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CLINICAL REPORT

Characterization of Vulvar Skin of Healthy Thai Women: Influence of Sites, Age and Menopause

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Although the physiological characteristics of vulvar skin have been characterized in Caucasians, little is known about the vulvar skin of Asian women. This study assessed the moisture content, transepidermal water loss (TEWL) and pH of vulvar skin of 99 healthy Asian women residing in Bangkok, aged 20–69 years, during their non-menstrual period, including 39 post-menopausal women. Skin pH was acidic at all sites, and the pH of the vulvar areas was significantly higher than the control sites (inner thigh, inner forearm). Skin moisture was slightly, but significantly, lower around the vulvar area and the thigh than around the forearm. TEWL was significantly higher in vulvar areas than control sites. Ageing and menopause did not cause notable alterations in most properties of vulvar skin. In conclusion, the vulvar skin of Asian women has similar properties to that of Caucasians. ***Key words: vulva; ageing; menopause; Asian; skin physiology.***

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Many studies have been reported concerning the physiology and anatomy of vulvar skin, which is one of the most specialized types of skin (1–8). Several studies have shown that vulvar skin has a greater degree of moisture than skin at other body sites, as measured by transepidermal water loss (TEWL). The higher moisture level in the vulvar area is attributable to occlusion and moisture from blood, sweat and vaginal secretions (2, 4, 5). However, it has been reported that the moisture content of vulvar skin measured by capacitance is equal to, or only slightly higher than, that of forearm skin (2, 4, 7). Studies have shown either no significant difference in skin pH between vulvar and forearm skin (8), or that vulvar skin shows a slightly, but significantly, lower value (2).

Changes in vulvar skin with ageing and menopause have also been characterized (3, 5, 7, 9), but these studies have been limited. Elsner & Maibach (7) reported that there are no significant differences in TEWL and hydration of vulvar skin between pre- and post-menopausal women, and those at different ages. Warren et al. (5) reported that there was no significant difference in the skin surface water loss (SSWL) of vulvar skin with age. Some effects of menopause on the percutaneous absorption of steroids by vulvar skin have also been reported (9).

Although it seems that the physiology of vulvar skin has been well investigated, the above studies have been conducted mainly with the Caucasian (white) ethnic population. Racial differences in skin are well known; for example, it has been reported that Japanese subjects show a higher tendency for skin irritation than do Caucasian subjects (10, 11). Hydration of the stratum corneum (SC) and/or TEWL are also different among ethnicities (12, 13).

The aim of this study was to investigate the vulvar skin properties of Thai women, focusing on functional properties of the SC.

MATERIALS AND METHODS

Subjects and ethics

Subjects who were residing in Bangkok city, Thailand, were recruited to the study. Provision of signed informed consent was necessary for inclusion, and subjects were free to withdraw from the study at any time with no obligation. All data were collected at Srinakharinwirot University, and were analysed at the university and at Kao Biological Science Laboratories. The clinical test was performed according to the Declaration of Helsinki. Prior to the start of the study, the protocol was approved by the ethics committees of Srinakharinwirot University and Kao Biological Science Laboratories. All instrumental analysis and sampling was performed in July 2007.

Inclusion criteria were healthy females, aged 20–69 years, with regular menstrual cycles for at least one year or post-menopausal. Subjects were instructed to avoid sexual activity for at least 24 h prior to each visit and to shower/bathe at approximately the same time in the morning. Subjects with uncontrolled disease, such as diabetes or hypertension, or who were pregnant, nursing or planning to become pregnant during the study, as determined by the health questionnaire, were excluded. Subjects with a known allergy to sanitary napkins, substances used in sanitary napkins or to fragrances were excluded. Subjects who were considered by the study physician as unsuitable to continue the study were also excluded.

Subjects were withdrawn from the study if they developed genital dermatitis, became pregnant, or had a severe communicable disease. When a subject withdrew from the study, her data was excluded from the analysis. All 99 subjects, aged 20–69 years (mean ± SD 43.9 ± 10.9 years) completed the study.

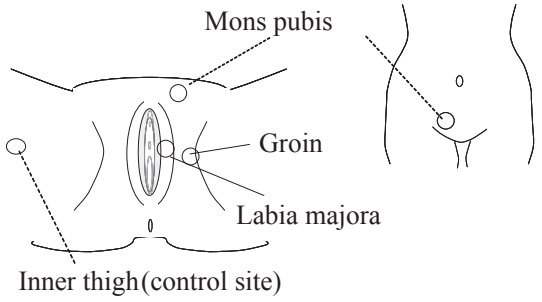

Fig. 1. Measurement sites: labia majora, groin, mons pubis, inner thigh as a control site near the vulvar area, and inner forearm as a neutral control site.

The distribution of subjects at a younger, middle and older post-menopausal age were 30.68 ± 5.57 (mean ± SD 21–39 years, $n = 31$), 43.39 ± 2.87 (40–49 years, $n = 28$), and 54.49 ± 4.29 years (47–60 years, $n = 40$), respectively. The mean post-menopausal period of the post-menopausal group was 6.26 ± 4.38 years.

Measurements

Measurements were performed after each subject had been physically inactive for at least 15 min. All measurements were carried out in the same, well-controlled air-conditioned room, which was kept at approximately 22–25ºC, 50–70% relative humidity, monitored by simple thermo-hygrometer. Subjects took off their undergarment then sit on a gynaecological examination chair, and were then acclimated for 15 min. Dermatologists measured the skin surface moisture (capacitance), TEWL and pH of the vulvar skin area of each subject. Skin moisture was measured with a Corneometer® (CM825, Courage+Khazaka, Cologne, Germany). Skin surface pH level was measured using a Skin-pH-Meter® (PH905, Courage+Khazaka). TEWL was measured using a Tewameter® (TM300, Courage+Khazaka). Measurements were performed at the labia majora, groin, mons pubis and inner thigh as a control site near the vulvar area, as shown schematically in Fig. 1, and at the inner forearm as a neutral control site. All measurements were performed by a dermatologist.

Statistical analysis

The Grubbs-Smirnov rejection test was performed to exclude outliers ($p < 0.01$) followed by statistical analysis. Statistical analysis of measurement data of regional differences in the skin was performed by Student's *t*-test and the significance level was set as $p \leq 0.05/10$, because of Bonferroni correction for multiplicity caused by 5 sites. Statistical analysis of measurement data of ageing and pre- or post-menopause differences was also performed by Student's *t*-test, and the significance level was set as $p \leq 0.05/3$, because of Bonferroni correction for multiplicity caused by 3 groups.

RESULTS

The Grubbs-Smirnov rejection test was performed to exclude outliers at each measurement parameter or site. All Figs were created without outliers.

Differences between sites

Skin pH, skin moisture (capacitance) and TEWL measurements were performed on all 99 subjects, except for several failed measurement items or sites. The results are summarized in Fig. 2. Skin pH was acidic at all sites, and was slightly, but significantly higher around the vulvar area (labia, mons pubis) than at the other 2 control sites (inner thigh and forearm). Skin moisture was significantly lower at the labia, mons pubis and thigh than at the forearm and groin; however, the quantitative differences were slight. On the other hand, TEWL showed significant and great differences between the vulvar around area (labia, groin) and the control sites (thigh, forearm).

Effect of ageing and menopause

The changes in skin pH, skin moisture and TEWL results are summarized in Fig. 3. No significant difference was observed among the younger/middle menstruating subjects and the older post-menopausal subjects, except for skin pH and moisture at the thigh, at the mons pubis, respectively. Individual plots of measurement values vs. age and conditions of menstruation are summarized in Fig. S1 (available from: http://www.medicaljournals.se/acta/content/?doi=10.2340/00015555-1534), which show skin pH, skin moisture and TEWL, respectively.

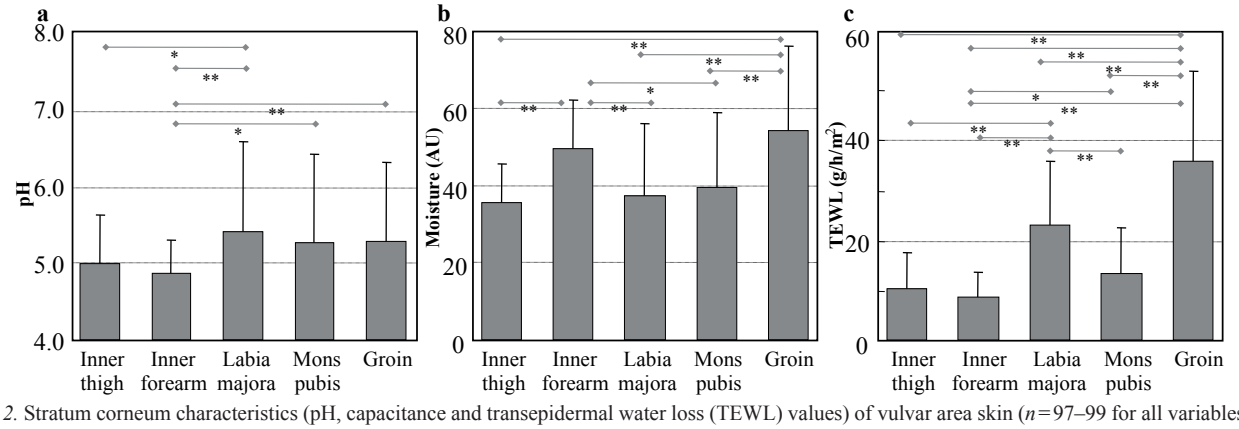

Fig. 2. Stratum corneum characteristics (pH, capacitance and transepidermal water loss (TEWL) values) of vulvar area skin ($n = 97$–99 for all variables). The Grubbs-Smirnov rejection test was performed to exclude outliers ($p < 0.01$) followed by statistical analysis. (a) skin pH; (b) capacitance (skin moisture); (c) TEWL. Statistical analysis of measurement data of regional difference of the skin were performed by Student's *t*-test and the significance level was set as $p \leq 0.05/10$, due to Bonferroni correction for multiplicity. *$p < 0.05/10$, **$p < 0.01/10$.

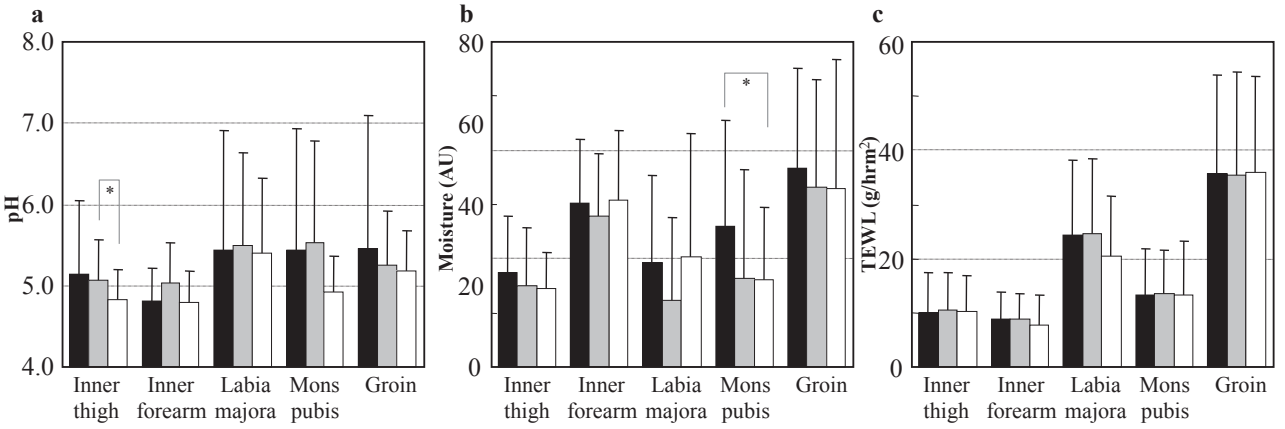

Fig. 3. Age and pre- and post-menopause-related changes of stratum corneum characteristics (pH, capacitance and transepidermal water loss (TEWL) values) (n=31–33 for each subgroup of variables). The Grubbs-Smirnov rejection test was performed to exclude outliers ($p<0.01$) followed by statistical analysis. (a) skin pH; (b) capacitance (skin moisture); (c) TEWL. ■: 21–39 years, menstrual subjects, ■: 40–49 years, menstrual subjects, □: 47–60 years post-menopausal subjects. Statistical analysis of measurement data of ageing and pre- or post-menopause differences were also performed by Student's t-test and the significance level was set as $p \leq 0.05/3$, due to Bonferroni correction for multiplicity.

DISCUSSION

In this study, skin moisture (capacitance) was found to be slightly, but significantly lower in labial, mons pubis and inner thigh skin than in skin from the other sites, inner forearm and groin. This finding is not consistent with previous reports, because in general, vulvar skin shows a greater degree of skin moisture than other skin sites, most likely due to occlusion and moisture from sweat and vaginal secretions (1, 2, 4, 5). This viewpoint includes the conclusion from SSWL measurement results. Meanwhile, Wilhelm et al. (8) reported that there was no difference between the capacitance of forearm and vulvar skin. Elsner & Maibach (2) and Elsner et al. (7) also reported that the capacitance of vulvar skin is only slightly, but significantly higher than forearm skin. We have reported that the moisture of labial skin of Japanese women is significantly lower than at the other sites (14). The reasons for these inconsistent relationships are unclear. Ethnic and/or habitual differences among Asians (Thai and Japanese) and Caucasians, and alternatively differences of measurement method might be involved. Overall, we consider there are no clear meaningful ethnic differences in the capacitance of vulvar skin, because these differences are relatively small.

Concerning the pH values, significant, but slight, differences were observed between vulvar areas and control area skin in this study. Our previous study of Japanese women indicated no significant differences in skin pH among vulvar and control sites (14). Elsner & Maibach (2) reported that vulvar skin shows a slight, but significantly higher, value than forearm skin. These results are similar to ours obtained from Thai women. On the other hand, Wilhelm et al. (8) reported that the vulvar and forearm skin showed the same pH values, which are similar to our results from Japanese. Taken together, we consider that there are no obvious ethnic and/or habitual differences in the pH of vulvar skin.

It is difficult to use TEWL measurements to understand skin conditions by comparing measured values with previously published results, because this parameter is affected severely by ambient conditions, such as temperature, humidity, acclimation time, and various physiological conditions of the subject. Moreover, the skin of the vulvar area is generally occlusive. However, with there limitations in mind we anyway compared differences in TEWL results among various body sites in the literature.

Elsner & Maibach (2) and Wilhelm et al. (8) reported that TEWL is higher in vulvar skin (labia majora) than in forearm skin. Elsner et al. (4) investigated the SSWL dynamics of vulvar and forearm skin by measuring continuously for 30 min to clarify the possible effect of occlusion on TEWL of vulvar skin. Their results for SSWL after 30 min, which are assumed to be TEWL, were significantly higher in vulvar skin than in forearm skin. Warren et al. (5) also investigated SSWL dynamics using a larger number of subjects, resulting in the same relationship, although the control region used was the inner thigh.

Our findings in Thai women recruited from a large population of subjects are consistent with previous reports, which indicate that TEWL is specifically higher in vulvar skin than in other sites, and that there is no ethnic and/or other difference.

Many reports have investigated changes in SC properties of various sites, such as the forearm and abdomen, with ageing and/or menopause. Wilhelm et al. (15) investigated the effect of skin ageing on SC functions in various anatomical regions. They concluded that TEWL is significantly lower in older populations of both males and females than in younger subjects, but there is no significant difference in hydration or pH of the skin. Man et al. (16) reported that hydration and pH show no significant difference between older populations under 70 years of age and younger ones, but were significant

over 70 years of age for both males and females in very large Chinese populations. On the other hand, Marrakchi & Maibach (17) reported that there are significant differences between young and elderly subjects with respect to skin hydration and pH, but not TEWL. These representative reports, which include some inconsistent relationships, also indicate that menopause, which will inevitably occur for elderly females, causes some changes in SC properties at general sites. It is likely that ageing and/or menopause affects vulvar skin properties.

However, there are very few studies showing changes in SC properties of vulvar skin with ageing and menopause. Elsner et al. (7) reported that there are no significant differences in TEWL and hydration of vulvar skin between pre- and post-menopausal women and with age. Warren et al. (5) also reported that there is no significant difference in SSWL (after 30 min acclimation, as described previously) of vulvar skin with age. Some effects of menopause on the percutaneous absorption of steroids by vulvar skin have been reported (9). These studies were conducted on the Caucasian ethnic population. Concerning Asian women, there is no literature investigating changes in vulvar skin properties with either age or menopause. In this study we have shown that neither ageing nor menopause cause remarkable alterations in the skin properties of vulvar and forearm skin of Thai women.

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The authors declare no conflicts of interest.

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