

CORRELATION BETWEEN POLYMORPHONUCLEAR LEUKOCYTE LEVELS AND GINGIVITIS IN THE UNIVERSITAS MUHAMMADIYAH SURAKARTA SECURITY UNIT

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ABSTRACT

Introduction: *Gingivitis is one of the most common periodontal diseases, with a prevalence of 96.58% in Indonesia (2018). Its causes include local and systemic factors. Poor sleep quality can increase polymorphonuclear (PMN) leukocyte levels, which may contribute to gingivitis. Shift workers, such as security guard, are prone to poor sleep.* **Aim:** *This study investigates the correlation between PMN leukocyte levels and gingivitis among security guards at Universitas Muhammadiyah Surakarta (UMS).* **Methods:** *This cross-sectional analytic study used purposive sampling to recruit 30 male security guards with poor sleep quality (PSQI >5). Gingivitis was assessed using the gingival index, and PMN leukocyte levels were measured with a hematology analyzer. Data were analyzed using the Chi-square test.* **Results:** *Most respondents (66,7%) had elevated PMN leukocyte levels. Gingivitis severity was predominantly moderate (63,3%), with 23,3% severe and 13,3% mild cases. A significant correlation was found between high PMN leukocyte levels and gingivitis ($p=0.035$).* **Conclusion:** *There is a significant correlation between PMN leukocyte levels and gingivitis among security guards at UMS, indicating that poor sleep quality and elevated leukocytes may contribute to gingivitis in this population.*

Received (05/05/2025);

Accepted (18/06/2025);

Available online (19/07/2025)

DOI:

<https://doi.org/10.33854/jbd.v12i1>

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Keywords: *gingivitis, polymorphonuclear leukocyte levels, sleep quality, security guard.*

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INTRODUCTION

Periodontal tissue is a functional system of tissue that surrounds the teeth and attaches them to the jawbone, thereby supporting the teeth so that they do not detach from their sockets. Periodontal tissue consists of four main

components that work as a unit: the gingiva, periodontal ligament, cementum, and alveolar bone.¹ Each tissue plays an important role in maintaining periodontal health and function. The state of this periodontal tissue varies greatly, depending on or influenced by dental morphology, function, and age.²

Periodontal disease is a condition that causes inflammation and damage to the supporting tissues of the teeth, namely the gingiva, periodontal ligaments, cementum, and

alveolar bones.³ Gingivitis and periodontitis are periodontal diseases often found in the oral cavity.⁴

The prevalence of dental and oral health problems in Indonesia is 57.6%, up from the results of the 2013 report of 31.7%.⁵ Meanwhile, the prevalence of gingivitis ranks second highest, reaching 96.58%.⁶

Gingivitis is an inflammation that involves the soft tissue around the teeth, namely the gingival tissue.⁷ Inflammation is a protective response caused by injury or tissue damage due to endogenous and exogenous stimuli, whether caused by mechanical, biological, chemical, or physical factors.⁸ The main cause of gingivitis is the accumulation of microorganisms that form dental plaque, which, if left untreated, can result in inflammation and further damage to the periodontal tissue.⁹

Gingival index examination is a method used to assess a person's level of gingival inflammation with a distinguishable inflammatory category.^{10,11} Leukocyte cells, especially polymorphonuclear leukocytes (PMNs), are important in the inflammatory response and protection against bacterial infections. In gingivitis, the number of PMN leukocytes tends to increase, indicating higher inflammatory activity.¹²

Leukocytes are an important part of the human immune system that fight infections and respond to inflammation.¹³ Under normal circumstances, the number of leukocytes in the blood ranges from 3200 to 10000 mm³.¹⁴ with PMN leukocytes making up about 50-70% of the total leukocytes.¹⁵ There is an association between PMN leukocyte rates and biological

rhythm disturbances. The mismatch of work time with biological rhythm causes body stress through hormonal changes controlled by the hypothalamus. The hypothalamus stimulates the anterior pituitary until cortisol increases. Then, cortisol increases the number of neutrophils.¹⁶ The body conducts an immunological response by activating B cells, T cells, and PMN Leukocytes. Activated epithelial cells will release inflammatory mediators IL-1, IL-8, prostaglandin E2 (PGE2), matrix metalloproteinase (MMP), and tumor necrotic factor (TNF), which are the earliest responses to bacterial stimuli and cause metabolic disorders of connective tissue and bone that appear to be early clinical signs of gingival tissue inflammation or gingivitis.¹⁷

Security guards, as part of self-defense security, are important in maintaining security and order in the workplace. Security guard duties often require night work or erratic shift patterns, which can disrupt sleep patterns and the body's biological balance.¹⁸ This study evaluated the correlation between Polymorphonuclear Leukocyte Levels and Gingivitis in UMS Security Guards.

METHODS

This research was conducted using an observational analytical method and a cross-sectional approach. The main purpose of this study was to explore and analyze the correlation between polymorphonuclear (PMN) leukocyte levels and gingivitis levels in security units at the University of Muhammadiyah Surakarta (UMS). The cross-sectional method was chosen because it allowed for data collection simultaneously and

the study of the correlation between risk factors (PMN levels) and effects (gingivitis).

The research period was carried out from January to February 2024, while the research site was Soelastri Dental and Oral Hospital, Surakarta. The sampling method used was purposive sampling, where the selected population was the UMS security unit. Inclusion and exclusion criteria have been applied, ensuring suitability with the study's objectives. This research has been approved by the Health Research Ethics Commission of Dr. Moewardi Regional General Hospital Surakarta, with number 2.313/XII/HREC/2023.

This study used a sample of security units at the University of Muhammadiyah Surakarta (UMS). Inclusion criteria included having at least three years of work experience, shift hours, good systemic health, not being on medication, having at least 10 teeth in one jaw, and the Pittsburgh Sleep Quality Index (PSQI) questionnaire results indicated poor sleep quality. Exclusion criteria included periodontitis conditions, poor oral hygiene habits, and alcohol consumption. By following these criteria, 30 samples from each group were selected for analysis in this study.

Study subjects were asked to fill out a Pittsburgh Sleep Quality Index (PSQI) questionnaire to evaluate their sleep quality. Furthermore, a venous blood sample of 3 mL was taken to check the polymorphonuclear leukocyte level using the Hematology Analyzer (HA) tool. After that, an oral hygiene check was carried out by calculating the debris and calculus indexes to obtain the Oral Hygiene Index-Simplified (OHI-S). Finally, gingival inflammation is examined using the Gingival Index (GI) with the WHO

periodontal probe, where the score is summed from all four areas and divided by the number of teeth examined to get a person's GI score. The criteria for a healthy score were 0.1-1.0, mild inflammation 1.1-2.0, severe inflammation 2.1-3.0. All examinations are carried out at RSGM Soelastri Surakarta by laboratory and young dentists, with researchers still supervising the process.

The study lasted for 3 days until all samples had been examined. The data collected in this study were then analyzed with an independence test to determine the correlation between hemoglobin levels and gingivitis using the Chi-Square statistical test. The results of the test showed that there was a relationship between polymorphonuclear leukocyte levels and gingivitis in the UMS security unit, with a value of $p=0.035$ ($p<0.05$).

RESULTS

Sleep Quality Characteristics of Respondents

Based on the screening that has been carried out, as many as 33 respondents were willing to participate in this study. Only 30 security guards had PSQI results of >5 or had poor sleep quality. Data on the sleep quality of 30 samples of this study is shown by the PSQI score of >5 , which indicates that all samples have poor sleep quality. The PSQI scores of the 30 samples are illustrated in Figure 1.

Figure 1 shows the distribution of PSQI scores from 30 security guards in this study. The PSQI score of 6 was owned by 43.3% of the respondents, the PSQI score of 7 was owned by 30.0% of the respondents, the PSQI score of 8 was owned by 20.0% of the respondents, while

the PSQI scores of 9 and 12 were each owned by 3.3% of the study respondents.

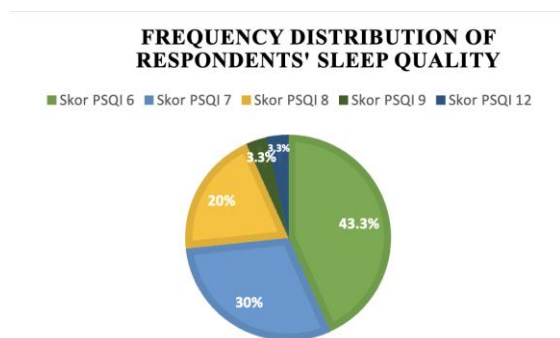


Figure 1. Frequency distribution of respondent's sleep quality

The gender and age characteristics of the respondents

A total of 30 respondents who met the inclusion criteria of this study had an age range of 21 – 53 years, and all were male. The respondents of this study were divided into three groups based on age, namely age 21-35, age 36-50, and age ≥ 50 (Table 1).

Table 1. Distribution of respondents by age

Ages	Total number	Percentage (%)
21 – 35	11	36.6%
36 – 50	18	60.0%
≥ 50	1	3.3%
Total	30	100%

Frequency distribution of PMN leukocyte levels based on the age of the respondents

A total of 30 respondents in this study have an age range of 21 – 53 years; according to the Ministry of Health of the Republic of Indonesia (2023), the age range includes the adult age group, which is 19 – 59 years old. Based on the characteristics of the respondents, the reference value of normal polymorphonuclear leukocyte levels used in this study is 50-70% in

the adult male category. The distribution of polymorphonuclear leukocyte levels based on the age of the respondents is as follows.

Table 2. Frequency distribution of respondents' PMN leukocyte levels

Ages	Polymorphonuclear Leukocyte Levels						Total	
	Low		Normal		High			
	N	%	N	%	N	%	N	%
21-35	0	0	8	26.7	3	10	11	36.6
36-50	0	0	2	6.6	16	53.3	18	60
≥50	0	0	0	0	1	3.3	1	3.3
Total	0	0	10	33.3	20	66.7	30	100

The table above shows that the category of high polymorphonucleotide levels is 20 (66.7%) respondents, with details of 3 (10%) respondents in the age group of 21-35 years, 16 (53.3%) respondents in the age group of 36-50 years, and 1 (3.3%) respondents in the age group of ≥ 50 years. A total of 10 (33.3%) respondents had normal polymorphonuclear leukocyte levels, specifically 8 (26.7%) respondents in the 21-35 year age group and 2 (6.6%) respondents in the 36-50 year age group.

Frequency distribution of gingivitis of respondents

Data on the condition of the gingiva of security guards at the University of Muhammadiyah Surakarta produced from this study showed that most of the security guards suffered from moderate gingivitis, and some others suffered from mild and severe gingivitis. Detailed data can be seen in Table 3.

Table 3. Frequency distribution of respondent gingivitis

Gingivitis	Total number	Percentage (%)
Low	4	13.3%
Normal	19	63.3%
High	7	23.3%
Total	30	100%

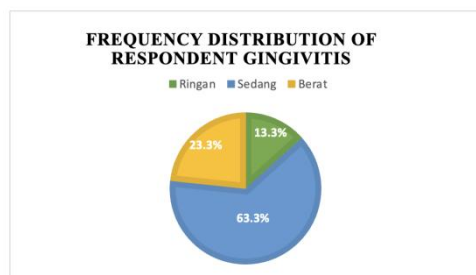


Figure 2. Frequency distribution of respondent gingivitis

Data from Table 3 and Figure 2 show that there are 4 (13.3%) respondents who suffer from mild gingivitis, 19 (63.3%) respondents who suffer from moderate gingivitis, and 7 (23.3%) respondents who suffer from severe gingivitis.

Analysis of the relationship between PMN leukocyte levels and gingivitis in the Chi-Square Test

The cross-tabulation results showed that respondents had high levels of PMN leukocytes. More details about the relationship between PMN leukocyte levels and gingivitis can be seen in Table 4.

Table 4. Results of Analysis of the Relationship between PMN Leukocyte Levels and Gingivitis.

PMN Leukocyte Levels	Gingivitis						Total	
	Low		Normal		High			
	N	%	N	%	N	%	N	%
High	1	3.3	12	40	7	23.3	20	66.7
Normal	3	10	7	23.3	0	0	10	33.3
Low	0	0	0	0	0	0	0	0
Total	4	13.3	19	63.3	7	23.3	30	100
p = 0.035								

$p = 0.035$

* $p < 0.05$

The results of the Chi-Square test in the table above showed that gingivitis with high levels of PMN leukocytes was suffered by 66.7% of respondents, while gingivitis with normal PMN leukocyte levels was suffered by 33.3% of respondents with a value of $p = 0.035$ (< 0.05). Based on these results, it can be concluded that

there is a significant relationship between PMN leukocyte levels and gingivitis in security guards at the University of Muhammadiyah Surakarta.

DISCUSSION

The sample of this study is the Security Unit of the University of Muhammadiyah Surakarta, which has met the inclusion criteria set by the researcher and is willing to be a research sample. A total of 33 security guards were willing to participate in this study, of which only 30 met the research criteria. One of the inclusion criteria in this study is that the research sample has a PSQI score of > 5 or has poor sleep quality. Diagram 1 illustrates that as many as 30 security guards in this study sample meet these criteria, which means that all samples have poor sleep quality. This is in line with research conducted.¹⁹ Regarding the picture of the sleep quality of night watchmen at Jenderal Soedirman University, stating that night watchmen have poor sleep quality as shown by the results of the PSQI score of > 5 . Table 2 shows the results of examining PMN leukocyte levels in 30 University of Muhammadiyah Surakarta security guards. The table shows that more security guards have high PMN leukocyte levels (20) than those with normal PMN leukocyte levels (10). This is in line with research conducted,²⁰ which revealed that one of the effects of poor sleep quality is circadian rhythm disorders that can increase the hormone cortisol, resulting in an increase in the number of PMN leukocytes in the blood circulation.

All samples of this study are male and are in adulthood. The research respondents were

divided into 3 categories based on age, with the details of the number as shown in Table 1. Based on these criteria, the reference value of normal PMN leukocyte levels used is 50-70% in the adult male category. Table 3 shows the distribution of PMN leukocyte levels based on the age of the respondents. In the age group of 21-35, 3 respondents had high PMN leukocyte levels, and 8 others had normal PMN leukocyte levels. In the age group of 36-50 years, out of 18 respondents, 11 had high PMN leukocyte levels, and 2 others had normal levels. In this study, only 1 respondent was in the ≥ 50 age group, and the respondent had high levels of PMN leukocytes.

According to Chakraborty et al.,²¹ in 2014, several environmental, physical, and psychosocial factors can alter the host's periodontal tissue and immune response. Several of these factors can cause the body to become susceptible to bacterial attack or easily become inflamed, and can cause relatively severe expression of periodontal disease. This study is depicted in Table 3 of all research samples suffering from gingivitis, as many as 13.3% of the samples suffered from mild gingivitis, 63.3% of the samples suffered from moderate gingivitis, and 23.3% of the samples suffered from severe gingivitis.

In Table 4, gingivitis was more common for respondents with high PMN leukocyte levels (66.7%), while respondents with normal PMN leukocyte levels only suffered from (33.3%). A person with poor sleep quality is prone to inflammation, which is caused by a disruption of the circadian rhythm, which triggers oxidative stress, which causes changes in immune function, resulting in an increase in PMN leukocyte levels

in the blood circulation. The body conducts an immunological response by activating B, T, and PMN Leukocytes. Activated epithelial cells will release inflammatory mediators IL-1, IL-8, prostaglandin E2 (PGE2), matrix metalloproteinase (MMP), and tumor necrotic factor (TNF), which are the earliest responses to bacterial stimuli and cause metabolic disorders of connective tissue and bone that appear to be early clinical signs of gingival tissue inflammation or gingivitis.¹⁶

The results of the relationship analysis using the Chi-Square test showed Asymp. Sig. (2-tailed) 0.035 ($p < 0.005$), meaning a significant relationship exists between PMN leukocyte levels and gingivitis. This result follows research conducted.²² stating that there is a meaningful relationship between hematological diseases and periodontal tissue diseases.

Based on the research results on the relationship between PMN leukocyte levels and gingivitis in security guards at the University of Muhammadiyah Surakarta, the study still has shortcomings, including the lack of research samples. The sample in this study still reaches the minimum limit of the quantitative research requirements. The lack of sample size is due to the fear of blood draws and trauma to dentists. The second shortcoming is the lack of a variety of other factors that cause gingivitis beyond the inclusions that have been determined by the security guards of the University of Muhammadiyah Surakarta.

Another factor that can cause gingivitis in security guards at the University of Muhammadiyah Surakarta is uncontrolled bad habits that cause poor oral hygiene, such as

brushing time, tobacco consumption, and coffee consumption. The recommendation for further research is to group the variations of the causes of gingivitis to identify the exact cause of gingivitis in security guards, in addition to the high levels of PMN leukocytes.

CONCLUSION

Based on the results of this study, it can be concluded that there is a correlation between PMN leukocyte levels and gingivitis among members of the Security Unit at the University of Muhammadiyah Surakarta. Future research is recommended to provide motivation, build confidence, and offer education to respondents about the importance of regular blood tests and dental check-ups for maintaining overall health. It is also suggested that future studies include additional variables that may be associated with gingivitis, as high PMN leukocyte levels are not the sole contributing factor to this condition.

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