



LONDON · UK

EWMA · LONDON 2015

Submitted to EWMA Journal, Based on presentation given in the key session Wound Care & Geriatrics / Dementia in Wound Care.

Of Youth and Age - What are the Differences Regarding Skin Structure and Function?

INTRODUCTION

The skin is often regarded as the largest organ of the human body, fulfilling a variety of tasks. It forms a boundary between the inside of the body and the usually dryer and cooler environment, provides protection against mechanical and chemical threats, participates in innate and adaptive immune defences, enables vitamin D production, acts as a sensory organ, and has important psychosocial functions^{1,2}. From birth until death, the skin and subcutaneous tissues grow, mature and age.

SKIN AGEING AND CLINICAL CHALLENGES

The physiologic cause of skin ageing is often called 'intrinsic' ageing³. This is a time-dependent, stochastic process. Intrinsically aged skin has a lax appearance with decreased elasticity and fine wrinkles^{3,4}. Continuous and repeated exposures to environmental factors, such as ultraviolet radiation, air pollution, and smoking, lead to 'extrinsic' skin ageing. This type of skin ageing results in coarse wrinkles, increased thickness, and dyspigmentation^{5,6}.

In addition to these morphological changes, skin and tissue ageing leads to the loss of functional capacity⁷. The skin is less able to cope with external stresses and is more susceptible to a wide range of age-related conditions, diseases, injuries, and wounds^{4,8,9}.

For example, altered lipid content and reduced water, sebum production, and natural moisturizing factors of the stratum corneum may cause dry skin and pruritus. Empirical evidence suggests that dry skin (xerosis cutis), including cracks and inflammation (eczema craquelé), is one of the most frequent skin conditions in the elderly (Fig. 1). The prevalence varies between 6% and 77% in outpatient settings^{10,11} and between 30%

and 85% in long-term care^{12,13}. There is a clear association between dry skin and pruritus, which is one of the most distressing and burdensome skin symptoms in the elderly. Across all care settings, the prevalence of pruritus ranges from 1%¹⁴ to 36%¹⁵. Severely dry skin leads to a high risk of secondary infection.

An impaired acidification of the skin surface leads to decreased stratum corneum cohesion, disturbed skin barrier recovery, and increased susceptibility to pathologic colonization and infection^{16,17}. Due to diminished immune responses, aged skin reacts more slowly to irritants and allergens but is more susceptible to infections¹⁸. Fungal infections of the feet, especially between the toes and of the nails, are also very frequent in the elderly populations (Fig. 2)¹⁹. Approximately one half of long-term care patients is affected by tinea unguium²⁰. The prevalence of tinea pedis ranges from 18% in home care¹² to 34% in nursing homes²¹.

The flattening of the dermalepidermal junction increases the risk for shear-type injuries, such as skin tears, and bullae formation. There is substantial evidence that chronological age is an independent predictor for the reduced strength of the dermoepidermal adhesion²². Due to a loss of collagen and extracellular matrix proteins, the dermis becomes thinner. Aged skin is less elastic and less deformable, increasing the susceptibility to deformation injuries, such as pressure ulcers²³. Decreases of dermal vessels and capillary loops²⁴ lead to impaired thermoregulation. A selection of age-related changes and associated risks and conditions is shown in (Table 1). A pronounced loss of functional and protective capacity may result in extreme fragility, leading to lacerations, nonhealing atrophic ulcers, and dissecting hematomas²⁵.



Jan Kottner
PhD, Scientific Director
Clinical Research
Charité-Universitätsmedizin
Department of Dermatology
and Allergy, Clinical
Research, Center for Hair
and Skin Science
Berlin, Germany.

Correspondence:
jan.kottner@charite.de

Conflicts of interest: None



Figure 1.
Dry skin with cracks and inflammation (Eczema craquelé).



Figure 2.
Fungal infection of the nail (Onychomycosis).

Table 1. Selected age-related skin and subcutaneous tissue changes and clinical relevance^{4, 8, 34}

	Changes	Risks and conditions
Skin surface	<ul style="list-style-type: none"> • Increase of pH 	<ul style="list-style-type: none"> • Pathologic colonization and infection • Reduced cohesion of the stratum corneum
Epidermis	<ul style="list-style-type: none"> • Reduced stratum corneum hydration • Altered intercellular lipid composition and corneocyte morphology • Reduced barrier function • Reduced number and function of melanocytes and Langerhans cells • Dysregulation of cytokine function • Change in number and function of antimicrobial peptides • Reduced activity of basal cells and reduced epidermal turnover 	<ul style="list-style-type: none"> • Xerosis cutis, pruritus • Increased susceptibility against physical, chemical, and biological insults (“immunosenescence”) • Increased risks for actinic keratosis and tumors • Delayed epithelialization and barrier recovery
Dermo-epidermal junction	<ul style="list-style-type: none"> • Flattening 	<ul style="list-style-type: none"> • Increased risk for shear-type injuries (skin tears) and blister development
Dermis	<ul style="list-style-type: none"> • Reduced number of dermal papillae • Reduced sensory perception • Reduced dermal circulation and PIV • Reduced collagen production 	<ul style="list-style-type: none"> • Increased risk for injuries (e.g., due to heat) and ulceration • Delayed wound healing • Altered thermoregulation
Subcutis	<ul style="list-style-type: none"> • Atrophy 	<ul style="list-style-type: none"> • Increased risk for injuries and pressure ulcers

Abbreviation: PIV, pressure-induced vasodilation.

SKIN CARE IN THE ELDERLY

Preventive strategies play a major role in maintaining and enhancing skin and tissue integrity and health in elderly individuals^{8, 26}. These strategies include not only well-known approaches to preventing specific conditions, such as diabetic foot²⁷ or pressure ulcers²⁸, but also general health promoting skin care strategies, including healthy lifestyles and appropriate cleansing and skin care^{8, 29}. The current evidence supporting skin care practice in the elderly is poor. One reason is that the elderly populations are frequently excluded from clinical trials, especially in skin research⁹. However, based on recent systematic literature reviews³⁰⁻³² and clinical experience³³, selected best practice recommendations include:

- Limit exposure to water and alkaline soaps. Use slightly acidic, mild cleansers. Avoid cleansing products containing anionic surfactants, are found in traditional soaps.
- Avoid or limit immersion in water, such as full baths.
- Keep the water temperature cool. Do not use hot water.
- Dry the skin carefully and gently but thoroughly, especially in areas of skin-to-skin contact.

- Apply moisturizers with a high content of lipids regularly for dry skin.
- Do not apply moisturizers in skin folds or the skin between the toes.
- Avoid skin exposure to urine, stool, and other body fluids. Use a skin protectant if urine or stool comes in contact with the skin.

OUTLOOK

Despite the above-mentioned risks, skin ageing per se is not a disease that must be treated. Ageing is a normal biological process affecting every organ and biological system. However, compared to the skin of youth, aged skin is compromised in many ways. Besides physiologic skin and tissue alterations over time, aged skin may also be negatively affected by other circumstances common in the elderly, including general functional impairments (e.g., immobility, incontinence), chronic disease (e.g., diabetes mellitus), and medications commonly used in geriatric care²³. Thus, preventive skin care strategies are of the utmost importance to maintain skin integrity in the increasing elderly population. ■

REFERENCES

1. Chuong CM, Nickoloff BJ, Elias PM, Goldsmith LA, Macher E, Maderson PA, et al. What is the 'true' function of skin? *Experimental Dermatology*. 2002 Apr;11(2):159-87.
2. Gupta MA, Gilchrist BA. Psychosocial aspects of aging skin. *Dermatologic Clinics*. 2005 Oct;23(4):643-8.
3. Pierard GE, Paquet P, Xhauflaire-Uhoda E, Quantresooz P. Physiological Variations During Aging. In: Farage MA, Miller KW, Maibach HI, editors. *Textbook of Aging Skin*. Berlin: Springer; 2010. p. 45-54.
4. Gilchrist BA. Skin aging and photoaging: an overview. *Journal of the American Academy of Dermatology*. 1989 Sep;21(3 Pt 2):610-3.
5. Dobos G, Trojahn C, Lichterfeld A, B DA, Patwardhan SV, Canfield D, et al. Quantifying dyspigmentation in facial skin ageing: an explorative study. *International Journal of Cosmetic Science*. 2015 Oct;37(5):542-9.
6. Dobos G, Lichterfeld A, Blume-Peytavi U, Kottner J. Evaluation of skin ageing: a systematic review of clinical scales. *The British Journal of Dermatology*. 2015 May;172(5):1249-61.
7. Ghadially R, Brown BE, Sequeira-Martin SM, Feingold KR, Elias PM. The aged epidermal permeability barrier. Structural, functional, and lipid biochemical abnormalities in humans and a senescent murine model. *The Journal of Clinical Investigation*. 1995 May;95(5):2281-90.
8. Kottner J, Lichterfeld A, Blume-Peytavi U, Kuhlmeier A. Skin health promotion in the elderly. *Zeitschrift für Gerontologie und Geriatrie*. 2015 Apr;48(3):231-6.
9. Chang AL, Wong JW, Endo JO, Norman RA. Geriatric dermatology review: Major changes in skin function in older patients and their contribution to common clinical challenges. *Journal of the American Medical Directors Association*. 2013 Oct;14(10):724-30.
10. Yap KB, Siew MG, Goh CL. Pattern of skin diseases in the elderly seen at the National Skin Centre (Singapore) 1990. *Singapore Medical Journal*. 1994 Apr;35(2):147-50.
11. Paul C, Maumus-Robert S, Mazereeuw-Hautier J, Guyen CN, Saudez X, Schmitt AM. Prevalence and risk factors for xerosis in the elderly: a cross-sectional epidemiological study in primary care. *Dermatology*. 2011;223(3):260-5.
12. Beauregard S, Gilchrist BA. A survey of skin problems and skin care regimens in the elderly. *Archives of Dermatology*. 1987 Dec;123(12):1638-43.
13. Weismann K, Krakauer R, Wanscher B. Prevalence of skin diseases in old age. *Acta dermato-venereologica*. 1980;60(4):352-3.
14. Siragusa M, Schepis C, Palazzo R, Fabrizi G, Guarneri B, Del Gracco S, et al. Skin pathology findings in a cohort of 1500 adult and elderly subjects. *International Journal of Dermatology*. 1999 May;38(5):361-6.
15. Adam JE, Reilly S. The prevalence of skin disease in the geriatric age group. *The Australasian Journal of Dermatology*. 1987 Aug;28(2):72-6.
16. Behne MJ, Meyer JW, Hanson KM, Barry NP, Murata S, Crumrine D, et al. NHE1 regulates the stratum corneum permeability barrier homeostasis. Microenvironment acidification assessed with fluorescence lifetime imaging. *The Journal of Biological Chemistry*. 2002 Dec 6;277(49):47399-406.
17. Hachem JP, Crumrine D, Fluhr J, Brown BE, Feingold KR, Elias PM. pH directly regulates epidermal permeability barrier homeostasis, and stratum corneum integrity/cohesion. *The Journal of Investigative Dermatology*. 2003 Aug;121(2):345-53.
18. Castelo-Branco C, Soveral I. The immune system and aging: a review. *Gynecological endocrinology : the official journal of the International Society of Gynecological Endocrinology*. 2014 Jan;30(1):16-22.
19. Hof H, Mikus G. Candida infections in the elderly. *Zeitschrift für Gerontologie und Geriatrie*. 2013 Jan;46(1):64-70.
20. Kilic A, Gul U, Aslan E, Soyul S. Dermatological findings in the senior population of nursing homes in Turkey. *Archives of Gerontology and Geriatrics*. 2008 Jul-Aug;47(1):93-8.
21. Smith DR, Sheu HM, Hsieh FS, Lee YL, Chang SJ, Guo YL. Prevalence of skin disease among nursing home patients in southern Taiwan. *International Journal of Dermatology*. 2002 Nov;41(11):754-9.
22. Hatje LK, Richter C, Blume-Peytavi U, Kottner J. Blistering time as a parameter for the strength of dermoepidermal adhesion: a systematic review and meta-analysis. *The British Journal of Dermatology*. 2015 Feb;172(2):323-30.
23. Kottner J, Beekman D. Incontinence-associated dermatitis and pressure ulcers in geriatric patients. *Giornale Italiano di Dermatologia e Venereologia*. 2015 Jul 17.
24. Helmbold P, Lautenschlager C, Marsch W, Nayak RC. Detection of a physiological juvenile phase and the central role of pericytes in human dermal microvascular aging. *The Journal of Investigative Dermatology*. 2006 Jun;126(6):1419-21.
25. Kaya G, Saurat JH. Dermatoporosis: a chronic cutaneous insufficiency/fragility syndrome. Clinicopathological features, mechanisms, prevention and potential treatments. *Dermatology*. 2007;215(4):284-94.
26. Gilchrist BA. Geriatric skin problems. *Hospital Practice*. 1986 Sep 30;21(9A):55, 9-65.
27. Bakker K, Apelqvist J, Schaper NC, International Working Group on Diabetic Foot Editorial B. Practical guidelines on the management and prevention of the diabetic foot 2011. *Diabetes/metabolism Research and Reviews*. 2012 Feb;28 Suppl 1:225-31.
28. National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel, Pan Pacific Pressure Injury Alliance. *Prevention and Treatment of Pressure Ulcers: Clinical Practice Guideline*. Osborne Park, Western Australia: Emily Heasler, editor, Cambridge Media; 2014.
29. Cowdell F. Promoting skin health in older people. *Nursing Older People*. 2010 Dec;22(10):21-6.
30. Lichterfeld A, Hauss A, Surber C, Peters T, Blume-Peytavi U, Kottner J. Evidence-Based Skin Care: A Systematic Literature Review and the Development of a Basic Skin Care Algorithm. *Journal of wound, ostomy, and continence nursing : official publication of The Wound, Ostomy and Continence Nurses Society*. 2015 Jul 10.
31. Kottner J, Lichterfeld A, Blume-Peytavi U. Maintaining skin integrity in the aged: a systematic review. *The British Journal of Dermatology*. 2013 Sep;169(3):528-42.
32. Cowdell F, Steventon K. Skin cleansing practices for older people: a systematic review. *International Journal of Older People Nursing*. 2015 Mar;10(1):3-13.
33. Cowdell F. Older people, personal hygiene, and skin care. *Med Surg Nursing*. 2011 Sep-Oct;20(5):235-40.
34. Fenske NA, Lober CW. Structural and functional changes of normal aging skin. *Journal of the American Academy of Dermatology*. 1986 Oct;15(4 Pt 1):571-85.