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Relationship between acne vulgaris and cosmetic usage in Sri Lankan urban adolescent females

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Summary

Background – Acne vulgaris is one of the commonest skin disorders affecting up to 80% of the world population at least during adolescence. Significant psychosocial effects such as depression and poor personality development have been linked with acne, especially in female adolescents. Various causative factors, including cosmetic exposure have been attributed towards acne.

Objective – To analyze the association between frequent exposure to cosmetics and severity of acne in adolescent females.

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Method – A cross sectional analytical study was performed on 140 girls from three schools in Colombo, Sri Lanka. A self-administered questionnaire was utilized to assess the patterns of cosmetic usage. Grading acne of the participants was done by the researchers utilizing a standard acne grading scale.

Results – The overall prevalence of acne in our study population was 91.4% with a mean acne grade of 3.09. At least one cosmetic type was used by 126 (90%) of the population. A Pearson Correlation Coefficient (r) value of 0.452 ($P < 0.001$) was obtained between cosmetic exposure and acne grade, which indicates a statistically significant correlation. A chi square value of 22.875 was obtained at a degree of freedom of 2 ($P < 0.001$), enabling us to reject the null hypothesis that there is no significant association between cosmetic usage and acne severity.

Conclusion – Our results convey a significant positive association between frequent exposure to cosmetics and severity of acne in adolescent females. Girls of this age group must be made aware that cosmetic usage may be a potential aggravating factor for their facial acne.

Key words – Acne vulgaris, cosmetic exposure, adolescent females

INTRODUCTION

Acne vulgaris is a disorder of the pilo-sebaceous unit with raised sebum production and blockage of pilo-sebaceous ducts in a background of inflammation due to enzymes released by *Propionibacterium acnes*.¹ Acne is one of the commonest skin diseases in the world affecting up to 80% of the world population at least during their puberty. The disease has its onset between 12–14 years of age and usually regresses by 23–25 years.² Although both males and females suffer from acne, females appear to be more commonly affected for a longer duration than their male counterparts.³ Acne can cause significant

distress in adolescents leading to psychosocial effects, such as reduced self-esteem, poor self-image, embarrassment, anxiety and depression, leading to adverse personality development, especially in the case of female adolescents.⁴ A significant association between acne and suicidal ideation was identified by a study performed in Norway.⁵ Furthermore, it was estimated that in the United States, the total cost for acne treatment exceeded one billion US dollars each year.⁶

Numerous cosmetics have been linked to causing acne. This phenomenon was first described in 1972 as a separate entity called *Acne cosmetica*, inspired by the observation

they made of persistent adult acne in females who used cosmetic products, an observation not shared with the same aged male counterparts of the population.⁷ In this study, Kligman and Mills assessed the comedogenicity of cosmetic creams on external ear canals of rabbits and discovered that majority of the cosmetic products used for their study were comedogenic. Subsequently, as a part of the same study, he assessed the comedogenicity of the same cosmetics on human samples which delivered similar results as the rabbit ear assays. Following this remarkable discovery, many attempts were made to assess the association between acne and cosmetic usage.

A study⁸ performed on post-adolescent females to assess the occurrence of acne following facial cream massages, concluded that there is a temporal relationship between the facial acne eruption and the massage. A review⁹ on comedogenicity of cosmetics discusses on ingredients in cosmetics that have been proven to be definitely comedogenic and those that were declared safe to be used and others with inconclusive results. They concluded that certain ingredients, for example cetyl alcohol and polyethylene glycol 300, used in cosmetics may show comedogenic properties with time and therefore raw materials must be constantly under evaluation.

A recent study¹⁰ performed to review the association between acne and cumulative cosmetic exposure concluded that the overall cosmetic exposure of an individual is inversely associated with post-adolescent acne, but the use of some individual cosmetics had a positive association. Therefore, the term *Acne cosmetica* is acceptable for some cosmetics that are comedogenic, but not for overall use of cosmetics. In their study, Singh *et al* (2013) introduced an index to numerically express the overall exposure of a person to cosmetic products. This index was named Cumulative Cosmetic Exposure Index (CCEI) and depicts the overall cosmetic exposure of each subject in terms of duration and frequency of usage.

The equivocal nature of the results of Singh's study¹⁰, to the other previous studies in this area^{7 8 9} motivated us towards investigating further on this phenomenon. Moreover, all the above studies focused on adult and post-adolescent females while adolescents appeared to be at the peak age of acne prevalence. To the best of our knowledge, this is the first work done to identify the association between acne and cosmetic exposure in the adolescent age group. Furthermore, a study performed on adolescent girls concluded that various cosmetic applications were used by them in order to conceal their facial acne,¹¹ which would be detrimental towards their current

acne severity if cosmetics do contribute towards causation of acne. Therefore, it is vital that investigations are carried out to conclusively determine the relationship between acne vulgaris and usage of cosmetics in pubertal girls.

METHODOLOGY

A cross sectional analytical survey was carried out among girls aged 15-16 years attending three girls' schools located in the country's capital city of Colombo; namely Yasodara, Gothami and Rathnawali Girls' schools. A study¹² that describes the epidemiology of acne concluded that out of adolescent girls, a peak in acne lesions was noted between the ages 15 and 17 years, which led us to restrict our study population. Those on a prescribed medication regime for acne and those who are diagnosed with or showing major symptoms of a systemic disease causing acne, such as polycystic ovarian syndrome, Cushing's syndrome were excluded. A representative sample of 140 subjects were recruited for our study using stratified random sampling.

Ethical considerations

Ethics clearance was obtained from the Ethics Review Committee (ERC) of the Faculty of Medicine, University of Colombo. Permission to procure student specific data during school hours was obtained from the Principal of each school. After determining the potential

participants, they were provided with adequate information about the research, both verbally as well as through an information sheet. Written informed consent was obtained both from the participants as well as their parents to ensure voluntary participation.

Study instruments

A self-administered questionnaire was handed out to each participant in their preferred language (English, Tamil, Sinhala). The questionnaire was pre-tested on five individuals within the same age group prior to data collection. The questionnaire comprised of questions on the participant's basic information and usage of cosmetic products in terms of cosmetic type, duration and frequency of usage. A list of cosmetics was included under five sub-categories namely, make-up products, non-make-up facial applications, self-medication, natural products and cosmetic procedures. A variety of commonly used cosmetics available in the local market were included under each category.

Cosmetic usage was assessed using a standard, Cumulative Cosmetic Exposure Index (CCEI) available in literature.¹⁰ Each cosmetic was analyzed in terms of frequency (times per month) and duration of usage (number of months). The product of these two values indicates the Cosmetic Exposure Index (CEI)

for each cosmetic type. The sum of all CEIs denote the CCEI value of each participant. Thereafter, all participants were categorized into non-frequent ($CCEI < 10000$) and frequent ($CCEI \geq 10000$) users.

Analyzing the current acne severity of the subjects is an important part of our study. For this purpose, several grading systems have been proposed in multiple studies. We selected a few studies which were more suitable for the Sri Lankan setting in order to compare the grading systems. A review on the existing scoring systems of acne offers a comparison between acne grading and lesion counting.¹³ Upon contemplation, a grading system was opted for instead of a lesion counting system due to the fact that it consumes significantly less time to assess each subject. Out of the grading systems available, the Global Acne Grading System (GAGS), was found to be most reliable.¹⁴ Here, lesions types are given a score and according to its location on the face, chest or back, the score is multiplied by a factor to obtain the total score. Acne severity is then assessed according to the final score. The major limitation of this method is having to assess the chest and back of the subjects, which is an unnecessary exposure as cosmetics are not often applied on these areas. A more suitable grading scale for our study was described as the Grading Scale

for Overall Severity (GSOS), where assessing the chest and back is avoided.¹⁵ Here, a severity grade is given according to the facial lesions and their distribution. A summary of the GSOS is shown in Table 1. The GSOS was utilized by three of us (MPNP, WMDMP, DP) to grade the acne of the study participants. Minimization of interviewer bias was done by rehearsing on photographs of individuals with different grades of acne.

The severity of acne in our study population was graded from 0 to 8, which was further subcategorized into mild (grade 0-2), moderate (grade 3-5) and severe (grade 6-8) acne.

Data analysis

Microsoft Excel was used for data capturing, and analysis was performed using Statistical Package for the Social Sciences (SPSS) version 22 by IBM and Matlab R2016b by Mathworks. Categorical data was summarized in contingency tables and analyzed for correlation and significance using Pearson correlation method and chi-squared test.

RESULTS

Study population data

The study population consisted of 140 participants, all of whom were females between 15 and 16 years of age. The mean age

of our sample was 15.59 years with a standard deviation of 0.494 years. Only 8.6% of our study population was free of acne (grade 0), whereas the vast majority (91.4%) rated at a higher rate. The distribution of subjects according to acne severity categories is shown in Figure 1. The mean acne grade of our population is 3.09 with a standard deviation of 2.016. Figure 2 presents a histogram showing the frequency data and the distribution curve of acne grades.

Cosmetic usage data

The CCEI of the study population ranges from 0 to 46550 with a mean CCEI of 6749.59 and a standard deviation of 9319.67. Out of the population, 126 (90%) use some form of cosmetic product, and only 14 (10%) are complete non-users with a CCEI value of zero. A total of 87 subjects (62.1%) are frequent users whereas 53 subjects (37.9%) are non-frequent users of cosmetics. Figure 3 illustrates the distribution of the study sample as a function of the CCEI values.

Patterns of cosmetic usage

To compare the usage of each cosmetic type, Cosmetic Exposure Index (CEI) of individual cosmetic products were analyzed separately. The product of frequency and duration of usage of a certain cosmetic type (CEI) for each subject was calculated. The sum of all CEIs was obtained and divided by the number

of subjects in order to achieve the mean CEI for each cosmetic.

Figure 4 represents the mean CEIs of each cosmetic type we analyzed. The highest mean CEI of 11.37 was obtained for moisturizer creams and 9.87 for powder/talc products. Cosmetic procedures, laser therapy and peeling were used by none.

ANALYSIS

The association between the CCEI and acne grade was analyzed using multiple statistical methods. A Pearson correlation coefficient (r) value of 0.452 was observed for the correlation between CCEI and acne grade, which indicates a statistically significant positive association ($P < 0.001$). The mean acne grade of non-frequent cosmetic users is 2.46 whereas, the mean acne grade of frequent cosmetic users is 4.11, which indicates that cosmetic usage has a positive impact on the acne grade. Figure 5 presents the scatter plot between CCEI and acne grade.

Table 2 represents the cross tabulation of data on categories of acne severity against categories of CCEI. It is evident that 75% of the mild acne sufferers were non-frequent cosmetic users and only 15.8% of the severe acne sufferers were non-frequent cosmetic users. Consistently, 84.2% of severe acne

sufferers were frequent cosmetic users and only 25% of mild acne sufferers were frequent cosmetic users.

The chi-square test was performed on the above cross tabulation (table 2) and a Pearson chi-square value of 22.875 was obtained with a degree of freedom of 2. The chi-square value we computed is larger than the corresponding value of 13.82 in the chi-square table with a significance level less than 0.1% ($P < 0.001$). Therefore, the null hypothesis that there is no significant relationship between acne severity and cosmetic exposure is rejected.

DISCUSSION

Acne vulgaris is one of the most common skin disorders affecting up to 80% of the world population at least during their pubertal years, leading to significant psychosocial effects including depression and poor personality development, especially in female adolescents. Although many causative factors have been attributed towards acne, our study focused on usage of cosmetic products and procedures towards causation of acne in adolescent females.

According to our findings, the total prevalence of acne among our sample is 91.4%. A cross sectional study performed on Iranian girls aged 16 ± 9 years revealed an acne prevalence of 92%¹⁶, which is reasonably comparable with our findings. According to the study by

Yoo and Kim, adolescent females use various cosmetic products to improve their body image as well as to conceal their acne.¹¹ According to our findings, 90% of the study population use at least one type of cosmetic application.

The phenomenon, *Acne cosmetica*, which was first described by Kligman and Mills⁷, where certain cosmetics were found to be comedogenic when tested on external ear canals of rabbits and subsequently on human subjects, was the first instance where cosmetic usage was attributed towards causation of acne. Our findings are compatible with Kligman's study as a significant association was obtained between cosmetic exposure and severity of acne.

A case-control study which revisited the *Acne cosmetica* study, concluded that the overall cosmetic usage is negatively associated, or rather protective of causing acne, while only some cosmetics were positively associated.¹⁰ Another study performed with the same intent, concluded that usage of cosmetics did not impair the existing acne severity, but actually helped them improve their quality of life.¹⁷ Our findings suggest considerably opposing views from both the above studies.^{10 17}

In conclusion, our findings demonstrate a statistically significant, moderately strong relationship between frequent usage of

cosmetics and severity of acne in adolescent females. Our results suggest that regular cosmetic usage might be a causative factor for acne vulgaris in pubertal girls and reduction in cosmetic usage may reduce the severity of acne. For future work, we suggest to study the comedogenicity of individual cosmetic products and procedures. Furthermore, male adolescents could also be incorporated into the same study design in order to investigate how cosmetic use affects their facial acne severity.

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Grade	Description
0	Clear facial skin. A few comedones or papules may be present. These should only be visible on close inspection.
2	About a quarter of the facial skin is occupied by small papules and comedones (6 – 12 in number). A few prominent, large papules or pustules may be present.
4	About half of the facial skin is covered with small papules and large or small comedones. A few pustules or large papules are usually present.
6	About three fourths of the facial skin is involved, with large, open comedones and/or papules. If large inflammatory lesions are present, a lesser facial area involvement is permissible.
8	Nearly all of the facial area is covered with lesions. Visible large prominent pustules are present. Other lesions of acne conglobate, including cystic and sinus type lesions may be present.

Table 1 – The grading scale for overall severity (GSOS). Grading is done by calculating the area of facial skin covered with acne lesions as well as the types of lesions present. Subjects that belong to intermediate grades may be given numbers in-between. (i.e.- A subject with half of the

			CCEI category		Total
			Non-frequent user	Frequent user	
Acne severity	mild acne	Count	48	16	64
		% within Acne severity	75.0%	25.0%	100.0%
		% within CCEI category	55.2%	30.2%	45.7%
		% of Total	34.3%	11.4%	45.7%
	moderate acne	Count	36	21	57
		% within Acne severity	63.2%	36.8%	100.0%
		% within CCEI category	41.4%	39.6%	40.7%
		% of Total	25.7%	15.0%	40.7%
	severe acne	Count	3	16	19
		% within Acne severity	15.8%	84.2%	100.0%
		% within CCEI category	3.4%	30.2%	13.6%
		% of Total	2.1%	11.4%	13.6%
	Total	Count	87	53	140
		% within Acne severity	62.1%	37.9%	100.0%
		% within CCEI category	100.0%	100.0%	100.0%

Figure 1-Distribution of subjects according to acne severity categories. The number of subjects with the particular acne severity category declines as the acne severity increases.

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Figure 2-Histogram illustrating the number of subjects against acne grade. The distribution curve is incorporated into the same diagram. The highest frequency is seen at an acne grade of 2 whereas the least frequency is seen at acne grade 8.

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Figure 3-Histogram illustrating the number of subjects against the CCEI. The distribution curve is incorporated into the same diagram.

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Figure 5-Scatter plot between CCEI and Acne Grade. The acne grade increases as the cumulative cosmetic exposure rises. There is a positive correlation between the two variables.

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