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by

Body Mass Index and Its Association with Cholesterol and Uric Acid Levels in Diabetes Mellitus Patients: A Cross-Sectional Study

Abstract

Diabetes Mellitus (DM) is a chronic metabolic disorder affecting millions of individuals worldwide. This study aims to explore the relationship between Body Mass Index (BMI) and cholesterol and uric acid levels in people with diabetes mellitus. A quantitative cross-sectional approach was employed, with 30 respondents sampled through purposive sampling at Anna Medika Madura General Hospital. The CHOD-PAP method was utilized for cholesterol examination, Uricase-PAP for uric acid, and BMI was calculated using body weight and height (kg/m^2). The results indicate not significant associations between BMI and cholesterol and uric acid levels in DM patients (p-value > 0.05). The highest recorded cholesterol level was 278 mg/dl, while the lowest was 136 mg/dl. Uric acid levels ranged from 3.4 mg/dl to 12.1 mg/dl, and BMI values ranged from 18.0 kg/m2 to 34.5 kg/m2. These findings highlight the importance of understanding the interplay between BMI and metabolic parameters in diabetes management.

Keywords: Diabetes Mellitus, Body Mass Index, Uric Acid, Cholesterol, Cross-Sectional Study.

Introduction

Diabetes mellitus (DM) is a disease caused by metabolic disturbances in the body, characterized by elevated blood sugar levels due to insulin resistance or insulin deficiency. The dangers associated with diabetes are substantial, ranging from blindness, kidney failure, gangrene, to the possibility of serious complications and even death. Blood glucose levels can fluctuate at different times, especially after meals and during physical activities (1). In 2019, Indonesia ranked 7th in the world with the highest number of diabetes patients,

27   reaching 10.7 million people. In Southeast Asia, Indonesia ranks 3rd with a prevalence of

28   11.3% of diabetes patients, and for East Java province, the prevalence is 2.6%

29   The Body Mass Index (BMI) is a method used to determine an individual's nutritional

30   status, particularly in relation to overweight or underweight conditions. To find out a

31   person's BMI, one can compare their weight in kilograms to their height in meters squared

32   (kg/m^2) (2). Based on previous research, it has been stated that there is a relationship

33   between Body Mass Index (BMI) and total cholesterol levels in patients with type 2 Diabetes

34   Mellitus (3).

35   It was recorded that as many as 537 million adults (20-79 years) suffer from DMT2 in the

36   world in 2021. Meanwhile in Southeast Asia it reaches 73 million people (4). The high

37   incidence of diabetes is inseparable from multiple factors that influence it, including genetics

38   and lifestyle (5,6). Diabetes is closely related to dietary intake, where excessive intake of

39   carbohydrates, fats, and proteins can trigger the onset of diabetes. However, the disease can

40   be controlled if patients follow appropriate diet plans, engage in physical activity, manage

41   stress, and maintain adequate water intake (7).

42   Diet plays a significant role in controlling blood glucose levels, lipid levels, and blood

43   pressure, while physical activity increases insulin sensitivity, helps control blood sugar, aids

44   in weight loss, and reduces depression (8). One of the impacts of insulin resistance is an

45   increase in blood uric acid levels or hyperuricemia, which is indirectly associated with

46   glucose intolerance and correlates with LDL and HDL levels (9)

47   Previous research has also shown a significant relationship between fasting blood glucose

48   levels and uric acid levels in patients with type 2 Diabetes Mellitus (10). Other studies have

49   indicated a meaningful correlation between HbA1c values and total cholesterol levels in

50   patients with type 2 Diabetes Mellitus. An increase in Body Mass Index or obesity can be

51   attributed to fat accumulation in the body when food intake exceeds the required energy

52 (11). Based on the above background, the researchers aim to investigate the relationship
53 between Body Mass Index and cholesterol and uric acid levels in patients with Diabetes
54 Mellitus.

55

Materials and Methods

57 The research method used in this study is quantitative with a cross-sectional approach. The
58 population used in this research is diabetes patients at RSU Anna Medika Madura, with
59 sample selection using purposive sampling consisting of 30 respondents, where the
60 respondents are diabetes patients at RSU Anna Medika Madura who voluntarily agreed to
61 participate. This research was conducted at the laboratory of RSU Anna Medika Madura.

62 This research was carried out after obtaining ethical clearance from the Ngudia Husada
63 Madura Health Sciences College with reference number:
64 1609/KEPK/STIKES-NHM/EC/III/2023. Sample collection was conducted at the laboratory
65 of RSU Anna Medika Madura. Cholesterol levels were tested using the CHOD-PAP method
66 with Elitech reagent, while uric acid examination used the Uricase-PAP method with Elitech
67 reagent. The instrument used in this study was a photometer (Microlab 300). Body Mass
68 Index measurements were performed by comparing weight and height using the formula
69 weight/height^2 with the unit kg/m^2. The data analysis technique was used cross-sectional
70 chi-square test with a confidence level of 95%, Meanwhile, the analysis of differences in
71 BMI, Cholesterol, and uric acid levels based on gender was conducted using an independent
72 T-Test.

Results

74 Research on the Relationship Between Body Mass Index and Cholesterol and Uric Acid
75 Levels in Patients with Diabetes Mellitus has been conducted at the Anna Medika Madura
76 Hospital laboratory, with a total of 30 examined samples. These samples were categorized as

77 high, low, and normal, as shown in Figure 1. The number of respondents examined in this

78 study consisted of 19 (63.3%) female respondents and 11 (36.7%) male respondents.
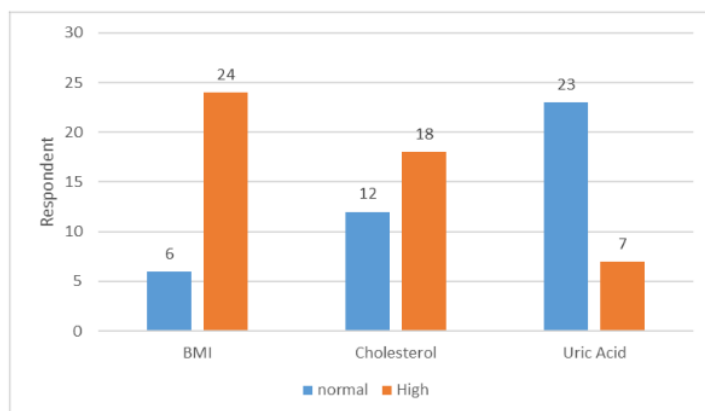
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80 **Fig. 1** The Frequency of Cholesterol, Uric Acid, and BMI Levels in DM Patients

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82   In the measurement of Body Mass Index, it was found that 24 respondents had a

83 high Body Mass Index, and 6 respondents had a normal Body Mass Index. Based on the

84 analysis results, 17 respondents had high cholesterol levels, while 13 respondents had normal

85 cholesterol levels. Among the respondents, 7 had high uric acid levels, while 23 other

86 respondents had uric acid levels within the normal range. Based on the analysis, this study

87 did not find any correlation between BMI and Cholesterol Levels, and Uric Acid. Fisher

88 Exact analysis showed values for both parameters > 0.05.

89   Tab. 1 The Relationship Between BMI and Cholesterol Levels, and Uric Acid

Parameter			Cholesterol		Total
			Normal	High	
BMI	Normal	Count	1	5	6
		Expected Count	2.6	3.4	6
	High	Count	12	12	24
		Expected Count	10.4	13.6	24
Total		Count	13	17	30
		Expected Count	13	17	30

Parameter			Uric Acid		Total
			Normal	High	
BMI	Normal	Count	1	5	6
		Expected Count	2.6	3.4	6.0
	High	Count	12	12	24
		Expected Count	10.4	13.6	24.0
Total		Count	13	17	30
		Expected Count	13.0	17.0	30.0

Fisher's Exact Test (1-sided)	**0.156**		**Fisher's Exact Test (1-sided)**	**0.17**

Analysis by gender on the differences in BMI, cholesterol, and uric acid reveals a significant difference in cholesterol. However, such a difference was not found in BMI and uric acid (Table 2).

Tab. 2 Analysis of Differences in BMI, Cholesterol, and Uric Acid Levels Based on Gender

Parameter	Male	Female	Sig. (2-tailed)
BMI	25.12	26.08	0.392
Cholesterol	193.55	224.68	0.039
Uric Acid	6.51	6.96	0.587

Discussion

Diabetes mellitus is a metabolic disorder characterized by elevated blood glucose levels. DM results in an imbalance in metabolic processes within the body (12). DM is caused by multifactorial factors including genetic factors and an unhealthy lifestyle. One parameter of an unhealthy lifestyle is the presence of abnormal body mass index. In this study, it is assumed that DM patients are associated with other parameters such as cholesterol and uric acid. Obesity can occur in anyone, from children to adults. Some factors that can lead to obesity include genetics, emotional factors, an unhealthy lifestyle, and frequent consumption of fast food (13).

Gender is a factor that influences an individual's cholesterol levels, with both females and males having similar risks around the age of 50 and above. In females, the hormone estrogen is present, which can prevent the formation of plaques in the bloodstream by increasing HDL levels and reducing LDL levels (14). Males are at a higher risk of developing uric acid than females, as the estrogen hormone in females accelerates the excretion process of uric acid. The average uric acid levels in this study tended to increase in

female respondents (see Table 2). Factors that can contribute to excessive uric acid accumulation include dietary habits of consuming high-purine foods such as organ meats, legumes, and certain types of vegetables (14). Individuals with DM usually manage their dietary habits to expedite their growth. Based on the findings, there is no correlation between patients' BMI and uric acid levels.

The tendency of the community to prefer consuming fast food and adopting unhealthy lifestyles such as eating at night, especially high-carbohydrate foods like white rice, along with a lack of physical activity, has become one of the factors leading respondents to experience obesity, characterized by excess fat in adipose tissues, which can compromise health. Pathologically, this is due to the beta cells being less sensitive to stimuli due to blood sugar levels and obesity, which reduces the number of insulin receptors on cells throughout the body (15)

Although this study did not find a correlation between BMI and Cholesterol Levels, and Uric Acid (see Table 1), the cholesterol levels among DM patients are relatively high (Figure 1). In diabetic patients, there are specific characteristics marked by elevated triglyceride levels, low HDL cholesterol, and an increase in small, dense LDL subfractions, also known as the lipid triad. This condition leads to a reduction of fatty acids in adipose tissues, while fatty acids and glycerol in the bloodstream increase. The excess plasma fatty acids can lead to the conversion of fatty acids in the liver into phospholipids and cholesterol, which are subsequently released into the bloodstream in the form of lipoproteins, resulting in increased total cholesterol levels in type 2 diabetes patients(14).

Conclusions

The research conducted at Anna Medika Madura Hospital laboratory indicates that there is no significant correlation between Body Mass Index and cholesterol or uric acid levels in diabetic patients.

Author contributions

The first author was involved in data collection. Meanwhile, the second, third, and fourth authors assisted in article preparation and provided guidance on the research concept.

Conflict of Interest

There is no conflict of interest in this article

Acknowledgment(s)

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