



The Effect of Sunscreen Use on The Incidence of Melasma in Police Officers: Meta-Analysis and Systemic Review

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ABSTRACT

Introduction: Melasma is a matter of concern for certain individuals due to its ability to cause changes in the visual appearance of the skin, ultimately impacting one's self-esteem and overall quality of life. Exposure to direct sunlight significantly influences the development of melasma. Indonesia's location below the equator results in a tropical environment with high temperatures throughout the year. Police officers are exposed to solar radiation for more than 6 hours every day while on duty. For certain police officers, particularly female officers, this is an issue as it can result in melasma, which affects appearances

Objective: This study aims to estimate the effect of sunscreen usage in the police environment on melasma incidence in police officers.

Methods: Electronic databases such as MEDLINE/PubMed, Cochrane Library, ClinicalTrials.gov, EBSCO, Scopus, ProQuest, Cambridge Core, reference lists, conference proceedings, and researchers in relevant fields of study were searched. The impact of sunscreen application on the prevalence of melasma in police personnel was evaluated using many parameters

Results: Based on the systematic review, police officers continue to have a very high prevalence of melasma because they have a low awareness of the importance of using sunscreen.

Conclusions: Awareness of sunscreen application on the skin is required to prevent the development of melasma in police personnel. Education on the prognosis, propensity, and chronicity of melasma is extremely important. In a police institution, Dermatovenereologists (DVE) play an important role.

Introduction

Melasma, also known as chloasma, is a condition of symmetrical hyperpigmentation of the skin with brownish pigmentation that is usually found

on the face and can sometimes occur in the forearms and back (Aishwarya et al., 2019). Melasma is prevalent among people of Asian, Latin American, and Hispanic descent with Fitzpatrick skin type III-V.

Retrospective study of new patients in Cosmetic Division, Dermatology, and Venereology Outpatient Clinic Dr. Soetomo General Hospital, Surabaya from January 2011 until December 2013. The total number of new patients of melasma in the Cosmetic Division, Dermatology and Venereology Outpatient Clinic, Dr. Soetomo General Hospital, Surabaya from January 2011 until December 2013 (3 years) is 869 patients. The data shows that the incidence of melasma is quite high.

Melasma is a multifactorial disorder that involves an interaction of genetic predisposition, hormonal effects, UV exposure, as well as other environmental variables (Chakraborty et al., 2017).

Indonesia is positioned below the equator, resulting in a tropical environment with high temperatures throughout the year. Police personnel are exposed to the sunlight for more than 6 hours every day while doing their duties. This is a concern for some police officers, particularly female officers because it can produce melasma, which affects their appearance (Mahajan et al., 2022).

Sunlight Exposure

Sunlight is one of the causes of melasma, which results in enhanced pigmentation and photodamaged forms known as solar elastosis. Ultraviolet radiation in melasma

can trigger the production of singlet oxygen and free radicals, which damage lipids and tissues in the skin. These free radicals will stimulate melanocytes to produce excessive melanin (Jirvis et al., 2024). Figure 1 depicts the pathophysiology of melasma caused by ultraviolet light.

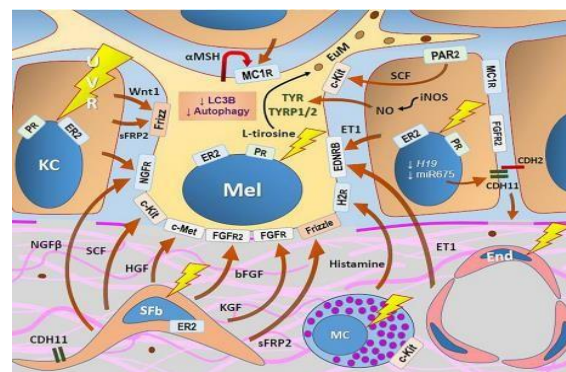


Figure 1. UVR causes melanogenic events, oxidative and inflammatory responses in the epidermis and dermis

Endocrine Stimulation

Luteinizing Hormone (LH), Follicle Stimulating Hormone (FSH), and Melanocyte Stimulating Hormone (MSH) contribute to the development of melasma by stimulating the tyrosinase and dopachrome tautomerase in melanogenesis. These hormones are present in substantial amounts during pregnancy, hence pregnant women have an increased risk of developing melasma (Sheth et al., 2011).

Oxidative Factors

UVB radiation activates the phosphatidylinositol 3-kinase/Akt pathway,

and nuclear factor kappa-light-chain enhancer activated B cells (NF- κ B) increase iNOS production in keratinocytes, resulting in paracrine nitric oxide activating tyrosinase in melanocytes. Fibroblast cell interaction with mast cells in the process of melanogenesis (Oluwatobi et al., 2017). Fibroblast cell interaction in the melanogenesis process is shown in Figure 2.

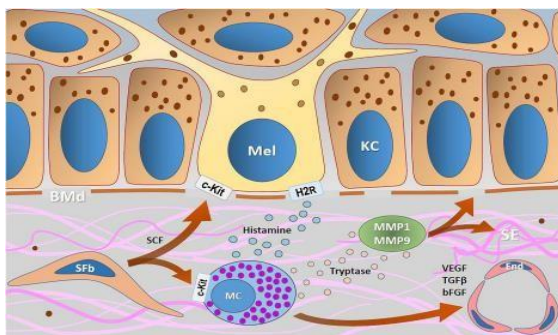


Figure 2. Fibroblast cell interaction with mast cells in the process of melanogenesis

Clinical Manifestation

Melasma is distinguished by the presence of symmetrical, irregular, light brown to dark brown hyperpigmented macules on areas of the body that are frequently exposed to sunlight, particularly the forehead, nose, chin, above the lips, cheeks, upper and lower jaw (Doolan & Gupta, 2021). Melasma can also affect the anterior chest and the dorsal forearm Neagu et al., 2021). Melasma lesions are distributed in three patterns: (1) centrofacial (63%) which covers the forehead, cheeks, nose, upper lip, and chin; (2) malar (21%),

which covers the cheeks and nose; and (3) mandibular (16%), which covers the mandibular ramus and adjacent regions (see Figure 3) (Oluwatobi et al., 2017). Melasma distribution in the facial region is shown in Figure 4 (Neagu et al., 2021).



Figure 3. A. melasma on the cheek with homogeneous pigment, B. melasma on the cheek, C. melasma on the lateral cheek

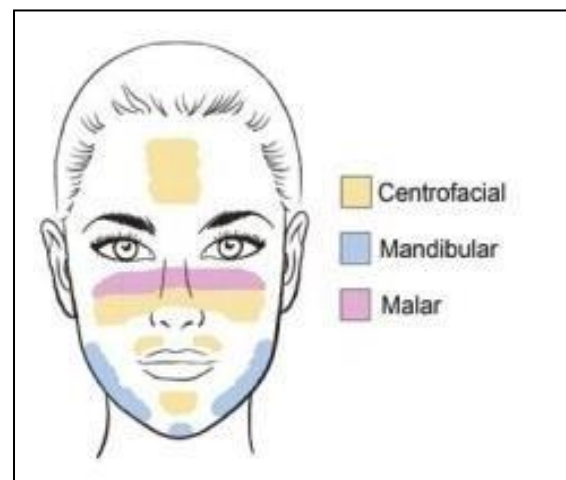


Figure 4. Melasma distribution

Treatment

Melasma treatment remains unsatisfactory due to the numerous factors involved in its etiology. Melasma treatment is time-consuming and may be chronically recurring. Sunscreen and sun protection,

topical treatment, and device therapy are all used to manage the condition (Asditya & Sukanto, 2017; Godse et al., 2023; McKesey et al., 2019).

Topical treatment

Hydroquinone (HQ), which inhibits tyrosinase and is toxic to melanocytes, is the gold standard in melasma therapy. The concentration used is 2-4% and is usually combined with other agents, such as the Kligman formula (HQ 5%, tretinoin 0.1%, and dexamethasone 0.1%), the modified Kligman formula (HQ 4%, tretinoin 0.05%, and hydrocortisone acetate 1%), the Pathak formula (HQ 2% and tretinoin 0.05-0.1%), and the Westerhof formula (N-acetylcysteine 4.7%, HQ 2%, and triamcinolone acetonide 0.1%). The safety of HQ is debatable, and prolonged usage may result in exogenous ochronosis and irreversible depigmentation. Tyrosinase enzyme inhibitors (arbutin, kojic acid, azelaic acid), tranexamic acid (topical or systemic), antioxidants (vitamin C, silymarin, orchid extract, α -tocopherol, hydrocumarin), niacinamide, linolenic acid, linoleic acid, oleic acid, phospholipase D2, glucosamine, tunicamycin, calcium D-pantethein-S-sulfonate, and numerous other topical agents that exhibit anti-melanogenic effects with varying degrees of success can also be used for melasma therapy. Chemical

peeling agents often used in melasma treatment include alpha hydroxy acid, salicylic acid, Jessner's solution, and 10-50% trichloroacetic acid. For the treatment of melasma, several novel peeling agents are also being developed, including tretinoin and Obagi blue peel (Aditya et al., 2020; Aishwarya et al., 2019; Cassiano & Claudia, 2022; Claudia et al., 2022; Ebrahimi & Naeini, 2014; Godsee et al., 2023; Mahajan et al., 2022; Viorizka et al., 2023).

Device assisted treatment

Melasma can be treated using lasers such as Q-switched Nd:YAG (532 and 1064 nm), Q-switched ruby (694 nm), and alexandrite (755 nm). Although melasma has been proven to improve with laser therapy, the laser is only advised for refractory melasma due to its post-inflammatory hyperpigmentation effects. Other treatments include intense pulsed light therapy (IPL), 1,550 nm fractional non-ablative laser, pulsed-dye laser, and copper bromide (Aditya et al., 2020; Doolan & Gupta, 2021; Sheth & Pandya, 2011).

Sunscreen and physical sun protection

Sunscreen and sun protection are essential for preventing melasma from developing, becoming worse, and recurring

back. Patients are recommended to use physical protection, such as wide-brimmed hats, umbrellas, and protective eyewear, and to stay out of direct sunlight. Patients are recommended to use physical protection, such as wide-brimmed hats, umbrellas, and protective eyewear, and to stay out of direct sunlight. For best outcomes, sunscreen must be used both during and after therapy. Figure 5 illustrates how effective sunscreen is against sun exposure (Geoffrey & Mwangi, 2024; Guan & Lim, 2021; Mumtazah et al., 2020; Sander & Burbridge, 2024).

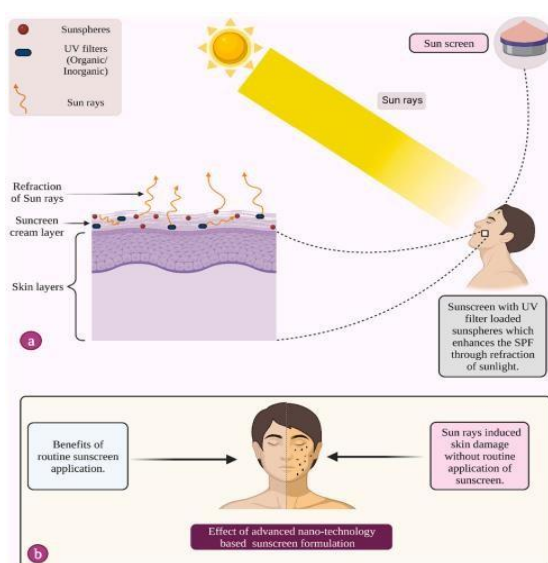


Figure 5. Effectiveness of sunscreen use against sun exposure

Sunscreens are protective cosmetics intended to protect the skin from UV radiation. Sunscreens are classified into two groups (Geoffrey & Mwangi, 2024; Guan & Lim, 2021; Mumtazah et al., 2020; Sander & Burbridge, 2024), namely:

1. Chemical sunscreen

Chemical sunscreens, also known as organic sunscreens, protect the skin by absorbing solar radiation and transforming it into thermal energy. These sunscreens are absorbed by the skin and may cause skin irritation; thus, they should not be used on newborns as young as 6 months. Avobenzone and Octinoxate are a few examples of these sunscreens.

2. Physical sunscreen

Physical sunscreens or sunblock shield the skin by reflecting solar radiation. These sunscreens are broad-spectrum, capable of protecting against UV A and UV B rays, stable, have a minimal allergy potential, and are not absorbed by the skin, making them safe and suitable for children. The Food and Drug Administration (FDA) states that physical sunscreen is the ideal type. Certain cosmetic manufacturers combine chemical and physical sunscreens to maximize the effectiveness of their products (Chavda et al., 2023).

Sun Protection Factor (SPF)

Sun Protection Factor is frequently listed on products intended for skin care. The SPF of sunscreen indicates how well it shields skin from UV rays. The SPF of sunscreen indicates how well it shields skin from UV rays. Sunscreens have different SPF values, ranging from 1 to 50. Ideally, apply a broad-

spectrum sunscreen with SPF 30 or above to protect against UV A and B, however, sunscreens cannot completely protect the skin from UV exposure.

Sunscreen potential

The ability of a sunscreen is not solely dependent on its SPF rating, other aspects influence the potency of sunscreens, namely:

1. The ideal sunscreen is one that protects against both UVA and UVB (broad spectrum), is non-irritating, and is widely accessible. A particular type of carrier material used in sunscreen influences stability features like water resistance as well as the possibility of active chemicals penetrating the skin.
2. Sunscreen application method that impacts the efficiency of sunscreen and must be considered while applying sunscreen, namely:
 - a. Sufficient quantity/thickness, uniformly spread.
 - b. Daily routine usage
 - c. Apply sunscreen 15-30 minutes before leaving the house or being exposed to UV rays and let it dry before applying makeup.
 - d. Reapply the sunscreen every 2-4 hours, depending on the activity. Sunscreen efficacy is diminished when exposed to perspiration or water. If the activity

involves swimming, reapply water-resistant sunscreen in 1 hour.

- e. Before using a new sunscreen for the first time, it's advised to test it on a tiny area to prevent irritation or allergic reactions.

As previously stated, a decent SPF rating is greater than 30, yet many cosmetics on the market indicate SPF but do not specify the type of sunscreen contained. Multiple studies on solar photoprotection have shown that frequent and appropriate usage of topical sunscreen (applied to the skin) helps prevent skin cancer. However, the efficacy of sunscreen is governed by various factors, such as the amount of sunscreen used, the appropriate time of use, reapplication (repetition) of application within 2-3 hours, and routine use every day (Chavda et al., 2023; Geoffrey & Mwangi, 2024; Guan & Lim, 2021; Mumtazah et al., 2020; Sander & Burbridge, 2024).

Various sunscreen types

According to skin type and activities, a variety of sunscreen cosmetics are available on the market. Types of cosmetics with sunscreen include:

1. Lotion

Sunscreen lotion is ideal for normal to oily skin and oily skin due to its low viscosity, non-stickiness, and ease of application.

2. Cream

For dry skin types, a cream sunscreen is recommended.

3. Water-based gel

The gel form is ideal for oily skin and males.

4. Spray

For the past several years, spray sunscreens have been increasingly popular, particularly with kids. Spray is suited for application to wide regions of the body.

5. Stick

Sunscreen in stick form efficiently protects narrow/limited and conspicuous regions such as the lips, nose, and eye circles. Suitable for use during activities since it is long-lasting and does not melt easily, which might irritate the eyes (Sander & Burbidge, 2024).

State Police of the Republic of Indonesia

Principal duties of the police

The concept of police originates from the Ancient Greek term "politeia" which implies the governance of a polis or city. Kamus Besar Bahasa Indonesia defines the police as a government agency responsible for keeping public order, such as arresting persons who break the law, or state officials in charge of ensuring security. Juridically, as stated in the UU No. 2 year 2002 about the Police Force, the main tasks of the Police are clearly defined as law

enforcement, protectors, and community guides, particularly in terms of compliance and obedience to applicable laws. To enforce the law in any part of the world, the police must act as the state's representative while enforcing and upholding the rule of law in all spheres of society. The goal of the Indonesian Police Act's renewal, UU No. 2 year 2002, is to further solidify the police's standing and role in government, including their ability to uphold public safety and order, enforce the law, protect the public, and provide services to the community that upholds human rights (Article 4, UU No. 2 year 2002), must be free from the influence of any party's power, which is exercised independently of the influence of other powers and the authority of the government. The Indonesian National Police is a state instrument that plays a role in maintaining security and public order, enforcing the law, and providing protection, protection, and services to the public in the context of maintaining domestic security (Article 5, UU No. 2, 2002). The police must uphold the rule of law to enforce it. However, the police also perform social and communal obligations for which the community's values must be taken into consideration. Currently, the police face the challenge of upholding the moral standards necessary to fulfill their roles as guardians and enforcers of the law, as well as societal protectors, to

be able to exercise sound judgment when faced with difficult choices related to their role (Anshar & Setiyono, 2020; Tasaripa, 2013).

Sunscreen use and Melasma incidence among police officers

Some livelihoods are usually exposed to excessive sun exposure for a full day such as farmers, construction workers, and some public services such as police. Mustafa et al. surveyed 200 participants (86% men and 14% women) regarding the hazards and protection from excessive sun exposure; most of them were exposed to the sun for 6 hours every day, among whom was a police officer. In the research, 44% of individuals had reddish skin from sunburn, 30% were unaware of the sun's detrimental effects, 72% did not apply sunscreen, and 92% did not utilize an umbrella or other forms of protection (Alfredsson et al., 2020; Lim & Aroman, 2021; Michilot & Tellez, 2020; Mustafa, 2017).

The awareness of sunscreen use in the community is still low due to.

1. There is a lack of awareness and understanding about the need to use sunscreen, particularly among seniors.
2. A misconception that sunscreen is only necessary for outdoor activities; even though UV radiation may pass through clouds and glass, many people still

believe that sunscreen should only be used at the beach or in direct sunshine.

Accessibility and affordability, given that certain people, particularly those from middle-class or lower-class backgrounds, may find the cost of high-quality sunscreen products prohibitive.

Methods

This study used meta-analytic observations, with systematic review and meta-analysis to determine the effect of sunscreen use in the police environment concerning the incidence of melasma in police officers. Electronic databases such as MEDLINE/PubMed, the Cochrane Library, ClinicalTrials.gov, EBSCO, Scopus, ProQuest, Cambridge Core, reference lists, conference proceedings, and a search of researchers in relevant fields of study were the sources of the methods utilized. The relationship between the prevalence of melasma in police officers and the usage of sunscreen in the workplace was associated with various related journals.

Results

Indonesia's location below the equator results in a tropical environment with high temperatures throughout the year. Sunlight is one of the causes of melasma, which results in enhanced pigmentation and photodamaged forms known as solar

elastosis. Ultraviolet radiation in melasma can trigger the production of singlet oxygen and free radicals, which damage lipids and tissues in the skin. UVB radiation activates the phosphatidylinositol 3-kinase/Akt pathway, and nuclear factor kappa-light-chain enhancer activated B cells (NF- κ B) increase iNOS production in keratinocytes, resulting in paracrine nitric oxide activating tyrosinase in melanocytes. Sunscreen and sun protection are essential for preventing

melasma from developing, becoming worse, and recurring back. However, there are several weaknesses in sunscreen applications in the community, Table 1 explains what should be done in sunscreen applications and mistakes in sunscreen applications sufficient quantity/thickness, uniformly spread.

Table 1. Do and don't in sunscreen application

Proper Sunscreen Application (Do)	Mistakes In Using Sunscreen (Don't)
1. Daily routine usage	1. lack of awareness and understanding about the need to use sunscreen, particularly among seniors
2. Apply sunscreen 15-30 minutes before leaving the house or being exposed to UV rays and let it dry before applying makeup.	2. The misconception that sunscreen is only necessary for outdoor activities; even though UV radiation may pass through clouds and glass, many people still believe that sunscreens should only be used at the beach or in direct sunshine
3. Reapply the sunscreen every 2-4 hours, depending on the activity. Sunscreen efficacy is diminished when exposed to perspiration or water. If the activity involves swimming, reapply water-resistant sunscreen in 1 hour.	3. Accessibility and affordability, given that certain people, particularly those from middle-class or lower-class backgrounds, may find the cost of high-quality sunscreen products prohibitive
4. Before using a new sunscreen for the first time, it's advised to test it on a tiny area to prevent irritation or allergic reactions.	

The goal of the Indonesian Police Act's renewal, UU No. 2 year 2002, is to further solidify the police's standing and role in government, including their ability to uphold public safety and order, enforce the law, protect the public, and provide services

to the community that upholds human rights. The Indonesian National Police is a state instrument that plays a role in maintaining security and public order, enforcing the law, and providing protection, protection, and services to the public in the

context of maintaining domestic security. Police officers are usually exposed to excessive sun exposure for a full day. Police officers are exposed to solar radiation for more than 6 hours every day while on duty. The study's findings indicate that while police is one of the professions with the highest daily sun exposure. This can trigger the occurrence of melasma according to the literature which states that excessive sun exposure is one of the factors that cause melasma. There are no publications that expressly address the prevalence of melasma in police officers. According to some studies, one of the risk factors for melasma is excessive sun exposure, thus it is highly conceivable that the prevalence of melasma among police officers is still extremely high. This is due to one of these variables, namely police officers' lack of understanding about sunscreen use (Liew & Anne, 2021). Journal related to the incidence of melasma in police members is still in a small number, so further research is needed on this matter.

Conclusion

Given that Indonesia is a tropical nation with year-round high levels of sun exposure, further investigation is required to determine the prevalence of melasma among police personnel there. Awareness of sunscreen application on the skin is

required to avoid the occurrence of melasma in police personnel. The necessity of education on the prognosis, propensity, and chronicity of melasma is strongly advised. Dermatovenereologists (DVE) play a significant role in the police institution.

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