The Effect of Hypertension and Body Mass Index on Hospitalized Type 2 Diabetes Mellitus Patients in Deli Serdang Regency Hospital in 2018

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DM in Deli Serdang Regency Hospital increased by 42.65% from 2013 to 2017. This is observational analytic research with a case-control design. A sample of 50 people in the case group (type 2 DM patients who were hospitalized) and 50 people in the control group (patients not having type 2 DM who were hospitalized) was taken by purposive sampling. Secondary data (history of hypertension, and BMI) was obtained from medical records at Deli Serdang Regency Hospital. The data analysis method used in this study is logistic regression analysis. The results showed 48% of hospitalized patients had hypertension and 70% BMI ≤25. The analysis using simple logistic regression test showing a significant correlation of hypertension (ρ=0.000, OR=4,529, 95% CI 1.952-10.508) and BMI (ρ=0.001, OR=5,233, 95% CI 1.977-13.850) with the incidence of type 2 DM at Deli Serdang Regency Hospital. The results of multiple logistic regression test showed that BMI is the most dominant variable affecting the incidence of type 2 DM (ρ=0.002, OR=5.367 95% CI 1.901-15.154). Patients with hypertension and higher BMI are more likely developed type 2 DM (p<0.00, OR=4,529 and OR=5,233, respectively). BMI is the most dominant variable associated with type 2 DM (p<0.00, OR=5.367).

Keywords: Diabetes, hypertension, BMI.

INTRODUCTION

Diabetes Mellitus (DM) is a chronic metabolic disorder characterized by blood glucose levels that exceed normal values. DM is a chronic disease that is still a concern because its frequency continues to increase and can cause death (Indonesian Ministry of Health, 2013). DM is often referred to as the silent killer, mainly because the patients do not have any symptoms until experiencing complications such as cardiovascular disease, chronic kidney failure, retinal damage that can cause blindness and nerve damage that can cause impotence and gangrene, with the risk of amputation (Supri, 2013).

World Health Organization (WHO) in 2015, the number of people with DM in Southeast Asia is 415 million with the percentage of adults who suffer from DM is 8.5% in the world. One of 11 adults in the world had DM in 2015. One in two (46.5%) adults with undiagnosed diabetes.

According to WHO (2016), the highest prevalence of DM in the world Indonesia is ranked 7th, after China, India, the United States, Brazil, Russia, and Mexico. According to the Basic Health Research (Risksesdas), there was an increase in the prevalence of Non-Communicable Diseases (NCD) such as DM, hypertension, stroke and joint disease from 2007 to 2013. DM was ranked 4th as the largest number of cases compared to other non-communicable diseases, with proportions DM of 6.9% in Indonesia (RI Ministry of Health, 2013). North Sumatera Province ranked in the top 10 provinces in Indonesia with a prevalence of 2.3% (RI Ministry of Health, 2014). The results of the Riskesdas data of patients diagnosed with symptoms of DM in Deli Serdang District were 2.9%, Medan (2.7%), PematangSiantar (2.2%), GunungSitoli (2.1%), Asahan (2.1%).

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Type 2 DM can cause visual disturbances, eyes, cataracts, heart disease, kidney disease, sexual impotence, gangrene, lung infections, vascular disorders, strokes and so on. Some patients can be amputated due to severe gangrene. (Fatimah, 2015).

The cause of type 2 DM is the lack of insulin availability produced in the pancreas resulting in a disruption of the delivery of sugar throughout the body (PERKENI, 2015). The main abnormalities depicted in type 2 DM are insulin retention and shrinkage of the secretory function of β cells. The insulin is a hormone that regulates the balance of blood sugar levels increasing blood glucose levels or hyperglycemia (Ministry of Health, 2014).

Factors contributing to the type 2 DM as described by Muflikhatin and Fahrudini (2015) study, Yunita and Kurniahaty’s (2016) study show that obese patients have the risk of type 2 DM 4 times higher than non-obese patients. Based study at Cengkareng Health Center showed that blood pressure was associated with the incidence of type 2 diabetes. Obese patients were at 7.14 times more likely to suffer from type 2 diabetes compared to non-obese people (TrisnawatidanSetyorogo, 2013).

The efforts to control Non-Communicable Diseases (NCD) risk factors can be done regularly at Posbindu NCD. Posbindu NCD is the role of the community in conducting activities for early detection and monitoring of the main NCD risk factors implemented in an integrated, routine and periodic manner. This is in line with the Ministry of Health program is regular health checks; Get rid of cigarette smoke; Diligent physical activity; Healthy diet with balanced calories; Get enough rest; and Manage stress (Indonesian Ministry of Health, 2016).

According to data available at Deli Serdang District Hospital, the number of cases of inpatient type 2 DM continued to increase from 2013 to 2017 at 42.65%. Based on the background and preliminary survey that has been carried out, researchers are interested in researching “The Influence of Hypertension and BMI on the Occurrence of Type 2 Diabetes Mellitus in Inpatients at Deli Serdang Regional Hospital in 2018”.

**METHOD AND SAMPLE**

This type of research is case-control with a sample of 100 people. This research was conducted at the Deli Serdang District Hospital from July to September 2018. Sampling was done by purposive sampling (Sugiyono, 2014). The selection of case samples in this study uses the following criteria: recorded as type 2 DM patients, new patients hospitalized in Deli Serdang Hospital from July to September 2018, patients suffering from type 2 diabetes based on a doctor's diagnosis, be aware and are at the research location, and can participate in research. The selection of control samples in this study used the following criteria: it was recorded as a new patient who was treated in the Internal Medicine Room and Surgical Room of Deli Serdang Hospital who were not patients with type 2 diabetes and hypertension from July to September 2018. The independent variables in this study were hypertension and BMI. The dependent variable is the incidence of type 2 DM. Data obtained by interviews using questionnaires. Bivariate analysis was carried out using simple logistic regression and multivariate tests using multiple logistic regression.

**RESULTS**

The results of this study are explained in the following sections:

**Hypertension**

The results of data analysis regarding variable hypertension can be seen in the following table:

**Table 1:** Distribution of Frequency Relationship between Hypertension and Type 2 DM Incidence in Deli Serdang Hospital in 2018

<table>
<thead>
<tr>
<th>Hypertension</th>
<th>DM (+)</th>
<th>DM (-)</th>
<th>P</th>
<th>95% CI</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>33</td>
<td>66</td>
<td>15</td>
<td>&lt;0.001</td>
<td>1.952-4.529</td>
</tr>
<tr>
<td>No</td>
<td>17</td>
<td>34</td>
<td>35</td>
<td></td>
<td>10.508</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100</td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1, From 100 samples 48 people (48%) have hypertension. This table also shows a value of <0.001 which means there is a relationship between hypertension and the incidence of type 2 DM in hospitalized patients at Deli Serdang Hospital. The results of the cross-tabulation showed an OR value of 4.529 with 95% CI 1.952-10.508. Hypertension is correlated to insulin resistance and normality in the renin-angiotensin system and metabolic consequences that increase morbidity (pain). Metabolic abnormalities are correlated to an increase in glucose levels in abnormalities in body function (Nirmala, 2013).

**BMI**

The results of data analysis regarding the variable Body Mass Index (BMI) can be seen in the following table 2:

**Table 2:** Frequency Distribution of Relationship between BMI and Type 2 DM in Patients Hospitalized in Deli Serdang Hospital in 2018

<table>
<thead>
<tr>
<th>BMI</th>
<th>DM (+)</th>
<th>DM (-)</th>
<th>P</th>
<th>95% CI</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;25</td>
<td>23</td>
<td>46</td>
<td>7</td>
<td>14</td>
<td>0.001</td>
</tr>
<tr>
<td>≤25</td>
<td>27</td>
<td>54</td>
<td>43</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100,0</td>
<td>50</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
Table 2 shows that the majority of respondents had BMI ≤25. This table also shows a p-value of 0.001 which means there is a relationship between BMI and the incidence of type 2 DM in Deli Serdang Hospital in 2018. The results of the cross-tabulation showed an OR value of 5,233 with 95% CI 1,977-13,850. This explains that respondents who had BMI> 25 had a 5.2 risk of developing type 2 diabetes compared with IMT≤25.

**Table 3: Effects of hypertension and BMI on Type 2 DM incidence in Deli Serdang Hospital in 2018**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Koefisien</th>
<th>P</th>
<th>OR (CI 95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>1,533</td>
<td>0,001</td>
<td>4,632 (1,882-11,403)</td>
</tr>
<tr>
<td>BMI</td>
<td>1,680</td>
<td>0,002</td>
<td>5,367 (1,901-15,154)</td>
</tr>
<tr>
<td>Constant</td>
<td>-1,206</td>
<td>0,001</td>
<td>0.299</td>
</tr>
</tbody>
</table>

The results of multivariate analysis with the enter method showed that hypertension and BMI variables affected DM Type 2 and the most dominant independent variable affecting the incidence of DM was BMI (p = 0.002, OR = 5.367, 95% CI = 1,901-15,154).

**DISCUSSION**

This research discusses the relationship between hypertension and BMI with the incidence of type 2 DM in hospitalized patients in Deli Serdang Regency Hospital in 2018.

**Effects of hypertension on Type 2 DM incidence in hospitalized patients Deli Serdang Regency Hospital in 2018.**

The results showed that there was an effect of hypertension on the incidence of type 2 DM in hospitalized patients at Deli Serdang District Hospital in 2018 with a p <0.001. The results of statistical tests with bivariate analysis using simple logistic regression test showed us that there is a relationship between hypertension and the incidence of Type 2 DM with a value (p <0.25), with an OR value of 4,529 (95% CI: 1,952-10,508), this means that hypertension has 4.5 times higher risk of developing type 2 diabetes compared to those without hypertension. Multivariate analysis using multiple logistic regression showed that hypertension was significantly associated with the incidence of type 2 DM in hospitalized patients at Deli Serdang District Hospital (p = 0.001).

Hypertension in this study was an increase in systolic blood pressure of more than 140 mmHg, measurements using a sphygmomanometer were seen from medical record data. Overall there were 48 hypertensive respondents (48%), of whom 33 were hypertensive in the case group (type 2 DM patients).

These results are similar to those of the Trisnawati and Setyorogo (2013) studies, which showed that there was a significant relationship between hypertension and the incidence of type 2 diabetes mellitus in the Cengkareng District Health Center, West Jakarta. Patients with hypertension have a 6 times risk of developing DM compared to those without hypertension. This is consistent with Oliveira’s (2015) study, showing that there was a significant relationship between the history of hypertension and the incidence of type 2 diabetes in adulthood in KulonProgo Regency.

In line with the research of Ichsantiarini and Nugroho (2013), it was shown that there was a significant relationship between type 2 DM and blood pressure control in hypertensive patients at Dr. CiptoMangunkusumo Hospital. Likewise with the study of Nainggolan et al. (2013), there was a relationship between the history of hypertension and DM in Bogor.

Research by Setyaningrum and Sugiyanto (2015), showed that there was a significant relationship between the history of hypertension and the incidence of type 2 DM at the age of fewer than 45 years in Tugurejo Hospital Semarang. Patients who have a history of hypertension are 2.6 times at risk of developing type 2 DM compared to those without a history of hypertension.

Hypertension is associated with insulin resistance and abnormalities in the renin-angiotensin system and metabolic consequences that increase morbidity. Metabolic abnormalities associated with increased DM in abnormalities in body function (Nirmala, 2013).

**Effect of BMI on Type 2 DM in Hospitalized patients in Deli Serdang District Hospital in 2018**

The results of statistical tests with variable analysis using a simple logistic regression test showed that there was a relationship between BMI and the incidence of Type 2 DM (p <0.25), with OR value of 5,233 (95% CI: 1,977-13,850), meaning that BMI> 25 (fat category) has a risk of 5.2 times greater risk of Type 2 DM than BMI ≤25. Multivariate analysis using multiple logistic regression showed that BMI was significantly associated with type 2 DM in hospitalized patients at Deli Serdang Hospital (p = 0.002).

BMI of respondents starting from 17 to 31, the average BMI of respondents was 22, namely as many as 20 people (20%). 7 respondents who were underweight (7%), normal as many as 75 people (75%), obese as many as 10 people (10%), and obese as many as 8 people (8%).

High free fat deposits can increase cell up-taking of free fatty acids and stimulate fat oxidation which will ultimately inhibit glucose use in muscles (Mc. Wright, 2008 in Adnan 2013). Obesity or overweight results in imperfect metabolism in the body so that it makes insulin in the body unable to function properly. The insulin hormone can be absorbed by fat in the body so that eating patterns and a healthy lifestyle can make the body deficient in insulin...
Obesity occurs when energy intake exceeds total energy expenditure including energy for physical activity (Welis and Rifki, 2013).

Associate Doctors type 2 diabetes with factors related to lifestyle such as obesity (Nall, 2018).

The same results were also found in the study conducted by Rabrusun (2014), showing that there was a relationship between BMI and the incidence of type 2 diabetes mellitus, in which the fat category had BMI (≥25 kg / m2) had a risk of 1.496 times greater incidence of Type 2 Diabetes Mellitus compared with BMI <25 in the Polyclinic Internal BLU RSUP Prof. Dr. R. D. Kandou Manado.

Research conducted by Adnan et al (2013), showed that there was a relationship between Body Mass Index (BMI) and blood sugar levels of 2 DM patients in Tugurejo Hospital, Semarang. The higher the IMT value is the higher the blood sugar level. In line with the research of Rosadi (2013), it was shown that there was a significant relationship between obesity and the incidence of type 2 in the Wates Health Center in KulonProgo Regency.

Oliveira's (2015) study showed that there was a significant relationship between obesity and the incidence of type 2 diabetes in adulthood in KulonProgo Regency. Likewise, with the Kusumawati (2016) study, it was shown that obesity had a significant relationship with type 2 diabetes in a productive age in Ngawi Regency.

Rahman's study (2013), showed there was a relationship between obesity and the incidence of type 2 diabetes mellitus in Tempe District, Wajo District. obesity (IMT≥25) suffered the most type 2 diabetes mellitus, 82 people (45.6%) while obese respondents diabetes mellitus who did not suffer from type 2 were 43.4%. The prevalence ratio is 2.34, then the incidence of type 2 times more than respondents who are not obese.

One of the diseases caused by BMI> 25 is DM. diseases caused by carbohydrate metabolism disorders is DM disease (Sediaoetama, 2010). High free fat deposits can cause increased cell take-up of fatty acid-free and spur fat oxidation which will ultimately inhibit the use of glucose in the muscles (Mc. Wright, 2008 in Adnan 2013).

Being overweight results in an imperfect metabolism in the body that makes insulin in the body unable to function properly. The hormone insulin can be absorbed by fat in the body so that eating patterns and unhealthy lifestyles can make the body deficient in insulin (Russel, 2011 in Masriadi, 2011). Obesity occurs when energy intake exceeds total energy expenditure including energy for physical activity (Welis and Rifki, 2013).

CONCLUSION

a. There is a relationship between hypertension and Type 2 diabetes mellitus (p = 0.001) and the relationship between BMI and type 2 diabetes mellitus (p = 0.001).

b. The results of the multiple logistic regression test indicate the BMI variable is a variable that influences the incidence of type 2 DM in Deli Serdang Regency Hospital in 2018.

RECOMMENDATION

a. The Deli Serdang Regency Health Office: to increase health promotion to increase public knowledge about improving nutritional status by regulating good eating patterns, which are guidelines for balanced nutrition.

b. Deli Serdang Regional Hospital: to pay more attention to DM patients by providing special DM counseling.

c. People / DM sufferers especially those who have a family history of DM to regulate diet and apply balanced nutrition in the family.

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