sweetened beverages, $F(2, 30) = 0.17$, $p = .85$, or screen time, $F(2, 8) = 2.09$, $p = .18$. As such, contrasts examining specific change from baseline to the first and second posttest were not conducted.

ICAN Dosage Effects

Because correlational and time effects cannot be confidently attributed solely to the effectiveness of the intervention without a randomized control group, dosage analyses taking into account number of ICAN sessions attended were also conducted using multiple regression. There was limited variability in attendance, with 66% of students attending at least four out of five treatment sessions and numerous confounding factors (e.g., stability, original skill level at chronic illness management) were present. Even so, results from the regression analyses indicated that increased ICAN dosage was significantly predictive of increased asthma QOL at the first, $b = .61$, $SE = .27$, $p < .05$, and second posttest, $b = .55$, $SE = .24$, $p < .05$; however, ICAN dosage was not predictive of any other study outcome. These findings suggest a limited role of level of exposure to the ICAN program, although important limitations to this approach are discussed below.

Discussion

Second to their home, youth spend the largest portion of their day at school. The CDC recommends that schools, families, and health care providers work together to assist high school students in managing their asthma by providing health services and education (CDC, 2005). If a student's asthma is well managed, there will be less impact on school absences and productivity. Although the sample size was

limited, significant increases in asthma knowledge, asthma self-efficacy, asthma QOL, asthma self-care, asthma control, as well as nutrition knowledge were noted over the course of the pilot test. In addition, the percentage of students who were in control of their asthma significantly increased over the course of the program from 56% to 76%.

These findings are consistent with the literature. For example, participation in an asthma education program resulted in positive asthma health outcomes (Burkhart, Rayens, & Oakley, 2011; Everhard & Flese, 2009). In addition, significant predictors of higher asthma-related QOL included better rating of overall health, lower depressive symptoms, and a decrease in asthma severity (Burkhart, Svavarsdottir, Rayens, Oakley, & Orlygsdottir, 2008).

Over the last 20 years, school-based asthma education and management programs have resulted in positive psychosocial and health outcomes (Blandon et al., 2004; Bruzzese et al., 2008; Srof et al., 2011). However, none of these programs have included nutrition education.

Similar to recommendations for asthma management, expert organizations have recommended that nutrition be incorporated into school curriculum and be focused on specific target behaviors for health and academic performance (Briggs, Mueller, & Fleischhacker, 2010). The ICAN program addressed these needs using the successful Planet Health (Gortmaker, Petersen, & Wiecha, 1999) and targeted evidence-based, obesity prevention behaviors (Barlow et al., 2007). Consistent with other high school nutrition interventions, the ICAN participants improved in nutrition knowledge (Chen et al., 2011; Melnyk et al., 2009), improved self-efficacy for fruit and vegetable intake (Werch et al., 2011), and reduced sugar-sweetened beverage intake (Contento, Koch, Lee, & Calabrese-Barton, 2010). These improvements are considered to be important mediators in promoting optimal dietary patterns (Thompson, Bachman, Baranowski, & Cullen, 2007). Significant changes were not

found in fruit and vegetable or breakfast consumption, screen time, or weight from ICAN participation. The effect of school-based nutrition programs on fruit and vegetable intake is varied (Gortmaker et al., 1999) and difficulty in achieving this outcome in adolescents has been reported (Contento et al., 2010). Fewer meals eaten at home combined with greater influence of peers are contributing factors for adolescents (Cutler, Flood, & Neumark-Sztainer, 2011; Granner & Evans, 2011). This highlights the important role of school interventions as they may intervene on both personal and environmental factors. ICAN baseline data were collected in early September when produce is more abundant at a lower cost, and farmer's markets were open in the neighborhoods of the ICAN schools than in December when final ICAN data were collected, making seasonal influences of this finding possible. A strong body of research demonstrates a dose-response relationship between sugar-sweetened beverage intake and adiposity (Malik, Schulze, & Hu, 2006; Vartanian, Schwartz, & Brownell, 2007), metabolic syndrome, type 2 diabetes, and inadequate nutrient intakes (Schulze et al., 2004) in youth.

Overall ANOVA analysis did not indicate a significant omnibus decrease in sugar-sweetened beverage intake. However, individual contrasts in ANOVA did identify a significant decrease from baseline to the second posttest. This suggests that if repeated in a larger sample and/or for a longer period of time, the ICAN program should continue to focus on sugar-sweetened beverage intake reduction. This may be the first of the dietary behaviors amenable to change in this target population. Contento, Koch, Lee, and Calabrese-Barton (2010) reported a significant decreased in sugar-sweetened beverage intake by urban teens in a school-based program ($p < .001$). This may be an easier dietary behavior to change than fruit and vegetable intake as alternative beverages, such as water or diet soda, are often readily available at the same cost.

Regular breakfast consumption is a protective factor against obesity during adolescence (Deshmukh-Taskar et al., 2010). Table 2 shows a trend toward increased breakfast intake from ICAN participation. Studies have reported improved breakfast patterns resulting from school programs in adolescent girls (Bayne-Smith et al., 2004; Flattum, Friend, Story, & Neumark-Sztainer, 2011). Regular breakfast consumption was a common goal because it was perceived as achievable (Flattum et al., 2011). The trend in breakfast intake in the ICAN pilot was encouraging though not significant, which may be due to small sample or program length.

Success in school-based obesity programs based on BMI percentile has been reported (Bayne-Smith et al., 2004; Khambalia, Dickinson, Hardy, Gill, & Baur, 2012). Due to the pilot nature of the ICAN project and heterogeneity in weight status of participants, significant BMI changes were not expected or observed. This challenge has been reported in other school-based weight management programs (Neumark-Sztainer et al., 2010).

The ICAN pilot project is unique in that it is the first to implement and report on a school-based project in adolescents with asthma, which included information related to healthy weight through dietary behaviors. Positive results included change in intermediate factors related to dietary behaviors reported in other school-based obesity interventions such as nutrition knowledge and nutrition self-efficacy (vanStralen et al., 2011). Program participation remained stable at 92.6% (25 of 27) after baseline data were collected and the intervention started. All participants remained active in the program to its conclusion, which demonstrates high retention.

Implications for School Nursing

School nurses have a unique potential for frequent contact with students. This potential places them in an ideal position for helping students to maintain a healthy weight and to achieve better asthma outcomes. School nurses should help to implement programs such as the ICAN program that provide education about asthma management and healthy nutrition. By implementing such programs, students will likely improve their abilities to maintain optimal health as well as experience increased QOL. School nurses work with the same students over the course of several years, enhancing their ability to build trust and to be effective with students and their families. By using technology such as the "Quest for the Code" and the ASA24 Recall, school nurses may see an increased interest among the participants with whom they work. In addition, school nurses should collaborate with registered dietitians, organizations such as the American Lung Association, and other community resources that address the conditions of asthma and pediatric obesity.

Limitations and Recommendations

This pilot study used a nonrandomized one group pre-/post-test design. To address this shortcoming, dosage analysis taking into account ICAN session attendance was conducted. However, other factors like characteristics of students or their families could have influenced these findings. For example, dosage may not have yielded stronger effects because those who attended the ICAN program already had more family support at home or better ability to manage their chronic illness. Without taking into account these factors, it is difficult to draw conclusions from the dosage analysis. Despite carrying out the program at lunch time, the ICAN program also competed against activities occurring during this time (e.g., debate team, honor society, choir rehearsals, field trips, and suspensions). Meetings with a school counselor related to behavior or scholarships conflicted with sessions, and many students relied on this time for homework or to study for tests. This limited recruitment and challenged participation for those enrolled. These factors all contributed to extraneous variability that limits the ability to draw stronger conclusions about the effectiveness

of the ICAN pilot program, especially with such a small sample size.

To address these limitations, future research should implement a randomized experimental design with a larger sample size. Randomization to treatment and control groups evenly disperses factors that may mask treatment effects and provides added ability to show differential change over time. A larger sample size could provide the statistical ability to find effects where present. Future directions may include collaborations with a larger school district for increased sample size and use of popular handheld technological devices to facilitate data collection.

Conclusions

Due to its dramatic rise, asthma has become a significant public health concern, particularly in minority adolescent populations. Youth with asthma are at risk for poor control of this life-threatening disease due to social and environmental stressors as well as the potential comorbidity of high BMI. Although prior studies have demonstrated the significant impact of asthma programs in the school-aged population, there are no such programs that include nutrition and weight management together with asthma. This pilot study addressed this need by implementing a school-based program to improve nutrition knowledge, dietary behaviors, and asthma outcomes in minority adolescents at risk for obesity. The combination of asthma and nutrition education with CST and RN/dietetic intern reinforcements can lay the groundwork for a transition from parent-managed care to self-care. Given the acceptability of the program with its promising outcomes, future research will be conducted in a larger sample for extended periods.

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