Risky Health Behaviors and Type 2 Diabetes Mellitus: Ecological Study in Central Java Province, Indonesia

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Abstract. The prevalence of Type 2 Diabetes Mellitus (T2DM) in Central Java Province, Indonesia in 2013 was 1.6% then increased to 2.1% in 2018. T2DM is determined by various factors, one of which was risky health behavior. The aim of this study was to examine correlation between risky health behavior and T2DM in Central Java. This study was ecological study with city/regency as unit analysis. We used secondary data from National Basic Health Research 2018. All collected data were analyzed with Pearson/Spearman test. We found that grilled foods consumption (p: 0.009; r: 0.435) as well as fruits and vegetables consumption (p: 0.049; r: 0.335) have correlations with T2DM. Furthermore, sweet foods consumption (p: 0.105; r: 0.279), fatty foods consumption (p: 0.947; r: 0.012), soft drinks consumption (p: 0.264; r: 0.194), and physical activity (p: 0.185; r: 0.229) have no correlations with T2DM.

Keywords: risky health behaviors, T2DM, ecological study

1. Introduction

The prevalence of non-communicable diseases in the world continues to increase. Even, in the last few decades experiencing an epidemiological transition, namely the pattern of disease spread that was initially dominated by communicable diseases, turning into non-communicable diseases. This increase in prevalence also occurs in one of non-communicable disease, namely Type 2 Diabetes Mellitus (T2DM). T2DM is one of the leading causes of death in the world. The prevalence of T2DM in the world continues to increase from year to year, especially in low- and middle-income countries [1]. T2DM can affect people's quality of life and become the leading cause of morbidity and premature mortality [2], [3]. One third of deaths due to T2DM occur in people under 60 years old [4].

In 2019, T2DM was ranked ninth as the leading cause of death in the world with 1.5 million deaths due to T2DM [5]. In Indonesia, the prevalence of T2DM continues to increase from year to year. Based on data from the National Basic Health Research, in 2013, the prevalence of T2DM based on a doctor's diagnosis in the population aged over 15 years was 1.5% then increased to 2.0% in 2018. Then in Central Java, the prevalence of T2DM in 2013 was 1.6 % then increased to 2.1% in 2018 [6], [7].

The increasing prevalence of T2DM can be influenced by various risk factors. T2DM risk factors can be divided into non-modifiable and modifiable risk factors. Non-modifiable risk factors include age, sex, and genetics. While one of the modifiable risk factor was risky behavior. These risky behaviors include consumption of foods that are too sweet and salty,

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consumption of fatty foods, less consumption of fruits and vegetables, lack of physical activity, consumption of alcohol, as well as consumption of cigarettes and tobacco. Based on data from Central Java Province Basic Health Research, people in Central Java have risky habits that are a risk factor for T2DM. The habit of consuming excess sweet food, consuming excess salty food, and consuming fatty food in Central Java are 40.5%, 32.0%, and 58.4%, respectively. In addition, as many as 63.6% of people consume less fruit and vegetables, and 29.5% do not do physical activity. This condition is estimated to have an influence on the high prevalence of T2DM in Central Java. Thus, this study aims to examine the correlation between risky health behavior and prevalence of T2DM in Central Java [8].

2. Material and Method

This study was ecological study with city/regency in Central Java Province as unit analysis. We used secondary data from Central Java Province Basic Health Research 2018. The dependent variable in this study took data from the indicator of diabetes mellitus prevalence diagnosed by doctors at all ages. Then for the independent variables using health behavior indicators consisting of the habit of sweet food consumption, fatty food consumption, grilled food consumption, soft drink consumption, fruit and vegetable consumption, and physical activity. All collected data were then analyzed using the Pearson/Spearman test.

3. Result

Risky health behavior is behavior related to the incidence or risk factors of non-communicable and communicable diseases. Based on the National Basic Health Research 2018, health behavior indicators consist of prevention of diseases caused by mosquito bites, consumption of risky foods, consumption of fruits and vegetables, bowel habits, hand washing behavior, cigarette and tobacco consumption, physical activity, as well as consumption of alcoholic beverages. Indicators of consumption of risky foods, less consumption of fruits and vegetables, consumption of cigarettes and tobacco, lack of physical activity, as well as consumption of alcoholic beverages are risk factors for non-communicable diseases. Meanwhile, the risk factors for communicable diseases consist of the habit of washing hands and defecating properly and correctly. The indicators measured in correlation to the prevalence of T2DM in this paper were consumption of risky foods, consumption of fruits and vegetables, and physical activity. Indicators of consumption of risky foods consist of excessive sweet and fatty foods consumption, grilled foods consumption, and soft drinks consumption.

Table 1. p-value and r-value of the Determinant of T2DM

No	Determinant	p-value	r-value
1.	Sweet food consumption (≥1 time per day)	0.105	0.279
2.	Fatty food consumption (≥1 time per day)	0.947	0.012
3.	Grilled food consumption (≥1 time per day)	0.009	0.435
4.	Soft drink consumption (≥1 time per day)	0.264	0.194
5.	Fruit and vegetable consumption (do not consume)	0.049	0.335
6.	Physical activity (less)	0.185	0.229

The sweet food consumption indicator represents the consumption of sweet foods in the population aged 3 years and over which is grouped into 1 time per day, 1-6 times per week, and 3 times per month. In 2018, 40.48% of people in Central Java had the habit of eating sweet foods 1 time per day, 47.86% consuming 1-6 times per week, and 11.66% consuming 3 times per month. The results of the calculation of the correlation test with the Pearson/Spearman test, obtained a p-value of 0.105, so it can be said that the habit of excessive sweet foods consumption in population in Central Java has no correlation with the prevalence of T2DM.

The physical activity indicator represents an overview of the physical activity carried out by household members aged 10 years and over. Physical activity measured includes heavy and moderate physical activity in daily life. This physical activity indicator is divided into sufficient and less categories. Physical activity is said to be sufficient if it meets the criteria for moderate or heavy physical activity. Moderate physical activity is defined as physical activity carried out for 5 or more days a week with an average activity duration of 150 minutes a week or 30 minutes per day. While heavy physical activity is physical activity that is carried out for 3 or more days a week and has a MET minute value per week 1500. In 2018, 70.52% of population in Central Java were categorized as having sufficient physical activity and 29.48% were classified as less. The results of the calculation of the correlation test with the Pearson/Spearman test, obtained a p-value of 0.185, so it can be said that physical activity in the population in Central Java has no correlation with the prevalence of T2DM.

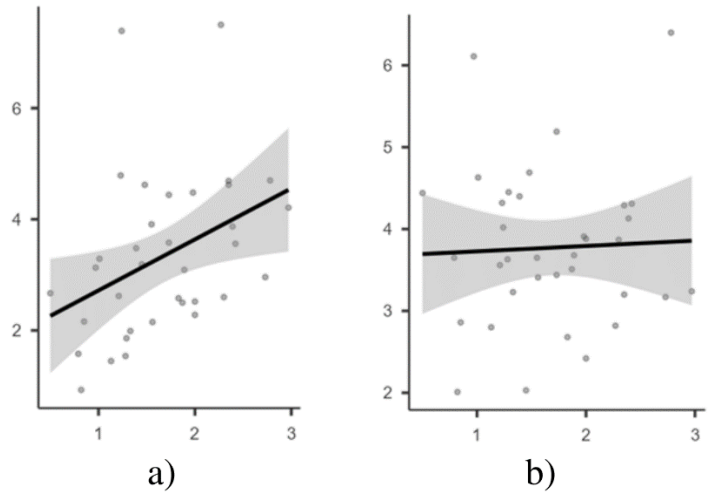

Figure 1. Graph of Correlation between a) Grilled Food Consumpion and b) Fruit and Vegetable Consumption with Prevalence of T2DM

4. Discussion

Type 2 Diabetes Mellitus (T2DM) is a type of non-communicable disease associated with metabolic disorders. This disease develops due to a combination of 2 main factors, namely impaired insulin secretion by pancreatic β-cells and the inability of insulin-sensitive tissue to detect the presence of insulin [9]. This condition makes insulin secretion unable to maintain glucose homeostasis, causing hyperglycaemia [10]. The prevalence of T2DM in the last decade

has continued to increase. The main factors that cause high T2DM prevalence include the increasing population of people who are obese, have sedentary lifestyle habits, eat foods that are high in calories, and the increasing elderly population [11].

Risk factors of T2DM can be divided into two major types, namely non-modifiable and modifiable risk factors. Non-modifiable risk factors are innate risk factors that cannot be intervened for prevention, for example are age, gender, ethnicity, and family history or genetic predisposition [12]. While modifiable risk factors are risk factors that can be intervened to be changed so as to reduce risk for getting T2DM. Modifiable risk factors for T2DM include obesity; lack of physical activity; eating foods that contain excess sugar, salt, and fat; smoking habit; less consumption of fruits and vegetables; as well as alcohol consumption habits [13].

This ecological study was conducted to determine the level of vulnerability of the people of Central Java to the prevalence of T2DM in relation to risky health behavior. Based on data analysis from the results of Central Java Province Basic Health Research 2018 and the correlation test using the Pearson/Spearman test, it was found that the habit of grilled food consumption (p: 0.009; r: 0.435) and fruit and vegetable consumption (p: 0.049; r: 0.335) in the population of Central Java have correlation with prevalence of T2DM. Meanwhile, habit of sweet food consumption (p: 0.105; r: 0.279), fatty foods consumption (p: 0.947; r: 0.012), soft drink consumption (p: 0.264; r: 0.194), and lack of physical activity (p: 0.185; r: 0.229) have no correlation with the prevalence of T2DM.

The correlation between grilled foods consumption with T2DM in the population of Central Java is in line with research conducted by Gang Liu, et al. (2018) which states that the process of cooking chicken, fish, or red meat with open flame and/or high-temperature, such as broiling, barbecuing, grilling, or roasting is associated with an increased risk of T2DM [14]. The cooking method with open-flame and/or high temperature has been shown to increase body weight significantly and increase the risk of obesity, so that it can increase a person's risk of developing T2DM. The exact mechanism underlying this association is unknown. However, some studies suggest that certain chemicals, such as HAAs, PAHs, nitrosamines, and AGEs, which are produced by cooking meat at high temperatures, are thought to increase the risk of diabetes [14]–[16].

Soft drink consumption habits in the people of Central Java also do not have a correlation with the prevalence of T2DM. This condition is not in line with the research conducted by Biggelaar, et al. (2019) which states that the habit of consuming artificially swettened soft drinks has an effect on the prevalence of T2DM. This is because the artificial sweeteners contained in soft drinks, if consumed in excess, can cause a decrease in the sensitivity of pancreatic β-cells in secreting insulin. In addition, it can also affect β-cell rate sensitivity and overall insulin secretion [19]. The absence of a correlation between soft drink consumption habits and the prevalence of T2DM in population in Central Java is estimated because the category used is only the frequency of consumption of soft drink per day/week/month, but it does not explain the quantity of soft drink that consume per certain time period.

Furthermore, the habits of the population of Central Java who lack physical activity also have no correlation with the prevalence of T2DM. This is in contrast to research conducted by Hermawan A., et al. (2021) which states that the less physical activity a person does, the higher the risk for developing T2DM. Physical activity can be useful to prevent obesity. When the body is actively moving or exercising, glucose in the body will be processed into energy, so that glucose levels in the blood can be controlled and cells become more sensitive to insulin [20]. The absence of a correlation between physical activity habits and the prevalence of T2DM in the popualtion of Central Java is estimated due to a bias in the data collection process for Central Java Province Basic Health Research, namely the respondent's bias in remembering the physical

activity carried out in a week and the bias when grouping for the category of sufficient or less physical activity [21].

5. Conclusion

Based on the results and discussion, it can be concluded that the risky health behavior that has a correlation with the prevalence of T2DM in Central Java is grilled food consumption as well fruit and vegetable consumption. Meanwhile, risky health behavior that has no correlation with the prevalence of T2DM include sweet food consumption, fatty food consumption, soft drink consumption, and physical activity.

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