The Adaptive Effect of Illness-Specific Panic-Fear on Asthma Outcomes in Mexican and Puerto Rican Children

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Objective To examine baseline measures of illness-specific panic-fear (ie, the level of anxiety experienced specifically during asthma exacerbations) as a protective factor in pediatric asthma outcomes over a 1-year period.

Study design The sample comprised 267 children (Mexican, n = 188; Puerto Rican, n = 79; age 5-12 years) from a longitudinal observational study conducted in Phoenix, AZ and Bronx, NY. Assessments were done at baseline and 3, 6, 9, and 12 months. The Childhood Asthma Symptom Checklist was administered at baseline to children and caregivers to assess children's illness-specific panic-fear. Asthma outcome variables quantified longitudinally included pulmonary function, the Asthma Control Test, acute healthcare utilization, and medication adherence, measured by devices attached to inhaled corticosteroids.

Results Child report of illness-specific panic-fear at baseline predicted higher forced expiratory volume in 1 second (FEV_1) % across 1-year follow-up in Mexican children ($\beta = 0.17$, $P = .02$), better asthma control in Puerto Rican children ($\beta = 0.45$, $P = .007$), and less acute healthcare utilization for asthma in both groups (Mexicans: $\beta = -0.39$, $P = .03$; Puerto Ricans: $\beta = -0.47$, $P = .02$). Caregiver report of child panic-fear predicted higher FEV_1% in Mexican ($\beta = 0.30$; $P = .02$) and Puerto Rican ($\beta = 0.19$; $P = .05$) children. Panic-fear was not related to medication adherence.

Conclusions Illness-specific panic-fear had beneficial effects on asthma outcomes in both groups of Latino children. The heightened vigilance associated with illness-specific panic-fear may lead children to be more aware of their asthma symptoms and lead to better strategies for asthma management. *(J Pediatr 2019; ■:1-9)*.

See editorial, p •••

The largest ethnic disparity in asthma prevalence and control exists between 2 Latino subgroups: Puerto Rican children and Mexican children. Puerto Rican children exhibit the highest rates of asthma prevalence and morbidity, whereas Mexican children have the lowest rates.[1,2] Poor adherence to inhaled corticosteroid therapy is common,[3,4] especially in Puerto Rican and Dominican children.[5-7] Fewer than 50% of prescribed doses are taken,[8,9] and inhaled corticosteroid adherence rates as low as 28% were found in a sample primarily consisting of Puerto Rican children with electronic monitoring devices.[10] A sample of primarily Mexican children with asthma had high controller medication adherence rates (87%), although these data were based solely on self-report.[11] Identifying predictors of positive asthma management behaviors (eg, attention to asthma symptoms, inhaled corticosteroid adherence, avoidance of asthma triggers) may play a key role in reducing these ethnic disparities in asthma outcomes.

Illness-specific panic-fear is the level of anxiety experienced specifically during asthma exacerbations. This construct is different from general anxiety or anxiety disorders, as illness-specific panic-fear may be adaptive for asthma. At 6 months after discharge, adult inpatients with asthma and high illness-specific panic-fear were rehospitalized for asthma 50% less frequently than patients with low panic-fear.[12] Low illness-specific panic-fear in a community sample of adults predicted future asthma attacks and emergency health care use in patients who recently suffered an asthma attack.[13] The adaptive nature of panic-fear for asthma may be due to increased vigilance of asthma symptoms and adherence to self-management plans.[14] Two recent pediatric studies[15,16] examined anxiety about asthma over the previous 2 weeks. This construct is similar to illness-specific panic-fear, although it does not specifically focus on anxiety symptoms during asthma attacks. Higher asthma-related anxiety in adolescents was associated with self-reports of taking breathing problems more seriously, visiting a provider for the presence of asthma symptoms,[15] and taking steps to prevent and manage asthma symptoms.[16] Therefore, asthma-related anxiety may be protective in children.

ACT	Asthma Control Test
CASCL	Childhood Asthma Symptom Checklist
FEV_1	Forced expiratory volume in 1 second
SEM	Structural equation model

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Theoretical models for the perception of asthma symptoms highlight the importance of recognizing a physical sensation as threatening and then mobilizing attentional resources toward this threat.[17] Social and contextual factors also play roles in models of asthma disparities that examine asthma symptom interpretation and treatment decisions for asthma.[18] One key input affecting the interpretation of asthma symptoms is the emotional component, such as anxiety, which can heighten the perceived threat level (**Figure**). Anxiety elicited specifically within the context of asthma attacks may lead to appropriate preventative asthma management behaviors, including trigger avoidance, medication adherence, and compliance with asthma action plans. We hypothesized that illness-specific panic-fear would prospectively have an adaptive effect on longitudinal asthma outcomes (ie, better asthma control assessed by pulmonary function and symptom report, less acute healthcare utilization, and better inhaled corticosteroid adherence) in both Puerto Rican and Mexican children over a 1-year period.

Methods

The overarching aim of the larger study was to understand the existing pediatric asthma disparities between Puerto Ricans and Mexicans using a longitudinal, observational design.[19] The focus is on the illness-specific panic-fear measure. This multisite study recruited participants from asthma/allergy clinics from 2 inner-city hospitals in the Bronx, New York (n = 110) and 2 school-based health clinics in Phoenix, Arizona and Phoenix Children's Hospital Breathmobile (n = 157) between June 2010 and October 2013. Data collection was completed by August 2014. A total of 267 Latino children aged 5-12 years with a diagnosis of asthma and their caregivers participated in the study. Electronic medical records were used to identify and confirm asthma diagnoses. Recruitment strategies included mailings from providers, phone calls, and in-person enrollment at clinics.

The children and caregivers were required to speak either English or Spanish, to have no learning/cognitive disabilities that would impact study participation, and to have no other significant pulmonary conditions in the child. The caregiver was chosen based on self-identification as being a primary caregiver of the child who had either primary or at least equal responsibility for the child's day-to-day asthma management. Only Puerto Rican (n = 79) and Mexican (n = 188) families were enrolled, and ethnicity was determined by caregiver self-report.

Caregivers and children provided consent/assent for their participation in the study. The Institutional Review Boards of Albert Einstein College of Medicine, Arizona State University, Ohio State University, Phoenix Children's Hospital, and Scottsdale Healthcare approved the study. Children and caregivers completed study measures at a baseline session and at 3-, 6-, 9-, and 12-month follow-up sessions, which allowed for seasonal variations in asthma symptoms across the year. The measures were completed in English or Spanish, based on each participant's preference. Children completed spirometry testing to assess pulmonary function at all sessions. Families were financially compensated for their participation and travel to the study sites.

Measures

Exogenous Variables

Illness-Specific Panic-Fear. The Childhood Asthma Symptom Checklist (CASCL) is a 47-item self-report measure of symptoms[20] modified from the adult version[21] of this scale with a similar factor structure and with modest correlations

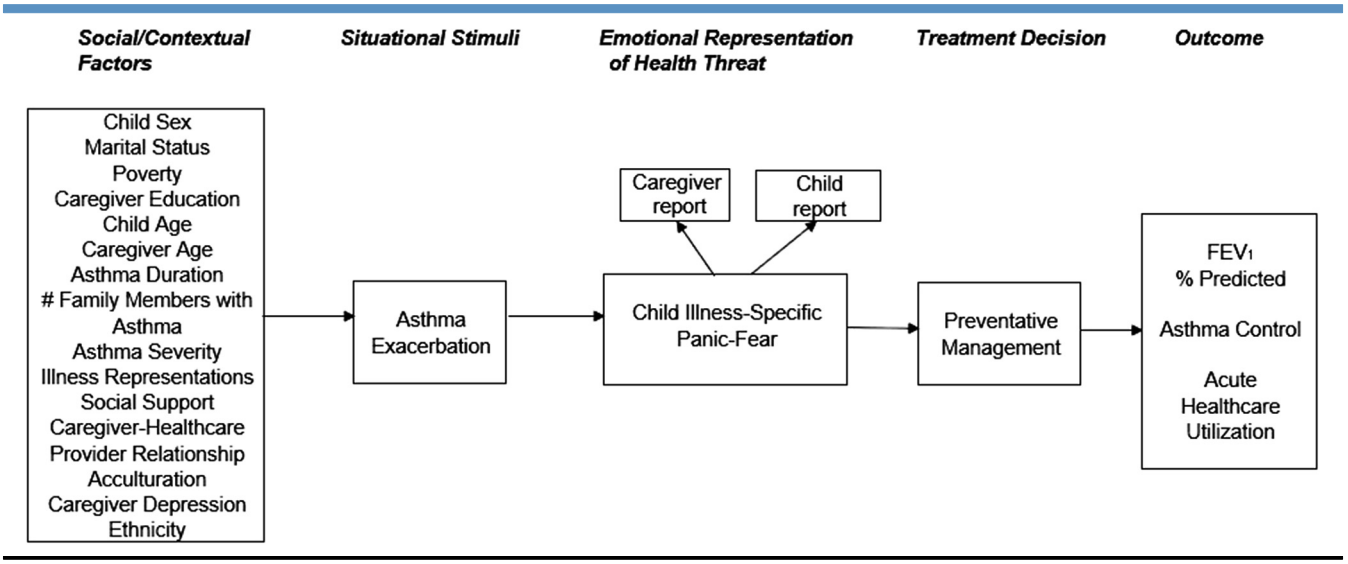

Figure. Conceptual model.

between child and caregiver reports of items. The panic-fear subscale includes 15 items assessing the frequency at which children experience anxiety symptoms (eg, scared, worried about the attack, frightened) during asthma attacks. The CASCL also includes subscales measuring irritability (eg, cranky, very angry/mad, unhappy with things) and general physical symptoms (eg, hard to breathe, heavy feelings in chest, worn out). The Spanish version of the CASCL has been shown to have good internal consistency and construct validity.[22] Caregivers also completed the CASCL with respect to how often they perceived that their children experienced these symptoms during asthma exacerbations. The panic-fear subscales were analyzed as the main predictors for this study.

Social/Contextual Factors. Demographic data, including self-reported socioeconomic status, were collected from the caregivers.[23] Caregivers also completed the Center for Epidemiological Studies Depression Scale[24] to assess caregiver depressive symptoms, the Asthma Illness Representation Scale[25,26] to assess health beliefs about asthma, the Stephenson Multigroup Acculturation Scale to assess degree of immersion to the ethnic and dominant society culture,[27] the Caregiver-Healthcare Provider Relationship Scale,[25,26] and the Family and Friend Support measure.[28] Asthma severity was rated by study clinicians and categorized as intermittent, mild persistent, moderate persistent, or severe persistent based on national guidelines.[29]

Endogenous Variables

Pulmonary Function. Spirometry testing was performed at the end of each session using a spirometer (nSpire Health, Longmont, Colorado) to assess multiple measures of pulmonary function. The testing was done in accordance with guidelines published by the American Thoracic Society.[30] The measure of pulmonary function analyzed for this study was the percentage of predicted forced expiratory volume in 1 second (FEV_1 % predicted), defined as the volume of air exhaled during the first second of a forced vital capacity maneuver.

Asthma Control. The Childhood Asthma Control Test (C-ACT)[31] is a combination of child (4 items) and caregiver (3 items) responses designed to assess asthma control over the previous month. Children aged 12 years completed the Asthma Control Test (ACT),[32] which consists of 5 items. Both versions assess interference with activities, asthma symptoms, and nighttime awakenings and have been verified to be reliable and valid in English[31-33] and Spanish.[34] Higher scores indicate better asthma control.

Acute Health Care Utilization. The total numbers of acute asthma-related sick visits to clinics, emergency department visits, and hospitalizations were summed based on a combination of medical chart review and caregiver report at each study visit across the 12 months of the study. At each visit, the higher number of visits obtained by self-report vs chart review was used, to account for visits that were outside the study sites' medical records.

Adherence Monitoring. Adherence to inhaled corticosteroid medications was objectively measured by a Doser device (Meditrack, Easton, Massachusetts), which was attached to the top of a metered dose inhaler at the baseline session. The Doser records the daily frequency of medication use over a 30-day period. This device is more reliable for tracking medication use than self-report or pharmacy records.[35] Data from the device were downloaded at all follow-up visits to assess longitudinal adherence across 12 months. Adherence data across the follow-up periods were available for 123 children (n = 89 Mexican, n = 34 Puerto Rican) out of 192 children prescribed inhaled corticosteroid medications compatible with the Doser device (eg, noncombination inhaled corticosteroids). Other reasons for missing adherence data included failure to bring medication to the visit, battery failure, and loss of the device. Overall percent adherence was calculated as the number of total doses taken per day, divided by the number of prescribed doses for that day across the monitoring period. Data reduction steps truncated adherence to a maximum of 100% per day if the number of doses recorded was greater than the prescribed doses on any particular day due to accidental recordings or "dumping" of doses to catch up for previously missed doses.

Statistical Analyses

Descriptive statistics were used to assess the distributional characteristics of the data, including mean and SD for continuous variables and proportion for categorical variables. Effect sizes were computed for continuous variables (Cohen *d*), and ORs were calculated for categorical variables to examine baseline differences between Mexicans and Puerto Ricans. To assess for sample bias, demographic characteristics were compared between participants and eligible individuals who declined to participate. A 2-group (Mexican and Puerto Rican) latent variable structural equation growth model was used to test the hypotheses and examine model fit statistics. Structural equation modeling (SEM) is a powerful multivariate approach that has several advantages over multiple regression. SEM allows for testing the hypothesized theoretical relationships not only by obtaining parameter estimates, but also by examining the fit of the data to the hypothesized model. SEM allows for specification of more complex models with multiple intervening and dependent variables and for examination of direct and indirect effects on the outcomes of interest. Instead of adjusting or controlling for variables in the model as in multiple regression, SEM allows the variables to correlate and model estimation is based on the covariance matrix – not correlations. Covariance structure models also allow us to test whether a set of variables have equal variances across two or more groups.

Baseline measures of the exogenous variables were used to model longitudinal changes in each endogenous variable over the 12-month period. Seasonality was examined as part of our model trimming analyses and was determined to not

Table I. Sample characteristics at baseline (N = 267)

Variables	Mexican (N = 188)	Puerto Rican (N = 79)	Effect size, OR, Cohen *d*	*P* value
Child sex, female, n (%)	62 (33.0)	32 (40.5)	0.72	.24
Caregiver sex, female, n (%)	180 (95.7)	74 (93.7)	1.52	.52
Married, n (%)	104 (55.3)	24 (30.4)	2.84	.0002
Poor, n (%)	126 (67.0)	25 (31.7)	4.39	<.0001
High school graduate, n (%)	85 (45.5)	48 (60.8)	0.54	.02
Language of caregiver interview, Spanish, n (%)	170 (90.4)	15 (19.0)	40.0	<.0001
Any controller medication use in past month, n (%)	130 (69.1)	62 (78.5)	0.61	.12
Asthma severity (clinician-rated), n (%)				.02
Intermittent (reference group)	32 (17.2)	11 (14.7)		
Mild persistent	63 (33.9)	16 (21.3)	0.74	
Moderate persistent	74 (39.8)	31 (41.3)	1.22	
Severe persistent	17 (9.1)	17 (22.7)	2.91	
Asthma Control Test, well controlled, n (%)	106 (56.4)	12 (15.2)	7.22	<.0001
Child age, yr, mean (SD)	9.67 (2.15)	9.23 (2.23)	0.20	.13
Caregiver age, yr, mean (SD)	35.47 (6.31)	38.42 (10.47)	0.34	.02
Asthma duration, mo, mean (SD)	67.94 (39.54)	88.46 (31.77)	0.57	<.0001
Family members with asthma, n, mean (SD)	1.24 (.73)	0.91 (1.09)	0.36	.02
Caregiver depression (CES-D scale), mean (SD)	10.95 (10.15)	16.03 (12.30)	0.46	.002
Asthma Symptom Checklist (C-CASCL): panic-fear (child), mean (SD)	35.12 (12.69)	31.10 (12.32)	0.32	.02
Asthma Symptom Checklist (P-CASCL): panic-fear (caregiver), mean (SD)	30.89 (11.88)	30.58 (12.24)	0.03	.85
FEV_1 % predicted, mean (SD)	101.23 (15.34)	92.51 (13.98)	1.30	.001
% inhaled corticosteroid adherence, 3 mo, mean (SD)	45.30 (30.45)	35.65 (28.91)	0.33	.28
% inhaled corticosteroid adherence, 6 mo, mean (SD)	51.70 (32.38)	35.44 (37.86)	0.46	.08
% inhaled corticosteroid adherence, 9 mo, mean (SD)	48.36 (29.52)	29.94 (27.57)	0.64	.03
% inhaled corticosteroid adherence, 12 mo, mean (SD)	49.13 (31.79)	26.41 (28.98)	0.75	.02

CES-D, Center for Epidemiological Studies Depression Scale.
N = 123 for inhaled corticosteroid adherence data.

be a significant variable in the models; thus, for parsimony, this variable was not included in the final models. The analyses reported by Bruzzese et al[16] revealed a curvilinear relationship between adolescent asthma-related anxiety and symptom prevention; thus, we ran linear and quadratic models for all outcomes. Our results revealed no curvilinear relationships between children's illness-specific panic-fear and the specified outcomes in this study.

A P value < .10 was considered statistically significant, which is the convention for SEM analyses.[36] SAS version 9.4 for Windows (SAS Institute, Cary North Carolina) was used for the descriptive analyses, and MPlus version 8.1[37] was used for the SEM analyses. In SEM, various fit statistics (eg, root mean square error of approximation, comparative fit index, Tucker-Lewis index, standardized root mean square residual) are used to ascertain how well the sample data fit the hypothesized model. All models met or exceeded the thresholds for determining acceptable fit. To test model effect sizes and equivalence between Puerto Ricans and Mexicans, the χ^2 difference test was performed on the 2 models[37]; if the difference was statistically significant, then the models were considered to differ. Missing data patterns were explored and determined to be missing completely at random. Multiple imputation was done when exogenous variables were missing.

Results

A total of 267 caregiver-child dyads (age range, 5-12 years; mean age, 9.5 years) were enrolled in the study. Retention was computed as the number of participants who completed 3 or more of the 5 assessments. Overall retention was 82% across the 12 months. As expected, the Arizona sites consisted of mostly Mexican families (99.4%), and the Bronx had mainly Puerto Rican families (70.9%) with a smaller number of Mexican families (29.1%). Mexican caregivers were younger and more likely to be poor, to be married, and to complete the interview in Spanish (Table I). Puerto Rican caregivers had a higher educational level and more depressive symptoms. Mexican children had greater illness-specific panic-fear, lower asthma severity, better asthma control, and shorter duration of asthma compared with Puerto Rican children. Adherence to inhaled corticosteroid medications was better in Mexican children than in Puerto Rican children at the 6-, 9-, and 12-month follow-ups. Diagnostic analyses revealed that children with missing adherence data were more likely to have mild or severe persistent asthma and to have caregivers who were older and high school graduates.

Child Report of Illness-specific Panic-Fear

Child self-report of illness-specific panic-fear at baseline predicted higher FEV_1 (Table II) across the 1-year follow-up in Mexican children, and a similar trend was observed in Puerto Rican children. The 2-group model explained more variance in Mexicans than Puerto Ricans ($P < .0001$). Child-reported illness-specific panic-fear predicted better asthma control (on the ACT) in Puerto Rican children, but not in Mexican children. The Puerto Rican model had higher explained variance than the Mexican model on the ACT ($P < .0001$).

Table II. Child-reported illness-specific panic-fear as a longitudinal predictor of FEV_1, asthma control, acute healthcare utilization, and controller medication adherence

Variables	FEV_1 % predicted				Asthma control				Acute healthcare utilization				Controller medication adherence			
	Mexican		Puerto Rican		Mexican		Puerto Rican		Mexican		Puerto Rican		Mexican		Puerto Rican	
	67%		62%		38%		53%		12%		41%		43%		48%	
Model R^2	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value
Child sex	−0.05 (0.08)	.04	−0.08 (0.13)	.17	−0.02 (0.09)	.86	−0.13 (0.12)	.21	−0.09 (0.12)	.49	0.13 (0.14)	.36	−0.46 (0.13)	<.0001	0.28 (0.23)	.23
Marital status	−0.06 (0.08)	.02	−0.05 (0.15)	.04	−0.19 (0.09)	.04	0.09 (0.13)	.52	0.29 (0.13)	.03	−0.32 (0.15)	.03	−0.04 (0.15)	.78	0.003 (0.26)	.99
Poverty	0.08 (0.08)	.05	0.12 (0.15)	.20	0.04 (0.09)	.64	0.44 (0.13)	.001	−0.22 (0.13)	.09	−0.52 (0.15)	.001	0.15 (0.14)	.28	−0.26 (0.27)	.34
Caregiver education	−0.01 (0.08)	.02	−0.21 (0.12)	.03	−0.11 (0.09)	.21	0.14 (0.12)	.26	−0.06 (0.13)	.65	0.31 (0.14)	.03	−0.006 (0.13)	.96	0.21 (0.22)	.36
Child age	−0.31 (0.08)	.01	−0.38 (0.16)	.14	0.004 (0.10)	.97	0.09 (0.12)	.45	−0.44 (0.15)	.003	−0.72 (0.21)	.001	−0.08 (0.16)	.63	−0.16 (0.29)	.59
Caregiver age	−0.12 (0.08)	.008	0.03 (0.15)	.30	−0.03 (0.11)	.79	0.71 (0.18)	<.0001	−0.09 (0.13)	.51	0.35 (0.14)	. 01	0.10 (0.13)	.44	0.17 (0.29)	.55
Asthma duration	−0.19 (0.08)	.01	0.16 (0.13)	.03	−0.09 (0.10)	.38	−0.28 (0.15)	.06	0.001 (0.14)	.99	0.39 (0.18)	.04	−0.006 (0.17)	.97	−0.24 (0.27)	.37
Family members with asthma	−0.03 (0.08)	.01	−0.42 (0.14)	.17	−0.05 (0.10)	.62	−0.38 (0.13)	.005	0.13 (0.14)	.33	0.40 (0.16)	.01	−0.03 (0.15)	.84	−0.31 (0.29)	.28
Asthma severity	0.05 (0.08)	.05	0.24 (0.14)	.06	0.04 (0.09)	.70	0.10 (0.13)	.47	−0.12 (0.13)	.35	0.22 (0.17)	.19	−0.20 (0.14)	.16	0.14 (0.36)	.70
Illness representations	0.02 (0.10)	.03	0.06 (0.14)	.09	0.20 (0.11)	.07	0.14 (0.13)	.27	−0.34 (0.16)	.03	0.04 (0.15)	.79	0.15 (0.18)	.40	−0.31 (0.26)	.23
Social support	0.05 (0.09)	.02	−0.11 (0.13)	.01	0.05 (0.10)	.65	0.14 (0.13)	.28	−0.24 (0.14)	.08	−0.06 (0.16)	.71	0.26 (0.14)	.07	−0.44 (0.26)	.08
Healthcare provider relationship	0.03 (0.09)	.05	−0.19 (0.13)	.11	0.01 (0.11)	.93	−0.02 (0.12)	.90	−0.12 (0.15)	.44	0.17 (0.15)	.25	0.04 (0.16)	.82	−0.18 (0.27)	.50
Ethnic society immersion	−0.10 (0.10)	.04	−0.38 (0.16)	.03	−0.01 (0.11)	.92	0.09 (0.16)	.56	−0.18 (0.15)	.24	0.06 (0.19)	.77	−0.24 (0.16)	.12	0.05 (0.32)	.87
Dominant society immersion	0.07 (0.10)	.03	0.55 (0.16)	.09	0.001 (0.11)	.99	0.04 (0.15)	.81	0.22 (0.15)	.15	−0.14 (0.18)	.44	−0.09 (0.16)	.60	−0.08 (0.42)	.85
Caregiver depression	0.05 (0.08)	.03	−0.17 (0.13)	.08	−0.07 (0.10)	.48	0.26 (0.15)	.08	−0.15 (0.13)	.25	−0.34 (0.18)	.06	0.19 (0.13)	.15	−0.21 (0.26)	.41
Illness-specific physical symptoms (child)	−0.08 (0.10)	.03	−0.04 (0.17)	.03	−0.16 (0.11)	.15	−0.86 (0.16)	<.0001	0.11 (0.15)	.49	0.44 (0.20)	.03	0.02 (0.16)	.92	0.41 (0.36)	.25
Illness-specific irritability (child)	−0.01 (0.11)	.04	−0.08 (0.15)	.11	−0.25 (0.12)	.04	−0.18 (0.14)	.20	0.20 (0.17)	.25	0.24 (0.16)	.15	0.10 (0.18)	.57	−0.07 (0.26)	.78
Illness-specific panic-fear (child)	0.17 (0.11)	.02	0.47 (0.18)	.10	0.08 (0.13)	.55	0.45 (0.17)	.007	−0.39 (0.18)	.03	−0.47 (0.20)	.02	−0.04 (0.17)	.81	−0.58 (0.36)	.11

Child panic-fear predicted less acute asthma-related healthcare utilization in both Puerto Rican and Mexican children. The Puerto Rican model accounted for a greater amount of explained variance compared with the Mexican model on acute healthcare utilization ($P < .0001$). Child illness-specific panic-fear did not predict inhaled corticosteroid adherence in Mexicans or Puerto Ricans. The other emotional CASCL subscale of irritability during asthma attacks predicted the opposite direction from panic-fear: worse asthma control and lower FEV_1 in Mexican children.

Caregiver Report of Illness-specific Panic-Fear

Child panic-fear reported by caregivers also predicted higher FEV_1 (Table III) in both groups of children. The model for Mexican children explained more variance compared with the model for Puerto Rican children ($P < .0001$). Caregiver report of panic-fear did not predict asthma control, acute healthcare utilization for asthma, or controller medication adherence. Caregiver-reported child irritability predicted lower FEV_1 in Mexican children, less acute healthcare utilization for asthma in Puerto Rican children, and better inhaled corticosteroid adherence in both groups.

Discussion

Child illness-specific panic-fear prospectively predicted better pulmonary function and asthma control, and less acute healthcare utilization for asthma across a 1-year follow-up period. Mexican children reported higher levels of illness-specific panic-fear and better asthma control compared with Puerto Rican children. Given the adaptive nature of illness-specific panic-fear, these findings highlight a potential mechanism to reduce disparities in asthma outcomes that merits further exploration. Child self-report of panic-fear was a stronger predictor across several positive asthma outcomes than caregiver report of the child's panic-fear, which predicted 1 measure, FEV_1. Children are likely more aware of their internal state of how much anxiety they experience during asthma attacks, and thus asking the child directly may be the best assessment of the panic-fear construct. Support was not found for the hypothesized association between panic-fear and inhaled corticosteroid medication adherence. This suggests that other potential pathways besides medication adherence might explain the adaptive nature of panic-fear, such as avoidance of asthma triggers, perception of asthma symptoms, and timely management of asthma exacerbations.

The heightened vigilance associated with illness-specific panic-fear may lead children to be more aware of their asthma symptoms and lead to better strategies for asthma management. In contrast, low illness-specific panic-fear might lead to disregard of asthma symptoms and lapses in asthma management. Children who are more focused on their asthma during attacks also might be more motivated to pay closer attention in between asthma flare-ups. Children's attention skills are a strong predictor of their ability to perceive asthma symptoms.[38] Illness-specific panic-fear and irritability in adults with asthma have been shown to influence provider decision making in the direction of stronger controller medications.[39,40] Given the problem of underprescribing inhaled corticosteroid medications in ethnic minority children,[41] greater child illness-specific panic-fear might lead providers to prescribe a more optimal medication regimen in Latino children who appear more anxious about their asthma attacks. Our finding of greater child illness-specific panic-fear predicting less acute healthcare utilization for asthma is consistent with previously reported findings that adolescents with asthma-related anxiety report being more likely to seek routine visits for asthma care[15] and to take steps to prevent and manage asthma symptoms.[16] The picture emerging across studies suggests that anxiety specifically about asthma elicits a more active and vigilant approach to asthma management.

These findings have important clinical implications for providers. Children who have low anxiety during asthma attacks might be at risk for disregarding symptoms and having poor asthma control. Providers should pay close attention to children who have little or no fear of their asthma and high rates of acute healthcare utilization for asthma. Illness-specific panic-fear and its adaptive focus on disease management is a different construct from general measures of anxiety and anxiety disorders. In contrast, children with high general anxiety may have excessive restriction of activities, such as not participating in gym class despite providers' encouragement of exercise. Providers should assess whether avoidance of triggers is asthma-related or anxiety-based.

Higher trait anxiety in children with asthma is associated with poor asthma control.[42] Panic disorder in adults is associated with worse asthma control and greater rescue medication use.[43,44] Children with asthma have a higher prevalence rate of anxiety disorders than children without asthma.[45] Trait anxiety in children and adults with asthma is associated with overperception of asthma symptoms, greater rescue medication use, and greater restriction of activities due to asthma.[46,47] Anxiety can become maladaptive when there is persistent worry between asthma attacks that is excessive compared with objective measures of asthma control. A key distinguishing feature of illness-specific panic-fear is that the anxiety occurs specifically during asthma exacerbations. Interventions for anxious children with asthma should attempt to reduce trait anxiety while maintaining illness-specific panic-fear.

It is also important to distinguish between illness-specific panic-fear and the construct of illness-related distress, which refers to emotional distress as a consequence of illness-related stressors.[48] Illness-related distress has been studied in other chronic diseases besides asthma; for example, diabetes-related distress measures depressive symptoms linked with the burden of living with diabetes and is associated with poor glycemic control.[49,50] Illness-related distress and its focus on maladaptive depressive symptoms is in contrast to the adaptive anxiety that characterizes illness-specific panic-fear in asthma. Future research should examine

Table III. Caregiver-reported child illness-specific panic-fear as a longitudinal predictor of FEV_1, asthma control, acute healthcare utilization, and controller medication adherence

	FEV_1 % predicted				Asthma control				Acute healthcare utilization				Controller medication adherence			
Variables	Mexican		Puerto Rican		Mexican		Puerto Rican		Mexican		Puerto Rican		Mexican		Puerto Rican	
	67%		64%		38%		12%		38%		38%		43%		46%	
Model R^2	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value	β (SE)	*P* value
Child sex	−0.06 (0.08)	.02	−0.003 (0.14)	.11	−0.03 (0.09)	.79	−0.23 (0.13)	.09	−0.07 (0.14)	.60	−0.03 (0.24)	.90	−0.47 (0.13)	<.0001	0.35 (0.25)	.16
Marital status	−0.06 (0.08)	.02	−0.004 (0.15)	.02	−0.14 (0.10)	.14	−0.07 (0.14)	.62	0.39 (0.14)	.006	0.08 (0.23)	.72	−0.05 (0.15)	.73	0.12 (0.24)	.61
Poverty	0.05 (0.08)	.03	0.18 (0.15)	.06	0.04 (0.10)	.66	0.33 (0.14)	.02	0.19 (0.14)	.20	−0.07 (0.19)	.72	0.21 (0.14)	.13	−0.38 (0.27)	.16
Caregiver education	−0.01 (0.08)	.03	−0.20 (0.13)	.05	−0.13 (0.09)	.18	0.24 (0.13)	.06	−0.12 (0.14)	.41	0.11 (0.19)	.57	−0.05 (0.13)	.72	−0.13 (0.21)	.54
Child age	−0.33 (0.08)	.01	−0.25 (0.15)	.22	−0.03 (0.11)	.81	0.18 (0.17)	.31	−0.57 (0.17)	.001	−1.21 (0.33)	<.0001	−0.10 (0.16)	.53	−0.28 (0.31)	.37
Caregiver age	−0.13 (0.08)	.06	−0.08 (0.14)	.09	0.008 (0.10)	.94	0.18 (0.14)	.17	−0.21 (0.14)	.13	0.39 (0.20)	.05	−0.18 (0.13)	.18	−0.49 (0.25)	.05
Asthma duration	−0.20 (0.08)	.03	0.13 (0.13)	.03	−0.10 (0.10)	.33	−0.24 (0.17)	.17	−0.03 (0.16)	.87	1.25 (0.36)	<.0001	−0.007 (0.16)	.97	0.30 (0.26)	.25
Family members with asthma	−0.03 (0.08)	.02	−0.43 (0.14)	.09	−0.03 (0.10)	.73	−0.45 (0.14)	.001	0.02 (0.14)	.89	0.27 (0.17)	.11	−0.04 (0.14)	.79	−0.18 (0.29)	.53
Asthma severity	0.03 (0.08)	.08	0.09 (0.14)	.14	−0.02 (0.10)	.84	0.10 (0.15)	.49	−0.11 (0.15)	.45	0.74 (0.26)	.004	−0.21 (0.14)	.13	0.95 (0.36)	.0009
Illness representations	0.03 (0.09)	.006	0.09 (0.14)	.04	0.24 (0.12)	.04	−0.008 (0.14)	.95	−0.51 (0.20)	.009	0.02 (0.16)	.91	0.25 (0.19)	.18	−0.41 (0.27)	.12
Social support	0.05 (0.09)	.008	−0.20 (0.15)	.007	0.05 (0.10)	.61	0.08 (0.15)	.60	−0.09 (0.15)	.53	−0.44 (0.19)	.02	0.29 (0.15)	.05	−0.65 (0.31)	.04
Healthcare provider relationship	−0.02 (0.09)	.02	−0.23 (0.15)	.13	−0.05 (0.11)	.65	0.18 (0.15)	.25	0.09 (0.18)	.63	−0.47 (0.26)	.07	0.03 (0.16)	.84	0.22 (0.25)	.39
Ethnic society immersion	−0.09 (0.10)	.02	−0.37 (0.16)	.02	−0.005 (0.11)	.96	−0.03 (0.18)	.87	−0.17 (0.17)	.32	−0.28 (0.30)	.34	−0.22 (0.15)	.14	0.44 (0.30)	.14
Dominant society immersion	0.07 (0.10)	.06	0.50 (0.17)	.09	0.001 (0.11)	.99	0.15 (0.16)	.37	0.16 (0.17)	.35	−0.04 (0.15)	.80	−0.09 (0.16)	.59	−0.71 (0.38)	.06
Caregiver depression	0.04 (0.08)	.007	−0.20 (0.15)	.21	−0.08 (0.10)	.41	0.02 (0.16)	.90	−0.22 (0.16)	.16	−0.60 (0.20)	.003	0.13 (0.13)	.33	−0.32 (0.25)	.21
Illness-specific physical symptoms (caregiver)	−0.03 (0.09)	.01	0.10 (0.18)	.04	0.14 (0.11)	.22	−0.57 (0.17)	.001	0.05 (0.16)	.76	0.83 (0.25)	.001	0.09 (0.17)	.60	−0.29 (0.28)	.30
Illness-specific irritability (caregiver)	−0.15 (0.10)	.03	−0.08 (0.20)	.22	−0.02 (0.12)	.84	−0.004 (0.19)	.98	0.21 (0.18)	.24	−0.77 (0.36)	.03	0.38 (0.17)	.02	0.75 (0.32)	.02
Illness-specific panic-fear (caregiver)	0.30 (0.11)	.02	0.19 (0.18)	.05	−0.10 (0.14)	.45	0.23 (0.18)	.21	−0.15 (0.20)	.44	−0.19 (0.25)	.44	−0.13 (0.19)	.51	−0.19 (0.35)	.59

illness-specific panic-fear in other pediatric chronic conditions to assess whether these findings are replicated.

In Latinos, there are culturally sanctioned ways of expressing distress and anxiety, which can be part of the context of asthma attacks.[51,52] An ataque de nervios is a cultural idiom of distress characterized by intense emotional reactions in connection to stressful events.[53] Such ataques can provide Latino patients with a normalized venue to express anxiety and panic and in some cases might help children and adults cope with the source of trauma or stress, such as an asthma attack.[51,54,55] A recent cultural adaptation of a behavioral treatment for anxiety in Latinos emphasized encouraging patients to discuss intense emotional reactions to asthma.[56] In the present study, the beneficial effects of illness-specific panic-fear in Mexican and Puerto Rican children might represent an adaptive expression of anxiety that is a culturally normative source for channeling panic and stress associated with asthma attacks.

The irritability subscale of the CASCL had mixed effects on asthma outcomes, and no a priori hypotheses were formulated for this subscale. Greater child-reported irritability during asthma attacks predicted lower FEV_1 and worse asthma control in Mexican children. Given that irritability is a symptom of depression, this finding might reflect airway constriction via cholinergic pathways,[57,58] which has been reported in children with asthma during depressive mood states and symptoms. However, greater caregiver-reported child irritability predicted better inhaled corticosteroid medication adherence in both groups and less acute healthcare utilization for asthma in Puerto Rican children. Caregivers who perceive their children as more irritable and upset during asthma exacerbations may be more motivated to ensure that their children are adherent to controller medications to prevent additional attacks. Better inhaled corticosteroid adherence might not be protective specifically for cholinergically mediated asthma exacerbations triggered by depressive or irritability symptoms. This might explain why illness-specific irritability was linked to worse pulmonary function despite better inhaled corticosteroid adherence, as well as provide insight into the difference between informants (caregiver vs self-report). Illness-specific irritability has received even less attention in the literature than panic-fear, and these findings should be explored further.

The main limitation of this study was the large amount of missing adherence data due to families losing or forgetting to bring the Doser device. Adherence data were analyzed for 64% of the families who were assigned a device. The low adherence rates in this study might actually underestimate the problem of medication adherence in asthma, because the families who failed to bring or lost the device might have the lowest adherence rates. The lack of support for the inhaled corticosteroid adherence hypothesis might be due to these missing data. Mexican caregivers primarily spoke Spanish and most Puerto Rican caregivers spoke English, which precluded teasing apart the role of language vs ethnicity regarding illness-specific panic-fear.

This study demonstrates that illness-specific panic-fear in children with asthma has an adaptive role in asthma management across Latino subgroups. These findings replicate the data reported in the adult literature and suggest that this construct of illness-specific panic-fear is highly relevant to children. Baseline measures of illness-specific panic-fear longitudinally predicted objective (FEV_1) and subjective (ACT) measures of asthma control over the following year. This demonstrates the importance of asking children directly about their emotional experiences with asthma. Providers should be aware of distinctions between adaptive anxiety focused on asthma and general anxiety. It is important to continue identifying these behavioral pathways and to develop interventions to reduce asthma disparities in ethnic minority, high-risk children. ■

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