Sebum Secretion of the Trunk and the Development of Truncal Acne in Women: Do Truncal Acne and Sebum Affect Each Other?

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Introduction

Acne is a common skin disease of the pilosebaceous unit that usually occurs on the face, chest and back. Most studies have focused on facial acne, and therefore there are few published data on truncal acne [1, 2]. Previous reports have indicated that approximately 50% of patients with facial acne had involvement of the chest and/or back, and that 1 out of every 4 patients who presented with both facial and truncal acne involvement did not voluntarily mention the presence of truncal acne [3]. Although truncal acne is frequently overlooked in dermatological practice, like facial acne, it can also impact self-esteem and body image [4]. Thus, it is important to identify the characteristics and pathogenesis of truncal acne in order to provide proper and effective acne treatment.

Abstract

Background: There are few published data on truncal acne because most studies have focused on facial acne. Aims: The objective of this study was to investigate truncal sebum secretion levels in patients with acne vulgaris and to evaluate the relationship between sebum secretion and the development of acne lesions. Methods: The sebum casual levels at five different facial sites and ten truncal sites were measured in 35 Korean females with acne using a Sebumeter®. We performed an analysis of the correlation between sebum excretion and acne lesion number. Results: We found that all of the truncal sites analyzed had lower sebum secretion levels than the facial sites. There was no significant correlation between sebum secretion and acne lesions on the trunk. Conclusion: Pathogenic factors other than sebum may have a predominant role in the development of truncal acne.

Key Words

Acne · Acne vulgaris · Face · Sebum secretion · Torso

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been performed. Moreover, the etiological differences between facial and truncal acne have not been evaluated.

In this study, we performed the first objective measurement of sebum secretion levels of the trunk in patients with acne vulgaris and made a correlative analysis of sebum excretion and number of acne lesions.

**Subjects and Methods**

**Subjects**

Thirty-five Korean women with acne of the face and trunk were voluntarily enrolled in this study. The eligibility criteria included a minimum age of 19 years and no history of a physical or dermatological illness with the exception of acne. We only included individuals with grade 2 or higher acne according to the Leeds revised acne grading system [9]. The institutional review board of our hospital approved the study protocol.

**Measurement of the Sebum Casual Levels on the Face and Trunk**

Facial and truncal sebum secretions were measured using the Sebumeter® (SM815; C-K Electronics, Cologne, Germany) as previously described [6, 10]. We selected the following 5 facial sites [6] and 10 truncal sites (fig. 1): the forehead (midglabella), the nose (tip), the chin (mental prominence), the right and left cheeks (the most prominent area of both zygomata), the sternal angle, the right and left midclavicle, the right and left scapular superior angles, the back superior median (middle of both the scapular superior angles), the right and left scapular inferior angles, the back inferior median (middle of both the scapular inferior angles), and the twelfth thoracic vertebra. Participants were asked to not apply any cosmetics and to not to wash within 2 h of the measurements. All procedures were performed by the same investigator in a room with a constant temperature (23 °C) and percent humidity (45%).

**Assignment of the Mean Sebum Level for Each Zone of the Face and Trunk**

The sites of the face and trunk were reclassified into a high and a low zone according to the measured sebum casual levels. The high sebum-secreting zone consisted of the T zone (forehead, nose and chin), the FH zone, and the BH zone, and the low sebum-secreting zone consisted of the U zone (cheeks), the FL zone (FL1 and FL2), and the BL zone (BL1, BL2, BL3, BL4, BL5 and BL6).

We used an area-weighted (AW) value to obtain the mean sebum level of the T zone as suggested by Youn et al. [11], because the three different regions of the T zone represent different areas of the face. The equation of the AW mean sebum level of the T zone is as follows:

\[
AW \text{ T sebum} = \frac{6 \times \text{forehead sebum} + 1 \times \text{nose sebum} + 2 \times \text{chin sebum}}{9}
\]

Because each site within the zones was an even area, we used the average sebum casual level when calculating the mean sebum level for the other zones.

**Clinical Photographs and Counting of Acne Lesions**

We took five standard clinical photographs (i.e. an anterior view and both lateral views of the entire face, and an anterior view of both the chest and back) with identical compositions. A single dermatologist counted the number of acne lesions using the ImageJ software (version 1.48; National Institutes of Health, Bethesda, Md., USA) [12]. The acne lesions were classified as either non-inflamatory (open and closed comedones, and uninflamed nodules) or inflammatory (papules, pustules, inflamed nodules, and cysts) lesions.

To compare acne severity, we measured the density of the acne lesions in each zone, which minimized the errors that could arise as a result of differences in area. To calculate the AW density of the acne lesions, the number of lesions was divided by the actual rate of the area, which was obtained using the ‘rule of four’ method for the face [13] and the simple mathematical rate for the trunk. We
then divided by 9 to get the AW T density, 10 to get the AW U density, 1 to get the AW FH density, 2 to get the AW FL density, 1 to get the AW BH density and 6 to get the AW BL density. For example, the AW T density was calculated using the following equation:

\[
\text{AW T density} = \frac{\text{The number of acne lesions on the forehead, nose, and chin}}{9}
\]

**Statistical Analysis**

A one-way ANOVA test was performed to compare the sebum casual levels at each site on the face and trunk. A paired t test was performed to compare the mean sebum levels and the AW density of the acne lesions in the high and low zones of the face and trunk. To evaluate the correlation between the mean sebum level and the mean number of acne lesions at each zone within the face and trunk, a Pearson’s correlation test was performed. Data were analyzed using the SPSS software (version 17.0; SPSS Inc., Chicago, Ill., USA), and p values <0.05 were considered to be significant.

**Results**

**Sebum Casual Level at Each Site on the Face and Trunk**

The average age of the 35 patients with acne was 25.06 ± 5.51 years, and the range was 19–42 years. The sebum casual levels measured for the forehead, nose, chin, right cheek and left cheek were 149.00 ± 64.69, 152.51 ± 103.35, 123.03 ± 57.80, 85.23 ± 67.81 and 80.69 ± 58.77 μg/cm², respectively. The sebum casual levels of the FH, FL1 and FL2 areas were 22.66 ± 18.16, 9.77 ± 7.81 and 16.23 ± 16.44 μg/cm², respectively. The sebum casual levels of the BH, BL1, BL2, BL3, BL4, BL5 and BL6 areas were 23.57 ± 20.99, 12.09 ± 11.36, 14.23 ± 14.73, 17.97 ± 14.84, 16.91 ± 29.34, 17.17 ± 30.50 and 11.37 ± 18.36 μg/cm², respectively. Higher sebum levels were observed at sites within the face compared to the trunk. The difference in sebum levels in the 5 facial and 3 chest sites was statistically significant. However, differences between sebum levels in the 7 sites within the back were not significant (fig. 2).

**Fig. 2.** Comparison of the sebum casual levels at each site on the face and trunk by ANOVA. FH = Sternal angle; FL1 = right midclavicle; FL2 = left midclavicle; BH = back superior median; BL1 = right scapular superior angle; BL2 = left scapular superior angle; BL3 = back inferior median; BL4 = right scapular inferior angle; BL5 = left scapular inferior angle; BL6 = twelfth thoracic vertebra. * Statistically significant (p < 0.05).

**Table 1.** Mean sebum levels (μg/cm²) in each zone of the face and trunk

<table>
<thead>
<tr>
<th>Zone</th>
<th>Mean (μg/cm²)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AW T</td>
<td>143.62 ± 57.19</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>U</td>
<td>82.96 ± 58.24</td>
<td></td>
</tr>
<tr>
<td>FH</td>
<td>22.66 ± 18.16</td>
<td>0.002*</td>
</tr>
<tr>
<td>FL</td>
<td>13.00 ± 10.38</td>
<td>0.239</td>
</tr>
<tr>
<td>BH</td>
<td>23.57 ± 20.99</td>
<td>0.011*</td>
</tr>
<tr>
<td>BL</td>
<td>14.96 ± 11.87</td>
<td></td>
</tr>
</tbody>
</table>

The p values were obtained from paired t tests. * Statistically significant (p < 0.05).
Comparison of the Mean Sebum Levels for Each Zone on the Face and Trunk

We reclassified all measured sites within the face and trunk into a high and low zone based on the mean sebum levels. The high sebum-secreting zone consisted of the T, the FH and the BH zones, and the low sebum-secreting zone consisted of the U, the FL and the BL zones (table 1). The sebum level of the T zone was higher than that of the U zone, and this difference was statistically significant (143.62 ± 57.19 and 82.96 ± 58.24, respectively; p < 0.001). The sebum level of the FH zone was higher than that of the FL zone (22.66 ± 18.16 and 13.00 ± 10.38, respectively; p = 0.001), and the sebum level of the BH zone was also higher than that of the BL zone (23.57 ± 20.99 and 14.96 ± 11.87, respectively; p = 0.011). This difference was also statistically significant.

Comparison of the AW Densities of the Acne Lesions

The mean number and standard deviation of the acne lesions in the T, U, FH, FL, BH and BL zones were 18.83 ± 16.48, 17.77 ± 14.04, 10.97 ± 9.42, 12.14 ± 15.51, 12.91 ± 10.76 and 58.89 ± 47.76, respectively. The mean AW density of the total acne lesions in the high sebum-secreting zone (T, FH and BH zones) was higher than that of the acne lesions in the low sebum-secreting zone (U, FL and BL zones), but only the difference between the FH and FL zones was statistically significant (table 2). A higher density of inflammatory acne lesions was observed in the U zone compared to the T zone (p = 0.049). The T and FH zones had a higher density of noninflammatory acne lesions than the U and FL zones, respectively (p = 0.009 and p < 0.000, respectively). When evaluating the relationship between the mean number of acne lesions in each zone of the face and trunk, we found a significant correlation between the T and FH zones (table 3, r = 0.364, p = 0.032).

Table 2. Comparison of the AW density of acne lesions in each zone of the face and trunk

<table>
<thead>
<tr>
<th>Zone</th>
<th>AW T density</th>
<th>AW U density</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflammatory lesions</td>
<td>0.71±0.61</td>
<td>1.02±0.97</td>
<td>0.049*</td>
</tr>
<tr>
<td>Noninflammatory lesions</td>
<td>1.38±1.58</td>
<td>0.76±0.74</td>
<td>0.009*</td>
</tr>
<tr>
<td>Total lesions</td>
<td>2.09±1.83</td>
<td>1.78±1.40</td>
<td>0.286</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone</th>
<th>AW FH density</th>
<th>AW FL density</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflammatory lesions</td>
<td>4.97±5.54</td>
<td>3.74±3.64</td>
<td>0.101</td>
</tr>
<tr>
<td>Noninflammatory lesions</td>
<td>6.00±7.08</td>
<td>2.33±3.90</td>
<td>&lt;0.000*</td>
</tr>
<tr>
<td>Total lesions</td>
<td>10.97±9.42</td>
<td>6.07±7.75</td>
<td>&lt;0.000*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone</th>
<th>AW BH density</th>
<th>AW BL density</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflammatory lesions</td>
<td>10.26±9.15</td>
<td>7.74±5.32</td>
<td>0.064</td>
</tr>
<tr>
<td>Noninflammatory lesions</td>
<td>2.66±4.48</td>
<td>2.08±3.60</td>
<td>0.397</td>
</tr>
<tr>
<td>Total lesions</td>
<td>12.91±10.76</td>
<td>9.81±7.96</td>
<td>0.055</td>
</tr>
</tbody>
</table>

The p values were obtained from paired t tests. * Statistically significant (p < 0.05).

Table 3. Relationship between the mean number of acne lesions in each zone of the face and trunk

<table>
<thead>
<tr>
<th>Zone</th>
<th>FH</th>
<th>FL</th>
<th>BH</th>
<th>BL</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>0.364 (0.032* )</td>
<td>0.183 (0.294)</td>
<td>0.036 (0.838)</td>
<td>–0.027 (0.876)</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>0.258 (0.134)</td>
<td>0.215 (0.216)</td>
<td>0.105 (0.548)</td>
<td>0.070 (0.688)</td>
<td></td>
</tr>
</tbody>
</table>

Data are presented as Pearson’s correlation coefficients with p values in parentheses. * Statistically significant (p < 0.05).

Comparison of the Mean Sebum Levels for Each Zone on the Face and Trunk

We reclassified all measured sites within the face and trunk into a high and low zone based on the mean sebum levels. The high sebum-secreting zone consisted of the T, the FH and the BH zones, and the low sebum-secreting zone consisted of the U, the FL and the BL zones (table 1). The sebum level of the T zone was higher than that of the U zone, and this difference was statistically significant (143.62 ± 57.19 and 82.96 ± 58.24, respectively; p < 0.001). The sebum level of the FH zone was higher than that of the FL zone (22.66 ± 18.16 and 13.00 ± 10.38, respectively; p = 0.001), and the sebum level of the BH zone was also higher than that of the BL zone (23.57 ± 20.99 and 14.96 ± 11.87, respectively; p = 0.011). This difference was also statistically significant.

Relationship between Mean Sebum Levels and Mean Number of Acne Lesions

The correlation analysis between mean sebum levels and mean number of acne lesions is summarized in table 4. On the trunk, there was a positive correlation between the mean sebum level and the number of noninflammatory and total lesions, but it was not statistically significant. In the FL zone, there was a negative correlation between the...
Discussion

Truncal acne is defined as the presence of acne on the back or chest [1, 3]. Although clinicians frequently encounter patients with truncal acne, there is little information regarding truncal acne characteristics and treatment. Truncal and facial acne are thought to have a common pathogenesis, and truncal acne is currently managed on the basis of facial acne treatment [1].

The four major causes of acne development are excess sebum secretion, follicular epidermal hyperproliferation, colonization of *Propionibacterium acnes* and inflammation [5, 14]. A positive correlation between increased sebum secretion and the development of facial acne has been established by previous studies [6–8]. It was also determined that sebum predominantly influences inflammatory lesions [7]. However, previous studies have not investigated truncal sebum secretion and the correlation between truncal secretion and the development of truncal acne.

In this study, we measured sebum secretion at ten different locations within the chest and back in conjunction with five locations within the face. This was performed based on the results of previous studies, which have shown that sebum secretion varies from location to location in the facial area. As a consequence, the trunk showed lower sebum secretion levels than the face, even in the highest sebum-secreting zone. This result is in accordance with the generally accepted fact that the face contains more oil than the trunk, which is caused by an abundance of sebaceous glands. In addition, there were statistically significant regional variations on the face and chest.

<table>
<thead>
<tr>
<th></th>
<th>AW</th>
<th>T</th>
<th>U</th>
<th>FH</th>
<th>FL</th>
<th>BH</th>
<th>BL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inflammatory lesions</strong></td>
<td>–0.037 (0.832)</td>
<td>–0.065 (0.711)</td>
<td>0.107 (0.540)</td>
<td>–0.026 (0.881)</td>
<td>0.082 (0.638)</td>
<td>0.096 (0.583)</td>
<td></td>
</tr>
<tr>
<td><strong>Noninflammatory lesions</strong></td>
<td>–0.082 (0.639)</td>
<td>–0.010 (0.957)</td>
<td>0.130 (0.457)</td>
<td>0.185 (0.286)</td>
<td>0.217 (0.210)</td>
<td>0.062 (0.723)</td>
<td></td>
</tr>
<tr>
<td><strong>Total lesions</strong></td>
<td>–0.083 (0.634)</td>
<td>–0.050 (0.777)</td>
<td>0.161 (0.356)</td>
<td>0.129 (0.461)</td>
<td>0.161 (0.357)</td>
<td>0.092 (0.598)</td>
<td></td>
</tr>
</tbody>
</table>

The data are presented as Pearson’s correlation coefficients with p values in parentheses and p < 0.05 as threshold of significance.
whereas topographical variations on the back were not observed. This could result from low overall sebum secretion on the back. Furthermore, it is associated that astematotic eczema frequently presents in areas of low sebum secretion such as the back and flank as compared to relatively high sebum-secreting areas such as the anterior chest [15].

The surface of the face and trunk can be classified according to sebum secretion into a high sebum-secreting zone consisting of the T, FH and BH zones and a low sebum-secreting zone consisting of the U, FL and BL zones. Although there may be some debate regarding a reference value to divide the high and low sebum-secreting zones, our results demonstrated definitive differences based on statistical comparisons between the FH and FL1 and FL2 regions as well as the BH and BL1, BL2, BL3, BL4, BL5 and BL6 regions. In terms of sebum secretion, the trunk consisted of 2 distinct zones, a high sebum-secreting zone at the midline (the FH and BH zones) and a low sebum-secreting zone at the periphery (the FL and BL zones). The mean sebum levels between both zones were significantly different in each compartment. These results support the results from previous studies, which demonstrated that the face has a central high sebum-secreting T zone and a peripheral low sebum-secreting U zone [6, 10]. Based on the observed distribution of differences in sebum secretion, we have proposed a central greasy/peripheral dry theory (fig. 3) of sebum secretion in which the center of the upper torso secretes more sebum than the peripheral area.

To evaluate acne severity, we calculated the acne density in each zone and adjusted for the area. The total acne density in the high sebum-secreting zones (T, FH and BH) was generally higher than in the low sebum-secreting zone (U, FL and BL). More detailed analysis revealed that the U zone had a higher density of inflammatory acne lesions than the T zone, while the T zone had a higher density of noninflammatory acne lesions than the U zone, which implies that follicular obstruction derived from increased sebum secretion could induce comedogenesis in the high sebum-secreting zones, and other factors such as *P. acnes* could play an important role in the development of inflammatory acne lesions in the low sebum-secreting zone. The FH zone had a higher density of comedones than the FL zone, but there was no difference in the distribution of lesions between the BH and BL zones. These results suggested that the influence of sebum secretion on acne lesion type differed between the face and trunk. This phenomenon may have resulted from the fact that the sebum-secreting levels of the trunk were generally far lower than those of the lowest sebum-secreting areas of the face (the U zone). Sebum secretion of the trunk could merely have affected the development of truncal acne.

Our study may not explain all cases of truncal acne. For example, this study was performed on women only, and there may be differences in men with acne.

In conclusion, this is the first study to objectively measure truncal sebum secretion and to evaluate the regional severity of truncal acne and the correlation between truncal sebum secretion and acne lesions. We found that the trunk had lower levels of sebum secretion than the face and defined 2 distinct zones similar to those defined for the face based on sebum secretion: a high sebum-secreting zone and low sebum-secreting zone. Additionally, we found that the high sebum-secreting FH zone had a higher density of comedones than the FL zone although there was no significant correlation between sebum secretion and acne lesions. A relative increase in sebum secretion of the trunk did not directly influence the development of truncal acne. The assessment of truncal acne could provide useful information regarding the pathogenesis of truncal acne involving a minimal effect of sebum secretion. Future studies of the roles of factors that affect acne pathogenesis, for example the role of *P. acnes* in the development of truncal acne, by using Visiopor® will be required to broaden our knowledge of acne pathogenesis.

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**Disclosure Statement**

All authors have no conflict of interests.

**References**