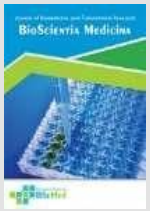
eISSN (Online): 2598-0580



**Bioscientia Medicina: Journal of Biomedicine & Translational Research**

Journal Homepage: www.bioscmed.com

# Correlation between Facial Skin Damage Due to UV Exposure and Facial Skin Porphyrin Level: Study on Students of SMA Kalam Kudus II Jakarta, Indonesia

**Fendy Wellen[1], Sukmawati Tansil Tan[2*], Yohanes Firmansyah[1], Hendsun Hendsun[1]**

[1]Faculty of Medicine, Universitas Tarumanagara, Jakarta, Indonesia

[2]Department of Dermatology and Venereology, Faculty of Medicine, Universitas Tarumanagara, Jakarta, Indonesia

**ARTICLE INFO**

**Keywords:**
Juvenile
Porphyrin level
Skin damage
Student
Ultraviolet

***Corresponding author:**
Sukmawati Tansil Tan

**E-mail address:**
*sukmawati@fk.untar.ac.id*

All authors have reviewed and approved the final version of the manuscript.

*https://doi.org/10.37275/bsm.v6i18.737*

**A B S T R A C T**

**Background:** UV exposure causes physical and chemical damage. UV causes damage to the skin barrier physically due to the heating process. Meanwhile, chemically, UV causes the formation of oxidants which are responsible for the process of oxidative stress. Damage to skin cells causes loss of the body's natural barrier against various threats from microorganisms. *Propionibacterium acnes* is one of the commensal bacteria on the skin, which will produce products in the form of porphyrins. This study aimed to determine the correlation between UV-induced skin damage and porphyrin levels in SMA Kalam Kudus II Jakarta, Indonesia. **Methods:** This study was an analytic observational study with a cross-sectional approach. A total of 92 research subjects who were students of SMA Kalam Kudus II Jakarta, Indonesia, participated in this study. Facial skin porphyrin levels and levels of facial skin damage due to sun exposure (UV damage proportion) as measured by a skin analyzer. UV damage and porphyrin assessments according to the T Zone and V Zone regions and obtained the average results from the 3 regions. Correlation analysis was performed with the help of SPSS software. **Results:** The higher the percentage of skin damage due to UV correlated positively with the higher the percentage of porphyrin levels, with a value of r = 0.529. **Conclusion:** There is a positive correlation between UV-induced skin damage and porphyrin levels in students of SMA Kalam Kudus II Jakarta, Indonesia.

## 1. Introduction

Indonesia is a tropical country with sun exposure throughout the year. Exposure to ultraviolet radiation (UV) has implications for various skin health problems. UV radiation has acute and chronic effects on the skin, such as sunburn, pigmentation response, erythema, photosensitivity, and skin cancer which are problems that affect the entire life span. Sunburn is observed as the most common reaction to excessive sun exposure, ultraviolet-B radiation (UVB) is also a physical carcinogen that causes skin cancer due to sun exposure.[1-5]

UV exposure causes physical and chemical damage. UV causes damage to the skin barrier physically due to the heating process. Meanwhile, chemically, UV causes the formation of oxidants which are responsible for the process of oxidative stress. Oxidative stress triggers a series of inflammatory processes in the skin tissue. The chronic inflammatory process causes the activation of the apoptotic process of skin cells. Damage to skin cells causes loss of the body's natural barrier against various threats from microorganisms. There are many commensal microorganisms that live on the skin, and if there is a problem with the skin, these commensal bacteria will invade and multiply more than they should. *Propionibacterium acnes* is one of the commensal bacteria on the skin, which will produce products in

the form of porphyrins. Porphyrins are a series of organic compounds and pigmented compounds that play important roles in processes such as oxygen transport and photosynthesis. Porphyrins have the ability to expose red fluorescence when exposed to ultraviolet light.[6-12] This study aimed to determine the correlation between UV-induced skin damage and porphyrin levels in SMA Kalam Kudus II Jakarta, Indonesia.

## 2. Methods

This study was an analytic observational study with a cross-sectional approach and used primary data obtained from SMA Kalam Kudus II Jakarta, Indonesia. A total of 92 research subjects participated in this study. The research subjects met the inclusion criteria in the form of SMA Kalam Kudus II Jakarta Indonesia, aged 15-18 years, and were willing to participate in this study with the approval of their parents or guardians. This study was approved by the medical and health research ethics committee at the Faculty of Medicine, Universitas Tarumanegara, Jakarta, Indonesia.

Facial skin porphyrin levels and levels of facial skin damage due to sun exposure (UV damage proportion) as measured by a Skin Analyzer. UV damage and porphyrin assessments according to the T Zone and V Zone regions and obtained the average results from the 3 regions (Figure 1). Data analysis was performed with the help of SPSS version 25 software. Univariate analysis was performed to present the frequency distribution data between the test variables. Correlation analysis was performed to determine the correlation between UV-induced skin damage and porphyrin levels.

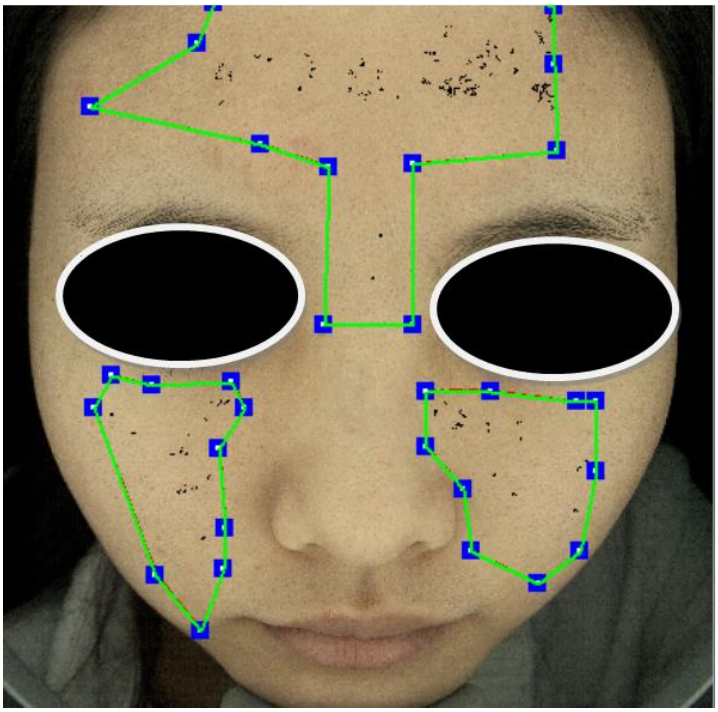


Figure 1. Research variable measurement region.

## 3. Results

Table 1 presents the baseline characteristics of the research subjects. The research subjects had an average age of 16 years, an average weight of 68.5 kg, and a height of 171.28 cm. The majority of subjects have a normal body mass index category and have blood pressure in the normotensive category.

Table 1. Baseline characteristics of research subjects.

| Variable | Mean (SD) | Median (Min-Max) |
|---|---|---|
| Age (Years) | 16,02 (0,83) | 16 (15 – 18) |
| Body weight (Kg) | 68,50 (16,57) | 65,5 (40 – 110) |
| Height (cm) | 171,28 (8,59) | 171,4 (117 – 189) |
| Body mass index (Kg/m$^2$) | 23,32 (5,17) | 22,87 (13,24 – 35,11) |
| Systolic (mmHg) | 125,87 (12,98) | 126 (97 – 161) |
| Diastolic (mmHg) | 76,46 (8,68) | 75,5 (60 – 104) |
| Porphyrin (%) | 55,55 (12,36) | 55 (27 – 85) |
| Skin damage (%) | 29,93 (10,71) | 26 (17 – 64) |

Figure 2 and Table 2 present the correlation between UV-induced skin damage and porphyrin levels. The results of the study showed that the higher the percentage of skin damage due to UV correlated positively with the higher the percentage of porphyrin levels, with a value of r = 0.529.

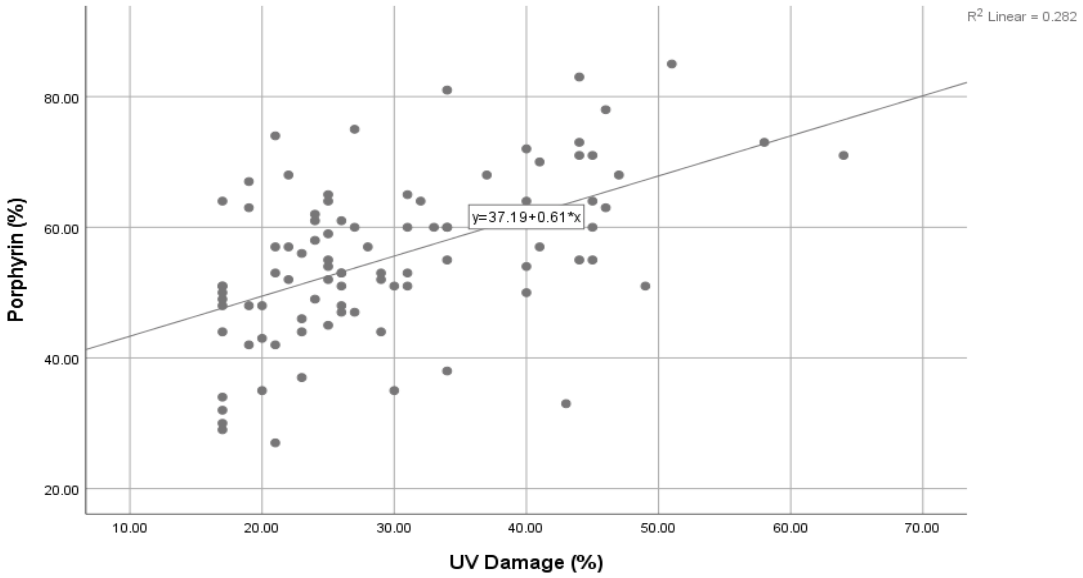



Figure 2. Scatter plot analysis correlation between skin UV damage and porphyrin percentage levels of facial skin.

Table 2. Correlation between skin UV damage and porphyrin percentage levels of facial skin.

| Variable | Mean (SD) | Median (Min-Max) | Correlation | p-value |
|---|---|---|---|---|
| Porphyrin | 55,55 (12,36) | 55 (27 – 85) | 0,529 | < 0,001 |
| UV damage | 29,93 (10,71) | 26 (17 – 64) | | |

**4. Discussion**

Porphyrins are a group of organic compounds. Several porphyrins play a major role in various processes, such as oxygen transport and photosynthesis. Heme, protoporphyrin, coproporphyrin, and uroporphyrin are the most common porphyrins found in the human body. Porphyrins are pigment compounds. While exposed to ultraviolet light of wavelength near 400 nm, porphyrins will expose a red fluorescence. Heme is essential for the human circulatory system. Although it functions as part of the structure of other proteins, heme is best known because it is made up of units of hemoglobin, a metalloprotein that transports oxygen.

Heme contains iron in its porphyrin ring, allowing the binding of oxygen. Porphyrins are involved in many major metabolic processes of prokaryotic and eukaryotic cells, including respiration, biological oxidation, photosynthesis, sulfate reduction, and carbon backbone rearrangement.[13-17]

*Propionibacterium acnes* produces porphyrins, which fluoresce on Wood's light examination, especially on the nose and forehead, and produce endogenous porphyrins like many other cell types. Porphyrins produced by *Propionibacterium acnes* may contribute to the perifollicular inflammatory reaction through their cytotoxic effects and by stimulating the expression of keratinocyte-derived Interleukin-8 (IL-8). Following the rupture of the follicular epithelium, perifollicular secreted porphyrins may also contribute to the inflammatory reaction of the follicle or its environment by promoting the development of cytotoxic agents such as squalene peroxide, possibly via singlet oxygen.[18-21] The various theories and studies above are in line with the results of this study which show that there is a positive correlation between UV-induced skin damage and porphyrin levels.

## 5. Conclusion

There is a positive correlation between UV-induced skin damage and porphyrin levels in students of SMA Kalam Kudus II Jakarta, Indonesia.

## 6. References


1. Grice EA, Segre JA, The skin microbiome. Nat Rev Microbiol. 2011; 9(4): 244–53.
2. Dréno B, Pécastaings S, Corvec S. Veraldi, S. Khammari A, et al. Cutibacterium acnes (*Propionibacterium acnes*) and acne vulgaris: a brief look at the latest updates. J Eur Acad Dermatology Venereol. 2018; 32 Suppl: 5–14.
3. Wikramanayake TC, Borda LJ, Miteva M, Paus R, Seborrheic dermatitis—Looking beyond Malassezia, Exp Dermatol. 2019; 28(9): 991–1001.
4. Suva MA, Patel AM, Sharma N, Bhattacharya C, Mangi RK, A brief review on acne vulgaris: pathogenesis, diagnosis and treatment. Res. Rev J Pharmacol. 2014; 1–12.
5. Barnard E, et al. Strains of the *Propionibacterium acnes* type III lineage are associated with the skin condition progressive macular hypomelanosis, Sci Rep. 2016; 1–9.
6. Shu M, et al. Porphyrin metabolisms in human skin commensal *Propionibacterium acnes* bacteria: Potential Application to monitor human radiation risk. Curr Med. Chem. 2013; 20(4): 562–8.
7. Asawanonda P, Taylor CR, Wood's light in dermatology. Int J Dermatol. 1999; 38(11): 801–7.
8. Seo I, Tseng SH, Cula GO, Bargo PR, Kollias N, Fluorescence spectroscopy for endogenous porphyrins in human facial skin. Photonic Ther Diagnostics. 2009; 7161: 716103,
9. Dobrev H, Fluorescence diagnostic imaging in patients with acne, Photodermatol Photoimmunol Photomed. 2010; 26(6): 285–9.
10. Patwardhan SV, Richter C, Vogt A, Blume-Peytavi U, Canfield D, et al. Measuring acne using Coproporphyrin III, Protoporphyrin IX, and lesion-specific inflammation: an exploratory study. Arch Dermatol Res. 2017; 309(3): 159–67.
11. Luchina L, Kollias N, Gillies R, Fluorescence photography in the evaluation of acne. J Am Acad Dermatol. 1996; 35(1): 58–63.
12. Fajarnés GP, Santonja MM, B. García BD, I. Lengua IL, Segmentation methods for acne vulgaris images: proposal of a new methodology applied to fluorescence images. Ski Res Technol. 2020; 26(5): 734–9.
13. Khongsuwan M, Kiattisin S, Wongseree W, Leelasantitham A. Counting number of points for acne vulgaris using UV fluorescence and image processing, in: BMEiCON-2011 - 4th Biomed Eng Int Conf. 2011; 142–6.
14. Suva MA, Patel AM, Sharma N. A brief review on acne vulgaris: pathogenesis, diagnosis and treatment a brief review on acne vulgaris:

Pathogenesis, Diagnosis, and Treatment. 2016; 0–12.

15. Balbin JR, Dela Cruz JC, Camba CO, Gozo AD, Jimenez SMB, et al. Facial fluid synthesis for assessment of acne vulgaris using luminescent visualization system through optical imaging and integration of fluorescent imaging system, Second Int Work Pattern Recognit. 2017; 10443: 1044311.
16. Abas FS, Kaffenberger B, Bikowski J, Gurcan MN. Acne image analysis: lesion localization and classification, in medical imaging 2016: Computer-Aided Diagnosis, 2016; 9785: 97850B.
17. Mcginley KJ, Webster GF, Leyden JJ, Facial follicular porphyrin fluorescence: correlation with age and density of *Propionibacterium acnes*. Br J Dermatol. 1980; 437–41,
18. Leyden JJ, McGinley KJ, Mills OH, Kligman AM, Age-related changes in the resident bacterial flora of the human face. J Invest Dermatol. 1975; 65(4): 379–81.
19. Dobrev H, Fluorescence diagnostic imaging in patients with acne. Photodermatol Photoimmunol Photomed. 2010; 26(6): 285–9.
20. Youn SW, Kim JH, Lee JE, Kim SO, Park KC. The facial red fluorescence of ultraviolet photography: is this color due to *Propionibacterium acnes* or the unknown content of secreted sebum? Ski Res Technol. 2009; 15(2): 230–6.
21. Xu DT, et al. Is Human sebum the source of skin follicular ultraviolet-induced red fluorescence? A cellular to histological study, Dermatology. 2018; 234(1–2): 43–50.