

## 아시아 여성의 피부 물리적 변수들의 비교

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### The Comparison of Skin Physical Parameters in Asian Women

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**요약:** 피부 특성은 다양한 내부 또는 외부 요인의 영향을 받는다. 이 연구는 아시아 여성들의 피부 특성을 조사 및 비교하기 위해 수행되었다. 우리는 7개국(말레이시아, 인도네시아, 베트남, 태국, 인도, 중국 및 한국)에서 1,500명의 아시아인의 피부 물리적 변수 및 지역 간 차이를 평가하였다. 경피 수분 손실, pH, 피부 수분, 피지 함량, 피부 민감도, 탄력, 눈가 주름 및 피부 밝기의 값을 측정하였다. 인도 여성들은 다른 국가들의 여성들보다 피부 수분량, 피지량 및 민감도 점수가 낮게 나타났고, 더 어두운 피부색을 갖는 것으로 조사되었다. 또한, 모든 부위의 피부 표면 pH는 7개국 중 가장 높게 나타났다. 베트남인은 가장 낮은 수치의 피부 표면 pH 값을 보였다. 한국인과 중국인은 일반적으로 탄력성이 높고 적은 눈가 주름을 가진 것으로 나타났다. 피부 수분과 경피 수분 손실량은 민감도와 양의 상관 관계가 있었으며, 주름과 민감도 간에는 음의 상관 관계가 있었다. 본 연구 결과는 해당 지역이나 지역과 관련된 명확한 추세를 없었다. 피부 물리적 매개 변수는 지역적 차이에 대한 이해와 함께 다양한 요인(피부 관리 습관, 라이프스타일 및 개인 민감도)에 대한 연구도 함께 진행되어야 할 것이다.

**Abstract:** Skin properties are influenced by a variety of internal or external factors. This study was conducted to investigate and compare the skin characteristics in Asian women. We evaluated values of skin physical parameters, and then assessed the correlations among the parameters, and regional differences in 1,500 Asian subjects in seven countries (Malaysia, Indonesia, Vietnam, Thailand, India, China, and South Korea). The values of transepidermal water loss (TEWL), pH, skin hydration, sebum content, skin sensitivity, elasticity, crow's feet wrinkles, and skin brightness were measured. New Delhi's women were observed to have a lower level of hydration in stratum corneum, sebum content, stinging scores, and darker skin color than others. Furthermore, their skin surface pH on all sites is the highest among seven countries. Vietnamese had the lowest pH values in skin surface. Korean and Chinese had generally higher elasticity and fewer wrinkles. Both the skin hydration and TEWL had positive correlations with the stinging test, and there was a negative correlation between wrinkles and stinging test. These results represent that there was no clear trend related to the area or region. Skin physical parameters should be studied along with understanding of regional differences and various factors (skin care habits, lifestyle and personal sensitivity).

**Keywords:** noninvasive measuring methods, skin characteristics, Asian

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## 1. Introduction

Nowadays, many people are interested in facial beauty and the ways to look more attractive to others, and, as a result, people want to know their own skin conditions[1]. Biophysical skin parameters are used as indicators of structural and functional skin changes in vivo[2]. By measuring non-invasive indicators of the skin's surface, states of the skin barrier can be determined. For example, skin surface pH of a patient with atopic dermatitis or other skin diseases is higher compared to the pH of a normal skin surface which is slightly acidic. In addition, a higher transepidermal water loss indicating a greater reduction of water content has been reported in atopic patients compared to those with normal skin. Recently researches have been conducted based on internal factors such as sex, age, and site. However, the skin, which is in the outermost layer of the body, is constantly exposed to external stimuli[3]. Therefore, environmental factors such as regional differences, ultraviolet radiation, or standard of living should be considered together as important factors.

There are many studies on the skin surface parameters, but the researches on the correlation of various parameters are comparatively fewer. And although many studies on human skin characteristics related to age or sex in various countries have been reported, the subjects of these studies were limited to black and white ethnic groups and their results are controversial[3-5]. Therefore, we saw the necessity to conduct this study for additional clinical assessment of Asian people.

To investigate the skin characteristics in Asian women, we evaluated the values of transepidermal water loss, pH, skin hydration, sebum content, elasticity, wrinkles, and skin brightness. Then, we assessed the correlations among each parameter, and regional differences in skin.

## 2. Experimental

### 2.1. Subjects

One thousand five hundred healthy women aged 20 to 59 years participated in this study and the study was re-

viewed and approved by the Institutional Review Board (IRB) prior to clinical test initiation. The measurements were taken from 2011 to 2013 in eight regions. Two hundred subjects were from seven cities, Kuala Lumpur in Malaysia, Jakarta in Indonesia, Ho Chi Minh in Vietnam, Bangkok in Thailand, New Delhi in India, Shanghai and Beijing in China, and 100 subjects were from Seoul or Gyeonggi in South Korea. For each age group (20s, 30s, 40s, and 50s), 25 Korean residents and 50 other subjects were selected as subjects. Before the measurement, all subjects understood the aim and details of this study, and gave informed consent. The climatological information of these regions is described in Table 1.

### 2.2. Measurements

Eight parameters of skin surface were evaluated: hydration, TEWL, pH, sebum, stinging test score, wrinkles, elasticity, and skin brightness. No subjects used cosmetics on the measurement day. All subjects washed their face and volar forearm and rested under regulated laboratory conditions at constant temperature and humidity ( $22 \pm 2$  °C, 40-60% RH) for half an hour.

#### 2.2.1. Hydration of the Stratum Corneum

Hydration of the stratum corneum was measured three times with Corneometer<sup>®</sup> (CM 825, Courage & Khazaka, Germany) on the forehead, cheek, and volar forearm. The average of three values was calculated for statistical analysis, and the results were expressed in arbitrary units (A.U.).

#### 2.2.2. Transepidermal Water Loss (TEWL)

As a parameter of skin barrier function, TEWL was measured once with Tewameter<sup>®</sup> (TM 300, Courage & Khazaka, Germany), an open chamber device, on the forehead, cheek, and volar forearm. Data was collected for 40 s after stabilization. The average was calculated from the collected data. The results were expressed in g/m<sup>2</sup>h.

#### 2.2.3. pH

The skin surface pH was measured once with Skin pH-meter<sup>®</sup> (PH 900, Courage & Khazaka, Germany) on

**Table 1.** The Climatological Information of Eight Different Regions\*

Region (Country)	Kuala Lumpur (Malaysia)	Jakarta (Indonesia)	Ho Chi Minh (Vietnam)	Bangkok (Thailand)	New Delhi (India)	Shanghai (Chinese)	Seoul (Korea)	Beijing (Chinese)
Studying period	Aug-Sep (2013)	Oct (2012)	May-Jun (2012)	May (2013)	Mar-Apr (2013)	Aug-Sep (2011)	Jul-Aug (2011)	Aug-Sep (2013)
Latitude	3° 13' N	6° 17' S	10° 82' N	13° 75' N	28° 61' N	31° 23' N	37° 56' N	39° 90' N
Longitude	101° 68' E	106° 86' E	106° 62' E	100° 50' E	77° 20' E	121° 47' E	126° 97' E	116° 40' E
Data from web site 'Latlong'								
Temperature	28.3 °C	28.2 °C	28.8 °C	32.2 °C	25.6 °C	26.7 °C	25.2 °C	22.8 °C
Humidity	78.6%	62.6%	81.5%	64.8%	47.9%	72.7%	76.7%	68.9%
Data from web site 'Weather Underground'								

\* Temperature, humidity; new values during study period.

the forehead, cheek, and volar forearm. Before the measurement, the pH-meter was calibrated using standard buffers of pH 4.0, and pH 7.0, and each measurement was performed after washing the pH probe with distilled water. The values were expressed in pH units.

2.2.4. Skin Surface Sebum Content

The skin surface sebum was measured once with Sebumeter® (SM810, Courage & Khazaka, Germany) on the forehead, and nose. A researcher gently pressed Sebumeter cassette against each skin surface site with invariable pressure for 30 s; the sebum content obtained was gravimetrically evaluated according to the photometric principle. Results were expressed in  $\mu\text{g}/\text{cm}^2$ .

2.2.5. Skin Wrinkle

The skin wrinkle was measured on the right and left lateral corners of eyes. PRIMOS lite (GF Messtechnik GmbH, Germany), an optical three-dimensional in-vivo skin measurement device[6], was used for our measurement.

2.2.6. Skin Elasticity

For measurement of skin elasticity, Cutometer® (MPA 580, Courage & Khazaka, Germany) was used. A 450 mbar suction was transmitted to the skin for 2 s through a 2 mm opening in the Cutometer probe, and was then followed by 2 s relaxation. After measuring either right or left half face randomly, we calculated the average of R2

(gross elasticity), R5 (net elasticity), and R7 (skin firmness) values where  $R2 = Ua/Uf$  indicating the rate of recovery after the first traction,  $R5 = Ur/Ue$  indicating the elastic ratio after the first traction, and  $R7 = Ur/Uf$  indicating the elasticity recovery rate.

2.2.7. Skin Brightness

The skin brightness was assessed from the front-view facial images of each subject taken with Janus® (PSI, Korea). In accordance with manufacturer's image analysis protocol, the average of all the images of forehead, cheek, nose, and eye rims was analyzed and indicated as percentage value.

2.2.8. Stinging Test

For the stinging test, the protocol was performed as a modified method of Frosch et al.[7]: 50  $\mu\text{L}$  (-90%; Fluka, Germany) of 5% lactic acid solution was applied to the nasolabial fold of one side using filter paper (Chemotechnique Diagnostics, Sweden), and distilled water was applied to the other side as a negative control in the same manner. The participants graded the degree of itching, irritation, and burning at 0, 2.5, 5, and 8 min in turn. Overall results of the stinging reaction were scored using a 0 (none) to 3 (severe) scale. Average of the final data was calculated to reflect the sum of the time and scores in the measurement.

**Table 2.** The Measurement and Analysis of Skin Hydration on the Forehead, Cheek, and Forearm in Asian Females

Parameters	Site	Regions	Mean ± S.D.	Kuala Lumpur	Jakarta	Ho Chi Minh	Bangkok	New Delhi	Shanghai	Seoul	Beijing	
Skin hydration	Forehead	Kuala Lumpur	55.09 ± 8.89		**	***	***	***	-	***	***	
		Jakarta	59.02 ± 10.67			***	*	***	*	***	-	
		Ho Chi Minh	63.06 ± 8.77				-	***	***	*	**	
		Bangkok	62.45 ± 7.66					***	***	**	-	
		New Delhi	46.63 ± 9.50						***	***	***	
		Shanghai	55.59 ± 10.01							***	**	
		Seoul	67.02 ± 10.40								***	
		Beijing	59.53 ± 11.02								***	
		Cheek	Kuala Lumpur	58.32 ± 8.96		***	***	***	***	***	-	***
	Jakarta		67.30 ± 7.72			-	***	***	***	***	-	-
	Ho Chi Minh		67.91 ± 7.48				***	***	***	***	-	-
	Bangkok		62.70 ± 8.43					***	***	**	*	
	New Delhi		45.46 ± 9.00						***	***	***	
	Shanghai		56.88 ± 10.48							***	***	
	Seoul		67.30 ± 10.70								-	
	Beijing		65.69 ± 10.66								-	
	Forearm		Kuala Lumpur	37.72 ± 5.94		*	-	-	***	***	-	***
		Jakarta	35.54 ± 7.04			-	-	***	***	***	***	-
		Ho Chi Minh	37.27 ± 5.98				-	***	***	-	***	-
		Bangkok	37.35 ± 6.11					***	***	-	***	-
		New Delhi	28.06 ± 6.16						***	***	***	
Shanghai		38.98 ± 6.53							***	-		
Seoul		42.62 ± 6.95								***		
Beijing		37.40 ± 5.80								***		

### 2.3. Statistics Analysis

Statistical analysis was performed using SPSS<sup>®</sup> software for windows computer (Version 21.0, Chicago, IL, USA). Variance ANOVA test was used to assess the significant differences between the values of different regions, or sites.  $p < 0.05$  was considered statistically significant.

## 3. Results and Discussion

### 3.1. Hydrations of the Stratum Corneum

The values of hydration on the forearm were the lowest on the forehead or cheek in all regions ( $p < 0.05$ ). The hydration values of the stratum corneum were the highest in Seoul on the forehead and forearm, and in Ho Chi

Minh, Seoul, Jakarta, and Beijing on the cheek. Hydration values for all three sites were the lowest in New Delhi (forehead;  $46.63 \pm 9.50$ , cheek;  $45.46 \pm 9.00$ , and forearm;  $28.06 \pm 6.16$ ) (Table 2).

### 3.2. Transepidermal Water Loss (TEWL)

In all regions, the levels of TEWL were ranked in following order: cheek > forehead > forearm. TEWL values were different depending on the regions and the sites. The highest TEWL values were from: Ho Chi Minh, Seoul, Shanghai, and Beijing on the forehead; Seoul, Ho Chi Minh, and New Delhi on the cheek; Ho Chi Minh on the forearm. The lowest TEWL values were from: New Delhi, Kuala Lumpur, and Jakarta on the forehead; Jakarta, Beijing, Bangkok, and Shanghai on the cheek;

**Table 3.** The Measurement and Analysis of TEWL on the Forehead, Cheek, and Forearm in Asian Females

Parameters	Site	Regions	Mean ± S.D.	Kuala Lumpur	Jakarta	Ho Chi Minh	Bangkok	New Delhi	Shanghai	Seoul	Beijing	
TEWL	Forehead	Kuala Lumpur	12.54 ± 2.99	-	-	***	***	-	***	***	***	
		Jakarta	12.96 ± 3.00	-	-	***	***	-	***	***	***	
		Ho Chi Minh	15.55 ± 4.19	-	-	-	*	***	-	-	-	
		Bangkok	14.44 ± 3.49	-	-	-	-	***	-	-	-	
		New Delhi	12.22 ± 2.82	-	-	-	-	-	***	***	***	
		Shanghai	14.63 ± 3.49	-	-	-	-	-	-	-	-	
		Seoul	15.40 ± 3.24	-	-	-	-	-	-	-	-	
		Beijing	14.62 ± 3.09	-	-	-	-	-	-	-	-	
	Cheek	Kuala Lumpur	16.68 ± 4.28	*	-	-	-	-	-	-	*	-
		Jakarta	15.27 ± 3.15	-	***	-	-	***	-	-	***	-
		Ho Chi Minh	17.55 ± 4.36	-	-	-	**	-	-	-	-	***
		Bangkok	15.80 ± 3.76	-	-	-	-	**	-	-	***	-
		New Delhi	17.62 ± 4.63	-	-	-	-	-	-	-	-	***
		Shanghai	16.59 ± 4.40	-	-	-	-	-	-	-	*	-
		Seoul	18.39 ± 8.15	-	-	-	-	-	-	-	-	**
		Beijing	15.54 ± 3.63	-	-	-	-	-	-	-	-	-
	Forearm	Kuala Lumpur	9.19 ± 1.74	-	***	***	***	***	***	***	-	-
		Jakarta	10.56 ± 1.83	-	-	***	-	-	-	-	-	-
		Ho Chi Minh	12.68 ± 2.76	-	-	-	***	***	***	***	***	***
		Bangkok	10.80 ± 2.16	-	-	-	-	-	-	-	-	**
		New Delhi	10.76 ± 2.57	-	-	-	-	-	-	-	-	*
Shanghai		10.36 ± 1.78	-	-	-	-	-	-	-	-	-	
Seoul		10.12 ± 5.21	-	-	-	-	-	-	-	-	-	
Beijing		9.89 ± 1.92	-	-	-	-	-	-	-	-	-	

Kuala Lumpur, Beijing, and Seoul on the forearm (Table 3).

### 3.3. pH

Skin surface pH values on the cheek in all regions, excluding New Delhi, were higher than on the forehead or forearm ( $p < 0.05$ ). Subjects from New Delhi, India had the highest values of skin surface pH on all three sites (forehead;  $5.77 \pm 0.50$ , cheek;  $6.11 \pm 0.36$ , and forearm;  $5.99 \pm 0.59$ ). In contrast, subjects from Ho Chi Minh, Vietnam had the lowest values of skin surface pH (forehead;  $4.55 \pm 0.44$ , cheek;  $4.77 \pm 0.47$ , forearm;  $4.47 \pm 0.37$ ) (Table 4).

### 3.4. Sebum Content

High values of sebum content were obtained from:

Seoul and Shanghai on the nose; Seoul, Shanghai, and Ho Chi Minh on the forehead; Kuala Lumpur, Bangkok, and Ho Chi Minh on the cheek. Subjects from New Delhi had the lowest sebum content on the nose, and those from New Delhi and Beijing had lower values on the forehead and cheek compared with other regions (Table 5).

### 3.5. Elasticity, Wrinkles, and Skin Brightness

The measurements of elasticity, wrinkles, and skin brightness according to the regions are shown in Table 6. The elasticity R2, and R7 from Seoul, South Korea were the highest, and subjects from Shanghai and Seoul showed the highest elasticity, R5. In contrast, the women from Kuala Lumpur, Ho Chi Minh, and Bangkok, had generally lower values of elasticity R2, R5, and R7. Subjects from Seoul, Beijing, and Shanghai had the low-

**Table 4.** The Measurement and Analysis of pH on the Forehead, Cheek, and Forearm in Asian Females

Parameters	Site	Regions	Mean $\pm$ S.D.	Kuala Lumpur	Jakarta	Ho Chi Minh	Bangkok	New Delhi	Shanghai	Seoul	Beijing	
pH	Forehead	Kuala Lumpur	5.17 $\pm$ 0.40		***	***	-	***	-	-	-	
		Jakarta	4.93 $\pm$ 0.44			***	***	***	***	***	***	
		Ho Chi Minh	4.55 $\pm$ 0.44				***	***	***	***	***	
		Bangkok	5.16 $\pm$ 0.35					***	-	-	-	
		New Delhi	5.77 $\pm$ 0.50						***	***	***	
		Shanghai	5.27 $\pm$ 0.37								-	
		Seoul	5.20 $\pm$ 0.33									
		Beijing	5.15 $\pm$ 0.47									
	Cheek	Kuala Lumpur	5.43 $\pm$ 0.31		-	***	***	***	***	-	-	***
		Jakarta	5.33 $\pm$ 0.40			***	***	***	***	***	-	***
		Ho Chi Minh	4.77 $\pm$ 0.47				***	***	***	***	***	***
		Bangkok	5.61 $\pm$ 0.26					***	-	***	-	
		New Delhi	6.11 $\pm$ 0.36						***	***	***	
		Shanghai	5.51 $\pm$ 0.35								-	
		Seoul	5.40 $\pm$ 0.34									
		Beijing	5.60 $\pm$ 0.43									
	Forearm	Kuala Lumpur	5.10 $\pm$ 0.47		***	***	-	***	-	-	-	
		Jakarta	4.85 $\pm$ 0.36			***	**	***	***	***	***	
		Ho Chi Minh	4.47 $\pm$ 0.37				***	***	***	***	***	
		Bangkok	5.01 $\pm$ 0.40					***	-	-	-	
		New Delhi	5.99 $\pm$ 0.59						***	***	***	
		Shanghai	5.11 $\pm$ 0.37								-	
		Seoul	5.11 $\pm$ 0.30									
		Beijing	5.08 $\pm$ 0.54									

est value for crow's feet than those from other regions. The women from Seoul, South Korea had the brightest skin color, while the women from New Delhi, India had the darkest skin color ( $55.73 \pm 2.77$  vs.  $42.17 \pm 4.96$ ).

### 3.6. Discussion

Among eight regions, women from New Delhi showed the lowest hydration level of the stratum corneum on the forehead, cheek and forearm. According to Fluhr et al.[8], sebaceous-gland derived glycerol plays an important role in maintaining the water content of the stratum corneum. Interestingly, sebum content in the subjects from New Delhi was lower than those from other regions. Some researchers have reported that sizes or activities of the sebaceous glands differ with race, sex, and age, and it could

be due to androgen or estrogen[9,10]. In addition, a negative correlation between pH and sebum secretion was reported, and in our study, the Indian women with the lowest sebum content showed the highest skin surface pH on all three sites, forehead, cheek, and forearm[11]. Despite the consistent findings, the influence of the physical parameters, including sex, race, and ethnicity remains controversial. In case of TEWL, an indicator of the skin barrier function, there was no clear trend related to the measurement site, or region of residence. Therefore, in addition to the above-mentioned factors, further study of the functional combination of factors is required.

Among various skin surface parameters, wrinkle is one of the most important factors representing the state of aging. According to Aznar-Casanova et al.[12], the num-

**Table 5.** The Measurement and Analysis of Sebum Content on the Nose, Forehead, and Cheek in Asian Females

Parameters	Site	Regions	Mean ± S.D.	Kuala Lumpur	Jakarta	Ho Chi Minh	Bangkok	New Delhi	Shanghai	Seoul	Beijing
Sebum content	Nose	Kuala Lumpur	28.44 ± 30.77	-	-	-	**	***	***	-	-
		Jakarta	26.56 ± 27.36	-	-	-	*	***	***	-	-
		Ho Chi Minh	32.68 ± 31.45	-	-	-	***	***	***	-	-
		Bangkok	26.68 ± 23.95	-	-	-	*	***	***	-	-
		New Delhi	15.90 ± 16.01	-	-	-	-	***	***	**	-
		Shanghai	53.31 ± 44.01	-	-	-	-	-	-	-	***
		Seoul	55.22 ± 48.61	-	-	-	-	-	-	-	***
		Beijing	28.49 ± 20.71	-	-	-	-	-	-	-	-
	Forehead	Kuala Lumpur	29.88 ± 22.34	-	-	-	***	-	**	***	-
		Jakarta	25.74 ± 18.29	-	-	-	***	*	***	-	-
		Ho Chi Minh	32.40 ± 21.70	-	-	-	***	-	-	***	-
		Bangkok	30.93 ± 21.68	-	-	-	***	-	*	***	-
		New Delhi	16.82 ± 13.79	-	-	-	-	***	***	-	-
		Shanghai	33.02 ± 25.45	-	-	-	-	-	-	-	***
		Seoul	39.30 ± 24.35	-	-	-	-	-	-	-	***
		Beijing	21.12 ± 17.53	-	-	-	-	-	-	-	-
	Cheek	Kuala Lumpur	18.67 ± 15.81	*	-	-	***	-	-	-	***
		Jakarta	14.62 ± 13.5	-	-	-	***	-	-	-	-
		Ho Chi Minh	16.87 ± 11.94	-	-	-	***	-	-	-	***
		Bangkok	17.23 ± 12.23	-	-	-	***	-	-	-	***
		New Delhi	8.46 ± 8.55	-	-	-	-	-	-	-	-
Shanghai		-	-	-	-	-	-	-	-	-	
Seoul		-	-	-	-	-	-	-	-	-	
Beijing		10.97 ± 11.48	-	-	-	-	-	-	-	-	

ber and depth of wrinkles on the face may be a ‘barometer’ for aging. Elasticity and brightness are also primary factors indicating skin aging. Recent researches found the relationships among wrinkles, elasticity, and age. In these reports, there was a negative correlation between wrinkles and elasticity, and a positive correlation between wrinkles and age[13,14]. Liu et al.[15] reported that UV exposure increased wrinkles, and skin roughness, and decreased skin elasticity. A number of alterations such as down-regulated TGF-β, activated MMPs, and degradation of collagen were observed in UV-irradiated and aging skin[16]. As a result, it was suggested that the people living in the region of lower latitude have more wrinkles and lower brightness[17]. In this study, the eight areas listed in the order of increasing latitude were Kuala

Lumpur, Jakarta, Ho Chi Minh City, Bangkok, New Delhi, Shanghai, Seoul, and Beijing. It was expected that Malaysians would have a high aging index such as darker skin color, and more wrinkles than the people who live in the higher latitude. However, while Korean had high elasticity and bright skin color, Indonesians, Vietnamese, and Malaysians living in the low latitude had generally low skin elasticity, high crow’s feet wrinkles, and dark skin. Despite the higher latitude of the region compared to Thailand and Malaysia, the reasons why Indian women have a relatively deeper and higher number of wrinkles, and darker skin color are thought to be due to various differences in factors such as sun exposure, skin care habits, life-styles, and racial characteristics[18].

According to previous studies, sensitivity is known to

**Table 6.** The Measurement and Analysis of Elasticity, Wrinkles, and Skin Brightness for the Skin in Asian Females

Parameters	Site	Regions	Mean ± S.D.	Kuala Lumpur	Jakarta	Ho Chi Minh	Bangkok	New Delhi	Shanghai	Seoul	Beijing	
Elasticity	R2	Kuala Lumpur	0.61 ± 0.09		-	-	-	-	-	***	*	
		Jakarta	0.60 ± 0.10			-	-	-	-	***	**	
		Ho Chi Minh	0.58 ± 0.09				-	*	*	***	***	
		Bangkok	0.60 ± 0.08					-	-	***	***	
		New Delhi	0.61 ± 0.09						-	***	-	
		Shanghai	0.61 ± 0.08							***	-	
		Seoul	0.68 ± 0.08								**	
		Beijing	0.64 ± 0.09									
	R5	Kuala Lumpur	0.43 ± 0.07		**	-	-	-	-	***	***	-
		Jakarta	0.46 ± 0.09			***	*	-	-	***	**	-
		Ho Chi Minh	0.42 ± 0.08					-	*	***	***	**
		Bangkok	0.43 ± 0.07						-	***	***	-
		New Delhi	0.45 ± 0.09							***	***	-
		Shanghai	0.51 ± 0.08								-	***
		Seoul	0.50 ± 0.08									***
		Beijing	0.45 ± 0.06									
	R7	Kuala Lumpur	0.28 ± 0.05		-	-	-	-	-	-	***	-
		Jakarta	0.29 ± 0.06			-	-	-	-	-	***	-
		Ho Chi Minh	0.27 ± 0.06					-	-	-	***	***
		Bangkok	0.28 ± 0.05						-	-	***	-
		New Delhi	0.28 ± 0.06							-	***	-
Shanghai		0.29 ± 0.05								***	-	
Seoul		0.31 ± 0.05									*	
Beijing		0.29 ± 0.04										
Wrinkles	Ra	Kuala Lumpur	18.25 ± 3.59		-	-	**	-	***	***	***	
		Jakarta	18.64 ± 3.60			-	***	-	***	***	***	
		Ho Chi Minh	18.35 ± 3.36				**	-	***	***	***	
		Bangkok	16.87 ± 3.27					***	-	**	-	
		New Delhi	18.78 ± 4.14						***	***	***	
		Shanghai	16.28 ± 4.09								-	
		Seoul	15.27 ± 2.62									
		Beijing	16.12 ± 3.34									
Skin brightness		Kuala Lumpur	48.60 ± 4.35		***	***	***	***	***	***	***	
		Jakarta	46.47 ± 3.56			***	***	***	***	***	***	
		Ho Chi Minh	54.91 ± 3.10				***	***	*	***	-	
		Bangkok	51.34 ± 4.42					***	***	***	***	
		New Delhi	42.17 ± 4.96						***	***	***	
		Shanghai	56.20 ± 3.34							***	-	
		Seoul	59.41 ± 3.00									
		Beijing	55.73 ± 2.77									



**Table 7.** The Measurement and Analysis of Elasticity, Wrinkles, and Skin Brightness for the Skin in Asian Females

Site	Regions	Mean ± S.D.	Kuala Lumpur	Jakarta	Ho Chi Minh	Bangkok	New Delhi	Shanghai	Seoul	Beijing
Stinging test Nasolabial fold	Kuala Lumpur	0.83 ± 0.80		***	*	-	***	***	-	-
	Jakarta	0.32 ± 0.48			*	***	-	-	***	***
	Ho Chi Minh	0.59 ± 0.69				***	-	**	-	-
	Bangkok	0.97 ± 1.12					***	***	-	*
	New Delhi	0.39 ± 0.49						-	***	**
	Shanghai	0.29 ± 0.56							***	***
	Seoul	0.78 ± 1.01								-
	Beijing	0.71 ± 0.84								

**Table 8.** The Correlation Coefficients between the Stinging Test and the Skin Physical Parameters in Asian Females in Skin Physical Parameters

Stinging test (score)	Site	Correlation
Capacitance	Forehead	0.125**
	Cheek	0.074**
TEWL	Forehead	0.100**
	Cheek	0.089**
Elasticity	R2	0.081**
	R7	0.075**
Crow's feet wrinkles	Ra	0.053*
Skin brightness	Whole face	0.080**

be positively correlated with the amount of TEWL, and the more alkaline the skin is, the more susceptible to external stress due to the weak skin barrier compared to the normal skin surface[19,20]. And it is believed to be influenced by internal factors such as race, ethnicity, gender, or cosmetic habits, including the types of products used, and frequency and amount of application[18]. In the study of Japanese and German women living in Germany, although Japanese women showed no significant differences in the physiological factors such as the amount of melanin or the skin moisture content, they showed a remarkably higher sensitivity than German women[21]. In our study, Thais, Malaysians, and Koreans had higher sensitivities than Indians who showed high TEWL, and higher skin pH. Therefore, the results should be analyzed in relation to ethnicity and the other factors while taking subjectively-received sensations under similar conditions into account, and further studies are required to objectify the

evaluation methods of sensitivity[22,23].

#### 4. Conclusion

In this clinical study, we measured the skin physical parameters in Asian females in various environment. However, there was no noticeable tendency between these results and regional or environmental characteristics. Country-specific characteristics exist, but they do not completely match local characteristics. Therefore, it is more necessary to study and understand various variables besides environment in skin research.

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## Reference

1. B. Fink and N. Neave, The biology of facial beauty, *Int. J. Cosmet. Sci.*, **27**(6), 317 (2005).
2. R. Muggli, Systemic evening primrose oil improves the biophysical skin parameters of healthy adults, *Int. J. Cosmet. Sci.*, **27**(4), 243 (2005).
3. R. Darlenski and J. W. Fluhr, Influence of skin type, race, sex, and anatomic location on epidermal barrier function, *Clin. Dermatol.*, **30**(3), 269 (2012).
4. N. O. Wesley and H. I. Maibach, Racial (ethnic) differences in skin properties: the objective data, *Am. J. Clin. Dermatol.*, **4**(12), 843 (2012).
5. A. V. Rawlings, Ethnic skin types: are there differences in skin structure and function?, *Int. J. Cosmet. Sci.*, **28**(2), 79 (2006).
6. P. M. Friedman, G. R. Skover, G. Payonk, A. N. Kauvar, and R. G. Geronemus, 3D in-vivo optical skin imaging for topographical quantitative assessment of non-ablative laser technology, *Dermatol. Surg.*, **28**(3), 199 (2006).
7. P. J. Frosch and A. M. Kligman, A method for appraising the stinging capacity of topically applied substances, *J. Soc. Cosmet. Chem.*, **28**(5), 197 (1977).
8. J. W. Fluhr, M. Mao-Qiang, B. E. Brown, P. W. Wertz, D. Crumrine, J. P. Sundberg, K. R. Feingold, and P. M. Elias, Glycerol regulates stratum corneum hydration in sebaceous gland deficient (asebia) mice, *J. Invest. Dermatol.*, **120**(5), 728 (2003).
9. M. Roh, M. Han, D. Kim, and K. Chung, Sebum output as a factor contributing to the size of facial pores, *Br. J. Dermatol.*, **155**(5), 890 (2006).
10. E. J. Giltay and L. J. G. Gooren, Effects of sex steroid deprivation/administration on hair growth and skin sebum production in transsexual males and females, *J. Clin. Endocrinol. Metab.*, **85**(8), 2913 (2000).
11. M. K. Kim, S. Y. Choi, H. J. Byun, C. H. Huh, K. C. Park, R. A. Patel, A. H. Shinn, and S. W. Youn, Comparison of sebum secretion, skin type, pH in humans with and without acne, *Arch. Dermatol. Res.*, **298**(3), 113 (2006).
12. J. Aznar-Casanova, N. Torro-Alves, and S. Fukusima, How much older do you get when a wrinkle appears on your face? modifying age estimates by number of wrinkles, *Aging, Neuropsychology, and Cognition*, **17**(4), 406 (2010).
13. Y. Takema and Y. Yorimoto, The relationship between age-related changes in the physical properties and development of wrinkles in human facial skin, *J. Soc. Cosmet. Chem.*, **46**(3), 163 (1995).
14. C. Nagata, K. Nakamura, K. Wada, S. Oba, M. Hayashi, N. Takeda, and K. Yasuda, Association of dietary fat, vegetables and antioxidant micronutrients with skin ageing in Japanese women, *Br. J. Nutr.*, **103**(10), 1493 (2010).
15. Z. Liu, S. Song, W. Luo, P. M. Elias, and M. Q. Man, Sun-induced changes of stratum corneum hydration vary with age and gender in a normal Chinese population, *Skin Res. Technol.*, **18**(1), 22 (2012).
16. L. Rittié and G. J. Fisher, UV-light-induced signal cascades and skin aging. *Ageing research reviews*, **1**(4), 705 (2002).
17. K. Tsukahara, K. Sugata, O. Osanai, A. Ohuchi, Y. Miyanuchi, M. Takizawa, M. Hotta, and T. Kitahara, Comparison of age-related changes in facial wrinkles and sagging in the skin of Japanese, Chinese and Thai women, *J. of Dermatol. Sci.*, **47**(1), 19 (2007).
18. C. Galzote, R. Estanislao, M. O. Suero, A. Khaiat, M. I. Mangubat, R. Moideen, H. Tagami, and X. Wang, Characterization of facial skin of various Asian populations through visual and non-invasive instrumental evaluations: influence of age and skincare habits, *Skin Res. Technol.*, **19**(4), 454 (2013).
19. S. An, E. Lee, S. Kim, G. Nam, H. Lee, S. Moon, and I. Chang, Comparison and correlation between stinging responses to lactic acid and bioengineering parameters, *Contact Dermatitis*, **57**(3), 158 (2007).
20. Y. Wu, X. Wang, Y. Zhou, Y. Tan, D. Chen, Y. Chen, and M. Ye, Correlation between stinging, TEWL and capacitance, *Skin Res. Technol.*, **9**(2), 90 (2003).

21. J. Aramaki, S. Kawana, I. Effendy, R. Happle, and H. Löffler, Differences of skin irritation between Japanese and European women, *Br. J. Dermatol.*, **146**(6), 1052 (2002).
22. T. Tempark, S. Chatproedprai, and S. Wananukul, Attitudes, knowledge, and behaviors of secondary school adolescents regarding protection from sun exposure: a survey in Bangkok, Thailand, *Photodermatol., photoimmunol. & photomed.*, **28**(4), 200 (2012).
23. M. R. Lee, G. W. Nam, Y. C. Jung, S. Y. Park, J. Y. Han, J. C. Cho, K. D. Suh, and J. K. Hwang, Comparison of the skin biophysical parameters of Southeast Asia females: forehead-cheek and ethnic groups, *J. Eur. Acad. Dermatol. Venereol.*, **27**(12), 1521 (2013).