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Literature List

Skin-Thermometer

L. Ambroisine, K. Ezzedine, A. Elfakir, S. Gardinier, J. Latreille, E. Mauger, M. Tenenhaus, C. Guinot, Relationships between visual and tactile features and biophysical parameters in human facial skin, Skin Research and Technology 2007; 13: p. 176 – 183

Skin properties, such as colour, hydration and texture, can be studied on a qualitative basis by a clinical assessment or on a quantitative basis using techniques that measure biophysical properties of the skin. The aim of this study was to explore the links between facial skin features and a range of skin biophysical parameters using multivariate methods.

A. del Pozo, M. Solans, C. Fernandez, M. Dolz, Corrias, M. Herráez, O. Diez-Sales, Efficacy evaluation and characterization of chitosan nano emulsions with Spirulina hydroglycolic extract, IFSCC Barcelona 2008 Presentation and Poster

Nanoemulsions represent an interesting prospect for use as vehicles in the development of formulations to deliver active ingredients to the human body. Particularly, nanoemulsion formulations have been shown to be superior for transdermal and dermal delivery of hydrophilic and lipophilic compounds, compared to conventional vehicles, such as hydrogels and emulsions. Lecithins (phosphatidylcholines) have been used in several studies as surfactants for topical nanoemulsion vehicles. These surfactants are able to form nanoemulsions without cosurfactants. In this context, less surfactant is associated with lesser irritation.

C. Try, R. Messikh, A. Elkhyat, J.M. Sainthillier, C. Vidal, T. Lihoreau, S. Mac-Mary, A. Jeudy, P. Humbert, Biometrological Assessment of Sweat Secretion. Clinical Study of Oral Oxybutynin in Primary Hyperhidrosis, ISBS 2010 Buenos Aires, Argentina

Primary hyperhidrosis may be a disabling condition causing emotional stress and negative impact on a patient's quality of life. Oral anticholinergics are some of the treatments available. There are few published data on the use of the anticholinergic drug oxybutynin given orally in the treatment of hyperhidrosis. To evaluate the efficacy and the safety of oral oxybutynin in the treatment of primary hyperhidrosis. From January to June 2010, patients with primary hyperhidrosis were treated with oral oxybutynin in the Department of Dermatology, Besançon, France, and attended follow-up. Treatment was started with oxybutynin 2.5 mg three times daily during 3 days. The 3 following days, the dose of oxybutynin was increased at 5 mg per day. Patients then took 7.5 mg of oxybutynin per day during 24 days. The study lasted 1 month from the first day of oxybutynin treatment. Patients were evaluated every two weeks by clinical and biometrologic methods. The following parameters were assessed on the palm and plant: degree of sweating was determined by measuring Trans Epidermal Water Loss (TEWL) using a double-probe Tewameter (TM 300; Courage+Khazaka), skin temperature (Thermometer® ST500), skin pH (pH-meter, PH 900) and skin hydration (Corneometer®, CM 825).

G. Mayeux. E. Xhaufnaire-Uhoda, G.E. Piérard, Patterns of aluminium hydroxychloride deposition onto the skin, Skin Research and Technology, 2011

The normal stratum corneum (SC) is nearly impermeable except for some small size xenobiotics and a minute amount of water evaporating from its surface. This property supports the concept of a diffusional barrier function that may be weakened in some conditions. The

remarkable barrier effect results from the highly organized structure of the SC. The predominant route for water passage is thought to reside in the intercorneocyte path composed of a complex mixture of lipids structured in rigid bilayer arrays. In practice, the measurement of transepidermal water loss (TEWL) is performed at rest in a cool environment in order to assess this physiological process. Under physical or emotional stress, TEWL is severely altered by sweating.

E. Xhaufaire-Uhoda, G. Mayeux, P. Quatresooz, A. Scheen, G.E. Piérard, Facing up to the imperceptible perspiration. Modulatory influences by diabetic neuropathy, physical exercise and antiperspirant, Skin Research and Technology 2011; 17: p. 487-493

Eccrine Sweating is under the control of the cholinergic sympathetic innervation. It plays an essential role in regulating body temperature in physiologic and pathologic conditions. This function is altered by some systemic diseases including diabetic neuropathy, which commonly involves the distal sensorimotor innervation. The resulting peripheral sweating deficit is often responsible for unequivocal abnormalities of length-dependent thermoregulatory sweating. Hence, the legs affected by diabetic neuropathy most often present hypohidrosis that has been thought to be compensated by hyperhidrosis on the upper body regions. Other sweating changes in diabetes include segmental hypohidrosis and more rarely isolated dermatome involvement.

P. Kleesz, R. Darlenski, J.W. Fluhr, Full-Body Skin Mapping for Six Biophysical Parameters: Baseline Values at 16 Anatomical Sites in 125 Human Subjects, Skin Pharmacol Physiol 2012; 25; p. 25-33

The skin, as the outermost organ, protects against exogenous hazards (outside-in barrier) and prevents the loss of essential parts of the body (inside-out barrier) The epidermal barrier exerts several functions with specific morphological elements. Regional differences in skin functions are well known. The aim of the present study was to assess and compare skin physiological parameters in vivo at 16 anatomical sites: Barrier function in terms of transepidermal water loss (TEWL), stratum corneum (SC) hydration (assessed by capacitance), skin surface pH, skin surface temperature, erythema index and skin pigmentation were quantified at 16 anatomical sites under basal conditions.

G.-B. Fan, P.-L. Wu, X.-M. Wang, Changes of oxygen content in facial skin before and after cigarette smoking, Skin Research and Technology 2012; 18; 511-515

Cigarette smoking is directly related to several potentially fatal conditions, including cardiovascular disease, chronic obstructive pulmonary disease, bronchial carcinoma, and cancer (1). Several studies had indicated that cigarette smoking affects the facial skin leading to wrinkles and pale-gray color tone of the skin, a condition often referred to as premature skin aging (2-4). Cigarette smoke contains a large number of free radicals and redox-active compounds. There is considerable evidence showing that reactive oxygen species (ROS) are the key contributors to the degradation (5-7). In addition, the change in the oxygen content of the facial skin after smoking may also be related to lipid peroxidation and protein degradation, although this has not been empirically evaluated.

C. Try, R. Messikh, A. Elkhyat, F. Aubin, P. Humbert, Utilisation de oxybutynine a la posologie de 7,5 mg par jours dans le traitement des hyperhidroses primitives, Rev Med Liège 2012; 67: 10: p. 520-526

Oxybutynin is being increasingly being prescribed in the treatment of hyperhidrosis but currently, there is no precise dosage for this treatment. Nine patients were treated for primary hyperhidrosis resistant to conventional therapies with oxybutynin between January to May 2010. The treatment was progressively increased at 7.5 mg per day. Oxybutynin efficacy was evaluated by iodine starch test and biometrological measurements at 2 and 4 weeks of treatment. Hyperhidrosis Disease Severity Scale (HDSS) and Dermatology Life Quality Index (DLQI) were obtained for each patient. The means of HDSS and DLQI were respectively 3.2 ± 0.7 and 17.0 ± 5.1 before treatment and were 1.8 ± 0.4 and 4.6 ± 4.4 at 4 weeks of treatment.

Oxybutynin at 7.5 mg per day significantly decreased intensity and area of sweat for palms but not for soles. Trans Epidermal Water Loss, conductance, pH and Skin temperature were modified with treatment. Oxybutynin at 7.5 mg per day has improved patient's quality of life. Efficiency of oxybutynin in primary palmar hyperhidrosis was proved by biometrological measurements and iodine starch test. (*Article in French*)

*C. Uhl, D. Khazaka, **Techniques for globally approved skin testing**, Personal Care April 2013*

In efficacy testing and claim support for cosmetic products, objective measurement systems became indispensable long ago, especially since subjective clinical assessments are often prone to bias and inter-observer variation. Without suitable instrumentation it is close to impossible to determine what a product is really doing for the skin. Those objective measurement methods and subjective evaluations are mutually dependent. No measurement can be performed without the subjective evaluation of the results by the user of such instrumentation. However, a pure subjective evaluation of the skin without appropriate measurement techniques is not able to achieve accurate results either. This relationship becomes clearer when looking for example at skin colour measurements. Subjectively, the human brain cannot process slight changes in colour, especially when the colours are not viewed side by side, but at different points in time. Instrumental measurement however will clearly detect such slight changes. The achieved result must then be interpreted in context with the expected outcome or the hypothesis. For this, you will always need a knowledgeable and experienced person because 'a fool with a tool is still a fool', as the late Albert Kligman used to say. This relationship between objective measurement and subjective evaluation is not only true for the determination of differences in skin colour, but also for all other skin measurement parameters important for the cosmetic industry.

*X. Li, C. Galzote, X. Yan, L. Li, X. Wang, **Characterization of Chinese body skin through in vivo instrument assessments, visual evaluations, and questionnaire: influences of body area, inter-generation, season, sex, and skin care habits**, Skin Research and Technology 2014; 20: 14-22*

Background/Purpose: The varying influence of multiple factors (e.g., aging, sex, season, skin care habits) on skin structure and function necessitates study within ethnic groups to fully characterize their skin. Methods: Men and women aged 40-50 years (n=43) and their consanguineous same sex-children, aged 18-25 years (n=43), living in Chengdu, China were enrolled in this single center, non-interventional study. Volunteers attended two study visits (summer, 2010 and winter, 2011) at which dermatologists measured transepidermal water loss (TEWL), skin hydration, sebum secretion, fine lines/roughness, melanin/erythema, temperature, and color, and clinically graded participants' skin.

*J. Kottner, G. Dobos, A. Andruck, C. Trojahn, J. Apelt, H. Wehrmeyer, C. Richter, U. Blume-Peytavi, **Skin response to sustained loading: A clinical explorative study**, Journal of Tissue Viability (2015) 24, 114 – 122*

Abstract Background: Severe illness, disability and immobility increase the risk of pressure ulcer development. Pressure ulcers are localized injuries to the skin and/or underlying tissue as a result of long enduring pressure and shear. Little is known about the role of the stratum corneum and the upper skin layers in superficial pressure ulcer development. Objectives: To investigate possible effects of long enduring loading on the skin barrier function under clinical conditions at two pressure ulcer predilection sites. Methods: Under controlled conditions 20 healthy females (mean age 69.9 (3.4) years) followed a standardized immobilization protocol of 90 and 150 min in supine position wearing hospital nightshirts on a standard hospital mattress. Before and immediately after the loading periods skin surface temperature, stratum corneum hydration, transepidermal water loss and erythema were measured at the sacral and heel skin. Results: Prolonged loading caused increases of skin surface temperature and erythema at the sacral and heel skin. Stratum corneum hydration remained stable. Transepidermal water loss increased substantially after loading at the heel but not at the sacral skin. Conclusions: Skin functions change during prolonged loading at the

sacral and heel skin in aged individuals. Accumulation of heat and hyperaemia seem to be primarily responsible for increasing skin temperature and erythema which are associated with pressure ulcer development. Increased transepidermal water loss at the heels indicate subclinical damages of the stratum corneum at the heel but not at the sacral skin during loading indicating distinct pathways of pressure ulcer development at both skin areas.

*E. Hahnel, U. Blume-Peytavi, C. Trojahn, G. Dobos, A. Stroux, N. Garcia Bartels, I. Jahnke, A. Lichterfeld-Kottner, H. Neels-Herzmann, A. Klasen, J. Kottner, **The effectiveness of standardized skin care regimens on skin dryness in nursing home residents: A randomized controlled parallel-group pragmatic trial**, International Journal of Nursing Studies 70 (2017) 1–10*

Background: Aged residents of institutional long-term care facilities are at high risk for developing skin and tissue diseases. Besides various common skin problems, dry skin (xerosis cutis) is one of the most frequent skin conditions in this setting.

*E. Hahnel, U. Blume-Peytavi, C. Trojahn, J. Kottner, **Associations between skin barrier characteristics, skin conditions and health of aged nursing home residents: a multicenter prevalence and correlational study**, BMC Geriatrics (2017) 17:263*

Background: Geriatric patients are affected by a range of skin conditions and dermatological diseases, functional limitations and chronic diseases. Skin problems are highly prevalent in elderly populations. Aim of this study was to investigate possible associations between health, functional and cutaneous variables in aged long-term care residents. Methods: This observational, cross-sectional, descriptive prevalence study was conducted in a random sample of 10 institutional long-term care facilities in Berlin. In total, n = 223 residents were included. Demographic and functional characteristics, xerosis cutis, incontinence associated dermatitis, pressure ulcers and skin tears were assessed. Stratum corneum hydration, transepidermal water loss, skin surface pH and skin temperature were measured. Data analysis was descriptive and explorative. To explore possible bivariate associations, a correlation matrix was created. The correlation matrix was also used to detect possible collinearity in the subsequent regression analyses. Results: Mean age (n = 223) was 83.6 years, 67.7% were female. Most residents were affected by xerosis cutis (99.1%; 95% CI: 97.7% - 100.0%). The prevalence of pressure ulcers was 9.0% (95% CI: 5.0% - 13.0%), of incontinence associated dermatitis 35.4% (95% CI: 29.9% - 42.2%) and of skin tears 6.3% (95% CI: 3.2% - 9.5%). Biophysical skin parameters were not associated with overall care dependency, but with age and skin dryness. In general, skin dryness and measured skin barrier parameters were associated between arms and legs indicating similar overall skin characteristics of the residents. Conclusion: Prevalence of xerosis cutis, pressure ulcers and skin tears were high, indicating the load of these adverse skin conditions in this population. Only few associations of demographic characteristics, skin barrier impairments and the occurrence of dry skin, pressure ulcers, skin tears and incontinence-associated dermatitis have been detected, that might limit the diagnostic value of skin barrier parameters in this population. Overall, the measured skin barrier parameters seem to have limited diagnostic value for the reported skin conditions except xerosis cutis.

*E. Hahnel, U. Blume-Peytavi, C. Trojahn, G. Dobos, A. Stroux, N. Garcia Bartels, I. Jahnke, A. Lichterfeld-Kottner, H. Neels-Herzmann, A. Klasen, J. Kottner, **The effectiveness of standardized skin care regimens on skin dryness in nursing home residents: A randomized controlled parallel-group pragmatic trial**, International Journal of Nursing Studies 70 (2017) 1–10*

Background: Aged residents of institutional long-term care facilities are at high risk for developing skin and tissue diseases. Besides various common skin problems, dry skin (xerosis cutis) is one of the most frequent skin conditions in this setting. Objectives: To investigate the effectiveness of two structured skin care regimens in comparison to routine skin care on xerosis cutis in nursing home residents. Design: A multi-center, pragmatic, randomized, controlled, investigator blinded study with three parallel groups. Settings: The study was

conducted in a random sample of ten out of 291 institutional long-term care facilities of the federal state of Berlin, Germany. Participants: Long-term care residents being 65+ years affected by dry skin were included. Methods: The residents were allocated into one of three study groups. Two interventional groups used standardized skin care regimens, consisting of a body wash and twice daily applications of leave-on products for eight weeks. The third control group performed skin care as usual. All participating residents were examined at baseline and after 4 and 8 weeks. Xerosis cutis was measured with the Overall Dry Skin score. Instrumental skin barrier measurements were performed at baseline and after 8 weeks. Diaries were used to document washing and skin care frequencies. Results: In total, 133 residents were included and allocated to one of the three groups. Mean age was 83.8 (SD 8.3) years, 65.4% were female and most residents had care levels I (42.9%) or II (42.9%) according to the German Social Code Book XI. Mean Barthel score was 46.8 (SD 24.2) and mean Braden score was 17.6 (SD 3.7). Leg skin areas were drier compared to arms and trunk areas. At the end of the study the Overall Dry Skin scores in the intervention groups were lower compared to the control group. There were statistically significant improvements of skin dryness in both intervention groups compared to the control group over time. Conclusions: The results of this pragmatic trial indicate that structured skin care regimens are effective in reducing skin dryness in aged nursing home residents within eight weeks.

T. Tomova-Simitchieva, A. Lichterfeld-Kottner, U. Blume-Peytavi, J. Kottner, Comparing the effects of 3 different pressure ulcer prevention support surfaces on the structure and function of heel and sacral skin: An exploratory cross-over trial, International Wound Journal, 2017; p. 1–9

Special support surfaces are key in pressure ulcer prevention. The aim of this study was to measure the effects of 3 different types of mattresses (reactive gel, active alternating air, basic foam) on skin properties of the sacral and heel skin after 2 hours loading. Fifteen healthy females (median age 66 years) were included. Transepidermal water loss, skin surface temperature, erythema, stratum corneum hydration, epidermal hydration, skin extensibility, elastic function, and recovery as well as skin roughness parameters were measured under controlled room conditions before loading, immediately after loading, and 20 minutes postloading in the supine position on the different mattresses. The highest increases in transepidermal water loss, skin temperature, and erythema were observed for the foam mattress after loading, indicating higher deformation and occlusion. Cutaneous stiffness decreased in all 3 groups, indicating structural changes during loading. There was a substantial decrease of mean roughness at the heel skin in the foam group, leading to a flattening of the skin surface. Study results indicate that the type of support surface influences skin structure and function during loading. The gel and air mattress appeared to be more protective compared with the foam mattress, but the differences between the gel and air were minor.

I.I. Shuvo, K. Chakma, D. Toutant, Prospect of 3D Warp Knitted Spacer Fabric and its Effect on Pressure Relieve for Reducing the Prevalence of Pressure Ulcers for Immobile Patients, Journal of Textile Science & Engineering, Volume 8, Issue 1, 2018

Many hospitals use paper thin bed sheets with high friction coefficients which are not ideal for patients with pressure ulcers and who are at risk of developing. These patients suffer a great deal of pain, which could have been prevented. Lying on a weak bed sheet with no regards to regulating micro-climate is a clear promoter of pressure ulcers. Another key factor of a hospital bed sheet is they are to be easily washed or disposed of because of all the unknown fluids that could seep onto the sheet. Therefore, the sheet must not only be to comfort those with pressure ulcers but to be easily washable and reusable. Again, in a hospital setting being able to easily wash the sheet and for it to hold its form is significant for reducing the cost of throwing away sheets less often. Therefore a theory has been proposed to design a 3D knit spacer bed sheet that will allow patients with pressure ulcers to be comfortable by ensuring a low friction coefficient between their skin and the material. The friction coefficient will be reduced by not only the structure but by the 70 percent polyester, 22 percent polypropylene and eight percent spandex blend. The friction coefficient will stay low due to a high wicking and

evaporation capability to ensure the skin stays dry as well as the material. The 3D knit spacer bed sheet also has a higher compressibility which distributes pressure more evenly as well as enabling a care giver to easily rotate an immobile person into a new position. The proposed bed sheet will be easily washable to ensure all bodily fluids such as vomit, blood, and others have been removed. This blanket will be slightly more expensive but is expected to last longer than a typical hospital bed sheet.

*T. Yazdanparast, K. Yazdani, P. Humbert, A. Khatami, S.A. Nasrollahi, H. Zartab, L. Izadi Firouzabadi, A. Firooz, **Biophysical and ultrasonographic changes in lichen planus compared with uninvolved skin**, International Journal of Women's Dermatology 5 (2019), p. 100–104*

Background: Lichen planus (LP) is a chronic inflammatory disease of the skin. Currently, noninvasive techniques are used to evaluate biophysical properties of the skin in vivo. **Objective:** In this study, we aimed to evaluate skin biophysical properties in patients with LP and make a comparison between involved and uninvolved skin to provide a better understanding of the pathogenesis of LP. **Methods:** The stratum corneum hydration, transepidermal water loss, pH, erythema, melanin, sebum, friction, temperature, elasticity parameters (R0, R2, R5), and thickness and echo-density of the epidermis, dermis, and subepidermal low echogenic band were measured on lesions of classic LP in 21 patients and compared with the average of perilesional and symmetrical uninvolved skin (as control) with a paired t test. **Results:** Stratum corneum hydration ($p = .002$), sebum ($p = .04$), R0 ($p = .005$), and echo-density of the dermis ($p = .005$) were significantly lower, but pH ($p = .007$), melanin content ($p < .001$), erythema ($p < .001$), temperature ($p = .01$), thickness of dermis ($p = .02$), and subepidermal low echogenic band ($p < .001$) were significantly higher in LP lesions. **Conclusion:** An evaluation of its biophysical, biomechanical, and ultrasonographic characteristics showed that the skin is an objective, noninvasive, and quantitative measuring tool that can be used to provide valuable information about skin changes in classic LP.

*F. Elban, E. Hahnel, U. Blume-Peytavi, J. Kottner, **Reliability and agreement of skin barrier measurements in a geriatric care setting**, Journal of Tissue Viability online, July 2020*

Background: The non-invasive skin barrier measurements transepidermal water loss, stratum corneum hydration and the skin surface pH are widely used in clinical skin research. Relative and absolute measurement errors of these measurements are unknown in geriatric care settings. **Material and methods:** Transepidermal water loss, stratum corneum hydration, skin surface pH and temperature were measured on the volar forearm and lower leg twice by trained raters within a cross-sectional study in ten nursing homes. Intrarater reliability was calculated using the ICC (1,1). Intrarater agreement was analyzed using Bland Altman Plots with limits of agreement. **Results:** Two hundred twenty-three residents were included and mean age was 84.2 years. The highest ICC was found for transepidermal water loss and skin surface temperature of the leg with 0.95 (95% CI 0.93 to 0.96). The ICC of the stratum corneum was 0.91 (95% CI 0.88 to 0.93) for both investigated skin areas. The measurement of the pH at the lower leg had the lowest ICC with 0.73 (95% CI 0.66 to 0.78). Highest limits of agreement of approximately 8 a.u. were calculated for stratum corneum hydration and lowest limits of agreement of approximately 1 °C were calculated for skin surface pH. **Conclusion:** Relative measurement errors of transepidermal water loss and stratum corneum hydration were very low indicating that single measurements provide reliable estimates in this population and setting. However, the absolute measurement errors were high for both of these parameters. To increase reliability of skin surface pH we recommend at least two repeated measurements.