

Validation of a Parental Questionnaire to Identify Atopic Dermatitis in a Population-Based Sample of Children up to 2 Years of Age

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Key Words

Child, preschool · Dermatitis, atopic/diagnosis · Infant · Questionnaire, written parental

Abstract

Background: Validated eczema questionnaires have been available for schoolchildren only, but the incidence of atopic dermatitis (AD) is highest during infancy. **Objective:** To validate a parental questionnaire to identify AD in children up to 2 years of age. **Methods:** Parents of 476 children answered a written questionnaire prior to an examination by a physician. Sensitivity, specificity, predictive values and test-retest reliability of the questionnaire were assessed. **Results:** A total of 245 (51%) girls and 231 (49%) boys, aged 1–24 months, with and without physician-diagnosed AD participated. Seventy-one children (15%) had physician-diagnosed AD. Validation of the questionnaire by comparisons with physicians' diagnoses showed a sensitivity of 0.87 (95% confidence interval, CI, 0.77–0.94) and a specificity of 0.98 (95% CI, 0.96–0.99). The positive predictive value was 0.90 (95% CI, 0.80–0.96) and the negative predictive value was 0.98 (95% CI, 0.96–0.99). **Conclusion:** The questionnaire identified AD in children aged 0–2 years with high accuracy.

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Introduction

Atopic dermatitis (AD) affects 15–20% of preschool children in Western countries [1]. In this article, AD and eczema are used synonymously [2]. AD in childhood can result in a significant reduction in quality of life compared with healthy children or children with other chronic illnesses, such as diabetes or neurological disorders [3–5]. Furthermore, AD leads to substantial social and financial costs [6]. Much knowledge has been gained regarding the pathophysiology of eczema [7], but there are still more questions regarding risk factors and long-term outcome, which can be answered by epidemiological methods [8]. Diagnosis of eczema via a questionnaire can be advantageous, especially in epidemiological studies that require large sample sizes, but also in clinical practice [9, 10]. Validated eczema questionnaires have been available for schoolchildren [11, 12], but the incidence of eczema is highest in pre-school children, with a peak during infancy.

In a previous study, a questionnaire for diagnosing eczema in pre-school children was developed and validated [13, 14]. A questionnaire should identify eczema as pruritic, chronically relapsing dermatitis, with typical features and distribution [15] and the questions for this

Children's Eczema Questionnaire (CEQ) were based on the International Study of Asthma and Allergies in Childhood (ISAAC) protocol and adapted to the age group of the study population and the cultural context.

The first validation showed that the CEQ was applicable in the general population of preschool children and valid for detection of eczema across different severity categories. However, there was a need to investigate the diagnostic accuracy of the questionnaire in infants. The aim of the current study was to estimate the diagnostic precision of the CEQ compared with physicians' clinical diagnoses as the gold standard in children from the age of 1 month up to 2 years.

Subjects and Methods

Population

A population-based sample of 476 children with and without eczema was recruited consecutively from 5 different primary health care centres in the county of Värmland, Sweden; 3 were in urban areas and 2 in rural communities; 99% of children attended the health centres, and the sample reflects the childhood population in Värmland. The centres were chosen as they each had a physician with long-term experience in preventive child health care and a special interest in allergic diseases. In addition, all 5 physicians had attended a workshop focusing on the diagnosis of eczema. Inclusion criteria were an appointment at the children's health care centre and age under 2 years. Exclusion criteria were children of parents who did not understand or speak Swedish.

Sample Size

A sample size calculation showed that a total sample of 80 children, 40 with and 40 without eczema, would be required to assess the sensitivity and specificity with a power of 0.8 and α of 0.05. When performing a sensitivity analysis of the required sample size by using the most extreme values of the confidence interval (CI) of the previous study [13], 84 children per group would be needed to assess diagnostic precision with the same accuracy. Taking unequal sample sizes into account, a smaller case group (eczema group) could contain 56 children, and a non-eczema group 168 children.

Procedures

The study was performed over a 1-year period. According to a standardized protocol, the parents of 476 consecutively invited children answered the CEQ. In addition, 74 of the consecutively selected parents answered the questionnaire a second time to determine test-retest reliability. Directly afterwards, these 476 children were examined by a physician. The physicians were blinded to the answers in the questionnaires.

Questionnaire

The questionnaire was developed especially for the age group and the cultural context. For better understanding among Swedish parents, we enquired about a 'red rash' instead of 'chronic relaps-

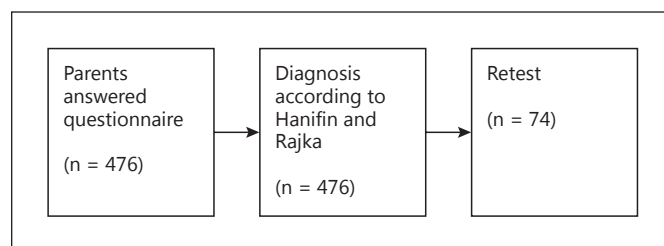


Fig. 1. Study procedures.

ing dermatitis' which occurs in the ISAAC questionnaire, and we asked about itch in a separate question. Furthermore, the list of involved sites was extended, since more sites can be involved in younger children [16]. Thus, the written parental CEQ had three key questions: (1) Does your child have or has your child had a *red rash/eczema which can come and go*? (2) If yes, has this caused *itching or scratching*? (3) Has this red rash/eczema affected any of the *following areas* during the last week: around the eyes, ears, scalp, cheeks, forehead, neck, trunk, folds of the elbows/behind the knees, wrist or ankle, outer arms/legs? The parent had to answer 'yes' in each of the three questions for the child to be classified as having eczema.

It has been proposed that the histopathology of eczema and dry skin are similar. To possibly increase sensitivity we aimed to include dry skin into our diagnostic criteria as well. In a secondary analysis, we therefore studied the effect of including dry skin into our diagnostic criteria, using the question 'Does your child have dry skin?' Answers of 'yes' to having (1) a red rash/eczema, (2) on a typical location during the last week, and (3) either itch or dry skin were used for a diagnosis of eczema.

Statistical Analysis

Physician diagnosis was used as the gold standard to validate the questionnaire. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated. The test-retest reliability was assessed using the κ -statistic.

Statistical analysis was performed with Stata IC 11.0 Statistics Data Analysis. The regional ethical committee in Uppsala approved the protocol for the study, Dnr-2010/019.

Results

Patient Characteristics

A total of 476 children, 245 (51.5%) girls and 231 (48.5%) boys, aged ≤ 24 months, with and without previous physician-diagnosed eczema, participated in the study (fig. 1; table 1). On examination 71 (15%) had eczema; 165 (35%) had dry skin and these children had a 16-fold higher risk of having eczema. Half of all children ($n = 229$, 49%) had a parental history of allergic disease in terms of reported asthma, eczema and/or rhinitis, and the odds of eczema in the children was increased 2-fold for

Table 1. Baseline characteristics of the children

	Age group				
	1–5 months	6–11 months	12–17 months	18–24 months	total
Number	123 (25.84)	122 (25.63)	109 (22.90)	122 (25.63)	476 (100)
Questionnaire diagnosis					
Yes	8 (6.50)	17 (13.94)	16 (14.68)	29 (23.77)	70 (14.71)
No	115 (93.50)	105 (86.07)	93 (85.32)	93 (76.32)	406 (85.29)
Physician diagnosis					
Yes	7 (5.69)	15 (12.30)	17 (15.60)	32 (26.23)	71 (14.92)
No	116 (94.31)	107 (87.70)	92 (84.40)	90 (73.77)	405 (85.08)

Figures in parentheses indicate percentages.

Table 2. Baseline characteristics of children with and without physician-diagnosed eczema

	Patients' diagnosis status		
	eczema	non-eczema	total
Number	71 (14.92)	405 (85.08)	476 (100)
Age, months			
Mean $\pm$ SD	13.6 $\pm$ 6.5	9.4 $\pm$ 6.5	10.0 $\pm$ 6.6
Median	12.0	7.0	10.0
Range	1–24	1–24	1–24
Sex, n			
Female	31 (43.7)	214 (52.8)	245 (51.5)
Male	40 (56.3)	191 (47.2)	231 (48.5)
Heredity, n			
Yes	44 (62.0)	185 (46.1)	229 (48.5)
No	27 (38.0)	216 (53.9)	243 (51.5)
Dry skin, n			
Yes	60 (84.5)*	105 (25.9)*	165 (34.7)
No	11 (15.5)*	300 (74.1)*	311 (65.3)
Itch, n			
Yes	62 (87.3)	13 (3.2)	75 (15.8)
No	9 (12.7)	392 (96.8)	401 (84.2)

Figures in parentheses indicate percentages. Eczema: physician-diagnosed, based on Hanifin and Rajka's criteria; itch: eczema severity assessed with SCORing Atopic Dermatitis. * $p < 0.05$ (Pearson χ^2 test).

those with a parental history of allergic diseases (table 2). In the eczema group, 6 children (8%) awoke at night several times per week, 21 (30%) awoke up to once per week, and 44 (62%) never awoke as a result of eczema, according to parental reports. Most frequent locations of eczema were the cheeks ($n = 24$, 34%), the exterior of the arms and legs ($n = 31$, 44%), flexural sites ($n = 20$, 28%), and

Table 3. Locations of eczema and awakening at night due to eczema during the last week

Features	n (%)
Awakening	
Several nights per week	6 (8.4)
Up to one night per week	21 (29.6)
Never	44 (62.0)
Locations of eczema	
Around the eyes	3 (4.2)
Scalp	4 (5.6)
Ears	6 (8.5)
Forehead	7 (9.9)
Neck	8 (11.3)
Wrist or ankle	13 (18.1)
Flexural sites	20 (28.2)
Cheeks	24 (33.8)
Exterior of the arms and legs	31 (43.7)
Trunk	33 (46.4)

Figures in parentheses indicate percentages.

the trunk ($n = 33$, 46%) (table 3). The children were equally distributed across age groups of 6 months; both physician and questionnaire diagnosis were more frequent in children aged ≥ 12 months.

Validation of the Questionnaire

A combination of affirmative answers to all three key questions, rash, itch and location, predicted clinical eczema with good sensitivity of 0.87 (95% CI, 0.77–0.94) and a specificity of 0.98 (95% CI, 0.96–0.99). PPV was 0.90 (95% CI, 0.80–0.96) and NPV was 0.98 (95% CI, 0.96–0.99). The intra-individual agreement was 95.73% with $\kappa = 0.86$.

Table 4. Questionnaire items and physician diagnoses

	Physician diagnoses		
	yes	no	total
Eczema			
Yes	69 (45.39)	83 (54.61)	152 (31.93)
No	2 (0.62)	322 (99.38)	324 (68.07)
Location			
Yes	68 (61.26)	43 (38.74)	111 (23.32)
No	3 (0.82)	362 (99.18)	365 (76.68)
Itch			
Yes	63 (82.89)	13 (17.11)	76 (15.97)
No	8 (2.00)	392 (98.00)	400 (84.03)
Dry skin			
Yes	60 (36.36)	105 (63.64)	165 (34.66)
No	11 (3.54)	300 (96.46)	311 (65.34)

Figures in parentheses indicate percentages.

Secondary Analysis Including a Question about Dry Skin

When the children had a red rash/eczema on a typical location during the last week, and either itch or dry skin, the sensitivity increased but the specificity dropped; for this combination of affirmative answers which included dry skin, the sensitivity was 0.93 (95% CI, 0.84–0.98) and the specificity 0.94 (95% CI, 0.91–0.96). PPV was 0.72 (95% CI, 0.61–0.81) and NPV 0.99 (95% CI, 0.97–1.00).

Some of the children who did not have eczema on examination reported eczema with typical location in the questionnaire, and a high proportion of non-eczema children reported dry skin (table 4). In contrast, itch was mostly reported of those children who had eczema on examination.

Discussion

This questionnaire identified eczema in infants with high diagnostic precision. To our knowledge, it is the first written parental eczema questionnaire validated for this age group. It is encouraging that eczema in the youngest children can be identified via a parental questionnaire as the sites of eczema can differ compared with that in older children [16], and itch in small children might be difficult to assess. This difficulty has occurred in the UK diagnostic criteria, where some eczema cases did not report itch [17]. In our questionnaire, itch was indeed the key question; itch was a positive sign in most eczema children but not

all, while almost none of the control children reported itch. The itch question thus had low sensitivity and good specificity. It is therefore logical to combine itch with the other questions to increase the overall accuracy of the CEQ and to exclude false-positive cases. If high sensitivity is required, including dry skin into the diagnostic criteria might be beneficial. Studies which use a single question on eczema prevalence might overassess eczema prevalence, and this should be taken into account when interpreting study results. The children with eczema were slightly older than the healthy children, possibly indicating that the incidence of eczema is highest slightly above the age of 10 months which was the mean age of all study participants. The children's age did not impact the validity of the questionnaire; the questionnaire was useful in both early and late infancy. The participants were recruited consecutively from a children's health care centre, and the sample should reflect the childhood population in Värmland as 99% of children living in Sweden attended the health centres.

Using three key questions, AD in children aged 0–2 years can be identified via a parental questionnaire. The high sensitivity and specificity indicate that this CEQ is a valuable diagnostic tool. The PPV of the questionnaire was the proportion of children with a positive result who actually had physician-diagnosed eczema. The results suggested that the risk of diagnosing eczema in healthy infants or young children was low. Predictive values are, however, related to the prevalence of eczema in the population; thus, the PPV can be lower in populations with a lower prevalence of eczema. Sensitivity measures the proportion of actual positive results, which are correctly identified as such. Even the measured sensitivity was high, indicating that not many eczema diagnoses were missed. The questionnaire did not indicate that healthy children had eczema, as shown by the high specificity.

The strength of the study is the large sample size and the population-based setting, as the questionnaire diagnosis can be particularly valuable for population-based studies. Using a questionnaire instead of physician diagnosis can have several advantages. A questionnaire diagnosis is usually more cost effective and an assessment of period prevalence can be determined more easily. This is beneficial as eczema is often intermittent. Furthermore, for large studies, a questionnaire diagnosis is a standardized method compared with physician diagnosis, which has low interrater reliability.

Because all children were invited consecutively from a preventive care register, and nearly all children in Sweden are registered, it is unlikely that selection bias occurred, even though the sample was not randomly selected. As-

assessment of the diagnostic accuracy of the diagnostic test on a population-based sample allows generalization of the results. The narrow CIs confirm that the sample size was adequate, and that estimates of the predictive value are within a reasonable range. In different linguistic and cultural contexts, adoption of similar questions and a new validation might be useful. With regard to the intermittent course of eczema, an assessment of a longer period prevalence can be useful and in this case a new validation should be considered.

In conclusion, this study indicates that the parental questionnaire can be a great help in diagnosing eczema in small children. The questionnaire can be used in a population-based setting and will be particularly useful in epidemiological research. It is however important to take cultural aspects into account and validate the questionnaire in the target population.

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Disclosure Statement

No conflicts of interest declared.

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