



The prevalence and persistence of atopic dermatitis in urban United States children



Costner McKenzie, BA^{*}; Jonathan I. Silverberg, MD, PhD, MPH^{†,‡}

^{*} Department of Dermatology, Northwestern University Feinberg School of Medicine, Chicago, Illinois

[†] Departments of Dermatology, Preventive Medicine and Medical Social Sciences, Northwestern University Feinberg School of Medicine, Chicago, Illinois

[‡] Northwestern Medicine Multidisciplinary Eczema Center, Chicago, Illinois

ARTICLE INFO

Article history:

Received for publication March 23, 2019.

Received in revised form May 10, 2019.

Accepted for publication May 15, 2019.

ABSTRACT

Background: Previous studies found that childhood atopic dermatitis (AD) and asthma are associated with residence in urban areas. However, little is known about the prevalence and determinants of AD in US urban populations and its impact on quality-of-life (QOL) and asthma.

Objective: To determine AD prevalence and persistence, sociodemographic predictors thereof, and association with QOL and atopic comorbidities in US urban children.

Methods: We analyzed data from The Fragile Families and Child Wellbeing Study, a prospective cohort study of 4898 women and their children born in 20 large US cities between 1998 and 2000. AD prevalence was determined at ages 5, 9, and 15 years, and stratified by sex, race/ethnicity, and household poverty income level.

Results: The prevalences (95% confidence interval [CI]) of childhood AD were 15.0% (11.0%–18.9%), 15.1% (11.5%–18.7%), and 14.5% (10.4%–18.5%) at ages 5, 9, and 15 years, respectively. Female sex (multivariable repeated measures logistic regression; adjusted odds-ratio [95% CI]: 1.56 [1.02–2.37]) and black race (1.80 [1.07–3.01]) were associated with persistent AD across all 3 ages. Children with AD at ages 5 and 15 (2.63 [1.42–4.86]), 5, 8 and 15 (1.47 [1.02–2.12]) and 9 and 15 years (1.61 [1.00–2.60]) had higher odds of poor/fair/good overall health. Children with AD at ages 5 and 9 years had the highest odds of ever having asthma (adjusted odds ratio [95% confidence interval]: 6.05 [5.88–6.22]), followed by children with AD at ages 5, 9, and 15 years (3.17 [3.07%–3.27]).

Conclusion: Atopic dermatitis prevalence and persistence were highest in US urban children who were female or black. Urban children with persistent AD were more likely to have poor QOL and asthma.

© 2019 American College of Allergy, Asthma & Immunology. Published by Elsevier Inc. All rights reserved.

Introduction

Atopic dermatitis (AD) is a chronic inflammatory skin disorder that affects approximately 13% of children¹ and 7% of adults^{2,3} in the United States. It is associated with substantial disability secondary to itch, pain,^{4,5} sleep disturbance,^{6,7} symptoms of anxiety and depression,^{8,9} and the development of comorbid asthma and other atopic disorders.^{1,10,11} Atopic dermatitis is associated with a heterogeneous clinical course, including variable age of onset, disease persistence, and development of comorbid atopic disease.^{12,13}

Atopic dermatitis is more prevalent in specific demographic groups, including females and blacks, and particularly in metropolitan areas.^{1,14} These association appear to be multifactorial, and the reasons have not been fully elucidated. One possibility is that children from metropolitan areas and these demographic groups have more persistent AD. Alternatively, they may have more late-onset cases that offset early-onset, transient disease. We hypothesized that these populations have higher AD prevalence because of both higher rates of late-onset AD and more persistent early-onset disease.

Similar to AD, previous studies found higher prevalence of asthma in urban children, females, and those of black race.^{15,16} We hypothesized that these associations may be partly attributable to greater persistence of AD, which in turn is associated with more asthma. In this study, we examined the associations of AD prevalence and persistence and the relationship between AD persistence and development of asthma.

Reprints: Jonathan I. Silverberg, MD, PhD, MPH, Department of Dermatology, Northwestern University Feinberg School of Medicine, Suite 1600, 676 N. St. Clair St., Chicago, IL 60611; E-mail: JonathanSilverberg@Gmail.com.

Disclosures: none.

Funding Sources: This publication was made possible with support from the Dermatology Foundation.

<https://doi.org/10.1016/j.anai.2019.05.014>

1081-1206/© 2019 American College of Allergy, Asthma & Immunology. Published by Elsevier Inc. All rights reserved.

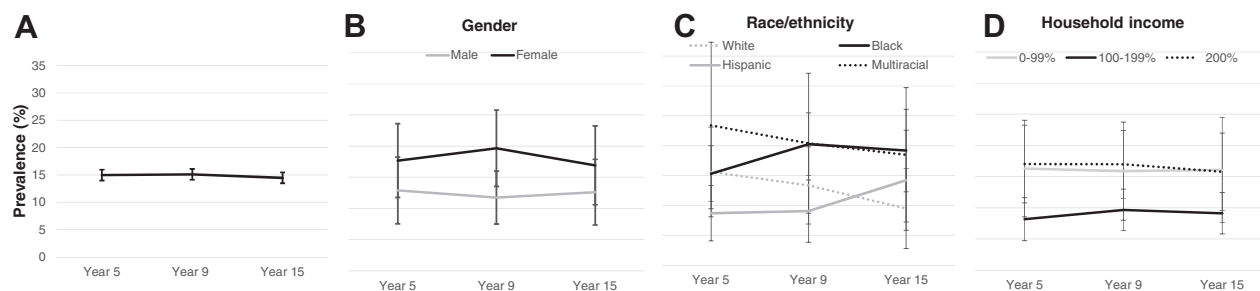


Figure 1. One-year prevalence of atopic dermatitis at ages 5, 9, and 15 years overall (A) and stratified by sex (B), race/ethnicity (C), and household income (D). Missing values occurred in 5 (<0.01%), 2 (<0.01%), and 4 (<0.01%) for AD at years 5, 9, and 15, 1 (<0.01%) for sex, 1 (<0.01%) for race/ethnicity, and 27 (<0.01%) for household income.

Methods

Data Source

The Fragile Families and Child Wellbeing Study (FFCWS) is a prospective cohort study that followed up with 4898 women and their children born in 20 large US cities.¹⁷ The FFCWS is a longitudinal study comprising baseline in-person interviews at a child's birth (between 1998 and 2000) and follow-up telephone or household interviews with mothers, fathers, or primary caregivers at ages 1, 3, 5, 9, and 15 years.¹⁸ The survey collects data on family characteristics, demographics, environment, health, and health behaviors. Sample weights were provided by FFCWS that adjust for

the sample design, nonresponse at baseline, and attrition based on observed characteristics over time. Survey results yield estimates that are representative of US urban children. The FFCWS was conducted as a cooperative effort by Princeton University's Center for Research on Child Wellbeing and Center for Health and Wellbeing, the Columbia Population Research Center, and the National Center for Children and Families.

AD, Asthma, and Overall Health

History of AD in the past year was determined by a positive response in the parent questionnaire to "In the past 12 months, has

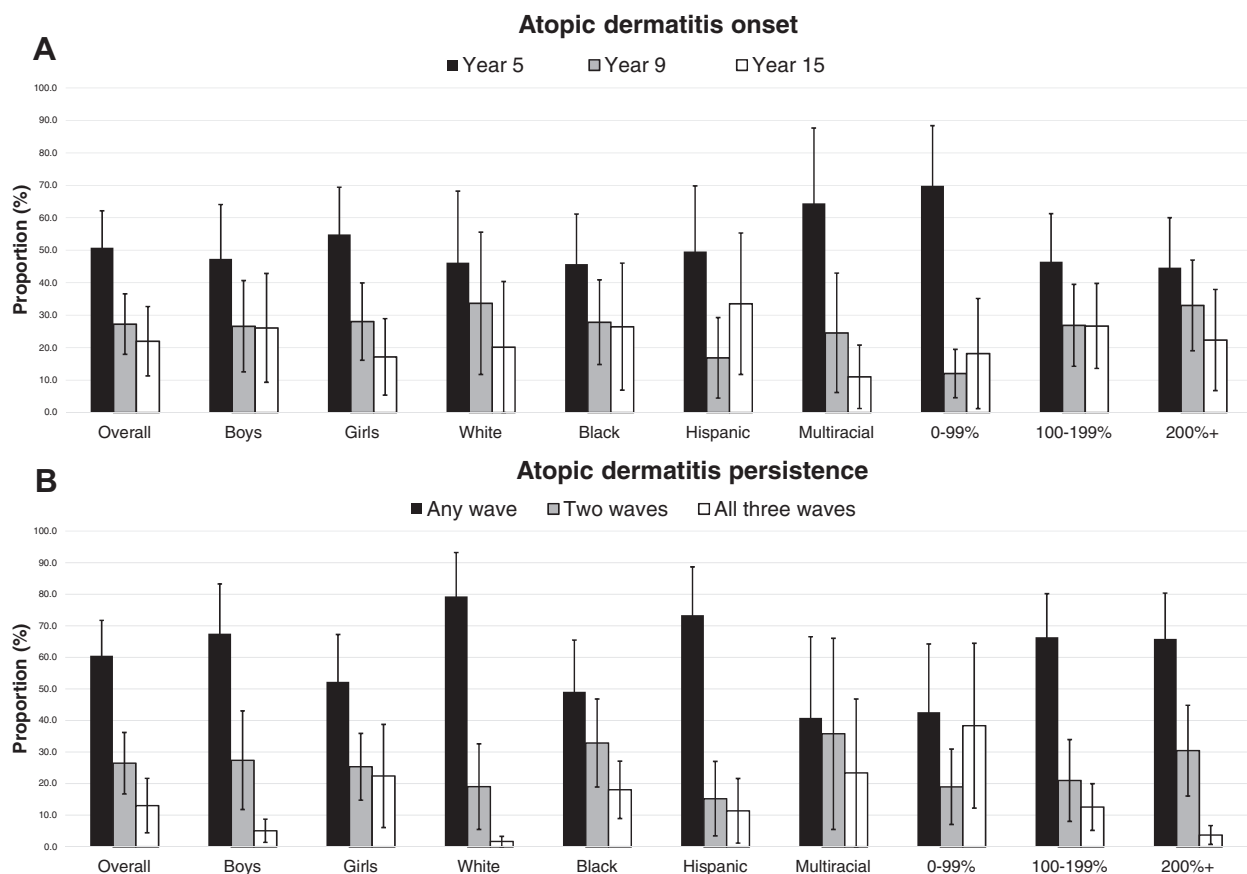


Figure 2. Sociodemographics associations with atopic dermatitis age of onset (A) and persistence (B) in US urban children.

Table 2
Associations between Atopic Dermatitis Course and Lifetime Prevalence of Poorer Overall Health Status

1-year history of AD		Lifetime prevalence of poor/fair/good vs very good/excellent overall health (95% CI)						Crude OR (95% CI)		Adjusted OR (95% CI)	
Age (yr)	Description	1	3	5	9	15					
5	No	No	12.9% (11.3%-14.5%)	18.4% (16.6%-20.3%)	24.2% (22.1%-26.2%)	32.0% (29.8%-34.2%)	38.7% (36.4%-41.0%)	1.00 [ref]	1.00 [ref]	1.00 [ref]	1.00 [ref]
	Yes	No	10.4% (5.0%-15.8%)	14.4% (8.3%-20.5%)	22.0% (14.8%-29.1%)	31.8% (23.8%-39.9%)	37.1% (28.8%-45.4%)	0.93 (0.65-1.35)	0.96 (0.66-1.40)	0.96 (0.66-1.40)	0.96 (0.66-1.40)
	Yes	No	20.0% (7.8%-32.2%)	28.3% (14.7%-41.8%)	32.6% (18.5%-46.7%)	45.7% (30.7%-60.7%)	58.7% (43.9%-73.5%)	2.25 (1.24-4.08)	2.63 (1.42-4.86)	2.63 (1.42-4.86)	2.63 (1.42-4.86)
	Yes	Yes	10.6% (4.3%-17.0%)	14.6% (7.4%-21.8%)	16.7% (9.1%-24.3%)	28.1% (19.0%-37.3%)	34.4% (24.7%-44.0%)	0.83 (0.54-1.28)	0.84 (0.54-1.31)	0.84 (0.54-1.31)	0.84 (0.54-1.31)
	Yes	Yes	17.6% (11.0%-24.2%)	23.3% (16.0%-30.6%)	31.8% (23.6%-39.6%)	42.9% (34.3%-51.4%)	49.6% (41.0%-58.2%)	1.56 (1.09-2.22)	1.56 (1.09-2.22)	1.56 (1.09-2.22)	1.56 (1.09-2.22)
	No	Yes	9.8% (4.4%-15.1%)	12.6% (6.7%-18.4%)	18.9% (12.0%-25.8%)	34.6% (26.3%-43.0%)	38.6% (30.0%-47.2%)	0.99 (0.69-1.44)	1.07 (0.74-1.58)	1.07 (0.74-1.58)	1.07 (0.74-1.58)
	No	Yes	11.1% (3.7%-18.5%)	20.0% (10.7%-29.3%)	28.0% (17.6%-38.4%)	42.7% (31.2%-54.1%)	49.3% (37.8%-60.9%)	1.54 (0.97-2.45)	1.61 (1.00-2.60)	1.61 (1.00-2.60)	1.61 (1.00-2.60)
	No	Yes	16.8% (10.3%-23.3%)	21.9% (14.9%-28.9%)	29.2% (21.5%-36.9%)	40.1% (31.8%-48.5%)	43.8% (35.4%-52.2%)	1.23 (0.87-1.75)	1.20 (0.84-1.72)	1.20 (0.84-1.72)	1.20 (0.84-1.72)
AD persistence		Lifetime prevalence of poor/fair/good vs very good/excellent overall health (95% CI)						Crude OR (95% CI)		Adjusted OR (95% CI)	
		Age (yr)	1	3	5	9	15				
None		12.9% (11.3%-14.5%)	18.4% (16.6%-20.3%)	24.2% (22.1%-26.2%)	32.0% (29.8%-34.2%)	38.7% (36.4%-41.0%)	1.00 [ref]	1.00 [ref]	1.00 [ref]	1.00 [ref]	1.00 [ref]
One year		11.9% (8.7%-15.1%)	16.4% (12.8%-20.1%)	23.5% (19.3%-27.7%)	35.6% (30.9%-40.3%)	39.9% (35.1%-44.7%)	1.05 (0.84-1.31)	1.07 (0.86-1.36)	1.07 (0.86-1.36)	1.07 (0.86-1.36)	1.07 (0.86-1.36)
Two years		12.4% (8.0%-16.9%)	19.4% (14.1%-24.7%)	24.0% (18.2%-30.0%)	36.9% (30.4%-43.3%)	44.7% (38.0%-51.4%)	1.28 (0.96-1.70)	1.35 (1.00-1.81)	1.35 (1.00-1.81)	1.35 (1.00-1.81)	1.35 (1.00-1.81)
Three years		17.3% (10.8%-23.8%)	23.3% (16.0%-30.6%)	31.6% (23.6%-39.6%)	42.9% (34.3%-51.4%)	49.6% (41.0%-58.2%)	1.56 (1.09-2.22)	1.56 (1.09-2.22)	1.56 (1.09-2.22)	1.56 (1.09-2.22)	1.56 (1.09-2.22)

Bold values indicate statistical significance.

had similar trends of AD prevalence by age but had consistently higher AD prevalence vs whites at all ages. In black children, AD prevalence slightly increased between the ages of 5 (15.3% [10.6%-20.0%]) and 9 (20.3% [15.0%-25.5%]) and remained stable at age 15 (19.2% [12.3%-26.1%]) years; AD prevalence was higher in blacks vs whites at ages 9 and 15 years. However, AD prevalence was lowest in Hispanic children ages 5 (8.7% [4.1%-13.3%]) and 9 (9.1% [3.8%-14.3%]) years but increased and was higher than that for whites at age 15 (14.2% [5.8%-22.6%]) years. Finally, AD prevalence was stable across all household income levels but was consistently higher in at least 200% and 0%-99% compared with 100%-199% poverty level at all ages.

AD Onset

Overall, AD onset was highest by age 5 (n = 301, 50.8% [39.4%-62.1%]) and decreased by age 9 (n = 147, 27.3% [17.9%-36.6%]) and age 15 (n = 86, 22.0% [11.3%-32.7%]) years (Fig 2). A greater proportion of females (54.8% [40.2%-69.4%]) reported early AD onset. Alternatively, a greater proportion of boys (26.1% [9.3%-42.9%]) reported late-onset AD (eTable 1). Those with a household income less than 99% FPL had the greatest proportion of early (68.8% [51.2%-88.4%]) and the smallest proportion of late (18.2% [1.2%-35.2%]) AD onset.

AD Persistence

Among urban children with AD, 60.5% (49.3%-71.7%, n = 293) only reported AD during 1 interview wave, 26.5% (16.7%-36.2%, n = 151) reported AD during 2 waves of interviews, and 13.0% (4.4%-21.7%, n = 90) reported AD during all 3 waves of interviews (Fig 2).

White (79.3% [65.4%-93.2%]) and Hispanic (73.3% [58.0%-88.7%]) children had the greatest prevalence of transient AD. Conversely, whites (1.7% [0.00%-3.4%]) and those with a household income of at least 200% FPL (3.7% [0.7%-6.7%]) had the lowest prevalence of AD reported during all 3 interview waves. Females (22.4% [6.1%-38.8%]), black (18.0% [8.9%-27.1%]) and multiracial/other (23.4% [0.0%-55.2%]) race/ethnicity, and household income 0%-99% FPL (38.4% [12.3%-64.5%]), however, had the greatest prevalence of AD reported during all 3 waves of interviews.

Associations with AD Course

Overall, early-, intermediate-, and late-onset, transient AD were similarly reported (Table 1). Furthermore, similar proportions of children had early-onset resolving, and persistent AD. White children had the highest rates of early-onset transient, early-onset intermittent, and intermediate-onset transient AD. Black and multiracial/other children had the highest rates of early-onset resolving and early-onset persistent AD. Among Hispanic children, the most commonly reported courses were late-onset AD, followed by early-onset transient AD. Finally, lowest household income (0%-99%) was associated with highest rates of early-onset persistent AD. However, higher household income ($\geq 200\%$) was associated with highest rates of transient and intermittent AD.

In repeated-measures logistic regression models, female vs male sex (aOR [95% CI]: 1.56 [1.02-2.37]), black (1.80 [1.07-3.01]) and multiracial/other (1.94 [1.00-3.78]) race, but not Hispanic ethnicity (0.99 [0.52-1.86]) or any household income groups (100%-199%: 0.56 [0.30-1.04]; $\geq 200\%$: 1.20 [0.63-2.29]) were associated with more persistent AD across age groups.

AD Course and Overall Health

In repeated-measures binary logistic regression, history of AD compared with no AD in the past year was associated with significantly higher odds of reporting only poor, fair, or good vs very good or excellent overall health (1.69 [1.54-1.96]). In

Table 3
Associations between Atopic Dermatitis Course and Lifetime Prevalence of Asthma by Age 15 Years in US Children

1-year history of AD		Lifetime prevalence of asthma (95% CI)					Description	Age (yr)					Crude OR (95% CI)	Adjusted OR (95% CI)
5	9	15	1	3	5	9		1	3	5	9	15		
No	No	No	13.3% (11.6%–15.0%)	16.7% (14.8%–18.6%)	16.4% (14.6%–18.2%)	19.9% (18.0%–21.9%)	None	13.3% (11.6%–15.0%)	16.7% (14.8%–18.6%)	16.4% (14.6%–18.2%)	19.9% (18.0%–21.9%)	20.3% (18.4%–22.2%)	1.00 [ref]	1.00 [ref]
Yes	No	No	16.5% (9.6%–23.4%)	19.8% (12.3%–27.4%)	23.7% (16.3%–31.0%)	28.0% (20.3%–35.8%)	Early-onset, transient	16.5% (9.6%–23.4%)	19.8% (12.3%–27.4%)	23.7% (16.3%–31.0%)	28.0% (20.3%–35.8%)	28.8% (21.0%–36.6%)	1.37 (1.33–1.41)	1.59 (1.54–1.63)
Yes	No	Yes	16.3% (4.8%–27.8%)	25.0% (11.0%–39.0%)	23.9% (11.1%–36.7%)	26.1% (12.9%–39.3%)	Early-onset, intermittent	16.3% (4.8%–27.8%)	25.0% (11.0%–39.0%)	23.9% (11.1%–36.7%)	26.1% (12.9%–39.3%)	45.7% (30.7%–60.6%)	1.00 (0.95–1.05)	1.10 (1.04–1.16)
Yes	Yes	No	18.9% (10.6%–27.1%)	21.0% (11.9%–30.0%)	24.0% (15.3%–37.1%)	34.4% (24.7%–44.0%)	Early-onset, resolving	18.9% (10.6%–27.1%)	21.0% (11.9%–30.0%)	24.0% (15.3%–37.1%)	34.4% (24.7%–44.0%)	38.5% (28.6%–48.5%)	5.25 (5.12–5.40)	6.05 (5.88–6.22)
Yes	Yes	Yes	20.3% (13.2%–27.4%)	33.9% (25.2%–42.6%)	35.3% (27.1%–43.6%)	45.1% (36.5%–53.7%)	Early-onset, persistent	20.3% (13.2%–27.4%)	33.9% (25.2%–42.6%)	35.3% (27.1%–43.6%)	45.1% (36.5%–53.7%)	48.1% (39.5%–56.7%)	2.33 (2.26–2.40)	3.17 (3.07–3.27)
No	Yes	No	11.7% (5.8%–17.5%)	18.2% (10.9%–25.5%)	20.5% (13.4%–27.6%)	35.4% (27.0%–43.9%)	Intermediate onset, transient	11.7% (5.8%–17.5%)	18.2% (10.9%–25.5%)	20.5% (13.4%–27.6%)	35.4% (27.0%–43.9%)	33.1% (24.8%–41.4%)	0.97 (0.94–0.99)	1.11 (1.08–1.15)
No	Yes	Yes	22.1% (11.9%–32.2%)	30.4% (19.3%–41.6%)	30.7% (20.0%–41.3%)	42.7% (31.2%–54.1%)	Intermediate onset, persistent	22.1% (11.9%–32.2%)	30.4% (19.3%–41.6%)	30.7% (20.0%–41.3%)	42.7% (31.2%–54.1%)	45.3% (33.8%–56.9%)	2.43 (2.34–2.53)	2.76 (2.65–2.88)
No	No	Yes	17.9% (11.0%–24.8%)	22.0% (14.2%–29.7%)	22.1% (15.0%–29.1%)	28.5% (20.8%–36.1%)	Late onset	17.9% (11.0%–24.8%)	22.0% (14.2%–29.7%)	22.1% (15.0%–29.1%)	28.5% (20.8%–36.1%)	29.9% (22.2%–37.7%)	1.17 (1.14–1.20)	1.21 (1.18–1.24)

Bold values indicate statistical significance.

multivariable binary logistic regression models, early-onset intermittent (2.63 [1.42–4.86]), early-onset persistent (1.47 [1.02–2.12]) and intermediate-onset persistent (1.61 [1.00–2.60]) AD courses were associated with significantly higher odds of ever having only poor, fair, or good overall health (Table 2). Furthermore, in multivariable models, having AD in 2 (1.35 [1.00–1.81]) or 3 (1.47 [1.03–2.09]) waves, but not only 1 wave (1.07 [0.86–1.36]) was associated with a higher lifetime prevalence of having only poor, fair, or good overall health.

AD Course and Asthma History

In multivariable repeated-measures logistic regression models, all AD courses were associated with significantly higher odds of ever having asthma (Table 3). However, early-onset resolving (aOR [95% CI]: 6.05 [5.88–6.22]) and early-onset persistent (3.17 [3.07–3.27]) AD were associated with highest odds of asthma. Among children with early-onset persistent AD, asthma was significantly increased in those of white (8.30 [7.21–9.56]) and black (17.64 [16.73–18.61]) race.

Discussion

This study found high prevalences of AD overall, and high proportions of more persistent AD in particular, among children residing in the urban United States. Prevalence of AD was higher in females vs males, black and multiracial/other vs white race across multiple time points. The increased prevalence in these groups was attributable to more persistent disease. White children had more transient AD, and Hispanic children had markedly lower prevalence of AD at all ages. Together, the results indicate that AD prevalence is driven by a complex overlap of new-onset and persistent cases. Finally, more persistent AD was associated with poorer overall health status and higher odds of ever having asthma, even after controlling for sociodemographics.

We found the prevalence of AD to be approximately 15% across all age groups, which correspond to the years 2003 to 2005, 2007 to 2009, and 2013 to 2015 when the surveys were conducted. These prevalences are higher than previously reported childhood AD prevalence estimates of 11.0% in 2003 to 2004¹⁴ and 13.6% in 2007 to 2008¹⁹ for metropolitan areas in the United States. The higher prevalences observed are likely attributable to the focused sampling of urban areas in the United States. Previous studies found higher rates of asthma in the urban United States.^{15,16} Furthermore, a systematic review including 26 studies provided some evidence for increased risk of AD in children living in urban areas.^{20,21} Taken together, AD prevalence appears to be increased in the urban United States.

This study also found that AD, particularly more persistent AD, has a significant impact on the overall health status of children across all age groups. These findings are consistent with analyses of the 2007–2008 National Survey of Children's Health, which found significant associations between AD and poorer health outcomes.¹ Whether poor health-related quality of life (HRQOL; as well as history of AD) is related to AD persistence per se or confounded by AD severity that is also associated with AD persistence.¹³ Future studies are needed to distinguish between the effects of AD severity and persistence on HRQOL.

Atopic dermatitis used to be considered a childhood disease that “burns out” with increasing age. Indeed, a systematic review and meta-analysis of 46 studies found that 80% of childhood AD cases had a period of observed disease clearance by 8 years, and only 5% of cases had no observed clearance after 20 years of follow-up.¹³ That meta-analysis found that female sex was associated with persistent AD, consistent with the results of this study. However, that meta-analysis did not assess the associations of urban residence on AD persistence. In addition, it may have underestimated

AD persistence, because it did not assess disease activity after the initial period of disease clearance. The high rates of AD persistence observed in FFCWS suggest differences of AD persistence rates between urban and nonurban areas. Epidemiological studies from the Pediatric Eczema Elective Registry study, a phase 4 cohort of US children with AD who were treated with pimecrolimus, found that more than 80% of cases continued to have clinical manifestations of or were using treatments for their AD across all ages. The high rates of AD persistence may have been attributable in part to the cohort consisting of children from mostly urban locations. Further studies are needed to understand difference of AD course in urban vs nonurban populations.

Understanding the patterns of and associations of AD persistence is clinically relevant. First, persistent AD was particularly found to negatively impact HRQOL in this study, as well as The Odense Adolescence Cohort Study.²² Second, persistent AD warrants specific topical or systemic considerations, such as proactive therapy or use of steroid-sparing agents.²³ Third, we found that persistent AD is associated with higher rates of asthma. Asthma is accompanied by its own substantial direct and indirect costs, psychological effects, and physical activity limitations.²⁴ Improved long-term control of AD may indirectly reduce asthma risk or severity, besides improving HRQOL. A recent murine study using a house dust mite model of the atopic march found that topical treatment with glucocorticoid receptor/peroxisome proliferator-activated receptor- γ agonists reduced skin inflammation and asthma severity.²⁵ We recommend that AD persistence routinely be included in the assessment and management of AD patients.

Strengths of this study include use of a large-scale, longitudinal cohort that is representative of the US urban population and has demonstrated external validity and reproducibility. We examined the individual and combined effects of AD onset and persistence. Rates of attrition and missing values were fairly low and the survey weights adjusted for attrition. However, the study has potential limitations. History of AD and asthma were self-reported and could not be verified by a clinician. However, caregiver-reported eczema or skin allergy was previously found to be valid in a multicenter outpatient cohort study.²⁶ We considered the first age of reported AD as the age of onset, because this was not directly assessed. Possibly some children had even earlier onset that was not captured by the survey. Similarly, AD persistence was defined using 4- to 5-year intervals and did not account for disease variability between those intervals. Finally, we were unable to assess the impact of family history of AD or atopic disease, AD treatment course, and the treating physician specialty on disease persistence. Future studies are needed to address these points.

In conclusion, US urban children have a high prevalence and more persistent AD, especially in females, black, and multiracial/other races. Persistent AD was associated with poor HRQOL and increased odds of asthma. Further research is warranted to confirm these findings and to better understand the reasons for increased AD in urban children and determinants of AD persistence.

Supplementary Data

Supplementary data related to this article can be found online at <https://doi.org/10.1016/j.anai.2019.05.014>.

References

1. Silverberg JI, Simpson EL. Association between severe eczema in children and multiple comorbid conditions and increased healthcare utilization. *Pediatr Allergy Immunol*. 2013;24(5):476–486.
2. Hua T, Silverberg JI. Atopic dermatitis in US adults: epidemiology, association with marital status, and atopy. *Ann Allergy Asthma Immunol*. 2018;121(5):622–624.
3. Silverberg JI, Gelfand JM, Margolis DJ, et al. Patient burden and quality of life in atopic dermatitis in US adults: a population-based cross-sectional study. *Ann Allergy Asthma Immunol*. 2018;121(3):340–347.
4. Silverberg JI, Gelfand JM, Margolis DJ, et al. Pain is common and burdensome symptom of atopic dermatitis in United States adults. *JAMA Dermatol*. 2019. in press.
5. Vakharia PP, Chopra R, Sacotte R, et al. Burden of skin pain in atopic dermatitis. *Ann Allergy Asthma Immunol*. 2017;119(6):548–552.
6. Silverberg JI, Garg NK, Paller AS, Fishbein AB, Zee PC. Sleep disturbances in adults with eczema are associated with impaired overall health: a US population-based study. *J Invest Dermatol*. 2015;135(1):56–66.
7. Yu SH, Attarian H, Zee P, Silverberg JI. Burden of sleep and fatigue in US adults with atopic dermatitis. *Dermatitis*. 2016;27(2):50–58.
8. Patel KR, Immaneni S, Singam V, Rastogi S, Silverberg JI. Association between atopic dermatitis, depression and suicidal ideation: a systematic review and meta-analysis. *J Am Acad Dermatol*. 2019;80(2):402–410.
9. Yu SH, Silverberg JI. Association between atopic dermatitis and depression in US adults. *J Invest Dermatol*. 2015;135(12):3183–3186.
10. Silverberg JI. Selected comorbidities of atopic dermatitis: atopy, neuropsychiatric, and musculoskeletal disorders. *Clin Dermatol*. 2017;35(4):360–366.
11. Silverberg JI, Gelfand JM, Margolis DJ, et al. Association of atopic dermatitis with allergic, autoimmune, and cardiovascular comorbidities in US adults. *Ann Allergy Asthma Immunol*. 2018;121(5):604–612.
12. Lee HH, Patel KR, Singam V, Rastogi S, Silverberg JI. A systematic review and meta-analysis of the prevalence and phenotype of adult-onset atopic dermatitis. *J Am Acad Dermatol*. 2019;80(6):1526–1532.
13. Kim JP, Chao LX, Simpson EL, Silverberg JI. Persistence of atopic dermatitis (AD): a systematic review and meta-analysis. *J Am Acad Dermatol*. 2016;75(4):681–687.
14. Shaw TE, Currie GP, Koudelka CW, Simpson EL. Eczema prevalence in the United States: data from the 2003 National Survey of Children's Health. *J Invest Dermatol*. 2011;131(1):67–73.
15. Joseph CL, Foxman B, Leickly FE, Peterson E, Ownby D. Prevalence of possible undiagnosed asthma and associated morbidity among urban schoolchildren. *J Pediatr*. 1996;129(5):735–742.
16. Robinson CL, Baumann LM, Romero K, et al. Effect of urbanisation on asthma, allergy and airways inflammation in a developing country setting. *Thorax*. 2011;66(12):1051–1057.
17. About the Fragile Families and Child Wellbeing Study. Fragile Families and Child & Wellbeing Study 2019. <https://fragilefamilies.princeton.edu/about>. Accessed February 2, 2019.
18. Reichman N, Teitler JO, Garfinkel I, McLanahan SS. Fragile families: sample and design. *Child Youth Serv Rev*. 2001;23:303–326.
19. McKenzie C, Silverberg JI. Association of family structure with atopic dermatitis in US children. *J Am Acad Dermatol*. 2018;79(4):638–644.
20. Schram ME, Tedja AM, Spijker R, Bos JD, Williams HC, Spuls PI. Is there a rural/urban gradient in the prevalence of eczema? A systematic review. *Br J Dermatol*. 2010;162(5):964–973.
21. Kantor R, Silverberg JI. Environmental risk factors and their role in the management of atopic dermatitis. *Exp Rev Clin Immunol*. 2017;13(1):15–26.
22. Mortz CG, Andersen KE, Dellgren C, Barington T, Bindlev-Jensen C. Atopic dermatitis from adolescence to adulthood in the TOACS cohort: prevalence, persistence and comorbidities. *Allergy*. 2015;70(7):836–845.
23. Prezzano JC, Beck LA. Long-term treatment of atopic dermatitis. *Dermatol Clin*. 2017;35(3):335–349.
24. Ferrante G, La Grutta S. The burden of pediatric asthma. *Front Pediatr*. 2018;6:186.
25. Deckers J, Bougarne N, Mylka V, et al. Co-activation of glucocorticoid receptor and peroxisome proliferator-activated receptor-gamma in murine skin prevents worsening of atopic march. *J Invest Dermatol*. 2018;138(6):1360–1370.
26. Silverberg JI, Patel N, Immaneni S, et al. Assessment of atopic dermatitis using self-report and caregiver report: a multicentre validation study. *Br J Dermatol*. 2015;173(6):1400–1404.

Appendix

eTable 1

Association of Sociodemographics with Onset and Persistence of Atopic Dermatitis in US Urban Children

Variables	AD onset (95% CI)		
	Year 5 (n = 301)	Year 9 (n = 147)	Year 15 (n = 86)
Overall	50.8 (39.4-62.1)	27.3 (17.9-36.6)	22.0 (11.3-32.7)
Sex			
Male	47.3 (30.6-64.1)	26.6 (12.5-40.7)	26.1 (9.3-42.9)
Female	54.8 (40.2-69.4)	28.0 (16.1-39.9)	17.2 (5.4-28.9)
Race/ethnicity			
White, non-Hispanic	46.2 (24.1-68.2)	33.7 (11.8-55.5)	20.2 (0.00-43.8)
Black, non-Hispanic	45.7 (30.3-61.1)	27.8 (14.8-40.9)	26.5 (6.9-46.0)
Multi/Other	64.4 (41.2-87.6)	24.6 (6.2-43.0)	11.0 (1.3-20.8)
Hispanic	49.6 (29.5-69.8)	16.9 (4.5-29.2)	33.5 (11.8-55.3)
Household income (family poverty level)			
≥200%	44.6 (29.3-60.0)	33.0 (19.0-47.0)	22.3 (6.8-37.9)
100%-199%	46.5 (31.7-61.2)	26.9 (14.2-39.5)	26.7 (13.6-39.8)
≤99%	68.8 (51.2-88.4)	12.0 (4.6-19.5)	18.2 (1.2-35.2)
	AD persistence (95% CI)		
	One year (n = 293)	Two years (n = 151)	Three years (n = 90)
Overall	60.5 (49.3-71.7)	26.5 (16.7-36.2)	13.0 (4.4-21.7)
Sex			
Male	67.5 (51.8-83.3)	27.4 (11.8-43.0)	5.1 (1.4-8.7)
Female	52.3 (37.3-67.2)	25.3 (14.8-35.9)	22.4 (6.1-38.8)
Race/ethnicity			
White, non-Hispanic	79.3 (65.4-93.2)	19.1 (5.5-32.6)	1.7 (0.0 -3.4)
Black, non-Hispanic	49.1 (32.7-65.5)	32.9 (18.9-46.8)	18.0 (8.9-27.1)
Multi/Other	40.8 (15.2-66.5)	35.8 (5.5-66.0)	23.4 (0.0-55.2)
Hispanic	73.3 (58.0-88.7)	15.3 (3.4-27.1)	11.4 (1.2-21.6)
Household income (family poverty level)			
≥200%	65.8 (51.3-80.4)	30.4 (16.1-44.8)	3.7 (0.7-6.7)
100%-199%	66.4 (52.6-80.2)	21.0 (8.0-34.0)	12.6 (5.2-20.0)
≤99%	42.7 (21.1-64.2)	19.0 (7.0-30.9)	38.4 (12.3-64.5)