The effects of pajama fabrics' water absorption properties on the stratum corneum under mildly cold conditions

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Background: The interaction of textiles with the skin is a fertile area for research.

Objective: The aim of this study was to investigate the effects of clothing fabric on the stratum corneum (SC) under mildly cold conditions.

Methods: A longitudinal controlled parallel study was designed to investigate the effects of the liquid/moisture absorption properties of pajama fabrics on the SC water content, transepidermal water loss, skin surface acidity (pH), and sebum.

Results: The hygroscopicity of pajama fabrics had significant associations with the SC water content and transepidermal water loss on the skin of the volunteers' backs. Sebum in the hydrophilic cotton group was slightly lower than in the polyester groups and hydrophobic cotton groups. Subjects felt warmer in the hydrophobic groups than in the hydrophilic groups. The hydrophilicity of the fabric also showed an association with overnight urinary free catecholamines.

Limitations: In this study, detailed components of sebum were not analyzed.

Conclusions: The hygroscopicity of the fabric may be a key factor influencing SC hydration during daily wear under mildly cold conditions. (J Am Acad Dermatol 2011;64:e29-36.)

Key words: clothing fabric properties; sensory response; skin surface acidity; stratum corneum hydration.

Clothing, as a "second skin," plays an important role in temperature regulation and heat balance, and has allowed human beings to expand their habitats around the world. Recently, there has been some interest in the interaction of textiles with the skin.[1,2] Topics studied have included clothing and thermoregulation, ultraviolet protection, application in prevention of skin infections, treatment after burns, irritant dermatitis, and textile allergens.

Abbreviations used:

OUNE:	overnight urinary noradrenaline
SC:	stratum corneum
SCWC:	stratum corneum water content
TEWL:	transepidermal water loss

The stratum corneum (SC) is the actual interface between the outer surface of the epidermis (or skin) and the environment. It provides a vital physical barrier protecting the human body.[3]

Hydration plays an important role in the SC structure and biochemistry. The SC water content (SCWC) and transepidermal water loss (TEWL) are the two indices used to elucidate skin hydration. The SCWC is determined by a number of factors, such as water gain from underlying viable layers of epidermis, the rate of proteolysis (filaggrin breakdown), the blend of natural moisturizing factors, and lipids

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in SC ceramides. In addition, aging in human beings and the humidity of the environment will also affect the SCWC. The TEWL is a key indicator of barrier repair,[4] showing the movement of free or very weakly bound water across the epidermis as a result of the lower relative humidity of the atmosphere.[5] It may be influenced by environmental temperature, relative humidity, thickness of the SC, and the level of membrane hydration.[6]

The acidity of the skin surface is an important part of the skin surface ecosystem, which operates as a protection against microbiological or chemical aggression.[5] It involves: (1) SC permeability barrier homeostasis[7]; (2) extracellular lipid processing[8-11]; (3) SC integrity/cohesion[7,9]; (4) proteolytic processes that are pH dependent, leading to desquamation[9]; and (5) an acidic pH providing important antimicrobial resistance.[12] Both exogenous and endogenous mechanisms have been hypothesized to contribute to SC acidification.[12]

The histidine-to-urocanic acid pathway,[13,14] the phospholipid-to-free fatty acid pathway,[9] and the sodium proton antiporter (NHE1)[15] are largely responsible for SC hydration. The main product of the histidine-to-urocanic acid pathway plays an important role in skin physiology by maintaining SC hydration and affecting ultraviolet protection.[16-18] The products of the phospholipid-to-free fatty acid pathway are free fatty acids, which not only influence the normal SC acidification, but also play an important role in the dual functions of SC integrity and cohesion.[9]

Lipids in the SC are known to play a decisive role in maintaining the barrier function of the skin.[19-21] As the source of two major lipids, cholesterol and free fatty acids, sebum plays a critical role in the barrier function of the skin.[22,23]

How then, does clothing interact with the SC? In 2004, we carried out an experiment to study the effect of wearing cotton or polyester pajamas on SCWC under mildly cold conditions,[24,25] and found that wearing cotton pajamas during nocturnal sleep induced a higher SCWC, a perception of greater warmth, and lower catecholamine levels than wearing polyester; polyester fabric had a negative effect on the SCWC compared with cotton. To clarify whether the differences were caused by the hydrophilicity or the hygroscopicity of the pajamas, and whether the water and moisture absorption of polyester fabric is lower than that of cotton fabric, we designed and conducted this investigation to study the influence of wearing hydrophilic and hygroscopic fabrics on the SC.

CAPSULE SUMMARY

- We studied the influence of the hygroscopicity and hydrophilicity of clothing fabric on the stratum corneum.
- The higher the hygroscopicity of the fabric (eg, cotton) the more beneficial it is for maintaining stratum corneum hydration under mildly cold conditions.
- This could be applied in the management of dry or atopic skin in the wintertime.

METHODS

Experimental pajamas and their physical properties

Four kinds of fabric were prepared to make the pajamas used in this investigation (Table I). Cotton fabric (54.88 N_m yarn, knitted in double face, 95% cotton, 5% spandex) was selected as the strongly hygroscopic fabric, and polyester (32s yarn, knitted in double face, 95% polyester, 5% spandex) as the weak hygroscopic fabric. The polyester fabric was treated with reagent HMW8870 (Herst, Qingdao, China) and the cotton fabric was enzyme desizing to obtain a hydrophilic performance. The cotton and polyester fabrics were treated with reagent WRS-B35 (Advanced, Hong Kong, China) to achieve a hydrophobic performance.

Questionnaires

Subjective responses were obtained from a questionnaire by rating the 6 sensations (dampness, coldness, itchiness, softness, breathability, and overall comfort) on an 11-point scale[26] on the morning of testing day.

The Pittsburgh Sleep Quality Index[27] was applied to obtain the quality and pattern of sleep in this experiment. A global score of 5 or more indicates poor sleep.

Measurements

The SCWC was measured using the Corneometer CM825 (CK Electronic, Köln, Germany).[28-30] The TEWL was measured using the Tewameter TM 300 (CK Electronic).[31] Sebum was measured with the Sebumeter SM 815 (CK Electronic) using a photometric method.[32,33] Skin surface acidity was measured using the Skin-pH-Meter PH 905 (CK Electronic).[34] Overnight urinary noradrenaline (OUNE) was measured using high performance liquid chromatography with electrochemical detection HPLC-ECD (EiCom, Kyoto, Japan).[35]

The physical properties of the pajama fabrics were measured following the standard American Society

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