

한국인과 몽골인의 주름 패턴분석

서영경[†] · 김민지 · 김소정 · 백지훈 · 고재숙 · 양성민* · 김종현* · 임유리* · 최성원*

주식회사 더마프로

*대한화장품 산업연구원

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Wrinkle Pattern in Korean and Mongolian Women Population

Young kyoung Seo[†], Minji Kim, So jeong Kim, Ji hwoon Baek, Jae sook Koh,
Sung Min Yang *, Jong Hyun Kim*, Yoo Ree Lim*, and Sung Won Choi*

Dermapro LTD., Skin Research Center, 30 Bangbaejungang-ro, Seoul, Korea

*Foundation of Korea cosmetic Industry Institue, Osan, Korea

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요약: 오늘날의 사회에서는 삶의 질 향상으로 실제 나이보다 젊어 보이며 이에 따라 노화방지에 대한 관심이 증가하고 있다. 또한 같은 나이의 사람들과 비교했을 때 본인이 젊어 보이는지에 대한 관심이 높아지고 있다. 이 연구에서 우리는 외적 노화에 가장 주요한 영향을 주는 주름 지수를 구하고자 하였다. 전체 얼굴의 주름은 8개로 분할된 영역에 의해 점수화되었고, 실제 연령과 피부 파라미터 사이의 상관 관계를 분석하였다. 연구 대상자 206명(한국인 여성 105명, 몽골 여성 101명)을 대상으로 하였다. 대상자는 연령대별로 20대, 30대, 40대, 50대를 네 군으로 나누었다. 주름 패턴은 주름, 미간, 코뿌리, 눈꺼풀, 눈밑주름, 눈꼬리, 팔자주름, 입가 8개 부위의 주름을 평가하고 주름 점수에 따른 계산식을 개발 하였다. 또한 계산식에 의해 얻어진 주름지수와 연관성 있는 피부 특성 파라미터를 알아보고자 피부 탄력, 모공, 주름, 피지 분비를 측정하였다. 방정식을 적용하여 계산한 한국인의 경우 주름연령과 실제연령과의 차이는 없었다. 반면, 몽골인에서는 실제연령과 비교하여 9세가 더 나이 들어 보인다고 밝혀졌다. 얼굴 주름 나이와 피부 특성 파라미터 사이의 상관 관계는 양국에서 피부 탄력 > 모공 또는 눈꼬리 주름 > 피부 색 > 피지 분비 순으로 나타났다. 피부 탄력은 얼굴 주름 나이와 가장 관련이 있는 변수로 나타났다. 본 연구를 통해 한국과 몽골 여성의 연령별 피부 주름 패턴을 규명하였으며, 이 연구로부터 개발된 주름살 계산식을 향후 화장품의 효능 연구에서 얼굴 주름의 나이를 계산하는 도구로 사용할 수 있을 것으로 생각된다.

Abstract: In today's society, where people look younger than their chronological age due to improvements in the quality of life, there is a gaining interest in anti-aging and how people compare to those in the same age group. We evaluated the wrinkle index, which is the most important attribute amongst skin parameters, to evaluate external age (wrinkle age). The wrinkles of the whole face were scored by divided 8 areas (forehead, glabella, nasal root, upper eyelid, lower eyelid, crow's feet, nasolabial groove and perioral skin) and analyzed the correlation between chronological age and skin parameters. 206 subjects (Korean female, n = 105 and Mongolians female, n = 101) were enrolled. Subjects were divided into four groups by ages: 20s, 30s, 40s, and 50s. Wrinkle scores of 8 areas were evaluated and developed a calculation formula based on the wrinkle scores. Skin characteristic parameters were measured about skin elasticity, pore,

† 주 저자 (e-mail: youngkyoungseo@gmail.com)
call: 02)595-5630

wrinkle, sebum secretion. There was no difference between the calculated ages and the chronological ages in Korean women. On the other hand, Mongolian looked older than chronological age by 9 years. The correlation between the facial wrinkle ages and skin physiology parameters was presented in the order of skin elasticity > pore or crow's feet > skin tone > sebum secretion in both countries. Skin elasticity represented the most related parameter with the facial wrinkle ages. This study identified the skin wrinkle patterns of Korean and Mongolian women and the wrinkle age calculation formula developed from this study can be used as a tool for calculating the facial wrinkle ages in cosmetic studies.

Keywords: wrinkle age, wrinkle pattern in Korean and Mongolian women, skin physiology parameters

1. Introduction

In today's society, where people look younger than their chronological age due to improvements in the quality of life, there is a gaining interest in anti-aging and how people compare to those in the same age group.

The characteristics of skin vary depending on ethnicities[1,2,3] but even in the same ethnic group there can be differences due to environmental factors such as seasons and changes in temperature and humidity[4,5,6]. E.J. Kim in a study reported that the moisture, oil, TEWL, and pH of Chinese women in different regions, Beijing, Guangzhou and Shanghai, showed different skin characteristics depending on the region where they live[7]. Kazue Tsukahara et al. after studying the differences in the formation of wrinkles, elasticity and moisture content in accordance with the humidity, identified that the area ratio of 'fine wrinkles with uneven skin texture' was increased at the low humidity compared to high humidity[8].

Andrea Vierkotter et al. developed a novel, validated score to simultaneously assess and differentiate between intrinsic and extrinsic skin aging[9]. Whilst Denise Dicanio et al. studied a predictive tool to evaluate the efficacy of cosmetic treatments using appeared age calculated by linear combination of facial parameters and to assess the predisposition to accelerated aging[10].

In addition, Nkengne et al. had reported the most important attributes to estimate age were eyes, lips and skin color uniformity through a study on the perceived age of Caucasian women[11].

In this study we evaluated the wrinkle index, which is the most important attribute amongst skin parameters, to

evaluate external age. The wrinkles of the whole face were scored by divided area and analyzed correlation between chronological age and skin parameters. Also, we conducted skin characteristics of Koreans and Mongolians in the Northern Asia region.

2. Materials and Methods

2.1. Participants

For the study, 206 subjects (105 Korean women and 101 Mongolian women) were enrolled. Subjects were divided into four groups by ages: 20s, 30s, 40s, and 50s (Table 1). The study was conducted in accordance with the intent and purpose of good clinical practice regulations as described in Korean good clinical practice (KGCP) and/or the declaration of Helsinki, as appropriate. The study protocol was approved by review committee of dermapro (IRB No. 1-220777-B-N-02-DICN14011) for Korean and Mongolian. All participants provided written informed consent before the study began. All the procedures for recruiting, screening and inclusion of the subjects in this study are designed to provide participants with clear and accurate information so that they can understand the purpose of the project and the outcome of the agreement. The study was carried out from March to April in 2014 under the controlled environmental conditions. The ambient temperature was maintained at 22 ± 2 °C and the relative humidity was maintained in the range of $50 \pm 5\%$. Average annual temperature and humidity of both cities are listed in Table 2.

Table 1. Distribution of Subjects Per Age Group

Group	Korean		Mongolian	
	Subjects (N)	Age	Subjects (N)	Age
20s	26	24.77 ± 2.78	26	23.27 ± 2.25
30s	25	35.84 ± 3.17	25	34.20 ± 2.74
40s	26	43.40 ± 3.22	25	44.32 ± 3.17
50s	28	54.86 ± 2.48	25	54.28 ± 2.76
Total	105	-	101	-

Table 2. The Climate of Both Regions

Region	Latitude	Longitude	Temperature range (°C)	Humidity (%)
Seoul	37.56N	126.97E	3.13 °C	52.35%
Ulaanbaatar	47.55N	106.55E	4.81 °C	41.88%

Data from <http://www.wunderground.com>

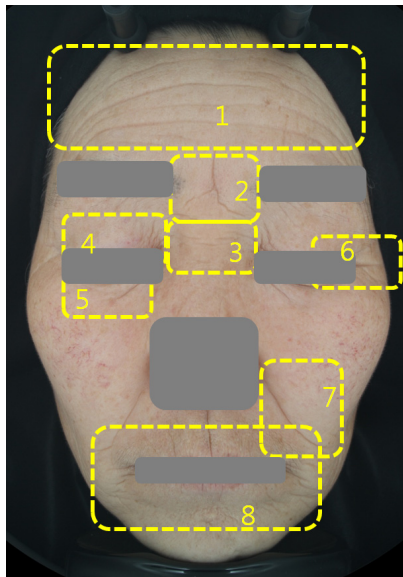


Figure 1. Evaluations of wrinkle score for 8 sites. 1: forehead, 2: glabella, 3: nasal root, 4: upper eyelid, 5: lower eyelid, 6: crow's feet, 7: nasolabial groove and 8: perioral skin.

2.2. Evaluation of Wrinkle Score for Wrinkle Pattern

Eight sites (forehead, glabella, nasal root, upper eyelid, lower eyelid, crow's feet, nasolabial groove and perioral skin) wrinkles were assessed by 4 well-trained researchers using facial photographs. Researchers classified the intensity of wrinkles in to 5 grades (1 = no wrinkle, 2 = slight wrinkles, 3 = mild wrinkles, 4 = moderate wrinkles, 5 = severe wrinkles) (Figure 1).

2.3. Skin Physiology Measurements

2.3.1. Skin Elasticity

Skin elasticity was measured using a Cutometer® MPA 580 (Courage and Khazaka, Germany). The measuring principle is based on suction and elongation. The device generates negative pressure, 450 mbar and 2 mm. Skin is drawn into the aperture of the probe during the measuring time with constant negative pressure for 2 seconds (on-time). Afterwards the negative pressure is switched off for 2 seconds and the skin returns to its original shape (off-time). It is set 3 repetitions in one measuring cycle. In this study skin elasticity on the cheek was analyzed in terms of R2 (gross elasticity).

2.3.2. Skin Pore Area

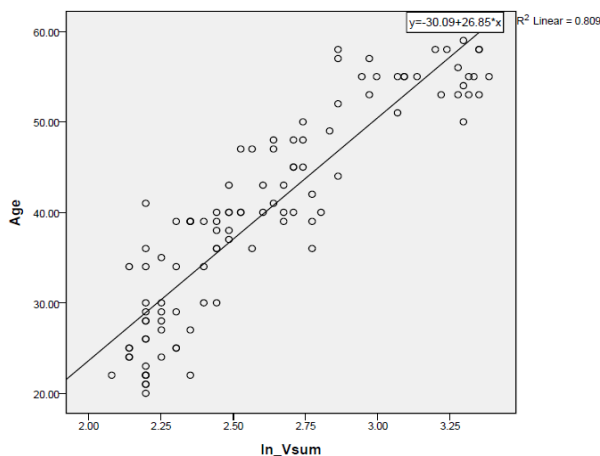
Facial skin pore area was analyzed by facial analyzing system after taken facial image using a Janus (PSI, Korea). The cheek, nose, forehead area were analyzed using the software programe (facial analyzing system). The analyzed data is calculated from the number and depth of skin pores and converted into a percentage.

2.3.3. Skin Wrinkle

Skin wrinkle on crow's feet was measured using PRIMOS® compact (GFMeSstechnik GmbH, Germany).

Table 3. The Regression Coefficients between The Chronological Age and The Vsum

Model	Coefficients				
	Unstandardized Coefficients		Standardized Coefficients	t	Sig
	B	Std. Error	Beta		
Constant	- 30.090	3.390	-	- 8.876	0.000
Vsum	26.854	1.285	0.900	20.903	0.000

**Figure 2.** Regression between the chronological age and the Vsum (Sum of wrinkle score for 8 sites).

This system allowed the quantitative analysis of the roughness (Ra: Arithmetic average value of profile peaks within the total measuring length) of the skin wrinkle.

2.3.4. Sebum Secretion

Sebum secretion of facial cheek was measured by Sebumeter[®] SM 815 (Courage and Khazaka, Germany). This system determines the translucency of special tape, which becomes transparent after contact with sebum in the skin surface.

2.3.5. Photography

Photography was taken by positioning the head of the subject, using stationary chin and forehead supports and maintaining consistent camera and lighting settings during the study. Images captured with the Janus (PSI, Korea) are saved directly to an electronic record in facial analyzing system software.

2.4. Statistical Analysis

All statistical analyses were performed by using SPSS package program 11.5 (SPSS Inc., USA). The result of wrinkle score was analyzed by intra-class correlation coefficient (ICC) to confirm verification of the coincidence between 4 researchers. The calculation equation of wrinkle age was derived through a regression. In addition, we used Pearson's correlation coefficient to see whether data are statistically correlated with 8 sites wrinkle index and skin physiology parameters. A *p*-value of < 0.05 was considered statistically significant.

3. Results

3.1. The Equation for Wrinkle Index

The ICC of all 8 sites were over 0.8 (forehead; 0.819, glabella; 0.907, nasal root; 0.878, upper eyelid; 0.823, lower eyelid; 0.837, crow's feet; 0.877, nasolabial groove; 0.854 and perioral; 0.862) which show that the results are reliable and consistent. The average wrinkle score was then used for simple regression analysis to derive a calculation equation for wrinkle age (Table 3, Figure 2).

$$\text{Wrinkle age (WA)} = 26.854 \times \log_e (\text{Vsum}) - 30.090$$

*Vsum is sum of wrinkle score for 8 sites.

3.2. Comparison of Facial Wrinkle Index and Chronological Age by Applying The Equation in Korean and Mongolian Women

The wrinkle index showed that in the 20s age group, Korean women looked older than their chronological age by 4.66 years, however in the older age groups (30s, 40s, 50s) there was a tendency of looking slightly younger. The average age difference across all age groups was cal-

Table 4. The Comparison of Calculated Wrinkle Age and Chronological Age

Group	Korean (n = 105)			Mongolian (n = 101)		
	CA ¹	WA ²	Difference ³	CA ¹	WA ²	Difference ³
20s	24.77	29.42	4.66	23.27	32.78	9.51
30s	35.84	34.42	- 1.42	34.20	43.83	9.63
40s	43.31	40.45	- 2.86	44.32	53.82	9.50
50s	54.86	54.46	- 0.40	54.28	63.37	9.09
Average			- 0.01			9.43

¹Chronological age (CA), ²Calculated wrinkle age (WA), ³Difference = WA - CA

Table 5. The Regression Coefficient of Wrinkle Sites with Ages

Model	Coefficients (a)					
	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
Korean	(Constant)	19.249	1.385	-	13.901	0.000
	Crow's feet	3.308	1.227	0.310	2.697	0.008
	Nasolabial groove	4.727	1.185	0.381	3.987	0.000
	Nasal root	2.875	1.197	0.231	2.403	0.018
Mongolian	(Constant)	17.338	1.180	-	14.696	0.000
	Crow's feet	3.558	0.798	0.425	4.460	0.000
	Perioral	2.721	0.779	0.290	3.491	0.001
	Nasal root	2.098	0.803	0.239	2.614	0.010

Dependent Variable: AGE

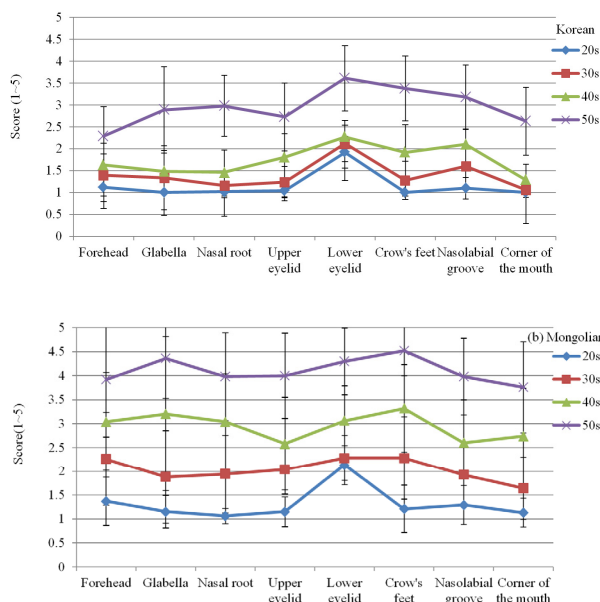


Figure 3. The wrinkle pattern of Korean and Mongolian woman at each age group. Researchers classified the intensity of wrinkles in to 5 grades (1 = no wrinkle, 2 = slight wrinkles, 3 = mild wrinkles, 4 = moderate wrinkles, 5 = severe wrinkles) at eight sites (forehead, glabella, nasal root, upper eyelid, lower eyelid, crow's feet, nasolabial groove, perioral skin).

culated to be - 0.01 years which suggest that there was no difference between the calculated age and the chronological age. In Mongolians, it was identified that compared to the chronological age, they looked older by 9 years in average in all age groups (Table 4).

3.3. The Wrinkle Pattern with Ages of Korea and Mongolian Woman

The results showed that with increasing age, out of the 8 sites of the face the sites that correlated the most with age were presented in the order of nasolabial groove (Beta = 0.381, $p < 0.001$) > crow's feet (Beta = 0.310, $p < 0.008$) > nasal root folds (Beta = 0.231, $p < 0.018$) in Korean. The results in Mongolian, were presented in the order of crow's feet (Beta = 0.381, $p < 0.000$) > perioral lines (Beta = 0.310, $p < 0.008$) > nasal root crease (Beta = 0.231, $p < 0.018$) (Table 5).

However, it was found that different age groups had a different site that correlated the most with each age group. The analyses of the age-classified wrinkle patterns showed that, the wrinkle of lower eyelid showed the high-

Table 6. The Correlation Coefficient between Wrinkle Age and Skin Physiological Parameters

Parameters		Korean (Wrinkle age)	Mongolian (Wrinkle age)
Elasticity (E/mm)	Pearson Correlation	- 0.696**	- 0.753**
	Sig. (2-tailed)	0.000	0.000
	N	105	101
Skin pore area (AU)	Pearson Correlation	0.620**	0.532**
	Sig. (2-tailed)	0.000	0.000
	N	105	101
Wrinkle (μm)	Pearson Correlation	0.538**	0.697**
	Sig. (2-tailed)	0.000	0.000
	N	105	101
Skin tone (AU)	Pearson Correlation	- 0.479**	- 0.538**
	Sig. (2-tailed)	0.000	0.000
	N	105	101
Sebum secretion ($\mu\text{g}/\text{cm}^2/\text{h}$)	Pearson Correlation	- 0.395**	- 0.257**
	Sig. (2-tailed)	0.000	0.010
	N	105	101

est rate in all age groups. In 30s and 40s, the highest score was presented in the order of the wrinkle of lower eyelid, nasolabial groove then crow's feet. In 50s age group, the highest score was presented in the order of the wrinkle of lower eyelid, crow's feet then nasolabial groove. In Mongolian, the wrinkle of lower eyelid has shown the highest score in 20s, while in 30s, 40s and 50s, it was crow's feet, and in 40s and 50s, it was presented in the order of crow's feet > glabella (Figure 3).

3.4. The Correlation Coefficient between Wrinkle Age and Skin Physiology Parameters

The correlation between the facial wrinkle age and skin physiology parameters was presented in the order of skin elasticity ($r = -0.696$, $p < 0.001$) > skin pore area ($r = 0.620$, $p < 0.001$) > crow's feet ($r = 0.538$, $p < 0.001$) > skin tone > sebum secretion. On the other hand, in Mongolian it was presented in the order of skin elasticity ($r = -0.753$, $p < 0.000$) > crow's feet ($r = 0.697$, $p < 0.000$) > skin pore area ($r = 0.532$, $p < 0.000$) > skin tone > sebum secretion. From these results, the skin parameters well reflecting the calculated wrinkle age were presented in the order of skin elasticity > pore or crow's feet > skin

tone > sebum secretion (Table 6).

4. Discussion

It was considered that evaluation of the apparent age rather than the chronological age would be an important tool to evaluate the efficacy of skin care products in the field of cosmetics for the beauty-seeking contemporary people.

Although there were some previous studies conducted on these assessments, they had disadvantages of difficult application due to too many parameters for the assessment item or included invasive method, there was no case actually applied with the existing studies. Thus, in this study, the assessment was performed by selecting wrinkles which is most notable in assessment of the apparent age.

The evaluation of specific area wrinkles was difficult to represent the entire facial wrinkles, so the facial wrinkles were divided by site and numerically scored. Based on the numeric scores, the relevance with parameters of skin measurement was analyzed and the calculation equation was developed for the facial wrinkle age.

In this study, the wrinkle age calculation equation de-

veloped was applied to Korean and Mongolian women in order to evaluate its objectivity. When compared the calculated wrinkle age and the chronological age, there was no differential result in Korean women. But in Mongolian, the calculated wrinkle age was older than the actual age for approximately 9 years.

The factors that led to these results can be considered to have been caused by the environment. Human skin is directly affected by the environment such as seasonal changes, temperature, humidity and sunlight. Sunlight is a primary environmental factor, which may cause photo-aging[12]. In addition, skin dehydration and facial expressions have been reported as causes of skin wrinkle formation[13-16].

In an additional study, the usage patterns of cosmetics of the participants of this study, found that Korean women used an average of 3.77 kinds of basic products (skin, cream, lotion, essence) after facial wash. Whereas Mongolians women used 2.2 kinds of products (cream, lotion, skin) in average (results not shown). After washing the face, oil and moisture decrease and TEWL changes occur. For recovery of such conditions, water recovery takes 40 minutes while oil and TEWL require 120 minutes[17]. Failure to care for the skin within these times can accelerate the skin aging.

When investigating the parameters that best reflect the facial wrinkle age among the skin parameters, the correlation between the facial wrinkle age and the skin measurement results were analyzed to find that the parameter best reflecting the age were presented in the order of skin elasticity > skin pore > crow's feet. Therefore, it was determined that the skin elasticity was the most appropriate parameter as an index representing the skin wrinkles.

Out of the eight sites of the face in Korean women, the sites that showed most correlation with increasing age were identified in order of nasolabial groove, crow's feet, and nasal root wrinkles. Among the facial wrinkles at eight sites the 3 sites listed above were identified as the sites that most reflect a person's aging skin.

Age-classified wrinkle patterns showed that, the wrinkle of lower eyelid showed the highest rate in all age

groups. In 30s and 40s, the highest score was presented in the order of the wrinkle of lower eyelid, nasolabial groove then crow's feet. In 50s age group, the highest score was presented in the order of the wrinkle of lower eyelid, crow's feet then nasolabial groove.

When compared the wrinkle site that had the most effects on aging and the Age-classified wrinkle patterns, the wrinkle of the lower eyelid was highly observed even in younger age groups, which suggest that wrinkle of the lower eyelid does not reflect aging. The wrinkles of the lower eyelid are formed by extrinsic factors such as a person's eye shape rather than aging.

In conclusion, this study identified the skin wrinkle patterns of Korean and Mongolian women and the wrinkle age calculation formula developed from this study can be used as a tool for calculating the facial wrinkle age in cosmetic studies. For further continuations of this study it is recommended a greater number of participants need to be involved in order to greater represent the Korean and Mongolian woman population.

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