

## Original Article

# Anxiety Contributes to Poorer Asthma Outcomes in Inner-City Black Adolescents

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**What is already known about this topic?** Comorbid psychiatric disorders including anxiety are common in patients with asthma and contribute to poor control and increased costs. Anxiety has not been studied in black adolescent asthma populations at high risk for adverse asthma outcomes.

**What does this article add to our knowledge?** Nearly one-third of inner-city black adolescents with persistent asthma have probable anxiety disorders that are associated with poorer asthma control, impaired quality of life, insomnia, and increased emergency department utilization for asthma.

**How does this study impact current management guidelines?** Routine screening for anxiety disorders may be useful in the clinical management of inner-city black adolescents with asthma and may help identify subgroups at risk for poorer asthma outcomes.

**BACKGROUND:** The factors associated with poor asthma control, exacerbations, and health care utilization in black adolescents are complex and not well understood. Although psychological comorbidities such as anxiety are common in patients with asthma, these have not been studied in this population.

**OBJECTIVE:** This study characterized anxiety and associated asthma features in a cohort of black inner-city adolescents with persistent asthma and determined the association between anxiety symptoms, persistent uncontrolled asthma, and prospective health care utilization over 1 year.

**METHODS:** Eighty-six black adolescents were enrolled, phenotyped, and screened for anxiety symptoms with the Hospital Anxiety and Depression Scale anxiety subscale (HADS-A). Participants were telephoned every 2 months and a second study visit was completed at 1 year. Primary outcomes included persistent uncontrolled asthma, asthma exacerbations requiring systemic corticosteroids, and unscheduled health care utilization during the 1-year study period.

**RESULTS:** A total of 31% (n = 27) of adolescents had probable anxiety (ie, HADS-A score >7) and 27% (n = 23) had possible anxiety (ie, HADS-A score 5-7) at the baseline visit. Anxiety

symptoms were associated with poorer asthma control, more impaired quality of life, and more insomnia symptoms. Adolescents with probable anxiety disorders also had increased odds of persistent uncontrolled asthma and emergency department utilization, with no differences in physician visits or systemic corticosteroid receipt.

**CONCLUSIONS:** Inner-city black adolescents with persistent asthma have a high prevalence of anxiety symptoms associated with poorer asthma control, impaired quality of life, insomnia, and increased prospective emergency department utilization for asthma. Routine screening for anxiety disorders may be useful in the clinical management of adolescents with asthma. © 2017 American Academy of Allergy, Asthma & Immunology (*J Allergy Clin Immunol Pract* 2017;■:■-■)

**Key words:** Asthma control; Asthma exacerbation; Mental health; Adolescent; Anxiety

Despite numerous efforts to improve asthma outcomes in the United States, asthma control remains suboptimal,<sup>1</sup> and nearly 50% of children experience an asthma exacerbation each year.<sup>2</sup> Although the prevalence of asthma exacerbations is highest in school-age children, adolescents also have significant asthma burden.<sup>2,3</sup> As they develop a sense of autonomy, adolescents learn to gain greater responsibility for treating their symptoms. However, this transition can result in impaired perception of asthma symptoms necessitating treatment,<sup>4</sup> decreased preventive asthma medication use,<sup>5</sup> and an increased risk of adverse outcomes including asthma-related mortality as compared with younger children.<sup>6</sup> These behaviors may ultimately place adolescents with asthma at increased risk for anxiety symptoms and anxiety-related disorders as their asthma functional status (ie, ability to complete schoolwork, participate in activities, and regulate emotions) deteriorates.<sup>7</sup>

Asthma treatment guidelines recommend accurate diagnosis and management of comorbid illnesses, including anxiety.<sup>8,9</sup> Although there are no available federal surveillance data on

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**Abbreviations used**

ACT- Asthma Control Test

AQLQ- Asthma Quality of Life Questionnaire

HADS- Hospital Anxiety and Depression Scale

HADS-A- Hospital Anxiety and Depression Scale, Anxiety subscale

mental health disorders in US youth,<sup>10</sup> the estimated prevalence of anxiety disorders in children and adolescents aged 6 to 18 years is approximately 6.5% worldwide<sup>11</sup> and may be significantly higher in adolescents with asthma. In separate analyses of adults with asthma treated at primary<sup>12</sup> and specialty<sup>13</sup> care centers, the prevalence of probable anxiety disorders was 31.6% and 36.9%, respectively. Anxiety symptoms are also greater in adults with severe, corticosteroid-refractory asthma than in adults with corticosteroid-responsive asthma.<sup>14,15</sup> There is also some emerging evidence of racial disparities in anxiety in black versus white populations. For example, adolescents at poorer schools, which tend to have a larger proportion of black students, report more anxiety symptoms.<sup>16</sup> Interactions between income and asthma have also been demonstrated, whereby individuals with asthma and incomes less than \$25,000 per year experience the highest number of days with anxiety symptoms.<sup>17</sup> More concerning are trends related to psychological functioning and minimally adequate outpatient mental health service utilization. Blacks with anxiety disorders (and particularly those with low income), compared with whites, have significantly worse global assessment of functioning and global psychosocial functioning,<sup>18</sup> yet they are treated markedly less frequently for anxiety disorders in early and middle adulthood.<sup>19</sup> This disparity worsened by 14.2 percentage points over 1 decade<sup>20</sup> and is more pronounced among blacks residing in the South.<sup>21</sup> The reasons underlying these disparities are complex and likely related to various socioeconomic and ecological variables that similarly influence disparities in asthma-related health care utilization.<sup>22</sup>

Despite the potential importance of anxiety in asthma management, anxiety can be difficult to identify in the clinical setting or overlooked entirely because the symptom manifestation of anxiety is quite similar to that of asthma and includes respiratory difficulty (ie, shortness of breath and/or chest tightness)<sup>23</sup> and sleep disturbances.<sup>24</sup> Limited studies of anxiety in adolescents and in black populations are also an existing limitation. Moreover, no studies have examined the contribution of anxiety symptoms to key asthma outcomes such as exacerbations and health care utilization. Therefore, the purpose of this study was to (1) characterize the pattern and prevalence of anxiety and associated asthma features in a well-phenotyped cohort of black inner-city adolescents with asthma and (2) to determine the association between anxiety symptoms and prospective asthma outcomes over 1 year of follow-up. Using a validated questionnaire of anxiety symptoms,<sup>25,26</sup> we hypothesized that adolescents with increased anxiety symptoms would have greater features of asthma severity and poorer asthma control and, moreover, that anxiety symptoms would predict future exacerbations and unscheduled health care utilization for asthma.

**METHODS**

Self-reported black adolescents aged 12 to 21 years were recruited for the study through community-based advertisements across

metropolitan Atlanta, Georgia. Inclusion criteria were ability to read and speak English, a physician diagnosis of asthma, and either 12% or more reversibility in the FEV<sub>1</sub> after bronchodilator administration or airway hyperresponsiveness to methacholine, evidenced by a provocative concentration of methacholine ( $\leq 16$  mg/mL). Exclusion criteria included premature birth before 35 weeks of gestation or other comorbid airway disorders such as aspiration or vocal cord dysfunction. Permission to proceed with this study was granted by the Emory University Institutional Review Board. Informed written consent and assent were obtained.

**Study design and procedures**

Participants completed a baseline study visit and a second study visit at 1 year. Study visits were postponed if participants were acutely ill or if an asthma exacerbation treated with systemic corticosteroids was reported within the preceding 4 weeks. Between visits, participants were telephoned every 2 months to assess for adverse events. Spirometry (KoKo PDS, Ferraris, Louisville, Colo) was performed at baseline and after bronchodilator reversibility testing with 4 inhalations of albuterol sulfate (90  $\mu$ g per inhalation). Participants withheld short-acting bronchodilators for 4 hours and long-acting bronchodilators for 12 hours before spirometry testing. The best of 3 forced vital capacity maneuvers was interpreted according to population reference equations.<sup>27</sup> Allergy skin prick testing was performed after a 3-day antihistamine withhold using 12 allergen extracts: tree mix (*Quercus alba*, *Ulmus americana*, *Platanus acerifolia*, *Salix caprea*, *Populus deltoides*), grass mix (*Cynodon dactylon*, *Lolium perenne*, *Phleum pratense*, *Poa pratensis*, *Sorghum halepense*, *Paspalum notatum*), weed mix (*Artemisia vulgaris*, *Chrysanthemum leucanthemum*, *Taraxacum vulgare*, *Solidago virgaurea*), common ragweed (*Ambrosia artemisiifolia*), *Alternaria alternata*, *Aspergillus fumigatus*, *Cladosporium herbarum*, dog dander, cat dander, German cockroach (*Blattella germanica*), *Dermatophagoides farinae*, and *Dermatophagoides pteronyssinus* (Greer Laboratories, Lenoir, NC). Histamine and saline served as positive and negative controls, respectively. Test results were considered positive if a wheal of 3 mm diameter or greater and flare of 10 mm or more was present 15 minutes after application. Exhaled nitric oxide concentrations were measured online (NIOX MINO, Circrassia Pharmaceuticals, Chicago, Ill) according to recommended standards.<sup>28</sup> Demographic and medical history questionnaires, the Hospital Anxiety and Depression Scale (HADS),<sup>26</sup> the Asthma Control Test (ACT),<sup>29</sup> the Asthma Quality of Life Questionnaire (AQLQ),<sup>30</sup> and the Insomnia Severity Index,<sup>31</sup> were also completed. Neighborhood characteristics were obtained from the 2010-2014 American Community Survey available at [www.factfinder.census.gov](http://www.factfinder.census.gov).<sup>32</sup> Crime rates were obtained from the Federal Bureau of Investigation, local police departments, and municipalities and were accessed through the City Profile feature available at [www.moving.com](http://www.moving.com).

**Anxiety classification and primary outcome measures**

Participants were classified into 3 groups according to baseline HADS anxiety subscale (HADS-A) scores as follows: (1) no anxiety (HADS-A score  $< 5$ ), (2) possible anxiety (HADS-A score 5-7), and (3) probable anxiety (HADS-A score  $> 7$ ).<sup>26,33</sup> Primary outcome measures at the 1-year visit included persistent uncontrolled asthma defined by an ACT score of 19 or less<sup>29</sup> at both visits, receipt of systemic corticosteroids for an asthma

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