Published in final edited form as:

Acad Pediatr. 2016 ; 16(8): 792–798. doi:10.1016/j.acap.2016.03.009.

The Association of Youth and Caregiver Anxiety and Asthma Care among Urban Young Adolescents

Jean-Marie Bruzzese, Ph.D.¹, Laura C. Reigada, Ph.D.², Alexandra Lamm, M.S.Ed.^{1,a}, Jing Wang, M.S.^{1,b}, Meng Li, M.A.¹, Stephanie O. Zandieh, M.D., M.S.^{3,c}, and Rachel G. Klein, Ph.D.¹

Laura C. Reigada: lreigada@brooklyn.cuny.edu; Alexandra Lamm: lamm.alexandra@gmail.com; Jing Wang: joanleewj@hotmail.com; Meng Li: Meng.Li@nyumc.org; Stephanie O. Zandieh: stz2001@med.cornell.edu; Rachel G. Klein: Rachel.Klein@nyumc.org

¹Department of Child and Adolescent Psychiatry, NYU School of Medicine, One Park Avenue, 7 FL, New York, NY 10016, USA

²Department of Psychology, Brooklyn College of the City University of New York, 2900 Bedford Avenue, Brooklyn, NY 11210, USA

³Department of Pediatrics, NYU School of Medicine, 550 First Avenue, New York, NY 10016, USA

Abstract

Objective—To examine the association of adolescent asthma-related anxiety, social anxiety, separation anxiety, and caregiver asthma-related anxiety, with asthma care by urban adolescents.

Methods—Participants were 386 ethnic minority adolescents (mean age=12.8) with persistent asthma and their caregivers. Adolescents reported what they do to prevent asthma symptoms and to manage acute symptoms, and if they or their caregiver is responsible for their asthma care. Adolescents completed the *Youth Asthma-related Anxiety Scale* and the social and separation anxiety subscales of the SCARED; caregivers completed the *Parent Asthma-related Anxiety Scale*. Linearity of the associations was assessed via Generalized Additive Models (GAM). When there was no evidence for non-linearity, linear mixed effects models were employed to evaluate the effects of the predictors.

Results—Adolescents asthma-related anxiety had a strong curvilinear relationship with symptom prevention ($P<0.001$). Adolescents took more prevention steps as their anxiety increased, with a plateau at moderate anxiety. There was a linear relationship of adolescent asthma-related anxiety to symptom management ($\beta=0.03$, $P=.021$) and to asthma responsibility ($\beta=0.11$, $P=.015$), and of

Address Correspondence to: Jean-Marie Bruzzese, Ph.D., NYU Child Study Center, NYU School of Medicine, One Park Avenue 7th FL, New York, NY 10016, Jean-Marie.Bruzzese@nyumc.org, Tel: 646.754.5137, Fax: 646.754.5211.

^aPresent Addresses for Authors Who Moved Since Work Was Complete:

Department of Psychology, Fordham University, 113 West 60th Street, New York, NY 10023

^b50 Riverchase Parkway East, Hoover, AL 35244

^cDepartment of Pediatrics, Weill Cornell Medicine, 56 East 76th Street, New York, NY 10021

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Conflict of Interest: There are not actual or potential conflicts of interest.

caregiver asthma-related anxiety to adolescent symptom prevention ($\beta=0.04$, $P=.001$). Adolescent social and separation anxiety had weak-to-no relationship with asthma care. Results remained consistent when controlling for each of the other anxieties.

Conclusions—Asthma-related anxiety plays an important, independent role in asthma care. When low, adolescents may benefit from increased support from caregivers and awareness of the consequences of uncontrolled asthma. When elevated, health providers should ensure the adolescents are not assuming responsibility for asthma care prematurely.

Keywords

asthma; anxiety; self-management; urban; adolescents; parents

Adolescents, a vulnerable population with relatively high asthma prevalence and morbidity,^{1,2} do not take adequate steps to care for their asthma.³ One potentially important explanation for inadequate self-care is co-morbid anxiety. Youth with asthma are at increased risk for experiencing anxiety symptoms,⁴ which in turn is associated with an increase in the perception of asthma symptoms,^{5–7} non-adherence to peak flow monitoring,⁸ and asthma-related school-absences.⁵ However, these findings lack clinical specificity as research has been limited to negative affect and undefined anxiety.

Separation anxiety,⁹ and to a lesser extent social anxiety,⁴ are prevalent among youth with asthma. Yet, their impact on asthma care has not been studied. Among adults, asthma-related anxiety, or the panic, fear, or worry in response to asthma symptoms, treatment, and consequences,¹⁰ has been found to impact asthma self-management,¹¹ with high and low levels of asthma-related anxiety hampering self-management.¹² When asthma-related anxiety is high, adults overreact to their asthma symptoms, and implement inappropriate self-management, including overusing quick-reliever medication. When low, asthma symptoms are ignored, and treatment is neglected.¹³ Both high and low asthma-related anxiety are associated with increased rates of hospitalizations.¹³ In contrast, moderate levels of asthma-related anxiety are adaptive for asthma care in adults by optimizing asthma management.^{14,15} The impact of asthma-related anxiety on asthma self-care has not been examined in adolescents, but it is plausible to expect similar patterns.

Caregiver disease-specific anxiety has been found to adversely impact glycemic control in their children with diabetes,¹⁶ and to reduce treatment adherence in children with seizure disorders.¹⁷ Despite this, caregiver asthma-related anxiety has yet to be studied.

Caregiver support around asthma care has been found to improve asthma control.¹⁸ Yet, caregivers often transfer medical responsibilities to their child before they possess the requisite skills or confidence to care for their asthma.³ Subsequently, this premature transfer may increase the adolescent's asthma-related anxiety. Additionally, caregiver anxiety may interfere with the caregiver's ability to assist their adolescent care for their asthma.¹⁹ Despite this potentially important association between adolescent and caregiver anxiety on responsibility for asthma care, it has not been evaluated.

In urban, ethnic minority young adolescents with persistent asthma, we report on the association of adolescent asthma-related anxiety, social anxiety, and separation anxiety, as well as caregiver asthma-related anxiety, to asthma care (i.e., symptom prevention and management, adolescent and caregiver responsibility for asthma care). We also tested if adolescent anxieties (i.e., asthma-related, social, and separation), and caregiver asthma-related anxiety would have independent relationships to asthma care. We hypothesized that 1) relatively low and high adolescent and caregiver asthma-related anxiety will be associated with fewer steps to prevent the onset of symptoms, and to manage existing symptoms; 2) adolescents' social anxiety and separation anxiety will be associated with asthma care; 3) relatively high adolescent and caregiver asthma-related anxiety will be associated with adolescents taking more responsibility for their asthma care than their caregivers; and 4) the anxieties will have independent relationships with asthma care.

Methods

Participants and Procedures

Participants were 386 adolescents ages 11 to 14 with persistent asthma and their primary caregivers who were part of a treatment study examining the efficacy of an intervention to improve asthma control among young adolescents.³ We recruited 392 families over 4 years from 27 New York City public middle schools, where at least 50% of students were African American or Hispanic, and where, on average, 76% of the students were eligible for free or reduced lunch. The adolescents were fifth through eighth grade students whose caregivers reported, on a symptom-focused case detection form, that their child was diagnosed with asthma, had taken prescribed asthma medication in the prior 12 months, had persistent asthma,²⁰ and had no significant learning or behavioral issues that would hinder participation in the treatment study. We defined persistent asthma based on national guidelines²⁰ in place at the onset of the study: in the last 12 months caregivers reported that their child experienced 1) daytime symptoms at least 3 to 6 days per week, or 2) night awakenings due to symptoms 3 or more times a month. Six of the 392 adolescents enrolled in the treatment study had intermittent asthma; they were excluded from this report because their medical management would differ from those with persistent asthma.²⁰

This study reports on measures obtained prior to treatment entry. Families completed surveys proctored by trained study staff after school, during evenings, or on weekends at the adolescent's school; adolescents and caregivers completed surveys in separate rooms, and were compensated \$10 and \$30, respectively. Study procedures were approved by the institutional review boards of the NYU School of Medicine, Columbia University College of Physicians and Surgeons, the New York City (NYC) Department of Education, and the NYC Department of Health and Mental Hygiene.

Measures

Asthma Care—The adolescents completed three measures of asthma care. The *Asthma Prevention Index* and the *Asthma Management Index*, developed by our team for use in prior clinical trials, have good reliability ($\alpha = 0.70$ and 0.53 , respectively), and are treatment sensitive (i.e., detect change in care following participation in an intervention).^{21,22} The

Asthma Prevention Index is a 9-item questionnaire regarding steps taken to prevent the onset of symptoms (e.g., take daily medication, avoid triggers) where a 3-point scale indicates the frequency of each step (never; yes, but not all the time; yes, all the time). Across the nine items, the two positive responses were collapsed into “yes” in order to obtain an overall count of steps taken, paralleling the format of the *Asthma Management Index*.

The *Asthma Management Index* reflects how adolescents manage existing symptoms; adolescents indicated yes/no to each of seven steps (e.g., observe if symptoms improve, ask for help). The total number of steps endorsed was used as an index of asthma management.

The *Asthma Responsibility Questionnaire* (ARQ)²³ is comprised of 10 items answered on a five-point scale (1=caregiver takes responsibility all the time, 3=caregiver and adolescent share responsibility about equally, 5=adolescent takes responsibility all the time). The mean of the items reflects whether the adolescent or caregiver is responsible for asthma care. The ARQ has demonstrated internal consistency and convergent validity.²³

Social and Separation Anxiety—Adolescents completed the social and separation anxiety subscales of the *Screen for Child Anxiety and Emotional Disorders* (SCARED).²⁴ Using a 3-point Likert scale (0=not true or hardly ever true to 2=very true or often true), adolescents indicated how much each of 15 statements described them in the last 3 months. The social anxiety subscale (7 items) assesses the extent to which the adolescent fears negative evaluation in social or performance situations. The separation anxiety scale (8 items) assesses the extent to which the adolescent experiences distress when temporarily leaving home or otherwise separating from a specific attachment figure. This measure of anxiety symptoms has well-established psychometric properties,²⁴ and has been used with children and adolescents with chronic illnesses.²⁵

Asthma-related anxiety—Adolescents and caregivers completed the *Youth Asthma-related Anxiety Scale* (YAAS) and *Parent Asthma-related Anxiety Scale* (PAAS), respectively.²⁶ Using the 10 item, 6-point scale (0=never, 5=always), adolescents rated how nervous or worried they were in the prior 2 weeks regarding their asthma. On a parallel format, caregivers completed 12-items reflecting how nervous or worried they were about their child’s asthma. Reliability, and content and construct validity of both the YAAS and PAAS have been established.²⁶

Asthma severity—Caregiver responses on the symptom-focused case detection form were used to classify the adolescent’s asthma severity of. Using N.H.L.B.I guidelines²⁰ in place at the onset of the study, we defined: mild persistent asthma as the adolescent experiencing daytime symptoms 3 – 6 days week, or night wakening 3 or more days a month; moderate persistent asthma as experiencing daytime symptoms everyday, but not all the time, or night wakening 3 – 6 days a week; and severe persistent asthma as experiencing daytime symptoms everyday, and all the time, or night wakening every night.

Statistical Analyses

The goal was to assess whether there were associations between students’ asthma-related anxiety, and the three aspects of their asthma care: prevention; management; and

responsibility. We first assessed the marginal associations (i.e., these associations without accounting for other anxieties), and then we assessed whether the inferences changed when we controlled for these additional anxiety measures. Of interest was also the shape of the association for prevention and management (i.e., whether the prevention and management steps increased or decreased linearly with asthma-related anxiety, or whether the relationship was non-linear). The evidence for non-linearity was evaluated based on likelihood ratio test comparing the fit of general additive model (GAM) versus a linear model (LM), in particular their versions for correlated Poisson distributed data that allowed for the accounting of the possible correlation between the outcomes of students from the same cohort. GAMs assume the outcome is a smooth (not necessarily linear or monotone) function of the predictors, and estimate the function non-parametrically from the data. The degrees of freedom (d.f.) associated with a predictor index the degree of non-linearity with d.f. larger than 1 indicating larger deviation from linearity. The advantage of GAMs is that they capture non-linear relationships that LM might miss while preventing over fitting.²⁷ For completeness, we also evaluated the marginal relationships of asthma prevention and management with each of the remaining anxiety measures.

All models controlled for potential cohort effects (i.e., adolescents enrolled from one school during a given study year), and for age, gender, and N.H.L.B.I severity because: (1) age and gender have been found to be associated with asthma care,³ and anxiety;²⁸ and (2) asthma severity has been found to be associated with anxiety.^{6,26} GAM models were fit using function `gam` in library `mgcv` of R language; linear models were fit using SAS. Significance was judged at level $\alpha=0.05$, two-sided.

Results

Sample Characteristics

As detailed in Table 1, there was an equal distribution of adolescents with mild, moderate, or severe persistent asthma. Half (55%) were male, and the majority was ethnic minority. Half of the primary caregivers (mostly mothers) reported the adolescent had an urgent visit to a doctor, an emergency department visit, or a hospitalization for asthma in the prior two months. A third of caregivers reported being married or living with someone, and half reported being unemployed. Descriptive statistics for the predictor and outcome variables are presented in Table 2. On average, adolescents took 6 out of 9 steps to prevent the onset of symptoms, and 6 out of 7 steps to manage existing symptoms. Caregivers were slightly more responsible for the adolescents' asthma care. The mean adolescent and caregiver asthma-related anxieties ($M=1.3$ and 1.9 , respectively) were in the lower third of the 5-point scales; adolescent social and separation anxiety were in the middle range.

Relationship of Adolescent and Caregiver Anxiety with Asthma Prevention and Management

Adolescent Anxieties—There was a significant relationship between adolescent asthma-related anxiety and prevention that was non-linear, see Figure 1 ($P < 0.001$ for non-linearity and d.f. = 2.39 for the regression of the outcome on the predictor). Adolescents reported taking more steps to prevent the onset of symptoms as their asthma-related anxiety

increased, but this plateaued when the anxiety was relatively moderate or greater (i.e., values beyond 2); about a quarter of the adolescent had values greater than 2. This non-linear relationship remained when adolescent social and separation anxieties, and caregiver asthma-related anxiety, were controlled for, indicating the adolescent's asthma-related anxiety had an independent, non-linear relationship on prevention beyond any contribution of the other anxieties.

There was a significant linear relationship between the adolescents' asthma-related anxiety and their management of existing symptoms ($\beta = 0.03$, $P = .021$), with higher anxiety associated with more steps to manage existing symptoms. This effect remained when controlling for social and separation anxieties, and caregiver asthma-related anxiety, indicating adolescent's asthma-related anxiety had an independent relationship with management.

Of the other adolescent anxieties, only separation anxiety had a marginal relation to prevention, and the relationship was linear ($\beta = 0.13$, $P = .021$). This relationship disappeared when the adolescent's asthma-related anxiety and social anxiety were included in the model, indicating that separation anxiety did not have an additive relationship with asthma-related anxiety.

Caregiver Asthma-related Anxiety—There was a significant linear relationship between caregiver asthma-related anxiety and adolescent prevention efforts ($\beta = 0.04$, $P = .0011$), which remained when controlling for adolescents' asthma-related anxiety. Thus, caregiver asthma-related anxiety was independently associated with prevention, such that with increased caregiver asthma-related anxiety related to adolescents taking more prevention steps. In contrast, caregiver asthma-related anxiety was not significantly related to the adolescents' symptom management.

Relationship of Adolescent and Caregiver Anxiety with Asthma Responsibility

Adolescent Anxiety—The marginal association between adolescents' asthma-related anxiety and responsibility was significant ($\beta = 0.11$, $P = .015$), with higher asthma-related anxiety related to more self-responsibility for their asthma. This linear relationship remained when social and separation anxiety, and caregiver asthma-related anxiety, were controlled for. Thus, adolescent asthma-related anxiety had an independent relationship with asthma responsibility.

The marginal relationship with responsibility was not significant for either social or separation anxiety. However, controlling for adolescent asthma-related and social anxiety, separation anxiety was negatively (although only slightly) associated with asthma responsibility ($\beta = -0.04$, $P = .029$): for a given level of asthma-related anxiety and social anxiety, higher separation anxiety was associated with lower self-responsibility (i.e., their caregivers, not them, were responsible for their asthma care).

Caregiver Asthma-related Anxiety—There was no evidence for an association between caregiver asthma-related anxiety and the degree of adolescents' asthma responsibility.

Discussion

Because untreated or undertreated asthma can have serious negative health consequences, it is important to identify factors that promote or hinder optimal asthma management. This study was designed to investigate the relationship of anxiety with adolescents asthma care. We report on associations between asthma care by young urban adolescents, and their levels of asthma-related anxiety, social anxiety, and separation anxiety, as well as caregiver asthma-related anxiety. Among the anxieties tested, adolescent asthma-related anxiety had the most robust relationship – it was associated with all aspects of asthma care. Social anxiety was not associated asthma care, and separation anxiety had a minimal relationship.

Consistent with adult studies,^{14,15} moderate levels of adolescent asthma-related anxiety was associated with taking significantly more steps to prevent the onset of asthma symptoms than somewhat higher and lower anxiety. Moderate levels may have enhanced preventive asthma care because of appropriately increased vigilance to asthma symptoms.¹³

As hypothesized, for both asthma prevention and management, relatively low asthma-related anxiety among adolescents was related to minimal care. Others have demonstrated that adults with lower levels of anxiety frequently experience denial, or inappropriately disregard the importance of asthma symptoms.²⁹ In turn, this disregard leads to inaction, which may contribute to worsened health outcomes. The same may be the case in adolescents.

Contrary to hypotheses and findings with adults, relatively high asthma-related anxiety was not associated with less asthma care. Relatively few adolescents reported high levels of asthma-related anxiety, but those who did reported a wide range of prevention and management steps as reflected in the large confidence intervals.

Findings suggest that adolescent asthma-related anxiety operates differently in symptom prevention compared with management. The differential association of relatively higher asthma-related anxiety with prevention and management may be due to adolescents adopting a reactive asthma management style, rather than an anticipatory style.³ Adults often interpret the absence of symptoms as meaning “no asthma”.³⁰ As a result, they do not anticipate the need for preventive actions; however, relatively moderate levels of asthma-related anxiety may motivate individuals to consider health consequences in advance, resulting in prevention. In contrast, when symptoms are active, asthma-related anxiety may function like signal anxiety, indicating danger, and enhancing self-management.³¹ The urgent, potential life-threatening, nature of asthma symptoms, coupled with anxiety, may result in an increase in steps taken to manage symptoms.

Of note, consistent with prior research,²⁶ results provide evidence that adolescent and caregiver asthma-related anxiety are distinct constructs, functioning differently in adolescents and caregivers. Unlike the relationship between adolescent’s anxiety and prevention, the relationship between caregiver’s anxiety and prevention was linear. Caregiver asthma-related anxiety was positively associated with adolescents taking more prevention steps. Caregivers with at least moderate concerns about their child’s health may take an active role in prevention behaviors, such as prompting their child’s to take daily medication or to avoid triggers. Alternatively, adolescents may realize that their caregivers are anxious

about their asthma, and take steps to prevent symptoms to avoid exacerbating parental anxiety. Caregiver anxiety did not influence adolescents' care of on-going symptoms. Further support of the independent effects of adolescent and caregiver asthma-related anxiety is the fact that each of their relationships with asthma care remained consistent in the presence of both adolescent and caregiver asthma-related anxiety.

With respect to adolescents' perceived asthma responsibility, we found, as hypothesized, that asthma-related anxiety was associated with an increased sense of responsibility for their care. However, caregiver anxiety did not influence adolescents' perceived responsibility. The somewhat unpredictable nature and intrapersonal variability²⁰ of asthma may increase anxiety regarding the disease. Given that being in control is a common theme during adolescence and in anxious adolescents, asthma-related anxiety may increase the desire to take responsibility as a means of coping with anxiety. Yet, doing so is potentially detrimental to asthma control because adolescents are often delegated responsibilities for their asthma care in spite of lacking requisite skills or confidence.³ It is also plausible that increased responsibility increases anxiety, especially if they are delegated responsibilities prematurely. Alternatively, moderate to high asthma-related anxiety in adolescents may serve as a protective factor by motivating adolescents to take charge of their care. This may be particularly true if caregivers are not effective in helping their child care for their asthma.

Contrary to hypotheses, social anxiety did not predict adolescents' self-care, and separation anxiety plays a minor role, predicting an increase in adolescent prevention. This relationship may be due to anxiety about having asthma symptoms, which in turn may cause the adolescents to be anxious when away from caregivers. In this sample, separation anxiety is likely circumscribed to reflect a desire to be close to someone to whom the adolescent can turn for help when experiencing asthma symptoms. This interpretation is supported by the fact that separation anxiety no longer significantly predicted prevention by the adolescent in the presence of asthma-related anxiety. It has been suggested that the relationship between separation anxiety and asthma symptoms is mediated by family interactions, such that greater family involvement may either permit caregivers to assist the adolescent in prevention efforts by monitoring symptoms, offering reminders to take medication, and planning the next day's events. Or it may increase the adolescents' sense of security in the family, thereby reducing separation anxiety.⁹

Additionally, findings from this study do not indicate a multiplicative effect of adolescents' anxieties. That is, the combined role of the anxieties does not appear to be above and beyond that of either anxiety alone, suggesting that asthma-related anxiety functions independently of social or separation anxiety.

Study results should be interpreted in light of study limitations. The cross-sectional data prevents interpreting causation. Additionally, since the study excluded adolescents with controlled asthma, results do not generalize to other clinical populations. Because self-report measures were used, which are subject to informant bias, the relationship between adolescents' anxiety and asthma care may have been inflated. Over-reporting is plausible given that the adolescents have poorly controlled asthma, but are reporting taking multiple steps to prevent and to manage symptoms. Alternatively, this inconsistency in asthma care

and control may be due to their performing the steps poorly or receipt of ineffective asthma care from medical providers. The sole use of adolescent-reported measures of asthma care precludes an understanding of the relationship between anxiety and caregiver reports of asthma care. Future research should consider the caregivers report of asthma care. Also, having additional measures of asthma care (e.g., asthma management efficacy) that could be combined in to one measure might offer a broader perspective of asthma care and be more applicable to clinicians. There were few adolescents and caregivers with high asthma-related anxiety, thus precluding a full test of how severe asthma-related anxiety impacts asthma care. It is unclear if these restricted responses are due to sampling, construct, or measurement issues. We did not measure generalized anxiety; instead we chose the anxieties assessed because each may be associated with adherence to the intervention tested in the larger clinical trial from which these data were drawn, or each may have been impacted by the intervention. The concern about this is somewhat lessened because generalized anxiety is co-morbid with social and separation anxiety.³² Nonetheless, it is plausible that generalized anxiety may moderate or mediate potential relationships between other anxieties and asthma care, and should be studied. Future research is also required with broader samples with respect to asthma control, levels of anxiety, socioeconomic status, age, and race/ethnicity.

Even in the context of these limitations, findings elucidate factors that impact asthma care among adolescents that have important clinical implications. Health providers should consider the potential merits of asthma-related anxiety on asthma care. As such, routinely assessing adolescent and caregiver asthma-related anxiety using validated measures such as those used in this study²⁶ may help to identify those vulnerable to asthma management and anxiety problems. Given these measures are brief and shorter versions have not been validated, we recommend using the full scales. For efficiency, should providers have limited time, using only the adolescent-reported version is recommended because adolescent anxiety was associated with more relationships. When providers identify those with little distress (i.e., 0 – 1 on the YAAS), they might focus on improving symptom prevention by stressing the consequences of uncontrolled asthma, and indicating bodily sensations associated with asthma symptoms. Because poor recognition of changes in pulmonary functioning among children and adolescents are associated with increased asthma-related morbidity,³³ helping adolescents identify airway obstruction and early onset of asthma symptom may increase their engagement in appropriate care strategies and reduce dangerous under-treatment of asthma symptoms.

Lastly, health professionals should ensure that young adolescents who report relatively low asthma-related anxiety have necessary support from caregivers to take steps to prevent and to manage symptoms. The creation of family routines surrounding asthma care can promote good asthma treatment adherence, which in turn can lead to better health and fewer symptoms.³⁴ Because poor communication patterns between children and caregivers are associated with poor asthma management,³⁵ health providers should assist families in learning how to communicate their thoughts and feelings regarding the asthma care to ensure optimal support. Similarly, when young adolescents' asthma-related anxiety is elevated, health providers may consider assessing the transfer of care from caregiver to adolescent, working with families to ensure that adolescents have the requisite knowledge and skills.

Acknowledgments

Funding Source: All phases of this study were supported by an NIH grant, #R01HL079953, to JMB. The sponsor had no role in the study design; in the collection, analysis and interpretation of data; in the writing of this manuscript; and in the decision to submit the manuscript for publication.

References

1. American Lung Association. Trends in asthma morbidity and mortality. American Lung Association, Epidemiological and Statistical Unit, Research and Program Services; 2012 Sep. 2012
2. Akinbami LJ, Moorman JE, Garbe PL, Sondik EJ. Status of childhood asthma in the United States, 1980–2007. *Pediatrics*. 2009; 123(Suppl 3):S131–S145. [PubMed: 19221156]
3. Bruzzese J-M, Stepney C, Fiorino EK, et al. Asthma self-management is sub-optimal in urban Hispanic and African American/black early adolescents with uncontrolled persistent asthma. *J Asthma*. 2012; 49(1):90–97. [PubMed: 22149141]
4. Bruzzese J-M, Fisher PH, Lemp N, Warner CM. Asthma and social anxiety in adolescents. *J Pediatr*. 2009; 155(3):398–403. [PubMed: 19555965]
5. Bender BG, Zhang L. Negative affect, medication adherence, and asthma control in children. *J Allergy Clin Immunol*. 2008; 122(3):490–495. [PubMed: 18602153]
6. Richardson LP, Lozano P, Russo J, McCauley E, Bush T, Katon W. Asthma symptom burden: relationship to asthma severity and anxiety and depression symptoms. *Pediatrics*. 2006; 118(3):1042–1051. [PubMed: 16950996]
7. Feldman JM, Steinberg D, Kutner H, et al. Perception of pulmonary function and asthma control: the differential role of child versus caregiver anxiety and depression. *J Pediatr Psychol*. 2013; 38(10):1091–1100. [PubMed: 23873703]
8. Burkhart PV, Rayens MK. Self-concept and health locus of control: Factors related to children's adherence to recommended asthma regimen. *Pediatr Nurs*. 2005; 31(5):404–409. [PubMed: 16295156]
9. Fiese BH, Winter MA, Wamboldt FS, Anbar RD, Wamboldt MZ. Do family mealtime interactions mediate the association between asthma symptoms and separation anxiety? *J Child Psychol Psychiatry*. 2010; 51(2):144–151. [PubMed: 19754662]
10. Kinsman RA, Dirks JF, Jones NF. Levels of psychological experience in asthma: general and illness-specific concomitants of panic-fear personality. *J Clin Psychol*. 1980; 36(2):552–561. [PubMed: 7372831]
11. Katon WJ, Richardson L, Lozano P, McCauley E. The relationship of asthma and anxiety disorders. *Psychosom Med*. 2004; 66(3):349–355. [PubMed: 15184694]
12. Carr RE. Panic disorder and asthma. *J Asthma*. 1999; 36(2):143–152. [PubMed: 10227264]
13. Feldman JM, Siddique MI, Thompson NS, Lehrer PM. The role of panic-fear in comorbid asthma and panic disorder. *J Anxiety Disord*. 2009; 23(2):178–184. [PubMed: 18667290]
14. Dahlem NW, Kinsman RA, Horton DJ. Panic-fear in asthma: requests for as-needed medications in relation to pulmonary function measurements. *J Allergy Clin Immunol*. 1977; 60(5):295–300. [PubMed: 915146]
15. Dirks JF, Kinsman RA, Staudenmayer H, Kleiger JH. Panic-fear in asthma. Symptomatology as an index of signal anxiety and personality as an index of ego resources. *J Nerv Ment Dis*. 1979; 167(10):615–619. [PubMed: 490148]
16. Barnard K, Thomas S, Royle P, Noyes K, Waugh N. Fear of hypoglycaemia in parents of young children with type 1 diabetes: a systematic review. *BMC Pediatr*. 2010; 10(1):50. [PubMed: 20633252]
17. Hazzard A, Hutchinson SJ, Krawiecki N. Factors related to adherence to medication regimens in pediatric seizure patients. *J Pediatr Psychol*. 1990; 15(4):543–555. [PubMed: 2124261]
18. Rhee HBM, Brasch J. Family support and asthma outcomes in adolescents: barriers to adherence as a mediator. *J Adolesc Health*. 2010; 47(5):472–478. [PubMed: 20970082]
19. Staudenmayer H. Parental anxiety and other psychosocial factors associated with childhood asthma. *J Chronic Dis*. 1981; 34(12):627–636. [PubMed: 7309827]

20. N.H.L.B.I. Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma. Bethesda: NIH; 2007. NIH Publication No. 07-4051
21. Bruzzese J-M, Sheares BJ, Vincent EJ, et al. Effects of a school-based intervention for urban adolescents with asthma: a controlled trial. *Am J Respir Crit Care Med*. 2011; 183(8):998–1006. [PubMed: 21139088]
22. Evans D, Clark NM, Feldman CH, et al. A school health education program for children with asthma aged 8–11 years. *Health Educ Q*. 1987; 14(3):267–279. [PubMed: 3654234]
23. McQuaid EL, Penza-Clyve SM, Nassau JH, Fritz GK, Klein R, Wamboldt F. The Asthma Responsibility Questionnaire: patterns of family responsibility for asthma management. *Child Health Care*. 2001; 30(3):183–199.
24. Birmaher B, Brent DA, Chiappetta L, Bridge J, Monga S, Baugher M. Psychometric properties of the Screen for Child Anxiety Related Emotional Disorders (SCARED): a replication study. *J Am Acad Child Adolesc Psychiatry*. 1999; 38(10):1230–1236. [PubMed: 10517055]
25. Perez ME, Coley B, Crandall W, Di Lorenzo C, Bravender T. Effect of nutritional rehabilitation on gastric motility and somatization in adolescents with anorexia. *J Pediatr*. 2013; 163(3):867–872. e861. [PubMed: 23587435]
26. Bruzzese J-M, Unikel LH, Shrout PE, Klein RG. Youth and parent versions of the Asthma-related Anxiety Scale: development and initial testing. *Pediatr Allergy Immunol*. 2011; 24(2):95–105.
27. Hastie, TJ.; Tibshirani, RJ. Generalized Additive Models. Vol. 43. New York: Chapman and Hall; 1990.
28. Beesdo K, Knappe S, Pine DS. Anxiety and anxiety disorders in children and adolescents: Developmental issues and implications for DSM-V. *Psychiatr Clin North Am*. 2009; 32(3):483–524. [PubMed: 19716988]
29. Vámos M, Kolbe J. Psychological factors in severe chronic asthma. *Aust N Z J Psychiatry*. 1999; 33(4):538–544. [PubMed: 10483849]
30. Halm EA, Mora P, Leventhal H. No symptoms, no asthma: The acute episodic disease belief is associated with poor self-management among inner-city adults with persistent asthma. *Chest*. 2006; 129(3):573–580. [PubMed: 16537854]
31. Kolbe J, Vámos M, Fergusson W, Elkind G. Determinants of management errors in acute severe asthma. *Thorax*. 1998; 53(1):14–20. [PubMed: 9577516]
32. Pine, DS.; Kline, RG. Anxiety disorders. In: Thapar, A.; Pine, DS.; Leckman, JF.; Scott, S.; Snowling, MJ.; Taylor, EA., editors. *Rutter's Child and Adolescent Psychiatry*, 6th Edition. 6th. Malden, MA: Wiley-Blackwell; 2015. p. 822-840.
33. Fritz GK, Adams SK, McQuaid EL, et al. Symptom perception in pediatric asthma: resistive loading and in vivo assessment compared. *Chest*. 2007; 132(3):884–889. [PubMed: 17573500]
34. Fiese B, Winter M, Anbar R, et al. Family climate of routine asthma care: associating perceived burden and mother-child interaction patterns to child well-being. *Fam Process*. 2008; 47(1):63–79. [PubMed: 18411830]
35. Bruzzese J-M, Unikel LH, Gallagher R, Evans D, Colland VT. Feasibility and impact of a school-based intervention for families of urban adolescents with asthma: results from a randomized pilot trial. *Fam Process*. 2008; 47(1):95–113. [PubMed: 18411832]

What's New

Asthma-related anxiety, a previously ignored construct in pediatric asthma, is associated with adolescents' prevention and management of asthma symptoms. This role is independent of their separation and social anxiety, and caregiver asthma-related anxiety.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1.
Plot for GAM Model: Number of Prevention Steps by Young Adolescent Asthma-related Anxiety

Table 1

Demographic and baseline clinical characteristics (N = 386).

	% (N)
Child Demographic Characteristics	
Age, mean $\pm$ SD, yr	12.77 $\pm$ 1.10
Male	55 (172)
Ethnicity	
Hispanic	48 (187)
African American/Black, not of Hispanic origin	34 (130)
Biracial	9 (36)
Other	9 (33)
Caregiver Demographic Characteristics	
Biological or adoptive mother	90 (347)
Marital status	
Married or living with someone as married	40 (152)
Separated or divorced	25 (97)
Widowed	4 (14)
Single, never married	31 (121)
Highest level of education	
Less than high school	33 (128)
High school, GED, or vocational school	24 (92)
Post high school	43 (165)
Employment status	
Unemployed	52 (198)
Employed, part-time	11 (44)
Employed, full-time	37 (143)
Baseline Clinical Characteristics	
NHLBI classification	
Mild persistent	33 (128)
Moderate persistent	33 (128)
Severe persistent	34 (130)
Symptoms in past 2 weeks (child-report)	
3 or more days	80 (310)
1 or two days	16 (61)
0 days	4 (15)
Take controller medication (caregiver-report)	68 (262)
Take quick reliever medication (caregiver-report)	92 (356)
At least one urgent visit to doctor, ED Visit, or hospitalization for asthma in past 2 months (caregiver-report)	53 (204)

Table 2
Distribution of and Pair-wise Correlations Coefficients Among Outcome Variables and Predictors.

	No. Prevention Steps	No. Management Steps	Asthma Responsibility	Adolescent Anxiety		Caregiver Asthma-related Anxiety
				Asthma-related	Social	Separation
<i>M (SD)</i>	6.17 (2.12)	5.51 (1.42)	2.51 (0.93)	1.51 (1.10)	13.86 (3.56)	13.63 (5.58)
<i>Median</i>	6.00	6.00	2.44	1.33	14.00	13.00
<i>Range</i>	0 – 9	0 – 7	1 – 5 ^a	0 – 5	7 – 21	8 – 24
<i>25th Percentile</i>	5.00	5.00	1.78	0.65	11.00	11.00
<i>50th Percentile</i>	6.00	6.00	2.44	1.33	14.00	13.00
<i>75th Percentile</i>	8.00	7.00	2.14	2.17	16.25	16.00

<i>Correlations</i>						
No. Management Steps	.372 ^{**}					
Asthma Responsibility	-.067	-.152 ^{**}				
Adolescent Anxiety: Asthma-related Anxiety	.289 ^{**}	.140 ^{**}	.118 [*]			
Social	.018	.009	-.031	.317 ^{**}		
Separation	.107 [*]	.091	-.103 [*]	.379 ^{**}	.474 ^{**}	
Caregiver Asthma-related Anxiety	.146 [*]	.078	-.021	.096	.061	.069

^a Higher scores = adolescent is responsible

^{*} $P < .05$,

^{**} $P < .01$