

Trends in eczema in the first 18 years of life: results from the Isle of Wight 1989 birth cohort study

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Summary

Background Trends in the prevalence of eczema in the course of childhood and adolescence are not clear although often a net remission during childhood is assumed.

Objectives To investigate the dynamics of change in eczema from 1 to 18 years in a prospective study and to understand the influence of gender and atopy.

Methods Detailed information regarding eczema were collected at ages 1, 2, 4, 10 and 18 years from the 1989 Isle of Wight birth cohort ($n = 1456$). Skin prick testing was performed at 4, 10 and 18 years of age. The 12-month period prevalence, positive and negative transitions (defined as change in disease status in two consecutive study assessments) were stratified by gender and atopic status.

Results The period prevalence of eczema from birth to 18 years of age remained relatively constant (11.9–14.2%) with minimal remission. Up to 10 years of age, gender did not influence prevalence. From 10 to 18 years, eczema became more prevalent among girls (16.3% for girls vs. 8.3% for boys, $P < 0.001$) as a result of a greater positive transition in girls (9.4% for girls vs. 4.3% for boys, $P = 0.001$) and greater negative transition in boys (65.4% for boys vs. 50% for girls, $P = 0.04$). The higher positive transition of eczema in girls was most pronounced for non-atopic eczema (5.9% for girls vs. 1.5% for boys, $P = 0.002$).

Conclusions We found only a minimal reduction in the prevalence of eczema during childhood and adolescence. During adolescence, more girls develop eczema and more boys outgrow it suggesting a role for gender-specific pubertal factors.

Keywords atopy, eczema, gender, incidence, negative transition, positive transition, prevalence, remission

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Introduction

The burden of allergic disorders has increased in the last decades, particularly in westernized countries where approximately 25% of children are affected [1]. Eczema is a chronic inflammatory skin disease characterized by a relapsing–remitting combination of skin dryness, itching and scratching, starting in childhood and perhaps persisting into adulthood [2, 3]. Most early childhood eczema is thought to remit [4, 5]. Various epidemiological studies have shown that eczema is more prevalent among boys during childhood with girls being more frequently affected after puberty [6–9]. These findings are based though on cross-sectional surveys. No study has yet investigated the dynamics of changes related to gender and allergic sensitizations from birth to adolescence period within one cohort.

There are two possible explanations for the changing pattern of eczema during adolescence, firstly, more girls may experience the new occurrence of eczema or secondly, more boys may grow out of eczema.

Using the Isle of Wight birth cohort, we aimed to examine the occurrence of eczema from infancy to age 18 years focusing on sex-specific differences in atopic and non-atopic eczema over this period. We hypothesize a gender reversal in the prevalence of eczema during adolescence.

Methods

The Isle of Wight 1989 birth cohort

A whole population birth cohort was established on the Isle of Wight, UK, in 1989 to prospectively study the

natural history of allergies from birth to age 18 years. The island is close to the British mainland, semi-rural, with no heavy industry. The population is 99% Caucasian. The local Research Ethics Committee approved the study (06/Q1701/34). Of the 1536 children born between 1 January, 1989, and 28 February, 1990, informed consent was obtained from parents to enrol 1456 newborns. Children were followed up at the ages of 1 ($n = 1167$), 2 ($n = 1174$), 4 ($n = 1218$), 10 ($n = 1373$) and 18 years ($n = 1313$). Detailed questionnaires were completed for each child at each follow-up. When a visit was not possible, a telephone questionnaire was completed or a short postal questionnaire sent for completion and return. Eczema was defined as 'ever eczema' plus an 'itchy rash during the previous 12 months'. Since the 1- and 2-year follow-up data on eczema were collected in a relatively small time window, we have combined them for analytic purposes (as 1-or-2 years). All questionnaires focused on eczema in the preceding 12 months to minimize the potential for recall bias that might occur if participants were asked to recall the entire period between assessments.

Skin prick testing

At age 1-or-2 skin prick testing (SPT) was performed on most symptomatic children. At 4, 10 and 18 years, regardless of symptoms, SPT was performed on most children attending the research centre to a standard battery of common allergens (ALK-Albello, Horsholm, Denmark). Inhalant allergens tested were house dust mite, cat, dog, *Alternaria alternata*, *Cladosporium herbarium*, grass pollen mix and tree pollen mix. Food allergens tested were cows' milk, soya, hens' egg, peanut and cod. Positive and negative controls were included. Atopy or allergic sensitization was defined by having an SPT to at least one allergen test with mean weal diameter of 3 mm greater than the negative control. At each exam, children with both eczema and positive SPT were regarded as having atopic eczema.

Statistical analysis

For each follow-up, the 12-month (24-month for 1-or-2 years) period prevalence of eczema was determined by dividing the number of children with eczema by the total

number of children who had available information regarding eczema status. Atopic and non-atopic period prevalence included only children who participated in the SPT and who had eczema status information. Thus, for example, the 12-month period prevalence of atopic eczema was the number of children who had both eczema and positive SPT divided by the total number of children with SPT and eczema information.

The study represents a dynamic cohort; some children did not participate in one assessment but re-joined the next (Fig. 1). The appropriate measure of changes in a dynamic cohort are positive and negative transitions. A positive transition is defined as a change in the individual status from eczema free to eczema, independent of whether this is the first occurrence. Calculations of atopic and non-atopic eczema positive and negative transitions were based on the eczema status during two consecutive investigations and SPT information for the second examination. For instance, positive transition of atopic eczema from age 4 to 10 took into account children who were eczema free at age 4 years (children at risk), developed eczema at age 10 and had a positive SPT result at age 10. This numerator was divided by all children who had SPT information at 10 years of age and were at risk. A negative transition of eczema between follow-up examinations was defined as the individual change in status from eczema to eczema-free. Calculations of negative transition of atopic eczema and non-atopic eczema followed similar rules as of the positive transition.

For each observation period (age 1-or-2, 4, 10, 18 years), we estimated the difference in rates in boys and girls using χ^2 -tests. To assess long-term development in individual children, we had to consider that repeated measurements for each individual child represent correlated observations. Applying generalized estimation equation (GEE) analysis [10] that takes the within-child effect into account, we estimated marginal probabilities for time and sex and their interaction using GENMOD in the SAS system (SAS, Cary, NC, USA). Time reflects the assessment of eczema at different ages and is considered as categorical variable, which does depend on the numeric value at each age or time interval. The reference for the overall time trend was age 1-or-2 years; for the group with SPT results, it was age 4 years. The combined effect of sex $\times$ time assesses whether boys and girls, during the

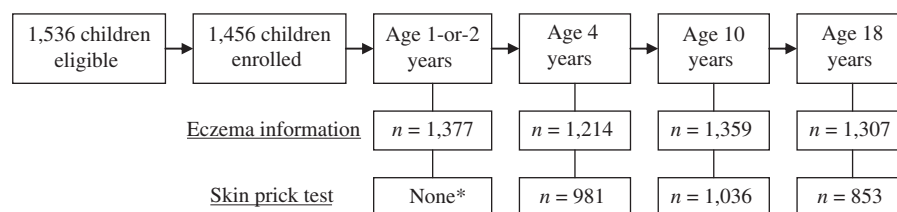


Fig. 1. Description of subjects participating in each assessment. *Skin prick test was preformed only on symptomatic children.

Table 1. 12-month prevalence of eczema, overall and stratified by sex and atopy

Period prevalence, % (n/total)	Ages 1-or-2	Age 4	Age 10	Age 18	Sex-time interaction <i>P</i> -value [‡]
All					
Time trend					
Both	14.2 (196/1377)	11.9 (145/1214)	13.7 (186/1359)	12.3 (161/1307)	
<i>P</i> -value [†]	Reference	0.183	0.692	0.003	
Sex differences					< 0.001
Males	14.6 (102/700)	12.6 (78/619)	13.4 (92/688)	8.3 (54/651)	
Females	13.9 (94/677)	11.3 (67/595)	14.0 (94/671)	16.3 (107/656)	
<i>P</i> -value*	0.715	0.472	0.733	< 0.001	
Atopic eczema					
Time trend	SPT was performed on				
Both	symptomatic children only	5.4 (53/981)	5.9 (61/1036)	6.6 (56/853)	
<i>P</i> -value [†]		Reference	0.782	0.747	
Sex differences					0.215
Males		6.3 (31/493)	6.2 (32/516)	5.9 (24/407)	
Females		4.5 (22/488)	5.6 (29/520)	7.2 (32/446)	
<i>P</i> -value*		0.218	0.669	0.452	
Non-atopic eczema					
Time trend	SPT was performed on				
Both	symptomatic children only	7.2 (71/981)	9.5 (98/1036)	5.7 (49/853)	
<i>P</i> -value [†]		Reference	0.305	0.007	
Sex differences					0.013
Males		6.9 (34/493)	8.5 (44/516)	3.0 (12/407)	
Females		7.6 (37/488)	10.4 (54/520)	8.3 (37/446)	
<i>P</i> -value*		0.679	0.307	< 0.001	

Numbers represent the percentage (number with eczema/total number available for analysis at each assessment). The 'All' row shows data for all children. The 'Atopic eczema' row takes into account children with positive skin prick test (SPT) results; in contrast, 'non-atopic eczema' looked only at children with negative SPT results.

**P*-value (two-sided) represents the difference between males and females.

[†]*P*-value represents the difference between study time-points in regard to the reference point (ages 1-or-2) or (age 4). The time trend is therefore controlled for the trend of sex and time-sex interaction.

[‡]*P*-value for the sex-time interaction which assesses whether males and females have a different trend over time.

course of the observation, have a different pattern of prevalence, incidence or remission, respectively. An α -value of <0.05 was taken to indicate statistical significance.

In a descriptive analysis, we also restricted the cohort to children who participated in all follow-ups (stable cohort) and calculated the cumulative incidence as the first occurrence of eczema in children who were never affected before. Cumulative incidence is defined for the investigation periods 1-or-2 to 10 years and 1-or-2 to 18 years as the proportion of children with first occurrence of eczema during each period. Furthermore, net remission was calculated for children who went into complete remission for the time of follow-up. Net remission represents the proportion of children who went into complete remission, and thus for the 1-or-2 to 18 period, it was the proportion of children with eczema at baseline with follow-up data (stable cohort) who outgrew their eczema.

Using the stable cohort, the proportion of persistent cases over the course of all assessments (ages 1-or-2, 4, 10

and 18 years) was determined by dividing the number of children who had eczema at all investigations by the number of children who had eczema at age 1-or-2 years. The proportion of persistence starting at age 4 years was calculated accordingly. Recurrence was determined by dividing the number of children who had eczema at age 1-or-2 and were in remission at age 4 but had eczema at 10 or 18 years or both by the number of children who had eczema at age 1-or-2 years. Recurrence at age 18 in children who had eczema onset at age 4 but no eczema at age 10 was derived similarly.

Results

A total of 1377, 1214, 1359 and 1307 children had available eczema information at ages 1-or-2, 4, 10 and 18 years, respectively. At age 1-or-2 years, SPTs were performed on symptomatic children ($n = 181$). Of these 181 children, 33.1% (60/181) had atopic eczema and 66.9% (121/181) had non-atopic eczema. At all other ages, SPTs

were performed on most children attending the research centre at age 4 ($n = 981$), 10 ($n = 1036$) and 18 ($n = 853$) years, regardless of symptoms. The total number of children who had allergic sensitization was 193 (19.7%), 279 (26.9%) and 352 (41.3%) at 4, 10 and 18 years of age, respectively. In all three assessments of atopy (4, 10 and 18 years), boys had statistically significantly ($P = 0.024$, 0.003 and <0.001) higher prevalences of allergic sensitizations (22.5%, 31% and 47.7%) than girls (16.8%, 22.9% and 35.4%).

12-month period prevalence of eczema

Only minor differences were detected in the period prevalence of eczema between boys and girls up to the age of 10 years (Table 1). However, at 18 years of age, the period prevalence was statistically significantly higher in girls (16.3%) compared with boys (8.3%). There was a different trend in the prevalence in boys and girls over the observation period (Fig. 2; $P < 0.001$), which already started between ages 4 and 10 years and contributed to an increased prevalence of eczema in girls at 18 years of age. The period prevalence of atopic eczema was not significantly different in girls in comparison with boys at any stage (Table 1). For non-atopic eczema, there was only a difference at 18 years when the period prevalence was significantly higher among girls (8.3%) compared with boys (3.0%) (sex $\times$ time interaction, $P = 0.013$). At ages 4 and 10 years, the non-atopic proportion accounted for 52.3% and 57.9% of the eczema cases in boys and 62.7% and 65.1% in girls, whereas at age 18 the proportion of non-atopic eczema to all eczema cases was lower in boys (12/36; 33.3%) than girls (37/69; 53.6%).

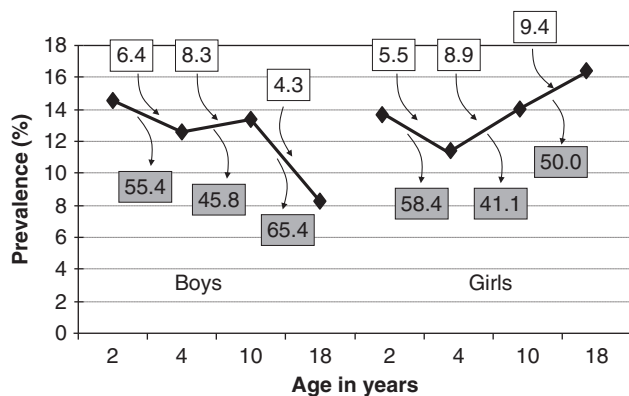


Fig. 2. Prevalence of eczema across childhood and adolescence. Lines represent the 12-month period prevalence of eczema for boys and girls. Figures in open boxes represent percentage of population without eczema who develop it (positive transition). Figures in closed boxes represent percentage of those with eczema who outgrow it (negative transition).

Positive transition and cumulative incidence of eczema

The positive transition of eczema between ages 10 and 18 years was found to be significantly higher in girls (9.4%) compared with boys (4.3%; Table 2) (sex $\times$ time interaction, $P = 0.012$). The trend was primarily driven by the onset of non-atopic eczema in girls (5.9% for girls vs. 1.5% for boys) (sex $\times$ time interaction, $P = 0.02$). Over the three periods (1-or-2 to 4 year, 4–10 years and 10–18 years), non-atopic eczema accounted for 73.5% (36/49), 72.0% (54/75) and 54% (27/50), respectively, of the positive transition cases. The decrease in the proportion of non-atopic eczema in the 10–18 year positive transition was found in both sexes but was more pronounced in boys (33.3%; 5/15) than girls (62.9%; 22/35). The reduction also led to a significant difference between the positive transition for non-atopic eczema in the 10-to-18 years period compared with the reference time period ($P = 0.019$).

The cumulative incidence of eczema from the 1-or-2 to 10 years investigation periods showed that of the 914 children (463 boys and 451 girls), who were eczema-free at age 1-or-2 and participated at ages 4 and 10 years, 49 (28 boys and 21 girls) had first occurrence of eczema at age 4 years and 60 children (29 boys and 31 girls) had onset at age 10 years. Therefore, the cumulative incidence from 1-or-2 to 10 years is 11.9% (109/914). The cumulative incidence between 1-or-2 and 18 years revealed that of 846 children (418 boys and 428 girls), who were eczema-free at age 1-or-2 years and participated in the examination at ages 4, 10 and 18 years, 46 (26 boys and 20 girls), 57 (27 boys and 30 girls) and 42 participants (11 boys and 31 girls) had eczema for the first time at 4, 10 and 18 years, respectively. Thus, the cumulative incidence of from 1-or-2 to 18 years eczema is 17.1% (145/846). There were no significant differences between the sexes in these two cumulative incidence periods but the property of cumulative incidence means that it is not a sensitive marker of the dynamics of eczema in childhood and adolescence.

Negative transition and net remission of eczema

The negative transition of eczema from age 10 to 18 was significantly higher in boys (65.4%) than in girls (50.0%, $P = 0.044$, Table 3). Negative transition was not significantly different between sexes during any period in the non-atopic eczema group; however, the sample sizes were small. Non-atopic negative transition was significantly lower during the 4- to 10-year time period than other ones. In contrast, there was an increase in the negative transition of atopic eczema for the 10- to 18-year period compared with 1-or-2 to 4 years ($P = 0.021$) that was independent of gender.

Net remission from age 1-or-2 to 18 years found to be 41.9% (67/160), which means that 67 children (37 boys,

Table 2. Eczema positive transition between different assessments stratified by sex and atopy

Positive transition % (n/total)	Ages 1-or-2 to 4	Ages 4–10	Ages 10–18	Sex–time interaction P-value [‡]
All				
Time trend				
Both	5.9 (57/962)	8.6 (88/1025)	6.9 (73/1063)	
P-value [†]	Reference	0.227	0.190	
Sex differences				0.012
Males	6.4 (31/488)	8.3 (43/518)	4.3 (23/532)	
Females	5.5 (26/474)	8.9 (45/507)	9.4 (50/531)	
P-value*	0.569	0.743	0.001	
Atopic eczema				
Time trend				
Both	1.7 (13/785)	2.5 (21/826)	3.3 (23/703)	
P-value [†]	Reference	0.397	0.283	
Sex differences				0.874
Males	1.8 (7/391)	2.7 (11/410)	3.0 (10/331)	
Females	1.5 (6/394)	2.4 (10/416)	3.5 (13/372)	
P-value*	0.769	0.799	0.725	
Non-atopic eczema				
Time trend				
Both	4.6 (36/785)	6.5 (54/826)	3.8 (27/703)	
P-value [†]	Reference	0.533	0.019	
Sex differences				0.020
Males	4.9 (19/391)	5.9 (24/410)	1.5 (5/331)	
Females	4.3 (17/394)	7.2 (30/416)	5.9 (22/372)	
P-value*	0.715	0.430	0.002	

A positive transition represents the change in the individual status from eczema-free to eczema. Numbers represent the percentage (number with eczema/total number available for analysis at each assessment). The 'All' row shows data for all children. The 'Atopic eczema' row takes into account children with positive skin prick test results (SPT); in contrast, 'non-atopic eczema' looked only at children with negative SPT results.

*P-value (two-sided) represents the difference between males and females.

[†]P-value represents the difference between study periods in regard to the reference time period (1-or-2 to 4 year) after adjusting for sex. The time trend is therefore controlled for the trend of sex and time–sex interaction.

[‡]P-value for the sex–time interaction, which assesses whether males and females have a different trend over time.

30 girls) of the 160 children (84 boys, 76 girls) who had eczema at age 1-or-2 went into complete remission (data not shown). For the 4- to 18-year period, net remission was 47.8% (22/46; 15/26 boys and 7/20 girls). No sex differences were observed in either remission period.

Persistence and recurrence of eczema

A cohort of 160 (84 boys and 76 girls) children who had eczema at age 1-or-2 years and available eczema information for the remaining assessments was used to determine persistence and recurrence. Of these 160 children, only 27 (16.9%) children (14 boys, 13 girls) had persistence eczema up to age 18 years. With regard to recurrence, of the 160 children only 28 (17.5%) (11 boys, 17 girls) had recurrence either at age 10, 18 or both ages after being in remission at age 4 years.

In the subgroup of 46 (26 boys and 20 girls), children who had eczema onset at age 4 years and eczema information for the following assessments, persistence

and recurrence after age 4 were assessed. Of the 46 children, only three (6.5%) girls had persistent eczema up to age 18 years. Recurrence at age 18 years occurred in 10.9% (5/46) of children who had eczema onset at 4 years but were in remission at 10 years of age.

Discussion

This longitudinal study on eczema covering childhood and adolescence, including puberty, is the first follow-up study that has investigated the dynamics of change in relation to gender and allergic sensitization. The time window of puberty is regarded as the period of change in the prevalence of eczema. In order to identify changes in the course of eczema between childhood and adolescence, we used positive and negative transitions as measures of change between consecutive investigation periods. There were no significant differences in the prevalence and the positive transitions of eczema up to the age of 10 years among boys and girls but more adolescent girls were

Table 3. Eczema negative transition between different assessments stratified by sex and atopy

Negative transition% (n/total)	Ages 1-or-2 to 4	Ages 4–10	Ages 10–18	Sex–time interaction P-value [‡]
All				
Time trend				
Both	56.9 (103/181)	43.8 (56/128)	57.5 (96/167)	
P-value [†]	Reference	0.235	0.012	
Sex differences				0.280
Males	55.4 (51/92)	45.8 (33/72)	65.4 (53/81)	
Females	58.4 (52/89)	41.1 (23/56)	50.0 (43/86)	
P-value*	0.684	0.590	0.044	
Atopic eczema				
Time trend				
Both	12.4 (20/162)	17.8 (19/107)	21.3 (26/122)	
P-value [†]	Reference	0.098	0.021	
Sex differences				0.503
Males	13.6 (11/81)	25.0 (14/56)	28.1 (16/57)	
Females	11.1 (9/81)	9.8 (5/51)	15.4 (10/65)	
P-value*	0.633	0.040	0.088	
Non-atopic eczema				
Time trend				
Both	43.2 (70/162)	21.5 (23/107)	36.9 (45/122)	
P-value [†]	Reference	0.003	0.940	
Sex differences				0.999
Males	40.7 (33/81)	17.9 (10/56)	36.8 (21/57)	
Females	45.7 (37/81)	25.5 (13/51)	36.9 (24/65)	
P-value*	0.526	0.337	0.993	

Negative transition of eczema between follow-up examinations was defined as the individual change in status from eczema to eczema-free. Numbers represent the percentage (number with eczema/total number available for analysis at each assessment). The 'All' row shows data for all children. The 'Atopic eczema' row took into account children with positive skin prick test results (SPT); in contrast, 'non-atopic eczema' looked only at children with negative SPT results.

*P-value (two-sided) represents the difference between males and females.

[†]P-value represents the difference between study periods in regard to the reference time period (1-or-2 to 4 year) after adjusting for sex. The time trend is therefore controlled for the trend of sex and time–sex interaction.

[‡]P-value for the sex–time interaction, which assesses whether males and females have a different trend over time.

affected with eczema. This was due to both higher positive transition of eczema in girls (9.4% for girls compared with 4.3% for boys) and increased negative transition among adolescent boys (65.4% for boys compared with 50.0% for girls). Stratifying for allergic sensitization demonstrated that prevalence and positive transition at age 18 years were increased in non-atopic but not atopic girls. The results demonstrate that there is only a small reduction in the prevalence of eczema over childhood and adolescence and that the female predominance that emerges during adolescence is due to more girls developing non-atopic eczema whereas adolescent boys were more likely to outgrow their eczema.

In all assessments, the proportion of participation remained high. Prevalence, positive transition and negative transition did not differ in the whole sample and the subgroup that had undergone SPT at 1-or-2, 4, 10 and 18 years. Additionally, the proportion of follow-up of boys and girls was similar (data not shown). Hence, there was

no indication of selection bias with regard to sex, time or SPT. For the assessments at age 1-or-2 years, we derived a 24-month prevalence. We assume that this proportion is comparable with the 12-month prevalence at ages 4, 10 and 18 as the incidence (positive transition) per year is balanced by the remission (negative transition) per year. Supporting this, the prevalence for all examinations is nearly identical. In addition, starting with a 24-month prevalence does not change the incidence or remission data, as these are based on changes.

The diagnosis of eczema in the assessments of all years followed identical questionnaire-based criteria ('ever eczema' plus having had an 'itchy rash during the previous 12 months'). These two questions originated before the inauguration of the International Study of Asthma and Allergies in Childhood (ISAAC) but are nearly identical to two of the seven ISAAC questions [11]. They also pre-date the UK working party definition [12]. The validity of the definition used in this study is supported by the fact that a

high proportion of subjects showed typical manifestation of eczema in usual locations (anticubital or popliteal fossae, ankles, face or neck for 97% at 1 year, 91% at 2 years, 75% at 4 years, 86% at 10 years and 76% at 18 years) strongly suggesting that other diagnoses, such as contact dermatitis or viral exanthem are not being mislabelled. In addition, the prevalence data for the different years are in agreement with other reports [13–15]. With the higher prevalence of eczema in 18-year-old girls than boys, there is a potential for girls to be more likely to report mild eczema. However, of the boys with eczema at 18 years, 34 (63%) had active eczema and four answered 'a lot' or 'very much' to itchy, sore, painful or stinging skin (12%) compared with 25 (29%) of the 86 (80%) girls with active eczema. Similar findings were reported for sleeplessness and pruritus. Eczema in girls was therefore not less severe than eczema in boys at age 18 years.

The long-term prognosis (natural history) of eczema is complex due to the relapsing and remitting nature of the disease. Different epidemiological studies have suggested that eczema is a disease of early onset, usually occurring during the first 2 years of life [16–18], which may persist to adulthood [3, 19]. In support of this assumption, it has been reported that eczema starting in infancy or early childhood in a group of clinical patients have a persistence between 40% and 60% [20–26]. Our population-based cohort found a lower persistence from age 1-or-2 to 18 years (16.9%). It is possible that the higher persistence in clinical cohorts can be attributed to more severe eczema compared with population-based groups. A report based on the NCDS birth cohort study showed that eczema persistence at age 16 years is 31% among those who had eczema onset in the first year of life [5]. With regard to growing out of eczema, this report shows that 41.9% of cases with onset at age 1-or-2 went into complete remission (up to age 18 years). This is further supported by another study showing that 42% of eczema cases (onset by age 2 years) were disease free at age 14 years [27].

There are several epidemiological investigations showing different prevalence of eczema among boys and girls. Before puberty, a few studies report an equal prevalence between the sexes [18, 28], while others demonstrate a higher frequency in boys [7, 8, 29]. Most studies agree that eczema becomes statistically significantly more prevalent after puberty in girls [6, 7, 9, 14, 30]. Our results support these observations within a longitudinal birth cohort.

Previous studies demonstrated that allergic sensitization is an important factor in the development of allergic disorders and 30–40% of cases of asthma, eczema and rhinitis during childhood can be attributed to atopy [1, 31]. Our study shows that atopic eczema accounts for approximately 40% of the eczema cases up to the age of 10 years. Regarding positive SPT in all examinations, boys at 4, 10 and 18 years had a statistically significantly higher prevalence of atopy than girls; however, the pre-

valence of atopic eczema did not differ. Other studies support this paradox [32–34]. Repeated cross-sectional studies in Germany in 1994, 1997 and 2000 demonstrated that non-allergic eczema is more prevalent in girls at age 5–7 years [32]. Non-atopic eczema was also more common among girls than boys in a longitudinal birth cohort that followed children up to age 5 years [35]. However, no previous study has reported longitudinal prevalence data, up to age 18, stratified by atopy and sex of the child.

Non-atopic positive transition of eczema accounted for more than 50% of all positive transition cases over the three examination periods and was higher in girls from age 10 to 18 years. Among non-atopic eczema, the negative transition also made up more than 50% of all negative transitions cases, but was not different in girls and boys. Hence, the total increase in eczema among girls at age 18 can largely be attributed to new cases of non-atopic eczema (22 of 35 total cases with new occurrence of eczema). The processes driving this differential change in boys and girls are not well understood. A German study reported that skin surface pH is higher among girls compared with boys (with and without eczema), and stratum corneum hydration is lower in girls than boys [32]. Because these are markers of essential properties of an intact skin barrier, girls may be at higher risk of developing eczema [32]. It is also proposed that sex hormones contribute to the observed skin structure differences between males and females and changes in these hormonal levels can alter skin surface pH [36]. Endocrine changes during puberty may play a role in the observed change in prevalence, incidence and remission between the sexes. It has been suggested that oestrogens may stimulate pro-inflammatory cytokines and increase the susceptibility to atopy [1, 7]. In contrast, androgens appear to be immune suppressor hormones protecting against allergic inflammation [1, 7]. However, contrary to this assumption, we found that non-atopic eczema increased in adolescent girls.

A limitation of this study is that we have information on atopy for the 1-or-2 year prevalence only for symptomatic children. This did not allow us to classify eczema into atopic and non-atopic forms. When comparing atopic and non-atopic children at ages 4, 10 and 18 years, we used concurrent information on SPT results. Another option would have been to take the preceding atopic status and determine the risk of developing eczema in the consecutive assessment. This approach may be superior with frequent, for instance yearly, assessments but with longer intervals we cannot be certain that any change in atopic status has occurred before the development of eczema. Additionally, the SPT positivity of individual children varied over time (data not shown). Therefore, atopy was not considered as a persistent and unchangeable status for the assessment in different years, but used as time-dependent information at each assessment.

In summary, our findings suggest that during adolescence girls develop more non-atopic eczema while more boys outgrow their eczema. There is a need to better understand changes in this developmental period. An improved knowledge of pathological processes driving these changes, such as alterations in epithelial integrity or endocrine regulations of skin tissue and immune responses, may provide new therapeutic or preventive approaches.

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