Risk of Nutritional Status and Blood Sugar on Type 2 Diabetes Mellitus with Pulmonary Tuberculosis in Sawahan Subdistrict, Surabaya, Indonesia

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Abstract

The diabetics have risk of pulmonary tuberculosis It caused by lacking of immune system and malnutrition, eventhough the diabetics' nutritional status commonly is normal or overweight. This research aimed to analyze risk of nutritional status and blood sugar to patients of diabetes mellitus with pulmonary tuberculosis. The study was observational analytic with case control design. There were 20 samples in each case and control located in Sawahan Sub-district, Surabaya. The data collection used questionnaire and medical record of participants from the community health care. The data was analysed using Pearson test correlation and odd ratio. The result showed no correlation between body mass index and blood sugar of both random (p=0.138) and fasting (p=0.166). The oberweight diabetics are much more likely to get pulmonary tuberculosis 1.3 times compared to normal diabetics (95% CI= 0.313<OR<5.393), while the odd ratio of pulmonary tuberculosis in underweight diabetics is estimated to be 1.2 times compared to diabetics who are normal (95% CI= 0,121<OR<11,865). The diabetics who have random blood sugar level of ≥200 mg/dL are 0.46 times to have pulmonary tuberculosis compared to blood sugar level of <200 mg/dL (95% CI=0.111<OR<1.94). The diabetics who have fasting blood sugar level of ≥126 mg/dL showed effect 2.43 times to be likely get pulmonary tuberculosis either they have <126 mg/dL 95% CI= 0.51<OR<11.51). There was no relationship between blood sugar level, nutritional status, and pulmonary tuberculosis on patients with type 2 diabetes mellitus.

Keyword *:Nutritional Status, Blood Sugar, Type 2 Diabetes Mellitus with Pulmonary Tuberculosis*

Introduction

Non-communicable diseases are a public health discussion globally due to the recent cases that have occurred this. In 2016, non-communicable diseases have caused 41 million deaths (71%). The problem of non-communicable diseases is more prevalent in developing countries. Metabolic factors such as high blood sugar and obesity require attention from public health experts. This is due to the prevalence of excessive blood sugar levels in 2014 estimated at 9% in the world according to WHO in 2018. The number of people with diabetes has nearly a quarter of the world's population since 1980 and it is estimated that there are 650 million obese people above the age of 18 in 2016(1).

Diabetes mellitus includes non- communicable diseases and is a metabolic disorder with characteristics of hyperglycemia caused by the pancreas not producing enough insulin or the body cannot use insects that are produced effectively so that there is an increase in glucose concentration in the blood[2]. Diabates include a serious threat to public health because of one of the diseases that contribute to high mortality, morbidity and health costs across the country(2). Indonesia as one of the developing countries is estimated to have total deaths from non-communicable diseases in 2016 of 73% of total deaths(1).

Diabetes is positively associated with the risk of tuberculosis (TB)(3). East Java Province has a diabetes prevalence of 2.02% while the prevalence of diabetes mellitus in the city of Surabaya alone reaches almost 3.5% (4). Sawahan Subdistrict in Surabaya City is one of the regions with a third population density of Mostof 29.75%(5). Variable occupancy density and contact

between households include risk factors for transmission of pulmonary TB[6].

The incidence of pulmonary TB in diabetics is related to nutritional status and blood sugar levels[7]. Patients with type 2 diabetes mellitus are in fact more often found with normal ornutritional status *overweight* so that the risk of nutritional status of the two categories needs to be studied against cases of pulmonary TB in patients. Based on these problems, the study will analyze the risk and correlation of nutritional status and blood sugar levels of patients with type 2 diabetes mellitus with and without pulmonary TB. This study aims to analyze the risk of blood sugar levels and nutritional status on the incidence of pulmonary TB in patients with type 2 diabetes mellitus. This study is expected to be useful for improving the quality of health services in disease prevention and adding new information about the incidence of type 2 diabetes mellitus with TB lung.

Material and Method

This study used design *case control* with observational analytic types. The research locations were in the Sawah Puloh and Sawahan Health Center, Surabaya City. The study took place from September 2017 to December 2017. The population of the case was all patients diagnosed with type 2 diabetes mellitus with pulmonary TB in Sawahan District, Surabaya City while the control population was all patients with type 2 diabetes mellitus in the same location. Retrieval of data using *probability sampling techniques* with method *simple random sampling*. Sample calculation using the formula *case control* uses the value of Zα = 95% and Zβ = 90% [8].The proportion of population effect cases P1 = 0.82 and control population P2 = 0.49[9]. The results of the sample calculation with the ratio of the number of cases compared to the number of controls of 1: 1, there were 20 samples in each case and control. Sampling of cases and controls were randomized (random).

Characteristic variables studied in the respondents included case group and control, sex, body mass index, random blood sugar, and fasting blood sugar of type 2 diabetes mellitus. The dependent variable is pulmonary TB while the independent variable is blood sugar levels and nutritional status.

Data retrieval is done by interviewing questionnaires and documentation from the respondent's medical record from the health center where the respondent is treated. Data taken from medical records is a diagnosis of pulmonary TB and type 2 diabetes mellitus.

RESULTS

The results of the study on the characteristics of the respondents (Table 1) showed that the majority were women (22%). The nutritional status of the respondents was mostly in thecategory *overweight* (62.5%) and the lowest was thegroup *underweight* (10%). The majority of respondents had random blood sugar 80-180 mg / dL (80%) and fasting blood sugar ≥100 mg / dL (85%).

The results of the Pearson test correlation with α = (0.05) showed no correlation between body mass index and random blood sugar levels (p = 0.14> 0.05) and fasting blood sugar (p = 0.17> 0.05) Pearson correlation coefficient showed a weak correlation in both correlations, namely the correlation of body mass index with random blood sugar levels (Pearson correlation = 0.24) and body mass index correlation with fasting blood sugar levels (Pearson Correlation = 0.22) (Table 2).

Tabel 1: Distribution of Respondents based on Characteristics of Diabetes Mellitus Patients

Variabel	Frequency (n)	Percentage (%)
Sex		
Male	18	45
Female	22	55
Nutritional Status		
Underweight	4	10
Normal	11	27,5
Overweight	25	62,5
Fasting Blood Sugar		
< 126 mg/dL	11	27,5
≥ 126 mg/dL	29	72,5
Random Blood Sugar		
< 200 mg/dL	9	22,5
≥ 200 mg/dL	31	77,5
Total	40	100

Tabel 2: Pearson Statistics Test Results on the Relationship between Body Mass Index (BMI) and Random Blood Sugar and Fasting Blood Sugar

Variabel	Pearson Corelation	p
BMI with Random Blood Sugar	0,24	0,14
BMI with Fasting Blood Sugar	0,22	0,17

Values *odds ratio* in table 3 show the meaning that the risk of type 2 diabetes mellitus with pulmonary tuberculosis in respondents who have a random blood glucose levels ≥200 mg / dL was 0.46 times than that flies random blood sugar levels <200 mg / dL. The result of the odd ratio in fasting blood sugar levels showed the risk of type 2 diabetes mellitus with pulmonary TB in respondents who had fasting blood sugar levels 6126 mg / dL was 2.43 times greater than respondents with fasting blood sugar levels <126 mg / dL . The two odd ratio values do not show the relationship between blood sugar levels and the incidence of pulmonary TB in patients with type 2 diabetes mellitus, which is viewed from the confidence interval values (Table 3)

The results odds ratio of the risk pulmonary TB in patients with type 2 diabetes mellitus with nutritional status *underweight* 1.2 times greater than respondents with normal nutritional status. In respondents with nutritional status they *overweight* have a risk 1.3 times more likely to be exposed to pulmonary TB than respondents who are of normal nutritional status.

Tabel 3: *Odd Rasio* Blood Sugar and Nutritional Status Type 2 Diabetes Mellitus Patients with and without pulmonary TB

Blood Sugar	Type 2 Diabetes Mellitus Patients				Total		Odd Ratio (95% CI)
	Case		Control				
	N	%	n	%	N	%	
Random Blood Sugar ≥ 200 mg/dL < 200 mg/dL Nutritional Status	16 4	55,2 36,4	13 7	44,8 63,6	29 11	100 100	0,46 (0,11<OR<1,94)
Nutritional Status I Underweight Normal	2 5	50 45,5	2 6	50 54,5	4 11	100 100	1,20 (0,121<OR<11,87)
Nutritional Status II Overweight Normal	13 5	52 45,5	12 6	48 54,5	25 11	100 100	1,30 (0,313<OR<5,40)

Discussion

The majority of respondents who suffer from type 2 diabetes mellitus have nutritional status *overweight*. Similar studies also state that the majority of the nutritional status of diabetics is *overweight* [10].The results of research in Indonesia also stated that based on the 2014 TB-DM Registry, comorbidities of TB and DM were more commonly found in patients who had a relatively heavier body weight than TB without DM[11]. Similar to the results of a study which states that someone with nutritional status obesity and overweight is associated with TB infection in diabetics [12]. This is

because obesity is a risk factor for diabetes[13]. The risk of developing diabetes is four times greater in obese people than those who have a normal BMI [14]. Other causes can be related to reduced exposure to rifampicin (antibiotics for pulmonary TB) in patients treated[15]. In contrast to the research of Chiang *et al* in 2019 the majority of patients with type 2 diabetes mellitus with pulmonary TB experienced weight loss. Decreasing weight occurs as a result of decreased appetite due to TB disease which is also experienced[15].

The risk of pulmonary TB for diabetics can occur in both patients with nutritional status *underweight* and *overweight* [16]. findings in this study found a different matter, namely there was no correlation between nutritional status of BMI of type 2 diabetes mellitus patients with the incidence of pulmonary TB. These results are also similar to the study by Lin *et al* in 2018 which is a non-significant risk between obesity, diabetes and tuberculosis. Possible causes of these results are confounding variables that affect like socio-economic status. If confounding variables can be controlled or regulated while the research is taking place, there may be an association between the two variables that can occur such as dividing the average number of people with obesity who are obese and not obese with their socio-economic status.The variable diabetes mellitus itself is an intermediate variable between the causal relationship between BMI and pulmonary TB but cannot be connected entirely because the BMI has two traits. The two characteristics of BMI associated with pulmonary TB are protective and risk. The biological mechanism in the body about this matter has also not been found clearly. Several possible mechanisms of origin originate from the role of fat tissue in the body against the bacteria *Mycobacterium tuberculosis* [17].

The risk of high blood sugar levels from normal limits in diabetics has been designated as a causal factor for type 2 diabetes mellitus with pulmonary TB [18]. It is different from the findings of this study which shows that there is no relationship between blood sugar levels and incidence of pulmonary TB in patients with type 2 diabetes mellitus. There are studies that also support these results, no relationship to the diagnosis of diabetes mellitus with a history of 37,862 respondents[4].

The results of the study by Lin et al in 2017 explain that 90% of TB patients who initially have fasting blood sugar levels <6.1 mmol / L can maintain <6.1 mmol / L while undergoing treatment for tuberculosis and show absolutely no symptoms of diabetes mellitus. This proves that TB patients who do not have a history of diabetes mellitus are proven by normal fasting blood sugar, there will not be comorbid diabetes mellitus [19].

This study shows no association between blood sugar levels and nutritional status with the incidence of pulmonary TB in type 2 diabetes mellitus, but the risk of nutritional status and blood sugar levels in diabetics needs to be considered together to avoid complications and comorbidities such as pulmonary TB. Lifestyle changes and physical activities to maintain normal nutritional status and routine blood sugar checks are preventative steps that can be taken for diabetics. Health services also need to improve diabetes care so that it can reduce comorbidities in patients and prevent diabetes with pulmonary TB [18]. For diabetics with TB, health services should have diabetes screening at the beginning of TB treatment, appropriate treatment, and monitoring treatment to reduce the failure of TB treatment in patients with diabetes mellitus [20].

Conclusion

There is no relationship between BMI and random blood sugar levels in people with diabetes mellitus with the incidence of pulmonary TB but there is a risk of BMI *underweight* and *overweight* and abnormal random blood sugar levels in diabetics for co-occurring pulmonary TB. The important thing to recommend for diabetics is to keep controlling blood sugar regularly, changing healthy lifestyles, and increasing physical activity in order to prevent comorbidities that arise.

Conflict of Interest: All authors have no conflicts of interest to declare.

Source of Funding: This is an article "Analisis risiko Tuberkulosis paru berdasarkan karakteristik, rerata kdar gula, lama diabetes dan status gizi pada penderita Diabetes Mellitus Tipe 2" of Epidemiology Department that was supported by Faculty of Public Health, Airlangga University.

Ethical Clearance: This study was approved by the Ethics Committee of the Faculty of Public Health Airlangga University No. 516-KEPK.

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