

Assessment of a correlation between Canine Atopic Dermatitis Extent and Severity Index (CADESI-03) and selected biophysical skin measures (skin hydration, pH, and erythema intensity) in dogs with naturally occurring atopic dermatitis

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Abstract

Atopic dermatitis is a common allergic skin disease in dogs. The aim of this study was to examine the possibility of a correlation between biophysical skin variables: skin hydration (SH), skin pH, and erythema intensity measured in 10 different body regions and both total Canine Atopic Dermatitis Extent and Severity Index (CADESI-03) and CADESI measured in a given region (CADESI L). The study was conducted using 33 dogs with atopic dermatitis. The assessment of the biophysical variables was done in 10 body regions: the lumbar region, right axillary fossa, right inguinal region, ventral abdominal region, right lateral thorax region, internal surface of the auricle, interdigital region of right forelimb, cheek, bridge of nose, and lateral site of antebrachium. Positive correlations were found between SH and CADESI L for the following regions: the inguinal region ($r = 0.73$) and the interdigital region ($r = 0.82$), as well as between total CADESI and SH on digital region ($r = 0.52$). Also, positive correlations were reported for skin pH and CADESI L in the lumbar region ($r = 0.57$), the right lateral thorax region ($r = 0.40$), and the lateral antebrachium ($r = 0.35$). Positive correlations were found in the interdigital region between erythema intensity and the total CADESI-03 ($r = 0.60$) as well as the CADESI L ($r = 0.7$). The results obtained suggest that it may be possible to use skin hydration, pH, and erythema intensity to assess the severity of skin lesion but positive correlation was only found in < 13.3% of possible correlations and usage of these measures in dogs is limited.

Résumé

La dermatite atopique est une maladie fréquente chez les chiens. Le but de notre étude était d'étudier la corrélation entre la probabilité d'occurrence des paramètres biophysiques de la peau : l'hydratation de l'épiderme (SH), pH de la peau et de la gravité de l'érythème mesurée à 10 zones différentes du corps et à la fois totale CADESI-03 ainsi que Cadesi calculée pour une zone donnée (Cadesi L). Des études ont été effectuées dans 33 chiens atopiques. Évaluation des paramètres biophysiques a été réalisée dans 10 régions du corps : la région lombaire, la fosse axillaire droite, la région inguinale droite, la région ventrale, la région latérale droite du thorax, la surface interne de l'oreille, région interdigitale de la patte avant droite, joue, l'arête du nez et de la surface latérale de l'avant-bras. Corrélation positive entre SH et Cadesi L a été détecté sur l'environnement suivantes : la région inguinale ($r = 0,73$), et interdigital ($r = 0,82$), ainsi qu'entre le total Cadesi — 03 et SH dans l'espace interdigital ($r = 0,52$). Une corrélation positive a également été trouvée entre la peau et la érythrocytaire Cadesi L dans la région lombaire ($r = 0,57$), la zone de la poitrine à droite ($r = 0,40$), l'avant-bras latéral ($r = 0,35$). Des corrélations positives ont également été trouvées dans l'espace interdigital entre la sévérité de l'érythème et totale Cadesi 03 ($r = 0,60$) et Cadesi L ($r = 0,7$). Les résultats obtenus suggèrent qu'il existe une possibilité d'essai de l'hydratation de la peau, et la sévérité de la réaction de la peau dans l'évaluation de la sévérité de l'érythème gravité retour sur la peau, mais les corrélations positives ont été trouvées uniquement dans < 13,3 % de la corrélation possible, ce qui signifie que l'utilisation de ces paramètres chez les chiens est limitée.

(Traduit par les auteurs)

Introduction

Atopic dermatitis (AD) is a common allergic skin disease in dogs defined as a genetically predisposed inflammatory and pruritic skin disease with characteristic clinical features associated with immunoglobulin (Ig)E antibodies, most commonly directed against environ-

mental allergens (1). Atopy is diagnosed in about 10% of the canine population (2). Recently in an epidemiological study of skin diseases in Poland, atopy was recognized as the most common of skin diseases constituting 28.7% of all skin disorders (3). Immunological, environmental factors, and skin barrier dysfunctions are responsible for the development of atopic dermatitis (4–6). The monitoring of the

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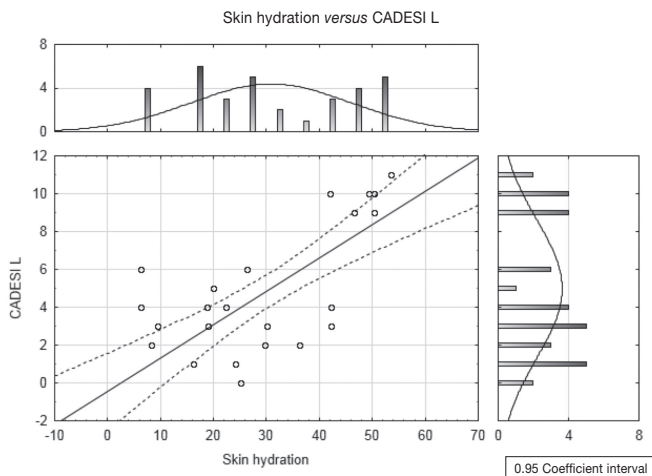


Figure 1. Correlation between skin hydration (SH) in the inguinal region and Canine Atopic Dermatitis Extent and Severity Index (CADESI) measured in the same region (CADESI L; $r = 0.73289$). The main diagram shows regression (straight line) and 95% coefficient intervals (dotted lines). Upper and right-hand histograms show distribution of date.

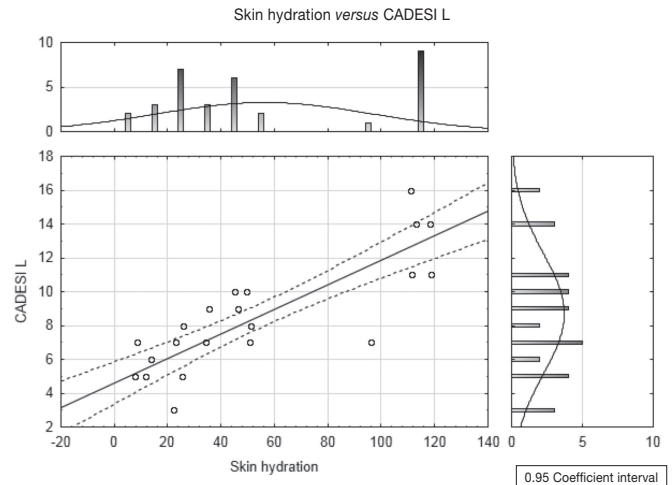


Figure 2. Correlation between SH in the interdigital region and CADESI measured in the same region (CADESI L; $r = 0.82537$). The main diagram shows regression (straight line) and 95% coefficient intervals (dotted lines). Upper and right-hand histograms show distribution of date.

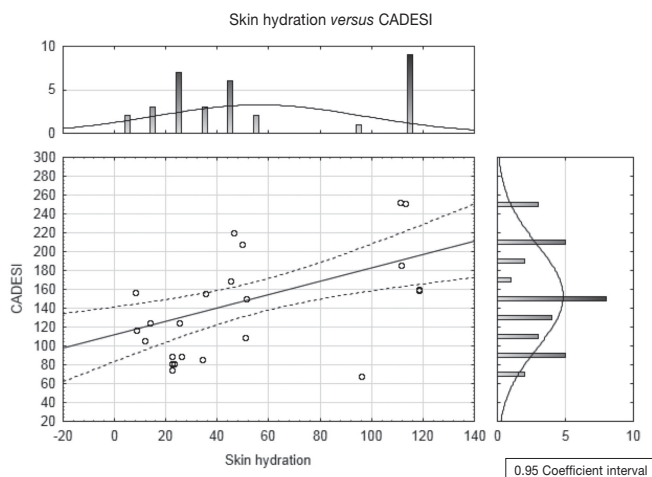


Figure 3. Correlation between SH in the interdigital region and total CADESI ($r = 0.52360$). The main diagram shows regression (straight line) and 95% coefficient intervals (dotted lines). Upper and right-hand histograms show distribution of date.

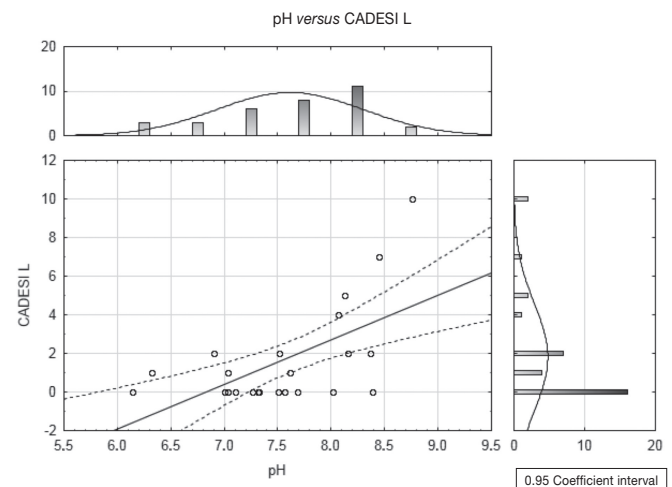


Figure 4. Correlation between skin pH measured in the lumbar region and the CADESI for this region (CADESI L; $r = 0.57000$). The main diagram shows regression (straight line) and 95% coefficient intervals (dotted lines). Upper and right-hand histograms show distribution of date.

effectiveness of treatment is one of its crucial elements. To this end, pruritus intensity assessment and the assessment of the intensity of skin changes are commonly applied (7,8). Thus, Canine Atopic Dermatitis Extent and Severity Index (CADESI-03) and Pruritus Visual Analog Scale (PVAS) are reliable and common methods used by experienced clinicians. The examination of skin conditions can also be done by measuring biophysical skin variables, such as transepidermal water loss (TEWL), skin hydration (SH), erythema intensity, and skin pH. The most commonly used variable is TEWL, which has so far been assessed in clinically normal dogs, cats, horses, as well as in atopic dogs (9–12). The studies demonstrated higher values of TEWL in atopic dogs than in clinically normal animals, as well as higher values on affected skin (13). In addition to this, a positive correlation was reported between the value of this variable

and symptom severity, as assessed with the CADESI-03 system (14). Skin hydration has been assessed in humans and in animals. Much of the research concentrated on examining this variable in different body regions of clinically normal animals (10,11,15). In the case of humans, the value of the variable was shown to decrease in patients with AD (16). Also, the potential influence of feeding practices as well as age, breed, and gender of the animal on the variable was investigated (17,18). However, the reports on the changes in this variable in atopic dogs have so far been scarce (19).

The assessment of skin pH was done on clinically normal animals (10,11,20,21) and in dogs over the course of pruritic infections (22). In regards to the assessment of erythema intensity, to our knowledge, there has been no research reporting on its changes in the course of canine skin diseases.

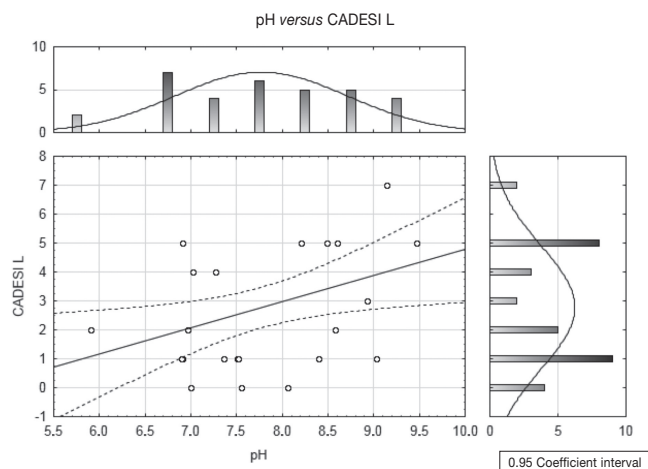


Figure 5. Correlation between skin pH measured in the lateral thorax region and the CADESI for this region (CADESI L; $r = 0.39853$). The main diagram shows regression (straight line) and 95% coefficient intervals (dotted lines). Upper and right-hand histograms show distribution of date.

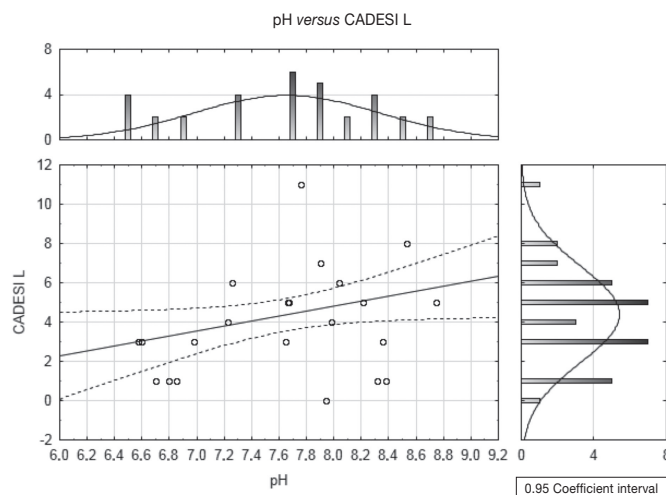


Figure 6. Correlation between skin pH measured in the antebrachium and the CADESI for this region (CADESI L; $r = 0.34531$). The main diagram shows regression (straight line) and 95% coefficient intervals (dotted lines). Upper and right-hand histograms show distribution of date.

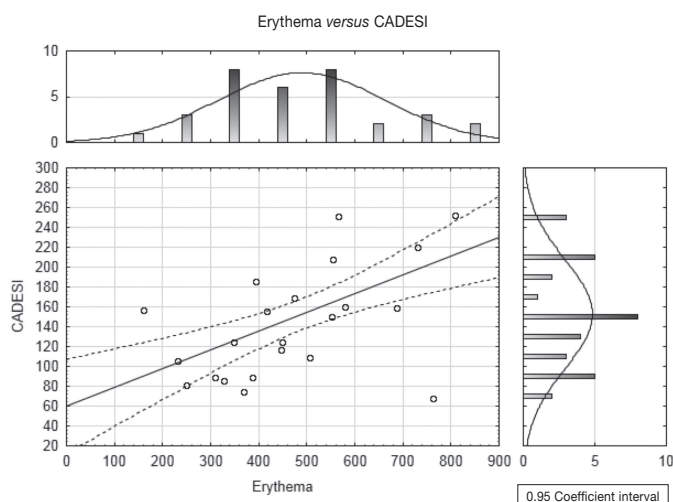


Figure 7. Correlation between erythema intensity in the interdigital region and the total CADESI ($r = 0.60169$). The main diagram shows regression (straight line) and 95% coefficient intervals (dotted lines). Upper and right-hand histograms show distribution of date.

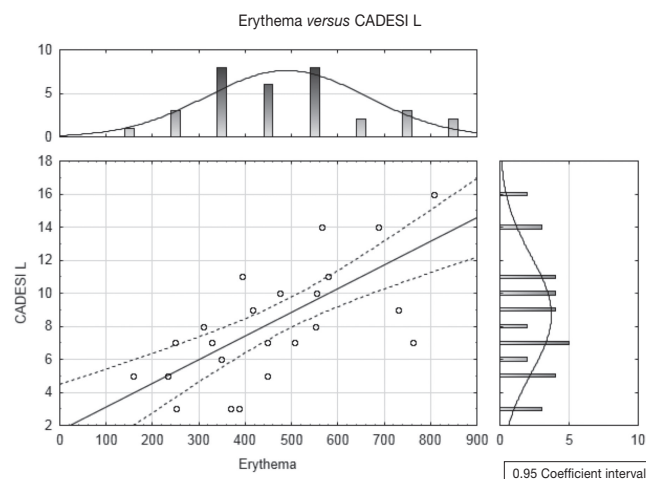


Figure 8. Correlation between erythema intensity in the interdigital region and the CADESI for this region (CADESI L; $r = 0.69732$). The main diagram shows regression (straight line) and 95% coefficient intervals (dotted lines). Upper and right-hand histograms show distribution of date.

The aim of this study was to investigate the relationship between the severity of changes assessed with the CADESI-03 system and SH, erythema intensity, and skin pH in dogs with AD due to environmental allergens.

Materials and methods

Thirty-three dogs with AD were selected for the study on the basis of the Favrot set number 1 diagnostic criteria (23). All dogs fulfilled at least 5 criteria. The age range of the animals was 2.5 to 7 y (median age 3 y). The experimental group comprised 12 females (6 intact, 4 neutered) and 21 males (all intact). The animals belonged to the following breeds: West Highland white terrier ($n = 6$), Labrador retriever ($n = 6$), German sheepdog ($n = 4$), shih tzu ($n = 3$), boxer ($n = 2$),

fox terrier ($n = 2$), Yorkshire terrier ($n = 2$), English bulldog ($n = 2$), French bulldog ($n = 2$), pug ($n = 1$), Jack Russell terrier ($n = 1$), cocker spaniel ($n = 1$), and Nova Scotia duck tolling retriever ($n = 1$). The animals were privately owned and patients of a private veterinary practice in Czeladz and the Department of Clinical Diagnostics and Veterinary Dermatology at the University of Life Sciences in Lublin, Poland. Animals in the study had medium to severe symptoms of AD (CADESI-03 > 66) (8). Other inflammatory-pruritic skin diseases were excluded on the basis of hair examination and skin scraping. Concurrent adverse food reactions were excluded after 8 wk of an elimination diet. Regular flea treatment was used on all dogs. All dogs were diagnosed for allergy-inducing factors with intradermal tests (Agroskin RTU 20; Agrolabo, Scarmagio, Italy). Positive results were those assessed as at least 2+ (0 to 4 scale). Additionally, IgE

levels were evaluated according to the manufacturer's instructions (Policheck Allergie Dog Panel; BioCheck GmBH, Münster, Germany).

All assessments were done over a 24-month period by the same investigators. All biophysical skin variables and CADESI-03 measurements were collected when dogs had active clinical disease and testing was done prior to undertaking treatment. No anti-inflammatory medications (steroids, antihistamines, ciclosporin, fatty acids) or antibiotics were permitted during the 3 mo prior to testing.

The CADESI-03 was calculated for all animals directly prior to assessment of skin variables (5). The animals were acclimatized in the test room 1 h before measuring the biophysical variables. The temperature in the room was $23 \pm 2^\circ\text{C}$ and the relative humidity (RH) was $46 \pm 6\%$ (operating conditions for the Courage Khazaka Multi Probe Adapter 5 and the probes according to the manufacturer's instructions: RH 30% to 70% and temperature 10°C to 30°C). Measurements were taken from 10 different sites: the lumbar region, right axillary fossa, right inguinal region, ventral abdominal region, right lateral thorax region, internal surface of the auricle, dorsal interdigital region of right forelimb, cheek, bridge of nose, and lateral site of antebrachium. The biophysical measures (SH, skin pH, and erythema intensity) were measured in each of the regions. For every region, 10 successive measurements were taken during about 30 s and the mean value was calculated. Appropriate probes were used to measure skin hydration in corneometer units (Corneometer @CM 825, Courage Khazaka Multi Probe Adapter 5; Courage + Khazaka electronic GmbH Cologne, Germany), skin pH (Skin-pH-Meter @PH 905, Courage Khazaka Multi Probe Adapter 5), and erythema index, results in scale from 1 to 999 (Mexameter MX16, Courage Khazaka Multi Probe Adapter 5). The correlations between SH, skin pH, erythema intensity, and both total and local CADESI-03 were calculated for each body region. Mean and standard deviation were calculated. The data obtained were tested for normality using the Shapiro-Wilk test. Correlations were analyzed using the Spearman-rank correlation test. All analyses were carried out using computer software (Statistica, version 10.0; Statsoft, Tulsa, Oklahoma, USA).

Results

Dogs had moderate to severe clinical signs of atopy at the time of measurement. Mean CADESI-03 score for investigated dogs was 152 (range: 68 to 252). A positive correlation was found between SH and the CADESI-03 coefficient assessed in a particular region (CADESI L). This was the case in 2 out of 10 body regions examined: the inguinal region ($r = 0.73$; $P = 0.05$; Figure 1) and the interdigital region ($r = 0.82$; $P = 0.05$; Figure 2). A correlation also was found between total CADESI-03 and SH on interdigital region ($r = 0.52$; $P = 0.05$; Figure 3). A positive correlation was shown to exist between skin pH and the CADESI-03 measured in a given region (CADESI L): the lumbar region ($r = 0.57$; $P = 0.05$; Figure 4), the lateral thorax region ($r = 0.40$; $P = 0.05$; Figure 5), and the antebrachium ($r = 0.35$; $P = 0.05$; Figure 6). Skin pH was more alkaline with an increase in CADESI-03. A positive correlation was found with erythema only for the interdigital region, but it referred to both total CADESI-03 ($r = 0.6$; $P = 0.05$, Figure 7) and CADESI L for this region ($r = 0.7$; $P = 0.05$, Figure 8).

Discussion

Our results point to a possibility of using biophysical variables other than transepidermal water loss to assess skin condition in the course of AD. The CADESI-03 score system assessing skin lesions in canine AD as a validated method is still the most reliable and sensitive method. In our opinion, measurement of the described variables has a limited application in the evaluation of skin conditions because few correlations between CADESI-03 and biophysical variables were found. In conclusion, the usefulness of these methods in dogs is more limited than in human medicine.

There is a large amount of literature in human medicine, but very few published research reports on animals concerning the assessment of measures other than TEWL in the course of various canine skin diseases. One study showed that SH and skin pH undergo changes depending on the age of animals and feeding practices (17). Shimada et al (19) noticed a decrease in SH in atopic dogs with skin lesions, while in atopic dogs whose skin was not affected the SH does not differ significantly from the skin of clinically normal dogs. A measurement of disturbances in SH on affected skin might hypothetically be used in monitoring of treatment. However, the results we obtained imply that the variable is probably not applicable in the assessment of a skin condition because positive correlations between the CADESI-03 and SH were only reported in 2 out of 10 body regions. In addition to this, the correlation observed in our study is positive, while Shimada et al (19) found that SH decreases in the lesional skin. With respect to the interdigital and inguinal region, an increase in SH with an increase in the CADESI-03 for this region can be probably be explained by the occurrence of hyperhydrosis in the course of AD or due to extensive licking of pruritic skin.

The assessment of skin pH has so far not been done in dogs with AD. The variable was investigated in dogs and it was shown that skin pH increases in the case of purulent pruritic dermatitis (22). In our study, a positive correlation was observed between the CADESI-03 assessed in a particular body region and skin pH in 3 of the regions examined. The correlation suggests that skin pH increases in AD, similar to the way it does in pruritic dermatitis (22). We speculate that increasing pH in atopic dogs could be connected with lipid disturbances in skin barrier and/or secondary infections (19,24).

Owing to the fact that so far there have been no assessments made on erythema intensity in dogs or any other animals with skin diseases, it is impossible to draw comparisons between the results obtained in this study and in other research.

Further research is necessary to take account of other body regions and other biophysical variables. This research may make it possible to develop an objective method of measuring of severity of canine AD similar to that used in human medicine (25).

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