

Health Care Resource Utilization and Costs Among Adults with Atopic Dermatitis in the United States: A Claims-Based Analysis



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What is already known about this topic? Atopic dermatitis (AD) is associated with significant direct medical costs but updated estimates are needed.

What does this article add to our knowledge? Adjusted incremental annual direct costs for patients with AD in this US study were \$3,302. Costs are higher in patients with more severe disease.

How does this study impact current management guidelines? Patients, clinicians, and payers should be aware of the costs associated with AD and factor these into clinical decision making.

BACKGROUND: Data on health care resource utilization (HCRU) and costs for patients with atopic dermatitis (AD) are lacking.

OBJECTIVE: The objective of this study was to determine HCRU and costs associated with AD in US adults.

METHODS: This retrospective study identified patients with AD from the Truven Health Marketscan Commercial Claims and Encounters database during 2013 based on ≥ 2 claims with International Classification of Diseases, Ninth Revision code 691.8 ($n = 10,533$; first claim = index event); 1-year

continuous enrollment before and after index was required.

Patients were age- and gender-matched in a 1:3 ratio to controls without AD ($n = 31,599$). Patients with AD were further categorized into 2 groups, with treatment regimens as surrogates for increasing disease severity: claim for phototherapy or systemic immunomodulatory agents (more severe) or no claim for either (less severe). Incremental differences in resource use and costs were evaluated using multivariate analysis.

RESULTS: AD was associated with higher utilization and costs across resource categories (all $P < .0001$); adjusted total incremental annual costs were \$3,302. Resource utilization and costs were higher in the more severe group, with adjusted total incremental annual costs of \$4,463.

CONCLUSION: AD is associated with significant incremental health care utilization and costs, which are higher in patients with more severe disease. © 2017 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2018;6:1342-8)

Key words: Atopic dermatitis; Eczema; Burden of disease; Direct costs; Health care resource utilization

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Atopic dermatitis (AD) is associated with an economic burden that results from direct medical costs, estimated in the United States to be approximately \$1 billion in 2004, and indirect costs related to lost productivity, which were estimated at \$619 million for the same time period.¹ In the 2010 and 2012 editions of National Health Interview Survey (NHIS) of US adults, participants with AD reported more physician visits, emergency department (ED) visits, and hospitalizations compared with controls without AD.² Similarly, participants in the National Health and Wellness Survey (NHWS) who reported being diagnosed with AD also reported higher health care resource utilization (HCRU) for the categories of outpatient visits, ED visits, and hospitalizations than participants without AD.^{3,4}

Abbreviations used

AD- Atopic dermatitis

ED- Emergency department

HCRU- Health care resource utilization

ICD-9- International Classification of Diseases, Ninth Revision

NHIS- National Health Interview Survey

NHWS- National Health and Wellness Survey

SD- Standard deviation

However, as indicated in a recent report on the burden of AD for the National Eczema Association,^{5,6} the 2004 cost estimates cited above are more than 10 years old and likely underestimate current costs given trends toward increasing AD prevalence and higher health care costs in the United States. In addition, NHIS and NHWS data are based on self-report, and as such may not reflect the true incremental cost differences between patients with AD and the general population. Moreover, because the NHIS data do not capture participants' AD severity, which potentially impacts resource use and costs, the effect of AD severity on HCRU and costs remains uncertain. Given current gaps in understanding the economic implications of AD,⁶ the purpose of this study was to conduct a claims-based analysis of HCRU and costs among patients with AD in a large US health care database relative to matched controls without AD and by disease severity.

METHODS

Data source

This retrospective study used data from the Truven Health Marketscan Commercial Claims and Encounters database and the Medicare database for 2013, with information on 47,726,034 individuals in the United States during this time period who are insured commercially or as part of the Medicare program. The database includes complete longitudinal records of inpatient services, outpatient services, long-term care, and prescription drug claims covered under a variety of health benefit plans.

Medical claims are linked to outpatient prescription drug claims and patient-level enrollment data through the use of unique enrollee identifiers. All database records are deidentified and fully compliant with US patient confidentiality requirements, including the Health Insurance Portability and Accountability Act of 1996. Because this study used only deidentified patient records, Institutional Review Board approval was not required.

Populations

Adults (≥ 18 years) with AD were identified based on the presence of a claim associated with an International Classification of Diseases, Ninth Revision (ICD-9) diagnosis code of 691.8 any time during 2013 (index event) and a second AD claim with this code during the 1-year post-index period. For inclusion in the analysis, patients were required to have 1 year of continuous enrollment before and after index with pharmacy benefit information for both periods.

Patients with AD meeting the above criteria were matched in a 1:3 ratio based on age and gender to controls without AD, defined as adults (≥ 18 years) who did not have a claim associated with ICD-9 code 691.8 between 2009 and 2014. As only the age in years at the index date, and not exact birthdates, was available, controls were matched to AD cases with the same age in years at the index date. For each control, the index date was taken to be the closest date of service to the first AD

code for their matched case, and controls were also required to have 1 year of continuous enrollment before and after index.

Because AD severity is not captured in claims, treatments received during the 1-year post-index period were used as surrogate measures of disease severity. Patients treated with phototherapy or who were prescribed any systemic immunomodulatory medications used for this disease (ie, prednisone, cyclosporine, methotrexate, azathioprine, or mycophenolate) were considered to have more severe AD, and patients not receiving any of these agents were considered to have less severe AD. This approach is consistent with how these treatments are recommended for use in the management of AD,⁷ and such an approach has been used in other studies of AD.⁸⁻¹⁰ Because the less severe AD group included patients who were not treated with prescription medications as well as those who were treated with topical agents (ie, corticosteroids or calcineurin inhibitors), a sensitivity analysis evaluated the incremental costs between AD cases treated with phototherapy or systemic immunomodulatory medications, and AD cases prescribed only topical agents.

Outcomes

All-cause HCRU and associated costs during the post-index period were determined for the resource categories of inpatient, ED, hospital ambulatory, office outpatient visits, and pharmacy prescriptions. The total costs were estimated as the sum of the costs of the individual resource categories. These costs were based on paid amounts of adjudicated claims, including insurer and health plan payments and patient cost-sharing in the form of copayments, deductibles, and coinsurance. All estimates are in US dollars inflated to calendar year 2014 using the medical care component of the Consumer Price Index.

Statistical analysis

Descriptive statistics are presented for all populations. Resource utilization and cost outcomes were evaluated as incremental differences between the cohorts, both for AD versus matched controls and by AD severity. As a matched design with a 1:3 ratio was used to identify AD cases and controls, categorical variables were compared using the conditional odds ratio (OR) test and continuous variables using the Wilcoxon signed rank test (non-normal distribution). For comparisons based on AD severity within AD cases only, categorical and continuous variables were compared using χ^2 and Wilcoxon tests, respectively.

Univariate and multivariate multiple linear regression models were used to assess the incremental difference in health care costs between groups. Covariates included in the multivariate models were type of health insurance plan, region of residence, and atopic comorbidities (asthma, allergic rhinitis, chronic rhinosinusitis, conjunctivitis, nasal polyps, allergic urticaria, and esophagitis). For the comparison between severity levels, age and gender were added as additional covariates.

All analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC).

RESULTS

Populations

Of 47,726,034 individuals in the database with claims during 2013, a total of 10,533 met the inclusion criteria for AD cases and were matched with 31,599 controls without AD (Figure 1). The mean (standard deviation [SD]) age of the matched populations was 49.7 (18.1) years and 37.7% were male (Table 1). Cases and controls were similar for insurance type, but

geographic distribution was significantly different (Table I); more patients with AD relative to matched controls were resident in the Northeast and Western regions. In the AD cohort, the prevalence of each of the other evaluated atopic conditions was significantly higher than matched controls (all $P < .0001$), with allergic rhinitis the most frequent atopic condition.

Among the AD cases, 3,849 (36.5%) were classified as having more severe disease based on prescription of phototherapy or systemic agents, and 6,684 (63.5%) had less severe AD; of the less severe group, 4,067 (60.8%) were prescribed topical agents only and the remaining 2,617 (39.2%) were not treated with any prescription treatment. The more severe group were generally older and more likely than the less severe group to have other atopic conditions including asthma ($P < .0001$), chronic rhinosinusitis ($P < .0001$), and nasal polyps ($P < .01$) (Table I).

Resource utilization and costs

Outpatient visits had the highest frequency of use followed by prescriptions filled, and hospitalizations and ED visits were the least frequently used resource category overall (Table II). Relative to matched controls, all-cause HCRU was significantly higher among the AD cohort for each resource category with regard to both frequency of use and units of resource used (all $P < .0001$) (Table II). These differences remained significant for units used for each resource category in the multivariate models (all $P < .0001$), with the greatest incremental differences among the AD cohort observed for outpatient visits (6.2) and prescriptions filled (5.6). However, the actual incremental differences for inpatient (0.03) and ED visits (0.05) were not large enough to suggest clinical relevance.

Consistent with the higher resource use, patients with AD had total costs that were significantly higher than matched controls, by \$4,257 ($P < .0001$), resulting from significantly higher incremental costs across the resource categories including inpatient (\$724), ED (\$214), ambulatory (\$674), outpatient (\$1,593), and prescriptions (\$1,052) (all $P < .0001$) (Table II). Significance was retained for the higher incremental costs in the AD cohort for all resource categories in the multivariate model, resulting in an adjusted incremental difference in total costs of \$3,302 relative to matched controls ($P < .0001$) (Table II).

Outpatient visits were the most frequently used resource in both AD severity groups, and were similarly used by nearly all patients, 99.7% and 99.6% in the more severe and less severe groups, respectively. However, the number of outpatient visits was significantly higher in the more severe AD group relative to the less severe AD group, 21.8 versus 15.8 ($P < .0001$). For each of the other categories, use was also significantly higher in the more severe group, both with respect to frequency of use and units used ($P < .0001$) (Table III). Significance was retained in the multivariate model for units of resources, with incremental differences for the more severe AD group that ranged from 0.04 for inpatient visits to 6.3 for outpatient visits (all $P < .0001$) (Table III).

The adjusted incremental difference in cost was \$4,463 higher in the more severe group compared with less severe AD ($P < .0001$), resulting from incremental differences in costs that were higher across all resource categories including inpatient (\$988), ED (\$328), ambulatory (\$938), outpatient (\$1,328), and prescription costs (\$936) (all $P < .0001$) (Table III). In the sensitivity analysis, total costs remained significantly higher in more severe disease compared with those in the less severe group

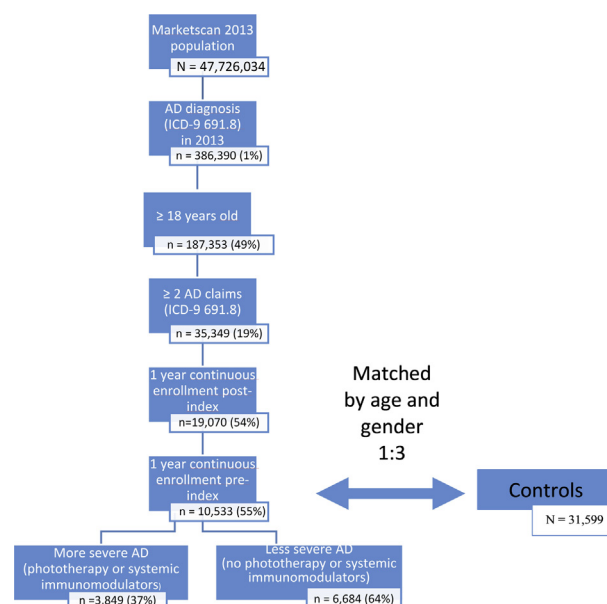


FIGURE 1. Flowchart of population attrition for identifying cases and controls for study inclusion. Percentages estimated at the $n - 1$ level. AD, Atopic dermatitis; ICD-9, International Classification of Diseases, Ninth Revision.

who received topical treatments only (ie, excluding those who did not receive treatment), resulting in a total incremental cost of \$3,849 (standard error \$809; $P < .0001$).

DISCUSSION

This study provides an update on HCRU and associated costs among US adults with AD based on commercial claims data and suggests the magnitude of the cost differential compared with a matched cohort. The results showed that AD was associated with significantly higher resource utilization and direct medical costs compared with age- and sex-matched controls. The annual total direct medical costs in the AD cohort were \$11,660 per patient, representing an incremental cost of \$3,302 even when controlled for the presence of atopic comorbidities. As may be expected for a condition generally treated on an outpatient basis, the resource category with the highest costs was outpatient visits, followed by prescription costs. Additionally, inpatient costs, which generally have the highest unit cost, were also significantly higher in the AD cohort relative to the matched controls, as were the costs of ED visits despite the low use of these resource categories.

These patterns of resource use are consistent with population-based surveys that also showed higher utilization among adults with AD relative to individuals without AD,^{2,3} although those surveys did not include matched controls to evaluate incremental differences between cohorts. A similar consistency for higher direct medical costs associated with AD was observed with an older claims-based study.¹¹ That study, which was based on an employee claims database for the time period of 1998-2005, estimated incremental costs of AD of \$51.51 per patient month, or approximately \$618 annually. Even after adjusting for inflation to calendar year 2013,¹² the incremental difference of \$737 is more than 4-fold lower than \$3,302 estimated in the current study. However, there are several methodological differences

TABLE I. Baseline characteristics of atopic dermatitis cases and controls, including stratification by atopic dermatitis severity

Variable	Matched populations			By atopic dermatitis severity		
	Atopic dermatitis (n = 10,533)	Matched controls (n = 31,599)	P value	More severe (n = 3,849)	Less severe (n = 6,684)	P value
Age (y), mean (SD)	49.7 (18.1)	49.7 (18.1)	—	52.1 (17.3)	48.4 (18.4)	<.0001
Male sex, no. (%)	37.7	37.7	—	38.5	37.2	.019
Insurance, %						
Commercial	80.3	80.3	NS	77.5	81.9	<.0001
Medicare	19.7	19.7		22.5	28.1	
US geographic region, %			<.0001			<.0001
Northeast	21.1	9.9		18.0	22.8	
North-central	21.9	34.6		25.4	19.8	
South	32.2	49.1		36.9	29.6	
West	23.1	6.1		18.3	25.9	
Unknown	1.8	0.3		1.5	0.6	
Atopic conditions, no. (%)						
Asthma	1,350 (12.8)	1,231 (3.9)	<.0001	567 (14.7)	783 (11.7)	<.0001
Allergic rhinitis	2,333 (22.1)	2,171 (6.9)	<.0001	871 (22.6)	1,462 (21.9)	.37
Chronic rhinosinusitis	1,764 (16.7)	4,183 (13.2)	<.0001	752 (19.5)	1,012 (15.1)	<.0001
Conjunctivitis	775 (7.4)	795 (2.5)	<.0001	272 (7.1)	503 (7.5)	.39
Nasal polyps	35 (0.3)	36 (0.1)	<.0001	20 (0.5)	15 (0.2)	.01
Allergic urticaria	654 (6.2)	191 (0.6)	<.0001	238 (6.2)	416 (6.2)	.93
Esophagitis	293 (2.8)	494 (1.6)	<.0001	125 (3.2)	168 (2.5)	.03

NS, not significant; SD, standard deviation.

between the studies, including the use of an employee claims database in the older study, which was also characterized by a younger demographic, mean (SD) age 21.2 (20.9) years compared with 49.7 (18.1) years in the current study. Similarly, methodologic differences likely account for the value of \$164 (\$238 adjusted to calendar year 2013) reported by Fivenson et al¹³ as the annual AD-specific costs per adult.

Resource utilization was high even among patients with AD with less severe disease, consistent with results from the 2010 NHIS in which 24% of participants with AD across all severity levels reported ≥ 10 physician visits in the preceding year.² Direct medical costs were significantly higher with more severe relative to less severe AD, as suggested in a previous study.¹³ Although this finding is limited by reliance on therapy utilization as a surrogate measure of severity rather than on clinical measures, a similar approach has been used in previous epidemiologic studies.⁸⁻¹⁰ Further evaluation of the economic burden based on validated measures of severity is warranted.

Costs assessed in this study are only those associated with payments for medical visits and prescriptions, and do not capture other economic consequences of AD such as out-of-pocket costs or lost productivity. Although limited data are available on out-of-pocket costs, an older study by Fivenson et al.¹³ estimated that among adults with AD, these costs exceed \$7,000 per year just for nonprescription medications, and may be more than twice that amount when copays and special household items are considered. Claims-based analyses are also unable to capture other economic outcomes such as the indirect costs associated with missed work days, reduced productivity at work, and disability payments due to AD,^{2,11,14} and intangible costs resulting from reductions in quality-of-life, which may account for 61% of the total economic burden of AD.¹

The strength of this study is the use of a claims database that is geographically representative of the US population and that includes a variety of public and private health care insurance plans. Nevertheless, use of such claims data has several limitations, including inability to capture other economic outcomes as mentioned above. There is also potential for misclassification of AD given that patient identification relied on ICD-9 codes for the diagnosis rather than on stringent diagnostic criteria.¹⁵ However, the requirement of ≥ 2 claims with an AD ICD-9 code likely improves specificity. Another limitation is that the observed incremental difference in resource use and costs cannot be directly attributed to AD, because in studies using retrospective claims data, it is not possible to link specific resource use with the condition of interest. Although our multivariate models account for atopic comorbidities, there was no adjustment for other conditions that have been associated with adult AD in epidemiologic studies, including attention deficit hyperactivity disorder (ADHD),¹⁶ depression,¹⁷ injuries,¹⁸ and infections,¹⁹ all of which may potentially increase resource use and costs. Last, these results may not be generalizable to other insured populations, such as Medicaid, that were not captured in the database; Medicaid patients with AD have been previously suggested to have different patterns of resource use and higher costs relative to privately insured patients with AD.²⁰

In summary, these findings provide important and more recent information on the economic burden of AD in the United States than currently available in the literature. The results demonstrate that adult AD is associated with significantly higher direct medical costs than matched individuals without AD, with these higher costs driven by outpatient visits. Additionally, significant cost differentials were observed across AD severity strata, indicating higher costs in patients with more severe disease.

TABLE II. Annual health care utilization and costs in atopic dermatitis and matched control cohort without atopic dermatitis

Resource category and metric	Unadjusted				Adjusted*			
	Atopic dermatitis (n = 10,533)	Matched controls (n = 31,599)	Incremental difference	P value	Atopic dermatitis (n = 10,533)	Matched controls (n = 31,599)	Incremental difference	P value
Inpatient visit								
≥1 visit, no. (%)	1,287 (12.2)	3,322 (10.5)	1.7	<.0001	—	—	—	—
No. of visits, mean (SE)	0.17 (0.6)	0.15 (0.5)	0.02	<.0001	0.31 (0.04)	0.28 (0.04)	0.03 (0.06)	<.0001
Length of stay (d), mean (SE)	0.5 (0)	0.4 (0)	0.1	<.0001	1.0 (0.2)	0.9 (0.2)	0.1 (0.3)	<.0001
Inpatient costs, mean (SE)	\$2,293 (\$162)	\$1,570 (\$57)	\$724	<.0001	\$3,954 (\$789)	\$3,362 (\$798)	\$592 (\$1,122)	<.0001
Emergency department (ED)								
≥1 visit, no. (%)	2,317 (22.0)	5,649 (17.9)	4.1	<.0001	—	—	—	—
No. of visits, mean (SE)	0.3 (0)	0.2 (0)	0.1	<.0001	0.4 (0)	0.39 (0)	0.05 (0.05)	<.0001
ED costs, mean (SE)	\$550 (\$27)	\$335 (\$8)	\$214	<.0001	\$951 (\$122)	\$781 (\$123)	\$170 (\$173)	<.0001
Ambulatory visits								
≥1 visit, no. (%)	6,035 (57.3)	16,749 (53.0)	4.3	<.0001	—	—	—	—
No. of visits, mean (SE)	2.9 (0.1)	2.2 (0)	0.7	<.0001	4.5 (0.4)	3.9 (0.4)	0.6 (0.5)	<.0001
Ambulatory costs, mean (SE)	\$2,477 (\$123)	\$1,803 (\$56)	\$674	<.0001	\$6,010 (\$699)	\$5,433 (\$707)	\$576 (\$995)	<.0001
Outpatient visits								
≥1 visit, no. (%)	10,529 (100.0)	28,386 (89.8)	10.2	<.0001	—	—	—	—
No. of visits, mean (SE)	17.5 (17.7)	9.4 (13.7)	8.1	<.0001	27.0 (1.0)	20.8 (1.0)	6.2 (1.4)	<.0001
Outpatient costs, mean (SE)	\$3,591 (\$141)	\$1,998 (\$42)	\$1,593	<.0001	\$5,447 (\$631)	\$4,236 (\$639)	\$1,211 (\$898)	<.0001
Prescriptions filled								
≥1 prescription filled, no. (%)	10,136 (96.2)	26,502 (83.9)	12.3	<.0001	—	—	—	—
No. of prescriptions filled, mean (SE)	17.6 (0.2)	12.1 (0.1)	5.5	<.0001	25.5 (0.8)	20.9 (0.9)	5.6 (1.2)	<.0001
Prescription costs, mean (SE)	\$2,749 (\$87)	\$1,697 (\$31)	\$1,052	<.0001	\$3,981 (\$423)	\$3,229 (\$428)	\$752 (\$601)	<.0001
Total costs, mean (SE)	\$11,660 (\$318)	\$7,403 (\$115)	\$4,257	<.0001	\$20,343 (\$1,557)	\$17,041 (\$1,575)	\$3,302 (\$2,215)	<.0001

SE, Standard error.

*Adjusted for type of health insurance plan, region of residence, and atopic comorbidities (asthma, allergic rhinitis, chronic rhinosinusitis, conjunctivitis, nasal polyps, allergic urticaria, and esophagitis).

TABLE III. Annual health care utilization and costs among patients with atopic dermatitis stratified by disease severity

Resource category and metric	Unadjusted				Adjusted*			
	More severe AD (n = 3,849)	Less severe AD (n = 6,684)	Incremental difference	P value	More severe AD (n = 3,849)	Less severe AD (n = 6,684)	Incremental difference	P value
Inpatient visit								
≥1 visit, no. (%)	587 (15.3)	700 (10.5)	5.2	<.0001	—	—	—	—
No. of visits, mean (SE)	0.23 (0.68)	0.15 (0.55)	0.08	<.0001	0.36 (.05)	0.32 (0.05)	0.04 (0.07)	<.0001
Length of stay (d), mean (SE)	0.7 (4.2)	0.4 (3.3)	0.3	<.0001	1.2 (0.3)	1.0 (0.3)	0.2 (0.5)	<.0001
Inpatient costs, mean (SE)	\$3,063 (\$362)	\$1,849.9 (\$82)	\$1,213	<.0001	\$5,325 (\$1,550)	\$4,392 (\$1,584)	\$933 (\$2,191)	<.0001
Emergency department (ED)								
≥1 visit, no. (%)	1,008 (26.2)	1,309 (19.6)	6.6	<.0001	—	—	—	—
No. of visits, mean (SE)	0.3 (0.7)	0.2 (0.6)	0.1	<.0001	0.5 (0.1)	0.4 (0.1)	0.1 (0.1)	<.0001
ED costs, mean (SE)	\$765 (\$63)	\$425 (\$82)	\$340	<.0001	\$988 (\$254)	\$661 (\$254)	\$328 (\$360)	<.0001
Ambulatory visits								
≥1 visit, no. (%)	2,458 (63.9)	3,577 (53.5)	10.4	<.0001	—	—	—	—
No. of visits, mean (SE)	3.7 (8.0)	2.4 (6.5)	1.3	<.0001	4.9 (0.6)	3.9 (0.6)	1.0 (0.9)	<.0001
Ambulatory costs, mean (SE)	\$3,234 (\$254)	\$2,041 (\$82)	\$1,192	<.0001	\$5,170 (\$1,172)	\$4,232 (\$1,171)	\$938 (\$1,656)	<.0001
Outpatient visits								
≥1 visit, no. (%)	3,837 (99.7)	6,659 (99.6)	0.1	.60	—	—	—	—
No. of visits, mean (SE)	21.8 (21.3)	15.8 (16.0)	6.0	<.0001	30.1 (1.6)	23.8 (1.6)	6.3 (2.3)	<.0001
Outpatient costs, mean (SE)	\$4,568 (\$296)	\$3,029 (\$82)	\$1,539	<.0001	\$6,444 (\$1,345)	\$5,116 (\$1,344)	\$1,328 (\$1,901)	<.0001
Prescriptions filled								
≥1 prescription filled, no. (%)	3,756 (97.6)	6,380 (95.5)	2.1	<.0001	—	—	—	—
No. of prescriptions filled, mean (SE)	21.8 (17.3)	15.2 (14.6)	6.6	<.0001	27.9 (1.3)	22.9 (1.3)	5.0 (1.9)	<.0001
Prescription costs, mean (SE)	\$3,492 (\$196)	\$2,321 (\$82)	\$1,171	<.0001	\$4,333 (\$826)	\$3,397 (\$825)	\$936 (\$1,167)	<.0001
Total costs, mean (SE)	\$15,122 (\$683)	\$9,667 (\$25,187)	\$5,455	<.0001	\$22,261 (\$3,016)	\$17,798 (\$3,013)	\$4,463 (\$4,263)	<.0001

AD, Atopic dermatitis; SE, standard error.

*Adjusted for age, gender, type of health insurance plan, region of residence, and atopic comorbidities (asthma, allergic rhinitis, chronic rhinosinusitis, conjunctivitis, nasal polyps, allergic urticaria, and esophagitis).

Studies are needed to confirm and expand on this economic burden, including evaluation of other costs borne by patients such as over-the-counter and alternative therapies, as well as indirect costs related to productivity that have broader implications for employers and society.

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