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Climatic influence on children's atopic skin studied by changes in skin hydration - a pilot study.

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Summary We have studied the effect of a four-week stay on a sunny, seaside resort on children's atopic dermatitis, assessed by means of changes in skin hydration level. The skin hydration was determined using low frequency electrical susceptance measurements. Skin hydration was found to drop significantly during the first two weeks, followed by a significant increase in hydration again during the next two weeks. We interpret this as being due to two different mechanisms that result from the treatment and healing of the skin. First there will be a decrease in skin hydration due to the restoration of the barrier function of the skin because of the curative effect of the climate and possibly the treatment with skin moisturisers. Secondly, the direct effects of e.g. the seawater and skin moisturisers will lead to an increase in the hydration of the stratum corneum.

Key words Atopic dermatitis, skin hydration, electrical susceptance, climate.

Sudden changes in weather condition, such as temperature, atmospheric pressure and wind, are known to trigger atopic dermatitis (AD). Furthermore, residence at a sunny resort at the seaside will generally have a beneficial effect on AD (7). The effect may be due to UV radiation and heat from the sun, salt from seawater or air moisturising the skin by osmosis, or other factors. We have earlier found that children's atopic skin has higher moisture content than normal skin (6), and wanted to study the effect of sunny, seaside climate on children's AD, assessed by means of skin hydration measurements.

The study was performed in October/ November when Norwegian children suffering from problematic and therapy-resistant AD, were sent on a four-week stay to the Los Teques center near Puerto Rico on the Spanish island Gran Canaria. The centre employs Norwegian medical personnel who offer daily personal assessment, guidance and help in the treatment of the children's AD. From visual assessment, all children improved considerably during the stay, and some attained virtually normal looking skin.

The low frequency electrical susceptance and hence hydration of the children's non-eczematous atopic skin, was found to drop significantly during the first two weeks, followed by a significant increase in hydration again during the next two weeks. Thus, there was no significant different in hydration level between the start and end of the four-week period.

The initial drop in hydration level was interpreted as being due to the normalisation of the skin barrier function, and is in agreement with our earlier results (6). The subsequent increase in skin hydration is possibly due to the daily treatment of the skin with moisturisers, and osmotic processes in the skin due to bathing in salt water.

These two opposing phenomena are both probably active during the whole period, but dominate at different phases of the stay.

Materials and methods

Ten children, 6 boys and 4 girls, aged 4-12 (mean age 8.1), were monitored during their four-week stay at the Los Teques centre on Gran Canaria. The children's daily activities included periods of sun bathing and swimming.

Hydration measurements were conducted with SensoDerm on the following 10 skin sites on the right side of the body and never directly on eczematous skin: forehead, cheek, upper back (shoulder), upper arm (dorsal), chest, elbow (ventral), underarm (ventral), hip (lateral), knee (ventral) and ankle (anterior). For practical reasons, measurements were first done on each child sometime during the first week of the stay (later called day A), and then repeated in the middle of week three (day B) and end of week four (day C). Measurements were always done both in the morning (7-8 am) before any treatment with skin moisturisers, and in the evening (5-6 pm), which was approximately 6 hours after treatment with skin moisturisers.

Three adjacent measurements were always done on each skin site, and the mean value of the three was used in the further calculations.

The weather conditions were stable throughout the period and outside temperature and ambient relative hydration for all days where measurements were conducted, are shown in Fig. 1.

Results

The measured susceptance data were found to be log-normal distributed and all statistical cal-

FIG. 1: Outside daytime temperature and ambient relative humidity for all days where stratum corneum hydration measurements were conducted.

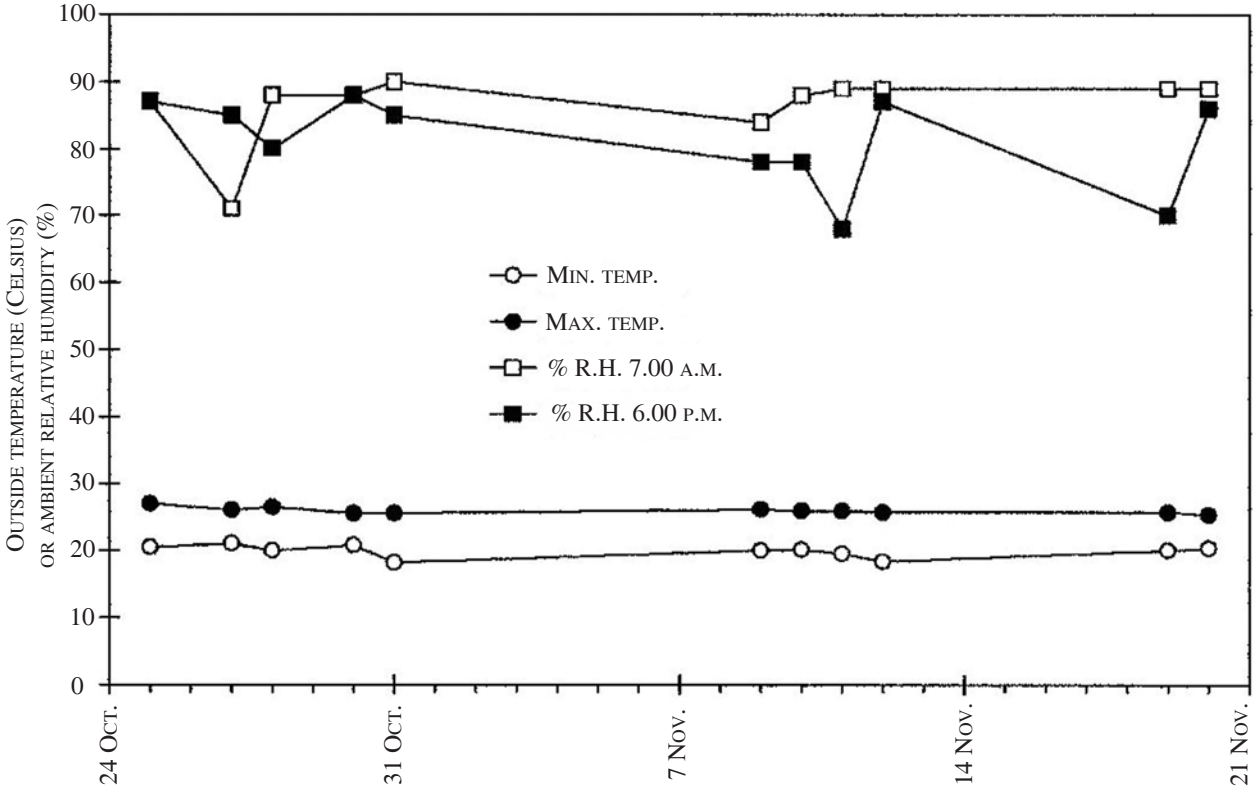


FIG. 2: Box-plot showing median value (line), mean value (cross), middle 50% (box) and smallest and largest point within 1.5 interquartiles from the box (whiskers) of all morning measurements on days A, B and C.

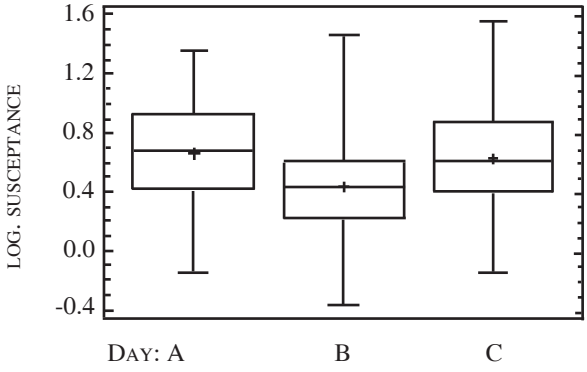
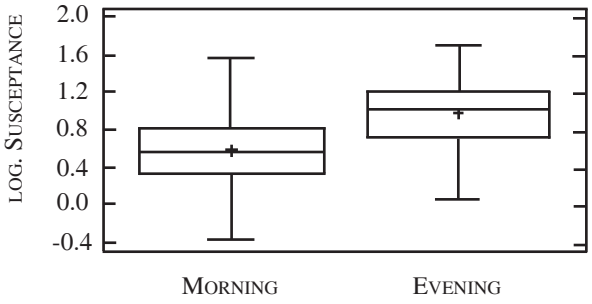


FIG. 3: Box-plot showing median value (line), mean value (cross), middle 50% (box) and smallest and largest point within 1.5 interquartiles from the box (whiskers) of all morning and evening measurements.



culations were hence performed on the logarithm of the data. The results from all the morning measurements are shown graphically in Fig. 2, as the logarithm of the measured susceptance, for days A, B and C.

A two-way ANOVA (factors = skin site and day) was performed on the morning measurements. The analysis showed that the logarithm of the susceptance, and hence the stratum corneum hydration, is significantly lower on day B than on day A ($p<0.05$), and furthermore significantly higher on day C than on day B. On the other hand, there is no significant difference between days A and C.

A graphical plot of all morning and evening measurements is shown in Fig. 3. A paired sample T-test showed that there is a significant difference between the morning and evening readings ($p<0.05$).

Discussion

Low frequency electrical susceptance measurements have earlier been found to be the preferred method for stratum corneum hydration assessment, as this parameter is highly sensitive to changes in skin hydration and furthermore unaffected by deeper skin layers, sweat duct filling or temperature fluctuations (2, 3, 6). The method is implemented in the commercially available SensoDerm, which was used in this study. The instrument measures stratum corneum susceptance in $\mu S/cm^2$, which we have found to be exponentially dependent on the absolute water content of the stratum corneum (unpublished data).

Hence, when we perform all statistical analysis on the logarithm of the measured susceptance, as described in the results section in this paper, in order to meet the criteria for normality, we actually derive values that are directly proportional to the moisture content of the stratum corneum. Skin hydration decreased during the first period of the stay and then increased again in the last period. We interpret this as being due to two different mechanisms that result from the treatment and healing of the skin.

Firstly, the direct effects of e.g. the seawater (8) and skin moisturisers are to increase the hydration of the stratum corneum. Secondly, there will be a restoration of the barrier function of the skin because of the curative effect of the climate and the treatment with skin moisturisers. This will generally reduce the skin hydration because of reduced water flux through the stratum corneum (1). Presumably, the latter effect dominates the two first weeks. Then the changes

due to improved barrier function become less pronounced, and the direct effect of bathing and skin moisturisers is more apparent.

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