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Comorbidity Between Asthma Attacks and Internalizing Disorders Among Puerto Rican Children at One-Year Follow-Up

Jonathan M. Feldman, Ph.D.,

Ferkauf Graduate School of Psychology, Yeshiva University, Bronx, NY

Alexander N. Ortega, Ph.D.,

Dept. of Health Services, School of Public Health, Univ. of California, Los Angeles

Elizabeth L. McQuaid, Ph.D., and

Dept. of Psychiatry and Human Behavior, RI Hospital/Brown Medical School, Providence, RI

Glorisa Canino, Ph.D.

Behavioral Sciences Research Institute, Univ. of Puerto Rico Medical Sciences Campus, San Juan, PR

Abstract

Authors examined the association between internalizing disorders and asthma attacks at 1-year follow-up among a community sample of 1,789 children and adolescents ages 5–18 years living on the island of Puerto Rico. The Diagnostic Interview Schedule for Children was administered to assess DSM-IV internalizing disorders during the past year. Children with a lifetime history of asthma attacks at baseline had greater odds of having an internalizing disorder at 1-year follow-up, independent of socio-demographic measures. However, an association was not found between asthma attacks and persistence of internalizing disorders. These findings show that the association between internalizing disorders and asthma attacks was replicated 1 year later in the same sample.

Asthma is the most prevalent chronic illness of childhood, and the cost of disability caused by pediatric asthma is immense. Children between the ages of 5 and 17 years have the highest point-prevalence rate (9.2% in 2002) of asthma across all age-groups in the United States.¹ Asthma accounts for approximately 140 deaths, 182,000 hospitalizations, and 14.6 million school absences per year among children. The largest indirect cost of asthma is lost productivity due to missed school days, which is estimated at \$1.4 billion in the United States.¹ Despite advances in pharmacologic management of the disease, asthma continues to be a major public health problem.

Puerto Rican children are disproportionately affected by asthma. Children of Puerto Rican descent, both in the U.S. Commonwealth of Puerto Rico and the U.S. mainland, have higher prevalence rates^{2–7} and worse morbidity^{5–8} for asthma than Anglos, other ethnic minorities, and other Latino subgroups. In contrast, previous studies have shown that there are few differences on the prevalence of internalizing disorders between children living on the island of Puerto Rico and children living on the United States mainland.⁹

Children with asthma who have comorbid behavioral problems appear to be at greater risk for poor control over their asthma.¹⁰ There is also evidence of a link between depressive symptoms

and asthma mortality among children.^{11,12} Given the high prevalence rate of asthma among Puerto Rican children, examining the relationship between psychological disorders and asthma is particularly important in this population. This research may have prevention and treatment implications for both diseases.

A metaanalysis showed that children with asthma have more symptoms of anxiety and depression than children without asthma.¹³ However, because of the cross-sectional designs of most of the previous studies, little is known about the temporal relationship between internalizing symptoms and asthma. Nevertheless, there is some evidence indicating that asthma precedes the development of psychological problems. For example, a longitudinal study of a community sample showed that asthma in childhood was associated with increased risk for the development of panic disorder and/or agoraphobia in early adulthood.¹⁴ Two longitudinal studies have focused on asthma as a predictor of behavioral problems in young children. Early onset of asthma (before age 3) was identified as a risk factor for behavioral problems by age 6.¹⁵ This finding is important because Puerto Ricans have been found to have the earliest age at onset of asthma, as compared with other ethnic groups.⁸ A separate study showed that early onset of asthma was not associated with increased risk of subsequent behavior problems at 6- and 12-month follow-up, after controlling for baseline behavioral difficulties.¹⁶ However, this finding is not surprising, given the persistence of behavior problems over a relatively short time-course.

A critical area of study is whether the established link between internalizing symptoms (i.e., anxiety, depression) and asthma can be replicated across time with the same sample, and whether internalizing disorders are more persistent (i.e., have a longer time-course) among children with asthma. Replication of the association across time is important to establish whether the increased risk for internalizing disorders changes as children with asthma get older. To our knowledge, this research has yet to be conducted in the field of pediatric asthma. A limitation of the previous research on children with asthma has been the assessment of internalizing symptoms, as opposed to internalizing disorders. The present study assessed internalizing disorders by use of a well-validated structured interview based on DSM-IV.¹⁷ Furthermore, this study expanded upon the limited number of longitudinal studies in this area, and those using clinical samples, by utilizing a representative community sample of children with a broad range in age and socioeconomic status in Puerto Rico.

The goals of the current study were twofold. We attempted to replicate the association between asthma attacks and internalizing disorders by examining whether baseline (Wave 1) report of asthma attacks predicted Wave 2 internalizing disorders. Previous analyses from the first wave of this study showed that children with a lifetime history of asthma attack were more likely to have an anxiety disorder (odds ratio [OR]: 2.1; 95% confidence interval [CI]: 1.4–3.3) and a depressive disorder (OR: 3.7; 95% CI: 1.7–8.2) at baseline than children without a lifetime history of asthma attacks.⁶ The second goal of the study was to go beyond the cross-sectional examination of asthma and internalizing disorders by determining whether the persistence of internalizing disorders from baseline to 1-year follow-up was associated with lifetime history of asthma attacks.

METHOD

The methods used in this study have been reported in greater detail in separate publications.^{6,9,18} Therefore, the description of the sample and measures will be described in brief and will focus on the description and results of Wave 2 of the study, which have not been previously reported.

Participants

Children between the ages of 4 and 17 years, living on the island of Puerto Rico, comprised an island-wide household probability sample drawn on four dimensions: urban versus rural areas, age, gender, and Puerto Rico's health-reform areas. At the time of the study (1999–2001), the government of Puerto Rico was undergoing a health-reform program and had begun contracting out all health services for medically indigent citizens. In this reform, services were provided through managed behavioral healthcare organizations. A total of 2,102 children from the community were deemed eligible.⁹ At Wave 1, 1,886 children and caregivers were interviewed, for a response rate of 90.1%. At Wave 2, 1,789 caregiver–child dyads, with children from 5 to 18 years old, were interviewed, for a 94.9% retention rate at 1-year follow-up.

Measures

The Diagnostic Interview Schedule for Children (DISC)-IV was used to assess children's internalizing disorders during the past year. The DISC-IV is a structured diagnostic interview that consists of separate parent and child versions. Lay interviewers administered the DISC-IV to children age 11 years and older and their primary caregivers. Children younger than 11 years old were not interviewed with the DISC-IV, since reliability with this age-group has been shown to range from poor to fair.¹⁹ Therefore, only caregiver report was used for children younger than 11 years old. The DISC-IV uses probes to assess the degree to which psychiatric symptoms have caused distress or interference with functioning. *Internalizing disorder* refers to conditions in which criteria are met for any study depressive disorder, which included major depressive disorder or dysthymia, and/or any anxiety disorder, which included social phobia, panic disorder, generalized anxiety, separation anxiety, and posttraumatic stress disorder. Internalizing disorders were coded as positive if either parent or child report met criteria for any DSM-IV depressive or anxiety disorder. Also, positive cases were defined by moderate impairment in functioning in at least one area, as described by the DISC-IV impairment algorithm. The most recent Spanish version of the DISC-IV²⁰ was used in the present study for child and parent interviews. The Spanish version has good test–retest reliability, which is comparable to that of the English version.^{20,21}

The asthma indicator used in the present study was parent report of the child ever having had an asthma attack (*un ataque de asma*, in Spanish). We selected this measure on the basis of data from Wave 1 showing more consistent associations between internalizing disorders and report of asthma attacks, as opposed to report of an asthma diagnosis.^{6,18} The analyses of Wave 1 data also showed that lifetime report of an asthma attack (22%) was less common than lifetime report of an asthma diagnosis (32%).

Sociodemographic information was also collected by parent report. Zone of residence was categorized as either Urban or Rural. Parents reported their perception of poverty as either living well, living from check to check, or living poorly. Perception of poverty was used instead of other usual indicators of poverty, such as household income or parental education, because previous analyses using the current data showed no relationship between psychiatric disorders and income or parental education.⁹ The items used to assess perception of poverty were adapted from a measure developed by Gore et al.²² This measure has been used in a number of other studies.^{23–25}

Procedure

Wave 1 was conducted from July 1999 to December 2000, and Wave 2 was conducted 1 year later, from July 2000 to December 2001. The same survey-interviewing procedure was used for Wave 1 and Wave 2. Interviews were conducted in the families' homes, and different interviewers were used for the child and parent interviews. Interviewers were blinded to the

results of each other's interviews. The adult informant was the child's biological mother in approximately 90% of the interviews. All interviews were audiotaped, and 15% were reviewed for quality-control purposes. The study was approved by the Institutional Review Board of the University of Puerto Rico, Medical Sciences Campus. Parent/Caregiver consent and child assent were obtained from each family.

Data Analysis

Analyses were weighted to account for the stratified sampling design and conducted with SUDAAN software.²⁶ We conducted chi-square analyses on sociodemographic measures to examine between-group differences (presence/absence of lifetime asthma attack, presence/absence of an internalizing disorder during past year) at Wave 2. Logistic-regression models were used to predict the presence of an internalizing disorder at Wave 2 from asthma attack at Wave 1, adjusting for gender, age, zone of residence, and perception of poverty. This analysis examined whether the association between lifetime history of asthma attacks and internalizing disorders would be replicated at 1-year follow-up. Also, we examined whether lifetime history of asthma attacks at Wave 1 predicted an internalizing disorder at Wave 2, after including initial diagnosis of internalizing disorder and sociodemographic variables in the model. This model included the interaction between report of asthma attacks and internalizing disorder at Wave 1 to examine the relationship between persistence of internalizing disorders and asthma attacks. We chose to combine anxiety and depressive disorders into the single category of internalizing disorders in this study to obtain adequate power to examine this interaction term. Also, we divided the sample into participants with and without an internalizing disorder at Wave 1 for the purposes of examining the rates of persistence, remission, and new diagnoses of internalizing disorders at 1-year follow-up. Chi-square analyses were conducted to examine whether there were between-group differences. We also report odds ratios (ORs), with 95% confidence intervals (CIs).

RESULTS

A total of 344 families (19%) reported a lifetime history of asthma attacks at Wave 2. Ninety-one children (5%) met criteria for an internalizing disorder during the previous year at Wave 2. Thirty-six children (2%) met criteria for any depressive disorder, and 75 children (4%) met criteria for any anxiety disorder.

Table 1 shows the sociodemographic characteristics of the sample at Wave 2. The only significant between-group difference was that older children were more likely to have an internalizing disorder.

A greater percentage of children with asthma attacks had an internalizing disorder at both Wave 1 and Wave 2 than children without asthma attacks. Table 2 shows that at Wave 1, approximately 15% of children with a lifetime history of asthma attacks met criteria for an internalizing disorder. At Wave 2, approximately 10% of children with a lifetime history of asthma attacks had an internalizing disorder. A similar downward trend in the prevalence of internalizing disorders was also found among children without asthma attacks. A systematic attenuation of symptoms over time has been documented in other epidemiologic studies.^{27,28}

Table 3 shows that children with a lifetime history of asthma attacks at Wave 1 were more likely to have an internalizing disorder at Wave 2 than children without a history of asthma attacks. This result was still significant after adjusting for gender (OR: 1.3; 95% CI: 0.8–2.2), age (OR: 1.6; 95% CI: 1.0–2.8), zone of residence (OR: 1.2; 95% CI: 0.6–2.2), and perception of poverty (OR: 1.1; 95% CI: 0.6–2.0; OR = 1.4; 95% CI: 0.6–3.3). However, lifetime report of an asthma attack at Wave 1 was no longer associated with an internalizing disorder at Wave 2, after entering Wave 1 internalizing disorder into the model. Children with an internalizing

disorder at Wave 1 were more likely to have an internalizing disorder at Wave 2, compared to children without an internalizing disorder at Wave 1 (OR: 11.4; 95% CI: 5.7–22.7).

There was no relationship found between report of asthma attacks and persistence of internalizing disorders. The interaction between asthma attacks and internalizing disorder at Wave 1 was not significant in predicting an internalizing disorder at Wave 2 (OR: 1.0; 95% CI: 0.3–3.4). Table 4 and Table 5 show the rates of remission, persistence (i.e., internalizing disorder at Wave 1 and Wave 2), new diagnoses at Wave 2, and no-diagnoses at both waves for internalizing disorders in both groups. No between-group differences were present.

DISCUSSION

This study replicates at 1-year follow-up our earlier finding showing an association between asthma attacks and internalizing disorders among island Puerto Rican children. Children with a lifetime history of asthma attacks had higher odds of having an internalizing disorder at baseline^{6,18} and at 1-year follow-up than children without asthma attacks, after controlling for sociodemographic measures. Therefore, these data show that comorbidity between asthma attacks and internalizing disorders is a consistent finding across time. However, this study did not show a relationship between asthma attacks and persistence of internalizing disorders. Therefore, the time-course of internalizing disorders may not be different between children with and without asthma attacks.

The longitudinal design of this study extends the literature by showing that the association between asthma attacks and internalizing disorders is a consistent finding in the same population over a 1 year-time period. It is important to examine this relationship longitudinally to determine whether this association exists over time at both the group and individual level. As a group, children with asthma consistently appear to be at greater risk for internalizing disorders. The present study is consistent with many cross-sectional studies showing an association between internalizing symptoms and asthma.¹³ Previous longitudinal studies have shown that pediatric asthma is associated with elevated risk for development of subsequent behavioral problems later in childhood¹⁵ and panic disorder in adulthood.¹⁴ These studies suggest that asthma may be a contributing factor to the etiology of internalizing symptoms.

Psychological and biological factors may contribute to the high rate of comorbidity between internalizing disorders and asthma. The ongoing, daily stressors involved in asthma management, such as trigger avoidance and medication regimens, may increase psychological symptoms among children. Also, cognitive variables associated with reactions to asthma, such as fear of bodily sensations²⁹ and learned helplessness,³⁰ may contribute to anxiety and depression, respectively. Mowrer's two-factor theory of classical and operant conditioning³¹ may also be applied to this relationship. For example, a child who has experienced repeated asthma attacks at social events might start avoiding parties because of embarrassment, which is then maintained via operant conditioning (i.e., negative reinforcement). Conversely, stress may contribute to greater asthma morbidity via autonomic^{32–33} and inflammatory^{34–36} pathways involved in stress responses. Behavioral factors, such as poor adherence with asthma self-management plans, may also play a role in poor asthma control.³⁷ These pathways may then lead to a cycle of asthma exacerbation and further stress, depression and/or anxiety among children with internalizing disorders.

The findings from the present study do not support the notion that asthma attacks are associated with persistence of internalizing disorders across a 1-year time period. The interaction between asthma attacks and internalizing disorders at Wave 1 was not significant in predicting an internalizing disorder at Wave 2. Therefore, the association found at 1-year follow-up may reflect the combination of higher baseline prevalence rates of internalizing disorders and the

natural time course of internalizing disorders among youths. Both groups displayed a similar rate of attenuation for internalizing disorders. One explanation for these findings is that asthma and internalizing disorders may simply be two chronic, coexisting conditions that do not reciprocally influence one another. Previous studies have demonstrated the continuity of internalizing disorders across time among youths in the community³⁸ and in primary care.³⁹ Costello and colleagues³⁸ found that children with a previous depressive episode were 7.0 times more likely to experience a later depressive episode. Children with a previous diagnosis of an anxiety disorder were 2.4 times more likely to meet criteria for a later diagnosis of an anxiety disorder. Indeed, longitudinal studies have shown that the strongest predictor of psychopathology at Wave 2 is psychopathology at Wave 1,⁴⁰ which was also found in the present study.

The continuity of depression and anxiety may explain why the association between asthma and internalizing disorders is seen over time, independent of any unique relationship between these two conditions. Rates of relapse and persistence of internalizing disorders may not be different between children with and without asthma. In the present study, 31% of children with asthma attacks and 24% of children without asthma attacks had an internalizing disorder at both waves of the study. It will be important to explore whether similar patterns of persistence and remission are found over longer periods of follow-up. Although the course of internalizing disorders may not be different between children with and without asthma, these findings show that children with asthma attacks are consistently at greater risk for having an internalizing disorder.

These conclusions should be interpreted with caution because of several limitations in the present study. Our measure of asthma was simply based on parent report of asthma attacks and not confirmed by medical chart review or physician assessment using current national guidelines.⁴¹ We also did not have information on asthma severity, which may be a key factor in the relationship between asthma and persistence of internalizing disorders. In addition, the assessment of asthma attack was based on lifetime history, although the assessment of psychiatric disorders was based on the past 12 months. Therefore, it was not possible to examine whether internalizing disorders preceded the development of asthma. Examining the etiology of the relationship between asthma and internalizing disorders was also limited by lack of information regarding the age at asthma onset. Finally, the small number of children who met criteria for an internalizing disorder at Wave 2 limited our ability to examine anxiety and depressive disorders separately. Nevertheless, the high retention rate of participants (94.9%) at 1-year follow-up suggests that this community sample was a representative one.

CONCLUSION

To our knowledge, this is the first study to examine the persistence of the relationship between internalizing disorders and asthma attacks among children. This study showed that Puerto Rican children with asthma attacks appear to be at greater risk for an internalizing disorder at baseline and at 1-year follow-up, thereby replicating this association in the same community sample. However, support was not found for a relationship between asthma attacks and persistence of internalizing disorders. The longitudinal design of this study is a first step toward a better understanding of the association between asthma and internalizing disorders. Nevertheless, these findings should be considered preliminary because of the limitations of the study. Future longitudinal studies should compare asthma outcomes across time between children with and without an internalizing disorder. Conversely, severity and persistence of internalizing disorders should also be examined across longer periods of time between children with asthma and healthy children. Age at onset for each condition would provide insight into the etiology among children with both conditions. These studies would provide further assessment of whether the relationship between asthma and internalizing disorders is an

interactive, reciprocal one or simply two chronic conditions that tend to co-occur. This area of research may have important clinical implications for whether treatment strategies need to be tailored to children with asthma and internalizing disorders.

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TABLE 1

Weighted Percentage Demographic Characteristics of Sample at Wave 2

	Ever Had an Asthma Attack (N = 344)	Never Had an Asthma Attack (N = 1,436)	p ^a	Internalizing Disorder (N = 91)	No Internalizing Disorder (N = 1,698)	p ^a
Gender			0.38			0.79
Male	21.0	79.0		5.2	94.8	
Female	18.1	81.9		4.8	95.2	
Age, years			0.28			0.01
5–10	21.5	78.5		3.1	96.9	
11–18	18.1	81.9		6.4	93.6	
Zone of residence			0.63			0.72
Urban	19.9	80.1		5.2	94.9	
Rural	18.5	81.5		4.6	95.4	
Perception of poverty			0.05			0.07
Live well	20.9	79.1		3.8	96.2	
Check-to-check	19.9	80.1		7.5	92.5	
Live poorly	12.8	87.2		4.5	95.5	

^a Chi-square tests.

TABLE 2Weighted Percentage for Asthma-Attack History $\times$ Internalizing Disorders at Wave 1 and Wave 2

	Ever Had an Asthma Attack: Wave 1	Never Had an Asthma Attack: Wave 1	p^a
Wave 1 internalizing disorder (N = 152)	14.8	7.2	0.002
	Wave 2	Wave 2	
Wave 2 internalizing disorder (N = 91)	9.7	3.9	0.008

^a Chi-square tests.

TABLE 3

Relationship Between Wave 1 Asthma-Attack History and Internalizing Disorders at Wave 1 and Wave 2

	Wave 1 Asthma Attack OR (95% CI)	Wave 1 Asthma Attack: Adjusted for Demographics ^a OR (95% CI)	Wave 1 Asthma Attack: Adjusted for Demographics and Wave 1 Internalizing Disorders OR (95% CI)
Wave 1 internalizing disorders (N = 152)	2.2 (1.5–3.4)	2.3 (1.5–3.6)	—
Wave 2 internalizing disorders (N = 91)	2.0 (1.1–3.6)	2.1 (1.2–3.8)	1.5 (0.7–3.2)

^aDemographics include gender, age, zone of residence, and perception of poverty.

TABLE 4

Weighted Percentage for Remission and Persistence of Internalizing Disorders at Wave 2 Among Participants With an Internalizing Disorder at Wave 1

	Ever Had an Asthma Attack, % (N = 53)	Never Had an Asthma Attack, % (N = 94)
Remission	69.4	75.9
Persistence	30.6	24.1

$\chi^2[1] = 0.36; p = 0.55.$

TABLE 5

Weighted Percentage of New Diagnoses of Internalizing Disorders at Wave 2 Among Participants Without an Internalizing Disorder at Wave 1

	Ever Had an Asthma Attack, % (N = 341)	Never Had an Asthma Attack, % (N = 1,286)
New internalizing disorder	3.8	2.6
No internalizing disorder at both waves	96.2	97.4

$\chi^2[1] = 0.92$; $p = 0.34$.