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Differences in Facial Skin Acidity Levels of Nurses in Sebelas Maret University Hospital, Before and After Surgical Mask Use During the COVID-19 Pandemic

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ABSTRACT

Background: Indonesia has reported more than 4 million confirmed COVID-19 cases as of November 2021. This has led to an increase in the use of personal protective equipment (PPE), for example, surgical masks in hospitals, especially referral hospitals for COVID-19 patients. The Potential Hydrogen (pH) or level of acidity plays an important role in the body's physiological functions and regulates the formation of an epidermal barrier (stratum corneum). Thus, the use of surgical masks is able to influence the pH of human skin. This study aimed to determine the difference in facial skin acidity (pH) levels of nurses at Sebelas Maret University Hospital before and after surgical mask use. **Methods:** The study utilized a cross-sectional observational method and was conducted at the Sebelas Maret University Hospital, Surakarta. A total of 55 subjects were involved in this study, and each subject's facial skin Potential Hydrogen (pH) was measured before and after surgical mask use. Subsequently, all data were analyzed with a T-test using SPSS 21.00, and a p-value <0.05 indicated statistical significance. **Results:** The results showed facial skin pH increased after surgical mask use for nurses at the Sebelas Maret University Hospital (p = 0.000). **Conclusion:** An increase in the physiological value of skin pH was observed in the nurses of Sebelas Maret University Hospital after surgical mask use.

1. Introduction

In December 2019, the World Health Organization (WHO) China Country Office reported a case of pneumonia of unknown etiology in Wuhan City, Hubei Province, China. Subsequently, China identified pneumonia's cause as a new type of coronavirus (2019-nCov), and the condition was called the coronavirus disease 2019 (COVID-19).^{1,2} The World Health Organization then designated this case as a pandemic due to the rapid increase in the number of COVID-19 and the spread between countries. By the end of May 2020, a total of over 4 million confirmed cases were reported, with 318,935 deaths occurring around the world.³

Indonesia alone had reported more than 4 million confirmed cases of COVID-19 as of November 2021.⁴ This led to an increase in Personal Protective Equipment (PPE) use within hospitals, especially referral hospitals for COVID-19 patients.⁵

Personal Protective Equipment are tools/means used to avoid or minimize injuries due to accidents and reduce the possibility of workplace hazards. These tools are the main protective equipment for primary prevention from the occurrence of workplace 'accidents'. Examples of PPE used by medical personnel include masks, gloves, and gowns/scrubs.⁴⁻⁶

Meanwhile, Potential Hydrogen (pH) or acidity level plays an important role in the body's physiological functions, and regulates the formation of an epidermal barrier (stratum corneum). The physiological value of pH in the stratum corneum is 4.1-5.8 and this value is influenced by various factors, whether endogenous or exogenous. An exogenous factor is the pH-raising effect caused by the use of occlusive products (for instance, gloves). Thus, restoring skin pH through various topical therapies forms good physiological microbiome for the skin, improves the epidermal barrier, stimulates epidermal differentiation and reduces inflammation.⁷ This study therefore aims to determine the differences in the facial skin acidity levels of medical personnel, at Sebelas Maret University Hospital, before and after PPE use.

2. Methods

This study is an observational cross-sectional study, and the study subjects were monitored and evaluated through physical examination. The research location is the COVID-19 isolation ward and the outpatient clinic of Sebelas Maret University Hospital (RS UNS), the study population is nurses serving in

the COVID-19 isolation room and outpatient clinic. A total of 55 subjects with an age range of 23-33 years, were obtained using the inclusion criteria of male and female willing to participate in the study.

Each subject's skin pH was measured with the PH100: ExStik pH Meter (FLIR Systems Inc., USA), at room temperature (25-29 degrees Celsius), before and after continuous use of PPE for 3 hours. Measurements were made three times on the face area, then averaged, thus, the skin surface pH was obtained. Subsequently, the data collected was entered into the demographic data table as well as the mean pH table, and subjected to analysis using the T-test from SPSS 21 software.

3. Results

The study subjects consisted of 37 females and 18 males, with an age range of 23-33 years, all subjects are nurses at Sebelas Maret University Hospital (Table 1). According to the results of T-test analysis, there is statistically significant difference before and after PPE use, with a p value < 0.05 (p = 0,000). The value is significant in cases where p < 0.05. Meanwhile, Table 2 shows the average pH before and after continuous PPE (mask) use, for 3 hours.

Table 1. Demographic table of research subjects.

Variable	Amount (n = 30)	Percentage
Gender		
Male	18	32%
Female	37	68%
Use moisturizer	30	55%
Not using moisturizer	25	45%
History of atopy		
Yes	10	18%
No	45	82%

Table 2. The average pH value before and after using PPE.

The mean pH value before using PPE	6.91
The mean pH value after using PPE	7.21

4. Discussion

The skin acts as a barrier protecting body from harmful insults such as chemicals, microorganism, and allergens. This barrier, exclusively epidermal

barrier integrity influenced by various factors involved in epidermal cell differentiation and proliferation, cell-cell adhesion, and skin lipids. The impairment of epidermal barrier could lead to various skin diseases,

including atopic dermatitis, irritant contact dermatitis and allergic contact dermatitis. The role of epidermal barrier disruption could be evaluated by non invasive parameters for skin irritation evaluation, such as transepidermal water loss, surface pH, or lipid composition.⁸ The epidermal's barrier main function is to provide a place on the body regulating water loss, because water homeostasis is an important requirement for normal body physiological function.⁹ Furthermore, skin homeostasis is achievable in cases where the regulation and metabolism of extracellular lipids into normal lamellar membranes in the stratum corneum functions optimally. This requires acidic potential hydrogen (pH), often referred to as the 'acid mantle', and changes in the acid mantle' cause impaired epidermal barrier function as well as decreased antimicrobial ability.¹⁰ In addition, moist-associated skin damage often occurs due to epidermal barrier breakdown, and is strongly related to PPE use.^{11,12} The possible side effects occurring on the face include pressure sores, itching, allergic/irritant contact dermatitis, and dryness of the skin. Another contributing factor is the length of PPE use as well as the skincare products used daily.¹³ Age is known to affect the pH skin. The pH of the skin in neonates and children tends to vary rapidly on a daily basis, however, this value becomes relatively constant within the age of 18-60 years.¹⁴

Based on the study results, the facial skin pH was quite high before PPE use, with an average value of 6.91. This is higher, compared to the normal physiological skin pH of 4.1-5.8, and is possibly due to the increased use of PPE by medical personnel, during the COVID-19 pandemic. Furthermore, continuous PPE use for 3 hours resulted in a mean pH increase of in medical personnel. Some subjects had a history of atopy that this might influences skin pH. According to Wendtner and Korting, in atopy patients, skin pH increases and slowly return to neutral or physiological pH conditions¹⁴, this is a possibly significant factor influencing the results of this study.

Meanwhile, moisturizers are generally defined as various ingredients used to reduce signs and

symptoms of dry and scaly skin, thus, making previously rough surfaces soft and smooth. However, this definition is not specific because moisturizers are often included in barrier creams for preventing various skin disorders. Moisturizers are able to stratum corneum's moisture, as well as the epidermal barrier function.^{9,15} In this study, 25 subjects are not using moisturizers daily, thus, this is a possible factor in the occurrence of increased pH.

5. Conclusion

The use of surgical masks by medical staff is mandatory in daily work practices, however, this tends to increase skin pH and could possibly impact the barrier epidermal physiological function. Based on this study, an increase in facial skin pH occurred after continuous use of surgical masks. The possible impacts of abnormal barrier epidermal function due to pH change include increase in microbial colonization, as well as in the occurrence of itchy and inflamed skin diseases. Therefore, regular use of moisturizers to lower skin pH value is recommended, in order to reduce the risk of skin disease due to mask use, during the COVID-19 pandemic.

6. References

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