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Accepted: 2 January 2018

DOI: 10.1111/all.13401

ORIGINAL ARTICLE

Skin and Eye Diseases

WILEY Allergy EUROPEAN JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY EAACI

# Epidemiology of atopic dermatitis in adults: Results from an international survey

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**Funding information**
This study was funded by Regeneron Pharmaceuticals, Inc. and Sanofi.

## Abstract

**Background:** There are gaps in our knowledge of the prevalence of adult atopic dermatitis (AD).

**Objective:** To estimate the prevalence of AD in adults and by disease severity.

**Methods:** This international, cross-sectional, web-based survey was performed in the United States, Canada, France, Germany, Italy, Spain, United Kingdom, and Japan. Adult members of online respondent panels were sent a questionnaire for AD identification and severity assessment; demographic quotas ensured population representativeness for each country. A diagnosis of AD required subjects to be positive on the modified UK Working Party/ISAAC criteria *and* self-report of ever having an AD diagnosis by a physician. The proportion of subjects with AD who reported being treated for their condition was determined and also used to estimate prevalence. Severity scales were Patient-Oriented SCORAD, Patient-Orientated Eczema Measure, and Patient Global Assessment.

**Results:** Among participants by region, the point prevalence of adult AD in the overall/treated populations was 4.9%/3.9% in the US, 3.5%/2.6% in Canada, 4.4%/3.5% in the EU, and 2.1%/1.5% in Japan. The prevalence was generally lower for males vs females, and decreased with age. Regional variability was observed within countries. Severity varied by scale and region; however, regardless of the scale or region, proportion of subjects reporting severe disease was lower than mild or moderate disease.

**Conclusions:** Prevalence of adult AD ranged from 2.1% to 4.9% across countries. Severe AD represented a small proportion of the overall AD population regardless of measure or region.

KEYWORDS
atopic dermatitis, epidemiology, prevalence, severity

## 1 | INTRODUCTION

Atopic dermatitis (AD) is a chronic, complex, often relapsing inflammatory skin disease. The clinical presentation of AD includes pruritus, xerosis, and eczematous lesions, and its pathology is characterized by interactions between skin barrier defects and immune dysregulation, with recent evidence suggesting that it is a systemic disorder.[1,2] There is a consistent association of AD with other atopic and allergic conditions including asthma and atopic rhinitis, often in a progression known as the atopic march.[3] The burden of illness associated with

AD has been well characterized in the pediatric population, including recognition of the impact of AD on the family and caregivers as well as on the patients themselves.[4,5] Similarly, among adult patients with AD, a multidimensional burden has been described that includes not only the skin symptoms associated with AD, but also sleep disturbances, impaired mental health, and reductions in quality-of-life and work productivity.[6-14] This burden is higher with greater AD severity,[6,11,12,15-18] which has been reported as moderate in 20%–37% and severe in 10%–34% of patients.[19,20]

The epidemiology of AD has focused on the pediatric population.[21] Limited information on the prevalence of AD among adults suggests variability that may be dependent on the population, disease definitions, and methodology. The European Community Respiratory Health Survey (ECRHS) study (N = 8206), which was based on self-diagnosis in the adult population of 11 European countries and the US, reported adult AD point prevalence rates that varied from 0.3% (Switzerland) to 6.2% (Estonia).[22] Among several US studies, reported point prevalence rates varied from 3.2% to 10.7% depending on the population evaluated and the definition used.[23-25] In the Japanese population, the point prevalence of adult AD was estimated to be 2.9%, with 1-year and lifetime prevalence rates of 3.0% and 3.3%, respectively.[26]

The above epidemiologic data indicate distinct gaps in our knowledge of the prevalence of AD in adults. Challenges that have contributed to these gaps include inconsistency in applying diagnostic criteria to epidemiologic evaluation, lack of a universally accepted measure for assessment of severity, and less than adequate representativeness of the samples that would enable generalizability to the broader population (eg, the US sample in the ECRHS study was represented by only a single city).[22]

The primary objective of this study was to fill these gaps by providing global data on the prevalence of AD in representative samples of adults from different countries using standardized diagnostic criteria and consistently applying established methods from previous studies. A secondary objective was to enable comparative and robust estimation of AD prevalence by disease severity in each country using validated patient-reported outcomes.

## 2 | METHODS

### 2.1 | Study design

This multinational, cross-sectional study was designed to represent the general populations of the US, Canada, European Union (EU) (France, Germany, Italy, Spain, United Kingdom [UK]), and Japan. Data collection was according to ethical codes of the European Society for Opinion and Marketing Research (ESOMAR) and European Pharmaceutical Market Research Association (EphMRA), and was compliant with the US Health Insurance Portability and Accountability Act (HIPAA) of 1996; all subjects provided informed consent prior to participation.

Data were collected through a web-based survey among subjects who were members of online respondent panels in their respective countries (Kantar LightSpeed GMI, all countries except Japan; Research Now, all countries except Japan; AIP, Japan; Netquest, Spain; Instantly, US; and Asking Canadians, Canada). Recruitment was by broad-reach portals, special interest sites, and direct emailing campaigns, and panel members who completed the questionnaire received points redeemable for items in a prize catalogue. For inclusion, members of an online respondent panel were required to be 18–65 years old, inclusive, and able to read and write the native country language.[27]

To reduce selection bias, panelists were blinded to the research topic when invited. To ensure robustness of the data collected, the personal information provided was matched to a third-party database to confirm validity; inactive e-mails and inactive members are regularly removed from the panels. The Internet Protocol address of the respondent was verified against a known list of fraudulent servers to identify fraud at the time of registration. Individuals who completed the survey in an unreasonably short time (<2 minutes for those without self-reported AD; <4 minutes for those with self-reported AD) were excluded. Individuals were excluded if their responses on severity scales lacked consistency (ie, very low scores on 1 scale and very high scores on another). Interim quality checks were conducted on the data after 1000, 2000, and 3000 respondents were recruited; in particular, consistency in the distribution of AD severity was confirmed in panels within and across countries.

The survey was conducted during the same period across all countries (February 29 through April 13, 2016), and the maximum total duration for questionnaire completion was 15 minutes. The questionnaire was administered in the native language of each country, and the outcome measures that were included were validated translations as made available by the developer of the measure.

### 2.2 | Questionnaire and outcomes

The questionnaire consisted of 5 sections, of which the first captured demographic characteristics. The second section elicited information to determine the presence of AD using an automated diagnosis algorithm that assessed whether the subjects were "non-AD" or "AD" (provided as online Supplementary material), and also included questions on the presence of comorbid atopic conditions (asthma, hay fever, chronic rhinosinusitis, food allergies, and allergic keratoconjunctivitis) and family history of AD. Only subjects who were classified as "AD" based on the algorithm were allowed to report disease severity. Sections 3–5 consisted of validated measures for the assessment of disease severity.

Table 1 shows the algorithm used for self-report of the presence of AD, which was based on questions from the International Study of Asthma and Allergies in Childhood (ISAAC)[28] and the UK Working Party criteria[29,30] modified for self-completion. ISAAC has been validated for population-based studies, and while the UK Working Party criteria were validated for clinician use, the self-completed version has not yet been validated. This combination was used as ISAAC alone has variable sensitivity and specificity across populations,[31] and it was considered that addition of the UK Working Party criteria would provide more rigorous identification of AD.

**TABLE 1** UK Working Party criteria modified for self-diagnosis of atopic dermatitis

| Criterion | Question | Origin | Requirement for AD identification |
|---|---|---|---|
| History of pruritic skin condition | • Have you ever had an itchy rash which was coming and going for at least 6 months?<br>• Have you had this itchy rash in the past 12 months? | ISAAC[21] | Mandatory |
| History of dry skin | In the last year, have you suffered from a dry skin in general? | UK Working Party[29,30] | Must meet at least 3 of 5 |
| History of asthma | Do you suffer or have you ever suffered from asthma (bouts of wheezing with coughing)? | UK Working Party[29,30] | |
| Age of rash onset < 2 y | At what age did this itchy rash first occur? | ISAAC[21] | |
| Flexural dermatitis | Has this itchy rash at any time affected any of the following places: the folds of the elbows, behind the knees, in front of the ankles, under the buttocks or around the neck, ears, or eyes? | ISAAC[21] | |
| Visible dermatitis | *Questions based on pictures:*<br>Have you observed signs of erythema/induration, papulation or edema/lichenification/oozing and crusting on your skin in the past 12 months? | | |

The question on visible dermatitis asked about the presence of erythema, induration, papulation, edema, lichenification, oozing, and crusting with the assistance of pictures from the Eczema Area and Severity Index (EASI) scale.[32] Subjects were identified with AD on the basis of giving a mandatory answer of "yes" to the questions "Have you ever had an itchy rash which was coming and going for at least 6 months" and "Have you had this itchy rash in the past 12 months?," plus a positive response to at least 3 of 5 other criteria (Table 1) *and* were required to have self-reported a physician diagnosis of AD based on the question: "Have you *ever* been diagnosed with atopic dermatitis or atopic eczema by a doctor?"

Disease severity was assessed using 3 validated measures including the Patient-Oriented Scoring of Atopic Dermatitis (PO-SCORAD),[33] the Patient-Orientated Eczema Measure (POEM),[34] and the Patient Global Assessment (PGA). On PO-SCORAD, severity was based on 0–24, 25–49, and ≥50, which by consensus represent the severity of mild, moderate, and severe, respectively.[35] Severity threshold scores on POEM were 0-7 (mild), 8-16 (moderate), and >16 (severe);[36] subjects self-reported PGA as mild, moderate, or severe.

A series of stand-alone questions were also included on the specialties of the physicians managing AD; consultations with healthcare professionals for AD treatment; whether the subject has sought treatment and is currently taking medication; AD medications used; and consumption of tobacco and alcohol (not reported here).

## 2.3 | Statistical analysis

Based on the assumption of a 3% prevalence, a sample size of 20 000 US subjects and 10 000 in each of the other countries was determined to provide a prevalence estimate with a precision of ±0.24% (US) and ±0.33% (other countries). This prevalence assumption would also enable identification of 600 and 300 AD subjects in the US and other countries, respectively, for assessment of severity with a precision of ±4.0% and ±5.7%.

Quota apportionment was used prior to data collection to ensure that sampled subjects were representative of the general adult population of the countries.[37] Hard quotas were set for gender, age-group, and region, with soft quotas for current occupation of the head of household (France, the UK, Italy, Spain, Japan) and income level (Germany, US, Canada). A minor weighting adjustment was applied at the country level where some deviations have been observed between the soft quota objectives and the final sample structure.

Populations were characterized with regard to demographics and AD severity using descriptive statistics. The point prevalence of AD was estimated based on meeting both of the individual criteria (ie, subjects both positive to modified UK Working Party criteria in the past 12 months *and* reporting having ever received a physician's diagnosis of AD). Additionally, prevalence was estimated using a prevalent population defined as subjects who met the UK Working Party criteria *and* received a physician diagnosis who also reported being treated for their AD.

Differences between countries were evaluated using bivariate analyses with *Z*-tests for categorical variables, and paired-sample *t* tests for continuous variables with 95% confidence intervals (CIs). All analyses were conducted using DAISIE version 2.4.25 (ADN, Paris, France).

# 3 | RESULTS

## 3.1 | Populations

The attrition flow resulting in the final sampled populations is shown in Figure S1. The demographic characteristics of these populations (Table 2) were representative of the individual countries. Regional distributions within each country reflected the study goals as being representative of each country, as did the ranges of income levels (data not shown).

**TABLE 2** Demographic characteristics of the sampled populations by country

| Variable | a) US (n = 19 986) | b) Canada (n = 10 004) | c) France (n = 9964) | d) Germany (n = 9971) | e) Italy (n = 9897) | f) Spain (n = 9924) | g) UK (n = 10 001) | h) Japan (n = 10 911) |
|---|---|---|---|---|---|---|---|---|
| Sex (%) | | | | | | | | |
| Male | 38.5 | 39.1 | 45.5 | 47.8 | 46.5 | 49.8 | 44.5 | 48.8 |
| Female | 61.5 | 60.9 | 54.5 | 52.2 | 53.5 | 50.2 | 55.5 | 51.2 |
| Age range, % | | | | | | | | |
| 18–24 y | 15.6 | 9.6 | 13.1 | 12.3 | 11.9 | 9.0 | 11.8 | 14.6 |
| 25–34 y | 20.1 | 18.2 | 20.1 | 20.7 | 20.4 | 21.3 | 22.2 | 17.2 |
| 35–44 y | 21.1 | 19.5 | 20.7 | 19.1 | 26.5 | 28.5 | 22.0 | 23.9 |
| 45–54 y | 23.6 | 27.9 | 24.1 | 26.3 | 25.6 | 24.3 | 24.1 | 22.2 |
| 55–64 y | 19.5 | 24.9 | 22.0 | 21.6 | 15.6 | 16.9 | 19.9 | 22.1 |

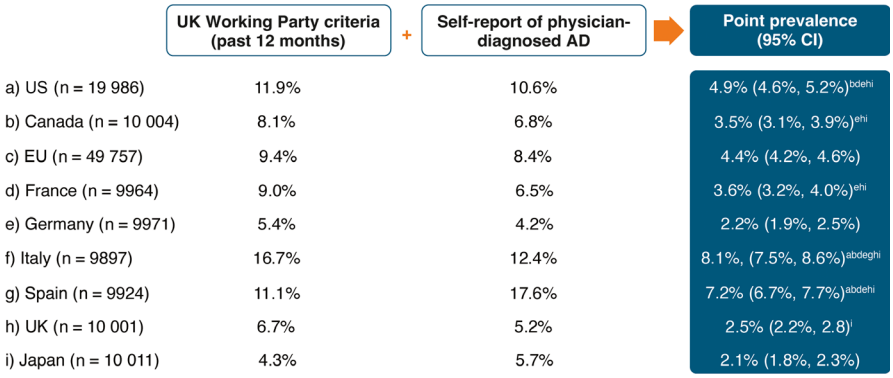


**FIGURE 1** Prevalence of adult atopic dermatitis in the sampled populations by country. A significantly higher point prevalence vs other countries is indicated by the superscript letters ($P < .05$)

## 3.2 | Prevalence

In the overall population, the 12-month adult prevalence of AD was 4.9% (95% confidence interval [CI]: 4.6%, 5.2%) in the US, 3.5% (95% CI: 3.1%, 3.9%) in Canada, 4.4% (95% CI: 4.2%, 4.6%) in the EU with individual country ranges of 2.2% (95% CI: 1.9%, 2.5%) for Germany to 8.1% (95% CI: 7.5%, 8.6%) for Italy, and 2.1% (95% CI: 1.8%, 2.3%) in Japan (Figure 1). There were regional differences across countries within Europe (Figure 1) as well as across regions within a country (Table S1). A higher point prevalence was observed in southern European countries (Italy and Spain) compared with the other countries ($P < .05$) (Figure 1). In the US, the Midwest region was associated with the lowest prevalence, and the difference was significant relative to the other regions (Table S1).

Positivity on the UK Working Party criteria ranged from 4.3% (Japan) to 16.7% (Italy) and was higher than the proportion of subjects who reported being diagnosed by a physician for all countries except Spain and Japan (Figure 1). The proportion of subjects who reported having been diagnosed by a physician was <10% except for the US (10.6%), Italy (12.4%), and Spain (17.6%) (Figure 1).

Females had a higher AD prevalence except in the UK, where the prevalence was the same in males and females (2.5%), and in the US, where males had a numerically but not significantly higher prevalence (5.1% vs 4.6%) (Figure 2A). Spain had the greatest difference between sexes, 9.3% among females vs 5.1% among males ($P < .05$). The prevalence of AD was generally lower among older age-groups ($P < .05$) with a peak prevalence most frequently observed in the 25- to 34-year or 35- to 44-year age-groups and decreasing prevalence in the 45- to 54-year and 55- to 64-year age-groups (Figure 2B).

As shown in Table 3 regarding the presence of the individual UK Working Party criteria in the overall populations, dry skin was the most frequently reported criterion (38.8%–65.5%) except in France (27.0%), where itchy skin had a higher prevalence (28.9%). Itchy skin, generally the second most frequent criterion, was highest in Italy (46.4%) and was significant vs the other countries (all $P < .05$). Asthma was highest in Spain (26.0%; $P < .05$ vs all other countries) and lowest in Japan (10.5%). While the onset of rash <2 years of age was low overall, the highest proportion was in France (9.6%; $P < .05$ vs all other countries).

## 3.3 | Severity

Differences in severity distribution were observed across the scales and across countries (Figure 3). Although the PGA consistently resulted in the lowest proportions of severe (2%–8%) relative to POSCORAD (10%–21%) and POEM (8%–17%), severe AD was generally stable within a particular scale across the countries. The US had the

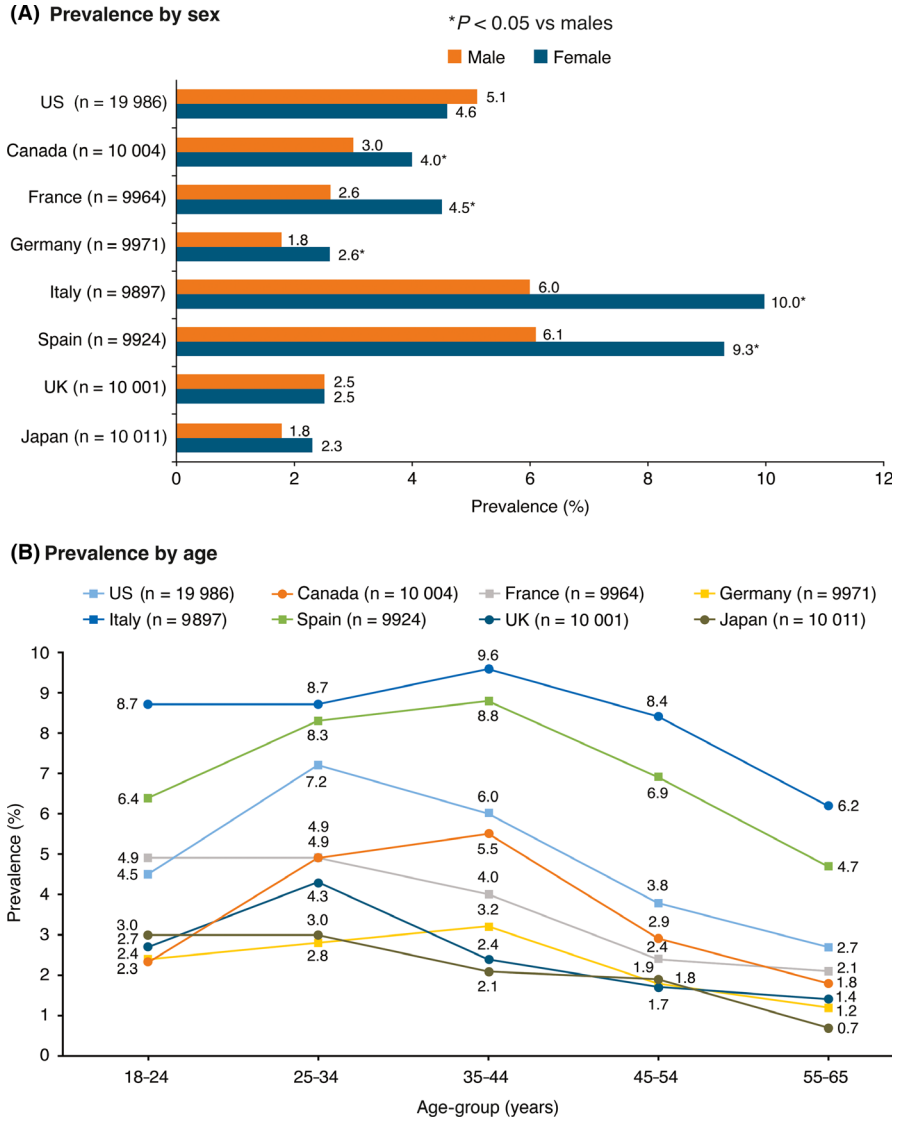


**FIGURE 2** Point prevalence by demographic characteristics. (A) Sex. (B) Age

**TABLE 3** Presence of the individual items of the UK Working Party criteria modified for self-completion in the overall adult populations. A significantly higher prevalence of the criterion vs other countries is indicated by the superscript letters ($P < .05$)

| Criterion | a) US (n = 19 986) | b) Canada (n = 10 004) | c) France (n = 9964) | d) Germany (n = 9971) | e) Italy (n = 9897) | f) Spain (n = 9924) | g) UK (n = 10 001) | h) Japan (n = 10 911) |
|---|---|---|---|---|---|---|---|---|
| Onset of rash < 2 y old | 3.0$^{dh}$ | 3.8$^{adfgh}$ | 9.6$^{abdefgh}$ | 0.9 | 3.8$^{adfgh}$ | 2.6$^{dh}$ | 2.9$^{dh}$ | 1.4$^{d}$ |
| Itchy skin condition in past 12 mo | 22.6$^{dg}$ | 24.4$^{adg}$ | 28.9$^{abdfgh}$ | 18.6 | 46.4$^{abcdfgh}$ | 23.8$^{adg}$ | 21.2$^{d}$ | 25.3$^{adfg}$ |
| Flexural dermatitis | 15.7$^{bdgh}$ | 14.4$^{gh}$ | 17.1$^{abdgh}$ | 13.9$^{gh}$ | 33.6$^{abcdfgh}$ | 16.6$^{bdgh}$ | 12.8$^{h}$ | 10.4 |
| Visible dermatitis | 18.4$^{bdgh}$ | 16.7$^{dgh}$ | 19.7$^{abdgh}$ | 13.3 | 24.3$^{abcdfgh}$ | 21.0$^{abcdgh}$ | 14.2$^{h}$ | 13.0 |
| Presence of asthma | 19.4$^{cdeh}$ | 21.4$^{acdegh}$ | 16.9$^{dh}$ | 12.8$^{h}$ | 16.9$^{dh}$ | 26.0$^{abcdegh}$ | 19.1$^{cdeh}$ | 10.5 |
| Dry skin | 62.2$^{cefgh}$ | 61.1$^{cefgh}$ | 27.0 | 62.5$^{bcefgh}$ | 57.5$^{cfh}$ | 47.2$^{ch}$ | 57.2$^{cfh}$ | 38.8$^{c}$ |

highest proportion of subjects with severe AD regardless of scale. France and the southern European countries Italy and Spain had higher proportions of mild AD relative to the UK and Germany; Germany consistently had the lowest proportion of mild AD on each scale. Severity ratings in Japan showed considerable variability depending on the scale.

## 3.4 | Diagnosis and management

Family practitioners/general practitioners were the primary diagnosing specialty in the UK (66%) and Canada (52%), in contrast to dermatologists in all other countries (51%–72%) (Figure 4). Other specialties were scarcely represented (≤10%), except for pediatricians

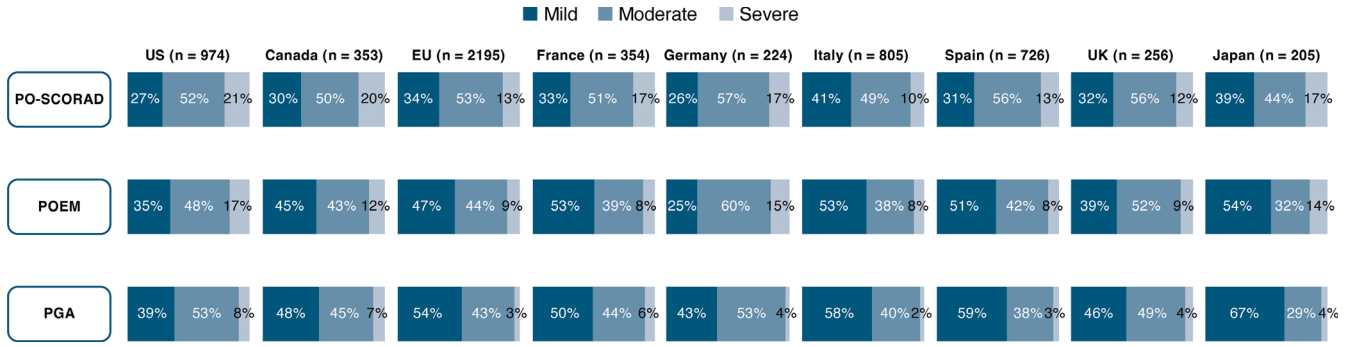


**FIGURE 3** Atopic dermatitis severity by country based on different assessment scales among the prevalent population (ie, those who met UK Working Party criteria and reported a physician's diagnosis). PO-SCORAD, Patient-Oriented Scoring of Atopic Dermatitis; POEM, Patient-Orientated Eczema Measure; PGA, Patient Global Assessment

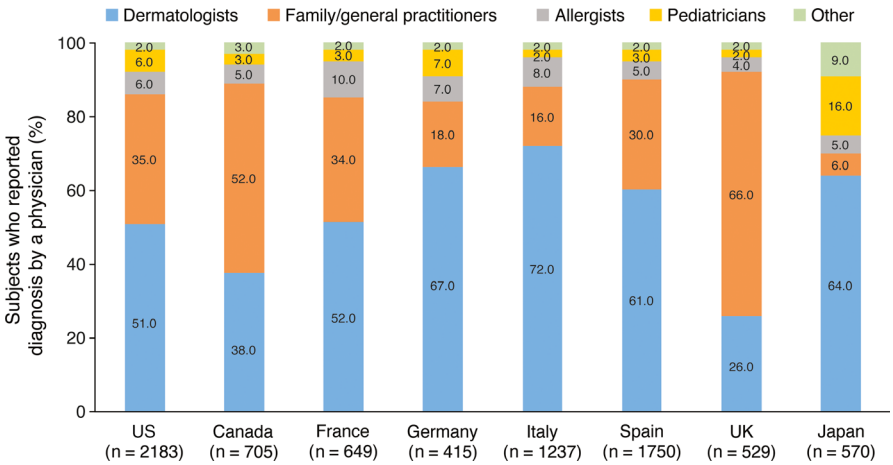


**FIGURE 4** Specialty of physicians who had made the diagnosis of atopic dermatitis (AD) in subjects who reported having been diagnosed with AD by a physician

in Japan (16%). Among subjects positive for UK Working Party criteria, less than half (48.2%) reported having received the diagnosis of AD from a physician. Among the prevalent AD subjects, that is, those with meeting the UK Working Party criteria and received a physician diagnosis of AD, the majority across countries reported treatment for their AD, which ranged from 69.3% in France to 80.2% in the UK (Figure 5).

When subjects who met the AD criteria (ie, UK Working Party criteria and reported a physician diagnosis) and who also reported being treated for their disease were considered as the prevalent population, the prevalence of adult AD was 3.9% in the US, 2.6% in Canada, 3.5% in the EU, and 1.5% in Japan.

## 4 | DISCUSSION

This study provides comparative estimates of the adult AD prevalence from several industrialized countries in North America, Europe, and Asia. Notably, the sample populations were large and representative of the individual countries by virtue of the use of demographic quotas. As such, this represents the first international study to gather AD prevalence data in adults stratified by severity from general populations. The study was also specifically designed to improve the accuracy of self-report by incorporating both the validated ISAAC scale and a self-reported modification of the validated UK Working Party criteria. The dual use of these scales would be expected to reduce misclassification and detection bias, and minimize issues associated with self-report that have previously been recognized,[38] thereby also increasing the epidemiologic and clinical relevance of the study.

Results of the study show that individual country point prevalence of AD in adults, which range from 2.1% (Japan) to 8.1% (Italy), is substantial and is consistent with the 2%–10% reported by the World Allergy Organization.[20] However, the observed rates are higher than the 12-month prevalence rates reported among specific countries in the multinational ECRHS,[22] especially in southern Europe and the US. These disparities may reflect methodologic differences, including the limited study sites evaluated in the ECRHS that in some cases were restricted to only a few regions of the countries surveyed (eg, the US and Germany were only represented by 1 and 2 cities, respectively), and reliance in ECRHS only on the ISAAC questionnaire to identify the population, which was smaller and more selected that also enabled clinical evaluation. Clinical evaluation is impractical in a larger multinational study of representative populations such as those evaluated in the current study.

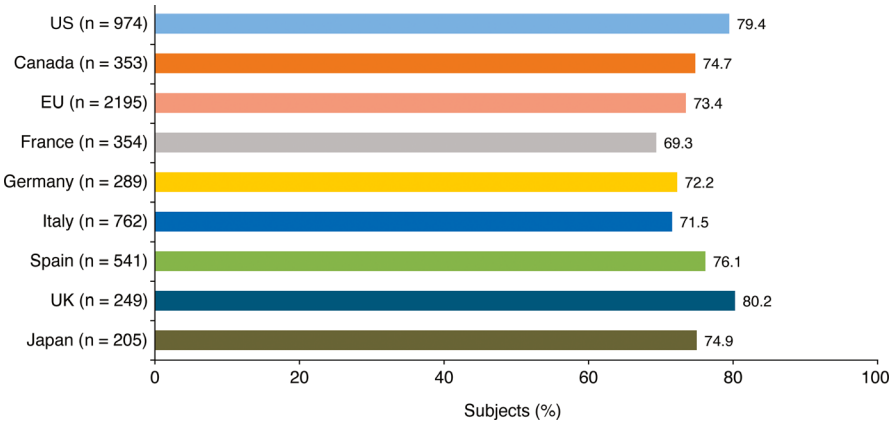


**FIGURE 5** Proportion of subjects meeting UK Working Party criteria and received a physician diagnosis who reported being treated for their atopic dermatitis

The estimated point prevalence in Japan (2.1%) and Germany (2.2%) was comparable to previous country-specific studies.[39,40] In the US, the point prevalence of 4.9% was slightly higher than the 3.2% population prevalence reported in a study using the criteria of eczema in conjunction with having a history of asthma and/or a 1-year history of hay fever as a proxy for AD.[24] The difference between these 2 numbers may be accounted for by the fact that the previous study relied on the presence of asthma or hay fever to confirm AD diagnostics. However, when the current study considered treated subjects (79.4%; n = 773) as the prevalent population, the prevalence is 3.9% (ie, 773/19 986), a percentage point lower than the overall point prevalence (4.9%) and closer to the 3.2% reported previously. Similarly, the point prevalence in Italy, 8.1%, was higher than the prevalence of 3.1% based on using a proxy of eczema with concurrent asthma and/or hay fever, and which also reported a high rate of adult onset.[41] In regard to adult onset, it should be noted that the current data did not enable assessment of the age of disease onset. Additionally, the generally low report of rash onset <2 years old (0.9%–9.6%) may reflect, at least in part, subjects not remembering their childhood disease.

Higher point prevalence in Italy (8.1%) and Spain (7.2%) relative to other countries (2.1%–4.9%) may reflect differences in presentation and diagnosis as indicated by the observed differences in proportions of subjects endorsing the individual UK Working Party criteria; subjects in Italy reported a higher rate of itchy skin and those in Spain had a higher rate of asthma. Furthermore, both countries had the highest proportions of subjects who reported having been diagnosed by a physician, which may reflect a greater access to health care that could have also potentially contributed to the higher prevalence in these countries.

Similar to what has previously been suggested by results from the ECRHS,[22] some regional variability in adult AD prevalence was observed within each country, with Italy and Spain having the highest inter-region variability. The regional variability for Italy was also in concordance with a previous study that showed higher prevalence rates in cities in Mediterranean regions relative to those in a more continental (northern) climate.[41] While regional variability is not well understood, several variables may be proposed as factors that may contribute to the observed variability, including genetic factors,[42] as well as extrinsic factors that vary across regions within a country such as behavioral or cultural dynamics and climatic elements. However, in countries where the prevalence of AD was higher, the proportion of severe forms was generally much lower, with a tendency to equalize the burden of severe AD among countries. The number of confounding factors increases the complexity of explaining regional differences.

The results reported here also confirm previous correlations of AD prevalence with sex and age;[39,40,43] prevalence was higher among females relative to males except in the US and was generally lower among older age-groups across all countries.

Mild or moderate severity were the most common individual severity presentations, with generally low proportions of severe AD. While other studies have reported moderate AD to be the most common presentation,[19,20,44] 2 studies have reported a high prevalence of severe AD, 51% and 55% in a UK and an Italian study, respectively, although the former used alternate cutoff scores and the latter used a different assessment scale.[44,45]

The observed distributions according to severity grading were dependent on the scales used, likely reflecting the fact that they do not necessarily assess the same AD-related constructs. The consistently higher proportions of severe AD on PO-SCORAD and POEM relative to PGA likely reflect what is being measured. Both PO-SCORAD and POEM rely on a more clinical and granular approach to assessing specific symptoms, including itch that substantially contributes to the severity rating, and effects that also include nonskin symptoms such as sleep disturbance. The PGA, in contrast, uses a more holistic approach, which may underestimate the impact of itch, and is also likely to introduce variability and limitations similar to what has been described for Investigator's Global Assessment measures.[46] However, the epidemiologic and clinical relevance of this holistic approach represented by the PGA should also be considered, as it may be informative of individuals who are more likely to seek medical attention because of poorer global health status.

The greatest variability in distribution across scales was observed in Japan, and this may indicate potential issues in the comprehensibility of the questions. There is currently no standardized patient-reported measure of AD severity, and thus, the observed variability further emphasizes the need for such standardization, as has been recommended by the Harmonizing Outcome Measures for Eczema

(HOME) initiative for defining and assessing AD.[47] Of note, HOME has also endorsed POEM as the core outcome instrument for measuring patient-reported symptoms.[48]

Geographic differences were observed with regard to severity prevalence. Milder disease was observed among countries that have generally a similar latitude with more uniform hours of daylight exposure and an overall continental climate (France, Italy, Spain, and Japan) relative to a greater prevalence of moderate and severe subjects in countries with a more northerly (Germany, UK, Canada) or diverse (US) range of latitudes and climate. This is consistent with a review of published data that indicated the low humidity and low temperatures of more northerly climates not only lead to a decrease in skin barrier function but also an increased prevalence and risk of AD flares.[49]

### 4.1 | Strengths and limitations

Strengths of this study are its large population and selection of subjects for broad representation of the populations and regions of each country, providing external validity and greater generalizability, and its use of validated measures for identifying AD and its severity. Additionally, this study provides a consistent method of measuring AD prevalence across continents. Selection bias represents a limitation that was manifested by the use of an online survey, which presupposes computer literacy and Internet access. Selection bias may also result from potential differences between subjects who agreed to participate and those who did not. Another limitation is that older subjects (ie, >65 years) were excluded. Online panel members in this older age-group may not necessarily have been representative of the general population given access to the Internet is generally lower for this age-group. As the study is based on self-report, another limitation is recall bias.

## 5 | CONCLUSIONS

A population-based comparison of prevalence using validated methods shows an adult AD prevalence generally within a fairly narrow range across North America, Europe, and Japan (2.1%-4.9%), although variations were observed across countries as well as across regions within a country. Except for a higher prevalence among males in the US, the association of AD with female sex was confirmed, as well as the lower prevalence in older age-groups. The severity distribution was observed to vary based on the outcome measure used, suggesting a need for standardization of severity assessment. Patient Global Assessment consistently provided the lowest rates of the severe AD (2%–8%), which formed a small proportion of the overall AD population regardless of scale or region.

## ACKNOWLEDGMENTS

Medical writing support was provided by E. Jay Bienen, PhD, and funded by Sanofi and Regeneron Pharmaceuticals.

## CONFLICTS OF INTEREST

S. Barbarot has received research grants from Pierre Fabre Laboratory and Fondation pour la dermatite atopique; personal fees from Bioderma, Laboratoire La Roche Posay, Sanofi-Genzyme, Novalac, Ferring; and nonfinancial support from Abbvie, Novartis, Janssen. A. Gadkari is an employee of and stockholder in Regeneron Pharmaceuticals, Inc. S. Auziere is an employee of Kantar Health, who received funding from Sanofi to conduct the study. E. Simpson's institution has received grants/research funding from Amgen, Inc, Anacor Pharmaceuticals Inc., Celgene Corporation, Chugai Pharma US, LLC, Eli Lilly and Company, Galderma Research and Development, Genentech Inc., MedImmune LLC, Novartis Pharmaceuticals Corporation, Pfizer Inc., Regeneron Pharmaceuticals, Inc., Sanofi, Tioga Pharmaceuticals Inc, and is a consultant for Regeneron Pharmaceuticals, Inc., Sanofi, Anacor, Celgene Corporation, Galderma Research and Development, Genentech, MedImmune LLC, Pfizer Inc., AbbVie, Dermira, and Valeant. M. de Bruin-Weller is a consultant for Regeneron Pharmaceuticals, Inc., Sanofi Genzyme; an advisory board member for AbbVie, Anacor, Regeneron Pharmaceuticals, Inc., Sanofi Genzyme; and principal investigator for AbbVie, Regeneron Pharmaceuticals, Inc., Roche, Sanofi Genzyme. G. Girolomoni has been principal investigator in clinical trials sponsored by and/or and has received personal fees from AbbVie, Abiogen, Almirall, Amgen, Bayer, Biogen, Celgene, Eli-Lilly, Galderma, Hospira, Janssen, Leo Pharma, Merck, MSD, Mundipharma, Novartis, Pfizer, Pierre Fabre, Regeneron Pharmaceuticals, Inc., Samsung, Sandoz, Sanofi, and Sun Pharma. L. Puig has received consultancy honoraria from and participated in clinical trials sponsored by Regeneron Pharmaceuticals, Inc., and Sanofi. L. Eckert is an employee of and stockholder in Sanofi.

## AUTHOR CONTRIBUTIONS

The authors were responsible for all content and editorial decisions and received no honoraria related to the development of this publication. All authors had full access to all the data in this study and take complete responsibility for the integrity of the data and accuracy of the data analysis. All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this manuscript, take responsibility for the integrity of the work as a whole, and have given final approval for the version to be published.

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## SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

**How to cite this article:** Barbarot S, Auziere S, Gadkari A, et al. Epidemiology of atopic dermatitis in adults: Results from an international survey. *Allergy*. 2018;73:1284–1293. https://doi.org/10.1111/all.13401