DESCRIPTION OF BLOOD GLUCOSE LEVELS IN OBESITY PATIENTS IN PUSKESMAS NORTH CITY

Rayhan Tantu[1], **Dr. Hj Titin Dunggio**[2], **danNiluh Arwati**[3]

[1,2,3] Bina Mandiri University Gorontalo, Indonesia

E-mail :rayhantantu@gmail.com

ABSTRACT

This study aims to assess blood glucose levels in obese patients at the North City Health Center and the factors that affect them.

The method in this study uses a descriptive quantitative approach. The type of data used is primary data from research results of blood glucose levels in obese patients and secondary data in data from the literature, books, questionnaires, and medical record books. The sampling technique in this study used accidental sampling, with a total sample of 29 people.

The results showed that from 29 obese patients, there were 24 people or 82.8% whose blood glucose levels were abnormal, while five people, or 17.2%, had normal blood glucose levels. Factors that affect blood glucose levels in obese patients are gender, age, physical pattern (Body Mass Index/BMI), physical activity, and eating patterns (number of calories). Suggestions to the next researcher are suggested to examine blood sugar levels between the obese and non-obese groups as a comparison.

Keywords: *Blood Glucose Levels, Obese Patients, Body Mass Index*

INTRODUCTION

Obese I or obedience, which means "obesity" or "overweight," comes from Latin. Central obesity or obesity based on waist circumference 11 is a condition of excess fat in the abdomen. Waist circumference is used as a deterministic indicator of obesity measured using a non-elastic measuring tape, ketosis 1 mm[29].

Body mass index is a parameter that describes body fat composition because its measurement is practical, and the correlation tends to be precise; it is the most widely used lately. Other parameters, such as underwater weighing and dual-energy X-ray (DAX), accurately describe fat composition. Still, due to high cost, complex equipment, and technology, they are not suitable for everyday clinical practice. [16].

The problem of overweight and obesity is widespread in Indonesia by age group and socioeconomic class. Among schoolchildren, obesity is a severe problem because it continues into adulthood. The lifestyle of teenagers now often skip breakfast. They prefer to eat fast food, and a sedentary lifestyle puts young people at risk of obesity. Obesity is a feature of metabolic syndrome, insulin resistance, fasting hyperglycemia, lipid disorders, and high blood pressure. All of these features of the metabolic syndrome are associated with weight-related overweight. This is where resistance occurs insulin and glucose metabolism is not normal, start gradually weight gain and obesity [9].

More than 1.9 billion adults over the age of 18 years and 600 million of them are classified as obese. In 2014, 41 million children < 5 years were judged to be obese. [32]. Meanwhile, from 2011 to 2014, children aged 6 to 11 in the United States were fatter, to be exact, 17.5%

compared to ages 2 to 5, which equates to about 8.9%. The frequency of obesity is not only a problem in developed countries; obesity is currently also growing in countries with low and middle income; For example, in African countries, the number of children who are obese increased from 5.4 million in 1990 to 10.6 million in 2014[21].

In Indonesia, adults are overweight as much as 13.5%. Meanwhile, those who are obese are 28.7%, and those aged 5-12 years are 18.8% fat, and 10.8% are obese. The problem of obesity has continued to increase since 2013 where the increase from 2013 to 2016 was 5.3%, namely, in 2013 it was 15.4% and increased to 20.7% in 2016 [10].

The prevalence of obesity in the center of population 15 in 2018 which was divided into several districts in Gorontalo Province, namely Boalemo District 32.05%, Gorontalo District 37.16%, Pohuwato District 33.71%, Bone Bolango District 33.63%, North Gorontalo Regency 35.24% and in Gorontalo City itself there is 43.96% [23].

Obesity is a risk factor that plays a role in DM [30]. When obese, insulin users will make it difficult for the body. The result is called insulin resistance. Obesity can also be influenced by physical activity such as in sports activities, which control blood sugar levels; glucose will be converted into energy, causing insulin to increase during physical activity. The increase in glucose levels decreases. Some of the wrong eating routines and not eating vegetables or fruit are often the reason for obesity [6].

Obesity can be called a chronic disease and a predictor of disease, as obesity increases, the prevalence of type 2 diabetes is also higher, and the growth is expected to continue. This is something that can happen because obese people have an increased risk of insulin resistance and elevated glucose [13].

Obesity is caused by changes in energy balance by exogenous components (actual body weight) caused by diet (90 percent) and endogenous variables (optional corpulence) due to hormonal changes, hereditary abnormalities, or imperfections (10 percent). The nerve center regulates energy balance through 3 physiological cycles: controlling the desire to eat and feel full, influencing energy utilization, and directing chemicals[7].

Blood sugar in the body is helpful for metabolic cycles and the primary energy source for the big brain. Glucose is sugar in the blood formed from carbohydrates and stored in skeletal muscles and liver for glycogen. Excess body weight can cause a change in the cells in the body to make the body's cells immune to the chemical insulin. Being overweight increases the release of free fatty acids into the blood. Free fatty acids released by endothelial lipoprotein lipase increase serum triglycerides and increase lipoproteins, causing lipolysis leading to insulin receptor dysfunction[1].

A glucose level above the typical glucose level (fasting < 126 mg/dL and 2 hours after eating 200 mg/dL or < 48 mmol/mol and 6.5% on an HbA1c test) is often referred to as hyperglycemia. If hyperglycemia is not controlled (> 200 mg/dl), possible clinical features include thirst, dry mouth, persistent urination, weakness, blurred vision, weight loss, recurrent disease[17].

Diseases associated with blood glucose are:

a) Hypoglycemia
   Hypoglycemia is a condition in which blood sugar levels drop. When the sugar level is below 50 mg/dL, a person suffering from hypoglycemia has dizziness, shaking, weakness, pale skin, restlessness, blurred vision, heartbeat, irritability, cold sweat, and loss of consciousness. If not treated

immediately, brain cells will not absorb energy, causing brain damage and death. A person afraid of diabetes will eat less and exercise too much. Hypoglycemia is caused by late eating, lack of food intake, excessive exercise, stress, taking higher doses of antidiabetic drugs than recommended, or taking other medicines that cause lower blood sugar levels and impaired adrenal or pituitary function. [19].

b) Hyperglycemia

Hyperglycemia is a condition in which glucose levels rise suddenly. Characteristics such as blood sugar levels can reach > 240 mg/dL. Hyperflikemia occurs because the patient does not follow the recommended lifestyle. Symptoms include frequent urination, thirst, leg cramps, weakness, loss of consciousness, and the onset of severe illness. High blood sugar causes the blood to thicken, which draws the fluid from the sl. As a result, the cells become dehydrated and consequently can become dehydrated [19].

Excess belly fat, equal to the total body fat percentage, was a significant independent risk factor for death. Excessive size is closely related to the expansion of the danger, causing BMI to be somewhere in the range of 25 and 34.9 kg/m2 in patients with type 2 diabetes, dyslipidemia, high blood pressure, and cardiovascular disease. [18].

When working on an individual weight list, the main thing is to decide on the particular weight. After estimating, calculate the weights using the Hellman et al., 2008 formula as below.

Formula: IMT =Bodyweight (Kg)

$\overline{\{Height\ (m)\}^2}$

Based on research conducted in 2017 on obese students at the Baiturrahmah University medical faculty to see a picture of blood sugar. The study concluded that all overweight students had normal glucose levels—more men (54.17%) than women. Obese students with a parent's history of obesity were found as many as 20 people (83.33%) with diabetes risk factors up to 1 person (4.17%). Based on physical activity, obese students were found to have lighter physical activity (41.67%) [3].

Based on research on the relationship between fasting blood sugar levels and obesity in adolescents in Kec. Bolangitang Barat found a weak and significant relationship between fasting glucose levels and body weight in adolescents. Fasting glucose levels in adolescents will generally be higher than adolescents who are not obese. Characteristics of adolescents are classified into body mass index of 25.0 - 29.9 kg/m2 (Obes I)[22].

RESEARCH METHODS

The type and approach used in this research are descriptive, which aims to describe blood glucose levels in patients at the North City Health Center. This research was conducted in July-August 2021.

There are two types of data used in this research: primary data and secondary data. The preliminary data in this study were obtained from interviews with obese patients at the North City Health Center, then for secondary data in medical records, questionnaires, and data from books.

In this study, data were collected from respondents/patients, which were obtained from the results of interviews with questionnaires and obtained directly from the effects of interviews with questionnaires and data obtained directly at the research site. This study also consisted of data on obesity in Gorontalo Province, Gorontalo City, and at the North

City Health Center. The data were taken from the Gorontalo Provincial Health Office and the North City Health Center Laboratory Installation.

This study uses data collection methods, namely the procedures in research include: Informed Consent, Questionnaire, Pre-Analytical, Analytical, and Post-Analytical.

By using the formula: $n = \frac{NZ^2 1 - a/2\, P\,(1-P)}{(N-1)d^2 + Z^2}$, Then produce a piece of information that is needed as a result of data processing through obtaining data or a summary of raw data. The data analysis technique in this study uses descriptive univariate, which describes the information or characteristics of the sample data to be studied.

RESEARCH RESULT

A. General Data of Respondents

Table.1 *Distribution of Samples by Gender*

Gender	Abnormal		Normal		Total	%
	F	%	F	%		
Man	8	27,58	3	10,34	11	37,92
Woman	17	58,62	1	3,44	18	63,08
Total	11	37,92	18	63,08	29	100%

(Source: Primary Data, 2021)

The table above shows that of the 29 obese patient respondents studied, based on gender, there were eight samples of men with blood glucose levels with a percentage (27.58%) and three samples with an average rate (10.34%). In contrast, women who had abnormal blood glucose levels were 17 samples with a percentage (58.62%) and 1 sample with average rates (3.44%).

Table. 2 *Distribution of Samples by Age*

Umur	Abnormal		Normal		Total	%
	F	%	F	%		
< 20 years	0	0	3	10,3	3	10,3
20 - 30 years	3	10,3	0	0	3	10,3
31 - 40 years	9	31,0	0	0	9	31,0
41 - 50 years	8	27,6	0	0	8	27,6
51 - 60 years	5	17,2	1	3,5	6	20,6
Total	25	86,20	4	13,79	29	100%

(Source: Primary Data, 2021).

The table above shows that of the 29 obese patient respondents who were studied by age, obese patients <20 years old who had normal blood glucose levels were three samples with a percentage (10.3%), obese patients aged 20-30 years who had high blood glucose levels. Abnormal blood glucose as many as three samples with a percentage (10.3%), obese patients aged 31-40 years who had abnormal blood glucose levels as many as nine pieces with a rate (31.0%), obese patients aged 41-50 years who had Abnormal blood glucose levels as many as eight samples with a percentage (27.6%) and obese patients aged 51-60 years who were abnormal as many as five models with a rate (17.2%) and normal as many as 1 sample with a percentage (20.6%).

Table. 3 *Sample Distribution Based on Physical Pattern (Body Mass Index/BMI)*

Physical Pattern	Abnormal		Normal		Total	%
	F	%	F	%		
Obesitity I	23	79,4	5	17,2	28	96,6
Woman	1	3,4	0	0	1	3,4
Total	24	82,8	5	17,2	29	100%

(Source: Primary Data, 2021)

The table above shows that the physical pattern or classification of body mass index (BMI) of 29 respondents from obese patients studied, obesity I, which has abnormal blood glucose levels as many as 23 samples with a percentage (79.4$) and normal as many as 5 samples (17 .2%), while obesity II which has abnormal blood glucose levels is 1 sample (3.4%).

Table. 4 *Distribution of Samples Based on Physical Activity*

Physical Activity	Abnormal	Normal	Total	%

	F	%	F	%		
Light	16	55,2	5	17,2	21	72,4
Curently	7	24,1	0	0	7	24,1
Heavy	1	3,4	0	0	1	3,4
Total	24	82,8	5	17,2	29	100%

(Source: Primary Data, 2021)

The table above shows the distribution or number of samples based on physical activity. After being examined from 29 respondents, the results of the biological activity of respondents in the mild category who had abnormal blood glucose levels were 16 samples with a percentage (55.2%) and regular as many as five samples with a rate (17.2%), then the physical activity of the respondents those in the moderate category who have abnormal blood glucose levels are seven samples with a percentage (24.1%), while respondents with heavy activities who have abnormal blood glucose levels are 1 sample with a rate (3.4%).

Table.5 *Sample Distribution Based on Diet (Total Calories)*

Physical Activity	Abnormal		Normal		Total	%
	F	%	F	%		
Normal	0	0	5	17,2	5	17,2
Abnormal	24	282,8	0	0	24	82,8
Total	24	82,8	5	17,2	29	100%

(Source: Primary Data, 2021)

The tables and graphs above show the respondents' eating patterns (number of calories) in consuming food from morning to evening (breakfast/breakfast, lunch, and dinner). After research, it was found that from 29 respondents who were obese patients, a regular diet had normal glucose levels, there were five samples (17.2%) whose number of calories or eating patterns were more than usual (abnormal) had abnormal blood glucose levels as many as 24 samples, with a percentage (82.8%).

B. Respondent Special Data

Table.6 *Distribution of Samples Based on Results of Examination of Blood Glucose Levels in Obese Patients*

Blood Glucose Level Examination Results	Frequency	Percentage (%)
Normal	5	17,2
Abnormal	24	82,8
Total	29	100%

(Source: Primary Data, 2021)

The table above shows that of 29 respondents with obesity whose blood glucose levels were measured, the results showed that most blood glucose levels were within abnormal limits, namely 24 people (82.8%) and only five people with normal blood glucose levels (17,2%).

DISCUSSION

Obesity is a feature of metabolic syndrome, insulin resistance, fasting hyperglycemia, lipid disorders, and high blood pressure. All of these features of the metabolic syndrome are associated with weight-related overweight. This is where resistance occurs insulin and glucose metabolism is not normal, start gradually weight gain and obesity [9].

Blood sugar is the amount or concentration of glucose in the blood. Under normal conditions, glucose is regulated by the chemical insulin, which is made by pancreatic cells [25]. In healthy individuals, fasting glucose levels are in the range of 600 to 100 mg/dl. Fixation was extended to 120-140 mg/dl after meals. The body's system then, at that point, returns to normal blood sugar levels about 2 hours after carbohydrate consumption. Glucose levels are handy in maintaining a healthy balance between the cerebrum and spherical germinal epithelium, as glucose is the leading supplement that can be used to provide dense energy. Most of the glucose is a consequence of the process of gluconeogenesis used by the mind[25].

The examination results of blood glucose levels can be seen in table 4.6. High blood glucose levels are not seen from the body

mass index (BMI). Still, they are seen based on diet and physical activity, namely consuming foods that contain lots of calories and lack of activity, so that it can cause blood glucose levels to increase. To find out the calories in the body, the researchers calculated the number of calories by counting the respondents' total calories for 24 hours from breakfast to dinner.

1. Gender of Respondent

According to previous research, central obesity is more common in women because, physically, women have a monthly cycle syndrome (Premenstrual syndrome). This allows body fat distribution to quickly accumulate due to hormonal processes, which can put women at a higher risk of developing type 2 diabetes.[27].

Based on the study results on gender characteristics, it can be concluded that most of the obese respondents are female than male. By the results of the 29 obese patient respondents studied, based on gender, eight samples of men had blood glucose levels with a percentage (27.58%) and three models with an average rate (10.34%). In contrast, the women with abnormal blood glucose levels were 17 samples with a percentage (58.62%) and 1 sample with average rates (3.44%).

The results of this study are in line with studies that suggest that women tend to be obese, but this is not the case in men. [5].Lower body obesity is a condition of high body fat accumulation in the gluteal-femoral region (hips, thighs, and buttocks) with a small stomach but larger pelvis or buttocks and thighs. This could be because the cells in that space are made of lipoprotein lipase. The catalyst pushes fat from the circulatory system into the fat cells. The presence of progesterone in women increases the movement of lipoprotein lipase in the lower spinal spaces of the body and can affect blood lipid levels. This type of obesity is more typical in women. This kind of obesity is closely identified with female problems in women and is experienced by women who are starting to enter menopause [4].

This is in line with the theory that women usually have a more stored muscle to fat ratio than in the abdomen than men. Women are at a higher risk of developing focal obesity, especially after menopause. With increasing age and the impact of menopause, there is an increase in the content of the muscle to fat ratio in women, especially in the delivery of the central power to fat ratio [27].

This is in line with the theory that women usually have a more stored muscle to fat ratio than in the abdomen than men. Women are at a higher risk of developing focal obesity, especially after menopause. With increasing age and the impact of menopause, there is an increase in the content of the muscle to fat ratio in women, especially in the delivery of the central power to fat ratio [8]. Then a study that examined the incidence of obesity in low-income families obtained the results that from 76 samples, there were 52 people (68.4%) were female, while 24 men (31.6%) suffered from obesity. [8].

2. Age of Respondent

Age, The incidence of obesity increases with age. Hypertrophic obesity (enlargement of fat cells, often in adults) and hyperplastic obesity (increased number of fat cells, often in children and adolescents) are associated[24].

Based on the results of research that has been carried out on the characteristics of age, the results obtained that from 29 respondents of obese patients who were studied by

age, obese patients <20 years who had normal blood sugar levels were three samples with a percentage (10.3%), obese patients aged 20-30 years who have abnormal blood sugar levels as many as three models with a rate (10.3%), obese patients aged 31-40 years who have abnormal blood sugar levels as many as nine pieces with a percentage (31.0%), patients. Obese patients aged 41-50 years who have abnormal blood sugar levels are eight samples with a rate (27.6%) and obese patients aged 51-60 years who are abnormal are five samples with a percentage (17.2%) and regular are 1 sample with rate (20,6%).

The high incidence of obesity in the 40-50 year age group is supported by a consistent theory that states that the dominance of obesity increases with age. With growing age, complete muscle versus fat substance increases, mainly focal fat spread. The supremacy of focal stoutness increased at the age of 44 years and decreased again at 45-54 years. The dominance of robustness is higher in more experienced examples. With increasing age (55 years and over), there is a significant reduction and change in the various types of chemicals that trigger intestinal fat accumulation[14].

The results of this review are by research that the highest absorption of body weight in rural countries, when viewed from this age group, is in the youngest age group (40-50 years) in contrast to developed nations. This can cause real public health problems in agricultural countries, such as in low- and middle-income countries [15].

Apart from the hypotheses and side effects of previous studies, these results are also through information which states that in Indonesia, around 13.5% of adults over the age of 18 are overweight, 28.7% are obese (BMI 25),

and according to the 2015-2019 RPJMN guidelines, even 15.4% is decent (BMI 27). In adult children 512 years old, 18.8% are overweight, and 10.8% are hefty. In addition, these results are also supported by Indonesia's 2019 health profile data, which shows that by age group, obesity rates are highest found in the age group 40-44 years (29.6%), followed by the age group 45-49 years 25, 10.%. age group 35-39 years 20.90%, age group 30-34 years 18.18%, and age group 18 years 6.2%[11].

3. Physical Patern (Body Mass Index/BMI)

Excess body weight can cause changes in body cells so that the body's cells become immune to the chemical insulin. Excess weight builds up the arrival of free unsaturated fats into the blood. Free unsaturated fats carried by endothelial lipoprotein lipase increase serum lipids and increase lipoproteins in lipolysis, leading to insulin receptor damage[1].

Based on the characteristics of the physical pattern or body mass index (BMI) of 29 respondents that the physical design or classification of the body mass index (BMI) of the 29 respondents who studied obese patients, obesity I am having abnormal blood glucose levels as many as 23 samples with a percentage (79, 4%) and standard as many as five samples (17.2%), while obesity II which has abnormal blood glucose levels is 1 sample (3.4%).

This result is by the facts and data which states that the average Body Mass Index (BMI) of the world's population is 24 kg/m2 (Obesity I). In addition, it was also mentioned that in Indonesia, 13.5% of people are overweight, while 28.7% are obese (BMI 25), and based on the 2015-2019 RPJMN indicators, as many as 15.4%

are obese. (BMI 27). Meanwhile, in children aged 5-12 years, 18.8% were overweight, and 10.8% were obese. Thus, it can be concluded that in Indonesia, the population of obesity I am more than obese II [12].

4. Physical Activity

Physical activity burns energy that enters the body, if the body consumes too many calories and is not balanced with exercise, physical balance can cause obesity, rarely resting or walking can cause the body to fall, cell sensitivity to insulin causes glucose in the blood, many substances are absorbed by the body, which can cause blood sugar rise [31].

On the characteristics of the respondent's activity, by the research results based on physical activity. After being examined from 29 respondents, the results of the biological activity of respondents in the mild category who had abnormal blood glucose levels were 16 samples with a percentage (55.2%) and regular as many as five samples with a rate (17.2%), then the physical activity of the respondents those in the moderate category who have abnormal blood glucose levels are seven samples with a percentage (24.1%), while respondents with heavy activities who have abnormal blood glucose levels are 1 sample with a rate (3.4%).

Most respondents' lack of physical activity (21 people/72.4%) indicates that the fat and glucose in the respondent's body are not burned or obtained entirely. This is by the hypothesis that dynamic individuals are less likely to develop cardiovascular infections, including dyslipidemia, so that exercise and active work can further build blood lipid profiles, significantly bringing down total cholesterol, LDL, and triglycerides. In addition, various risk factors such as high blood pressure, obesity, and diabetes mellitus can be reduced by practicing the right portion, range, and recurrence. [2].

5. Diet

Diet is a collection of data that describes the amount and type of food eaten every day, which is a feature of a particular group. A diet can be characterized as a consistent dietary pattern depending on the kind of food: main meals, protein sources, vegetables, natural products, and repetitions: day after day, every day, never. In human food and eating decisions, time affects age, habits, economic status, personal tastes, and culture[2].

On the characteristics of the respondents' number of calories (dietary pattern), the research data was taken on the informed consent form that the respondents filled out in consuming food from morning to night. This data was obtained by researchers from filling out questionnaires by respondents. The respondent's eating pattern was calculated based on the theory that the number of calorie consumption by the respondent was calculated per day, so from breakfast to dinner. There are 2 (two) categories of eating patterns in the study, namely regular and abnormal. The standard interpretation is that men consume around 2,000 – 3,000 kilocalories (kcal). Whereas in women, the average calorie consumption is 1,600 – 2,400 kcal [19].

Based on the characteristics of the respondents' eating pattern (number of calories) in consuming food from morning until. After research, it was found that from 29 respondents who were obese patients, a regular diet had normal glucose levels, there were five samples (17.2%) whose number of

calories or eating patterns were more than usual (abnormal) had abnormal blood glucose levels as many as 24 samples, with a percentage (82.8%).

The results of this study are by what was stated that several factors cause obesity and overweight in a person. These factors include genetic factors, environmental factors consisting of diet and physical activity patterns, and drug and hormonal factors. Eating habits that can cause obesity and obesity here are the amount of excess energy intake that causes obesity and obesity. Varieties of foods with high energy viscosity (rich in fat, fiber, and sugar cause energy imbalances)[11]

6. **Blood Glucose Level Examination Results**

Glucose is one of the most useful carbohydrates in the body. It is used as a source of energy, and the term glucose denotes the glucose level in the blood. The focus of glucose is directed into the body. Normally sugar levels are within certain limits throughout the day (70-105 mg/dl), blood sugar generally rises after eating [1].

Based on the results of an examination of blood glucose levels in obese patients in PKM North City, Gorontalo City, it showed that of the 29 obese respondents whose blood glucose levels were measured, the results showed that the majority of blood glucose levels were within abnormal limits, namely 24 people (82.8%) and only five people (17.2%) had normal blood glucose levels.

The high blood glucose level in obese patients in this study was caused by insulin resistance in the body of obese patients. This is based on the theory that compared to adults, fat cell hypertrophy due to obesity has been shown to lead to an increase in pro-inflammatory mediators such as IL1, IL6, and TNF, which are believed to

inhibit phosphorylation of IRS1 (insulin receptor substrate1), thereby inhibiting insulin signaling mechanisms. The current situation can also be the cause of changing quality. Insulin obstruction causes plasma blood sugar to rise, so this situation forces the pancreatic cells to make up for this by expanding insulin release, promoting hyperinsulinemia. If the weight is maintained and the pancreatic cells are currently unable to cope with the insulin problem. Glucose fixation is controlled in the body[26]

CONCLUSION

Based on the results of research and data analysis in this study, it can be concluded:

1. Of the 29 obese patients, 24 people or 82.8%, whose blood sugar levels were abnormal. Meanwhile, five people with normal blood sugar levels or 17.2%..

2. Several factors that affect blood glucose levels in obese patients are gender, age, physical pattern (BMI), diet (number of calories), and physical activity.

REFERENCE

[1] Ali, S., Rose Alinda, A., Syed Norris, H., Marlia, P., Siti Hamisah, T., Cotet, G. B., Othman, A. (2018). *Hubungan Obesitas Sentral Terhad Gula Darah Postprandial Pada Laki-laki Dewasa Di Lingkungan Kerja Universitas Lampung. https://doi.org/10.1051/matecconf/20 1712107005.*

[2] Almatsier, S (2009*) Prinsip Dasar Ilmu Gizi.*Jakarta: PT. Gramedia Pustaka Utama.

[3] Anofi .A., Widaastuti.W, Nurwiyeni. (2018) *Gambaran Gula Darah Mahasiswa YangObesitas di Fakultas Kedokteran Universitas Baiturrahmah Tahun 2017*.

[4]Arisman, M. B. (2010).*Obesitas, Diabetes MelitusdanDislipidemia*, Buku Ajar IlmuGizi.EGC. Jakarta.

[5]Budiman, Hendra. 2010. *Asamlemak omega-3 dankesehatanjantung. MajalahKedokteran. 2010;8(1).*Diaksespada 31 Juli 2021.

[6] Hutagaol, H. (2014). *Pengaruh Gaya Hidup terhadap Kejadian Diabetes Melitus Tipe 2 di Rumah Sakit Umum Daerah Kota Padangsidimpuan Tahun 2014 IDF. 2014. IDF Diabetes Atlas Sixth Edition. http://www.idf.org.* Diakses pada tanggal 23 Mei 2021.

[7] Henderson, KE, Baranski RJ, Bickel PE, Clutter WE, McGill JB (2009), *Subspecialty Consult Series Endocrinology Subspecialty Consult, 2and Edition Philadelphia: Lippincott Williams and Wilkins, USA, pp. 202-205.*

[8]Janghorbani, M., Amini, M., Willett, W.C., Mehdi Gouya, M., Delavari, A., Alikhani, S. &Mahdavi, A. (2007). *First Nationwide Survey of Prevalence of Overweight, Underweight, and Abdominal Obesity in Iranian Adults, Obesity , 15(11): 2797-2808.*Diaksespada 01 Agustus 2021.

[9] Kementrian Kesehatan Republik Indonesia, (2012). *Pedoman Pencegahan dan Penggulangan Kegemukan dan Obesitas Pada Anak Sekolah*

[10]Kementrian Kesehatan Republik Indonesia, (2017). Integrasi Seluruh Komponen Bangsa Mewujudkan Indonesia Sehat. Bakti Husada

[11]KementrianKesehatanRepublik Indonesia, (2019). *Kit Informasi :EpidemiObesitas.* KementerianKesehatan RI. Jakarta.

[12] KementrianKesehatanRepublikIndonesia,(2020).*ProfilKesehatan Indonesia Tahun 2019.*KementerianKesehatan RI. Jakarta.

[13]Kurniawan, I. (2014) *Hubungan antara Indeks Massa Tubuh dengan Kadar Gula Darah Postprandial pada Anggota Kepolisian Resor Karanganyar.* Skripsi. Surakarta: Universitas Muhammadiyah Surakarta.

[14]Listiyana, A.D., Mardiana. & Prameswari, G.N. (2013). *Obesitas Sentral dan Kadar Kolesterol Darah Total. Jurnal Kesehatan Masyarakat, 9(1): 37-43.* Diakses pada 03 Agustus 2

[15] Low, Chin & Deurenberg-Yap, 2009. *Review of Epidemic Of Obesity. National Canter for Bioteknologi Information 38(1):57-9.*, Dari http://www.ncbi.nlm.nih.gov/pubmed/19221672. Diakses tanggal 03 Agustus 2021.

[16] National Heart, Lung, and Blood Institute. *Calculate your body mass index. National Institutes of Health. [online] nhlbi.nih.gov, availableat*:https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.html. Diakses pada tanggal 23 Mei 2021.

[17] National Health Services Choices. *Hyperglycaemia (high blood sugar) - NHS Choices. [online] Nhs.uk, accessed 13 Apr. 2017, Available at:*http://www.nhs.uk/conditions/Hyperglycaemia/Pages/Introduction.aspx. Diakses pada tanggal 23 Mei 2021.

[18] NHLBI, 2007 *Determination of Degree of Abdominal Obesity, Gudelines On* Overweight and Obesit. Diakses [30 Juni 2021) dari www.nhlbi.gov/guideline/abdominal [2]Almatsier, S (2002*) Prinsip Dasar Ilmu Gizi.*Jakarta: PT. Gramedia Pustaka Utama.

[19] Nursyamsiyah (2017). *BerdamaiDengan Diabetes.* Jakarta: Tim BumiMedika.

[20] Nadimin. Ayumar.Fajarwati.(2015). *ObesitasPada Orang DewasaAnggotaKeluargaMiskin Di KecamatanLembangKabupatenPinrang.JURNAL MKMI, September 2015, hal.9-15.*Diaksespada 01 Agustus 2021.

[21] Ogden, Cynthia L; Carroll, Margaret D; Fryar, Cheryl D; Flegal, Katherine M. (2015). *Products - Data Briefs. United States: Centers for Disease Control and Prevention. Retrieved Juni 16, 2017, from Centers for Disease Control and Prevention:* https://www.cdc.gov/nchs/products/databriefs/db219.htm

[22] Polii. C. R, Kepel. J. B, Bodhi. W, Manampiring. E. A (2016) *Hubungan kadar glukosa darah puasa dengan obesitas pada remaja di Kecamatan Bolangitang Barat Kabupatem Bolaang Mongondow Utara.* [8] Janghorbani, M., Amini, M., Willett, W.C., Mehdi Gouya, M., Delavari, A., Alikhani, S. & Mahdavi, A. (2007). *First Nationwide Survey of Prevalence of Overweight, Underweight, and Abdominal Obesity in Iranian Adults, Obesity , 15(11): 2797-2808.* Diakses pada 01 Agustus 2021.

[23] Riset Kesehatan Dasar (Riskesdas), (2018). Badan Penelitian dan Pengembangan Kesehatan Kementerian RI [10] Kementrian Kesehatan Republik Indonesia, (2017). Integrasi Seluruh Komponen Bangsa Mewujudkan Indonesia Sehat. Bakti Husada

[24] Salam, A. (2006). *FaktorResikoKejadianObesitaspadaRemaja.Jurnal MKMI, [online] 6(3), pp.185-190, accessed 16 Juni 2021, Available at:* https://media.neliti.com/media/publications/27394-ID-faktor-risikokejadianobesitas-pada-remaja.pdf

[25] Sherwood L., 2006,*Textbook Of Human Physiology*, Edisi 2, EGC, Jakarta.

[26] Sjarif, D.R (2011). *ObesitasAnakdanRemaja.Dalam: Buku Ajar NutrisiPediatrikdanPenyakitMetabolik.* Jakarta: BadanPenerbit IDAI; 230-

[27] Soegondo, Sidartawan, et all. (2011) *Penatalaksanaan Diabetes Melitus Terpadu,* edisi 2, Badan Penerbit FKUI, Jakarta.

[28] Suhartini. (2017). *gambaran kadar glukosa darah sewaktu pada guru SD yang obesitas dikecamatan Tanjung Raja kabupaten Ogan Ilir tahun 2017*. palembang.

[29] Susetyowati, emy huriaty, istiti kandarinal, farah faza. (2019). *Peranan Gizi Dalam Upaya Pencegahan Penyakit Tidak Menular* (1st ed.). yogyakarta.

[30] Suyono, S. (2012). *Buku Ajar Ilmu Penyakit Dalam*. Jakarta Pusat: Penerbitan Departemen Penyakit Dalam FK UI.

[31] Widiantini, W., Tafal, Z. (2014). *Aktivitas Fisik, Stres, dan Obesitas pada Pegawai Negeri Sipil. Kesmas: National Public Health Journal, (4), 325.* https://doi.org/10.21109/kesmas.v0i0.374. Diakses pada tanggal 23 Mei 2021.

[32] World Healthy Organization (WHO), (2016). *Obesity and Overweight*. Retrieved September 5, 2017, from WHO: http://www.who.int/mediacentre/factsheets/fs311/en/