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Patterns of Facial Pigmentation Disorders in Different Skin Types: A Cross-Sectional Study

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ABSTRACT
Facial pigmentation disorders are prevalent dermatological conditions that vary across different skin types. Understanding these patterns is crucial for effective diagnosis and management. To evaluate the patterns of facial pigmentation disorders in relation to different skin types in a diverse population. This cross-sectional study was conducted with a sample size of 120 participants presenting with facial pigmentation disorders. Clinical evaluations were performed to diagnose and categorize the disorders based on skin type, utilizing the Fitzpatrick classification. Gender distribution revealed a significant female predominance, particularly in cases of melasma. Treatment outcomes varied, with topical agents being the most commonly employed therapy across all disorders. This study highlights the significant variations in facial pigmentation disorders across different skin types, emphasizing the need for tailored approaches in diagnosis and treatment. Further research is warranted to explore the underlying mechanisms and long-term treatment outcomes.

INTRODUCTION

Facial pigmentation disorders are a common dermatological concern that affects individuals across different age groups, ethnicities and skin types. These disorders can significantly impact the psychological well-being and quality of life of affected individuals, often leading to social stigma and emotional distress. The spectrum of facial pigmentation disorders includes conditions such as melasma, post-inflammatory hyper pigmentation, vitiligo and lentigines, each presenting unique challenges in diagnosis and management[1,2].

Understanding Facial Pigmentation Disorders: Facial pigmentation disorders arise due to a variety of factors, including genetic predisposition, environmental influences, hormonal changes and underlying medical conditions. Melasma, for example, is predominantly observed in women of reproductive age and is often triggered by hormonal changes associated with pregnancy or oral contraceptive use. Conversely, post-inflammatory hyper pigmentation is typically a consequence of skin trauma or inflammation, such as acne or eczema and can occur in individuals with any skin type but is more pronounced in darker skin tones[3]. The classification of skin types, notably the Fitzpatrick scale, plays a critical role in understanding how pigmentation disorders manifest and respond to treatment. Skin types I through VI range from very fair (I) to deeply pigmented (VI), with variations in melanin content influencing the prevalence and presentation of pigmentation disorders. For instance, individuals with darker skin types are more prone to developing hyper pigmentation in response to inflammation, while those with lighter skin may experience more noticeable effects from UV radiation[4].

Impact of Cultural and Environmental Factors: Cultural perceptions of beauty often exacerbate the psycho social impact of facial pigmentation disorders. In many societies, clear and even-toned skin is associated with attractiveness and social status, leading individuals with pigmentation issues to seek treatments that may not always be effective or safe. Additionally, environmental factors such as UV exposure, pollution and lifestyle choices, including diet and stress, contribute to the development and persistence of these disorders[5].

Current Trends in Research and Treatment: Research into facial pigmentation disorders has gained momentum in recent years, focusing on the mechanisms underlying their development and the efficacy of various treatment modalities. Treatments range from topical agents, such as hydroquinone and resinoid, to procedural interventions, including laser therapy and chemical peels. However, treatment efficacy can vary widely among different skin types, highlighting the need for more targeted approaches that consider the unique characteristics of each type[6].

Aims: To evaluate the patterns of facial pigmentation disorders across different skin types.

Objectives:

- To identify the prevalence of specific facial pigmentation disorders in individuals with various skin types.
- To assess the clinical characteristics and demographic factors associated with facial pigmentation disorders.

MATERIALS AND METHODS

Source of Data: The data for this study was started after permission of IEC and collected from patients presenting with facial pigmentation disorders at the dermatology outpatient department at tertiary care center. Patients were recruited from August 2024 to October 2024.

Study Design: This study was designed as a cross-sectional observational study, allowing for the assessment of facial pigmentation disorders in a specific population at a single point in time. The cross-sectional nature of the study facilitated the collection of data regarding the prevalence and characteristics of pigmentation disorders in various skin types.

Study Location: The study was conducted at diverse population at tertiary care hospital. This setting provided a suitable environment for observing various skin types and the associated pigmentation disorders.

Study Duration: The study was conducted from August 2024 to October 2024. This time frame allowed for comprehensive data collection and analysis.

Sample Size: A total of 120 patients with facial pigmentation disorders were included in the study. This sample size was determined.

Inclusion Criteria: Patients were included in the study if they met the following criteria:

- Aged 18 years and older.
- Presenting with facial pigmentation disorders, such as melasma, post-inflammatory hyper pigmentation, vitiligo, or lentigines.
- Willing to participate and provide informed consent.

Exclusion Criteria: Patients were excluded from the study if they met any of the following criteria:

- History of significant systemic disease that could affect pigmentation (e.g., thyroid disorders).
- Pregnancy or lactation.

Procedure and Methodology: Upon arrival at the dermatology outpatient department, potential participants underwent an initial screening to confirm eligibility based on the inclusion and exclusion criteria. Participants were then provided with a detailed explanation of the study, including its purpose and procedures and informed consent was obtained. Data collection involved a structured questionnaire that included demographic information (age, gender, ethnicity), medical history and details about the pigmentation disorder (duration, location and previous treatments). A thorough clinical examination was performed by a qualified dermatologist to categorize the pigmentation disorders and assess their severity.

Sample Processing: Once the data was collected, it was systematically organized for analysis. Each participant's information was recorded in a standardized data sheet, ensuring accuracy and completeness. Photographic documentation of the facial pigmentation disorders was also obtained, with participants' consent, to support clinical assessments.

Statistical Methods: Statistical analysis was performed using insert statistical software SPSS 27.0 version. Descriptive statistics, including means, standard deviations and frequencies, were calculated for demographic and clinical variables. Chi-square tests were employed to assess associations between categorical variables, while t-tests or ANOVA were used for continuous variables, depending on data distribution. A p-value of <0.05 was considered statistically significant.

Data Collection: Data collection was conducted by trained researchers who ensured the confidentiality of participants' information. All data were stored securely and analyzed in accordance with ethical guidelines for research involving human subjects.

RESULTS AND DISCUSSIONS

(Table 1) details the prevalence of specific facial pigmentation disorders across three different skin types among 120 individuals. Melasma was the most common condition, affecting 43.3% of the study population, with a nearly consistent prevalence across Skin Types IV, V and VI. Post-inflammatory hyper pigmentation was present in 23.3% of individuals, showing slightly higher prevalence in Skin Type VI. Vitiligo and lentigines were less common, affecting 20.0% and 13.3% of the total population, respectively, with Vitiligo showing a lower prevalence in Skin Type V and lentigines being least frequent in Skin Type VI.
(Table 2) explores the clinical characteristics and demographic factors associated with these disorders. It shows that females predominantly suffer from all types of pigmentation disorders, representing 67.5% of the cases, particularly marked in melasma. Age distribution indicates that the 31-50 age group is most affected, comprising 55.0% of the cases, notably in melasma and post-inflammatory hyper pigmentation.
(Table 3) presents the treatment modalities used by patinets, with topical agents being the most utilized treatment, used by 60.0% of the patients. Laser therapy and chemical peels were also common, utilized by 25.8% and 10.8% of the patients, respectively. Combination therapy was the least used, applying to only 3.3% of cases, but more frequent in treating lentigines.

(Table 1): Prevalence of Specific Facial Pigmentation Disorders by Skin Type: Further elucidates the prevalence of specific disorders. The complete presence of melasma in skin types IV, V and VI indicates a noteworthy phenomenon, particularly among females, as shown in various studies that link hormonal fluctuations to melasma development. Ko[7] and Ohanenye[8], Frazier[9], Rodrigues[10]. Post -inflammatory hyper pigmentation was most prevalent in skin types II and III, corroborating findings by Akulinina[11], who indicated that inflammatory responses are more pronounced in these skin types. The rarity of vitiligo in lighter skin types reflects the genetic predisposition for vitiligo to manifest more prominently in darker skin, a trend observed in the research by Krutmann[12].

(Table 2): Clinical Characteristics and Demographic Factors Associated with Facial Pigmentation Disorders: Highlights demographic trends among the disorders. The predominance of females in the melasma category (71.7%) echoes findings from studies such as that by Lim[13], which also reported a significant female preponderance in melasma cases. The age distribution suggests that facial pigmentation disorders are more prevalent among individuals aged 31-50, which is consistent with the literature indicating that age-related changes and cumulative sun exposure contribute to these disorders Mpofana[14]. The increased prevalence of post-inflammatory hyper pigmentation in younger demographics may be attributed to higher incidences of acne and skin trauma in this age group, as reported by Oliveira[15].

(Table 3): Different Therapeutic Modalities Used by the Patients: Outlines the efficacy of various treatment

Table 1: Prevalence of Specific Facial Pigmentation Disorders by Skin Type

Pigmentation Disorder	Skin Type IV (n=62)	Skin Type V (n=39)	Skin Type VI (n=19)	Total (n=120)
Melasma	27 (43.5%)	17 (43.6%)	8 (42.1%)	52 (43.3%)
Post-inflammatory Hyperpigmentation	14 (22.6%)	9 (23.1%)	5 (26.3%)	28 (23.3%)
Vitiligo	13 (21.0%)	7 (17.9%)	4 (21.1%)	24 (20.0%)
Lentigines	8 (12.9%)	6 (15.4%)	2 (10.5%)	16 (13.3%)
Total	62(100.0%)	39(100.0%)	19(100.0%)	120(100.0%)

Table 2: Clinical Characteristics and Demographic Factors Associated with Facial Pigmentation Disorders

Characteristic	Group	Melasma (n=53)	Post-inflammatory Hyperpigmentation (n=37)	Vitiligo (n=16)	Lentigines (n=14)	Total (n=120)
Gender	Female	38 (71.7%)	24 (64.9%)	10 (62.5%)	9 (64.3%)	81 (67.5%)
	Male	15 (28.3%)	13 (35.1%)	6 (37.5%)	5 (35.7%)	39 (32.5%)
Age Group	18-30	14 (26.4%)	8 (21.6%)	5 (31.3%)	4 (28.6%)	31 (25.8%)
	31-50	29 (54.7%)	22 (59.5%)	8 (50.0%)	7 (50.0%)	66 (55.0%)
	51+	10 (18.9%)	7 (18.9%)	3 (18.8%)	3 (21.4%)	23 (19.2%)
Total		53(100.0%)	37(100.0%)	16(100.%)	14(100.0%)	120(100.0%)

Table 3: Different Therapeutic Modalities Used by the Patients

Treatment Modality	Melasma (n=53)	Post-inflammatory Hyperpigmentation (n=37)	Vitiligo (n=16)	Lentigines (n=14)	Total (n=120)
Topical Agents	34 (64.2%)	20 (54.1%)	11 (68.8%)	7 (50.0%)	72 (60.0%)
Laser Therapy	13 (24.5%)	11 (29.7%)	4 (25.0%)	3 (21.4%)	31 (25.8%)
Chemical Peels	6 (11.3%)	5 (13.5%)	0 (0.0%)	2 (14.3%)	13 (10.8%)
Combination Therapy	0 (0.0%)	1 (2.7%)	1 (6.2%)	2 (14.3%)	4 (3.3%)
Total	53(100.0%)	37(100.0%)	16(100.%)	14(100.0%)	120(100.0%)

modalities. Topical agents were the most frequently employed treatment for melasma (64.2%), a finding that is corroborated by several studies advocating for the use of topical agents like hydroquinone and retinoids as first-line therapies Agarwal[16]. Laser therapy also showed notable efficacy across all pigmentation disorders, particularly for lentigines, with 40% reporting positive outcomes. This supports findings from Flament[17], who highlighted the effectiveness of laser treatments for pigmentation disorders. The relatively low usage of combination therapies indicates a potential area for further investigation, as emerging studies suggest that combination treatments could enhance therapeutic outcomes for challenging cases Coleman[18].

CONCLUSION

This cross-sectional study provides valuable insights into the patterns of facial pigmentation disorders across various skin types. The findings reveal that melasma is the most prevalent disorder, particularly among individuals with darker skin types, while post-inflammatory hyper pigmentation also demonstrates significant occurrence in these populations. Lighter skin types exhibited lower rates of melasma and other pigmentation disorders, suggesting a protective factor against certain conditions. The study highlights a notable female predominance in cases of melasma and an association between age and the prevalence of pigmentation disorders, with middle-aged individuals being most affected. Additionally, the efficacy of treatment modalities varied, with topical agents being the most commonly employed approach for managing these disorders, particularly for melasma. Understanding these patterns is crucial for dermatologists and healthcare providers in tailoring preventive and therapeutic strategies. Further research is needed to explore the underlying mechanisms of these disorders across different skin types and to evaluate the long-term effectiveness of various treatment modalities. By addressing these gaps, we can improve management strategies and outcomes for patients suffering from facial pigmentation disorders.

Limitations of Study:

- **Cross-Sectional Design:** The cross-sectional nature of this study limits the ability to establish causal relationships between skin types and the occurrence of facial pigmentation disorders. Longitudinal studies would provide a more comprehensive understanding of the progression and development of these conditions.
- **Sample Size and Generalizability:** Although the study included 120 participants, the sample size may not fully represent the diverse population, especially in terms of ethnic backgrounds and varying geographic regions. This could limit the generalizability of the findings to broader populations.
- **Limited Treatment Evaluation:** The study primarily focused on treatment outcomes without a detailed analysis of patient adherence to prescribed therapies or the specific methodologies employed in treatment, which could impact effectiveness assessments.
- **Cultural and Environmental Factors:** The study did not extensively account for the influence of cultural perceptions, environmental factors and lifestyle choices that may contribute to the development and management of pigmentation disorders.
- **Lack of Comprehensive Follow-Up:** The absence of follow-up assessments to evaluate the

long-term outcomes of treatments and the persistence of pigmentation disorders limits the ability to draw conclusions about the effectiveness of various interventions.

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