

Short Report

Measurement of body surface area in atopic dermatitis using specific PC software (ScoradCard[©])

Tripodi S, Panetta V, Pelosi S, Pelosi U, Boner AL. Measurement of body surface area in atopic dermatitis using specific PC software (ScoradCard[©]).

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In skin diseases, evaluation of involved surface area is a crucial factor in grading the degree of severity. We examined the reliability of body surface area assessment and relative inter-observer and intra-observer variability using new software (ScoradCard[©]), specifically designed to evaluate automatically the extension of the involved area in the SCORAD index. Twenty pediatricians, untrained in the evaluation of skin disease, estimated the percentage of surface area involved in photo-tests of two children with artificial well-delimited lesions, at first by sight and then through software. As 'gold standard' the exact amount of pixels was counted for the whole body surface of the children, for the different body zones and for the painted artificial lesions, expressed as percentage of the respective zone. For photo 1, gold standard was 38.06% and median percentage was 43.44% (95% CI 40.7–46.21) by sight ($p = 0.002$) and 37.99% (95% CI 36.04–39.94) by ScoradCard ($p = 0.79$). For photo 2, gold standard was 27.84%, median percentage was 30.44% (95% CI 28.25–32.63) by sight ($p = 0.047$) and 27.8% (95% CI 26.55–29.04) by ScoradCard ($p = 0.79$). The level of agreement (kappa statistic), cumulative for the two photo tests, was 0.38 (fair agreement) by sight method and 0.67 (good agreement) by ScoradCard[©]. Among the 10 pediatricians who repeated the computer aided evaluation 3 months apart, the intra-observer variability was not significantly different: the median percentage was 31.5% (95% CI 27.0–49.4) at time 0 and 29.0% (95% CI 26.7–47.2) 3 months later ($p = 0.76$). This new software could be a useful tool in evaluating skin lesions extension, minimizing inter- and intra-observer variability, which is an important goal in multi-centre studies.

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It is sometimes difficult to assess objectively the extent and severity of skin diseases such as eczema or psoriasis (1). One of the most widely used methods for the evaluation of skin disease extension is the 'rule of nine': 9% for the head and neck, each arm, the front and back of each leg, the four trunk quadrants, and 1% for the genitalia. This rule was adopted by the European Task Force on Atopic Dermatitis to assess the extent of the lesion in the SCORAD index (2). However, wide inter-observer variations occur even with the use of the two-dimensional

(2-D) schematic figure outlines (3), especially when the 'rule of nine' is used by untrained observers (2). This problem was found to be present also in the evaluation of psoriasis even when the assessment was made by well-trained dermatologists (4). In order to solve this problem, the reliability of body surface area assessment and the relative inter-observer and intra-observer variability was evaluated using a new simple, inexpensive and fast software specially designed to score the severity of skin diseases.

Materials and methods

Software

The software was developed (S.T. and S.P., Visual Basic®, release 6.0, Microsoft; Seattle, CA, USA) for scoring atopic dermatitis according to the SCORAD criteria (2).

We elaborated a user-friendly way to record objective data (erythema, oedema/papulation, oozing/crusts, excoriation, lichenification and xerosis) with a 0–3 score range and subjective symptoms (pruritus and sleep loss) using a visual analogue scale with a 0–10 score range. In order to simplify and to standardize the grading of severity of objective signs of atopic dermatitis, the software has been programmed to show on the screen, like example of comparison, the pictures (kindly provided by the Audiovisual Department, Nantes University Hospital, France) employed and already validated by the Scord task force (2).

The patient's age is automatically calculated from the date of birth. This is important as the skin area percentage differs for patients over 2 years of age.

The innovation consists in the automatic evaluation of skin lesion extension. On the PC screen, 2-D schematic figure outlines are shown (slightly modified from those proposed for the SCORAD), in front and back view. With the use of the personal computer's mouse it is possible to draw the area of skin lesions very precisely by choosing different dimensions of brushes, and to erase eventual mistakes (Fig. 1 a,b). It is possible to

paint only within the figures, because the program does not allow to go outside the figure's limits (Fig. 1b). The software ('ScoradCard®', TPS Production; Rome, Italy) automatically calculates the involved area as a percentage of the specific part of the schematic figures (head, trunk, arms, hands and legs), by counting the exact amount of the painted pixels in comparison with the total zone surface. By putting the weight in kilogram and the height in centimetre, the lesion's extension is calculated in cm², for the single zone and for the total surface of the figures. From the total percentage of skin area involved, the extension score for SCORAD is calculated by the formula: total surface percentage/5 (2).

On the hard disk it is possible to save and store the following: patient's data, subjective and objective symptoms, the percentage of surface area involved, as well as the SCORAD index and the design itself. Thus, in further controls, it is possible to re-evaluate and adjust data according to the spontaneous or treatment-induced evolution of the illness.

Obviously the drawing of the skin lesion and the automatic evaluation of the involved surface can be used for different skin diseases such as psoriasis or burns. We used atopic dermatitis as a model to evaluate the feasibility of the process.

Photographs for the test

For the study, we have used two different colour prints of two children, in front and back view, with well-delimited artificial painted zones, rep-

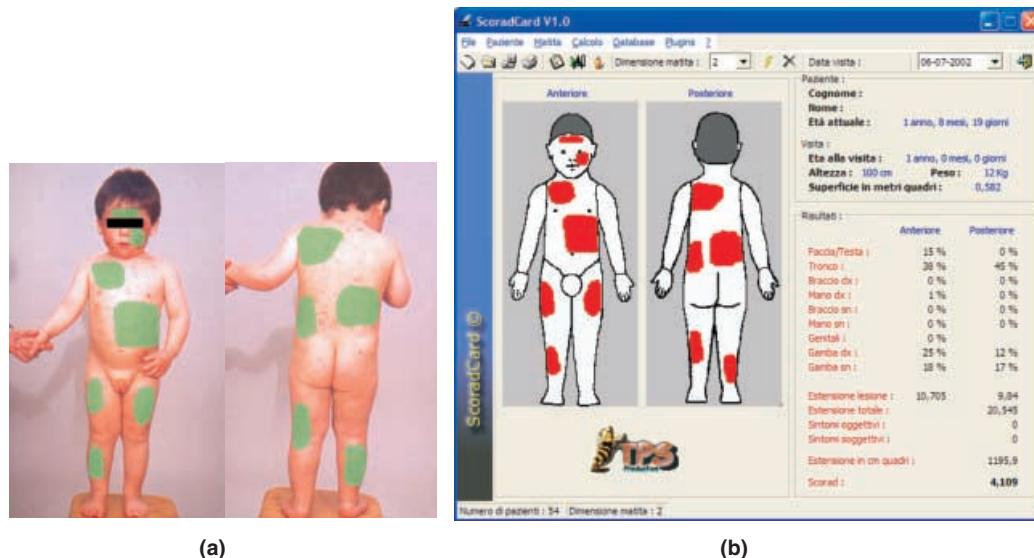


Fig. 1. (a) Photo-test with artificial lesions of child 2 (modified from the original, taken by kind concession from the UCB ETAC ATLAS). (b) An example of a ScoradCard® principal screen, with painted lesions on schematic figures and Scord extension score calculation related to Fig. 1a.

representing skin lesions (Fig. 1a). For each child the exact amount of pixels was counted by using a specific photograph elaborating software (Photoshop®, release 6.0, Adobe; San Jose, CA, USA) for the whole body surface and for the different zones (head, trunk, arms, legs and genitalia), each expressed as percentage of the total body surface. With the same method the precise extension of the painted artificial lesions was evaluated and expressed as percentage of each respective zone. These values, used as 'gold standard' for statistical analysis, were not revealed to the study observers.

Observers

Twenty pediatricians, not trained in the evaluation of skin diseases, participated in the study. Each of them was given the children's photos in random order so as to evaluate the extension of the painted lesions. None was acquainted of the gold standard results and of the other observers' evaluations. The extension of each lesion was evaluated as a percentage of the involved zone at first, only by sight and then by the use of the computer. The results of the gold standard software calculation were not revealed to any operator. To evaluate intra-observer variability the software test for photo 1 was repeated by 10 pediatricians 3 months later.

Statistics

The percentage of total extension of artificial painted zones, expressed as median of all the data of the 20 observers, was calculated, separately for each photo-test, both for sight evaluation and for 'ScoradCard®' evaluation. The distributions were compared with the 'gold standard' distribution using Wilcoxon test for paired data.

Descriptive statistics were used to illustrate inter-observer variation. The kappa statistic (k) was used as a measure of chance-corrected agreement between the 20 observers. The value for k can range from -1 to $+1$: zero, indicating chance agreement only; one, indicating perfect agreement and negative values, less agreement than expected by chance only, k -values of < 0.20 , $0.21-0.40$, $0.41-0.60$ and > 0.61 represent poor, fair, moderate and good agreement, respectively. To calculate k , the results were categorized as in the Rajka and Langeland's system (5): $< 9\%$, $9-36\%$, or $> 36\%$. The data from photo 1 and photo 2 were used together for calculating k both for the sight method and for the software method.

Intra-observer variation was calculated using the Wilcoxon test for paired data comparing data of the test at time 0 and 3 months later. A p -value of < 0.05 (two-tailed) was considered statistically significant for tests. All the analyses were performed with STATA (Intercooled Stata®, release 7.0; Stata Corp., College Station, TX, USA).

Results

The 'gold standard' extension percentage for artificial lesions, median and 95% CI of surface percentage for sight and for ScoradCard estimations are represented in Fig. 2a,b), respectively for photo 1 and 2. As can be seen, the k agreement between the 20 observers was 0.38 (fair agreement) for sight scoring while the 'ScoradCard®' scoring was $k = 0.67$, indicating a good agreement.

For the intra-observer variability of the 10 pediatricians who repeated the evaluation with the help of the ScoradCard®, the median of the test at time 0 was 31.5 (95% CI 27.0–49.4) and

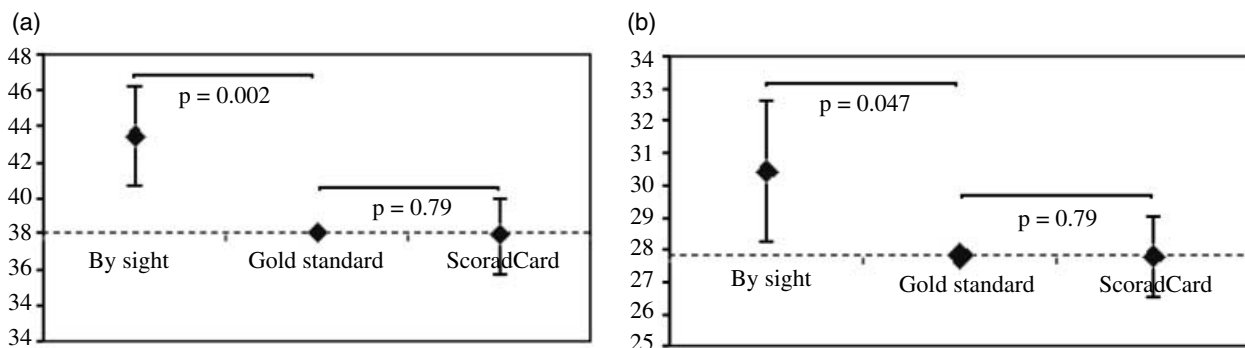


Fig. 2. 'Gold standard' percentage of artificial lesions' surface, median and 95% CI of involved surface percentage for the estimation 'by sight' and by 'ScoradCard®', for photo-test 1 (a) and photo-test 2 (b).

29.0 (95% CI 26.7–47.2) 3 months later. The difference between the two tests was not significant ($p = 0.76$).

Discussion

Our study demonstrates that ScoradCard[®] software, for the automatic calculation of skin involved area, allows a precise evaluation even by untrained observers. This is the major advantage of this computer-aided evaluation. The software clearly minimizes inter-observer and intra-observer variability. This is an important issue in multi-centre studies, where inter-observer variability can affect global data analysis. Effectively, a previous study, using photographs and involving 98 non-expert investigators, showed a very large variation in sight evaluation of surface area in atopic dermatitis (6).

In a previous study, a similar software method was used (7). The sites involved were marked on a standard computer aided design (CAD) graph, representing the ventral and dorsal shape of the human body and the marked area was determined by Auto Cad[®] software (Autodesk Inc; San Rafael, CA, USA). This was clearly an advance compared with the usual clinical method, but this system presents some limitations. First, it requires an expensive software for engineering design, not easy to use by untrained people. Secondly, this CAD method was validated by the 9% rule method by way of comparison but previous studies have demonstrated that the 9% rule method is not an accurate method and cannot be used as 'gold standard' (2, 3). Moreover, this type of computer-based planimetry has not been shown to reduce inter-observer and intra-observer variability (8).

Recently, a computer image analysis (CIA) has been proposed as a useful method in estimating the actual skin surface involved in psoriasis, but this method has the disadvantage of being time-consuming (photographing, processing of pictures) and technically demanding (9, 10). Our method, instead, requires only 2–3 min to score one patient.

A limitation of our study is, of course, the use of photographs with artificial well-defined painted zones representing skin lesions. As a consequence, the evaluation of the extensions is easier than in a real clinical setting. However, this situation could be similar to that of skin diseases with well-marked lesions such as psoriasis. The situation in atopic dermatitis, a less well-demarcated disease, is certainly different.

Of course, this is a preliminary validation of a new software, which has to be confirmed in

different diseases, both in real-life clinical settings and with the use of standardized photographs (6) of children with atopic dermatitis.

Further studies will need to be performed to assess whether also physicians, with greater experience in the evaluation of skin-disorders, will benefit from this computer-aided system.

Furthermore, the effects of 'disturbances', such as the presence of wine spots, nevi telangiectatica or haemangioma, should be considered in further studies. However, the ease of use and the good reproducibility of the evaluations, performed by pediatricians not specifically trained in the evaluation of skin diseases, are reassuring and encouraging in planning further applications of the method.

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