

ORIGINAL ARTICLE

Effects Of Eye Cosmetics Usage, Knowledge, Hygiene And Management Towards Dry Eye Symptoms Among University Students

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ABSTRACT

Introduction: Appropriate management and knowledge are essential while using eye cosmetics as poor hygiene can cause ocular inflammation and disrupt the tear film. This study has investigated the effects of eye cosmetic usage, knowledge on the ingredients, hygiene, and management towards dry eyes symptoms. **Methods:** Ocular Surface Disease Index (OSDI) and eye cosmetic questionnaires were distributed using a google form to 165 eligible universities' students in Malaysia. The demographic data, eye cosmetic usage, hygiene, management, knowledge and dry eye symptoms were recorded and analyzed using the Mann-Whitney U- test, with the significant value, which was set at $p < 0.05$. **Results:** There was no statistically significance of OSDI score between light and regular users using cosmetics products except for the pencil eyeliner, which was statistically significant, $p < 0.05$. Additionally, there was no significant difference of dry eye symptoms (OSDI score) between good and bad management $p = 0.730$ and good and bad hygiene $p = 0.229$ of eye cosmetics usage. Nonetheless, many cosmetic users have adequate knowledge regarding eye cosmetics ingredients. **Conclusion:** Discomfort is primarily caused by applying eye cosmetics close to the ocular surface, such as pencil eyeliner, which increases dry eyes' symptoms by contaminating the tear film. Although users had sufficient knowledge of eye cosmetic ingredients, negligence towards reading labels was high. Eye cosmetics should be used with proper hygiene and management due to the proximity of application to the ocular region, as contaminated cosmetics could cause more severe symptoms of ocular discomfort and dry eyes.

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INTRODUCTION

Eye cosmetics are widely used to enhance the natural beauty of the eyes and create an illusion for the eyes to appear larger and more prominent, which acts as a favourable perception of attractiveness. Psychologically and physically, a study showed that cosmetics could boost self-esteem and positively impact women worldwide (1). The significance of eye cosmetics to a female facial attractiveness could be described in facial neoteny (2). According to the statistics, the use of eye cosmetics among young adults and university students are quite high worldwide. In comparison to women in the Arab world, the West, and the Gulf, female students spend more on makeup (3). The common eye cosmetics used are eyeshadow, eyeliner, mascaras. The eye shadows come in a few forms, such as pencil,

cream, and powder formulations. The composition of pressed powders is mostly talc with pigments and zinc or magnesium stearate used as a binder (4). The pencil, stick and cream formulations used anhydrous cream that is completely waterproof, composed of pigments in petrolatum, cocoa butter, or lanolin base. These formulations are created by adding more wax to creams for firmness purposes (5).

Meanwhile, the pencil eyeliners are the most popular eyeliner formulations due to the ease of their application. Liquid eyeliner is most preferable, due to the ingredient which has been premixed in a water-soluble latex base. It consists of waxes combined with pigments, mineral or vegetable oils, and lanolin derivatives formulated into a rod encased in wood. Instead, the mascara is safely formulated for easy application without smudging, irritancy, or toxicity (3). Mascaras are available in two modern formulations: cake and liquid. Liquid mascaras are further divided into water-based and solvent-based mascaras. Preservatives such as parabens are usually inserted into the formula to inhibit bacterial growth

because water-based mascara is easily contaminated. Study showed that female undergraduate students used personal care products that contained chemicals and preservatives, even though they were aware of the ingredients. It's simply due to a lack of awareness of the negative consequences of long-term use (3). Moreover, the ingredients such as preservatives, fragrances, and metal can cause irritation and inflammation on the ocular surface and disrupt the tear film and cause dry eyes symptoms; OSDI score(5).

Cosmetic users had more severe dry eye symptoms and a higher OSDI value than non-users, according to previous research.(6). Furthermore, there was an association between changes in perceived comfort and the regularity of cosmetic use (7). A more detailed study has reported on the impact of make-up towards ocular comfort and meibomian gland atrophy(8). In addition, patients who wore less cosmetics and removed them more often, which considered good hygiene, were positively correlated to their perceived ocular comfort. Proper hygiene and appropriate management are essential while using eye cosmetics. In terms of hygiene, poor hygiene can be classified based on the users who do not clean thoroughly, rarely clean or dry the brushes, and improperly store cosmetics and brushes in the bathroom. Microorganisms from the bowl can rise with the plume and land on surfaces and objects in your bathroom after just one flush (9).

Thus, dirt and organisms can transfer from the face to the product and back to the face. A study on the impact of the environment on the skin found that improper hygiene would cause the skin to break out or flare up pre-existing acne (10). Poor hygiene may lead to the contamination by bacterias such as *staphylococcus aureus*, *escherichia coli*, *pseudomonas aeruginosa*, and *citrobacter freundii* which induce ocular discomfort. Other bacterias species, *streptococcus pyogenes* and *klebsiella pneumoniae* are a concern which are primarily found in eye-area cosmetic products (11,12). Moreover, microbiomes such as *staphylococcus aureus* and *streptococci* caused ocular infections such as conjunctivitis, keratitis and endophthalmitis (13,14).

Studies among university students have shown several adverse effects such as tearing (36.4%), redness (27.3%) and itchiness due to poor hygiene and the use of expired eye cosmetics (15, 16). The eye products are typically used for a long time due to their high price. Nevertheless, the cosmetic has an expiration date where the exact expiry time depends on the specific product, how it is stored, and whether it is sealed or opened (17). Therefore, this study investigates the effects of eye cosmetics on ocular comfort in terms of its usage, knowledge, hygiene and management among university students. It has been hypothesized that poor hygiene, management, and knowledge of eye cosmetics ingredients increases ocular discomfort, such as dry eyes

symptoms among university cosmetics users.

MATERIALS AND METHODS

This cross-sectional study was adapted and modified from Ng et al., 2012 (15) that investigated the relationship between ocular comfort and eye cosmetic usage. A self-administrative eye cosmetic and Ocular Surface Disease Index (OSDI) questionnaires were used in this study which consisted of 37 questions related to eye cosmetic usage, knowledge, hygiene and management. The questions were divided into five parts; the first part was the users' demographic and eye health status. The second part elucidated the level of comfortness and dry eyes symptoms of the users. The comfort score is calculated using an ordinal scale ranging from 0 to 10, with 0 indicating very uncomfortable eyes and 10 indicating very comfortable eyes. Meanwhile the Ocular Surface Disease Index (OSDI; Allergen Inc Irvine, California) explicated the dry eyes symptoms. A score of 0 to 12 points is normal, 13 to 22 points is mild, 23 to 32 points is moderate, and 33 to 100 points is severe, with 0 to 12 points being normal, 13 to 22 points being mild, 23 to 32 points being moderate, and 33 to 100 points being severe (18-19).

The third part consisted of questions regarding the knowledge of ingredients in eye cosmetics, including the metals, fragrance and preservatives that may harm the eyes. The level of knowledge was categorized into two groups which were adequate knowledge (score ≥ 7) and poor knowledge (score < 6). The fourth part then investigated the user's profile related to eye cosmetics such as choice, frequency, comfortability of using the product, hygiene and managing profile while using the product. A simple scale of 0 to 5 was used to determine the hygiene and management of the users on their cosmetic care. 0 to 3 indicates a bad outcome which categorizes them as poor hygiene and management while a score of 4 to 5 indicates a good outcome which categorizes them as good hygiene and management.

The Research Ethics Committee of Universiti Teknologi MARA (UiTM) has approved this study with reference number REC/05/2021 (UG/MR/479). All respondents involved in this study were voluntarily selected based on inclusion and exclusion criteria. Respondents were attained using the convenience sampling method, and the questionnaires were distributed online via different social media platforms such as WhatsApp, Instagram and Twitter. Written consent was obtained prior to the study. A total of 165 respondents have participated in this which were from Universiti Teknologi Mara (UiTM), Universiti Kebangsaan Malaysia (UKM), Universiti Islam Antarbangsa Malaysia (UIAM), University Putra Malaysia (UPM), Universiti Malaya (UM), Universiti Tun Hussein Onn Malaysia (UTHM) and Universiti Utara Malaysia (UUM).

Data Analysis

All completed questionnaires were analyzed using Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics were used to determine and summarize the variables. Meanwhile, the Kolmogorov-Smirnov test was implemented to test the normality of the collected data. The test showed that the data for perceived ocular comfort, cosmetic eye usage, hygiene level, management level, and knowledge on eye cosmetic ingredients were not normally distributed, $p=0.00$ for all data; thus, non-parametric statistics were applied. Data analysis for categorical and continuous variables was conducted using the Mann-Whitney U test. The significant comparison between those two variables was set at $p<0.05$.

RESULTS

A total of 165 university cosmetic users have completed the questionnaires, and their mean age was 22.93 (SD±1.8), ranging between 19 to 28 years old final year students. The respondents was comprised of 41.2% of light users; who uses cosmetic less than three times per week, and 58.8% of regular users; who uses cosmetic equal or more than three times per week. The ocular comfort of the respondents who used cosmetics received the highest score of 6 (N=34, 20.6%), while those who did not used cosmetics received the highest score of 10 (N=88, 53.3%) (Table I). Respondents were significantly more comfortable without the cosmetic usage ($t(164) = -14.446, p<0.0005$), based on the dependent T-test.

Table 1 :The ocular comfort score of the university cosmetic users

Ocular comfort score	With make-up usage (%)	Without make-up usage (%)
0	0 (0)	2 (1.2)
1	0 (0)	1 (0.6)
2	4 (2.4)	1 (0.6)
3	7 (4.2)	3 (1.8)
4	17 (10.3)	2 (1.2)
5	29 (17.6)	3 (1.8)
6	34 (20.6)	1 (0.6)
7	25 (15.2)	2 (1.2)
8	30 (18.2)	20 (12.1)
9	15 (9.1)	42 (25.5)
10	4 (2.4)	88 (53.3)

In terms of reflecting the symptoms of ocular dryness, the mean OSDI score attained by the respondents was 30.54 ± 17 , ranging between 2.08 – 77.08. Overall, 17% of the respondents had normal OSDI scores, 26.6% for mild, 18.2% for moderate, and 38.2% for severe (Fig.1). Meanwhile, most of the respondents (72.7%) had adequate knowledge regarding the cosmetic ingredients, even though (62.4%) of them were unaware of the presented ingredients in the products as the negligence on the ingredient labels upon buying the cosmetic eye products (Table II). Moreover, most respondents showed poor management by not discarding the cosmetic products as directed by packaging (Fig.2).

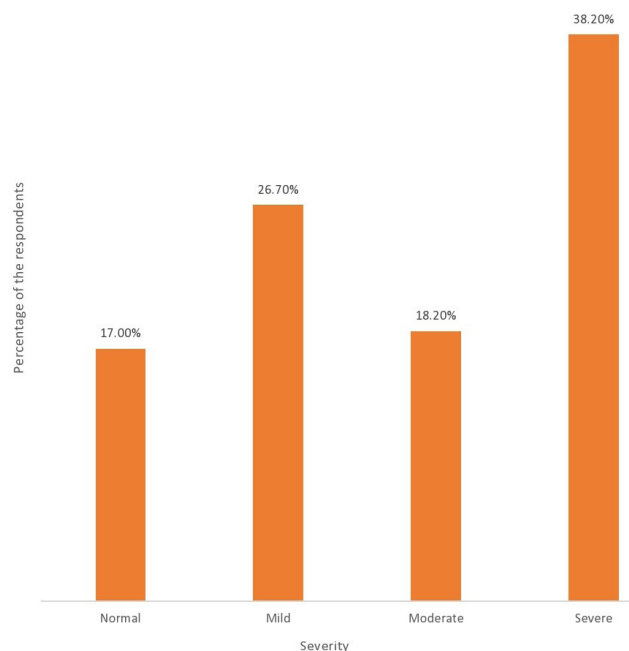


Figure 1: Severity of dry eyes from the OSDI score of respondents

Table II: The awareness and reading caution among university cosmetic users

Variable	Total number of people (n=165)	Percentage (%)
Do you know what ingredients are in your eye cosmetics?		
Yes	62	37.6
No	103	62.4
Do you check the ingredients list before buying cosmetics?		
Yes	53	32.1
No	111	67.3
Do you think that these ingredients are in cosmetics?		
Metals		
Yes	61	37.0
No	27	16.4
I do not know	77	46.7
Frangrances		
Yes	12	84.2
No	14	8.5
I do not know	139	7.3
Preservatives		
Yes	112	67.9
No	13	7.9
I do not know	40	24.2
Do you think that these ingredients will affect the eye?		
Metals		
Yes	111	67.3
No	7	4.2
I do not know	47	28.5
Frangrances		
Yes	112	67.9
No	15	9.1
I do not know	38	23.0
Preservatives		
Yes	101	61.2
No	17	10.3
I do not know	47	28.5

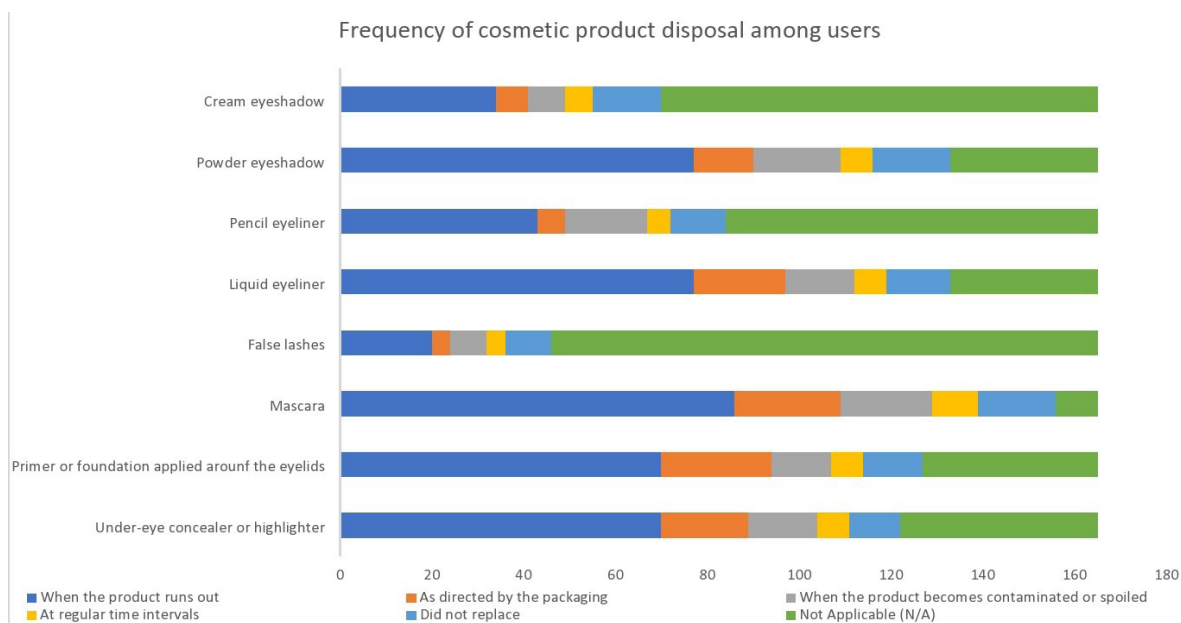


Figure 2: Summary of product disposal eye cosmetic users

Cosmetic usage on dry eyes symptoms

The percentage of regular users indicated more significant dry eyes symptoms; higher OSDI values than light users for all products (58%, n=97). Nonetheless, only pencil eyeliner applied within the lash line showed a significant relationship, (p<0.05), between dry eyes symptoms and cosmetic usage. Although other products show an insignificant relationship, most of the score values were more than 15, indicating the cut-off score for dry eyes diagnosis (18-19).

The cosmetic product that contributed to the highest OSDI score was mascara; the regular users had a mean score of 72.69, whereas the light users had a mean score of 77.23, indicating that both had symptoms of dry eyes. On the other hand, the cosmetic product with the lowest OSDI score was false lashes, 8.50 and 3.30 for regular and light users, respectively. The mean OSDI score for both regular and light users for all cosmetic products were summarised in (Table III).

Comparison of dry eyes symptoms for cosmetic user’s management and hygiene

88% (n=145) of the respondents had poor management, which contributed to the value of OSDI score; 83.48 indicates higher dry eyes symptoms. However, there was no statistically significant difference of dry eyes symptoms (OSDI score) between good and poor management of the eye cosmetic usage (p=0.730). There was also no statistically significant difference of the OSDI score between good and poor hygiene in wearing eye cosmetics (p=0.229) using the Mann Whitney U test (Table IV).

Additionally, the users with good hygiene showed a much lower mean value OSDI score of 80.51, indicating a lower dry eye symptom than those who had poor

hygiene. Furthermore, results showed only 42% of the respondents store cosmetic tools in a covered setting, which manifested a low percentage of the population that had practised good hygiene (Fig.3).

DISCUSSION

Overall, most respondents can be classified as mild dry eyes based on the OSDI score, which exceeds the 15 score value (18-19). Moreover, the perceived ocular comfort was significantly higher without eye cosmetics regardless of users. This finding corroborated a previous study that reported a 65% reduction in comfort with eye cosmetic usage (6). Other contributing factors such as habits and psychology will influence the toleration in perceived comfort, especially among light cosmetic users. This is possible because of self-selection; whereby light cosmetic users may restrict their frequency of cosmetic use due to discomfort. Nonetheless, regular users may be the opposite (20).

On the other hand, most respondents among university users reported a good knowledge of the cosmetic ingredients they used. Less than half of users had poor knowledge that could cause ocular discomfort, such as dry eyes. The finding was contradicted with the previous study that found; about half of the female respondents (52%) did not know about the ingredients such as; parabens and phenoxyethanol in the cosmetic products they used, and about a quarter of the participants (19% of males and 25% of females) were unaware of the adverse effects of cosmetic use (21). Cosmetic consumption is influenced by price, quality, brand name, brand loyalty, and labelling. These characteristics have now become a new market trend (22). Therefore, consumers tend to overlook the ingredients before purchasing the product. Ingredients such as preservatives, fragrances, and metals

Table III: The summary of the OSDI score for all eye cosmetic products

Frequency of usage	N	Mean OSDI	p-value
Under-eye concealer or highlighter			
Regular users (≥3x)	59	51.61	0.473 ^{ns}
Light users (<3x)	48	55.94	
Primer or foundation applied around the eyelids			
Regular users (≥3x)	49	58.80	0.141 ^{ns}
Light users (<3x)	58	49.95	
Mascara			
Regular users (≥3x)	89	72.69	0.528 ^{ns}
Light users (<3x)	59	77.23	
Liquid eyeliner - within the lash line			
Regular users (≥3x)	29	31.07	0.133 ^{ns}
Light users (<3x)	26	24.58	
Liquid eyeliner - outside the lash line			
Regular users (≥3x)	66	56.64	0.492 ^{ns}
Light users (<3x)	50	60.96	
Pencil eyeliner - within the lash line			
Regular users (≥3x)	17	29.21	0.045*
Light users (<3x)	30	21.05	
Pencil eyeliner - outside the lash line			
Regular users (≥3x)	28	32.16	0.157 ^{ns}
Light users (<3x)	29	25.95	
Powder eyeshadow			
Regular users (≥3x)	60	62.73	0.222 ^{ns}
Light users (<3x)	57	55.05	
Cream eyeshadow			
Regular users (≥3x)	17	22.26	0.769 ^{ns}
Light users (<3x)	28	23.45	
False lashes			
Regular users (≥3x)	3	8.50	0.959 ^{ns}
Light users (<3x)	13	3.30	

*Significant difference - Mann-Whitney U test
 ns-Not significance difference – Mann-Whitney U test

Table IV: The comparison of the OSDI score for cosmetic users' management and hygiene

Management	N	Mean rank (OSDI)	p-value
Good	20	79.55	0.730 ^{ns}
Poor	145	83.48	
Hygiene			
Good	126	80.51	0.229 ^{ns}
Poor	39	90.04	

ns-Not significance difference – Mann-Whitney U test

included in eye cosmetics could cause several adverse effects such as irritation and inflammation, disruption of tear film and impact of ocular surface disorders (5). Preservatives can cause inflammation on the ocular surface and periocular region, of which 10% are allergic-inflammatory reactions, and the other adverse reactions induced by chemicals in ocular products are

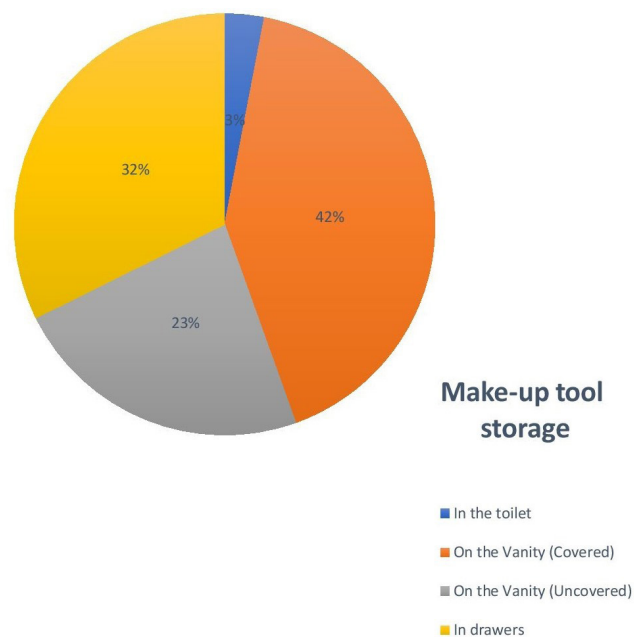


Figure 3: The storage of cosmetic tools among users

chemical irritation (23). Furthermore, when fragrances are mixed with cosmetics, it is commonly known to cause allergy symptoms. A retrospective study of 115 people found that cosmetic goods were shown to be the source of fragrance allergic contact dermatitis in 95.8% of cases (24). As for the effects of metals on the eye, a study following the application of metal (Ni) in green eye pencil in a patient was found to have clinical symptoms such as itching, erythema, mild infiltration, and scaling of both eyelids (25).

Cosmetic usage on dry eyes symptoms

There were no significant differences in OSDI scores between regular and light cosmetic users on ocular comfort in terms of frequency, except for the usage of pencil eyeliner specifically within the lash line. However, both users had attained high OSDI scores, which can be related to other factors such as poor hygiene and management. The highest OSDI score was in mascara, followed by powder eyeshadow users. A study found that the practice of sharing eye cosmetics, such as mascara, eyeliner, and eye shadow, has been related to infectious conjunctivitis (26). Mascara applicators can induce mechanical corneal abrasion, getting infected with pseudomonas aeruginosa if the mascara is contaminated (27).

Furthermore, the OSDI score was higher in regular users who apply pencil eyeliner within the waterline than light users. From a study in Japan, “eye appeal cosmetic” is a growing trend among young people, and some have presented with dry eye symptoms due to obstructed meibomian glands at a young age. The possible cause was from the cosmetic technique known as “tightlining,” where the eyeliner applied to the eyelid borders over the meibomian glands (28). The cosmetic pencil eyeliner migrated the most when applied within

the lash line. The migration of eyeliner applied to the periocular skin or outside the lash line happens at a slower rate, and the tear film contamination is less evident (7,8,29). Additionally, cosmetic materials have the potential to migrate when applied close to or above the eyelash line, and migration might rise significantly with time following the application (30).

Comparison of dry eyes symptoms for cosmetic user's management and hygiene

Generally, most of the respondents had increased dry eyes symptoms, especially those who had poor management in handling their cosmetic products. However, the comparison between both was not statistically significant. The finding contradicted a previous study where 70.5% of their respondents observed no adverse effects when wearing eye cosmetics. However, 29% of the respondents who did experience an adverse reaction to cosmetics was primarily due to the usage of expired cosmetics, specifically expired mascaras (16).

In this study, respondents mostly failed to discard their cosmetic products as advised on the packaging. This could be a prime reason why the OSDI evaluation showed high scores of dry eyes symptoms. A study has found that the symptom of watery eyes was reported by 18.2% of the participants induced by a variety of cosmetic products used around the eyes that were found to be expired (16). The bacteria such as *pseudomonas aeruginosa* has been reported to be the most common cause of eye infections such as conjunctivitis, keratitis, and ophthalmitis, which can compromise the eye's integrity by damaging tissues and impairing vision (31). *Pseudomonas aeruginosa* infections have been documented due to contaminated mascara, eye damage, or poor hygiene (4). According to the Food and Drug Administration (FDA) year, eye-area cosmetics are more susceptible to microbial infection during use by the consumer and have a higher risk of eye infections, which causes the shelf life for eye cosmetics to be much shorter. So, if these products have expired according to the packaging, users should discard them immediately.

As discussed earlier, hygiene can be one of the contributing factors that can affect ocular comfort. Findings indicated that those who had poor hygiene (88%, n=145) showed higher scores of dry eyes symptoms than those with good hygiene care (12% n=20) of their eyes and cosmetic tools. Higher scores of dry eye symptoms may result from clogging of the meibomian gland orifices caused by the deposition of cosmetic particles within the meibomian gland openings (32).

Eyelid hygiene regimens and digital manipulation associated with routine removal of cosmetic materials have been identified as having the potential to introduce confounding effects (6). The removal of eye cosmetics is essential to reducing the risk of dry eyes and meibomian

gland dysfunction (MGD). Using an oil-based cosmetic remover or a micelle-based cleansing solution such as micellar water and performing lid hygiene is the most effective method to remove eye cosmetics (7). Eyelid hygiene can also be considered a preventative means of maintaining eyelid health. Cleansing is a well-established aspect of treating anterior blepharitis, but it also helps improve other conditions. The removal of crusts around the eyelid margin can lower the risk of bacterial infection, which contributes directly to anterior blepharitis and has a severe effect on meibomian gland function (33,34). Another study discovered that applying eye shampoo to clean the eyelids helped avoid the areas skipped by eye cosmetic removal and kept the eyelids cleaner, thus resulting in minor blockage and improved meibum secretion (28).

Besides, the physical presence of dust particles (sized 1–2 mm) may change the distance between the epithelium and the lipid surface of the 10-mm-thick tear film, which may cause a decrease in breakup time. The greater the tear film breakup, the thinner the tear film (35). It was also shown that more than half of the users store their cosmetic tools in places more susceptible to dust accumulation (uncovered settings). House dust is known to be a reservoir for many released compounds and a marker for what is in the air, and human exposure might pose a health risk (8). Dust can affect the ocular comfort of the eyes by decreasing the breakup time.

CONCLUSION

There was a reduction in the ocular comfort trend in regular university users more than three times per week, users with poor management and poor hygiene. The eye cosmetic usage had negatively impacted ocular comfort by increasing the symptoms of dry eyes. Discomfort is primarily caused by applying some eye cosmetics close to the ocular surface and contaminating the tear film. Although users had sufficient knowledge of eye cosmetic ingredients, negligence towards reading labels was high. Eye cosmetics should be carefully used with proper hygiene and management due to the proximity of application to the ocular region, as contaminated cosmetics may cause more severe symptoms of ocular discomfort, especially dry eyes. These eye cosmetics should be carefully used with proper hygiene and management due to the proximity of application to the ocular region, as contaminated cosmetics may cause more severe symptoms of ocular discomfort, especially dry eyes. Investigation regarding the number of ingredients such as metal, fragrances, and preservatives in cosmetics is a must before purchasing. These ingredients need to follow the FDA guidelines to prevent adverse reactions due to toxicity.

Further investigation regarding the ocular health and quantitative assessments of ocular discomfort such as dry eyes evaluations are essential to give more representative

outcomes due to insufficient clinical data on the physical condition of the eyes. Hence, in the future, it is recommended to conduct the additional Standard Patient Evaluation for Eye Dryness (SPEED) components and the tear breakup time assessments to quantify the tear film and investigate the eye health, especially the corneal staining through slit-lamp assessments prior to the study.

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