Study on surface sebum content and stratum corneum hydration of facial skin surface of adults in Guangzhou

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Abstract

The study investigated the surface sebum content and the stratum corneum hydration in the different age and gender on the skin surface of different locations (forehead, canthus, regio zygomatica and chin) in the face of healthy adults in Guangzhou. The results showed that the facial skin sebum content of male was higher than that of female. There was no significant difference in stratum corneum hydration between male and female. The comparison result of sebum content between different sites is forehead and chin> zygomatica part > canthus. The comparison result of stratum corneum hydration between different sites is canthus > forehead and chin > regio zygomatica. There was no significant interaction effect on sebum content and skin hydration between gender and location and there was no difference in sebum content of the four location of the male face among the three age groups. However, there were differences in stratum corneum hydration of the four locations of the male face among the three age groups. The comparison results of the male were the stratum corneum hydration of youth group > middle age group > elder group. There were differences in sebum contents of the four locations of the female face among the three age groups (*P<0.05*). Moreover, the comparison results of the female were the skin sebum content of youth group > middle age group > elder group. However, the difference in stratum corneum hydration in female was not significant among the three age groups. There was no linear correlation between sebum content and age in the four locations of the male face. However, there were negative linear correlations between stratum corneum hydration and male age (*P<0.05*). There were negative linear correlations between sebum content and age in four locations of the female face (*P<0.05*). However, there was no significant linear correlation between stratum corneum hydration and age.

Keywords

Face; Sebum; Hydration; Stratum Corneum; Gender; Age; Location.

1. Introduction

Healthy facial skin is extremely important for appearance and is a window of the body's systemic state. Sebum, the complex lipid mixture secreted by the glands, can lubricate the skin and reduce the evaporation of water from the skin surface[1]. It can also act as a delivery system for antibacterial and antioxidant substances, accompanied by the production of pheromones and body odour[2]. Moreover, it is even closely related to the diversity of the microbiome on the skin surface[3]. Abnormal sebum volume is closely related to coarse pores[4] and increased dandruff[5]. Stratum corneum hydration is also critical to healthy skin. Adequate hydration is conducive to enzymatic reactions that promote cuticle maturation and maintain the elasticity of the cuticle to maintain normal skin function. Abnormal skin moisture content is closely related to many skin diseases, such as acne, seborrheic dermatitis, atopic dermatitis[6-7]. It is of great significance to study the amount of sebum and stratum corneum hydration in different areas of the face of different people and to guide the use and development of skin care products for the study of facial skin diseases. In the present study a noninvasive skin physiological function tester (Soft5.5) was used to measure the sebum content and stratum corneum hydration of facial skin of 150 healthy adults in Guangzhou.

2. Materials and methods

2.1 Subjects

A total of 150 healthy adult volunteers in Guangzhou, aged between 18 and 70 years old (mean 45.1 years old), were divided into young group (18-35 years old), middle-aged group (36-50 years old) and old group (51-70 years old) based on the physiological development cycle according to the age grouping method of Ma et al.[8] and Man et al.[9]. There were 25 men and 25 women in each group. The participants have lived in Guangzhou for more than 5 years, and have given informed consent to the purpose and content of the study. They had no skin diseases such as facial eczema, contact dermatitis, acne, and seborrheic dermatitis. They had not used glucocorticoids, retinoids or other topical drugs in the 3 months prior to the test, and had not received laser treatment or fruit acid skin peels or other treatment programs in the 1 month prior to the test.

2.2 Detection method

One hour before the test, the volunteers' faces were washed with Saumenka soap, and the skin sebaceous and moisture were tested successively using a non-invasive skin physiological function tester Soft5.5 (Calgari Technology Company, Italian) [10]. The measured locations are forehead, canthus, regio zygomatica and chin on the right face. The working temperature is 15~20 ºC and the relative humidity is 50~60%. The study conducted in November and December in Guangzhou, and the testing time was 10-12 am.

2.3 Statistical analysis

The statistical software SPSS17.0 (SPSS Inc. Chicago, IL, United States) was used for statistical analysis. The analysis of variance with a factorial design was used for the comparison between different genders and different locations, and the analysis of single factor analysis of variance was used for the comparison between different age groups. The relationship between sebum content and stratum corneum hydration and age was analyzed by *Pearson* correlation linear analysis.

3. Results

3.1 Influence of sex and skin location on sebum content and stratum corneum hydration

The skin sebum contents and stratum corneum hydration of different genders and locations showed in Table 1 and 2. The results showed that the skin sebum content in males (70.3 ± 0.8 μC) was higher than that in females (50.8 ± 0.7 μC), and the difference was statistically significant ($F=313.510$, $P<0.05$). There was no significant difference in stratum corneum hydration between male and female ($F=0.84$, $P=0.360$). There was statistically significant difference in sebum content between different locations of skin ($F=159.427$, $P=0.00$). Moreover, the stratum corneum hydration of canthus is high than that of forehead, while the stratum corneum hydration of chin is high than that of regio zygomatica. However, there was no statistical significance between forehead and chin ($P=0.102$).

Table 1. Skin sebum contents of different genders and locations

Location	Skin sebum content (μc)	
	Male*	Female
Forehead	82.3±15.7	63.0±17.7
Canthus[a]	52.3±10.1	34.0±9.4
Regio zygomatica[b]	66.8±10.5	44.6±10.7
Chin	79.7±14.8	61.7±16.0

Note: The results of variance analysis of factorial design showed that the main effect of gender is significant ($F=313.510$, $P=0.00$, and the main effect of position is significant ($F=159.427$, $P=0.00$). There was no significant interaction effect of sex × position ($F=0.768$, $P=0.512$). *: the sebum content is greater than that of women significantly ($P<0.05$). a: the sebum content is less than the other 3 locations significantly ($P<0.05$). b: the sebum content is less than that of forehead and chin significantly ($P<0.05$).

Table 2. Stratum corneum hydration of different genders and locations

Location	Stratum corneum hydration (μc)	
	Male	Female
Forehead	38.9±8.7	38.0±8.1
Canthus[a]	43.1±10.0	42.8±8.2
Regio zygomatica[b]	35.7±8.3	35.0±6.9
Chin	39.3±9.4	39.0±7.5

Note: The results of variance analysis of factorial design showed that the main effect of gender is significant (F=0.84, P=0.360) and the main effect of position is significant (F=21.177, P=0.00). Age group × site have no significant interaction effect (F=0.043, P=0.988). a: the skin moisture content is higher than the other three locations significantly (P<0.05); b: the skin moisture content is less than the other three locations significantly (P<0.05).

3.2 Comparison of sebum content and stratum corneum hydration in different locations of male and female

The sebum content and stratum corneum hydration in different locations of male and female showed in Table 3 and 4. There was no difference in the sebum content in the forehead, canthus, regio zygomatica and chin among the three age groups (P>0.05). However, there were significant differences in the sebum content among the three age groups (P<0.05) and the order of sebum content is young group > middle-aged group> elderly group. There was significant difference in the stratum corneum hydration of the four locations of male face among the three age groups (P<0.05) and the order of stratum corneum hydration is young group > middle-aged group> elderly group. However, there was no difference in the stratum corneum hydration of four locations of women among three age groups (P>0.05).

Table 3. Skin sebum contents of male and female in different ages

Gender	Skin sebum content (μc)					
	Male			Female		
	Youth group	Middle age group	Elderly group	Youth group	Middle age group	Elderly group
Forehead	81.9±15.7	84.8±15.4 F=0.511, P=0.602	80.3±16.3	76.4±13.6[#]	63.6±14.1[#] F=24.398, P=0.00	49.7±13.7[#]
Canthus	51.6±10.2	55.6±11.4 F=2.350, P=0.103	49.6±7.6	41.6±8.3[#]	34.6±6.9[#] F=33.786, P=0.00	25.7±5.0[#]
Regio zygomatica	69.6±9.0	67.1±11.1 F=2.048, P=0.136	63.1±10.8	52.3±10.1[#]	44.2±8.8[#] F=18.50, P=0.00	37.1±7.4[#]
Chin	80.9±15.7	79.2±13.5 F=0.115, P=0.891	79.1±15.7	73.0±12.7[#]	64.6±12.9[#] F=28.526, P=0.00	47.6±10.7[#]

#: It is significant compared with other age groups of the same sex (P<0.05).

Table 4. Stratum corneum hydration of male and female in different ages

Gender	Stratum corneum hydration (μc)					
	Male			Female		
	Youth group	Middle age group	Elderly group	Youth group	Middle age group	Elderly group
Forehead	42.9±8.56[#]	40.5±9.3[#] F=9.779, P=0.00	33.5±9.1[#]	38.1±9.2	37.0±7.3 F=0.343, P=0.71	38.9±7.8
Canthus	48.6±10.8[#]	43.6±9.7[#] F=10.38, P=0.00	37.1±10.7[#]	43.6±8.7	42.6±8.3 F=0.19, P=0.827	42.6±7.7
Regio zygomatica	40.7±11.4[#]	36.1±10.5[#] F=13.5, P=0.00	30.2±8.3[#]	35.6±7.1	34.2±6.8 F=0.259, P=0.773	35.1±7.0
Chin	43.2±12.5[#]	41.3±11.9[#] F=9.185, P=0.00	34.1±7.4[#]	39.5±8.2	38.2±11.9 F=0.068, P=0.93	38.8±7.8

#: It is significant compared with other age groups of the same sex (P<0.05).

3.3 Linear analysis of sebum content, stratum corneum hydration and age in different locations of male and female

The results of *Pearson* correlation analysis showed in Table 5 and 6. There was no linear correlation between the sebum content on the forehead, canthus, regio zygomatica and chin and age ($P>0.05$). However, there was a negative linear correlation between the sebum content in the forehead, canthus, regio zygomatica and chin ($P<0.05$), and the *Pearson* correlation coefficients were -0.513, -0.575, -0.450, and -0.539, respectively. The sebum content on female face decreased with age. There was a negative linear correlation between the stratum corneum hydration of male forehead, canthus, regio zygomatica and chin and age ($P<0.05$), and the Pearson correlation coefficients were -0.637, -0.619, -0.677, and -0.603, respectively. The stratum corneum hydration of male face decreased with age. However, there was no significant linear correlation between the stratum corneum hydration of different location of female and age ($P>0.05$).

Table 5. The linear correlation coefficients between sebum content and age (*n*=75)

	Male				Female			
	Forehead	Canthus	Regio zygomatica	Chin	Forehead*	Canthus*	Regio zygomatica*	Forehead*
P	0.548	0.946	0.444	0.576	0.000	0.000	0.000	0.000
R	-	-	-	-	- 0.513	- 0.575	- 0.450	- 0.539

*: there is a significant linear correlation between sebum content and age ($P<0.05$).

Table 6. The linear correlation coefficients between stratum corneum hydration and age (*n*=75)

	Male				Female			
	Forehead*	Canthus*	Regio zygomatica*	Forehead*	Forehead	Canthus	Regio zygomatica	Chin
P	0.00	0.00	0.00	0.00	0.165	0.132	0.172	0.23
R	-0.637	-0.619	-0.677	-0.603	-	-	-	-

*: there is a significant linear correlation between stratum corneum hydration and age ($P<0.05$).

4. Discussion

Although it has reported that gender, age and different anatomical sites have certain effects on skin physiological functions[9], there are few studies on the comparison of sebum content and skin moisture content between different facial locations. In the present study, the sebum content and stratum corneum hydration of different facial skin locations of healthy adults in Guangzhou were investigated. The results demonstrate that the sebum content on male face was greater than that on female face. The sebum content on different facial locations was found to be: forehead, chin>regio zygomatica, canthus. Facial hair follicle sebum units are divided into two types[11]: (1) The most common type is shallow, with small openings that are difficult to see with naked eyes and less sebum secretion; (2) There are a small number of deep positions, sebaceous gland volume, bulky opening, secretion of sebum more. In this study, it showed that the sebum content in the forehead and chin was more than that in the zygomatic region. The results were consistent with the results of Tagami[12]. This may be related to the fact that the forehead and chin are T-shaped regions where the coarse hair follicle sebum units are dominant[11].

The results of studies on the change of sebum content with age in adults are mixed. Man et al. found that the content of forehead sebum decreased in female after the age of 50, while there was no significant decrease in men[9]. Marrakchi and Maibach[13] believed that the content of sebum in the forehead of the elderly was higher than that of the young. In this study, it was found that the content of sebum on male face was relatively stable, while the content of sebum on female face decreased with age. In addition, it was roughly consistent with the results of Luebbberding et al. on the sebum on forehead and cheek[14]. Reduced sebum content in elder women may be associated with lower levels

of estrogen in the body. Guinot et al. found that estrogen supplementation could increase sebum secretion in postmenopausal women[15].

It is generally believed that with the increase of age, the sebum contents, ceramide and glycerol contents in the stratum corneum, and the skin moisture content decreases accordingly[16]. In the present study, in male facial skin, there was no significant decrease in sebum content with age while the stratum corneum hydration decreased. The content of sebum on female face decreased with age. However, the stratum corneum hydration of skin did not decrease significantly. Kobayashi et al.[17] also found that elder women such as dry skin is mainly in the limbs, while trunk of facial skin moisture content is very good. The results of Ramman lens observation showed that the in older women cheek, the corneous layer density was the same with young people. It makes the face and other locations of the body skin very big contrast. They believe that it is the compactness of the cuticle on older women's faces that holds water. Studies also showed that there is no direct relationship between sebum content and stratum corneum hydration, while the glycerol content in the cuticle is one of the important factors affecting stratum corneum hydration[18]. Triacylglycerol synthesized by epidermal keratinocytes and triacylglycerol secreted by sebaceous glands are the sources of glycerol in the stratum corneum. However, the reason for gender differences between male and female is the difference in skin care habits or other internal reasons, which is worth further study.

In addition, it is worth noting that the stratum corneum hydration on canthus is the highest and the lowest sebum content in the facial area according to the results in the present study. Pratchyapruit et al. also observed this phenomenon in the lower eyelid skin[19]. They believed that although the eyelid location of the corneum is thin and with less sebum, the water retention ability is very strong. This is mainly because the area of the corneum cells is much larger than the area of the corneum cells in the cheeks and nose. This unique large area of the corneum cells plays an important role in water retention[19]. We believe that the higher stratum corneum hydration in the canthus, near the eyelid, may be another reason related to this.

5. Conclusion

The results of this study demonstrated that the sebum content and stratum corneum hydration of facial skin of normal adults in Guangzhou vary with gender, age and anatomical site. Therefore, it suggested that gender, age, position and other factors should be considered comprehensively when choosing skin care products to maintain facial skin health.

Acknowledgements

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