THE ASSESSMENT OF NEUTROPHIL-TO-LYMPHOCYTE RATIO IN OBESITY: A DESCRIPTIVE STUDY ON UNIVERSITY STUDENTS IN SURABAYA, INDONESIA

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ABSTRACT

The incidence of obesity worldwide is rapidly increasing, both in developed and developing countries. Obesity, particularly central obesity, is an inflammatory condition occurring within the body. The neutrophil-to-lymphocyte ratio (NLR) is a simple biomarker used to indicate the inflammatory response. This study aims to determine the profile of the neutrophil-to-lymphocyte ratio in students with obesity at the Faculty of Medicine, Universitas Wijaya Kusuma Surabaya. This study employs a descriptive-analytic method with a cross-sectional approach. The study population comprises students from the Faculty of Medicine, Universitas Wijaya Kusuma Surabaya; 47 individuals, with 30 obese individuals and 17 individuals with a normal BMI. The results showed that the average neutrophil-to-lymphocyte ratio (NLR) for individuals with a normal BMI is 1,95. In contrast, the average NLR for obese individuals is 2,09. There is an increase in the average neutrophil-to-lymphocyte ratio (NLR) among obese students at the Faculty of Medicine, Universitas Wijaya Kusuma Surabaya.

Keywords: *Obesity, Neutrophil, Lymphocyte, Neutrophil-To-Lymphocyte Ratio*

INTRODUCTION

Since 1975, the incidence of obesity worldwide has been rapidly increasing, both in developed and developing countries (Schetz et al., 2019). In Indonesia, 13.5% of individuals over 18 years old are overweight, 28.7% have mild obesity, and 15.4% have severe obesity. In Surabaya, the incidence of obesity ranks second highest in East Java Province, with a total of 98,344 cases (Gunawan & Adriana, 2020).

Obesity is an chronic inflammatory condition. Excess fat accumulation in adipose tissue results in substantial changes in both the number and activity of immune cells, thus triggering a constant secretion of pro-inflammatory cytokines (Prahalnitya & Hendrianingtyas, 2021).

A study by Dirican *et al* showed that neutrophil-to-lymphocyte ratio (NLR) may serve as a biomarker for inflammatory condition (Dirican et al., 2015). However, its diagnostic

value in obesity requires further investigation. Thus, this study aims determine the profile of the neutrophil-to-lymphocyte ratio in students with obesity at the Faculty of Medicine, Universitas Wijaya Kusuma Surabaya.

LITERATURE REVIEW

Obesity is a condition in which the body accumulates too much fat, resulting in a larger body weight than normal. Obesity can also result from an imbalance between energy intake and energy expenditure (Septiyanti & Seniwati, 2020). One indicator to determine nutritional status is the body mass index (BMI), a simple index of weight-for-height that is used to classify overweight and obesity in adults (Nuttall, 2015).

The pathogenesis of obesity involves chronic inflammation. The inflammatory mechanism begins when immune cells encounter adipocytes as unrecognized proteins, triggering pro-inflammatory mediators. This process aims to eliminate and neutralize foreign proteins through apoptosis and phagocytosis, which are subsequently removed via the lymphatic drainage process. Disturbances in this mechanism can lead to chronic inflammation (Prahalnitya & Hendrianingtyas, 2021). Excess fat accumulation in adipose tissue results in substantial changes in activity of immune cells that lead to dysregulated immune homeostasis (Mraz & Haluzik, 2014).

The first defense cell in the immune system is the neutrophil. Neutrophils are highly sensitive to triggering stimuli and can be mobilized minutes to the area of inflammation quickly and efficiently in large numbers (A. R. Indrati et al., 2022; Petri & Sanz, 2018; Sahamastuti et al., 2019; Supardi et al., 2018; Susanto et al., 2018).

Lymphocytes play an important role in the adaptive immune response (A. Indrati et al., 2024). The adaptive and innate immune systems work together to fight organisms that enter and develop in the body. After the antigen enters the body, ingestion occurs by the antigen presenting cell (APC) then digested by lysosomes, then attached to the major histocompatibility complex class II (MHC-II) molecule. Furthermore, lymphocytes interact with antigens that have been attached to MHC II and become effective immune cells (Chapman & Chi, 2022).

Therefore, neutrophil-to-lymphocyte ratio may have significant predictive value in as a biomarker in inflammation-related disease and can be integrated into daily practice (Qian et al., 2023). Thus, this study want to determine the profile of the neutrophil-to-lymphocyte ratio in students with obesity.

METHODS

This study employed an analytical descriptive method with a cross-sectional approach and obtained ethical clearance with research approval No. 41/SLE/FK/UWKS/2024. The population consisted of students from the 2020-2023 cohorts at the Faculty of Medicine, Universitas Wijaya Kusuma Surabaya. Sampling was conducted using consecutive sampling techniques on 50 samples without infection, allergies, blood disorders, and not receiving anti-inflammatory therapy. The samples were divided into 2 groups: samples with BMI 18.9-22.9 as controls and samples with BMI > 25 as the research group. The data collection procedure began with participants filling out an informed consent form, followed by an explanation of the

procedures, including potential complications that participants might experience. BMI measurements were conducted by the researcher, while sample collection was performed by health analysts at the Dukuh Kupang Health Center laboratory in Surabaya.

RESULTS

A total of 47 samples were obtained with an age range of 19-28 years, with more male participants than female. Based on the BMI calculations, varied results were obtained: the normal group ranged from 18.5 to 24.9 kg/m2, while obesity ranged from 25.6 to 42.9 kg/m2 (Table 1).

Table 1. Basic Characteristics of Study Subjects

Variable	Mean ± SD	Median (min - max)	(%)
Age (year)		21 (19 – 28)	
Gender			
Male			52%
Female			48%
Height (cm)	163,2 ± 9,9	164 (140 - 188)	
Weight (kg)	73,7 ± 19,4	72,4 (39,5 – 120)	
BMI (kg/m^2)			
Normal	21,9 ± 2,0	22,2 (18,5 – 24,9)	
Obesity	30,6 ± 4,4	29,4 (25,6 - 42,9)	

BMI: body mass index

Table 2 shows that the average neutrophil-to-lymphocyte ratio for subjects with normal BMI is 1,95. On the other hand, the average neutrophil-to-lymphocyte ratio for subjects with obesity is 2,09; 9% and 3,4% with neutrophilia and lymphocytosis, respectively (Table 3).

Table 2. The Neutrophil-to-Lymphocyte Ratio Profile in Subjects with Normal Body Mass Index (BMI)

Variable	Amount	(%)	Mean ± SD	Median (min - max)
Neutrophils				
within normal limits	17	85	4,6 ± 1,6	4,2 (1,6-8,81)
high	-	-		
Lymphocytes				
within normal limits	17	100	2,6 ± 0,50	2,0 (1,3-3,28)
high	-	-		
NLR			1,95 ± 0,46	1,9 (1,0-2,9)

NLR: neutrophil-to-lymphocyte ratio

Table 3. The Neutrophil-to-Lymphocyte Ratio Profile in Subjects with Obesity

Variable	Amount	(%)	Mean ± SD	Median (min - max)
Neutrophil				
within normal limits	21	70	5,2 ± 1,7	5,2 (1,7-8,82)
high	9	30		
Lymphocyte				
within normal limits	29	96,6	2,8 ± 0,8	2,8 (1,4-4,8)
high	1	3,4		
NLR			2,09 ± 0,50	2,1 (1,2-2,9)

NLR: neutrophil-to-lymphocyte ratio

DISCUSSION

Based on our findings, it is evident that there is an increase in the average neutrophil-to-lymphocyte ratio (NLR) among students with obesity at the Faculty of Medicine, Universitas Wijaya Kusuma Surabaya. These results are consistent with Fisher *et al*, which indicate that obesity can influence NLR outcomes (Fisher et al., 2016).

Obesity causes an increase and expansion of adipose tissue, inducing molecular signals and protein mediators called adipokines. Inflammatory responses stem from the high production of adipokines, leading to the release of inflammatory mediators such as leptin, adiponectin, resistin, and visfatin that modulate cytokine production. The inflammatory responses will cause increase of neutrofil count (neutrophilia). In obesity, macrophages are activated normally to produce pro-inflammatory cytokines with an increased TNF□ level. On the other hand, adiponectin secretes anti-inflammatory cytokines that lead to a decrease in lymphocyte count under normal condition (Park et al., 2014).

The normal physiological value of NLR has not been definitively established; however, a study by Azab *et al* showed that the average values of neutrophils and lymphocytes were 4,300/µl and 2,100/µl, respectively, with an average NLR of 2.15 (Azab et al., 2014). NLR can also be influenced by various conditions such as age, race, medications and chronic diseases. These conditions affect the function, activity, behavior, and dynamic changes in the number of neutrophils and lymphocytes (Buonacera et al., 2022).

Dynamic changes in NLR precede clinical conditions over several hours and can alert doctors to ongoing pathological processes early on. NLR can aid in distinguishing between more severe and milder diseases. It is a cost-effective, simple parameter with high sensitivity and low specificity for stress and inflammatory parameters (Zahorec, 2021).

To date, this is the first study to evaluate neutrophil-to-lymphocyte ratio in obese subjects in Indonesia. However, further investigations are necessary to understand the correlation of NLR in physiological condition in cohort study design in population of Indonesia.

CONCLUSION

There is an increase in the Neutrophil-lymphocyte ratio in obese students at the Faculty of Medicine, Wijaya Kusuma University, Surabaya because of the inflammatory mediators releasing. A larger sample size and further research using the correlation statistical analytical research method are needed to obtain significant results. This study can be used as a reference for further research using other hematological parameters such as monocytes/high-density lipoprotein ratio (MHR)

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