

# Poverty and Trends in 3 Common Chronic Disorders

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abstract

**OBJECTIVES:** For asthma, attention-deficit/hyperactivity disorder (ADHD), and autism spectrum disorder (ASD), the objectives were to: (1) describe percent increases in parent-reported lifetime prevalence and comorbidity over time and how these vary by socioeconomic status and (2) examine the extent poverty status is a predictor of higher-than-average comorbidities.

**METHODS:** Secondary analyses of the National Survey of Children's Health for years 2003, 2007, and 2011–2012 were conducted to identify trends in parent-reported prevalence and comorbid chronic health conditions from a list provided in the survey among children with asthma, ADHD, and ASD, and we examined variation by sociodemographic characteristics and insurance coverage. By using 2011–2012 data, multivariable regression was used to examine whether poverty status predicted higher-than-average comorbid conditions after adjusting for other sociodemographic characteristics.

**RESULTS:** Parent-reported lifetime prevalence of asthma and ADHD between 2003 and 2011–2012 rose 21% and 43%, respectively, whereas the parent-reported prevalence of ASD rose 32% between 2007 and 2011–2012. The percent increase in asthma was higher among girls and uninsured children. For ADHD, the rise in parent-reported prevalence only varied by age. Being poor was associated with nearly twice the adjusted odds (adjusted odds ratio = 1.72) of having at least 1 comorbidity among children with asthma and more than twice the adjusted odds (adjusted odds ratio = 2.60) of having at least 2 comorbidities among children with ADHD.

**CONCLUSIONS:** Poverty status differentially influenced parent-reported lifetime prevalence of comorbidities for these target disorders. Future research is needed to examine how poverty influences lack of access and chronic stress and exposure on children to induce comorbidities, especially mental disorders.



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**WHAT'S KNOWN ON THIS SUBJECT:** Children in poverty with chronic conditions are more likely to have higher rates of comorbid disorders and worse outcomes than those not in poverty.

**WHAT THIS STUDY ADDS:** The relationship between poverty and comorbid health conditions differs for children with asthma, attention-deficit/hyperactivity disorder, and autism.

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Poverty negatively affects the development and well-being of children and adolescents in a variety of ways. Poor children are often exposed to inadequate nutrition, violence, and environmental toxins among other risk factors.<sup>1</sup> Children in poverty with chronic conditions also are more likely to have higher rates of comorbid disorders and worse outcomes.<sup>2-4</sup> Nevertheless, it is less clear whether the rate of chronic comorbidities among children living in poverty is rising and whether the trends in chronic conditions are differentially influenced by poverty status.

These questions are of significance because the overall expenditure in the Supplemental Security Income (SSI) program for children in 2015 was \$10.5 billion.<sup>5</sup> Established in the 1970s, the SSI program for children with disabilities was created to provide income support to families living under or near the federal poverty level (FPL). The program recently experienced controversy because of its large growth, especially among children with mental health disorders. This controversy resulted in a Government Accountability Office report<sup>6</sup> and a National Academies of Sciences, Engineering, and Medicine<sup>7</sup> report that recognized the challenges in identifying comorbidities among children receiving SSI benefits.<sup>8</sup> However, no data to our knowledge have been published utilizing national data sets to estimate the prevalence of common chronic health conditions and comorbidities among those in poverty utilizing income data as a potential proxy for SSI recipient status.

In addition, the prevalence rates of asthma, attention-deficit/hyperactivity disorder (ADHD), and autism spectrum disorder (ASD) have significantly increased for more than a decade, mirroring trends in overall chronic health conditions in children and in the SSI program.<sup>6,9-11</sup>

Children with chronic diseases, such as these target conditions, are also at higher risk for comorbid physical and mental health conditions that are chronic in nature and add to the disease burden for the child,<sup>4,12-14</sup> which are often associated with the substantial rise in their medical costs.<sup>15-23</sup> Additionally, the well-established relationship between childhood poverty and greater risk for chronic conditions including developmental and behavioral disorders<sup>2,24-28</sup> may place children living in low-income families in double jeopardy of greater need for care and poorer access to care.<sup>29,30</sup> This rise in disease risk is coupled with an overall increase in childhood poverty within this time period.<sup>31</sup>

Although of high public health significance, there is a paucity of information regarding the prevalence trends of comorbid disorders such as depression and anxiety among US children with asthma, ADHD, and ASD and the extent poverty influences their rates of comorbid chronic conditions. To address this knowledge gap, we conducted a data analysis by using the 3 waves of the National Survey of Children's Health (NSCH) from 2003 through 2011-2012. For these 3 target conditions, the study objectives were to: (1) describe the percent increases in prevalence and comorbidity and how these vary by poverty status and (2) examine the extent to which poverty status is a predictor of higher-than-average comorbid conditions.

## METHODS

### Data Source

The data source is the NSCH and includes data from the survey administration for the years 2003, 2007, and 2011-2012.<sup>32-34</sup> The NSCH was designed to provide cross-sectional national prevalence estimates of a large number of health indicators for children and uses the State and Local Area Integrated Telephone

Survey Program.<sup>32-34</sup> Additionally, cell phone sampling methods were newly employed in 2011-2012. The completion rate was 65.8% in 2003, 66.0% in 2007, and 54.1% for the landline sample and 41.2% for the cell phone sample in 2011-2012.<sup>3</sup> Of the 95 677 completed interviews in 2011-2012, 31 972 were conducted with respondents' cell phones, with no expected nonresponse bias from cell versus landline.<sup>32,35</sup>

### Study Variable Construction

Children were identified as having asthma, ADHD, or ASD if their primary caregiver reported that their child had ever been diagnosed with the condition. In addition, children were classified as having at least 1 comorbid condition if their primary caregiver reported an additional chronic condition. The list of comorbid conditions a parent could identify used in this analysis included: bone, joint, and/or muscle problems; vision and/or hearing problems; depression and/or anxiety; learning disability; diabetes; asthma (for ADHD and ASD); and ADHD (for asthma and ASD). There were some important methodological differences for several of the condition questions between the 2003 to the 2007 and 2011-2012 surveys leading to the exclusion of a number of chronic conditions listed in the survey. In addition, in the 2003 survey, the indicator on ASD only asked if the child had ever received a diagnosis of autism, whereas in 2007 and 2011-2012, the question was expanded to include Asperger disorder, pervasive developmental disorder, or other ASD. As a result, analyses in which the ASD indicator were used were limited to comparisons between 2007 and 2011-2012. Another methodological change was that the vision and/or hearing problems and depression and/or anxiety questions from 2003 were split into separate condition questions for 2007 and 2011-2012. For our analyses,

these conditions were regrouped and treated as single indicators for analysis of 2007 and 2011–2012 data to remain comparable to the 2003 data. Sociodemographic characteristics of the child were identified by parent report. Child age was classified into 3 groups: (1) 3 to 5 years, (2) 6 to 11 years, and (3) 12 to 17 years, and race and/or ethnicity was categorized as: (1) white non-Hispanic, (2) black non-Hispanic, (3) Hispanic, and (4) other.<sup>36</sup> Poverty levels were categorized by using FPL standards: (1) <100 FPL (poor), (2) 100% to 199% FPL (near poor), (3) 200% to 399% FPL, and (4) ≥400% FPL. Insurance coverage categories were private, public, and uninsured.

### Data Analysis

Survey weights and multiple imputation files provided by the National Center for Health Statistics were employed.<sup>37</sup> For each target condition, weighted parent-reported prevalence was calculated in each survey year by age, sex, race and/or ethnicity, poverty status, and insurance coverage.  $\chi^2$  tests were used for within-group differences, and Wald F tests were used to test the significance of year by group interaction terms to identify differences in time trends across subgroups. For each target condition, the rates of comorbid conditions were compared for children living >200% and <200% of the FPL. By using the 2011–2012 sample, multivariate regression analysis was conducted to identify associations of greater than the average number of comorbidities with each target condition. Statistical significance was set a priori at  $P < .05$ . This study was deemed exempt by the University of Pittsburgh Institutional Review Board.

## RESULTS

### National Prevalence Trends by Poverty Status

In each of the survey administrations, poverty was associated with a

higher parent-reported prevalence of asthma (Supplemental Table 4) and ADHD (Supplemental Table 5) in a stepwise relationship, such that the parent-reported prevalence of these conditions was higher among children in families with lower incomes. The parent-reported prevalence of ASD did not differ by poverty status (Supplemental Table 6). There was a rise in parent-reported lifetime prevalence of all 3 target disorders over time (Table 1, Fig 1). The lifetime parent-reported prevalence of asthma rose 21%, from 13.6% in 2003 to 16.4% in 2011–2012. For ADHD, the lifetime parent-reported prevalence increased by 43%, from 7.2% in 2003 to 10.4% in 2011–2012, and for ASD the percent rise was 32%, from a prevalence of 1.8% in 2007% to 2.4% in 2011–2012 (Supplemental Tables 4–6).

The rise in lifetime parent-reported prevalence of asthma of 33% was not statistically significantly higher among poor children (FPL <100%) than children living in less poor household. Girls compared with boys and the uninsured compared with children with insurance had higher percentage change in the parent-reported prevalence of asthma (Table 1). For ADHD, the increase in lifetime parent-reported prevalence did not differ by poverty status but did by age. In contrast, increases in the lifetime parent-reported prevalence of ASD did not differ by any sociodemographic status variable.

### National Prevalence Trends of Comorbid Conditions by Poverty Status

The rise in the extent of parent-reported comorbid conditions for these target conditions was differentially influenced by poverty status for asthma and ADHD (Table 2). On average, children with asthma had 0.61 parent-reported comorbid condition in 2011–2012, and among poor and/or near-poor children, the most

common comorbid conditions were depression and/or anxiety (15.5%), ADHD (20.8%), and learning disability (20.9%); all 3 of these conditions were more prevalent among the poor and/or near poor than those living >200% of the FPL (Supplemental Table 7).

For children identified as having ADHD from 2003 to 2011–2012, the rise in parent-reported 2 or more comorbid conditions significantly increased for poor and near-poor children (19%), compared with an 8% decline among children living >200% of the FPL, ( $P = .01$ ), see Table 2. On average, children with ADHD in 2011–2012 had 1.23 reported comorbid conditions, and among the poor and near-poor children, the most common comorbid conditions were learning disability (51.2%), depression or anxiety (37.0%), and asthma (32.7%). All 3 of these conditions were more prevalent among the poor and near poor than those living >200% of the FPL (Supplemental Table 8).

On average, children with ASD in 2011–2012 had 2.15 parent-reported comorbid conditions, and for poor and near-poor children, the most common comorbid conditions were learning disability (75.6%), ADHD (50.7%), and depression or anxiety (45.9%) (Supplemental Table 9). There were no statistically significant differences in the rise in the parent-reported prevalence of these conditions, although poor and near-poor children more commonly had asthma as a comorbid condition compared with children living >200% of the FPL,  $P < .05$  in both survey administration years.

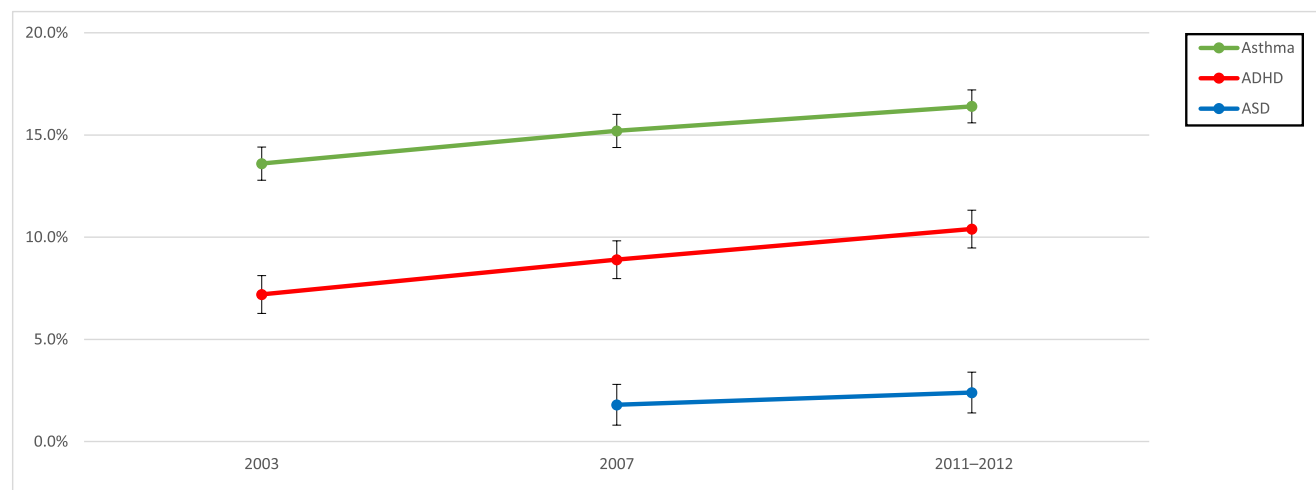
In addition, the percent increase in type of parent-reported comorbid disorder for each target disorder was differentially influenced by poverty status (Supplemental Tables 7–9). Among children identified as having asthma, parent-reported ADHD rose 50% among the poor and near poor and 16% among those living >200% of the FPL (Supplemental Table 7). Likewise, among children identified as having ADHD, parent-reported asthma

**TABLE 1** Percent Change in Parent-Reported Lifetime Prevalence of Asthma, ADHD, and ASD Among US Children Aged 0 to 17 y by Sociodemographic Characteristics

	Asthma		ADHD		ASD <sup>a</sup>	
	% Change 2003–2011/2012 (95% CI)	<i>P</i>	% Change 2003–2011/2012 (95% CI)	<i>P</i>	% Change 2007–2011/2012 (95% CI)	<i>P</i>
Total percent change	+21 (16 to 27)	—	+43 (35 to 52)	—	+32 (12 to 55)	—
Age, y		.05		.05		.33
3–5	8 (–4 to 22)		99 (47 to 169)		18 (–28 to 80)	
6–11	20 (11 to 29)		34 (22 to 48)		20 (–6 to 55)	
12–17	27 (18 to 35)		46 (35 to 58)		53 (20 to 95)	
Sex		.002		.29		.36
Boy	13 (7 to 20)		39 (30 to 49)		36 (12 to 64)	
Girl	32 (23 to 42)		54 (37 to 72)		16 (–15 to 56)	
Race		.12		.23		.84
White non-Hispanic	17 (10 to 24)		46 (36 to 56)		42 (18 to 72)	
Black non-Hispanic	30 (17 to 45)		53 (29 to 82)		15 (–41 to 85)	
Hispanic	29 (13 to 47)		91 (51 to 142)		37 (–23 to 132)	
Other	13 (–4 to 32)		38 (9 to 76)		53 (–6 to 148)	
Poverty status		.11		.74		.68
<100% FPL	33 (19 to 48)		42 (23 to 64)		11 (–32 to 63)	
100%–199% FPL	21 (9 to 35)		49 (31 to 70)		27 (–11 to 80)	
200%–399% FPL	15 (6 to 25)		42 (27 to 58)		49 (11 to 101)	
≥400%FPL	15 (6 to 25)		36 (21 to 53)		32 (–3 to 78)	
Insurance coverage		.03		.99		.11
Private	13 (6 to 20)		37 (26 to 48)		49 (20 to 84)	
Public	18 (9 to 28)		35 (22 to 49)		6 (–22 to 38)	
Uninsured	55 (23 to 95)		41 (3 to 92)		0 (–108 to 107)	

Wald F test group interaction term was used to identify differences in time trend; *P* < .05 was considered significant. All results are weighted to provide population estimates. Imputed files were used to address missing values for income. CI, confidence interval; —, not applicable.

<sup>a</sup> Change in prevalence restricted to 2007 to 2011/2012 because we cannot compare with the 2003 survey because the question was asked differently.



**FIGURE 1**

Parent-reported prevalence change in asthma, ADHD, and ASD among US children aged 3 to 17 years, 2003 to 2011/2012. ASD prevalence is restricted to 2007 to 2011/2012 because the prevalence question was asked differently in 2003.

rose 31% among the poor and near poor compared with a decline of 4% among those living >200% of the FPL (Supplemental Table 8). Conversely, for children identified as having ASD, no statistically significant differences were noted for the rate of rise of comorbid conditions (Supplemental Table 9).

### Extent Poverty Status Is a Predictor of Higher-Than-Average Comorbid Conditions

By using 2011–2012 data, children identified as having asthma and being poor had nearly 2 times the adjusted odds of having at least 1 comorbid

condition compared with their counterparts in households with incomes >400% of the FPL (Table 3). Having public insurance was also associated with higher adjusted odds of at least 1 comorbidity, but minority race was associated with lower adjusted odds compared with

**TABLE 2** Percent Change in Chronic Comorbid Conditions by FPLs Among US Children 3 to 17 y With Asthma, ADHD, and ASD

Poverty Status		2003	2007	2011 / 2012	2003–2011 /2012	Time by Poverty Group Interaction	2007–2011 /2012	Time by Poverty Group Interaction
		% (SE)	% (SE)	% (SE)	% Change	<i>P</i>	% Change	<i>P</i>
Asthma	0%–199% FPL					.05	—	—
	0–1 comorbidities	85.4 (0.9)	79.2 (1.6)	79.9 (1.1)	–6 (–11 to –3)			
	≥2 comorbidities	14.6 (0.9)	20.8 (1.6)	20.1 (1.1)	38 (18 to 62)			
	≥200% FPL							
ADHD	0%–199% FPL					.006	—	—
	0–1 comorbidities	64.5 (1.7)	56.8 (2.2)	57.9 (1.7)	–11 (–20 to –3)			
	≥2 comorbidities	35.5 (1.7)	43.2 (2.2)	42.1 (1.7)	19 (5 to 34)			
	≥200% FPL							
ASD <sup>a</sup>	0%–199% FPL					—	—	.48
	0–1 comorbidities	—	29.9 (5.4)	29.8 (3.4)	—		0 (–52 to 51)	
	≥2 comorbidities	—	70.1 (5.4)	70.2 (3.4)	—		0 (–19 to 20)	
	≥200% FPL						—	
ASD <sup>a</sup>	0%–199% FPL					—	—	.48
	0–1 comorbidities	—	33.6 (3.6)	39.7 (3.4)	—		18 (–11 to 54)	
	≥2 comorbidities	—	66.4 (3.6)	60.3 (3.4)	—		–10 (–28 to 6)	
	≥200% FPL						—	

—, not applicable.

<sup>a</sup> Comparison restricted to 2007 to 2011/2012 because we cannot compare with the 2003 survey because the question was asked differently.

whites. Among children with ADHD, those who were poor had higher adjusted odds (2.60) of having at least 2 comorbid conditions. In contrast, for ASD, poverty status was not a significant predictor of having at least 3 parent-reported comorbidities. Public insurance was a significant predictor of at least 3 comorbid conditions (adjusted odds ratio = 2.27).

## DISCUSSION

Although poverty is a well-established risk factor for chronic health problems,<sup>2,38</sup> our findings suggest that the national rise in parent-reported prevalence of asthma, ADHD, and ASD as well as comorbid disorders is differentially influenced by poverty status, such that being poor was predictive of higher-than-average comorbid conditions for children with asthma and ADHD, but not ASD, consistent with previous studies.<sup>12,39–41</sup> These

**TABLE 3** Adjusted Odds of Having Higher-Than-Average Comorbid Conditions in 2011/2012 (CI) by Target Condition

	Asthma	ADHD	ASD
Average no. of comorbidities	0.61	1.23	2.15
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age, y			
3–5	0.56 (0.43 to 0.73)	0.89 (0.53 to 1.50)	0.64 (0.31 to 1.32)
6–11 (ref)	Ref	Ref	Ref
12–17	1.67 (1.40 to 1.99)	1.50 (1.22 to 1.85)	1.43 (0.92 to 2.21)
Sex			
Boy (ref)	Ref	Ref	Ref
Girl	0.69 (0.59 to 0.82)	1.10 (0.89 to 1.35)	1.05 (0.65 to 1.69)
Race and/or ethnicity			
White non-Hispanic (ref)	Ref	Ref	Ref
Black non-Hispanic	0.48 (0.38 to 0.62)	0.91 (0.69 to 1.21)	0.53 (0.29 to 0.97)
Hispanic	0.60 (0.47 to 0.78)	1.15 (0.81 to 1.65)	0.53 (0.24 to 1.14)
Other	0.72 (0.57 to 0.91)	1.23 (0.90 to 1.68)	0.60 (0.35 to 1.03)
Poverty status			
<100% FPL	1.72 (1.29 to 2.29)	2.60 (1.85 to 3.68)	1.71 (0.84 to 3.49)
100%–199% FPL	1.09 (0.84 to 1.41)	1.47 (1.07 to 2.02)	1.35 (0.67 to 2.72)
200%–399% FPL	1.06 (0.84 to 1.32)	1.37 (1.04 to 1.80)	1.51 (0.87 to 2.59)
≥400%FPL (ref)	Ref	Ref	Ref
Insurance coverage			
Private (ref)	Ref	Ref	Ref
Public	1.91 (1.54 to 2.38)	1.30 (0.99 to 1.70)	2.27 (1.29 to 3.99)
Uninsured	1.12 (0.70 to 1.78)	1.23 (0.75 to 2.02)	0.75 (0.24 to 2.31)

Modeled as 1+ for Asthma, 2+ for ADHD, and 3+ for ASD. CI, confidence interval; OR, odds ratio.

findings underscore the importance of increased clinician awareness of higher risk for comorbid conditions

when caring for children with asthma and ADHD who are living in impoverished households.

The parent-reported prevalence of asthma and ADHD is higher among poor children, but the percentage change in prevalence over time did not statistically differ by poverty status. When considering comorbid conditions among children with asthma and ADHD, poverty was predictive of having greater than the average number of comorbid conditions. In contrast, the percent change in the prevalence of ASD and presence of comorbidities were not associated with poverty. Past research has postulated that greater parent awareness, better detection, less stigma, change in diagnostic classification, more financial resources, and private insurance may help explain our findings.<sup>39,42</sup> Our conclusions reinforce the importance of clinicians to remain steadfast in their evaluation of all children with ASD because comorbidities are exceedingly common in all income groups.<sup>15,40,41</sup>

Past studies indicate that comorbidities can impact a child's overall health and functioning in daily life, and children with complex health conditions have higher rates of unmet need than other children with special health care needs.<sup>43,44</sup> They also have higher rates of emotional and behavioral problems and mental health disorders than other children.<sup>45,46</sup> Unmet needs are higher for children with special health care needs living in or near poverty compared with those living >400% the FPL,<sup>44</sup> and significant sociodemographic disparities exist.<sup>47,48</sup> Minority children have poorer access to care and have increased odds of suboptimal health.<sup>49</sup> For children with ADHD, higher numbers of comorbidities was associated with poorer functioning, and disparities in the diagnosis of ASD and access to services have been identified.<sup>12,50</sup> Coexisting mental health disorders increased the cost of care for children with ADHD as well.<sup>51</sup> The presence of comorbidities is associated with

higher health care costs for children with asthma.<sup>52</sup> Further research is needed to examine how child-level (ie, sociodemographics, especially race and/or ethnicity), parent-level (ie, care burden, distress), and system-level characteristics (ie, access to mental health and special education resources if identified) are related to parental reporting of these target disorders and comorbidity.

Poverty status also differentially impacted the type and number of comorbid conditions reported by the parent. These data are thus also important in evaluating support programs for children with disabilities, including the SSI program, because comorbidities are often not accurately recorded and may be an important facet of a child's function.<sup>8</sup> Of note, our findings are similar to the findings of high rates of comorbidities among children with mental health disorders including ADHD and autism in the Medicaid population identified by the National Academies of Sciences, Engineering, and Medicine's report.<sup>7</sup> In addition, some of the children with these target disorders may have also been receiving SSI for a mental health impairment. Public insurance was a significant predictor of higher-than-average comorbid disorders for asthma and ASD; early and periodic screening, diagnosis, and treatment standards in Medicaid may contribute to this finding.

Although we could not discern the causal and temporal nature of the relationship of poverty to chronic medical conditions and comorbidities, it has been well established that having a family member with a disability increases one's likelihood of being poor. Potential reasons why this is true include increased out-of-pocket health care expenses and the time of caretaking away from work.<sup>53–60</sup> This is consistent with data on childhood poverty, which show an overall

increase during our study period.<sup>61</sup> These associations have important implications on health care utilization and cost for children and families in poverty and suggest that many families are struggling financially to care of their children with chronic medical conditions.

In this analysis, we also identified that after adjustment for income, minority race was associated with lower odds of higher-than-average numbers of comorbidities for children with asthma. We note that although the diagnosis of asthma has been associated with minority race in previous studies in regard to overall prevalence,<sup>62</sup> in our study and others it is not necessarily associated with multiple comorbidities.<sup>4</sup> Poverty remains the most important risk factor for higher-than-average comorbidities in this population.

The study has several limitations. Utilization of only 3 data points through time, and 2 for ASD over the period of a decade, limits our ability to identify definite trends over time. Other weaknesses include the challenges in comparing these survey findings to other surveys, given differences in the methodology of survey administration. Additionally, we do not know the impact on our results of adding cell phone methodology in 2011–2012 of the NSCH, although current data do suggest that there was not evidence of any response bias between years of survey administration with this change.<sup>32,36</sup> The diagnosis of the target conditions and comorbid chronic conditions were based on primary caregiver reports; this method has been supported in the literature as reliable.<sup>32–34</sup> We also note that some of the comorbid conditions listed by caregivers of children with ASD and ADHD may be considered part of the clinical profile of the condition. Lastly, the list of chronic conditions included on the NSCH that a parent can report is limited and was further limited

in our analysis because of changes in question wording between 2003 and 2011–2012. The list also heavily favors mental health conditions and excludes some rare conditions such as congenital heart disease, cystic fibrosis, etc, which may underestimate our findings in regard to comorbidity.

## CONCLUSIONS

Poverty differentially influenced parent-reported lifetime prevalence and comorbidities of children with asthma, ADHD, and ASD. For children with asthma or ADHD, poverty was associated with more comorbidity. Future research is merited to examine how lack of access to health care and the burden of living in poverty influences risk

for comorbidities, especially mental disorders. In contrast, increases in both prevalence and comorbidities among children with ASD were similar among all income groups.

Understanding the impact of comorbid health conditions is also an area for additional research to develop best practices for health assessment and management. Attention to comorbidities can result in improved quality of life and optimal disease control.<sup>63,64</sup> Policies that support practitioners, promote medical homes, and support children and families in poverty or near poverty, including strengthening current programs such as SSI, should be considered to adequately address the complex medical needs of these children.

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## ABBREVIATIONS

ADHD: attention-deficit/hyperactivity disorder  
ASD: autism spectrum disorder  
FPL: federal poverty level  
NSCH: National Survey of Children's Health  
SSI: Supplemental Security Income

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