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Family resilience and health among adolescents with asthma only, anxiety only, and comorbid asthma and anxiety

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ABSTRACT

Objectives: The objectives were to examine the relationships between current asthma and anxiety and family resilience and overall health status in US adolescents.

Methods: Data were from parents of adolescents (12–17 years) who completed the 2017–2018 National Survey of Children's Health (NSCH). Examined variables included: current asthma and anxiety diagnoses, family resilience, child health status, number of adverse childhood experiences (ACEs), family poverty, parent education, and child demographic factors. Multinomial logistic regression models were performed.

Results: Findings indicated that compared to adolescents with high resilience scores, adolescents with anxiety only and comorbid asthma and anxiety were more likely to have moderate or low family resilience scores than adolescents with no asthma or anxiety. Compared with adolescents with an excellent/very good health status, youth with asthma only, anxiety only, and asthma and anxiety had higher odds of having good or fair/poor health status than adolescents with no asthma or anxiety. Among those with current diagnoses, adolescents with asthma only were less likely to have moderate and low resilience scores than adolescents with asthma and anxiety. Adolescents with asthma only and anxiety only were also at reduced odds to have good or fair/poor health status than those with comorbid diagnoses.

Conclusions: Results indicated that anxiety is linked to family resilience of adolescents with and without comorbid asthma. Experiencing a higher number of ACEs was a risk factor for lower family resilience scores and health status. Future research should consider the impact of other mental health problems and family resilience and health status.

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Introduction

Asthma affects 8–9% of children and adolescents (1–3). Youth with asthma may experience increased rates of social and emotional problems (4,5), the most common being anxiety (6,7). Prevalence of anxiety for youth with asthma is higher than rates of anxiety in the general population, ranging from 16% to over 50% (7,8). Anxiety symptoms may mimic some symptoms of asthma attacks, indicating a complex relationship between the two diseases that increases risk for emotional and health problems for youth (5,9–11). Risk for poor health outcomes and family functioning may be increased when youth experience both asthma and anxiety (6,10). More information is needed to understand the “profile” of youth with asthma and anxiety in terms of health outcomes and risk-resilience factors for this group (12,13).

Family resilience may be related to asthma and anxiety symptoms (6,14). Experiencing anxiety may be associated with worse asthma symptomology and risk for negative family functioning, thereby decreasing family resilience (5). Family resilience involves adjustment or rebounding in the face of stress (15–17). Family resilience can involve problem-solving, interacting positively with each other, and at the same time be influenced by a multitude of environmental stressors experienced by family members (15). Buehler (15) recommended that continued research is needed to examine sociodemographic factors related to family functioning. As such, in the present study sought to gain an understanding of how asthma and anxiety are related to family resilience and health, by examining how sociodemographic factors and exposure to adverse experiences are related to family resilience and health outcomes.

Facing adverse life events may affect child health, response to illness, and family functioning. For example, Mattson and Kuo (2) reported that youth with special health care needs experiencing two or more adverse childhood experiences (ACEs) were more likely to experience exacerbations of their chronic conditions. Wing et al. (3) found that children with asthma had higher risk for experiencing ACEs. There was a dose–response relationship, from 0 to 4 ACEs. Children with a higher number of ACEs were more likely to have asthma, with those with four ACEs having approximately a 70% chance of having asthma. Others also have reported that increased ACEs are related to lower family functioning (18,19).

Several sociodemographic factors may influence family resilience. For example, females and older youth may have higher family resilience (19). Wing et al. (3) found that youth who were non-Hispanic black and Hispanic were at greater risk of having asthma than their non-Hispanic white counterparts. Crouch et al. (20) suggested it is important to examine economic hardship. The present study assessed two proxy measures of socioeconomic status that may indicate economic hardship—parent education level and family poverty level.

For this study, we examined the relationship between current asthma and anxiety diagnoses and family resilience and overall health status of adolescents, our two dependent variables. We also examined the associations between adolescent characteristics (i.e. age, sex, racial/ethnic group, ACEs, parent education level, and family poverty level) and family resilience and overall health status of adolescents. Then, we assessed the sub-sample of adolescents with current asthma and/or anxiety diagnoses to examine the relationship between current asthma and anxiety diagnoses and family resilience and overall health status of adolescents. We assessed whether severity ratings of anxiety and asthma were associated with family resilience and overall health status. We hypothesized that adolescents with asthma only, anxiety only, and comorbid asthma and anxiety would be more likely to have low or moderate family resilience scores and good or fair/poor overall health status than adolescents with no asthma or anxiety diagnoses. We also hypothesized that adolescents who were racial/ethnic minorities, had low parent education, had a family poverty level <200%, and at least one reported ACE would have low or moderate family resilience scores and fair/poor health status than adolescents who were non-Hispanic white, had high parent education, had a poverty level $\geq$ 200%, and no reported ACEs. Among

those with current diagnoses, we hypothesized that adolescents with asthma only or anxiety only would be at reduced odds to have low or moderate family resilience scores and good or fair/poor overall health status than adolescents with comorbid asthma and anxiety. We also posited that those with moderate/severe severity of asthma would be more likely to have low or moderate family resilience scores and good or fair/poor overall health status than those with mild severity of asthma. We also posited that adolescents with moderate/severe severity of anxiety would be at increased likelihood to have low or moderate family resilience scores and good or fair/poor overall health status than adolescents with mild severity of anxiety.

Methods

Participants and procedures

Data for this study were from the 2017–2018 NSCH—a cross-sectional survey delivered online or via mail in states and territories of the US conducted by the US Census Bureau (21,22). Information is gathered about one child (under 18 years of age) from parents or guardians assessing several variables, among them child physical and mental health, health visits, health care needs, and family functioning. There were 30 530 child surveys (weighted response rate = 43.1%) completed in 2018 and 21 599 (weighted response rate = 37.4%) were completed in 2017 (21,22). Children with special healthcare needs are oversampled, with 6976 in 2018 and 4912 in 2017 (21,22). Information about sampling and procedures are available from the Child and Adolescent Health Measurement Initiative (CAHMI, 21,22).

The sample for this study included 20 723 adolescents between the ages of 12 and 17 years. There were 16 268 adolescents without asthma and without anxiety, 1610 with asthma, 2383 with anxiety, and 465 with comorbid asthma and anxiety. This study was approved by the Institutional Review Board at the University of Cincinnati.

Measures

Asthma and anxiety

Variables were those provided in the 2017–2018 NSCH Codebook (23). Respondents were asked to report whether a doctor or other healthcare professional ever told them that their child had asthma and they reported whether their child had anxiety problems, and whether the child currently has asthma and

currently has anxiety problems. We created a composite diagnosis variable, with four categories, based on adolescents' *current* condition status: (1) has no asthma or anxiety including those who ever had these conditions, but does not currently have either of these conditions, (2) has asthma only, (3) has anxiety only, and (4) has comorbid asthma and anxiety.

We also screened for depression (6.2% of participants had been told by a doctor their child had depression) in the selected participants. Of the 1587 with a depression diagnosis, 1.3% ($n=289$) had depression only, 3.8% ($n=1020$) had depression and anxiety, 0.2% ($n=51$) had depression and asthma, and 0.8% ($n=227$) had all three diagnoses. We assessed including depression as a potential confounder, and based on the reductions in sample size and final adjusted estimates, we excluded this variable from the present study.

Severity of asthma and anxiety conditions

Among adolescents with current asthma only, anxiety only, or comorbid asthma and anxiety, a follow-up question was asked about how severe the conditions are: mild or moderate/severe.

Family resilience

Family resilience, our dependent variable, was originally measured by four items with four-point Likert type scale response options (none of the time, some of the time, most of the time, or all of the time): "When your family faces problems, how often are you likely to do each of the following?": (1) "Talk together about what to do," (2) "Work together to solve our problems," (3) "Know we have strengths to draw on," and (4) "Stay hopeful in difficult times." We used a NSCH-provided "family flourishing" variable, with categories developed by a Technical Expert Panel (21–23) as our measure of family resilience. These four items calculated a composite score that was categorized into: (1) high family resilience (all or most of the time responses to all four questions); (2) moderate family resilience (all or most of the time responses to 2–3 questions); and (3) low family resilience (all or most of the time responses to 0–1 questions).

Overall health status

Overall health status was measured by the following question: "In general, how would you describe this child's health?" Response options included: excellent, very good, good, fair, or poor. After assessing response distributions, we opted to use the NSCH-

provided variable with the following response options: excellent/very good, good, and fair/poor.

Adolescent characteristics

We included sociodemographic characteristics including adolescent age, sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or Non-Hispanic other race/multiracial), parent education level (less than high school, high school graduate/equivalent, some college, or college degree), and family poverty level (FPL; 0–199%, 200–299%, 300–399%, or $\geq 400\%$). FPL was calculated by NSCH based on State Children's Health Insurance Program income groups using the income level of the child's household. To assess ACEs, the respondent was asked whether the sampled child ever experienced nine ACEs (e.g. parent divorced or separated, parent/guardian died, parent/guardian served time in jail/prison, lived with anyone who had an alcohol or drug problem, lived with anyone who was mentally ill/depressed; lived with anyone using alcohol/drugs; violence in home/neighborhood; judged/treated unfairly due to race/ethnicity). NSCH combined these nine ACEs into a count variable with 10 854 adolescents having no 0 ACEs, 4972 having one ACE, 2202 having two ACEs, 1206 having three ACEs, 695 having four ACEs, 405 having five ACEs, 230 having six ACEs, 115 having seven ACEs, 37 having eight ACEs, and 7 having experienced all nine ACEs. Based on the right-skewed distribution, we followed prior literature (24) that presents ACE scores in the following numeric categories: (1) 0 ACEs, (2) 1 ACE, (3) 2–3 ACEs, and (4) 4–9 ACEs.

Statistical analysis

Descriptive statistics provided information on counts and frequencies for variables of interest. To assess the relationship between the adolescent characteristics and current asthma and anxiety diagnoses, chi-square analyses for categorical variables and one-way analysis of variance (ANOVA) for age (continuous) were conducted. We conducted one multinomial regression analysis to assess the relationship between asthma and anxiety diagnoses, adolescent characteristics and family resilience scores. We used "no current asthma or anxiety" and "high" resilience scores as the reference category in this model. We conducted another multinomial regression analysis to assess the relationship between asthma and anxiety diagnoses and adolescent characteristics and overall health status. We used "no current asthma or anxiety diagnoses" and "excellent/

Table 1. Characteristics of adolescents 12–17 years old based on current asthma and anxiety diagnoses, 2017–2018 NSCH.

	Current asthma and anxiety					<i>p</i> -value
	Overall (<i>N</i> = 20 723) <i>n</i> (%) ^a	No asthma or anxiety (<i>n</i> = 16 268) <i>n</i> (%) ^a	Asthma only (<i>n</i> = 1610) <i>n</i> (%) ^a	Anxiety only (<i>n</i> = 2383) <i>n</i> (%) ^a	Asthma and anxiety (<i>n</i> = 462) <i>n</i> (%) ^a	
Sociodemographic characteristics						
Adolescent age, <i>M</i> (SD)	14.5 (1.7)	14.5 (1.7)	14.5 (1.7)	14.7 (1.7)	15.1 (1.7)	<.001
Adolescent sex						<.001
Male	10 799 (51.1)	8722 (52.4)	888 (50.3)	1006 (43.5)	183 (36.4)	
Female	9924 (48.9)	7546 (47.6)	722 (49.7)	1377 (56.5)	279 (63.6)	
Adolescent race/ethnicity						<.001
Non-Hispanic white	14 586 (50.2)	11 359 (49.0)	1007 (40.1)	1886 (69.6)	334 (53.6)	
Non-Hispanic black	1371 (14.7)	1059 (14.5)	209 (25.7)	77 (6.2)	26 (14.8)	
Hispanic	2293 (25.4)	1825 (26.5)	196 (23.6)	217 (17.7)	55 (22.1)	
Non-Hispanic other/multiracial	2473 (9.7)	2025 (9.9)	198 (10.6)	203 (6.4)	47 (9.5)	
Adverse childhood experiences						<.001
0 adverse experiences	10 854 (48.6)	9084 (52.1)	747 (38.3)	897 (31.8)	126 (21.5)	
1 adverse experience	4972 (26.5)	3897 (26.4)	389 (26.3)	580 (26.3)	97 (28.7)	
2–3 adverse experiences	3408 (17.0)	2383 (15.2)	331 (23.4)	538 (25.0)	156 (30.1)	
4–9 adverse experiences	1489 (8.0)	904 (6.4)	134 (12.0)	368 (16.9)	83 (19.7)	
Adolescent severity of asthma						.005
Mild	1471 (64.8)	–	1168 (64.5)	–	303 (66.1)	
Moderate/severe	597 (35.2)	–	440 (35.5)	–	157 (33.9)	
Adolescent severity of anxiety						.03
Mild	1294 (44.3)	–	–	1106 (45.1)	188 (40.2)	
Moderate/severe	1531 (55.7)	–	–	1261 (54.9)	270 (59.8)	
Parent education level						<.001
Less than high school	561 (11.6)	465 (12.4)	37 (8.9)	40 (7.3)	19 (9.6)	
High school graduate/equivalent	2928 (19.9)	2282 (19.7)	267 (21.2)	309 (20.7)	70 (18.7)	
Some college	4957 (22.1)	3782 (21.1)	425 (29.4)	619 (22.6)	131 (30.8)	
College degree	12 227 (46.3)	9739 (46.7)	881 (40.6)	1415 (49.4)	242 (40.9)	
Family poverty level						<.001
0–199%	5501 (41.0)	4190 (40.6)	497 (49.1)	646 (37.2)	168 (42.4)	
200–299%	3127 (15.0)	2470 (15.1)	243 (13.7)	340 (14.7)	74 (17.8)	
300–399%	3028 (12.2)	2360 (12.4)	258 (10.5)	367 (12.3)	43 (6.9)	
≥400%	9067 (31.8)	7248 (31.9)	612 (26.6)	1030 (35.8)	177 (32.9)	

^aRaw counts and weighted column percent unless noted otherwise. Missing values excluded.

very good” health status as the reference category in this model. As a sub-analysis among adolescents with current asthma and/or anxiety diagnoses, we assessed the relationship between asthma and anxiety diagnoses and resilience scores and overall health status, while using comorbid asthma and anxiety as our reference group. We also conducted two separate multinomial regression models to assess whether severity of asthma and severity of anxiety differed based on family resilience in one model, and then overall health status in another model. We followed the NSCH methodology guidelines (21–23) and weighted analyses to reflect the population of adolescents ages 12–17 years in the USA. All analyses were performed using SPSS (Version 26) and the alpha was set at 0.05 to determine statistical significance.

Results

Characteristics of the sample are presented in Table 1.

The overall mean age of participants was 14.5 (SD = 1.7) years and 48.9% were females (Table 1). Half of participants were non-Hispanic white (50.2%), 25.4% were Hispanic, 14.7% were non-Hispanic black,

and 9.7% were Non-Hispanic other race or multi-racial. Nearly half had 0 ACEs (48.6%), 26.5% had 1 ACE, 17.0% had 2–3 ACEs, and 8.0% had 4–9 ACEs. A total of 46% of parents had a college degree, 22.1% had completed some college, 19.9% had completed high school or equivalent, and 11.6% did not complete high school or equivalent. FPL varied with the most being in the lowest FPL (0–199%; 41.0%) and highest categories (≥400%; 31.8%). About 8% of participants had asthma only (*n* = 1610), 8.9% had anxiety only (*n* = 2383), and 1.8% (*n* = 462) had comorbid asthma and anxiety. Of participants with asthma, including those with comorbid diagnoses, 35.2% had moderate/severe asthma. Of participants with anxiety, including those with comorbid diagnoses, 55.7% had moderate/severe anxiety.

Adolescent characteristics by current asthma and anxiety

Adolescent age, sex, race/ethnicity, ACEs, parent education level, and FPL differed based on asthma and anxiety (see Table 1). Adolescents who were non-Hispanic white (40.1%), non-Hispanic black (25.7%),

Table 2. Current asthma and anxiety diagnoses and family resilience composite scores among adolescents, 2017–2018 NSCH.

Variable	Moderate resilience composite score					Low resilience composite score				
	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^b	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^b
Diagnosis										
No current asthma and anxiety	1906 (12.9)	(Ref)	(Ref)	(Ref)	(Ref)	1065 (7.3)	(Ref)	(Ref)	(Ref)	(Ref)
Current asthma	184 (13.2)	0.91	0.78	1.08	.27	128 (7.5)	1.09	0.90	1.32	.39
Current anxiety	441 (16.4)	1.74	1.54	1.96	<.001	304 (14.8)	2.02	1.75	2.34	<.001
Current asthma and anxiety	79 (16.4)	1.45	1.13	1.88	.004	61 (21.4)	1.73	1.30	2.31	<.001
Adolescent age, <i>M</i> (SD)	14.6 (1.6)	–	–	–	.19	14.7 (1.7)	–	–	–	.01
Adolescent sex										
Male	1360 (14.4)	(Ref)	(Ref)	(Ref)	(Ref)	828 (8.1)	(Ref)	(Ref)	(Ref)	(Ref)
Female	1250 (12.2)	0.96	0.89	1.05	.38	730 (8.4)	0.91	0.82	1.01	.08
Adolescent race/ethnicity										
Non-Hispanic white	1751 (11.5)	(Ref)	(Ref)	(Ref)	(Ref)	978 (6.7)	(Ref)	(Ref)	(Ref)	(Ref)
Non-Hispanic black	212 (15.5)	1.27	1.08	1.50	.003	132 (11.4)	1.26	1.03	1.54	.02
Hispanic	313 (15.1)	1.12	0.97	1.28	.11	203 (8.0)	1.18	0.99	1.39	.06
Non-Hispanic other/multiracial	334 (14.8)	1.20	1.06	1.37	.005	245 (12.3)	1.54	1.33	1.80	<.001
Adverse childhood experiences										
0 adverse experiences	1109 (10.3)	(Ref)	(Ref)	(Ref)	(Ref)	516 (5.0)	(Ref)	(Ref)	(Ref)	(Ref)
1 adverse experience	674 (15.0)	1.36	1.23	1.51	<.001	403 (9.1)	1.69	1.47	1.94	<.001
2–3 adverse experiences	546 (17.4)	1.66	1.48	1.87	<.001	402 (12.3)	2.47	2.14	2.86	<.001
4–9 adverse experiences	281 (17.6)	2.02	1.73	2.36	<.001	237 (17.0)	3.27	2.73	3.92	<.001
Parent education level										
Less than high school	83 (17.4)	1.15	0.89	1.49	.29	80 (12.8)	1.84	1.40	2.42	<.001
High school graduate/equivalent	435 (15.5)	1.08	0.95	1.23	.23	262 (9.3)	1.06	0.90	1.25	.46
Some college	614 (11.3)	0.89	0.80	0.99	.04	420 (8.9)	1.01	0.89	1.16	.85
College degree	1478 (12.3)	(Ref)	(Ref)	(Ref)	(Ref)	796 (6.3)	(Ref)	(Ref)	(Ref)	(Ref)
Family poverty level										
0–199%	803 (14.8)	1.17	1.04	1.32	.009	545 (10.5)	1.22	1.05	1.41	.01
200–299%	395 (12.7)	1.08	0.95	1.23	.26	292 (9.8)	1.31	1.12	1.54	.001
300–399%	411 (13.9)	1.19	1.05	1.35	.007	191 (5.1)	0.96	0.81	1.15	.67
>400%	1001 (11.5)	(Ref)	(Ref)	(Ref)	(Ref)	530 (5.8)	(Ref)	(Ref)	(Ref)	(Ref)

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.

^aRaw counts and weighted row percent unless noted otherwise.^bMultinomial regression including all variables in the model. Reference category is “high” resilience composite score.

had 2–3 ACEs (23.4%), and 4–9 ACEs (12.0%) had significantly high rates of asthma only. Concerning anxiety only and comorbid asthma and anxiety diagnoses, adolescents who were female (56.5%, 63.6%), non-Hispanic white (69.6%, 53.6%), 2–3 ACEs (25.0%, 30.1%), or 4–9 ACEs (16.9%, 19.7%) had highest rates, respectively. Severity of asthma differed based on asthma only and comorbid diagnoses, and severity of anxiety differed based on anxiety only and comorbid diagnoses. Parent education level and FPL varied by diagnoses (see Table 1).

Current asthma and anxiety and family resilience scores among all adolescents

Irrespective of diagnoses, a total of 8.3% (*n* = 1558) adolescents had a low resilience score, 13.3% (*n* = 2610) had a moderate resilience score, and 78.4% (*n* = 16555) had a high resilience score. Compared to participants with a high resilience score, participants with anxiety only and comorbid asthma and anxiety were more likely to have a moderate resilience score than adolescents with no asthma or anxiety, after adjusting for the other independent variables (i.e.

adolescent age, sex, race/ethnicity, ACEs, parent education level, FPL; Table 2).

Compared to participants with a high resilience score, participants with anxiety only and comorbid asthma and anxiety were at increased odds to have a low resilience score than adolescents with no asthma or anxiety, after covariate adjustment. No differences were found based on asthma only and resilience scores.

While assessing the covariates in the same multinomial model, participant age ($\beta = 0.04$, standard error = 0.02) differed based on having a low resilience score. Every one-year increase in age was associated with a low resilience score. Participants who were non-Hispanic black and Non-Hispanic other race or multiracial were more likely to have moderate and low resilience scores (see Table 2). Compared to participants with a high resilience score, participants with 1 ACE, 2–3 ACEs, and 4–9 ACEs were at increased odds to have moderate and low resilience scores. Participants with parents who completed some college were at reduced odds to have a moderate resilience score. Alternatively, participants with parents who did not complete high school or equivalent were at increased odds to have a low resilience score. FPL

Table 3. Current asthma and anxiety diagnoses and overall health status among adolescents, 2017–2018 NSCH.

Variable	Good overall health status					Fair/poor overall health status				
	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^b	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^b
Diagnosis										
No current asthma and anxiety	892 (7.7)	(Ref)	(Ref)	(Ref)	(Ref)	127 (1.3)	(Ref)	(Ref)	(Ref)	(Ref)
Current asthma	243 (23.4)	2.81	2.40	3.29	<.001	38 (4.5)	3.14	2.17	4.55	<.001
Current anxiety	451 (20.4)	4.30	3.77	4.90	<.001	129 (6.0)	8.30	6.38	10.79	<.001
Current asthma and anxiety	118 (31.4)	6.10	4.82	7.72	<.001	57 (12.6)	19.60	13.81	27.83	<.001
Adolescent age, <i>M</i> (SD)	14.5 (1.7)	–	–	–	.02	14.9 (1.7)	–	–	–	.07
Adolescent sex										
Male	870 (9.8)	(Ref)	(Ref)	(Ref)	(Ref)	164 (1.8)	(Ref)	(Ref)	(Ref)	(Ref)
Female	834 (11.3)	0.95	0.86	1.06	.37	187 (2.6)	1.03	0.83	1.28	.80
Adolescent race/ethnicity										
Non-Hispanic white	1034 (7.5)	(Ref)	(Ref)	(Ref)	(Ref)	216 (1.5)	(Ref)	(Ref)	(Ref)	(Ref)
Non-Hispanic black	195 (16.0)	1.67	1.40	2.00	<.001	29 (3.4)	1.33	0.88	2.01	.18
Hispanic	256 (13.2)	1.31	1.12	1.53	.001	62 (3.1)	1.55	1.14	2.11	.005
Non-Hispanic other/multiracial	219 (10.7)	1.29	1.10	1.52	.002	44 (1.5)	1.34	0.96	1.89	.09
Adverse childhood experiences										
0 adverse experiences	583 (6.5)	(Ref)	(Ref)	(Ref)	(Ref)	84 (1.3)	(Ref)	(Ref)	(Ref)	(Ref)
1 adverse experience	412 (11.8)	1.23	1.07	1.41	.003	105 (2.5)	2.07	1.54	2.79	<.001
2–3 adverse experiences	443 (14.9)	1.61	1.40	1.85	<.001	92 (2.3)	2.02	1.47	2.78	<.001
4–9 adverse experiences	266 (21.6)	1.89	1.59	2.25	<.001	70 (6.6)	2.83	1.99	4.03	<.001
Parent education level										
Less than high school	101 (17.9)	2.26	1.75	2.91	<.001	29 (4.9)	3.22	2.02	5.13	<.001
High school graduate/equivalent	364 (14.5)	1.48	1.27	1.72	<.001	75 (2.4)	1.49	1.08	2.04	.01
Some college	522 (14.2)	1.32	1.16	1.51	<.001	102 (2.5)	1.22	0.92	1.61	.17
College degree	717 (5.2)	(Ref)	(Ref)	(Ref)	(Ref)	145 (1.3)	(Ref)	(Ref)	(Ref)	(Ref)
Family poverty level										
0–199%	778 (16.6)	2.19	1.89	2.54	<.001	170 (3.8)	2.08	1.52	2.84	<.001
200–299%	285 (9.6)	1.59	1.35	1.88	<.001	52 (1.2)	1.30	0.90	1.88	.16
300–399%	215 (6.1)	1.32	1.11	1.58	<.001	40 (0.7)	1.17	0.80	1.73	.42
>400%	426 (4.8)	(Ref)	(Ref)	(Ref)	(Ref)	89 (1.1)	(Ref)	(Ref)	(Ref)	(Ref)

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.

^aRaw counts and weighted row percent unless noted otherwise.^bMultinomial regression including all variables in the model. Reference category is “excellent/very good” overall health status.

varied based on resilience scores. Participants with 0–199% FPL and 300–399% FPL were more likely to have a moderate resilience score, while participants with 0–199% and participants with 200–299% FPL were more likely to have a low resilience score. No differences were found between adolescent sex and resilience scores.

Current asthma and anxiety and overall health status among all adolescents

Most adolescents had excellent/very good health status (87.3% *n* = 18 634), followed by a good health status (10.5% *n* = 1704), and fair/poor health status (2.2%; *n* = 351). Compared to participants with excellent/very good health status, participants with asthma only, anxiety only, and comorbid asthma and anxiety were 2.81 times, 4.30 times, and 6.10 times more likely, respectively, to have good health status than adolescents with no asthma or anxiety, after adjusting for the covariates (Table 3).

Participants with asthma only, anxiety only, and comorbid asthma and anxiety were more likely to have increased odds of fair/poor health status than

adolescents with no asthma or anxiety, after adjusting for the covariates.

While assessing the covariates in the same multinomial model, participant age ($\beta = 0.04$, standard error = 0.02) differed based on good health status. Every one-year increase in age was associated with a good health status. Compared to adolescents with excellent/very good health status, adolescents who were non-Hispanic black (aOR = 1.67), Hispanic (aOR = 1.31), and non-Hispanic other race or multi-racial (aOR = 1.29) were more likely to have good health status. Only Hispanic adolescents were at increased odds to have fair/poor health status. Compared to participants with excellent/very good health status, participants with one ACE, 2–3 ACEs, and 4–9 ACEs were at increased odds to have good health status and fair/poor health status. Participants with parents who did not complete high school or equivalent, graduated high school or equivalent, and had completed some college were more likely to have good health status than an excellent/very good health status. Participants with parents who did not complete high school or equivalent and graduated high school or equivalent were at increased odds to have fair/poor overall health status. Participants with lower FPL

Table 4. Current asthma and anxiety and family resilience composite scores and overall health status among adolescents with current diagnoses, 2017–2018 NSCH.

Variable	Family resilience									
	Moderate resilience composite score					Low resilience composite score				
	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^b	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^b
Current diagnosis (<i>n</i> = 4455)										
Current asthma	184 (13.2)	0.63	0.47	0.85	.003	128 (7.5)	0.60	0.43	0.85	.004
Current anxiety	441 (16.4)	1.17	0.89	1.53	.27	304 (14.8)	1.14	0.84	1.55	.40
Current asthma and anxiety	79 (16.4)	(Ref)	(Ref)	(Ref)	(Ref)	61 (21.4)	(Ref)	(Ref)	(Ref)	(Ref)
Overall health status										
Variable	Good overall health status					Fair/poor overall health status				
	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^b	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^b
Current diagnosis (<i>n</i> = 4455)										
Current asthma	243 (23.4)	0.43	0.33	0.57	<.001	38 (4.5)	0.15	0.10	0.24	<.001
Current anxiety	451 (20.4)	0.69	0.54	0.88	.003	129 (6.0)	0.41	0.29	0.58	<.001
Current asthma and anxiety	118 (31.4)	(Ref)	(Ref)	(Ref)	(Ref)	57 (12.6)	(Ref)	(Ref)	(Ref)	(Ref)

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.

^aRaw counts and weighted row valid percent. Missing values excluded.

^bMultinomial regression also including adolescent age, sex, race/ethnicity, adverse childhood experiences, parent education level, and family poverty level. Reference category is "high" resilience composite score.

^cMultinomial regression also including adolescent age, sex, race/ethnicity, adverse childhood experiences, parent education level, and family poverty level. Reference category is "excellent/very good" overall health status.

including 0–199%, 200–299%, and 300–399% were more likely to have good health status. Only participants with 0–199% FPL were 2.08 times more likely to have fair/poor overall health status (see Table 3).

Current asthma and anxiety and family resilience scores and overall health status among adolescents with a current diagnosis

Among those with a current diagnosis of asthma and/or anxiety (*n* = 4455), participants with asthma only were significantly less likely to have moderate resilience and low resilience scores compared to participants with comorbid asthma and anxiety, while adjusting for the covariates (Table 4).

Compared to participants with asthma and/or anxiety with excellent/very good health status, participants with asthma only and anxiety only were less likely to have good or fair/poor health status than participants with comorbid asthma and anxiety, after covariate adjustment (see Table 4).

Severity of asthma and anxiety among adolescents with a current diagnosis

Of participants with severity of asthma data (*n* = 2068), 35.5% (*n* = 440) of participants with asthma only and 33.9% (*n* = 157) of those with a comorbid diagnosis had a moderate/severe asthma condition. Of participants with severity of anxiety data (*n* = 2825), 54.9% (*n* = 1261) of participants with anxiety only and 59.8% (*n* = 270) of those with a

comorbid diagnosis had a moderate/severe anxiety condition. Compared to participants who had a high resilience score, participants with moderate/severe asthma and moderate/severe anxiety were more likely to have a low resilience composite score, while adjusting for the covariates (see Table 5).

Compared to participants who had an excellent/very good health status, participants with moderate/severe asthma and moderate/severe anxiety were at increased odds to have good health status, after covariate adjustment (see Table 5). Participants with moderate/severe asthma and moderate/severe anxiety were at increased odds to have fair/poor health status, while adjusting for the covariates.

Discussion

Results of this study indicated that youth with anxiety only and comorbid asthma and anxiety were at increased odds for having lower family resilience compared to those with no asthma or anxiety diagnoses. Although resilience was relatively high for many families included in the present study (over 75% were resilient), anxiety for adolescents emerged as a risk factor for family resilience. When adolescents with asthma also had comorbid anxiety, there was risk for low resilience. Health professionals should monitor family functioning as well as the functioning of the adolescent when youth with asthma report having anxiety. As expected, adolescents with current asthma were at reduced odds to have low or moderate resilience scores when compared to adolescents with

Table 5. Severity of asthma and anxiety and family resilience composite scores and overall health status among adolescents with current diagnoses, 2017–2018 NSCH.

Variable	Family resilience									
	Moderate resilience composite score					Low resilience composite score				
	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^b	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^b
Severity of current asthma (<i>n</i> = 2068)										
Mild condition	188 (12.7)	(Ref)	(Ref)	(Ref)	(Ref)	119 (10.1)	(Ref)	(Ref)	(Ref)	(Ref)
Moderate/severe condition	72 (15.8)	0.98	0.73	1.31	.89	70 (10.1)	1.51	1.10	2.06	.01
Severity of current anxiety (<i>n</i> = 2825)										
Mild condition	231 (16.8)	(Ref)	(Ref)	(Ref)	(Ref)	131 (13.8)	(Ref)	(Ref)	(Ref)	(Ref)
Moderate/severe condition	284 (15.8)	1.13	0.93	1.37	.23	231 (17.2)	1.62	1.28	2.04	<.001
Variable	Overall health status									
	Good overall health status					Fair/poor overall health status				
	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^c	<i>n</i> (%) ^a	aOR	95% CI lower	95% CI upper	<i>p</i> -value ^c
Severity of current asthma (<i>n</i> = 2068)										
Mild condition	188 (12.7)	(Ref)	(Ref)	(Ref)	(Ref)	119 (10.1)	(Ref)	(Ref)	(Ref)	(Ref)
Moderate/severe condition	72 (15.8)	2.93	2.31	3.71	<.001	70 (10.1)	4.47	2.92	6.84	<.001
Severity of current anxiety (<i>n</i> = 2825)										
Mild condition	231 (16.8)	(Ref)	(Ref)	(Ref)	(Ref)	131 (13.8)	(Ref)	(Ref)	(Ref)	(Ref)
Moderate/severe condition	284 (15.8)	2.07	1.70	2.51	<.001	231 (17.2)	3.17	2.24	4.49	<.001

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.

^aRaw counts and weighted row valid percent. Missing values excluded.

^bMultinomial regression also including adolescent age, sex, race/ethnicity, adverse childhood experiences, parent education level, and family poverty level. Reference category is “high” resilience composite score.

^cMultinomial regression also including adolescent age, sex, race/ethnicity, adverse childhood experiences, parent education level, and family poverty level. Reference category is “excellent/very good” overall health status.

comorbid asthma and anxiety. We did not find differences between the anxiety only and comorbid groups. Thus, it may be that family resilience is affected by anxiety, albeit by a small degree due to the lower odds ratio, given that anxiety may have a significant impact on interpersonal relationships. Moreover, it may be that families were better able to manage asthma compared to anxiety, although this idea is speculative and bears research.

Covariates were related to family resilience. Adolescents who were non-Hispanic black or other Non-Hispanic other/multi-racial, had higher odds of low family resilience outcomes compared to youth who were non-Hispanic white. There were no significant differences for family resilience for Hispanic youth. More research is needed to understand sources of family resilience for youth in this ethnic group, as they may be at higher risk for having asthma (3). There were no sex differences in family resilience, and improving family strengths and support may help both males and females. Older youth may face lower resilience, which differed from existing research (19). Older youth may have experienced lower family resilience, because they were becoming more independent and relying less on the family for support. Consistent with other literature (2,18,19), children with ACEs had lower family resilience and the odds of having a low family resilience score increased as level of ACEs increased. Low level of parent education was a risk

factor—if parents had not completed high school, then adolescents were at increased odds of having low family resilience. Results were mixed for FPL, and not as clear-cut as anticipated, at the moderate level of resilience. Conversely, there were increased odds that families at lower FPL levels (0–199% and 200–299% FPL) would have low family resilience.

Ninety-seven percent of caregivers indicated that their adolescent had a health status that was “excellent/very good” or “good.” Adolescents with comorbid asthma and anxiety had the highest odds of experiencing poor health, followed by youth with anxiety only, and youth with asthma only. Youth with asthma only, anxiety only, and comorbid asthma and anxiety were at risk for lower health status, and monitoring their overall health remains important. Youth with anxiety had higher odds of poor health compared to those with no asthma or anxiety. We also found that as hypothesized, when compared with those who had excellent health status, adolescents with asthma only and anxiety only were at decreased odds to experience good or fair/poor health than adolescents with comorbid asthma and anxiety. Thus, it is important to teach adolescents with comorbid asthma and anxiety good self-management skills to increase their general health and decrease somatic complaints that their parent may interpret as poor health.

Covariates were related to health status. Non-Hispanic black, Hispanic, and non-Hispanic other or

multiracial youth were more likely to have good health status rather than excellent/very good health status. Only Hispanic youth were at significantly increased odds to have fair/poor health status, and this group may need greater monitoring to ensure good health care and ensure they have access to services. Sex was not related to health status, which is positive, in that interventions encouraging positive health behaviors for male and female adolescents may be similar. Older youth had higher odds of better health, and perhaps were taking better care of themselves. Adolescents who experienced higher numbers of ACEs typically had poorer overall health. This is consistent with current literature (25). Screening for ACEs may be a good way to determine if guidance about safety and self-care is needed (25). Low parental education (high school graduate/equivalent or less education) was a risk factor for poor health, as was being at the 0–199% poverty level, and this background information is informative in terms of providing anticipatory guidance for screening related to adolescent health status.

Among those with anxiety, whether an exclusive or comorbid diagnosis, severity of anxiety was negatively associated with family resilience. As mentioned, anxiety may influence family resilience, albeit by a small degree due to the lower odds ratio, given that anxiety may have a significant impact on interpersonal relationships. Severity of the asthma diagnosis did not have as noticeable of a relationship with low family resilience among those with asthma, which was encouraging. Youth with moderate/severe asthma had lower health status than those with mild severity levels. This was expected, given that having more severe asthma symptoms is related to many health risks (26). Severity of anxiety was related to poorer health, presumably through increased physical complaints, as youth with anxiety may have many somatic concerns (27). The sample size for the comorbid asthma and anxiety group was small. Assessing severity levels for youth with both conditions will provide information to guide interventions. Moreover, examining asthma severity using objective measures (e.g. spirometry), and severity of anxiety, using clinical diagnoses and standardized measures, will provide objective data about diagnoses and severity of impairment.

Limitations

The study was cross-sectional in nature, and learning about change over time will add to the literature. Analyses were conducted using a preexisting data set,

and questions were general in nature. Asking more focused questions about the nature of family resilience may have yielded more information. Future mixed methods studies, with qualitative methods for depth information, may uncover critical information to allow an exploration of ways in which having anxiety increases risk.

As mentioned, we used data from the National Survey of Children's Health (NSCH) to assess relationships between having the diagnoses of asthma, anxiety or both, the severity of the diagnoses, having adverse childhood experiences (ACEs), and parental ratings of family flourishing (resilience) and child health status. Overall, the results of several multinomial regressions show that both diagnoses, demographic factors and ACEs were negatively associated with family resilience and health status. Our findings, which support our hypotheses, provide some useful information. However, the use of multiple regression analysis based on an implicit causal model could potentially provide information about which of the implied causal factors affect the outcomes most, and allow additional questions to be asked of the data.

Our outcome variables of interest, family resilience and overall health status, were assessed as separate categorical measures to answer the present study's aims. Gathering data from multiple informants and sources longitudinally may add information about additional factors related to resilience and health and provide the opportunity to determine causal relationships. We were limited to the overall health status measured subjectively via parent-report. Future research should consider assessing the longitudinal relationship between family resilience and overall health status using several objective and subjective measures to determine whether family resilience may modify overall health status among adolescents with asthma and other types of health problems over time. We did examine the influence of depression, but the low occurrence of depression and limited findings, resulted in a decision to exclude this variable in our analyses. Further research to understand the risks of anxiety and depression and other mental health problems for adolescents with asthma, and the associations among these problems and child and family functioning is needed (5).

Conclusions

A majority of the sample had good family resilience and good health, and exploring functioning in youth in families not characterized by resilience and

adolescents who are not in good health may provide ideas about ways to foster resilience and health. Having anxiety was a risk factor for youth with asthma, and understanding the ways in which anxiety impacts family resilience and health of adolescents with asthma is an area for future study. Exploring whether anxiety impacts asthma management, care of one's health, somatic complaints, and how family members feel and react to youth anxiety are areas for exploration. It may be that asthma is a protective factor for family resilience and adolescent health, because the family and adolescent work to focus on youth health concerns. Improving quality of life, physical health, and the family environment for youth with asthma and anxiety and youth residing in poverty, those in minority groups, and youth experiencing ACEs is important to reduce health disparities. Screening questions in these areas can improve anticipatory guidance and ultimately service provision for vulnerable youth. Youth who were Hispanic faced increased odds of poor health, and continuing to improve their access to care and screen for health problems is vital. Moreover, screening older youth for family resilience, and referring those in need for supportive counseling may improve functioning for those experiencing poor family functioning. Youth with several mental health problems may be at risk for poorer health and functioning (5). Thus, in the future, it will be important to examine adolescent health, family functioning, and child resilience for youth facing asthma and other mental health problems and potentially multiple comorbid mental health problems.

Disclosure of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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