

Correlation between HbA1c level and monocyte percentage in obesity

Edward Kurnia Setiawan Limijadi*, Meita Hendrianingtyas

ABSTRACT

Background : HbA1c is one of the parameters that can be useful for diagnosing diabetes mellitus that can occur in obesity. Monocyte as an inflammatory cell is widely studied in relation to diabetes mellitus and obesity. The purpose of this study is to analyze the correlation between HbA1c levels and monocyte percentage in obesity.

Methods : A Cross-sectional study of 30 medical students at a private laboratory in Semarang on March – April 2017 was done. The monocyte percentage included incomplete blood count was examined with the Sysmex XS-800i hematology analyzer, while HbA1c level was examined with Hemocue HbA1c 501 System. Spearman test was done for analyzing data with $p < 0.05$ was considered statistically significant.

Result and discussion : Median of HbA1c level was $5.8 \pm 0.23\%$. Medians of leukocyte count, lymphocyte percentage, neutrophil percentage, and monocyte percentage were $8,600 \pm 339,77 /\mu\text{l}$, lymphocyte percentage $33\% \pm 1.19\%$, neutrophil percentage $56\% \pm 1.35\%$, and monocyte percentage of $9.0\% \pm 0.26\%$, respectively. Spearman test showed that correlation value (r) was 0.131 ($p = 0.489$).

Conclusion and suggestion : There was no correlation between HbA1c levels and monocyte percentage in obesity. The increased of monocyte percentage can be used as monitoring and evaluation parameters in obesity that can lead to diabetes mellitus. Further study can be done in an obese population with older age as well as other parameters related to obesity and diabetes mellitus.

Keyword : HbA1c level; monocyte percentage; obesity

INTRODUCTION

Obesity is a condition with abnormal or excessive fat accumulation in the adipose tissue.¹ Obesity occurs due to more calories entering the body through food than is used to support the body's energy. The accumulation of fat in the abdominal area is called central obesity or obesity android.²

In 2030, obesity is estimated to occur in 20% of the world population, and 38% of the world population is overweight. Obesity in the United States reaches 30% of the adult population.³ In the same idea, obesity in Indonesia has increased from 2013 to 2018 about 7% reaching 21,8%. Pekanbaru has high rates of obesity (63.4%), especially central obesity.⁴ Obesity prevalence based on Basic Health Research Results (RISKESDAS) 2018, North Sulawesi province had the highest prevalence of obesity that is 30,2% and for the highest prevalence of central obesity was also occupied by North Sulawesi Province reaching 42,5%.⁵

Individuals with obesity will be susceptible to various diseases that appear chronically. Various organs will be affected by the condition of obesity. One of the abnormalities that can occur is the emergence of diabetes mellitus in addition to abnormalities that may appear in blood vessels in the form of blockage (atherosclerosis). The disorder occurs as a result of chronic inflammation in the body of obese individuals.

Inflammation occurs in obesity that affects the entire system of the body. Inflammation leads to an

increase in proinflammatory cytokines that will determine the next process. Proinflammatory cytokines will make a disturbance in target organs related to the hormone insulin that plays a role in insulin resistance. The inflammatory process also results in disruption in fat tissue. Insulin resistance will lead to a condition of diabetes which will further increase HbA1c levels as one of the parameters in the diagnosis of diabetes mellitus.⁶

The inflammation that occurs will also activate the leucocyte cells as inflammatory cells, especially monocytes as chronic inflammatory cells. Monocytes play a role in stress-induced cells and induce an ongoing inflammatory response. Increased monocytes occur in these circumstances will aggravate the state of inflammation and increasingly affect the insulin resistance in obesity.^{7,8,9}

The study by Onal *et al* and Lee *et al* suggest that HbA1c may be used as a marker in detecting insulin resistance or impaired glucose metabolism in obese children.^{10,11} HbA1c levels rise in obese adults both with diabetes and without diabetes mellitus as revealed by Emeribe *et al*. This suggests that HbA1c levels are important parameters used in evaluating obese individuals leading to diabetes mellitus.¹²

Research conducted by Breslin *et al* suggests that monocyte and inflammatory markers can be a marker for obese children at risk of developing in chronic diseases such as diabetes mellitus.¹³ There are various monocyte subpopulations associated with obesity. These subpopulations play a role in the development toward

Department of Clinical Pathology, Faculty of Medical, Universitas Diponegoro. Prof Soedarto, SH. Street, Tembalang, Semarang, Jawa Tengah 50275, Indonesia

*Corresponding author : E-mail: edwardksl@fk.undip.ac.id

chronic diseases as revealed by Devevre *et al.*¹⁴ Mattos *et al* described the same thing that monocytes play a role in the inflammatory process and the occurrence of advanced immune responses in obese children.¹⁵

Research on the relationship between HbA1c and monocyte levels has not been done much, further related to obesity in young adulthood. This condition makes the need to do research on both parameters are related to obesity of young adult age.

METHODS

Descriptive analytic research with a cross-sectional approach was conducted on 30 medical students of obesity in Medical Science student at Semarang. The study was conducted in March-April 2017. Samples were taken by accidental sampling by meeting inclusion and exclusion criteria. Inclusion criteria are 18-24 years old, healthy physical, $IMT \geq 27$ kg/m^2 , and willing to follow the research. Exclusion

criteria were respondents were pregnant, lipemic, and hemolysis sample.

The independent variable of this research was HbA1c level with scale ratio, and dependent variable was monocyte percentage with scale ratio. The percentage of monocytes included in the complete blood was examined with Sysmex XS-800i hematology analyzer, whereas HbA1c was examined using Hemocue HbA1c 501 System.

Data analysis was done by using the parametric test—Spearman test. Significance was expressed at $p < 0.05$. The research permission was obtained by ethical clearance from Medical Research Ethics Commission of Medicine Faculty of Diponegoro University.

RESULTS

Characteristics of this research subject can be seen in table 1 as follows:

Table 1. Characteristics of research subjects

Characteristics	N (%)	Mean \pm SD	Median (Minimum- Maximum)
Sex	30 (100%)	-	-
Male	18 (60 %)		
Female	12 (40 %)		
Age (year)	-	20,30 \pm 1,418	20 (18-23)
Height (cm)	-	166,6 \pm 7,98	167,5 (149-180)
Weight (kg)	-	88,91 \pm 15,79	90,20(63,1-118,6)
Body mass Index (kg/m^2)	-	31,85 \pm 3,77	31,20 (27 – 38,7)

Table 1 shows that the subjects of the study with male sex are higher than female, that is 18 respondents (60%) compared to 12 respondents (40%). The average age of respondents is 20 years, with an age range of 18 to 23 years.

The calculation of Body Mass Index requires height and weight data. The height of the respondent has an average of 166.6 ± 7.98 cm, with a minimum height of 149 cm and a maximum of 180 cm. The average weight of respondents is 88.91 ± 15.79 kg with a minimum body weight of 63.1 kg and a maximum value of 118.6 kg. Body mass index was calculated and got mean equal to $31,85 \pm 3,77$ kg/m^2 with minimum value 27 kg/m^2 and maximum value $38,7$ kg/m^2 .

A complete blood examination was performed to see the leukocyte profile obtained from the analytical tool examination can be seen in table 2.

Table 2. Leukocyte profile of subjects

Variabel	Median \pm SE
Leucocyte counte (μl)	8.600 \pm 339,77
Lymphocyte percentage (%)	33 \pm 1,19
Neutrophil percentage (%)	56 \pm 1,35
Monocyte percentage(%)	9,0 \pm 0,26

Table 2 shows the leukocyte profile of subjects who were examined by using a hematologic analyzer. It appears that the number of leukocytes in the respondents is still within normal limits. The percentage of leukocyte cell types that has values exceeding the normal limit value was monocytes, while lymphocytes and neutrophils were still within normal limits. HbA1c examination with monocyte percentage and Spearman's test statistical analysis are presented in table 3 below. Spearman test analysis showed that there was no correlation between HbA1c and monocyte percentage in the obesity respondent.

Table 3. Results of statistical analysis of HbA1c levels with monocyte percentage in obesity

Variabel	Median \pm SE	Correlation (r)	Significance (p)
HbA1c (%)	5,8 \pm 0,23	0,131	0,489
Monocyte (%)	9,0 \pm 0,26		

DISCUSSION

This study took obese respondents from medical students. This study was taken with the reasons to see the association of obesity which has a risk of diabetes mellitus with the percentage of monocytes that are inflammatory cells play a role in the occurrence of diabetes mellitus in obese individuals. The results of the HbA1c examination on the majority of respondents were still below the reference value of less than 6.5%, but there was one respondent who has high HbA1c levels more than the reference value. The percentage of monocytes examined has a higher value that is more than its reference value. More than 70% of respondents have this, so it can lead to a separate interpretation of chronic inflammation in the body of the obese individual.

The examination was also performed on the leukocyte profile of respondents in the form of leukocyte count, percentage of lymphocyte, and percentage of neutrophils. The entire result of the parameters has a value within the reference value (normal). This suggests that overall leukocytes are not yet activated for chronic inflammation that runs in the body of obese individuals, but the movement and the number of chronic inflammatory cells of the monocyte are already beginning to appear. This allows it to occur on an ongoing basis, and at some later date, at a more mature age can lead to a more severe or widespread inflammation, which can lead to diabetes mellitus. The next process will certainly lead to an increase in HbA1c levels in obese individuals in these circumstances. This situation will make the analysis of the relationship between the two variables becomes meaningful.

Other studies have much to say about HbA1c in obesity as well as monocyte levels in obesity. Research on the relationship between these two parameters on obesity is still not widely done. More research is done on conditions of certain diseases such as diabetes mellitus, coronary heart disease, stroke, and other related conditions. Research by Liu *et al* showed that HbA1c and monocyte levels increased in obesity without diabetes mellitus with the achievement of meaning value. Both parameters can be part of an inflammatory marker in obese individuals.¹⁶

The same is also written by Kohut *et al.*, which explained that there is a significant positive relationship between HbA1c and inflammatory markers and monocytes through monocyte chemokine examination. It suggests that monocytes are a parameter that responds to the contribution of type 2 diabetes mellitus in obese individuals.¹⁷

Inflammation with a classical process needs to be discussed in the state of the metabolic system, in this case, obesity, to explain the inflammatory processes that affect metabolic conditions and abnormalities that occur in cells and tissues.^{18,19} Obesity is a condition that is said

to induce the occurrence of inflammation due to injury at body obesity. This condition spurred the occurrence of excessive oxidation (especially lipid oxidation) in cells. It follows that a continuous increase in the cycle leads to inflammation.²⁰

Increased proinflammatory cytokines in these conditions will activate endothelium, leukocytes, and induce acute-phase proteins. Cells and tissues will experience stress that will experience cell death. The next effect that arises is the activation of macrophages, in this case, monocytes in response to cell stress and cell death. Activation of this monocyte will induce the subsequent inflammatory response so that the inflammatory process will continue.^{21,22}

This inflammatory process disrupts to glucose metabolism in obese individuals. The occurrence of disorders of the vascular and functional abnormalities of fat cells or tissues can trigger and increase insulin resistance. The incidence of type 2 diabetes mellitus will increase with the occurrence of insulin resistance. HbA1c levels will increase with the occurrence of insulin resistance is getting worse.^{23,24,25}

The study did not examine the parameters of inflammatory proteins and proinflammatory cytokines, which may increase with the increase of monocytes. This study did not directly measure insulin levels in respondents who could rule out abnormalities in the pancreas as insulin-forming organs. Further research is needed in the obese population with adult or older age without diabetes mellitus to see further relationship between the two variables in this study. Research on monocytes and biomolecular parameters associated with monocytes in inflammation or obesity needs to be done to find out further relationships, and research with other parameters is needed that develop with these obese populations.

CONCLUSION

There is no association between HbA1c and monocyte percentage in obesity. The increased monocyte count can be used as a monitoring and evaluation parameter in obesity that can develop in the direction of diabetes mellitus. Further research can be done on the obese population with older age as well as other parameters related to obesity and diabetes mellitus.

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