Brief Report: Factors Associated with Asthma Management Self-Efficacy Among 7th and 8th Grade Students

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Objective Examine correlates of asthma self-management among 12,154 adolescents with physician-diagnosed asthma. **Methods** All 7th and 8th grade students in North Carolina completed a survey to assess asthma prevalence and self-management behaviors among those with asthma. **Results** Adolescents who were allowed to carry their inhaled medication at school, shown how to use a peak flow meter, and had access to more asthma care resources were more confident that they could prevent an asthma exacerbation. Adolescents who were allowed to carry their inhaled medication at school and who had a private doctor were more confident that they could control their symptoms. Adolescents taking anti-inflammatory medicine were less confident that they could prevent an exacerbation and control their symptoms. **Conclusions** Various indicators of autonomy and control were associated with greater self-efficacy for managing asthma. Adolescents who require anti-inflammatory medicines would benefit from additional intervention efforts to improve their asthma management self-efficacy.

Key words adolescents; asthma; self-efficacy; self-management.

Introduction

The developmental period between childhood and adolescence involves numerous social, cognitive, and physiological changes, including gaining autonomy from parents and developing cognitive capacities (Furstenberg, 2000). Asthma is most often diagnosed during childhood, when parents have primary control over disease regulation (Van Es et al., 1998). Although parents remain an important source of social support (van Dellen, Stronks, Bindels, Öry, & van Aalderen, 2008), as a child with asthma ages, management responsibilities are often shifted from the parent to the adolescent (Ayala et al., 2006; McQuaid et al., 2001). Research has suggested that adolescents who assume disease management responsibility without a sufficient level of developmental readiness have poorer adherence than adolescents who are developmentally ready to manage their disease (Walders, Drotar, & Kercsmar, 2000). Moreover, adolescents are generally less adherent than children (Bender et al., 2000; McQuaid, Kopel, Klein, & Fritz, 2003).

Self-efficacy, or one's confidence for success in a given situation, is an important determinant of initiation and maintenance of behavior change (Bandura, 1986). As a core construct in Social Cognitive Theory, self-efficacy is influenced by a number of factors including opportunities to learn and practice a behavior, observing others engaging in the behavior, and the perceived consequences associated with that behavior. Among youth, higher levels of self-efficacy are associated with using more asthma management strategies (Clark & Valerio, 2003) and with being more adherent (van Dellen et al., 2008), making it an important target for behavioral interventions. This is further supported by a recent review which determined that among six studies that assessed changes in self-efficacy, four achieved significant improvements in self-efficacy (Wolf, Guevara, & Grum, 2003). Thus, self-efficacy is a potentially

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Journal of Pediatric Psychology 34(8) pp. 862–868, 2009
doi:10.1093/jpepsy/jsn134
Advance Access publication February 11, 2009

modifiable determinant associated with asthma management and adherence.

The purpose of this study was to identify behavioral factors associated with asthma management self-efficacy that could be targeted in future interventions. Self-efficacy was defined as the degree of confidence in preventing an asthma exacerbation at school and in using an inhaler at school. It was hypothesized that adolescents who have access to their asthma medication, who report receiving some instruction on how to engage in management behaviors, and who are less forgetful about taking their medication, would report greater self-efficacy for managing their asthma. Analyses controlled for potential confounders including age, gender, socio-economic status, race/ethnicity, asthma symptoms, and source of health care (Baranowski, Perry, & Parcel, 2002).

Methods

Study Design

This study represents a secondary data analysis of data obtained from the North Carolina School Asthma Study (NCSAS), a large population-based cross-sectional study designed to evaluate the respiratory health of all 7th and 8th grade public school students (Yeatts, Shy, Sotir, Music, & Herget, 2003). NCSAS was a collaborative effort of the NC Department of Health and Human Services, the NC Department of Public Instruction, and the Department of Epidemiology at UNC at Chapel Hill.

Participants

The target population was enumerated from 1999 to 2000 enrollment records kept by the NC Dept. of Public Instruction and included 565 public schools with 192,248 adolescents in the 7th and 8th grades. The final response rate was 67% (128,568/192,248). Of the 128,568 students who filled out questionnaires, 5739 (4.4%) had more than 20% of data missing on the asthma questions (see ISAAC below) and thus were excluded from analyses.

Study participants consisted of 7th and 8th graders who self-reported physician-diagnosed asthma on the NCSAS ($N = 12{,}174$, or 9.46% of the total sample). Students reported a median age of 13 years, half were female, and almost 40% were enrolled in the free and reduced price school lunch program. The racial/ethnic breakdown was approximately 50% Caucasian, 30% African American, 9.7% Latino/Hispanic, 2.8% Native American, and 7.5% other race. In terms of asthma-related characteristics, 63% reported use of a bronchodilator and 36% reported receiving their usual source of health care from a private doctor. On average, they reported experiencing only one asthma symptom in the past month and approximately two symptom-related functional consequences in the past year (Table I).

Procedures

In December 1999, questionnaires were mailed to the 565 public school principals. The 30 min survey was administered in each school by designated school personnel during homeroom, science class, or physical education class. A waiver of active informed consent was approved by the NC State Health Department and UNC's School of Public Health Institutional Review Board, as the data were anonymous and to be used primarily for public health surveillance. To standardize survey administration and to facilitate completion among students with reading difficulties, the entire survey was administered via videotape that included a narrator who read each question aloud one at a time and emphasized which questions could be skipped if they were not applicable to the respondent. Students were instructed to complete the survey on their own by filling in bubbles to indicate their responses to 66 questions. All questionnaires were administered and completed by June 2000. To ensure high quality data, questionnaires were checked for missing data.

Measures

The survey was adapted from the International Survey of Asthma and Allergies in Childhood (ISAAC, 1998) and included additional questions regarding health care utilization and demographic information. The primary outcome variables were: confidence in preventing an asthma exacerbation at school and confidence in using an inhaler at school. Both variables were measured using one question each with a Likert-type response option ranging from 0 = not at all confident to 4 = very confident. A composite score was created by collapsing responses across the two questions and creating a mean self-efficacy score ($\alpha = .64$).

The primary independent variables consisted of single item questions on whether the adolescent was allowed to carry his/her asthma inhaler at school (0 = no, 1 = yes), whether the adolescent had been shown how to use a peak flow meter (0 = no, 1 = yes), level of access to asthma resources (0 = no asthma action plan or access to rescue inhaler, 1 = have access to rescue inhaler, or 2 = have asthma action plan and access to rescue inhaler), and whether they had ever forgotten to take inhaled medication during the past year (0 = no, 1 = yes). Additional asthma care items included type of inhaler used (1 = bronchodilator or 2 = anti-inflammatory) and how

Table I. Descriptive statistics on participant asthma-related characteristics and differences by ethnicity

	Total sample	Caucasian	African American	Hispanic	Native American	Other
Mean behavioral confidence in managing asthma (95% CI)						
Confidence to prevent asthma exacerbation	2.76 (2.73–2.79)	2.80 (2.77–2.84)	2.78 (2.72–2.83)	2.52 (2.42–2.62)[a]	2.45 (2.25–2.65)[a]	2.78 (2.66–2.89)
Confidence to use an inhaler at school	2.87 (2.85–2.90)	2.89 (2.85–2.92)	2.97 (2.92–3.02)	2.58 (2.48–2.68)[a]	2.47 (2.25–2.68)[a]	2.94 (2.82–3.05)
Overall confidence score	2.82 (2.79–2.84)	2.84 (2.81–2.87)	2.87 (2.82–2.91)	2.55 (2.47–2.64)[a]	2.45 (2.28–2.62)[a]	2.87 (2.77–2.97)
Mean asthma symptoms and consequences (*SD*)						
Mean number of asthma symptoms in past month	1.04 (1.02–1.06)	0.92 (0.89–0.95)	1.18 (1.14–1.23)[a]	1.26 (1.17–1.35)[a]	1.21 (1.05–1.37)[a]	1.13 (1.03–1.23)[a]
Mean number of functional consequences in past yr	2.20 (2.17–2.23)	1.97 (1.94–2.01)	2.48 (2.43–2.54)[a]	2.51 (2.40–2.61)[a]	2.48 (2.29–2.68)[a]	2.45 (2.33–2.58)[a]
Access to asthma care resources						
Percentage allowed to carry medicine at school	71% (6613)	72%	73%	62%[a]	67%[b]	67%[b]
Percentage shown how to use a peak flow meter	53% (5058)	52%	55%	54%	51%	56%
Have action plan and access to rescue inhaler	32% (1986)	29%	37%[a]	37%[a]	34%[a]	33%[a]
Asthma management						
Percentage on an anti-inflammatory	37% (3050)	36%	36%	40%[b]	43%[b]	42%[b]
Percentage ever forgotten to take medicine	62% (2664)	62%	61%	67%	68%	60%
Percentage use a peak flow meter at least once a week	26% (2580)	23%	29%[a]	31%[a]	30%[a]	27%[b]

0 = not at all confident to 4 = very confident. Denominator varies due to missing data.

[a]Notation denotes significant differences between indicated ethnic group compared with Caucasians (reference group) at $p < .001$.

[b]Notation denotes significant differences between indicated ethnic group compared with Caucasians (reference group) at $p < .05$.

often they used a peak flow meter (0 = no, do not use or 1 = yes, use 1 time per week or more).

Potential confounders included asthma symptoms, usual source of care, and demographic characteristics. Asthma symptoms were assessed using the internationally validated ISAAC video questionnaire. This method of administration was found to be feasible for statewide surveillance (Yeatts & Shy, 2001). Clinicians have rigorously validated the ISAAC (specificity of .87, sensitivity of .75) (Fuso et al., 2000; Gibson et al., 2000; Shaw et al., 1992) and found that it is more reliable than measures of bronchial hyperresponsiveness when compared with physician diagnosis of asthma as a gold standard (Jenkins et al., 1996; Pearce, Pekkanen, & Beasley, 2000; Renzoni et al., 1999). In a validation study of the ISAAC questionnaire, Renzoni reported a 73.3% agreement rate between parents and adolescents reporting physician-diagnosed asthma (Renzoni et al., 1999). Research has shown that parents underestimate the presence of wheezing in their adolescent children and recommend obtaining information directly from adolescents for a correct evaluation of respiratory symptoms (Braun-Fahrlander et al., 1998; Renzoni et al., 1999). In the ISAAC, adolescents were shown five scenes of an adolescent wheezing and asked to indicate how many of these wheezing symptoms they had experienced in the last month: (i) at rest during the day; (ii) after exercise; (iii) waking at night; (iv) a severe attack with intercostal retractions; and (v) waking at night by cough. Number of asthma symptoms was used as an indicator of disease severity, with a higher number indicating more severe asthma. Students were asked about their usual source of health care using a closed-ended question with the following response options: emergency room, hospital, public health clinic, private doctor, no usual source, other, or don't know. These responses were collapsed into two categories: 1 = private doctor versus 2 = public health clinic/ER/hospital/other/no usual source/don't know, based on observed differences in hospitalization rates such that adolescents using public health clinics were more likely to report a hospitalization compared with those who received care from a private doctor.

Demographic questions included the adolescent's age, gender, socioeconomic status (SES), race/ethnicity, and self-rated health. SES was estimated based on self-reported enrollment in the free and reduced price school lunch program. Two questions assessed race and ethnicity. General self-rated health, as assessed on the Behavioral Risk Factor Surveillance System (CDC, 2005), was measured using one item with a 5-point response option from 1 = poor to 5 = excellent.

Finally, functional consequence of asthma was a summary score based on experiencing one or more of the following limitations in the past year: activity, missed school days, unplanned doctor visits, emergency room visits, and hospital admissions. This variable was used to examine the clinical significance of the self-efficacy scores.

Data Analyses

Analyses were conducted using SAS software, Version 8.01. Descriptive univariate statistics were calculated, followed by unadjusted bivariate analyses. Ethnic group differences were examined using one-way ANOVAs with Bonferroni adjustment to control for Type I error when examining differences between Caucasians and each ethnic group. To test the primary hypothesis, multivariate linear regressions were used adjusting for potential confounders. The primary outcome variables were confidence in preventing an asthma exacerbation at school, confidence in using an inhaler at school, and an overall composite score. The primary independent variables were entered simultaneously: allowed to carry inhaler at school, level of access to asthma resources, shown how to use a peak flow meter, and forgotten to take medicine. Confounders included age, gender, socioeconomic status, race/ethnicity, self-rated health, asthma symptoms, and source of health care.

Results

Participating ($n = 499$) and non-participating ($n = 66$) schools were compared using demographic data obtained from the statistical branch of the NC Department of Public Instruction. There were no differences between the schools on the number of students enrolled in the free/reduced price school lunch program, race, and gender (p-values = .66, .61, .58, respectively). Adolescents who reported greater self-efficacy for managing asthma reported fewer functional consequences in the past year (all p's $\leq .01$). However, the two self-efficacy items were negatively skewed requiring additional considerations: confident in prevention: 41% very confident, 19% somewhat confident, 21% confident, 11% not that confident, 8% not at all confident; confident in using an inhaler: 48% very confident, 16% somewhat confident, 19% confident, 10% not that confident, 7% not at all confident. Log transformed outcome variables were examined but yielded similar results with only one exception.[1]

[1]In the log-transformed model examining confidence in inhaler use, access to asthma resources was statistically significant ($p < .05$). However, in the non-transformed model, access to asthma resources was not statistically significant.

Table II. Factors associated with confidence in preventing an asthma exacerbation and using an inhaler at school

	Prevent asthma attack[a]		Use inhaler at school[b]		Overall confidence[c]	
	β	SE	β	SE	β	SE
Age	−.056	0.032	−.032	0.030	−.048	0.027
Gender (1 female/0 male)	−.029	0.055	−.018	.053	−.026	.046
SES (1 low/0 high)	−.102	0.064	.059	0.061	−.033	0.054
Race (1 other/0 white)	−.003	0.063	.021	0.060	.008	0.053
Self-rated health[d]	.166	.027***	.168	0.026***	.169	0.023***
Usual source of care[e]	−.060	0.058	−.158	0.056**	−.110	.049*
Number of asthma symptoms	−.028	0.020	−.013	0.019	−.017	0.017
Type of inhaler uses[f]	−.115	0.057*	−.212	0.053***	−.173	0.048***
Forgotten inhaler	−.223	0.057***	−.165	0.055**	−.206	0.048***
Use a peak flow	−.129	0.070	–		−.119	0.059*
Allowed to carry meds at school	.315	0.064***	.413	0.062***	.369	0.054***
Shown how to use peak flow	.243	0.072***	–		.156	0.060**
Access to asthma resources[g]	.113	0.039**	.063	0.037	.090	0.032**

[a] $F = 10.407$, $p \leq .001$; $R^2 = 0.062$.
[b] $F = 12.120$, $p \leq .001$; $R^2 = 0.058$.
[c] $F = 14.129$, $p \leq .001$; $R^2 = .081$; composite of two confidence scores.
[d] 1 = poor to 5 = excellent.
[e] 1 = private doctor, 2 = public health clinic, ER, hospital, no usual, other, don't know.
[f] 1 = anti-inflammatory, 2 = bronchodilator.
[g] 0 = no asthma action plan or access to rescue inhaler, 1 = have access to rescue inhaler, or 2 = have asthma action plan and access to rescue inhaler.
*$p < .05$, **$p < .01$, ***$p < .001$.

Thus, for simplicity, we present findings using non-transformed data.

As shown in Table I, most adolescents reported that they were allowed to carry their medicine at school and over half had been shown how to use their peak flow meter. However, less than a third reported having an asthma action plan and access to their rescue inhaler when needed. In addition, two-thirds reported having forgotten to take their medicine during the past year. Ethnic differences suggested that Hispanics and Native-Americans compared with Caucasians felt less confident and experienced more asthma symptoms and functional consequences. Table II illustrates that confidence in preventing an asthma exacerbation at school was greater among adolescents who were allowed to carry their medicine at school, who had been shown how to use a peak flow meter, and who had greater access to asthma resources. On the other hand, less confidence in preventing an asthma exacerbation was observed among those who used an anti-inflammatory medication and among those who had ever forgotten to take their medication during the past year. Greater confidence in using an inhaler at school was observed among those who were allowed to carry their medicine at school, if they had never forgotten to take their inhaler, if they were only on a bronchodilator, and if they reported care from a private doctor. Similar results were observed for the association between overall confidence and the various independent variables. Importantly, although the observed relationships were statistically significant, the overall percent variance explained for all three models was small (preventing attack $r^2 = 0.06$; use an inhaler $r^2 = 0.06$; overall confidence $r^2 = 0.08$).

Discussion

The data supported our hypotheses; adolescents allowed to carry their inhaled medication at school reported greater self-efficacy for preventing an asthma exacerbation and using an inhaler at school. Similarly, adolescents shown how to use a peak flow meter and who had greater access to asthma care resources reported greater self-efficacy for preventing an asthma exacerbation at school.

Reviews led by Bernard-Bonin, Stachenko, Bonin, Charette, and Rousseau (1995) and Wolf et al. (2003) suggest that teaching asthma management skills to youth can have moderate to good outcomes, including improved functional status, better medication adherence, and reductions in the impact of the disease on social development. This study presents evidence that allowing adolescents to carry their medication at school, as supported by current policy initiatives (Jones & Wheeler, 2004), showing them how to use their peak flow meter, and allowing them greater access to asthma resources, are associated with

greater confidence in managing their asthma. Given the modifiability of self-efficacy (Wolf et al., 2003) and its association with both using more asthma management strategies (Clark & Valerio, 2003) and improved adherence (van Dellen et al., 2008) this study contributes to our understanding of what factors to target in future interventions.

Limitations

Data were collected at a single point in time thus causality cannot be inferred. On the one hand, it is possible that being allowed to carry one's medication at school makes one feel more confident; however, it is also possible that greater confidence results in more active self-management behaviors such as carrying one's medication to school. Second, self-efficacy was measured using only two questions and the distribution of scores were moderately skewed with youth reporting high levels of self-efficacy. A more rigorous approach would involve administering a self-efficacy scale and then examining the scale's psychometric properties to determine how well it measures what it purports to measure. Nevertheless, to provide some evidence for the validity of our single item indicators, we examined and found a modest though positive correlation between the two self-efficacy items ($r = 0.47$, $p \leq .001$) and a negative association between the self-efficacy items and functional consequences including missed school days and hospitalizations. A third limitation of this study is that the data were based on self-report, including reported asthma severity. However, this limitation is tempered by the use of ISAAC, a rigorously validated approach to measuring symptoms (Fuso et al., 2000; Gibson et al., 2000; Shaw et al., 1992). In addition, the prevalence of asthma observed in this study is comparable to national estimates of 9.2% for youth under 18 years of age (American Lung Association, 2007). A fourth limitation pertains to the operationalization of asthma diagnosis (i.e., ever diagnosed with asthma by a physician); it is possible that some of the youth may have been asymptomatic and not required medication at the time the study was conducted.

Parent and health care provider involvement and access to health care resources are instrumental to effective asthma management. During a clinical visit, a provider can show youth how to use a peak flow meter and engage them in a discussion about their asthma action plan and the importance of having access to their rescue inhaler. Elder and colleagues (Elder, Ayala, & Harris, 1999) recommend that health care providers use theoretically-driven approaches to health care delivery. These data provide specific recommendations for intervention strategies that can be incorporated into a short clinic visit with the potential to improve confidence for managing asthma.

Funding

National Institutes for Child Health and Human Development [BIRCWH award K12 HD01441 to G.X.A.]; American Lung Association [CG-939-N to G.X.A.].

Conflict of interest: None declared.

Received November 8, 2008; revisions received November 23, 2008; accepted November 24, 2008

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