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Classification and characteristics of periorbital hyperpigmentation

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Abstract

Introduction: Periorbital hyperpigmentation (POH) is among the commonest esthetic and dermatological complaints. Despite its frequency, there are inadequate information detailing its incidence and prevalence. This subsequently leads to lack of comprehensive POH classification and stratification of impact on an individual's general well-being. Malaysia, a multiracial country with an expansive expatriate population, provides a unique opportunity to identify demographics of POH and subsequently attempts to group this esthetic and dermatological entity.

Objective: This study aims to develop a new and clinically relevant POH classification system and to measure impact on quality of life of POH individuals.

Methods: One hundred patients with POH were enrolled, of which all underwent clinical assessment by a clinician. Objective assessment with mexameter and digital analysis were performed. All recruited patients also completed a questionnaire based on dermatology life quality index (DLQI).

Results: Assessments noted the commonest type of POH among the subjects was vascular (51%) with the least being pigmentary (6%). The location of POH majority involved both the upper and lower eyelids (65%). DLQI scoring shows that a majority (58%) did not disrupt their quality of life.

Conclusion: Vascular type POH was the frequent most form observed, and involvement tends to occur on both eyelids. A majority of noted that POH does not affect they QOL, but the due consideration must be given in those whom are moderately and minimally affected. A thorough and comprehensive holistic approach is required in managing POH despite its focal presentation as it does affect a patient's quality of life.

KEYWORDS
classification, dermatology life quality index, periorbital hyperpigmentation, pigmentary, vascular

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1 | INTRODUCTION

One of the commonest esthetic and dermatological complainant by an individual regardless of gender although more in the female population is periorbital hyperpigmentation (POH). It has been documented to be more marked in certain ethnic groups and is also frequently seen in multiple members of the same family.[1]There is various loose definition of this facial presentation, but generally it is an ill-defined entity which presents on a person as bilateral round or semi-circular homogenous brown or dark brown pigmented macules in the periorbital region.[1,2] Its clinical severity and presentation may vary; however, it usually presents bilaterally with one periorbital region more affected than the other. It can affect either the upper or lower eyelid or both upper and lower. POH may also affect the upper nose and glabella.[3]

Although POH is a dermatological problem, it does interfere with the visual aspect of the face and may modify the esthetics of one's facial presentation, giving the individual a tired, gloomy look or even an aging face [1,4] subsequently involves one's self-esteem. It affects psychological and emotional well-being of a person which in turn affects their quality of life. The magnitude of the problem is mirrored in the sheer number of commercial products advertised to cover the pigmentation and lighten the skin tone or color.[5] By far the most convenient way to start for the majority of patients are topical applications[5] but sadly, most have poor therapeutic efficacy.[6,7] Besides that, there are not enough credible evidence-based or significant studies to ultimately justify its use.[1]

It must be emphasized that identification of each etiologic factors of POH and classify them accordingly is one crucial step to develop a new and effective treatment.[3] Etiologically, POH can be generally divided into primary or idiopathic type and secondary type, which is related to systemic or local diseases of known causes[8] and even drugs. Secondary POH is caused by multiple external and intrinsic factors. The contributing factors may be multifactorial with no exact etiological factor predominating.[5] This includes genetic or heredity inclination, excessive pigmentation, post-inflammatory hyperpigmentation due to atopic and allergic contact dermatitis, periorbital swelling, excessive vascularity, shadowing secondary to skin laxity, and tear trough related to aging.[1,3,5] Variation in periorbital anatomy among individuals and races may also exacerbate the presentation of POH. Observations noted that ethnic groups originating from South Asia, Middle East plus the Iberian Peninsula, and their respective descendants; POH tends to appear earlier—often during childhood.[9] This was due to the skin's transparency that gets higher when they grow up.[9]

In the previous study conducted by Ranu and his team, POH can be classified into 4 types, namely vascular, constitutional, post-inflammatory hyperpigmentation, and shadows effects,[10] with vascular to be the commonest type. Their definition of vascular type POH is presence of erythema predominantly involving the inner aspect of the lower eyelids, with conspicuous capillaries or telangiectasia or the presence of bluish discoloration of the lower eyelid due to visible blue veins, which became more prominent when the overlying skin is stretched. Another study classified POH on the foundation of clinical pattern of pigmentation and vasculature.[7] This study classified POH into pigmented (brown color), vascular (blue/pink/purple color), structural (skin color), and mixed variety based on the clinical appearance assessed by a physician via Wood's lamp and ultrasonogram.[11] It has also been proposed that POH despite its periocular presentation is merely an extension of pigmentary Fuschner line (F-line) on the face.[12]

Classification of POH is never been an easy task. It necessitates careful elimination by adequate history taking, thorough clinical examination and proper investigations prior to labeling the problem as primary or idiopathic in nature. Therefore, despite it being an esthetic complaint it creates a unique opportunity for clinician to diagnose an underlying health condition prior to develop a holistic treatment program. Therefore, this study aimed to develop a new and clinically relevant classification of POH. In addition, psychological aspect of POH patients will also be studied to gauge further their insight toward this problem, self-perception of other individual's impression of their presentation and their self-esteem.

2 | MATERIALS AND METHODS

2.1 | Patients

This was a single-center, cross-sectional, descriptive, anonymous conducted on general population living in Kuala Lumpur, Malaysia. The study was conducted from January 2017 to December 2017, with the ethical clearance given by Malaysian Research Ethics Committee (MREC) (NMRR-13-931-16582). One hundred new patients presented with POH having age between 16 and 35 years and Fitzpatrick skin type III, IV, and V were included in this study. Informed consent of each volunteer was taken. Detailed history was taken including duration of the condition, family history, associated faulty habit or lifestyle, triggers, precipitating factor such as photosensitivity, allergies, and presence of any concomitant illness.

2.2 | Assessment of periorbital hyperpigmentation

Careful physical examination was conducted to examine the characteristics of patient's POH, including involvement of upper or lower or both eyelids and extension beyond the periorbital region, color of hyperpigmented areas (Light brown/Dark brown/Red/Blue), homogeneity of the pigmentation, visibility and nature of vessels, presence of pigmentary demarcation lines, tear trough and lichenification/thickening.

Photographs of the patients' faces from the frontal hairline to the nasal tip were taken. Diagnosis of POH was done clinically, and the patients were classified into the followings:

a. Pigmentary—Presence of pigmentation when the area is being stretched, no visible vessels and heterogeneous pigmentation.

b. Vascular—Visible vessels when skin is being stretched; either capillaries or veins/venules, visible vessels on the outer aspect of the eye. Diascopy will be performed to visualize the vascular components.
c. Constitutional—Homogeneous pigmentation over the lower eyelid with strong family history association.
d. Tear trough—Presence of a deep tear trough over the medial aspect of inferior orbital rim that disappear with direct lighting. Apparent hyperpigmentation only over the depressed area.
e. Others—POH from other causes including anemia, hormonal disturbances, nutritional deficiencies, acanthosis nigricans, skin laxity, associated chronic illness, habits, etc

2.3 | Objective assessment

Degree of pigmentation (MI) and erythema (EI) were measured using Mexameter MX-18 (CK Electronic GmbH) on the following points for each eye.

1. Medical aspect of lower eyelid
2. Lateral aspect of lower eyelid
3. Medial aspect of upper eyelid
4. Lateral aspect of upper eyelid
5. Malar prominence

2.4 | Image analysis

Image was processed using method proposed by Hiroshi et al (2008). ImageJ, a freeware was used. Image brightness and color were adjusted according to the standard color chart taken during image acquisition to ensure image brightness kept constant. Regions of interest (ROI) were defined 3 times for both upper and lower eyelid. After splitting image into RGB channel, the (log R-log G) image was defined as EI image and inverse log R image was defined as MI image. Brightness intensity was multiplied by 4 to enable visualization of the image. The mean brightness values within respective ROI were adopted as MI and EI.

2.5 | Dermatology life quality index

DLQI assessed patient's QoL over the past 7 days. It consisted of 6 sections: symptoms and feelings (2 items), daily activities (2 items), leisure (2 items), work and school (1 item), personal relationships (2 items), and treatment (1 item).[13] HSS is lengthier and consisted of 3 sections: symptoms (7 items), function (12 items), and emotion (10 items).[14] In both instruments, higher score indicates more severe QoL impairment and vice versa. Similar approach had been published previously.[15,16]

TABLE 1 Demographic characteristic of patients

Variables	Frequency (n)
Gender	
Male	36
Female	64
Ethnicity	
Malay	18
Chinese	76
Indian	6
Current medical illness	
No	92
Yes	8
First notice	
During childhood	8
Around puberty	42
During adulthood	20
Unsure	30
Family members having dark circles	
Yes	66
No	34
Factors worsening dark circles (multiple selections)	
Sleepless/disturbance	93
Menstruation	6
Stress	34
Illness	11
Skin type	
Type III	9
Type IV	65
Type V	26

2.6 | Statistical analysis

Quantitative data were analyzed using SPSS 21.0. Continuous data were described as mean and standard deviation when normally distributed. Median and interquartile range were used for continuous data that is not normally distributed. Categorical was expressed as proportion and analyzed via chi-square or Fisher's exact test when applied. Clinical features of each category of POH were described.

3 | RESULTS

3.1 | Demographic characteristic of patients

A total of 100 patients fulfill the selection criteria were recruited in the study, and the response rate was 100%. Patients were predominantly women (n = 64, 64%), with the ratio of 1.8-1, woman to man. Racial breakdown noted a majority of Chinese accounting for 76% of patients, followed by 18% of Malays and 6% of Indian. Mean age of the

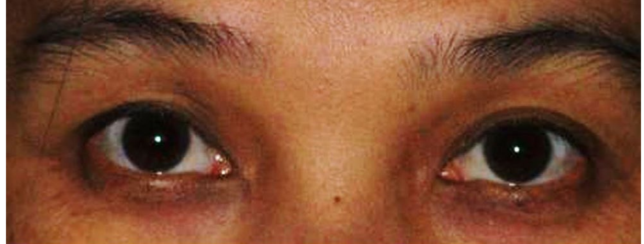

FIGURE 1 Pigmentary type periorbital hyperpigmentation

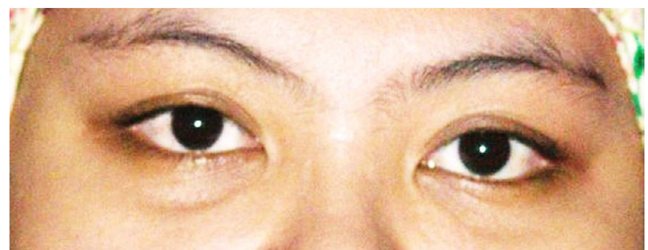

FIGURE 3 Tear trough type periorbital hyperpigmentation

patients was 21.2 years old. Of all the patients, 8% of respondents reported to have underlying medical illness namely rhinitis, asthma, and allergy. 42% of the patients first noticed POH at or around the age of menarche, while 20% of patients claimed onset was during adulthood. Only 8% of the patients claimed that their POH had persisted since their childhood. As for familial predisposition, more than half (n = 66, 66%) of the patients reported to have family members with POH. When inquired about factors that intensifies the present dark circles, majority of patients (n = 93, 93%) identify lack of sleep as a contributing factor while a second distant factor, stress was reported by 34 patients. Other causative factors to exacerbation of the periorbital hyperpigmentation were illness (n = 11, 11%) and menstruation (n = 6, 6%). Proportion of Fitzpatrick skin type was 65% of type IV, 9% type III, and 26% of type V. Further details were recorded in Table 1.

3.2 | Types of POH

Majority of the patients (n = 51, 51%) are having vascular type of POH, followed by 27% of combination type of POH (pigmentary and vascular), 16% of tear trough, and only 6% of the patients reported to have pigmentary type of POH. Constitutional type was no reported in our study. Statistical analysis showed that there is a significant association ($P < .05$) between types of POH with ethnicity and Fitzpatrick skin types. All three different races had a dominant occurrence of a type of POH. It is noted that among the Chinese population vascular type of POH was more frequent (n = 47, 62%); while the Malays had mostly a combination type of POH (n = 7, 39%). Half of the Indian respondents tear trough type POH (n = 3, 50%). On the other hand, vascular type of POH is significantly higher ($P < .05$) in patients with type IV and type V skin type as compared to other types of POH. Interestingly, the commonest type of POH for skin type III is tear trough POH (n = 4, 44%). In addition, types of POH also showed to be significantly associated ($P < .01$) with DLQI, with most of the patients reported that POH has no effect at all on their quality of life. No significant association was found between types of POH with other demographic factors such as gender and age. (Figures 1-3).

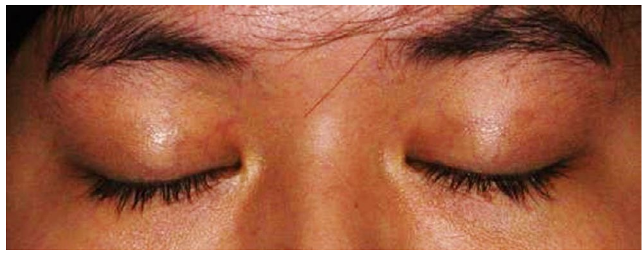

FIGURE 2 Vascular type periorbital hyperpigmentation

TABLE 2 DLQI grade of patients

DLQI Grade	Frequency (n)
No effect at all	58
Small effect	29
Moderate effect	12
Extremely large effect	1

3.3 | Dermatology life quality index

The DLQI is calculated by summing the score of each question resulting in a maximum of 30 and a minimum of 0. The higher the score, the more quality of life is impaired.[13] Results showed that most of the patients (n = 58, 58%) reported that the presence of POH has no effect at all on their quality of life. Among those that claimed that POH does affect their daily living, 29 noted small effects, 12 had moderate effect and only a single respondent noted that it does have an extremely large effect on her life (Table 2).

3.4 | Clinical presentation and types of periorbital hyperpigmentation

Results showed that clinical presentation of POH is significantly correlated ($P < .05$) with the types of POH. When analyzing the location of the hyperpigmentation, vascular type hyperpigmentation had a tendency of either only involves the upper eyelid or both but does not occur in isolation at the lower eyelid. Thirty-two (63%) patients have upper eyelid involvement, while the remaining showed both eyelids involvement. No involvement of lower eyelid was reported. Interestingly, combination type hyperpigmentation observed in our study population all involved both eyelids and similarly in those with tear trough. Only the pigmentary type of POH may occur isolated on the lower eyelids.

TABLE 3 Clinical presentation and types of POH

Variable	Pigmentary	Vascular	Combination	Tear through	*P*-value
Involvement					
Upper	1	32	0	0	<.005
Lower	2	0	0	0	
Both	3	19	27	16	
Hyperpigmentation lower eyelid					
Homogenous	5	0	25	14	<.005
Heterogenous	0	19	2	2	
Hyperpigmentation upper eyelid					
Homogenous	3	0	2	9	<.005
Heterogenous	1	51	25	7	
Visible vessel					
Not present	5	0	0	4	<.005
Present	1	51	27	12	

TABLE 4 Objective assessment of POH

Variable	Pigmentary	Vascular	Combination	Tear through
Melanin Index (MI)				
RUM	280.88	217.32	296.83	393.75
RUL	232.78	189.17	233.81	279.04
RLM	234.12	186.71	247.79	303.32
RLL	230.00	185.54	230.54	292.82
Erythema Index (EI)				
RUM	380.05	343.75	371.86	410.91
RUL	336.47	247.85	297.80	325.55
RLM	393.43	349.66	376.84	400.15
RLL	329.78	257.20	276.29	332.17

Without taking into consideration of POH type, the distribution of pigmentation tends to be mostly heterogeneous on the upper eyelid (n = 84, 84%) and but on the lower eyelid tends to be homogenous (n = 44, 44%), as compared to heterogeneous (n = 23, 23%). Interestingly, homogenous hyperpigmentation involving lower eyelid involvement wase mostly combination or tear trough types, but heterogeneous hyperpigmentation was usually vascular in nature. Visible vascularity was observed in majority of POH among the subjects (n = 91, 91%). This significant statistical correlation was evident in hyperpigmentation with vascular type, both vascular and combination types. Pigmentary type POH mostly had no vascularity observed (Table 3).

3.5 | Objective assessment

No significant association was found between MI and EI readings with the types of POH in our study. MI outcomes showed that right upper medial (RUM) quadrant has a tendency to have a higher index (280.88, 217.32, 296.83, 393.75) as compared to the all other quadrants. The right lower lateral (RLL) quadrant has a lower index reading (230.00, 185.54, 230.54, 292.82) regardless of the types of POH. Vascular type POH has a tendency to have the lowest MI, while tear trough has the highest MI (317.23). When assessing erythema index (EI) comparable with MI; the right upper medial (RUM) quadrant has the highest index reading (380.05, 343.75, 371.86, 410.91) when comparing with all the other quadrants. Overall results revealed that pigmentary type of POH has higher MI than vascular type. Surprisingly, EI reading of pigmentary type of POH also higher than vascular type (Table 4).

3.6 | Image analysis

Similar to the Mexameter reading, photographic assessment with Image J does not show any correlations of both the MI and EI with the POH types. As shown in Table 5, overall index for MI is higher than EI for all types of POH. MI for pigmentation type of POH is noted to higher than EI for pigmentation type of POH; MI of 95.01 for right upper lateral (RUL) and EI of 37.49 for RUL. However, for vascular type of POH, the MI has a higher index than EI. MI of RUL for vascular type of POH is 99.42, while EI index is 38.33 lower than what was initially expected.

TABLE 5 Image analysis of POH

Variable	Pigmentary	Vascular	Combination	Tear through
ImageJ MI				
RUL	95.01	99.42	93.89	78.47
RLM	120.73	117.21	104.92	90.82
ImageJ EI				
RUL	37.49	38.33	36.85	31.88
RLM	47.53	46.11	44.73	39.81

4 | DISCUSSION

Despite the common prevalence of POH, it remains as an enigma for physicians to manage and treat this clinical presentation. Though only a hand full has sought to classify this esthetic problem, it is believed that adequate categorizing or grouping POH will offer a guided management pathway and also effective treatment with respect to its generalized cause. Notably, 2 studies have recommended their classification of POH; Huang et al on the basis of examination with Wood's Lamp and ultrasonogram and Ranu et al which was based on clinical observations by physicians. Our study among 100 Malaysian subjects was similar to Ranu, et al via direct clinical observation and grouping on a basis of the hue of pigmentation, uniformity of the pigmentation and observed periorbital hyperpigmentation with the structural presence of a tear trough. The etiology of POH is various, and genetic predisposition is seen to play a strong role in this esthetic problem. Therefore, a recognition and categorization of the problem in a local setting would allow a more specific management.

In comparison to previous studies, his study has simplified and condensed the classifying groups into 4. Namely what has been observed by Ranu et al as constitutional and post-inflammatory hyperpigmentation has been grouped into a single group: hyperpigmentation. While the association of blood vessel hyperpigmentation type has been grouped as vascular, it is also agreed that the hyperpigmentation would significantly heightened in its intensity of presentation with presence of tear trough providing a justification to classify it in its own grouping.

Our study showed that periorbital hyperpigmentation is more prevalent (64%) among the female population. In contrast, Ranu et al in their study had 62.5% of men and 37.5% of women. Although POH is not rare among men, it is found that women are commonly more affected owing to the effect of hormonal changes. Previous studies had cited hormones as a causative agent as an increased incidence of POH was observed in women on hypothyroidism treatment and also aggravation of dark circles during pregnancy.[17] Moreover, the anxious nature among woman is also a contributing factor to the more reported POH compared to men. Prior to seeking proper medical attention from dermatologists they may have tried various skincare products and treatments which may result in adverse outcomes such as acne, hirsutism, erythema, skin thinning, and even aggravation of skin pigmentation worsening the preexisting condition.[18]

In terms of race, our studies encompasses of other race groups reflecting the multiracial population in Malaysia while most studies only encompass a single race. The classification proposed by Huang et al in Taiwan also only consist of patients who were primarily of Chinese origin. POH from our study noted a significant difference among races; supporting its genetic prevalence. Ranu et al noted that a majority of their study had vascular type hyperpigmentation, in part due to a majority of Chinese subjects concurring with our study. Ranu et al used a constitutional type hyperpigmentation in their study and noted its strong prevalence in the Indian community; however, a slight difference in classification where we noted that Indians were majority of combination type (vascular and pigmentation) periorbital melanosis similarly to the Malays.

To the best of our knowledge, there are no published previous studies investigating the association of quality of life with POH. Studies on quality of life have generally revolved around other pigmentary disorders such as melasma and vitiligo. Our findings also reflected that DLQI score is significantly associated ($P < .01$) with types of POH. Majority of the POH patients reported no effect on their quality of life. Unlike other chronic skin diseases, POH does not cause severe physical or emotional symptoms and worrying impact which may lead to impairment of daily life.

Our study noted that presence of tear trough was prevalent throughout the 3 races profiled but mostly occurred among the Malays and Indians. In support of the study proposed by Goodman et al who proposed that periorbital hyperpigmentation is an autosomal dominant trait; our research shows more than two-thirds of the sample population noted familial predisposition. In comparison, it is slightly higher than the 42.2% observed by Ranu et al in Singapore. Despite its genetic prevalence, our study also concurs with the idea that genetic conditions does not essentially present at birth but the phenotyping may occur later in life. Our studies noted that onset of periorbital hyperpigmentation mostly occurred at around puberty similarly to findings of Ranu et al In addition, recent genetic study among a Malaysian Chinese population showed that polymorphisms in P53 and VEGFA genes were associated with different subtypes of periorbital hyperpigmentation.[19] This reflects that besides environmental factors, the genetic makeup of an individual may affect the type of POH, makes it potentially more challenging to treat the condition.

With regard to mexameter measurement, our observation encompassing the whole eyelid rather than only of the lower eyelid

compared to study by Oshima et al Besides that, their study recruited solely Japanese subjects and use Mexameter MX16, while our study has a multiracial population and used Mexameter MX18. However, we were not able to establish an association between the Mexameter reading and periorbital hyperpigmentation as reported by them. Our findings are in line with the observations of Ranu et al The setback in our study was that we were unable to correlate among Asians or Pacific Islanders, Black people, and White people. An individual's minimal erythema dose is highly correlated with melanin content, as determined by reflectance spectrophotometry.[20]

5 | CONCLUSION

In summary, POH can be classified into 4 types: pigmentation, vascular, combination, and tear through. The quality of life among patients was not affected by the types of POH that an individual has. Nevertheless, the types of POH showed a significant association with ethnicity groups and Fitzpatrick skin types. MI and EI obtained from Mexameter reading and image analysis does not show any correlation with the types of POH.

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CONFLICT OF INTEREST

No conflict of interest to be reported.

ETHICAL APPROVAL

Malaysian Research Ethics Committee (MREC) (NMRR-13-931-16582).

INFORMED CONSENT

Informed consent of each volunteer was obtained.

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REFERENCES

1. Freitag FM, Cestari TF. What causes dark circles under the eyes? *J Cosmet Dermatol*. 2007;6(3):211-215.
2. Maruri C, Diaz L. Dark circles around the eyes'. *Cutis*. 1969;5:979-982.
3. Roberts WE. Periorbital hyperpigmentation: review of etiology, medical evaluation, and aesthetic treatment. *J Drugs Dermatol*. 2014;13(4):472-482.
4. Roh MR, Chung KY. Infraorbital dark circles: definition, causes, and treatment options. *Dermatol Surg*. 2009;35(8):1163-1171.
5. Alsaad SM, Mikhail M. Periocular hyperpigmentation: a review of etiology and current treatment options. *J Drugs Dermatol*. 2013;12(2):154-157.
6. Hacker SM. Common disorders of pigmentation: when are more than cosmetic cover-ups required? *Postgrad Med*. 1996;99(6):177-186.
7. Garcia A, Fulton Jr JE. The combination of glycolic acid and hydroquinone or kojic acid for the treatment of melasma and related conditions. *Dermatol Surg*. 1996;22(5):443-447.
8. Cymbalista NC, Prado de oliveira ZN. Treatment of idiopathic cutaneous hyperchromia of the orbital region (ICHOR) with intense pulsed light. *Dermatol Surg*. 2006;32(6):773-783; discussion 783–774.
9. Souza DM, Ludtke C, Souza ERdM, Scandura KMP, Weber MB. Periorbital hyperchromia. *Surg Cosmet Dermatol*. 2011;3:233-239.
10. Ranu H, Thng S, Goh BK, Burger A, Goh CL. Periorbital hyperpigmentation in Asians: an epidemiologic study and a proposed classification. *Dermatol Surg*. 2011;37(9):1297-1303.
11. Connelly LM. Pilot studies. *Medsurg Nurs*. 2008;17(6):411-412.
12. Malakar S, Lahiri K, Banerjee U, Mondal S, Sarangi S. Periorbital melanosis is an extension of pigmentary demarcation line-F on face. *Indian J Dermatol Venereol Leprol*. 2007;73(5):323-325.
13. Finlay AY. Quality of life measurement in dermatology: a practical guide. *Br J Dermatol*. 1997;136(3):305-314.
14. Chren MM, Lasek RJ, Flocke SA, Zyzanski SJ. Improved discriminative and evaluative capability of a refined version of Skindex, a quality-of-life instrument for patients with skin diseases. *Arch Dermatol*. 1997;133(11):1433-1440.
15. Han S-H, Byun J-W, Lee W-S, et al. Quality of life assessment in male patients with androgenetic alopecia: result of a prospective, multicenter study. *Ann Dermatol*. 2012;24(3):311-318.
16. Williamson D, Gonzalez M, Finlay AY. The effect of hair loss on quality of life. *J Eur Acad Dermatol Venereol*. 2001;15(2):137-139.
17. Chatterjee M, Suwal B, Malik A, Vasudevan B. A study of epidemiological, etiological, and clinicopathological factors in periocular hyperpigmentation. *Pigment Int*. 2018;5(1):34-42.
18. Mashhood AA.Treatment of hyperpigmentation disorders. Vol 162006.
19. Amini F, Thazin Oo NM, Okechukwu PN, Seghayat MS, Ng ESC. Polymorphisms in P53 and VEGFA genes in different subtypes of periorbital hyperpigmentation in a Malaysian Chinese population. *Australas J Dermatol*. 2019;60(2):e99-e104.
20. Coelho SG, Zmudzka BZ, Yin L, et al. Non-invasive diffuse reflectance measurements of cutaneous melanin content can predict human sensitivity to UVR. *Exp Dermatol*. 2013;22(4):266-271.

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