THE RELATIONSHIP OF OBESITY WITH THE INCIDENCE OF DIABETES MELLITUS IN WORKING AREA OF SUKODONO HEALTH CENTER

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Abstract. Obesity is defined as the accumulation of excess fat in the body. Obesity causes various health problems, one of which is diabetes mellitus. Diabetes mellitus (DM) is a chronic metabolic disorder that causes the greatest morbidity and mortality characterized by high blood sugar levels. In Sukodono Health Center, diabetes ranks fourth among 18 health centers in Sidoarjo. This study aims to analyze the relationship of obesity, both obesity based on body mass index (BMI) or central obesity based on abdominal circumference (LP) with the incidence of DM in the Sukodono Puskesmas work area. The research design used analytic observations with a cross sectional approach. The sampling technique used total sampling of 77 respondents. Of the 77 respondents, 37 people (48%) had BMI obesity, 53 people (69%) had central obesity, and 20 people (26%) had DM. The results of the data analysis of the chi-square test obtained $p = 0.3$ which means $p > 0.05$ so that there is no relationship between BMI obesity and the incidence of DM and obtained $p = 0.00$ which means $p < 0.05$ so that there is a relationship between central obesity and the incidence of DM. The majority of respondents who have diabetes also have BMI obesity or central obesity. This condition occurs due to factors of age, gender, accumulation of fat under the abdomen, and people who are less able to maintain an ideal body IMT. It is known that accumulated fat (obesity) can cause inflammation in the body and if left unchecked will interfere with the work of insulin, causing metabolic abnormalities that increase the risk of insulin retention and diabetes mellitus.

Keywords: Obesity, Body Mass Index (BMI), Abdominal circumference (LP), Central, Incidence of diabetes mellitus (DM)

1 INTRODUCTION

Diabetes mellitus (DM) is an example of a chronic metabolic disease caused by failure to regulate blood sugar or failure to metabolize carbohydrates (Bagus et al., 2021). Diabetes mellitus is a long-term disease that is difficult to cure but very controllable. Diabetes is a type of non-communicable disease (NCD) which since 2010 has become the biggest cause of morbidity and mortality (Utomo et al., 2020) . In this case there are two factors that can affect a person suffering from diabetes mellitus, namely unmodifiable factors (age, gender, and genetics) and modifiable factors (diet, smoking, hypertension, stress, physical activity, and obesity) (Nasution et al., 2021; Mendola et al., 2018; Al-Goblan et al., 2014) .

In the world, about 150 million people have diabetes mellitus (Nasution et al., 2021). According to the World Health Organization (WHO), diabetes mellitus is the sixth leading cause of death and about 1.3 million people die from DM in (Nasution, 2018). In 2019, the International Diabetes Federation (IDF) organization stated that the total number of DM cases was 9.3% of the total population in the world or the equivalent of 463 million people in old age and in 2021 there were as many as 537 million adults with diabetes (Meilani et al., 2022) .

In Indonesia, the prevalence of diabetes mellitus continues to increase from 10.7 million in 2019 to 18 million in 2020. Then in 2021, it will increase to 19.5 million and Indonesia will be the seventh highest in the world. In East Java Province, people with diabetes are in the top 10 in Indonesia. In 2019 the number of people with diabetes was 841,994. In 2020 it increased to 875,743 and in 2021 the number of people with DM was 929,810. In Sidoarjo Regency, people with DM in 2019 amounted to 72,291. In 2020 it amounted to 73,559 and increased to 75,909 in 2021.

Data from the Sukodono Health Center states that in 2019 there were 3,953, in 2020 there were 4,023, and in 2021 there were 4,151. From this data, the Sukodono Health Center ranks fourth out of 18 health centers in Sidoarjo and one of the villages in it, namely Jumputrejo, ranks sixth. In addition to data on DM patients in general, the results of a preliminary study conducted by researchers on January 12, 2023 found that 6 out of 10 DM patients were also obese.

Obesity is a condition of the body with too high levels of fat. Obesity in general can be measured by body mass index (BMI) or central obesity by measuring abdominal circumference (LP). Obese conditions, especially central obesity, are significantly associated with metabolic syndrome (dyslipidemia, hyperglycemia, hypertension) based on insulin resistance. Several studies also state that someone with obesity, especially with conditions of fat levels above normal limits, especially cholesterol and triglycerides, can later make the work of insulin produced by the pancreas not work optimally in helping the body absorb glucose in (Oroh, 2018; Philippe et al., 2011) .

From the 2018 Basic Health Research (Riskesdas) data, it was found that obesity among Indonesian adults increased from 19.1% to 35.4% and 2013 Indonesian national survey data showed obesity almost doubled the risk of developing DM and four times the risk of DM-hypertension comorbidities (D.I.F, 2021) .

Seeing the large incidence of diabetes mellitus in the Sukodono Health Center working area which is getting higher every year and with several influencing factors, one of which is obesity. Therefore, the authors are interested in conducting research with the aim of identifying the relationship between obesity and the incidence of diabetes mellitus (DM) in the Sukodono Health Center work area.

2 RESEARCH METHOD

This study uses quantitative research with an analytic observational design using a cross sectional approach (Nursalam, 2017) . All variables will be observed and measured simultaneously at a certain time which is relatively short (Arsyam & Yuduf, 2021) . This research was conducted starting from January 12, 2023 until completion or around April 2023 in the working area of the Sukodono Health Center, precisely at the Jumputrejo Village Hall. The population in this study were people who were recorded at the Integrated Development Post (Posbindu) activities in the Sukodono Health Center working area in 1 month as many as 77 respondents.

The sampling technique uses the total sampling method, namely sampling from the total population (Sujarweni, 2022). The instrument in this study was an observation sheet. The first part of the observation was done with a glucometer to assess the blood sugar level during capillary blood measurement. The criteria for not DM <90 were coded 1, uncertain DM 90-199 were coded 2 and DM ≥200 were coded 3. The second part used a calibrated microtoa scale to measure body weight and height by looking for body mass index results. Normal criteria (BMI 18.5-25.0) were coded 1, grease (BMI 25.0-27.0) were coded 2 and obese (BMI >27) were coded 3. Part three measured abdominal circumference using a metlin or tape measure. Non-central obesity was coded 1 (if the abdominal circumference of men <90 and women <80) while central obesity was coded 2 (if the abdominal circumference of men >90 and women >80). Data processing through the stages of data editing, coding, tabulation and percentage data (Majalaya et al., 2021). Data analysis used Chi-square test with 95% confidence level or $\alpha \leq 0.05$.

3 RESULT

The results of a study conducted in March 2023 on 77 respondents obtained the following result:

General data based on of gender characteristics

Table 1. Characteristics of Respondents Based on Gender in the Sukodono Health Center Working Area, March 2023

No.	Gender	N	(%)
1.	Male	10	13
2.	Female	67	87
Total		77	100

Source: Primary data March 2023

Based on the Table 1, it is known that of the 77 respondents studied, most were female as many as 67 respondents (87%).

General data based on age characteristics

Table 2. Characteristics of Respondents Based on Age in the Sukodono Health Center Working Area, March 2023

No.	Age	N	(%)
1.	36-45 year	21	27
2.	46-55 year	39	51
3.	56-65 year	15	19
4.	66-85 year	2	3
	Total	77	100

Source: Primary data March 2023

Based on Table 2, it is known that of the 77 respondents studied, most were in the early elderly (46-55 years) as many as 39 respondents (51%).

General data based on disease history

Table 3. Characteristics of Respondents Based on History Disease, March 2023

No.	Disease History	N	(%)
1.	DM dan Hypertension	13	17
2.	DM	7	9
3.	Hypertension	13	17
4.	Pain, dizziness, hypercholesterolemia, tingling and gastritis	44	57
	Total	77	100

Source: Primary data March 2023

Based on Table 3, it is known that of the 77 respondents studied, almost half had a history of DM disease as many as 20 respondents (26%).

Custom data of respondents based on body mass index (BMI)

Table 4. Characteristics of Respondents Based on Body Mass Index (BMI), March 2023

No.	Category	N	(%)
1.	Normal	23	30
2.	Fat	17	22
3.	Obese BMI	37	48
	Total	77	100

Source: Primary data March 2023

Based on Table 4, it is known that of the 77 respondents studied, most were obese IMT as many as 37 respondents (48%).

Custom data of respondents based on abdominal circumference

Table 5. Characteristics of Respondents Based on Abdominal Circumference (Central Obesity), March 2023

No.	Category	N	(%)
1.	Not central obesity	24	31
2.	Central obesity	53	69
	Total	77	100

Source: Primary data March 2023

Based on table 5, it is known that of the 77 respondents studied, most were central obesity as many as 53 respondents (69%).

Custom Data Of Diabetes Mellitus Incidence

Table 6. Data on the Incidence of Diabetes Mellitus in the Sukodono Health Center Working Area Based on Glucometer Result, March 2023

No.	Category	N	(%)
1.	Not DM	20	26
2.	Not Definitely DM	37	48
3.	DM	20	26
	Total	77	100

Source: Primary data March 2023

Based on table 6, it is known that of the 77 respondents studied, almost half were DM as many as 20 respondents (26%).

Cross Tabulation

Table 7. The Relationship between BMI Obesity an the Incidence of Diabetes Mellitus in the Sukodono Health Center Workin Area, March 2023

No.	Obesity Categories based on BMI	Incidence of DM						Total	
		Not DM		Not Definitely DM		DM			
		N	%	N	%	N	%	N	%
1	Normal	9	39	9	39	5	22	23	30
2	Fat	3	18	11	64	3	18	17	22
3	Obese BMI	8	22	17	46	12	32	37	48
	Total	20	26	37	48	20	26	77	100
	Uji *Chi-Square*	p = 0,3							

Source: Primary data March 2023

Table 8. The Relationship of Obesity Based on Abdominal Circumference (Central Obesity) with the Incidence of Diabetes Mellitus in the Sukodono Health Center Working Area, March 2023

No.	Central Obesity Category	Kejadian DM						Total	
		Not DM		Not Definitely DM		DM			
		N	%	N	%	N	%	N	%
1	Not Central Obesity	11	46	11	46	2	8	24	31
2	Central Obesity	9	17	26	49	18	34	53	69
	Total	20	26	37	48	26	77	77	100
	Uji *Chi-Square*	p = 0,00							

Source: Primary data March 2023

Based on table 7, it is known that 8 people (22%) have obese IMT not DM, 17 people (46%) are not certain of DM, and 12 people (32%) are DM. Then respondents with

obese BMI are not DM as many as 3 people (18%), 11 people (64%) are not definitely DM, and 3 people (18%) are DM categories. In addition, there are 9 people (39%) respondents with normal BMI who are not DM, 9 people (39%) are not definitely DM, and 5 people (22%) are in the DM category.

Based on table 8, it is known that 9 people (17%) have central obesity that is not DM, 26 people (49%) are not definitely DM, and 18 people (34%) are in the DM category. While those who are not centrally obese and not DM are 11 people (46%), 11 people (46%) are not definitely DM, and 2 people are in the DM category.

4 DISCUSSION

Obesiy Based on Body Mass Index (BMI)

Obesity is a condition that occurs when the amount of adipose tissue in the body is greater than normal compared to the total body weight, or excessive consumption of body fat so that a person's body becomes much heavier than normal and is more at risk of degenerative diseases, such as, type 2 diabetes, stroke, and cardiovascular disease (Septiyanti & Seniwati, 2020; Magkos et al., 2016). Obesity can cause the response of pancreatic beta cells to blood elevation to decrease, in addition to insulin receptors on cells throughout the body including in muscle are reduced in number and less sensitive (Ruze et al., 2023). Insulin resistance increases in the presence of obesity which can block the distribution of glucose into muscles and fat cells so that blood glucose increases (Gizi et al., 2020; Aras et al., 2021) **.**

BMI obesity or generalized obesity is a simple indicator commonly used to classify a person as obese or overweight with a BMI >27 (Ye, 2013). In (Eka et al., 2021), It is said that age and gender can affect a person's exposure to obesity. It is explained that most people with obesity are 35-60 years old with factors such as diet, lifestyle, work activities and psychological conditions. As for why women are more affected by obesity, it is due to hormonal factors and low daily activity, as well as a higher percentage of fat in the body than men.

Obesity Based on Abdominal Circumference (Central Obesity)

Central obesity or apple-type obesity is a condition of excess fat with fat accumulation in the subcutaneous fat tissue and visceral fat in the central abdominal area (Nauck et al., 2018). Fat accumulation in visceral fat tissue is a form of malfunctioning of subcutaneous fat tissue in dealing with excess energy due to excess fat consumption (Gadde et al., 2018. Excess energy occurs when a person has less physical activity and high sedentary behavior. In addition, the inability of subcutaneous fat tissue to buffer excess energy will cause fat production to accumulate in unwanted parts, such as the liver, heart, kidneys, muscles, and pancreas glands. A person with obesity, especially central obesity, has a high risk of developing metabolic syndrome or insulin resistance. The condition occurs due to the location of the stomach which is closer to the heart than the hips and according to research (Di et al., 2019). There is a rapid transfer of fatty acids to the abdominal region and their distribution through the blood circulation is free in a person with central obesity.

Incidence of Diabetes Mellitus

Diabetes mellitus (DM) according to Mohamed Yosri Mohamed Yong (2011:3) in (Olivia, 2012). Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia that occurs due to abnormalities in insulin secretion, insulin action or both. Diabetes mellitus is a chronic hyperglycemia condition that can affect all body systems. This condition if left unchecked will cause complications (Fatimah, 2015) .

The causes of diabetes mellitus can be caused by factors that inhibit the work of insulin or the amount of insulin that decreases, such as gender, age, diet, hypertension, physical activity, and obesity (PERKENI, 2021) in (Napitupulu, 2019). In the gender factor, women are more at risk of developing diabetes than men. This is due to an increase in women's fat levels which are higher than men [18]. As for the age factor, as we get closer to the elderly, insulin sensitivity will decrease, affecting blood glucose level (Rahmawati, 2021; Bray et al., 2016) .

According to (PERKENI, 2021) a person is categorized as not DM or normal if the blood sugar test results are <90 mg/dL, not definitely DM or can include prediabetes if the results are 99-199 mg/dL, and including DM if ≥200 mg/dL. In addition to blood sugar checks, the diagnosis of DM, especially type 2 DM, can be made by observing complaints that lead to DM, such as itching, frequent urination, numb hands / feet, etc.

The Relationship between Obesity and the Incidence of Diabetes Mellitus (DM) in the Sukodono Health Center Working Area

Based on the results of statistical test analysis between BMI obesity and DM incidence using chi-square, a significant value of p = 0.3 was obtained and when compared, p> 0.05 so that there was no relationship between BMI obesity and the incidence of diabetes mellitus (DM). While the results of the statistical test analysis between central obesity and the incidence of DM, obtained a significant value of p = 0.00 and when compared, p < 0.05 so that there is a relationship between obesity based on abdominal circumference (central obesity) with the incidence of diabetes mellitus (DM).

The above results are in line with research (Suwinawati et al., 2020) entitled "The Relationship between Obesity and the Incidence of Type 2 Diabetes Mellitus at the Integrated Development Post for Non-Communicable Diseases at the Kendal Health Center, Ngawi Regency". In this study, it was stated that there was a relationship between central obesity and the incidence of DM. It is known from 74 respondents that 25 people (67.6%) suffering from DM also have central obesity. The study used the same measurement results, almost the same total sample of 74 people, and the selected respondents were not all centrally obese (categorized into non-centrally obese and centrally obese).

Meanwhile, the causes of differences in research results regarding the relationship between obesity based on BMI and the incidence of DM can be influenced by several factors, such as differences in the number of samples (Tchang et al., 2021). The larger the research sample, the greater the level of confidence and validity of the data (Chukir et al., 2021). In addition, the number of samples will affect the number of respondents and the number of cells. The minimum sample size is 10 x the number of cells. As for the study (Hidayat et al., 2021) which uses a sample size of 97 people with each variable using 3 categories, this means that it requires 9 cells and a sample of at least 90 respondents. inclusion criteria for people with diabetes and a significant value of 0.05.

From the results of the study, it is known that someone with obesity is more at risk of developing diabetes mellitus. In accordance with (Kusumawardani, 2016) in (D.I.F, 2021) obesity increases the risk of almost doubling DM and four times the risk of DM-hypertension comorbidities. The researcher's assumption regarding the cause of the absence of correlation between BMI obesity and DM incidence is that the research methods used are different, which affects the number of research respondents, respondent characteristics, and variable measurement results. Even so, when viewed from the cross tabulation, the average respondent with DM has a BMI above normal limits. Meanwhile, regarding the relationship between central obesity and the incidence of DM, it was found that there was a relationship between the two, where previous studies used the same central obesity measurement results.

5 CONCLUSION

There are still many respondents who are obese based on body mass index (BMI), namely 36 people (47%). Most of the respondents or as many as 53 people (69%) were obese based on abdominal circumference (central obesity. There are still many respondents who suffer from diabetes mellitus (DM) with blood sugar ≥200 mg/dL, namely 20 people (26%). Respondents who are centrally obese and suffer from DM are more than those who are not centrally obese, namely 18 people (34%), while in IMT obesity some respondents also suffer from DM, namely 12 people (32%). So there is a relationship between obesity, especially central obesity with the incidence of diabetes mellitus (DM).

6 REFERENCES

Al-Goblan, A. S., Al-Alfi, M. A., & Khan, M. Z. (2014). Mechanism linking diabetes mellitus and obesity. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, *7*, 587-591. https://doi.org/10.2147/DMSO.S67400.

Andiana, Olivia. (2012). Hormon Anabolik Pada Olahrawan. *MEDIKORA Vol. IX, No 1*

Aras, M., Tchang, B. G., & Pape, J. (2021). Obesity and Diabetes. *The Nursing clinics of North America*, *56*(4), 527–541. https://doi.org/10.1016/j.cnur.2021.07.008.

Arsyam, M & Yusuf Tahir, M. 2021. Ragam Jenis Penelitian dan Perspektif. *Al-Ubudiyah J. Pendidik. dan Stud. Islam*, vol. 2, no. 1, pp. 37–47, 2021, doi: 10.55623/au.v2i1.17.

AUtomo, A.A., Rahmah, S., and Amalia, R. (2020). Faktor Risiko Diabetes Mellitus Tipe 2. vol. 01, pp. 44–53, 2020.

Bagus, I.G., Diksa, N., and Fithriasari, K. (2021). Analisis Faktor Resiko Penyebab Diabetes Mellitus dengan Regresi Logistik Biner. vol. 4, no. March, pp. 69–76, 2021, doi: 10.12962/j27213862.v4i1.8480.

Bray, G.A et al. (2016). Management of obesity. *Lancet*

Chukir, T et al. (2021).Metformin-induced weight loss in patients with or without type 2 diabetes/prediabetes: a retrospective cohort study. *Obes Res Clin Pract.*

D. I. F. Kesehatan, “Di fasilitas kesehatan tingkat pertama (fktp),” 2021.

Fatimah, R. N. (2015). Diabetes Melitus Tipe 2,” vol. 4, pp. 93–101.

Gadde, K. M., Martin, C. K., Berthoud, H. R., & Heymsfield, S. B. (2018). Obesity: Pathophysiology and Management. Journal of the American College of Cardiology, 71(1), 69–84. https://doi.org/10.1016/j.jacc.2017.11.011.

Hidayat, N., Putri, E. S.,Yarmaliza, Y., Darmawi, D., and Fera, D. (2021). Hubungan Obesitas dan Pola Makan dengan Diabetes Melitus Komplikasi pada Pasien Rawat Jalan Di Wilayah Kerja Puskesmas Meureubo Kabupaten Aceh Barat,” J. Mhs. Kesehat. Masy., vol. 1, no. 1, pp. 59–69, 2021.

Magkos F, et al. (2016). Effects of moderate and subsequent progressive weight loss on metabolic function and adipose tissue biology in humans with obesity. *Cell Metab.*

Majalaya, K., Azahrah, F. R., Afrinaldi, R., and Karawang, U. S. (2021). Jurnal Ilmiah Wahana Pendidikan. vol. 7, no. 4, doi: 10.5281/zenodo.5209565.

Meilani, N., Ode,W., Azis, A., and Saputra,R. (2022). Faktor Resiko Kejadian Diabetes Mellitus Pada Lansia Risk Factors for The Event of Diabetes Mellitus at Elderly Fakultas Kesehatan Masyarakat Universitas Dayanu Ikhsanuddin, Indonesia. vol. 15, no. 4, pp. 346–354, 2022.

N.D. Mendola et al. (2018). Prevalence of total, diagnosed, and undiagnosed diabetes among adults: United States, 2013-2016. *NCHS Data Brief*

Napitupulu, M. (2019). Hubungan Pengetahuan Keluarga Terhadap Pengendalian Kadar Glukosa Darah Penderita Diabetes Melitus. vol. 4, no. 2, pp. 54–59.

Nasution, F., Andilala, A., and Siregar, A.A. (2021). Faktor Risiko Kejadian Diabetes Mellitus. *J. Ilmu Kesehat.*, vol. 9, no. 2, pp. 94–102, 2021.

Nasution, L.K. (2018). Pengaruh Obesitas Terhadap Kejadian Diabetes Melitus Tipe 2 Pada Wanita Usia Subur di Wilayah Kerja Puskesmas Pintupadang,” *J. Muara Sains, Teknol. Kedokt. dan Ilmu Kesehat.*, vol. 2, no. 1, pp. 240–246, 2018.

Nauck, M. A., & Meier, J. J. (2018). Incretin hormones: Their role in health and disease. Diabetes, obesity & metabolism, 20 Suppl 1, 5–21. https://doi.org/10.1111/dom.13129.

Nursalam,I.I. (2017). Metodologi Penelitian Ilmu Keperawatan: Pendekatan Praktis. vol. 4, 2017.

Oroh, Oroh. (2018). Hubungan Obesitas Dengan Kejadian Diabetes Melitus. vol. 6, 2018.

Philippe MF, Benabadji S, Barbot-Trystram L, Vadrot D, Boitard C, Larger E. (2011). Pancreatic volume and endocrine and exocrine functions in patients with diabetes. *Pancreas*;40(3):359–363.

Rahmawati, R. (2021). Hubungan Usia , Jenis Kelamin dan Hipertensi dengan Kejadian Diabetes Mellitus Tipe 2 di Puskesmas Tugu Kecamatan Cimanggis Kota Depok The Relationship Between Age , Sex And Hypertension With The Incidence Of Type 2 Diabetes Mellitus In Tugu Public Health Center , Cimanggis District , Depok City in 2019. vol. 6, pp.

15–22.

Risdayani, Eka. (2021). Hubungan Obesitas Dengan Usia, Jenis Kelamin , Genetik , Asupan Makanan , dan Kebiasaan di Dusun Bangkalan. Indonesian Journal of Health; 2(1).

Ruze, R., Liu, T., Zou, X., Song, J., Chen, Y., Xu, R., Yin, X., & Xu, Q. (2023). Obesity and type 2 diabetes mellitus: connections in epidemiology, pathogenesis, and treatments. Frontiers in endocrinology, 14, 1161521. https://doi.org/10.3389/fendo.2023.1161521

Septiyanti & Seniwati. (2020). Obesitas dan Obesitas Sentral pada Masyarakat Usia Dewasa di Daerah Perkotaan Indonesia. Jurnal Ilmiah Kesehatan; 2(3), pp. 118–127, 2020.

Sujarweni, V.W. (2022). *Metode Penelitian: Lengkap, praktis, dan mudah dipahami*. Yogyakarta: Pustaka baru press.

Suwinawati, Eni et al. (2020). Hubungan Obesitas dengan Kejadian Diabetes Melitus Tipe 2 Di Pos Pembinaan Terpadu Penyakit Tidak Menular Puskesmas Kendal Kabupaten Ngawi. Journal of Health Science and Prevention; vol. 014, pp. 8–13, 2020.

T. Di, P. Iii, and D. Utara, "*Hubungan Obesitas Sentral dan Aktivitas Fisik dengan Kejadian Diabetes Melitus Tipe 2 di Denpasar Utara*," vol. 6, no. 2, pp. 119–129, 2019.

Tchang, B.G et al. (2021). Best practices in the management of overweight and obesity. *Med Clin North Am.*

Ye J. (2013). Mechanisms of insulin resistance in obesity. Frontiers of medicine, 7(1), 14–24. https://doi.org/10.1007/s11684-013-0262-6