

Accepted Manuscript

Association of family structure with atopic dermatitis in United States children

Costner McKenzie, BA, Jonathan I. Silverberg, MD, PhD, MPH

PII: S0190-9622(18)30835-1

DOI: [10.1016/j.jaad.2018.05.039](https://doi.org/10.1016/j.jaad.2018.05.039)

Reference: YMJD 12553

To appear in: *Journal of the American Academy of Dermatology*

Received Date: 16 March 2018

Revised Date: 11 May 2018

Accepted Date: 16 May 2018

Please cite this article as: McKenzie C, Silverberg JI, Association of family structure with atopic dermatitis in United States children, *Journal of the American Academy of Dermatology* (2018), doi: 10.1016/j.jaad.2018.05.039.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Title: Association of family structure with atopic dermatitis in United States children

Short Title: Atopic dermatitis and family structure

Costner McKenzie, BA¹ and Jonathan I. Silverberg, MD, PhD, MPH^{2,3}

1. Department of Dermatology, Northwestern University Feinberg School of Medicine, Chicago, IL 60611

2. Departments of Dermatology, Preventive Medicine and Medical Social Sciences, Northwestern University Feinberg School of Medicine, Chicago, IL, 60611

3. Northwestern Medicine Multidisciplinary Eczema Center, Chicago, IL, 60611

Word count: 1,803

Abstract word count: 200

Figures: 0

Tables: 3

Supplemental Table: 3

Key Words: atopic dermatitis (AD); divorce; poverty; disparities; food security

Abbreviations used: AD=atopic dermatitis; NHIS=National Health Interview Survey; OR=odds ratio; aOR=adjusted odds ratio; CI=confidence interval

Corresponding author:

Jonathan I Silverberg, MD, PhD, MPH

Department of Dermatology

Suite 1600

676 N. St. Clair St.

312-503-4985

Northwestern University Feinberg School of Medicine

Chicago, IL 60611

JonathanISilverberg@Gmail.com

JI Silverberg had full access to all the data in the study and takes responsibility for the integrity of the data and accuracy of the data analysis.

Study concept and design: JI Silverberg

Acquisition of Data: JI Silverberg, C McKenzie

Analysis and interpretation of data: C McKenzie, JI Silverberg,

Drafting of the manuscript: C McKenzie, JI Silverberg

Critical revision of the manuscript for important intellectual content: C McKenzie, JI Silverberg

Statistical analysis: JI Silverberg, C McKenzie

40 Obtained funding: JI Silverberg
41 Administrative technical or material support: None
42 Study supervision: None
43 Financial disclosures: None
44 Funding Support: This publication was made possible with support from the Agency for
45 Healthcare Research and Quality (AHRQ), grant number K12 HS023011, the Dermatology
46 Foundation and American Medical Association Foundation.
47 Design and conduct of the study? No
48 Collection, management, analysis and interpretation of data? No
49 Preparation, review, or approval of the manuscript? No
50 Decision to submit the manuscript for publication? No
51 Conflicts of interest: None
52 Acknowledgements: This research was presented as an oral presentation in part at the 2018
53 International Investigative Dermatology meeting in Orlando, FL.

Capsule summary

- The relationship between family structure and atopic dermatitis has not previously been elucidated.
- Children from family structures without two married, biological parents have increased odds of AD and poorer overall health outcomes.
- Children from family structures without two, married, biological parents may benefit from increased surveillance, closer follow-up and optimized treatment for incident AD.

Abstract

Background: Children from families without two married, biological parents have increased risk of poverty and poor health. The relationship between family structure and atopic dermatitis (AD) has not been elucidated.

Objectives: To determine the prevalence of AD and related outcomes in children from different family structures.

Methods: Data were analyzed from 13,275 children (≤ 17 years) and their parents from the 2012 National Health Interview Survey.

Results: In multivariable logistic regression models adjusting for socio-demographics, children from single adult households (adjusted odds ratio [95% confidence interval]: 1.272 [1.050–1.542]), families with ≤ 2 members (1.413 [1.079–1.852]), families with a mother, but no father present (1.402 [1.179–1.667]), non-biological fathers (1.464 [1.089–1.969]), or unmarried mothers (1.508 [1.017–2.237]) had increased odds of AD. Among children with AD, there were significantly increased odds of having only good/fair/poor vs. very good/excellent overall health (1.545 [1.262–1.893]), greater odds of depression (2.287 [1.523–3.434]), anxiety (2.001 [1.543–2.595]), and stress (2.013 [1.499–2.704]).

Limitations: Cross-sectional study.

Conclusions: US children from families with single adults, single mothers, non-biological fathers, or unmarried mothers may have increased odds of AD. Family structures were associated with poorer overall health, depression, anxiety, and stress in children with AD.

Introduction

Atopic dermatitis (AD) is a chronic inflammatory skin condition associated with itch, pain, and sleep disturbance. The prevalence of eczema in United States children is 12.97%, with considerable variation across states and socio-demographics¹. AD can be triggered or worsened by emotional factors, e.g. anxiety and stress; this is in fact one of the minor diagnostic criteria for AD². Childhood AD can also have a profound emotional and financial burden on parents and other family members³⁻⁶. However, little is known about the relationship between childhood AD and familial instability.

Families that deviate from the two married, biological parent family structure are at greater risk of breaking up and experiencing poverty than their counterparts⁷. Recent research also suggests that children living in patterns of familial instability have worse physical health outcomes, including asthma, obesity, and overall health⁸. We hypothesized that children from family structures without two married, biological parents have higher prevalence of AD, and that children with AD from these families have poorer health outcomes. We sought to determine the prevalence of AD and related outcomes in US children born to various family structures.

Methods

Data source

The 2012 National Health Interview Survey (NHIS) is a cross-sectional household interview survey collected by The National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC). The survey collects data on a broad range of health topics and serves to monitor the health of the US population. A complex, multistage probability design was used that involves stratification, clustering, and oversampling of specific population subgroups; 54,603 households were sampled throughout the United States. Personal interviews were conducted in each household in either English or Spanish. Data were collected for each family and person within a household. Subsequently, one sample adult and one sample child were randomly selected from each family for additional data collection. Sample weights were created using data from the US Census Bureau to adjust for age, sex, race/ethnicity household size, and educational level of the most educated household member. The complex weighting is incorporated in all estimates presented in this study, to yield estimates that are representative of the civilian, noninstitutionalized population of the US. This study was approved by institutional review board at Northwestern University Feinberg School of Medicine.

Definition of AD and family structure

Childhood AD was determined by caregiver report of healthcare diagnosed AD. The questions used to assess AD, mental and overall health are presented in Supplemental Table 1.

Family type, family size, relationship to each parent in the household, and parents present in the family were each used as variables to assess family structure. Measures of poverty were also assessed given their strong association with both family structure and health outcomes.

129

130 **Data processing and statistical methods**

131 All data processing and statistical analyses were performed in SAS version 9.4 (SAS
132 Institute, Cary, NC). Analyses were performed using SURVEY procedures that accounted for
133 study strata, clusters and weights. Bivariable and multivariable logistic regression models were
134 constructed with history of AD as the binary dependent variable and variables pertaining to
135 family fragility as the independent variables. Multivariable models included sex (m/f), age
136 (continuous), highest level of family education (< high school [HS]/HS or equivalent/>HS),
137 race/ethnicity (white/non-white), imputed ratio of family income to poverty threshold (<1/1-
138 2/>2), and parental history of AD (yes/no). Crude and adjusted odds ratios (OR and aOR) with
139 95% confidence intervals (CI) were estimated. Complete case analysis was performed, i.e.
140 persons with missing data were excluded from analyses. The relationship to mother and
141 relationship to father variables are limited to children with a mother or father in the household,
142 respectively. If a mother or father was not in the household, then the relationship to mother or
143 father variable was not applicable.

Results

Population characteristics

Data were collected on 13,275 children and adolescents, representing all pediatric age, sex, race/ethnicity, family education level, and ratio of family income to poverty threshold groups. The US prevalence (95% CI) was 12.29% (11.59–12.97) for pediatric AD. 14.20% [13.52–14.88] currently had asthma, 9.51% [8.86–10.17] had hay fever, and 5.55% [5.10–6.00] had food or digestive allergies.

Prevalence of pediatric eczema was significantly associated with non-white race (survey logistic regression; crude odds ratio (OR) [95% CI]: 1.745 [1.529–1.991]), ratio of family income to poverty threshold <1 (1.286 [1.100–1.502]) or 1–2 (1.220 [1.057–1.408]), and parental history of eczema (3.122 [2.416–4.035]) but inversely associated with ages 11–17 (0.635 [0.554–0.728]), and less than HS education (0.742 [0.601–0.915]) or HS or equivalent (0.853 [0.734–0.990]) Prevalence was not associated with sex (Table 1).

Association between family structure and AD

In multivariable logistic regression models, there were significantly higher odds of AD in children from single adult households (aOR [95% CI]: 1.272 [1.050–1.542]), families with 2 members, e.g. one adult and one child (1.413 [1.079–1.852]), families with a mother, but no father present (1.402 [1.179–1.667]), non-biological fathers (1.464 [1.089–1.969]), or unmarried mothers (1.508 [1.017–2.237]). Children from families with a father, but no mother present (0.566 [0.338–0.947] or unmarried fathers (0.663 [0.447–0.983]) had decreased odds of AD. Children whose families lived under the poverty threshold (1.315 [1.073–1.613]) or were

experiencing very low food security (1.804 [1.266–2.571]) also had increased odds of AD (Table 2).

Associations between family structure and overall and mental health

In multivariable logistic regression models, there are significantly increased odds of only good, fair or poor vs. very good or excellent overall health (1.545 [1.262–1.893]), as well as greater odds of depression (2.287 [1.523–3.434]), anxiety (2.001 [1.543–2.595]), and stress (2.013 [1.499–2.70]) in children with vs. without AD (Supplemental Table 2).

In particular, among children with AD, those in a family with a non-biological mother had increased odds of good, fair or poor health compared to very good or excellent health (3.162 [1.633–6.121]) (Table 3), depression (3.073 [1.433–6.593]), anxiety (3.290 [1.680–6.440]), and frequent stress (2.300 [1.229–4.302]) (Supplemental Table 4). Similarly, those in a family with a non-biological father had increased odds of good, fair or poor health compared to very good or excellent health (1.731 [1.005–2.981]), depression (4.386 [2.440–7.887]), anxiety (3.778 [2.230–6.401]), and frequent stress (2.542 [1.461–4.425]).

Discussion

The present study found an association between family structure and childhood AD, even after controlling for age, sex, race/ethnicity, highest family education, ratio of family income to poverty threshold, and parental history of AD. Single adult households, families with two members, i.e. one adult and one child, no father present, presence of non-biological father, unmarried mothers, low household income, and food insecurity were all associated with AD. In addition, children with AD from families diverging from the two biological, married parents structure had poorer overall health and higher rates of depression, anxiety and stress. These results are consistent with previous studies that found living with two biological parents or married parents have better physical health outcomes than those in fragile homes⁹. Recognition of different family structures as a risk factor and/or predictor of poor health outcomes is important for a number of reasons. It sheds light on a particularly vulnerable and at risk group for AD. It may also allow for improved risk stratification for AD. There may also be clinical relevance, as children from certain family structures may benefit from increased surveillance, closer follow-up and optimized treatment for incident AD.

Single adult households were found to be associated with greater odds of AD than multiple adult households. This may be attributable to increased caregiver stress and child's time spent outside the home, both of which can occur in single parent households^{10,11}. Several prospective studies found increased caregiver stress to be associated with onset of childhood asthma, yet the underlying mechanism remains undetermined. Maternal stress has been proposed to alter endocrine and autonomic development, with subsequent immune alterations and increased susceptibility to atopic disease^{12,13}. More time outside the home may also increase risk of AD by increasing exposure to environmental triggers, such as climate exposures, irritants, etc.

Of note, families with only a mother present had increased odds of childhood AD compared to families with only a father present. This may result from selection effect as courts may require fathers to provide a more nurturing, healthier household than mothers or fathers may be less likely to seek custody of children with AD¹⁴. Single-father families are also more likely to result from widowhood, which has comparable health outcomes to two-parent households¹⁴. However, these are speculative and little research regarding this notable difference has been conducted.

Children residing in families with unmarried vs. married mothers or fathers were found to have increased odds of AD. These results are consistent with a previous study that found children with cohabitating parents had poorer behavioral and emotional outcomes compared to children of married parents, despite differences in economic status or parental resources¹⁵. Yet, few studies examined the impact of marriage on physical outcomes. Previous studies examining the relationship between marriage and allergic disease found no statistically significant relationship after controlling for demographics, socioeconomic characteristics, and health insurance¹⁶. In addition, childhood AD was associated with a non-biological father-child relationship. There is no significant association between childhood AD and mother-child relationship. Despite adoptive parents typically being more educated, affluent, and invested economically, culturally, interactively, and socially than biological parents¹⁷, their children tend to have more behavioral and attention problems. Possible reasons include early childhood trauma and genetics, which may also influence immune development and AD. Conversely, childhood AD can have a significant emotional and financial impact on families³⁻⁶. Previous studies found that persons with AD have difficulty forming relationships with their partners¹⁸ and lower quality of relationships with family members¹⁹. Future studies are needed to better understand the mechanism(s) of how certain family structures are related to childhood AD.

Strengths of this study include evaluation of data from a very large, random, population-based, diverse sample, which demonstrate external validity and reproducibility. The use of multivariable logistic regression allowed us to control for several confounding variables, namely socio-demographics and parental history of AD. The study also has its limitations. We were not able to account for potentially confounding indoor and outdoor environmental factors. History of AD was defined by self-report and not verified by physician diagnosis. Similarly, family structure was also self-reported. Finally, the study was cross sectional, thereby precluding assessment of temporality or direction of association between AD and family structure. Future prospective cohort studies are needed to determine the influence of dynamic family relationships on childhood AD.

In conclusion, AD is associated with family structure, poor overall health and increased depression, anxiety and stress in US children. Interventions may be warranted to mitigate the risk of AD in children from families consisting of single adults, single mothers, non-biological fathers, or unmarried mothers and to reduce the burden of childhood AD on their families.

References

1. Silverberg JI, Simpson EL. Associations of childhood eczema severity: a US population-based study. *Dermatitis : contact, atopic, occupational, drug : official journal of the American Contact Dermatitis Society, North American Contact Dermatitis Group*. 2014;25(3):107-114.
2. Hanifin J, Rajka G. Diagnostic features of atopic eczema. *Acta dermato-venereologica*. 1980;92:44-47.
3. Aziah MS, Rosnah T, Mardziah A, Norzila MZ. Childhood atopic dermatitis: a measurement of quality of life and family impact. *The Medical journal of Malaysia*. 2002;57(3):329-339.
4. Balkrishnan R, Housman TS, Carroll C, Feldman SR, Fleischer AB. Disease severity and associated family impact in childhood atopic dermatitis. *Archives of disease in childhood*. 2003;88(5):423-427.
5. Gil KM, Keefe FJ, Sampson HA, McCaskill CC, Rodin J, Crisson JE. The relation of stress and family environment to atopic dermatitis symptoms in children. *J Psychosom Res*. 1987;31(6):673-684.
6. Su JC, Kemp AS, Varigos GA, Nolan TM. Atopic eczema: its impact on the family and financial cost. *Archives of disease in childhood*. 1997;76(2):159-162.
7. Anderson J. The impact of family structure on the health of children: Effects of divorce. *Linacre Q*. 2014;81(4):378-387.
8. Bzostek SH, Beck AN. Familial instability and young children's physical health. *Social science & medicine (1982)*. 2011;73(2):282-292.
9. Angel R, Worobey JL. Single motherhood and children's health. *J Health Soc Behav*. 1988;29(1):38-52.
10. Moncrief T, Beck AF, Simmons JM, Huang B, Kahn RS. Single parent households and increased child asthma morbidity. *J Asthma*. 2014;51(3):260-266.
11. Yamamoto N, Nagano J. Parental stress and the onset and course of childhood asthma. *Biopsychosoc Med*. 2015;9:7.
12. Cacioppo JT, Berntson GG, Malarkey WB, et al. Autonomic, neuroendocrine, and immune responses to psychological stress: the reactivity hypothesis. *Ann N Y Acad Sci*. 1998;840:664-673.
13. Howerton CL, Bale TL. Prenatal programming: at the intersection of maternal stress and immune activation. *Horm Behav*. 2012;62(3):237-242.
14. Bramlett MD, Blumberg SJ. Family structure and children's physical and mental health. *Health Aff (Millwood)*. 2007;26(2):549-558.
15. Brown SL, Manning WD, Stykes JB. Family Structure and Child Well-Being: Integrating Family Complexity. *J Marriage Fam*. 2015;77(1):177-190.
16. Harknett K. Why are Children with Married Parents Healthier? The Case of Pediatric Asthma. *Popul Res Policy Rev*. 2009;28(3):347-365.
17. Hamilton L, Cheng S, Powell B. Adoptive parents, adoptive parents: Evaluating the importance of biological ties for parental investment (vol 72, pg 95, 2007). *Am Sociol Rev*. 2007;72(6):1018-1018.
18. Zuberbier T, Orlow SJ, Paller AS, et al. Patient perspectives on the management of atopic dermatitis. *J Allergy Clin Immunol*. 2006;118(1):226-232.

- 285 19. Mattered U, Schmitt J, Diepgen TL, Apfelbacher C. Children and adolescents' health-
286 related quality of life in relation to eczema, asthma and hay fever: results from a
287 population-based cross-sectional study. *Qual Life Res.* 2011;20(8):1295-1305.
288

Supplemental Table 1. Questions used in this study.

Variable	Question asked
Atopic Dermatitis	During the past 12 months, has (sample child name) had any of the following conditions eczema or any kind of skin allergy?
Depression	During the past 12 months, has a doctor or other health professional told you that (sample child name) had depression?
Anxiety	During the past 12 months, has (sample child name) frequently felt anxious, nervous, or worried?
Stress	During the past 12 months, has (sample child name) frequently felt stressed?
Overall health	Would you say (sample child name) health in general is excellent, very good, good, fair, or poor?
Atopic dermatitis (parent)	During the past 12 months, have you had eczema or any kind of skin allergy?

Table 1. Socio-demographic associations of atopic dermatitis in US children.

Variables	No History of AD (n=11658)	History of AD (n=1603)	Crude OR (95% CI)	Adjusted OR (95% CI)
Age				
0-5	3891	640	1 (ref)	1 (ref)
6-10	2964	431	0.903 (0.782–1.044)	0.864 (0.722–1.034)
11-17	4803	532	0.635 (0.554–0.728)	0.611 (0.513–0.727)
Sex				
Female	5725	781	1 (ref)	1 (ref)
Male	5933	822	1.049 (0.933–1.180)	1.090 (0.946–1.257)
Race/ethnicity				
White	8361	965	1 (ref)	1 (ref)
Non-White	3267	636	1.745 (1.529–1.991)	1.712 (1.476–1.985)
Highest level of family education				
More than HS	7887	1160	1 (ref)	1 (ref)
HS or equivalent	2435	300	0.853 (0.734–0.990)	0.846 (0.689–1.039)
Less than HS	1320	143	0.742 (0.601–0.915)	0.707 (0.548–0.912)
Ratio of family income to poverty threshold				
>2	2446	766	1 (ref)	1 (ref)
1-2	2511	375	1.220 (1.057–1.408)	1.382 (1.147–1.664)
<1	5843	382	1.286 (1.100–1.503)	1.315 (1.073–1.613)
Parental history of atopic dermatitis				
No	7281	955	1 (ref)	1 (ref)
Yes	399	153	3.122 (2.416–4.035)	3.114 (2.387–4.063)

Freq, Frequency; HS, High school; OR, odds ratio; CI, confidence intervals; ref, reference. Adjusted OR included sex, age, highest level of family education, race/ethnicity imputed ratio of family income to poverty threshold, and parental history of AD.

Table 2. Associations between family structure and atopic dermatitis in US children.

Family Variables	No History of AD	History of AD	Crude OR (95% CI)	Adjusted OR (95% CI)
	No (n=11658)	Yes (n=1603)		
Type				
Multiple adult	9633	1224	1 (ref)	1 (ref)
Single adult	2025	379	1.397 (1.193–1.637)	1.272 (1.050–1.542)
Size				
≥5	3525	419	1 (ref)	1 (ref)
3-4	7179	995	1.146 (0.998–1.317)	1.248 (1.044–1.491)
0-2	954	189	1.542 (1.237–1.923)	1.413 (1.079–1.852)
Food security scale – raw score				
0-3	10432	1341	1 (ref)	1 (ref)
4-6	767	152	1.466 (1.199–1.792)	1.320 (1.013–1.719)
7-10	454	110	1.973 (1.499–2.596)	1.804 (1.266–2.571)
Ratio of family income to the poverty threshold				
≥2.00	5843	766	1 (ref)	1 (ref)
1.00–1.99	2511	375	1.220 (1.057–1.408)	1.382 (1.147–1.664)
<1.00	2446	382	1.286 (1.100–1.503)	1.315 (1.073–1.613)
Relationship with mother				
Biological	10307	1449	1 (ref)	1 (ref)
Not biological	372	61	1.130 (0.827–1.542)	1.169 (0.779–1.753)
Relationship with father				
Biological	7385	861	1 (ref)	1 (ref)
Not biological	747	108	1.204 (0.921–1.573)	1.464 (1.089–1.969)
Parents present in family				
Both mother and father	7635	925	1 (ref)	1 (ref)
Mother, no father	3047	585	1.570 (1.376–1.791)	1.402 (1.179–1.667)
Father, no mother	505	44	0.581 (0.416–0.810)	0.566 (0.338–0.947)
Neither	471	49	1.071 (0.753–1.522)	NE
Paternal variables				
	No (n=2872)	Yes (n=353)		
Age (yr)				
>20	2749	334	1 (ref)	1 (ref)
≤20	123	19	1.343 (0.726–2.486)	1.445 (0.767–2.724)
Marital status				
Married	2402	306	1 (ref)	1 (ref)
Not married	468	47	0.674 (0.462–0.984)	0.663 (0.447–0.983)
Paternal history of atopic dermatitis				
No	2758	321	1 (ref)	1 (ref)
Yes	112	32	3.041 (1.934–4.780)	3.005 (1.889–4.780)
Maternal variables				
	No (n=4811)	Yes (n=755)		
Age (yr)				
>20	4177	619	1 (ref)	1 (ref)
≤20	634	136	1.475 (1.158–1.879)	1.366 (1.053–1.772)
Marital status				

Married	2761	342	1 (ref)	1 (ref)
Not married	2043	412	1.586 (1.295-1.899)	1.390 (1.152-1.677)
Maternal history of atopic dermatitis				
No	4523	634	1 (ref)	1 (ref)
Yes	287	121	3.061 (2.264-4.138)	3.069 (2.237-4.210)

Freq, Frequency; HS, High school; OR, odds ratio; CI, confidence intervals; NE, not estimable; ref, reference.

Adjusted OR included sex, age, highest level of family education, race/ethnicity imputed ratio of family income to poverty threshold, and parental history of AD.

Supplemental Table 2. Association between atopic dermatitis and good, poor or fair vs. very good or excellent overall health, depression, anxiety and stress in US children.

Atopic dermatitis	No History of AD		History of AD	
	Freq	Freq	Crude OR (95% CI)	Adjusted OR (95% CI)
Good, poor or fair vs. very good or excellent overall health				
No	9663	1989	1 (ref)	1 (ref)
Yes	1226	377	1.556 (1.357–1.785)	1.545 (1.262–1.893)
Depression				
No	7484	273	1 (ref)	1 (ref)
Yes	898	65	1.798 (1.328–2.434)	2.287 (1.523–3.434)
Anxiety				
No	7046	706	1 (ref)	1 (ref)
Yes	790	172	2.201 (1.823–2.659)	2.001 (1.543–2.595)
Stress				
No	6988	759	1 (ref)	1 (ref)
Yes	789	173	1.993 (1.611–2.466)	2.013 (1.499–2.704)

AD, Atopic dermatitis; Freq, Frequency; OR, odds ratio; CI, confidence intervals; ref, reference. Adjusted OR included sex, age, highest level of family education, race/ethnicity imputed ratio of family income to poverty threshold, and parental history of AD.

Table 3. Associations between family structure and good, fair or poor vs. very good or excellent overall health in US children with atopic dermatitis.

Family Variables	Very Good / Excellent Health	Good/ Fair/ Poor Health	Crude OR (95% CI)	Adjusted* OR (95% CI)
	No (n=1226)	Yes (n=377)		
Type				
Multiple adult	953	271	1 (ref)	1 (ref)
Single adult	273	106	1.424 (1.074-1.887)	1.076 (0.738-1.567)
Size				
≥5	313	106	1 (ref)	1 (ref)
3-4	769	226	0.739 (0.550-0.994)	0.875 (0.603-1.269)
0-2	144	45	0.903 (0.578-1.441)	0.891 (0.527-1.506)
Relationship with mother				
Biological	1115	334	1 (ref)	1 (ref)
Not Biological	43	18	2.020 (1.049-3.889)	3.162 (1.633-6.121)
Relationship with father				
Biological	693	168	1 (ref)	1 (ref)
Not Biological	84	24	1.288 (0.752-2.204)	1.731 (1.005-2.981)
Parents present in family				
Both mother and father	742	183	1 (ref)	1 (ref)
Mother, no father	416	169	1.762 (1.382-2.245)	1.080 (0.768-1.518)
Father, no mother	35	9	1.412 (0.548-3.636)	1.535 (0.478-4.928)
Neither	33	16	2.394 (1.303-4.399)	NE
Paternal marital status				
Married	1186	370	1 (ref)	1 (ref)
Not married	40	7	0.839 (0.331-2.125)	0.614 (0.226-1.669)
Maternal marital status				
Married	926	264	1 (ref)	1 (ref)
Not married	299	113	1.441 (1.095-1.895)	0.938 (0.660-1.334)

Freq, Frequency; HS, High school; OR, odds ratio; CI, confidence intervals; NE, not estimable; ref, reference.

Adjusted OR included sex, age, highest level of family education, race/ethnicity imputed ratio of family income to poverty threshold, and parental history of AD.

Supplemental Table 3. Associations between family structure and depression, anxiety and stress in US children with of atopic dermatitis.

Family Variables	Depression				Anxiety				Stress			
	Freq	Freq	Crude OR (95% CI)	Adjusted OR (95% CI)*	Freq	Freq	Crude OR (95% CI)	Adjusted OR (95% CI)*	Freq	Freq	Crude OR (95% CI)	Adjusted OR (95% CI)*
	No (n=898)	Yes (n=65)			No (n=790)	Yes (n=172)			No (n=789)	Yes (n=173)		
Type												
Multiple adult	679	41	1 (ref)	1 (ref)	599	120	1 (ref)	1 (ref)	599	120	1 (ref)	1 (ref)
Single adult	219	24	1.512 (1.060–2.158)	1.564 (0.906–2.669)	191	52	1.284 (0.907–1.819)	0.859 (0.530–1.393)	190	53	1.250 (0.895–1.747)	0.978 (0.610–1.567)
Size												
≥5	248	17	1 (ref)	1 (ref)	223	42	1 (ref)	1 (ref)	222	43	1 (ref)	1 (ref)
3-4	547	31	0.880 (0.394–1.965)	1.089 (0.527–2.254)	477	100	1.172 (0.707–1.943)	1.319 (0.743–2.342)	476	101	1.132 (0.716–1.790)	1.030 (0.595–1.783)
0-2	103	17	2.068 (0.864–4.946)	2.121 (0.856–5.258)	90	30	1.893 (1.062–3.374)	1.468 (0.736–2.931)	91	29	1.696 (1.019–2.824)	1.258 (0.651–2.248)
Relationship with mother												
Biological	790	56	1 (ref)	1 (ref)	705	140	1 (ref)	1 (ref)	702	143	1 (ref)	1 (ref)
Not Biological	44	4	1.857 (0.535–6.447)	3.073 (1.433–6.593)	35	13	1.814 (0.836–3.937)	3.290 (1.680–6.440)	35	13	2.554 (1.270–5.097)	2.300 (1.229–4.302)
Relationship with father												
Biological	455	19	1 (ref)	1 (ref)	411	63	1 (ref)	1 (ref)	405	68	1 (ref)	1 (ref)
Not Biological	78	8	3.178 (1.483–6.811)	4.386 (2.440–7.887)	67	19	2.032 (1.147–3.600)	3.778 (2.230–6.401)	66	20	2.139 (1.180–3.879)	2.542 (1.461–4.425)
Parents present in family												
Both mother and father	502	25	1 (ref)	1 (ref)	452	75	1 (ref)	1 (ref)	445	81	1 (ref)	1 (ref)
Mother, no father	332	35	1.634 (0.891–2.996)	1.091 (0.557–2.139)	288	78	1.450 (1.006–2.091)	1.057 (0.666–1.677)	292	75	1.237 (0.862–1.776)	0.869 (0.553–1.364)
Father, no mother	31	2	1.328 (0.255–6.911)	0.874 (0.087–8.788)	26	7	1.836 (0.657–5.132)	0.854 (0.271–2.689)	26	7	1.624 (0.571–4.619)	1.062 (0.337–3.350)
Neither	33	3	1.451 (0.343–6.129)	NE	24	12	3.932 (1.787–8.652)	*	26	10	2.751 (1.353–5.594)	NE
Paternal marital status												
Married	872	64	1 (ref)	1 (ref)	766	169	1 (ref)	1 (ref)	766	169	1 (ref)	1 (ref)
Not married	26	1	0.920 (0.119–7.138)	0.634 (0.710–5.700)	24	3	0.715 (0.201–2.546)	0.615 (0.199–1.901)	23	4	0.820 (0.251–2.679)	0.811 (0.265–2.479)
Maternal marital status												
Married	671	41	1 (ref)	1 (ref)	594	117	1 (ref)	1 (ref)	583	128	1 (ref)	1 (ref)

Not married	226	24	1.763 (1.113–2.792)	1.678 (0.883–3.189)	195	55	1.297 (0.890–1.892)	1.193 (0.767–1.854)	205	45	0.903 (0.619–1.317)	0.832 (0.529–1.309)
-------------	-----	----	--------------------------------------	------------------------	-----	----	------------------------	------------------------	-----	----	------------------------	------------------------

Freq, Frequency; OR, odds ratio; CI, confidence intervals; NE, not estimable; ref, reference. Adjusted OR included sex, age, highest level of family education, race/ethnicity imputed ratio of family income to poverty threshold, and parental history of AD.