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European Task Force on
Atopic Dermatitis

Severity Scoring of Atopic Dermatitis: The SCORAD Index

Consensus Report of the European Task Force on Atopic Dermatitis

Key Words

Atopic dermatitis
Eczema
Scoring
Composite index
Severity

Abstract

Background. Assessment methods for atopic dermatitis (AD) are not standardized, and therapeutic studies are difficult to interpret.

Aims. To obtain a consensus on assessment methods in AD and to use a statistical method to develop a composite severity index.

Methods. Consensus definitions were given for items used in the scoring system (extent, intensity, subjective) and illustrated for intensity items. Slides were reviewed to address within- and between-observer variability by a group of 10 trained clinicians, and data were statistically evaluated with a two-way analysis of variance. Two variants of an assessment system were compared in 88 patients at 5 different institutions. Data were analyzed using principal-component analysis.

Results. For 5 intensity items studied (erythema, edema/papulation, oozing/crusts, excoriations, lichenification), within- and between-observer variability was good overall, except for edema/papulation which was difficult to assess with slides. In the series of 88 patients, principal-component analysis allowed to extract two unrelated components: the first one accounting for 33% of total variance was interpreted as a 'severity' component; the second one, accounting for 18% of variance, was interpreted as a 'profile' component distinguishing patients with mostly erythema and subjective symptoms and those with mostly lichenification and dryness and lower subjective symptoms. Of the two evaluation systems used, the one using the rule of nine to assess extent was found more workable than the one using a distribution $\times$ intensity product. A scoring index (SCORAD) combining extent, severity and subjective symptoms was mathematically derived from the first system and showed a normal distribution of the population studied.

Conclusion. The final choice for the evaluation system was mostly made based on simplicity and easy routine use in outpatient clinics. Based on mathematical appreciation of weights of the items used in the assessment of AD, extent and subjective symptoms account for around 20% each of the total score, intensity items representing 60%. The so-designed composite index SCORAD needs to be further tested in clinical trials.

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Introduction

Most physicians involved in the care of patients with atopic dermatitis (AD) rely on the diagnostic criteria of Hanifin and Rajka [1]. However, assessment methods are far from being standardized, and therapeutic studies are often difficult to interpret. Efforts have been done recently to classify patients in groups of severity [2–4] and to establish simple and reliable assessment methods [5–11]. Variants of the scoring system proposed in psoriasis (PASI score [12]) have been published [13, 14]. More accurate measurement methods have been applied to itching [15]. However, a consensus on how to assess this complex chronic disease has not yet been reached [16].

Members of the European Task Force on Atopic Dermatitis met for the first time in Bordeaux on September 20, 1990. The following grading atlas and recommendations are derived from five working sessions held in 1990–1992. The first aim of the Task Force was to provide a tool to record data precisely and consistently for routine evaluations and clinical studies at various institutions. The second aim was to develop a composite scoring index for AD. This article reports the design of the SCORAD index derived from data obtained using the consensus definitions and methods.

Methods

Illustrations

Photographs of elementary AD lesions were taken to illustrate the scoring system. To standardize results, the following conditions were used: enlargement ratio 1:2 using a 72 × 108 mm gray cardboard background to avoid dominant colors, Kodachrome 64 A film processed in the same laboratory (Nantes University Hospital).

Data Analyzed

A set of 10 pictures of the atlas was evaluated by 10-trained investigators. These slides were first collectively classified as representative of one intensity item (e.g. erythema 2) by the panel. In a second session the slides were reevaluated independently by each panelist for 4 out of 5 items (erythema, edema/papulation, oozing/crusts, lichenification, excoriation, dryness being excluded). The item classified collectively was scored as previously by definition.

Two types of assessment sheets (reference evaluation systems [RES] 1 and 2, detailed in table 1) were compared in 5 centers by 9 trained investigators. Briefly, RES 1 used the rule of nine to grade extent based on front-back drawings on a 0–100 scale, a list of 6 intensity items graded 0–3 (0–18 scale) and 3 subjective items (pruritus, sleep loss, 'overall skin condition'), each measured on a 0–10 analog scale (0–30 total scale). RES 2 [17] used the same measurement for subjective items and a distribution × intensity product (0–72 scale).

A total of 88 patients (61% males) aged 1 month to 60 years (mean 7 years) was studied for the following 16 variables: extent in percent

Table 1. Reference evaluation systems 1 and 2

A. RES 1

Extent (0–100): rule of nine applied to a front-back drawing of the patient's inflammatory lesions; dry skin not taken into account
Intensity (0–18): 6 items (erythema, edema/papulation, oozing/crust, excoriation, lichenification, dryness) each evaluated at its average intensity on a 0–3 scale; dryness evaluated on noninflammatory skin
Subjective symptoms (0–30): analog scale (0–10) evaluation of the following: pruritus, sleep loss, overall skin condition, for the last 3 days/nights; overall skin condition was supposed to be a global quality of life index and corresponded to the question: 'How much does skin condition interfere with everyday life?'

B. RES 2

Item	Intensity (0–3)	Distribution ¹ (0–4)	Total
Erythema			
Edema/papulation			
Oozing/crusts			
Excoriations			
Lichenification			
Dryness		4 ²	

The right (total) column is the product of symmetrical affected areas × intensity. The maximum grand total is 72.

¹ Symmetrical areas are arbitrarily defined as follows: 0 = no affected site; 1 = 1 affected site; 2 = 2 affected sites; 3 = 3 affected sites; 4 = more than 4 affected sites.

² Dryness is evaluated on noninflammatory skin and is assigned a maximum distribution coefficient (4).

graded 0–100; 6 intensity items each graded 0–3; 3 subjective symptoms (pruritus, sleep loss, overall skin condition) each scored 0–10; 6 intensity × distribution products of RES 2 (0–12 each).

Statistical Methods

For scoring intensity items of 10 atlas slides by 10 trained investigators, a two-way analysis of variance for each item with random effect for picture and observer was used to estimate within- and between-clinician variations in assessment. Within-observer variability was defined as the residual variation remaining after subtraction of systematic differences among pictures and among observers.

In an assessment of AD patients using two scoring sheets in 5 centers (9 investigators), the 16 parameters were analyzed using principal-component analysis [18–20] after rescaling each parameter in a 0–1 range (division by its maximum possible value). This analysis derives linear combinations of the parameters maximizing variance between patients. The 1st principal component is a new parameter, more or less correlated to the original parameters, with maximum variance among patients. The 2nd principal component is uncorrelated to the 1st and is the second combination with maximum variance. Regression analysis on the 1st principal component was used to estimate appropriate coef-



Fig. 1–15. Atlas with reference photographs to illustrate the scoring system (grades 1–3).

Fig. 1–3. Erythema (E) or redness; 1 = E₁, 2 = E₂, 3 = E₃.

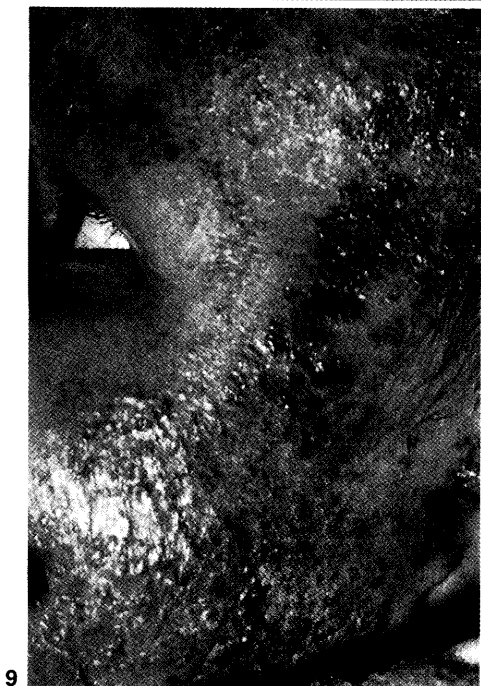
Fig. 4–6. Edema/papulation (P); 4 = P₁, 5 = P₂, 6 = P₃.



7



8



9

Fig. 7–9. Oozing/crusts (O); 7=O₁, 8=O₂, 9=O₃.

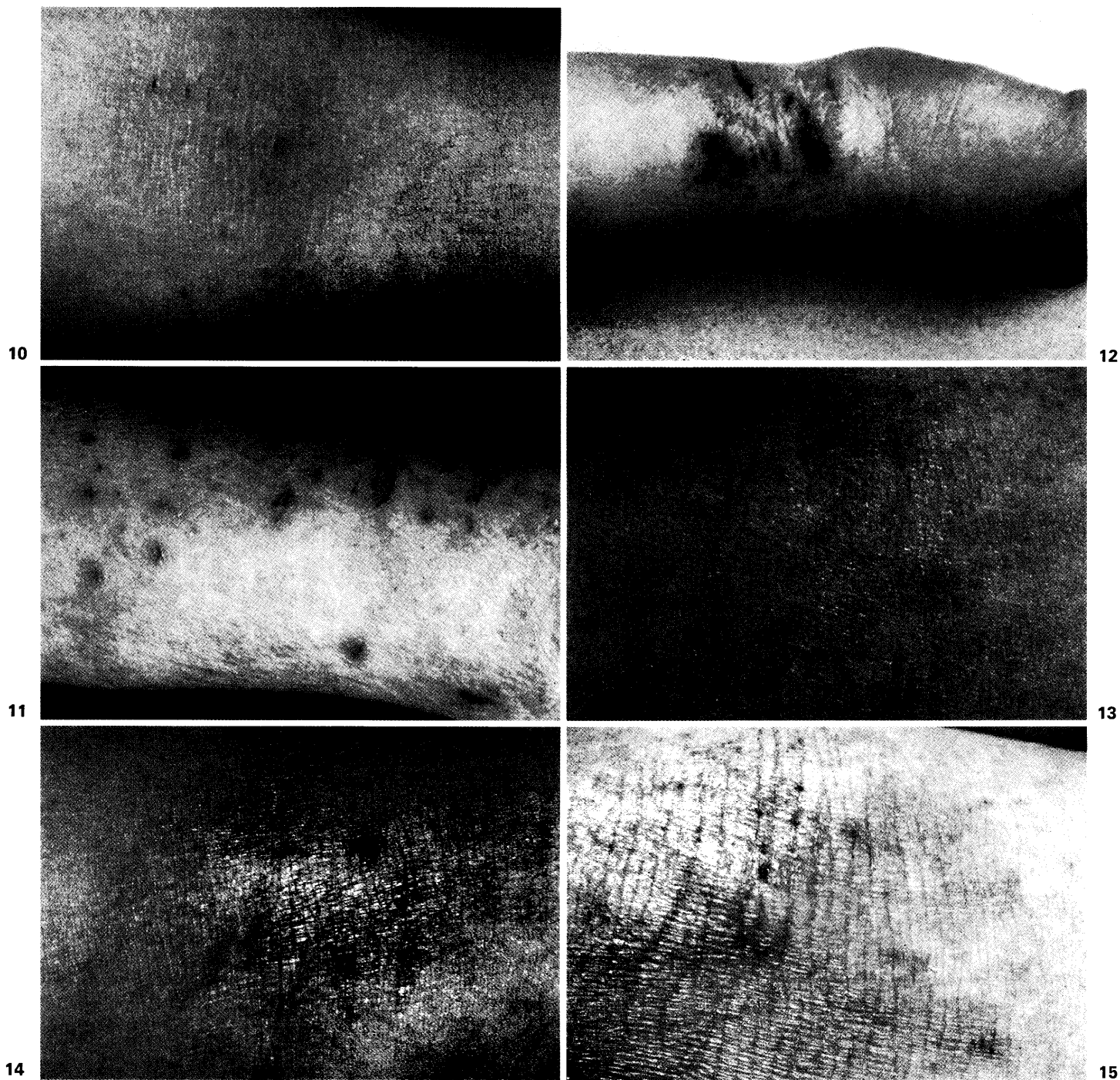


Fig. 10–12. Excoriations (Ex); 10=Ex₁, 11=Ex₂, 12=Ex₃.
Fig. 13–15. Lichenification (L); 13=L₁, 14=L₂, 15=L₃.

ficients for different combinations of extent, intensity, subjective symptoms or distribution $\times$ intensity. The resulting coefficients are those which maximize the correlation of the index with the 1st principal component, which itself maximizes severity differences among patients. Pearson correlation coefficients were used in pairwise correlation analyses.

Results: Consensus Recommendations for Grading AD and Atlas

There are many limitations to a universal method for grading patients due to variation of disease with age and particular clinical presentations. The following situations have not been illustrated and are mostly beyond the scope of this work designed for clinical studies with patients fulfilling usual diagnostic criteria: prurigo lesions; nummular lesions; associated ichthyosis vulgaris; keratosis pilaris; superinfection.

Definition and Grading of Intensity Items (Objective Signs)

Six items have been selected: (1) erythema, (2) edema/papulation, (3) oozing/crusts, (4) excoriations, (5) lichenification, (6) dryness.

Each item should be graded 0–3 (0 = absent; 1 = mild; 2 = moderate; 3 = severe) according to reference photographs (see 'Atlas', i.e. fig. 1–15). Half-point scoring is not recommended. The area chosen for grading must be representative (average intensity) for each item in a given patient as determined by the investigator, thus excluding one 'target' area or the worst affected site. The same site may however be chosen for 2 or more items. For example, one site may serve for evaluation of both excoriations and erythema. On the other hand, dryness must be appreciated on areas not involved by acute lesions or lichenifications.

Erythema or Redness (fig. 1–3). There is no problem to define this item on light-colored skin. If grading is impossible, just mention it in the evaluation sheet (fig. 16) under remarks.

Edema/papulation (fig. 4–6). Edema/papulation stands for palpable infiltration of the skin that may occur both in acute erythematous, excoriated lesions as well as in chronic lesions during flares. This item is difficult to define with clinical photographs. Thus palpation of the lesion should be taken into account in assessing this item. Induration, previously used in a workshop AD evaluation [10] has been discarded because its meaning was found equivocal.

Oozing/Crusts (fig. 7–9). This item applies to exudative lesions resulting from epidermal edema and vesiculation. The quantitative aspect of exudation may also be appreciated at the clinical examination and during an interview with the parents, and if serum albumin levels are low to normal or low without any other etiology.

Excoriations (fig. 10–12). This item is per se an objective marker for pruritus, more visible in nonlichenified lesions. The number and intensity of scratching marks for each grade are illustrated in the atlas.

Lichenification (fig. 13–15). This item is synonymous with epidermal thickening in chronic lesions. Grossly accentuated skin furrows separate shiny rhomboid areas, and the color is grayish or brownish. Prurigo lesions and common large fold involvement undergo lichenification. This is generally noted in patients over 2 years of age.

Dryness. Whenever possible, this item should be appreciated at best at a distance from inflammatory lesions and without prior application of emollients/moisturizers. Scales from healing inflammatory lesions should not be taken into account. Palpation is also important

to assess the roughness of the skin. It is important to note if there is ichthyosis vulgaris in association (under remarks in the evaluation sheet, fig. 16). The presence of fissures is usually associated with severe dryness on the extremities.

Grading Extent

The rule of nine is detailed in the front-back drawing on the evaluation sheet (fig. 16) with a variant (head and lower limbs) for patients under 2 years of age. Lesions taken into account must include only inflammatory lesions and not dryness. In practice it is recommended to draw directly the extent of individual lesions on the printed figure of the evaluation sheet. Note that one patient's palm represents 1% of his body surface.

Subjective Items

These include pruritus and sleep loss. Make sure that the patient (generally over 7 years) or his/her parents is/are capable of answering properly. Ask him/her to indicate on the 10-cm scale of the assessment form the point corresponding to the average value for the last 3 days/ nights.

Statistical Evaluations

Set of 10 Slides of the Atlas Evaluated by 10 Trained Investigators. Table 2 summarizes the data, and table 3 summarizes the analysis of variance.

The within-observer variation was the same for all signs evaluated. It indicated that 2 slides with the same severity for 1 particular item had a minimum of 70% probability to be graded identically when scored by the same clinician.

Between-observer variability was noted mostly for edema/papulation, an item difficult to evaluate on slides. However, overall agreement was good in this pilot test, since the poorest agreement was obtained for the item edema/papulation (fig. 4) which was graded 1 by 7/10 clinicians, corresponding to a 54% probability to be graded identically by 2 clinicians randomly chosen.

Study of the Multicenter Assessment of 88 Patients. A summary of data is found in table 4, and figure 17 shows histograms for extent, intensity, subjective symptoms and distribution $\times$ intensity values. Extent has a nonnormal distribution, skewed to the right (smaller than 20% for a majority of patients). Distribution $\times$ intensity follows the same pattern. Distribution of subjective symptoms suggests two populations for subjective symptoms. Intensity can be qualified as having the more normal distribution. Correlation analyses (not shown) show that all parameters are positively correlated to each other: these results were expected (e.g. highest correlation $r = 0.93$ for subjective symptoms and pruritus). To maximize differences among patients the principal-component analysis was applied to the 16 parameters defined in the Methods section. A 1st component was extracted that represents 33% of the total variance among patients. The 2nd component, uncorrelated to the 1st, represents 18% of the variance. The weights assigned to each parameter for each component can be found in table 5. The 1st component represents the linear combination of the parameters which has the largest variance among the 88 observations. It is clearly a severity component, since all weights are positive and close in value, indicating that all parameters participate in severity of disease. The 2nd component, independently of the overall severity, separates patients with severe dryness and lichenification from patients with severe subjective symptoms and moderate erythema or edema. It is a 'profile' component. In other words, it can be anticipated that in a group of patients with a similar global severity, the lar-

SCORAD
EUROPEAN TASK FORCE
ON ATOPIC DERMATITIS

Last Name First Name

Date of Birth: DD/MM/YY

Date of Visit

INSTITUTION

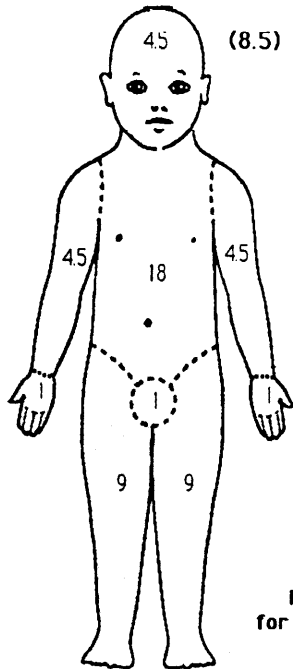
PHYSICIAN

Topical Steroid used:

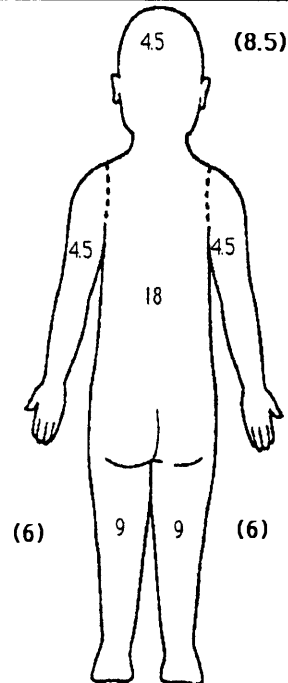
Potency (brand name)

Amount / Month (6)

Number of flares / Month



Figures in parenthesis
for children under two years



A: EXTENT Please indicate the area involved

B: INTENSITY

CRITERIA	INTENSITY
Erythema	
Edema/Papulation	
Oozing/crust	
Excoriation	
Lichenification	
Dryness *	

MEANS OF CALCULATION

INTENSITY ITEMS
(average representative area)
0= absence
1= mild
2= moderate
3= severe

* Dryness is evaluated
on uninvolved areas

C: SUBJECTIVE SYMPTOMS
PRURITUS+SLEEP LOSS

SCORAD A/5+7B/2+C

Visual analog scale
(average for the last
3 days or nights)

PRURITUS (0 to 10)

SLEEP LOSS (0 to 10)

0

10

TREATMENT:

REMARKS:

Table 2. Mean score (0–3) assigned to each slide by 10 clinicians

		Slide									
		1	2	3	4	5	6	7	8	9	10
Erythema	Mean	2.00	1.40	1.70	1.70	2.90	0.60	1.00	1.10	1.40	0.00
	SD	0.00	0.52	0.48	0.48	0.32	0.52	0.00	0.32	0.52	0.00
Edema	Mean	1.00	1.10	2.00	1.10	2.60	0.50	0.50	0.70	0.70	0.10
	SD	0.47	0.32	0.00	0.57	0.52	0.53	0.53	0.48	0.48	0.32
Oozing	Mean	0.20	0.40	1.00	1.00	3.00	0.60	0.10	0.50	0.60	0.00
	SD	0.42	0.52	0.47	0.00	0.00	0.52	0.32	0.53	0.52	0.00
Lichenification	Mean	0.40	0.50	0.60	0.60	0.20	1.50	1.00	2.00	3.00	0.10
	SD	0.52	0.53	0.52	0.52	0.42	0.53	0.00	0.00	0.00	0.32
Excoriation	Mean	0.30	0.80	1.50	0.90	1.20	1.00	0.20	1.00	1.40	0.00
	SD	0.48	0.42	0.53	0.32	0.42	0.00	0.42	0.00	0.52	0.00
Total	Mean	3.90	4.20	6.80	5.30	9.90	4.20	2.80	5.30	7.10	0.20
	SD	1.10	1.03	1.14	1.25	0.88	0.92	0.79	0.82	0.57	0.42

SD is the standard deviation between clinicians; total is the sum of the 5 items.

Table 3. Analysis of variance, data from table 2

	Erythema	Edema	Oozing	Lichenification	Excoriation	Total score
Mean	1.4	1.0	0.7	1.0	0.8	5.0
Within-observer SD	0.37	0.38	0.37	0.38	0.38	0.84
Between-observer SD	0.38	0.45**	0.40**	0.40*	0.38	0.92**

The within-observer SD is precisely the standard deviation for the clinician $\times$ picture interaction. It can be regarded as the standard deviation which would be obtained if an observer evaluated several pictures, independently of each other, representing the same severity.

The between-observer SD is the standard deviation that is obtained when several observers evaluate the same picture independently. * $p < 0.05$, ** $p < 0.01$: significant systematic differences among observers.

gest difference between them as concerns clinical presentation is that a subset has high subjective symptoms associated with erythema/edema but no dryness or lichenification, while another subset has mostly dryness and lichenification and low subjective symptoms. For example, the 2 patients who are the most extreme on the second component have a profile shown in table 6. There was no relationship of age and sex with the 2nd component. A slight relationship was noted between age and the 1st component ($r = 0.28$; $p < 0.01$).

Defining a Severity Index

Two indices were used during the study, as previously defined: RES 1 (a combination of extent, intensity and subjective symptoms) and RES 2 (a combination of subjective symptoms and the intensity $\times$ distribution product). To define appropriate weights for extent, intensity, subjective symptoms or the intensity $\times$ distribution product in a severity index, multiple regression was used to determine coefficients in a linear relationship of the 1st component with these parameters.

The best regression of the 1st component with 2 parameters was obtained with subjective symptoms and the intensity $\times$ distribution product ($R^2 = 0.926$), subjective symptoms accounting for approximately 20% and the intensity $\times$ distribution product for 80%. The regression versus the 3 parameters extent, intensity and subjective symptoms yielded $R^2 = 0.937$, which was thus slightly better. In this case, extent, intensity and subjective symptoms account for 20, 63 and 17%, respectively. Considering these results the following proposals can be made to define more precisely indexes derived from RES 1 and 2 with approximations to obtain simpler coefficients:

RES 1 (0–103) = extent/5 (0–20; 19.4%) + $3.5 \times$ intensity (0–63; 61.2%) + subjective symptoms (0–20; 19.4%).

RES 2 (0–92) = subjective symptoms (0–20; 21.7%) + distribution $\times$ intensity (0–72; 78.3%).

In each case, it was proposed to include only 2 items to define subjective symptoms in order to obtain a total of 20, namely sleep loss and pruritus, overall skin condition as a marker of quality of life being unmanageable for most investigators. When these coefficients are applied to the patients included in the study populations (88 patients), the distribution is as indicated in figure 18. 50% of patients have a score situated between 28 and 54 for RES 1 and between 17 and 41 for

Fig. 16. Evaluation sheet.

Table 4. Multicenter study of two assessment systems (n=88 patients)

Parameter	Mean	SD
Extent	0.29	0.29
Erythema	0.57	0.22
Edema/papulation	0.45	0.28
Oozing/crusts	0.42	0.30
Excoriations	0.47	0.27
Lichenification	0.29	0.31
Dryness	0.31	0.33
Subtotal intensity	0.42	0.17
Erythema × D	0.37	0.24
Edema × D	0.31	0.27
Oozing × D	0.24	0.23
Excoriations × D	0.27	0.22
Lichenification × D	0.19	0.27
Dryness × D	0.31	0.33
Subtotal intensity × D	0.28	0.18
Pruritus	0.55	0.28
Overall skin condition	0.52	0.28
Sleep loss	0.35	0.32
Subtotal subjective symptoms	0.47	0.26

D = Distribution as used in RES 2. Each parameter has been re-scaled to lie within 0–1. Mean ± SD for each parameter.

RES 2. RES 1 and RES 2 are highly correlated ($r=0.91$), and both are equally correlated to the 1st principal component ($r=0.96$). However, RES 2 has a more skewed distribution than RES 1. Considering the personal experience of the participants of the study, RES 1 was found more workable and should be considered the best cumulative index candidate for future studies. It is proposed to name RES 1 for easier memorization SCORAD for 'scoring atopic dermatitis' (a suggestion of A. Oranje, Rotterdam).

Discussion

Clinical Assessment of AD Patients

A group of clinicians originating from 9 European countries has proposed a consensus for grading AD patients. The intensity items included were chosen because of their incidence, clinical importance and potential for variation.

The proposed evaluation sheet (fig. 16) takes about 10 min to fill in for the trained individual. Visual analog scales are difficult to use in children under 7 years, and it should be remembered that parental global judgement on health status is prone to systematic error. The evaluation sheet indicates the type and amount of steroids used, as well as the number of flares in the previous month, but these data are not included in the final score.

Table 5. Principal-component analysis, multicenter analysis of 88 patients

Items analyzed	1st component	2nd component
Percent total variance	33	18
Extent	0.29	0.14
Erythema	0.14	0.04
Erythema × D	0.23	0.20
Edema/papulation	0.26	0.13
Edema/papulation × D	0.29	0.20
Oozing/crusts	0.13	0.05
Oozing/crusts × D	0.18	0.07
Lichenification	0.34	−0.27
Lichenification × D	0.31	−0.15
Excoriations	0.18	−0.10
Excoriations × D	0.22	0.00
Dryness	0.31	−0.46
Dryness × D	0.31	−0.46
Pruritus	0.24	0.33
Sleep loss	0.24	0.37
Overall skin condition	0.23	0.30

Weights are assigned to each parameter and define a linear combination of them representing a component. The 1st component is the combination with the largest variance among patients. D = Distribution.

Table 6. Individual scores in the 2 most extreme patients (2nd component)

Individual items	1st patient	2nd patient
Erythema	3	1
Edema/papulation	3	1
Oozing/crusts	1	1
Lichenification	0	3
Dryness	0	3
Pruritus	9	2
Sleep loss	5	6
Overall skin condition	10	1

Those that have participated in the session with exercises on clinical slides have acknowledged the value of training and discussion about definitions. Thus this system, even though designed to be the simplest possible, necessitates an initial period of training, and a set of coded slides would be probably useful to tune up one individual's evaluation to that of a reference group. Further studies are planned to address interindividual and intraindividual variations in scoring, as well as therapeutic trials of systemic

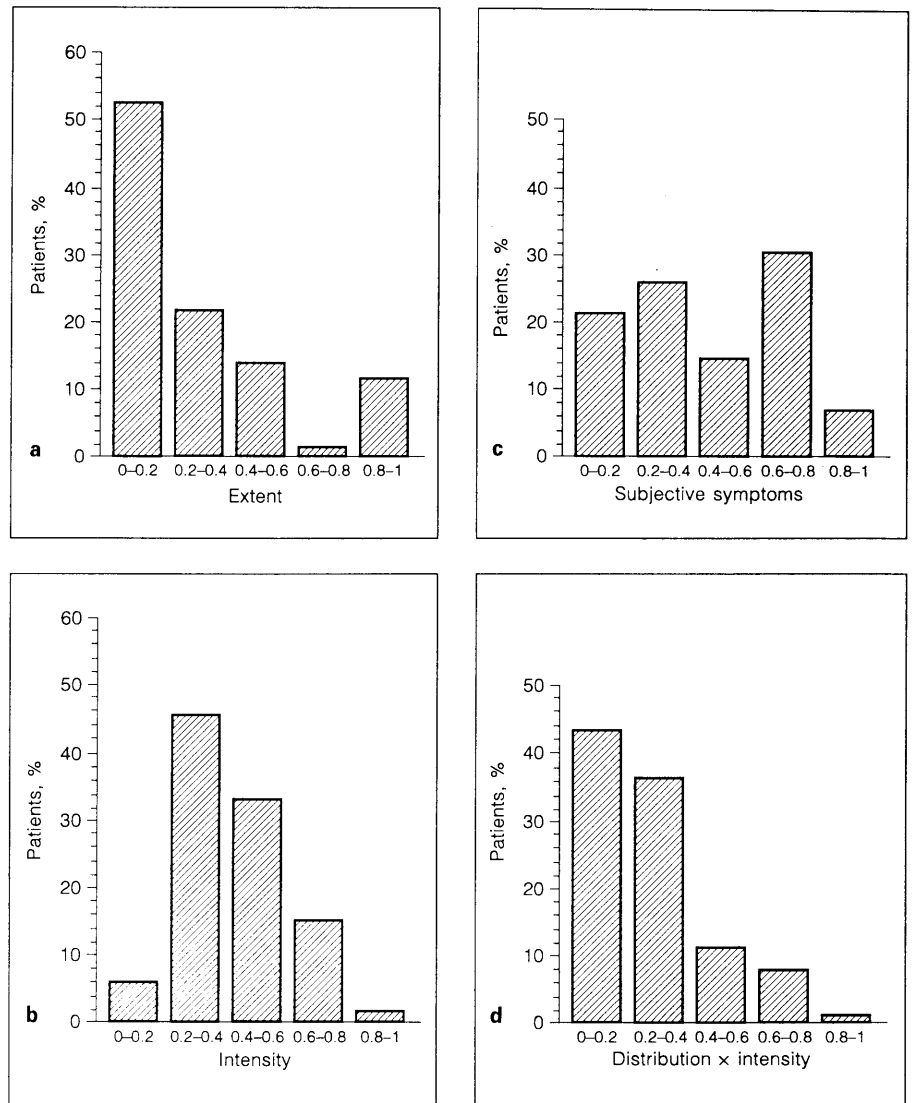


Fig. 17. Histograms for extent (a), intensity (b), subjective symptoms (c) and distribution $\times$ intensity (d); values rescaled to lie within 0-1.

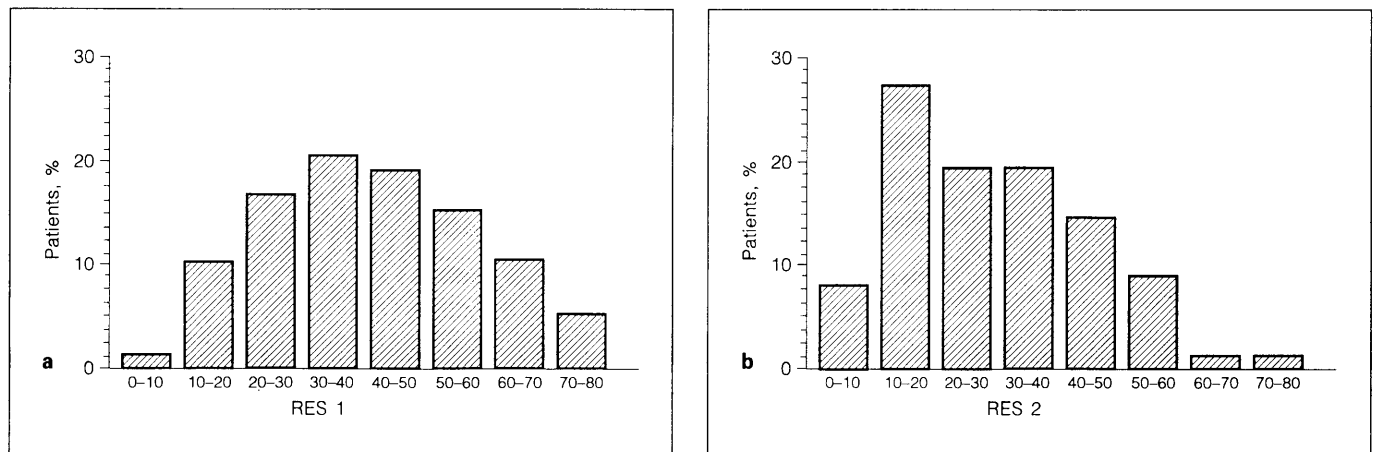


Fig. 18. Distribution of RES 1 (0-103; a) and RES 2 (0-92; b) for 88 patients.

and topical treatments in AD, which are needed for a validation.

A Composite Index for AD: SCORAD

Trying to develop a universal scoring system might be misleading, since different studies may have to use different evaluation criteria depending on their goals. However, there is also an immediate advantage to combine assessment data in one figure to follow patients. Two methods are generally proposed [21] to combine individual items into an index: (1) experts may provide a global appreciation on various combinations of individual measures, and the weight given to each item in the global assessment is determined statistically in a second step; (2) an a priori arbitrary weight is given to each item by experts. We have chosen the first method, and it is interesting to note that the extent value derived from statistical calculations (20%) is even below the 30% value given by the a priori method [9, 10].

It should be remembered that different schemes of index formation can produce different assessments of the severity of a single case so that variants of SCORAD may help in specific goals. Our statistical study has shown that besides a severity component, a profile component was evidenced explaining that patients with an identical composite index may differ greatly in the measures of individual items. Defining this profile may further help to include more homogenous populations in future trials and avoid that drugs affecting separate manifestations of the disease may have an apparently similar impact on the composite index.

As concerns the SCORAD index, its validity remains to be established, but some of the following criteria recommended to develop a composite index [21] have been met: (1) comprehensiveness and (2) credibility including feasi-

bility, sensitivity and usefulness as judged by various investigators. Other features not yet tested include (1) accuracy, or reflection of the true clinical state of the patient, (2) sensitivity, allowing to detect the smallest possible clinical modification and (3) biological relevance: Does the SCORAD index agree with expected results based on current knowledge of the disease? There is preliminary evidence to support the present classification when functional aspects are evaluated. However, intervals between severity grades within a given item are not equal quantitatively and in terms of skin function changes [22].

Assessment of Quality of Life in AD

It seems difficult to propose an assessment system in a chronic disabling disease like AD which interacts with every aspect of social life without reference to a measurement of quality of life. We have proposed to include one question addressing overall skin condition as a global quality of life index in the multicenter study comparing RES 1 and 2. The patients had to answer the question how much skin condition interfered with everyday life on a 10-cm analog scale. It was found that this type of global evaluation, even though highly correlated to pruritus ($r=0.773$) and sleep loss ($r=0.613$) was difficult to handle in a routine outpatient clinic evaluation. A special study using a comprehensive list of items to the impact of AD on everyday life is needed, as already studied in other chronic diseases [23–25], but we think that such items can be omitted in conventional assessment forms for drug trials.

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