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Association between atopic dermatitis and race from infancy to early childhood: A retrospective cohort study

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Abstract

Background: Atopic dermatitis (AD) is a common pediatric skin condition with significant morbidity. It is unclear what factors contribute to racial differences in disease prevalence.

Methods: A single-site, retrospective cohort study of infants born from June 1, 2011, to April 30, 2017, was performed.

Results: Of the 4016 infants included, 39.2% (n = 1574) were black, 38.5% (n = 1543) white (non-Hispanic), 7.1% (n = 286) Hispanic, 5.3% (n = 213) Asian, 6.5% (n = 262) “other” race, 3.4% (n = 135) multiracial, and 0.1% (n = 3) not reported. Prevalence of AD differed by race, with 37.0% (n = 583) of black, 25.8% (n = 55) of Asian, 24.1% (n = 69) of Hispanic, 23.0% (n = 31) of multiracial, 19.1% (n = 50) of “other” race, and 17.9% (n = 276) of white patients diagnosed ($p < .0001$). Delivery mode, NICU stay, and gestational age were all significantly associated with race. In modeling AD with logistic regression, race was significantly associated with the development of AD ($p < .0001$, OR black = 2.6 [2.2–3.2], OR Asian = 1.6 [1.1–2.2], OR Hispanic = 1.4 [1.0–1.9], OR multiracial 1.4 [0.91–2.2], OR “other” 0.97 [0.67–1.4], and OR white 1.0).

Conclusions: Racial differences in rates of AD arise early in life. Diagnosis is associated with race rather than delivery mode, insurance type, and gestational age. Further investigation into these disparities and interventions to mitigate them should focus on infancy and early childhood.

Keywords

atopic dermatitis; eczema; race; infancy; pediatric

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Introduction

Atopic dermatitis (AD, i.e. eczema) is a common, chronic, and relapsing skin condition characterized by xerosis, intense itch, and recurrent infection. Disease onset is typically during infancy or early childhood. Infants classically present with scaly erythematous papules and plaques on the cheeks and extensor surfaces, whereas older children usually present with eczematous plaques of the skin folds. For affected children and their families, AD leads to significant morbidity, including compromised sleep,[1] behavioral issues,[2] parental guilt and exhaustion,[3] and impaired parental employment.[3] The national financial impact of AD is staggering, with a total annual cost burden equivalent to 5.297 billion dollars in 2015.[4]

Though race is known to impact disease course and treatment for a wide range of dermatologic conditions, studies examining the relationship between race and AD are limited. A number of studies on AD lack racial diversity and include primarily white children.[5,6] Existing studies with racial diversity are limited by bias. Some studies examined visits rather than specific patients, introducing selection bias toward children with more severe disease and thus more visits. Other studies introduced recall bias by asking parents to remember a diagnosis of eczema rather than review of the medical record.[7–10]

Most studies show increased prevalence of atopic dermatitis in black and Asian children compared to white children.[7,9,11–18] Black and Asian children also have increased disease severity,[8] with more frequent and longer hospitalizations for AD.[19] Data for Hispanic children is conflicting. Some studies show that AD is less common than in white children,[13,17] while others show AD is more common[16] and more severe,[8] with more frequent and longer hospitalizations.[19]

Proposed explanations for the racial disparities in AD include genetic variations in skin structure,[20] bacterial colonization,[21] and lesion appearance.[22] Socioeconomic status (SES) appears to play a role as well, though the association is unclear. Studies show a positive correlation between SES and eczema prevalence,[7,13] a negative correlation between SES and eczema severity,[15,19] and persistence of racial disparities when controlling for SES.[7,12–15,18]

Herein, we examine the association between AD, race, and potential contributing factors in pediatric patients from a diverse population. A better understanding of racial disparities in AD will aid in developing targeted treatment and prevention strategies.

Materials and Methods

This study was approved by the University of Florida Institutional Review Board.

Infants born at UF Health Shands Hospital from June 1, 2011, to April 30, 2017, were included if they met the following criteria: (1) two or more well-child visits after birth and (2) at least one visit at 300 days of life or later (see Fig. 1). The electronic health record was reviewed retrospectively for information including demographic, birth, and clinical data (sex, race/ethnicity, payer, delivery mode, NICU stay, NICU length of stay, gestational age at birth, and time to diagnosis of atopic dermatitis). Race and ethnicity

were self-reported by parents upon initial registration. Documentation of at least one of the following ICD-9 or 10 codes in the UF Health administrative data was used to identify children with atopic dermatitis: 691.8 (other atopic dermatitis and related conditions), L20.83 (infantile (acute) (chronic) eczema), L20.84 (intrinsic (allergic) eczema), L20.89 (other atopic dermatitis), L20.9 (atopic dermatitis, unspecified). Data were inspected for implausible values, missingness, and distributional form. Summary statistics (i.e., means, standard deviations (SD), frequencies) were computed for study variables. Bivariate analyses were conducted using chi-square tests for categorical data and t-tests or ANOVA for continuous data. We used logistic regression to simultaneously examine the association between the predictor variable of race while controlling for gestational age, insurance type, delivery mode, and time spent in the neonatal intensive care unit (NICU), with the response variable of atopic dermatitis. The level of significance was set at .05, and all hypothesis testing was two-sided. SAS version 9.4 (Cary, NC) was used for all analyses.

Results

Our study sample included 4,016 infants. Racial distribution was diverse with 39.2% (n = 1574) black, 38.5% (n = 1543) white (non-Hispanic), 7.1% (n = 286) Hispanic, 5.3% (n = 213) Asian, 6.5% (n = 262) “other” race, and 3.4% (n = 135) multiracial patients. Approximately half (52.9%, n = 2118) of patients were covered by government insurance (Medicaid and Medicare), and 33.2% (n = 1331) held private insurance. The majority of infants (86.1%, n = 3457) did not have a NICU stay after birth (see Table 1). Delivery mode, insurance coverage, neonatal intensive care unit (NICU) length of stay, and gestational age differed between races (see Table 2).

During the study period, 26.6% (n = 1064) of the sample was diagnosed with atopic dermatitis (95% CI = [25.2%, 27.9%]). Prevalence of atopic dermatitis differed by race, with AD present in 37.0% (n = 583) of black, 25.8% (n = 55) of Asian, 24.1% (n = 69) of Hispanic, 23.0% (n = 31) of multiracial, 19.1% (n = 50) of “other” race, and 17.9% (n = 276) of white patients during the study period ($p < .0001$, see Table 3). Mean time to diagnosis of AD significantly differed between groups (see Table 3) and ranged from 284 days (Asian infants) to 377 days (white infants).

Payer was significantly associated with the development of atopic dermatitis; 29.4% (n = 622) of children with public and 23.3% (n = 438) of children with private insurance were diagnosed with AD ($p < .0001$). Delivery mode, neonatal intensive care unit (NICU) stay, and gestational age were all also significantly associated with atopic dermatitis (see Table 3). In modeling AD with logistic regression including these predictor variables, only NICU stay ($p =0.039$, OR = 0.99 [0.98–1.0]) and race ($p < .0001$, OR black = 2.6 [2.2–3.2], OR Asian = 1.6 [1.1–2.2], OR Hispanic = 1.4 [1.0–1.9], OR multiracial = 1.4 [0.91–2.2], OR “other” = 0.97 [0.67–1.4], OR white = 1.0) were significantly associated with the development of AD (see Table 4).

Discussion

Our results show striking racial differences in rates of AD arising early in life. Racial differences in insurance type, delivery mode, and gestational age did not explain the association.

In this sample, black infants were diagnosed with AD significantly more often than white infants (37.0% vs 17.9 %) with an odds ratio for the development of atopic dermatitis of 2.6 compared to white infants. Nearly a quarter of Asian and Hispanic children were diagnosed with AD during the study period (25.8% and 24.1%, respectively), with odds ratios for the development of atopic dermatitis of 1.6 and 1.4 compared to white children, respectively. This is consistent with prior studies showing a higher prevalence of AD in black, Hispanic, and Asian children compared to white children, though as previously mentioned, data for Hispanic children is conflicting.[7,9,11–18] Our study, however, observed more pronounced racial differences and higher overall AD prevalence than in prior studies (8.7–16.1% for white children and 15.9–19.3% for black children[7,12,13,17]). These findings may be driven by several factors. First, we specifically examined the early childhood period. AD is more common in infants and young children,[7,11,13] and 80% of children outgrow the condition by eight years old.[23] Inclusion of older children and teens in our analysis would dilute AD prevalence, as was seen in prior studies examining kids from infancy into adulthood.[7,11,13,17] Wegienka et al.,[18] who reported findings most similar to ours (AD prevalence of 13.5% for white and 27% for black children), examined the prevalence of atopic dermatitis at age two. Second, our data included atopic dermatitis diagnosed by a healthcare provider, as indicated by an ICD-9 or 10 code. These methodological measures were employed to minimize the recall and selection biases present in prior studies which may have affected disease prevalence. Third, our study drew from the diverse population served by our institution, including Asian, Hispanic, black, and white children, while many prior studies had limited racial diversity. Specifically, the high percentage of black babies in our sample (39.2%) makes our study more inclusive and relevant to this population, providing a more accurate representation of true disease prevalence.

Reasons for the racial differences in AD are unclear. Socioeconomic status (SES) is a commonly proposed explanation. In the current literature, the relationship between SES and eczema prevalence is complex, with seemingly conflicting relationships described. Eczema prevalence is greater in children of higher SES,[7,13] yet eczema severity and hospital admissions are associated with lower household income, lower parental education level, public insurance, and non-white race/ethnicity.[15,19] Institutional racism likely contributes to the aforementioned effect, with limited access to care causing later presentation when disease is more severe. We found that public insurance (used as a marker of SES) was significantly associated with AD prevalence in the present study but did not explain the relationship between race and eczema ($p = 0.434$), consistent with a number of prior studies.[7,12–15,18].

Underlying genetic variations in skin structure[20] and bacterial colonization[21] may play a role. Atopic dermatitis in African Americans and Asians has distinct a molecular profile compared to that of European Americans.[24,25] Ceramide/cholesterol ratios also differ

beetween races,[20] impacting skin barrier function, an important factor in the pathogenesis of atopic dermatitis. Filaggrin is a structural protein imperative for epidermal barrier function. Filaggrin loss of function mutations are known to vary by race in children and may also play a role in the racial differences seen.[26]

Cultural and environmental factors also likely contribute. Attending daycare and shorter duration of breastfeeding are risk factors for atopic dermatitis that may differ between races.[9] Skin care regimens and interactions with the skin microbiome may also contribute. Larger studies are needed to evaluate the complex interplay of these factors

Another possible explanation is that the racial differences in AD lesional morphology complicate or expedite diagnosis. For example, the subtle distinction between infantile atopic and seborrheic dermatitis may be more apparent in lighter skin compared to darker skin. In a recent review of images in two major dermatology textbooks, only 22 to 32% of images were of individuals with skin of color.[27] Thus, inadequate training in skin of color may lead rashes unrelated to AD to be labeled as AD, thus increasing apparent disease prevenance.

Limitations of this study include duration of follow-up, which differed for each patient based on birthdate during the study period. Differences between duration of follow-up for groups of participants may have biased the “opportunity” for some patients to develop eczema. Additionally, medical providers with differing clinical specialties diagnosed AD; diagnosis was not confirmed by a dermatologist or other subspecialist trained in atopic dermatitis (unless the child was seen in a subspecialty clinic during the study period) and instead was based on ICD diagnostic codes. We examined a single, tertiary care institution, so results may not be applicable to smaller, community hospital settings.

In our cohort, racial differences in rates of AD were apparent early in life. Diagnosis is associated with race rather than the examined confounders. Further investigation into these disparities and subsequent interventions to mitigate them should focus on infancy and early childhood.

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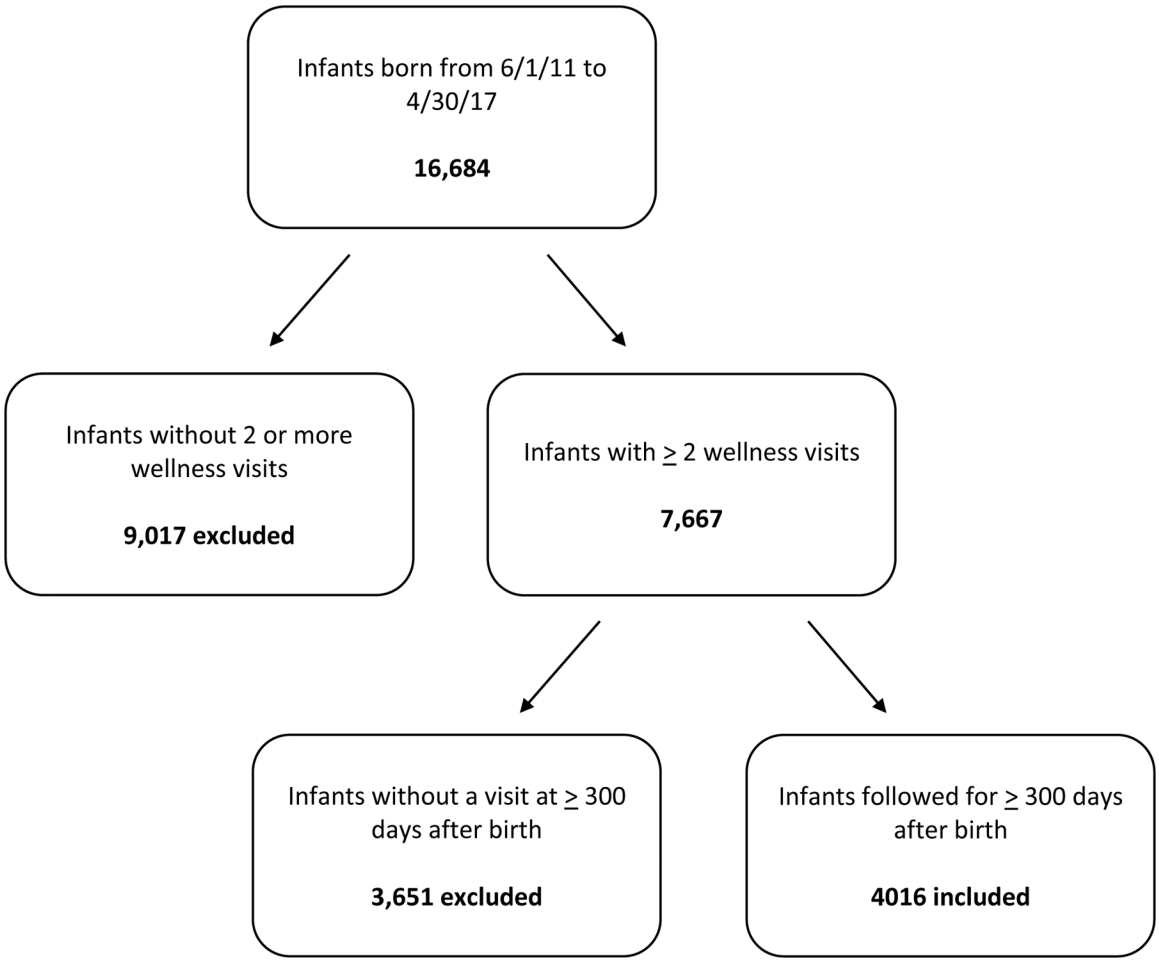

Figure 1:

Flowchart of participants included in the study. Infants born at UF Health Shands Hospital from June 1, 2011, to April 30, 2017, were included if they met the following criteria: (1) two or more well-child visits after birth and (2) at least one visit at 300 days of life or later.

Table 1.

Infant demographic and clinical features.[a]

Characteristic	N (%) or Mean (SD)
Sex	
Female	1954 (48.8%)
Male	2052 (51.2%)
Race	
Asian	213 (5.3%)
Black	1574 (39.2%)
Hispanic	286 (7.1%)
Multiracial	135 (3.4%)
Other	262 (6.5%)
White, non-Hispanic	1543 (38.5%)
Not reported	3 (0.1%)
Payer	
Medicaid	2079 (51.9%)
Private insurance	1331 (33.2%)
Managed care	485 (12.1%)
Self-pay	62 (1.6%)
Medicare	39 (1%)
Other	10 (< 1%)
Delivery mode	
Vaginal	2425 (64.9%)
Caesarean section	1309 (35.1%)
NICU stay	
Mean NICU length of stay (days)	3.9 (18.1)
No	3457 (86.1%)
Yes	559 (13.9%)
Gestational age	
Mean Gestational age (weeks)	38.1 (3.3)
Early preterm (< 28 weeks)	119 (3.1%)
Very preterm (28 to < 32 weeks)	121 (3.2%)
Moderate to late preterm (32 to < 37 weeks)	448 (11.7%)
Early term (37 to < 39 weeks)	1089 (28.3%)
Full term (39 to < 41 weeks)	1765 (45.9%)
Late/post term (41 weeks or greater)	301 (7.8%)

[a]Categorical responses may not sum to total sample size of 4,016 due to missing data.

Table 2.

Relationship between infant characteristics and race.

Characteristic		Race/Ethnicity						
	Overall Cohort N (%)	Asian % [95% CI]	Black % [95% CI]	Hispanic % [95% CI]	Multiracial % [95% CI]	Other % [95% CI]	White NH % [95% CI]	p-value
Delivery mode								
C-section	1309 (35.1%)	27.1% [21.1, 33.9]	37.1% [34.6, 39.6]	29.8% [24.3, 35.8]	28.2% [20.5, 37.0]	31.2% [25.5, 37.3]	36.3% [33.8, 38.8]	.006
Vaginal	2425 (64.9%)	72.9% [66.1, 78.9]	62.9% [60.4, 65.4]	70.2% [64.2, 75.7]	71.8% [63.0, 79.5]	68.8% [62.7, 74.5]	63.7% [61.2, 66.2]	
Payer								
Private	1331 (33.2%)	85.9% [80.5, 90.3]	26.4% [24.2, 28.7]	45.5% [39.6, 51.4]	54.1% [45.3, 62.8]	59.5% [53.3, 65.5]	60.1% [57.6, 62.6]	<.001
Public	2118 (52.9%)	14.1% [9.7, 19.5]	73.6% [71.3, 75.8]	54.6% [48.6, 60.4]	45.9% [37.2, 54.7]	40.5% [34.5, 46.7]	39.9% [37.4, 42.4]	
NICU Stay	559 (13.9%)	6.6% [3.6, 10.8]	14.9% [13.2, 16.7]	9.8% [6.6, 13.8]	8.9% [4.7, 15.0]	11.8% [8.2, 16.4]	15.5% [13.7, 17.4]	<.001
Gestation								
Early preterm (< 28 wks)	119 (3.1%)	1.0% [0.1, 3.5]	3.5% [2.6, 4.6]	3.6% [1.7, 6.5]	1.6% [0.2, 5.6]	< 1.0% [0.1, 2.9]	3.4% [2.5, 4.4]	<.001
Very preterm (28 to < 32 wks)	121 (3.2%)	2.0% [0.5, 5.0]	3.6% [2.2, 4.7]	1.1% [0.2, 3.1]	3.2% [0.9, 7.9]	2.4% [0.9, 5.2]	3.3% [2.4, 4.3]	
Moderate to late preterm (32 to < 37 wks)	448 (11.7%)	5.4% [2.7, 9.5]	14.0% [12.6, 15.8]	10.4% [7.1, 14.6]	11.1% [6.2, 17.9]	10.6% [7.0, 15.1]	10.6% [9.1, 12.3]	
Early term (37 to < 39 wks)	1089 (28.3%)	26.1%) [20.2, 32.7]	31.6% [29.3, 34.1	23.7% [18.9, 29.2]	31.8% [23.7, 40.6]	25.6% [20.3, 31.5]	26.3% [24.0, 28.6]	
Full term (39 to < 41 wks)	1765 (45.9%)	58.6% [51.5, 65.5]	42.1% [39.6, 44.6]	52.2% [46.1, 58.2]	45.2% [36.4, 54.4]	49.2% [42.8, 55.6]	46.5% [43.9, 49.1]	
Late/post term (≥ 41 wks)	301 (7.8%)	6.9% [3.8, 11.3]	5.2% [4.1, 6.4]	9.0% [5.9, 3.0]	7.1% [3.3, 13.1]	11.4% [7.7, 16.0]	10.0% [8.5, 11.6]	

Table 3.

Relationship between infant characteristics and atopic dermatitis.

Characteristic	Rate of atopic dermatitis N (%) or Mean (SD)	P Value	OR [95% CI]
Sex		0.62	
Female	512 (26.2%)		
Male	552 (26.9%)		
Race/ethnicity		<.001	
Asian	55 (25.8%)		1.6 [1.1, 2.2]
Black	583 (37.0%)		2.6 [2.2, 3.2]
Hispanic	69 (24.1%)		1.4 [1.0, 1.9]
Multiracial	31 (23.0%)		1.4 [0.91, 2.2]
Other	50 (19.1%)		0.97 [0.67, 1.4]
White, non-Hispanic	276 (17.9%)		1.0
Payer		<.001	1.1 [0.91, 1.3]
Private	438 (23.3%)		
Public	622 (29.4%)		
Delivery mode		.01	0.86 [0.73, 1.0]
Caesarean section	315 (24.1%)		
Vaginal	675 (27.8%)		
NICU stay		<.001	0.99 [0.98, 1.0]
No	960 (27.8%)		
Yes	105 (18.8%)		
NICU length of stay (days)		<.001	
No atopic dermatitis	4.6 (20.1)		
Atopic dermatitis	2.0 (10.9)		
Gestational age (weeks)		< .001	1.0 [0.99, 1.1]
Early preterm (< 28 weeks)	13 (10.9%)		
Very preterm (28 to < 32 weeks)	23 (19.0%)		
Moderate to late preterm (32 to < 37 weeks)	129 (28.8%)		
Early term (37 to < 39 weeks)	295 (27.1%)		
Full term (39 to < 41 weeks)	486 (27.5%)		
Late/post term (41 weeks or greater)	72 (23.9%)		
Time to AD diagnosis (days)		.009	
Asian	284 (268)		
Black	305 (317)		
Hispanic	358 (328)		
Multiracial	317 (325)		
Other	347 (371)		
White	377 (339)		

Table 4:

Logistic Regression: Odds ratio estimates with outcome of atopic dermatitis.

Odds Ratio Estimates				Logistic Regression
Race (compared with white infants)	**OR**	**95% CI**		**p value**
Asian	1.6	1.1	2.2	0.016
Black	2.6	2.2	3.2	<.001
Hispanic	1.4	1.0	1.9	0.038
Multiracial	1.4	0.91	2.2	0.127
Other	0.97	0.67	1.4	0.852
Delivery mode (c-section vs vaginal)	0.86	0.73	1.0	0.076
NICU stay	0.99	0.98	1.0	0.039
Gestational age	1.0	0.99	1.1	0.177
Insurance type (public vs private)	1.1	0.91	1.3	0.434