The prevalence of atopic dermatitis in adults: systematic review of population studies

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Abstract

Atopic dermatitis (AD) is a common multifactorial skin disease occurring primarily in young children. AD has increased in prevalence over the past decades, but little knowledge exists on the prevalence of AD in adults. Herein, published estimates of the point-prevalence and one-year prevalence of AD in adults are reviewed in the context of various study characteristics such as the age and gender distribution of the populations, sampling methods, study design, and geographical area of origin. In total, 14 different population studies reporting the prevalence of AD in adults in 17 countries were identified. There was a substantial between-country variation in both the point-prevalence (1.6 to 11.5%) and one-year prevalence (2.2 to 17.6%) of AD with heterogeneity explained partly by gender, age, geography, study design, and diagnostic criteria.

Keywords: atopic dermatitis, prevalence, adults

Introduction

Atopic dermatitis (AD) is a frequently occurring inflammatory skin disease in young children, characterised by dry itchy skin. Atopic dermatitis is considered a multifactorial disease in which several innate and external triggering factors act in concert to increase the risk of the disease. These factors are both genetic and environmental. For example, genes that encode epidermal structural proteins such as filaggrin [1] as well as genes that encode key cytokines of the adaptive immune system are implicated [2]. A few environmental risk factors for AD have been identified and collectively these point to a detrimental role of an increasingly hygienic pre- and perinatal environment in the development of AD [3].

Atopic dermatitis is closely linked to the other atopic diseases, asthma and allergic rhinoconjunctivitis, probably also in part because of shared immunogenetic and environmental mechanisms. Approximately 95% [4] of all cases of AD have an onset before the age of five, whereas presumably only around 5% of patients have an onset in adulthood. More than 80% of patients with childhood-onset AD experience remission before adulthood, which leaves a small fraction still affected by AD into adulthood [5].

The majority of population studies of AD have been performed in childhood populations, whereas much less is known about the epidemiology of AD in adults. Particularly, little knowledge exists on the prevalence of AD in adults. Herein, we review published estimates of the prevalence of AD in adults.

Discussion

A literature search was performed in PubMed in August 2017 using the terms: "atopic dermatitis," "atopic eczema," "eczema," "adults," "prevalence" and "incidence" (**Figure 1**). Only articles published after January 2000 and containing original data on the population prevalence of AD in adults were included. Reference lists were scrutinized for additional publications not identified in the initial search. Review articles were also consulted for unidentified studies. Estimates of point-prevalence

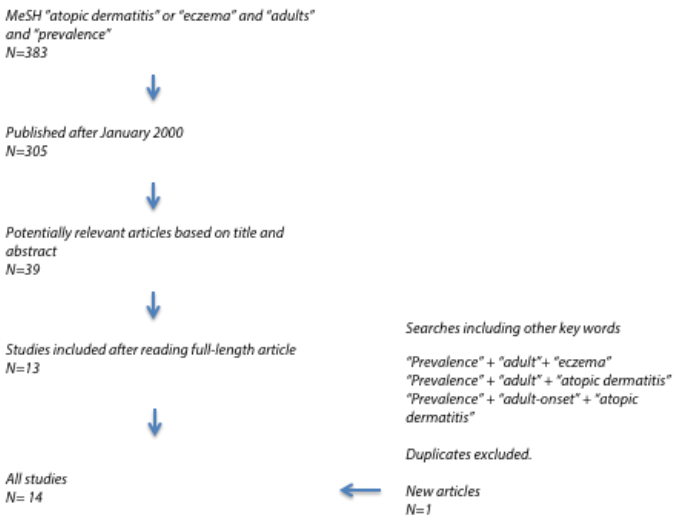

Figure 1. *Literature search diagram of identified studies.*

and one-year prevalence of AD were retrieved and the study populations, sampling methods, study designs, age, and gender differences were recorded. A modified version of the Newcastle-Ottawa Scale (NOS), [6] was used to assess the quality and risk of bias based on five parameters: population representativeness and size, comparability of respondents and non-respondents, ascertainment of AD, and statistical quality. The scale ranges from 0 to 6 and the results were divided into low risk of bias (≥3 points) or high risk of bias (<3 points), [7, 8].

The literature search identified 14 different studies reporting the prevalence of AD in 17 countries. There was a substantial between-country variation in both the point-prevalence and one-year prevalence of AD in adults ranging from 1.6 [9] to 11.5% [10] (point-prevalence) and from 2.2 to 17.6% [11], (one-year prevalence), (**Table 1**). The NOS scores for each study ranged from 2 [12] to 6 [13] points with an average score of 3.7. Population representativeness and size and ascertainment of AD were given the highest scores whereas the lowest scores were given for comparability of respondents and non-respondents (**Table 1**).

The size of the individual populations varied from 120 individuals to 27,157 [14, 15]. In all studies the populations were randomly selected and representative of the population as a whole in the respective area. Also, the age of the populations varied from studies comprising individuals 21 years of age [14] to studies including subjects up to 85 years of age [16]. Most of the studies were cross sectional, whereas two were prospective cohort studies [13, 14] in which the individuals were initially examined as children and later as young adults. Data were sampled through various strategies in the different studies: questionnaires, clinical examinations, telephone interviews, and video interviews. Different diagnostic criteria were used including Schultz Larsen Criteria [17], Hanifin, and Rajka criteria [18], ISAAC (International Study of Asthma and Allergies in Childhood), [19], UK Working Party diagnostic criteria [20], GA^{2}LEN (Global Allergy and Asthma European Network), [21], and self-reported doctor-diagnosed atopic dermatitis [22].

Factors explaining variation in the prevalence of AD

Overall, the identified studies showed a higher prevalence of AD in women than in men and a higher prevalence among younger age groups. In the studies assessing disease severity, mild AD was diagnosed in more than 50% of the cases whereas only a small fraction suffered from very severe AD. There was no clear pattern of variation in the prevalence of AD explained by geographical origin of the study, which is in line with observations among children in the ISAAC studies [23], in which the highest prevalence of AD symptoms in children was reported to be above 15% in urban Africa, the Baltics, Australia, and Northern and Western Europe; the lowest prevalence (<5%) was observed in China, Eastern Europe, and Central Asia. Different study designs and diagnostic criteria were used in the identified studies with cross-sectional studies being most common. The most frequently used diagnostic criteria were the UK Working Party criteria [20] and the Hanifin and Rajka criteria [18].

Gender

A total of eight studies found a significantly higher prevalence of AD in women compared with men [10, 11, 13, 15, 22, 24-26]. The exception was a study from Korea [27] which found a higher prevalence in men and two [12, 14] of the studies did not find any significant gender difference in the prevalence of AD. Three studies [9, 16, 28] did not assess the difference in prevalence between men and women. The higher prevalence in women is consistent with a

gender shift in the prevalence of the atopic diseases from childhood to adulthood and a resulting higher prevalence in women of the atopic diseases in general [29]. However, it can possibly also be explained by an increased tendency of seeking medical assistance [30] or more frequent exposure to allergens or irritants in women leading to diagnostic confusion with contact dermatitis in women [31].

Severity

Five studies [9, 13, 25-27] examined the severity of AD. They differentiated the severity in mild, moderate, severe, and very severe based on SCORAD (SCOring Atopic Dermatitis), [9, 13, 32], EASI (Eczema Area and Severity Index), [27, 33], or by own criteria [25, 26]. All five studies found mild AD to be the dominating group varying from 51.8% [9] to 84.6% [26]. The fraction of moderate AD varied from 15.4% [26] to 29.6% [9], whereas severe AD varied from 3.4% [25] to 18.5% [9]. Two studies [13, 26] did not identify any individuals with severe or very severe AD.

Age

Overall, studies reported a higher prevalence among the younger age groups compared to older age groups except a study from the United States, which found a higher prevalence of AD in the oldest age group (62-85 years), [15]. However, after multiple adjustments also including health care interaction in the past year, this tendency was no longer statistically significant, consistent with confounding from frequent contact to the health care system on the prevalence of AD. The lower prevalence observed among older age groups in most of the studies [10-12, 24-26] is possibly caused by remission of AD, which was observed in several prospective studies [13, 14]. Alternatively, it could relate to a cohort effect resulting from an overall increase in prevalence of AD over the past generations, or by recall bias contributing to a lower prevalence in the older age groups.

Geography

The identified studies comprised 17 different countries. The point prevalence was investigated in 6 different countries. The highest point prevalence was observed in Sweden (11.5%), [10] and in Denmark (9.7%), [13] by questionnaires. The lowest point prevalence was observed in Germany (1.6%), [9], Korea (2.6%), [27] by clinical examination, and Japan (2.9%), [12] by questionnaires, whereas a moderate point prevalence of 8.1% [22] was observed in Italy.

The one-year prevalence was investigated in 16 different countries covering four continents. The highest one-year prevalence was seen in some of the North European countries: Estonia (17.6%), [11], Denmark (14.3% [24] and 10% [13]), Sweden (9%), [11] and Norway (8.6%), [11]. Also Colombia (11.45%), [16], Thailand (15%), [28] and the United States (10.2), [15] had a high one-year prevalence. Countries with a moderate one-year prevalence were Iceland (8% [14] and 8.15% [11]), Germany (8.4%), [9], United Kingdom (8.1%), [11], France (8%), [11] and the United States (7.4%), [11]. The lowest prevalence was observed in Italy (6.6%), [11], Belgium (5.9%), [11], Germany (5.1%), [11], Spain (4.2%), [11] and Switzerland (2.2%), [11].

Overall, there were no clear geographical patterns in the point-prevalence or one-year prevalence, although it seemed that countries in the north might have a slightly higher prevalence than countries in the south. This might be explained by lower temperatures, humidity, and UV index of the north [34] or by other environmental or genetic differences. The high prevalence in the United States might be explained by a greater variation in climate and genetic ancestry similar to the northern European countries. An increase in the prevalence of AD in developing countries was also seen in the ISAAC studies [35] and also in the studies from Thailand [28] and Colombia [16]. The increased prevalence in developing countries can be explained by a change in environmental risk factors alluding to family size, allergens, and hygiene [35]. Further it has been described that there are notable differences in the medical approach to AD. There are different prevention strategies and, national guidelines. In addition, individual doctors' knowledge about the disease lead to differences in prevalence rates across nations [36].

Study design

Most of the identified studies were cross-sectional, whereas two were prospective cohort studies [13,

14]. These showed a decrease in the prevalence of AD from childhood to adulthood, which supports that a large proportion of children with AD experience remission of the disease before adulthood [5]. Possible recall bias was investigated in one of the prospective cohort studies [13], in which 43.7% of the population diagnosed with AD as children had forgotten as adults. Further, the fluctuating nature of the disease can also lead to biased estimates, particularly of the point- and one-year prevalence, if patients are examined during a period of transient remission. Consequently, if the symptoms are absent at the time of the study the observed prevalence will be underestimated. Finally, selection bias can occur when people with symptoms are more willing to participate, which was exemplified in a study from Denmark [13] in which the group of participants in the follow-up part of the study were more often women than men and more of them had had childhood AD.

Studies from Japan [12, 25, 26] and Korea [27] used data from yearly obligatory health examinations of officials and staff members at a university, but they argue that there is no difference between the social status of officials and the general population. A study from Colombia [16] used a community based strategy in which a person was selected randomly along with four other individuals from the neighbourhood. Such sampling strategies could have influenced the true estimate of AD in the studied countries. However, most of the studies used randomly selected populations.

All the identified studies collected their data through questionnaires or a combination of questionnaires and clinical examination [9, 13, 27] except one [14], which diagnosed AD based only on clinical examination. The observed prevalence rates of AD were consistently lower among the studies that examined participants clinically, possibly explained by false positive self-reports of AD. For example the same study from Germany [9] found a prevalence of AD of 23.5% by self-report and 1.6% by clinical examination.

Diagnostic criteria

The most frequently used diagnostic criteria for AD were the United Kingdom Working Party criteria [20] and the Hanifin and Rajka criteria [18]. Studies performed on infants have shown agreement between the different diagnostic criteria for AD [37], whereas less is known about their applicability in adults. Using different diagnostic criteria makes it more difficult to compare studies. A study from Thailand [28] used the diagnostic criteria of ISAAC, but in the Thai language there is no word for eczema and instead it was translated into allergic rash, which may have led to a higher prevalence of AD-related symptoms. One study [11] defined AD as eczema and increased specific IgE to at least one allergen and this may have decreased the reported prevalence.

It is difficult to compare prevalence estimates of AD in adults between studies owing to marked differences in design, diagnostic criteria, and age groups. Moreover, the majority of the identified studies were from developed countries and therefore little is known about the prevalence of AD in adults from developing countries, although studies from Thailand [28] and Colombia [16] did report a high prevalence. Particularly, it is not known whether the epidemiology and secular trends of AD in adults correspond to what has been observed among children from different parts of the world [38]. Comparable studies of childhood prevalence estimates of AD were found in the ISAAC studies [38], which investigated some of the same countries/centers as we identified herein, particularly from Europe (Sweden, Belgium, Germany, United Kingdom, Italy, Spain), Thailand, and United States. The ISAAC studies investigated the prevalence of AD in children in the age groups 6-7 and 13-14 years. The prevalence varied from 5.9% (Spain) to 22.3% (Sweden) in the age group 6-7 years. In the older group of children (13-14 years of age) the prevalence varied from 4% in Spain to 12.9% in Sweden. Compared to the ISAAC studies the difference in prevalence among children and adults in the specific country was between 0.9% (United States) and 13.3% (Sweden), [11, 38].

Conclusion

There are few studies of the incidence of AD in adults. Specifically, the point prevalence and one-year prevalence are only representative of a short period

of time. On the other hand, estimates of lifetime prevalence would include AD exclusively confined to childhood and are therefore not representative of adult AD. In conclusion, the available literature suggests large variation in the point prevalence of AD in adults (between 1.6 and 11.5%), whereas the one-year prevalence varies between 2.2 and 17.6%. Further, prevalence estimates are consistently higher in the younger populations and in women. The large variation in the prevalence of AD might be explained by differences in environment, geography, and genetic makeup between populations but also methodological factors such as different diagnostic criteria, different data collection methods, and study design.

Potential conflicts of interest

The authors declare no conflicts of interests.

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Table 1. *Summary of worldwide studies of atopic dermatitis in adults.*

Study	Country	Study design	Population	Age	Data collection	Diagnostic criteria	QU point prevalence	CL point prevalence	QU 1-year prevalence
Pesce 2014 [22]	Italy	CS	10464	20-44	QU	SR	8.1%	-	-
Kim 2010 [27]	Korea	CS	3563	19-60+	QU CL	HR	7.1%	2.6%	-
Muto 2003 [12]	Japan	CS	10762	30-60+	QU	UK	2.9%	-	3%
Mortz 2015 [13]	Denmark	PCS	899	27-32	QU	UK	9.7%	6.2%	17.1%
Worm 2006 [9]	Germany	CS	1739	18-65	QU TL CL	HR	-	1.6%	8.4% (TL)
Rönmark 2012 [10]	Sweden	CS	18087	16-75	QU	GA	11.5%	-	-
Saeki 2006 [25]	Japan	CS	2123	20-69	CL	Japanese criteria	6.9% *	-	-
Saeki 2009 [26]	Japan	CS	2120	20-69	QU	UK	6.1%*	-	-
Uthaisangsook 2007 [28]	Thailand	CS	2693	17-53	QU VI	ISAAC	-	-	15%
Vinding 2014 [24]	Denmark	CS	16507	30-89	QU	SL HR	-	-	14.3%
Dennis 2012 [16]	Colombia	CS	4504	17-85	ISAAC	QU	-	-	11.45%
Silverberg 2013 [15]	USA	CS	27157	18-85	NS	QU	-	-	10.2%
Finnbogadóttir 2012 [14]	Iceland	PCS	120	21	NS	CL	-	-	-
Harrop 2007 [11]	Estonia	CS	259	27-56	UK	QU	-	-	17.6%

	Sweden		1423				-	-	9%
	Norway		584				-	-	8.6%
	Iceland		455				-	-	8.15%
	UK		551				-	-	8.1%
	France		1170				-	-	8%
	USA		197				-	-	7.4%
	Italy		520				-	-	6.6%
	Belgium		627				-	-	5.9%
	Germany		590				-	-	5.1%
	Spain		1384				-	-	4.2%
	Switzerland		446				-	-	2.2%
	Total		8206				-	-	7.1%

Study	Country	CL 1-year prevalence	Population representativeness	Sample size	Non-respondents	Ascertainment of AD	Statistical quality	NOS Total Score
			NOS SCORE:					
Pesce 2014 [22]	Italy	-	1	1	0	0	1	**3**
Kim 2010 [27]	Korea	-	0	1	0	2	0	**3**
Muto 2003 [12]	Japan	-	0	1	0	1	0	**2**
Mortz 2015 [13]	Denmark	10%	1	1	1	2	1	6
Worm 2006 [9]	Germany	-	1	1	0	2	0	4
Rönmark 2012 [10]	Sweden	-	1	1	1	1	0	4
Saeki 2006 [25]	Japan	-	0	1	0	2	0	3
Saeki 2009 [26]	Japan	-	0	1	1	2	0	4
Uthaisangsook 2007 [28]	Thailand	-	0	1	1	1	0	3
Vinding 2014 [24]	Denmark	-	1	1	0	1	1	4
Dennis 2012 [16]	Colombia	-	1	1	0	1	1	4

Silverberg 2013 [15]	USA	-	1	1	0	1	1	4
Finnbogadóttir 2012 [14]	Iceland	8%	1	0	0	2	0	3
Harrop 2007 [11]	Estonia	-	1	1	1	1	1	5
	Sweden	-						
	Norway	-						
	Iceland	-						
	UK	-						
	France	-						
	USA	-						
	Italy	-						
	Belgium	-						
	Germany	-						
	Spain	-						
	Switzerland	-						
	Total	-						

The Modified Newcastle-Ottawa Scale ranges from 0 to 6 and assesses the quality in the categories: sample representativeness and size, comparability between respondents and non-respondents, ascertainment of atopic dermatitis and statistical quality. Studies were judged to be of low risk of bias (≥3 points) or high risk of bias (<3 points): 1) Representativeness of the population; 1 point: The population was randomly selected and representative, 0 points: Population was a selected group. 2) Sample size; 1 point: Sample size was greater than 200 participants, 0 points: Sample size was less than 200 participants or a convenience sample. 3) Non-respondents; 1 point: Comparability between respondent and non-respondent characteristics was established or the response rate was satisfactory (>80%), 0 points: The response rate was unsatisfactory (<80%), the comparability between respondents and non-respondents was unsatisfactory, or there was no description of the response rate or the characteristics of the responders and the non-responders. 4) Ascertainment of atopic dermatitis; 2 point: AD diagnosed by clinical examination, 1 point: AD diagnosed with survey prepared via known diagnostic criteria for atopic dermatitis, 0 points: AD not diagnosed by clinical examination or by known diagnostic criteria. 5) Quality of descriptive statistics reporting; 1 point: Reported descriptive statistics to describe the population (e.g., age, sex) with proper measures of dispersion (e.g., standard deviation, standard error, range), 0 points: Descriptive statistics were not reported, were incomplete, or did not include proper measures of dispersion.

Abbreviations: CL=clinical examination, CS=Cross-sectional study, GA=GA²LEN, HR=Hanifin and Rajka criteria, NS=not supplied, PCS=Prospective cohort study, QU=Questionnaire, SL=Schultz Larsen criteria, SR=self-reported doctor diagnosed eczema, TL=telephone interview, UK=UK Working Party criteria, VI=video interview.`

*The prevalence type is nonspecific.