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## **CORRELATION BETWEEN FASTING BLOOD GLUCOSE LEVELS AND SERUM TRIGLYCERIDE AND HDL CHOLESTEROL LEVELS IN ELDERLY PATIENTS WITH TYPE 2 DIABETES MELLITUS**

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### **ABSTRACT**

**Background:** Blood glucose levels over normal limits are a hallmark of diabetes mellitus (DM), a chronic metabolic disease with several causes. Disorders in lipid metabolism can result from type 2 diabetes mellitus. This study investigated the correlation between fasting blood glucose (FBG) levels and serum triglyceride and HDL cholesterol in elderly people with type 2 diabetes. **Objectives:** To prove that in elderly people with type 2 diabetes mellitus, FBG levels are correlated with serum triglyceride and HDL cholesterol levels. **Methods:** A cross-sectional study of 46 secondary data on elderly patients with diabetes mellitus at Diponegoro National Hospital in Semarang. data analysis using Pearson's correlation test ( $p < 0.05$ ). **Results:** The Pearson's correlation test between fasting blood glucose levels and triglyceride levels was  $p = 0.076$ , and serum HDL cholesterol was  $p = 0.270$  in elderly patients with type 2 diabetes mellitus. **Conclusion:** There is no correlation between FBG levels and serum triglyceride and HDL cholesterol levels in elderly people with type 2 diabetes mellitus.

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### **BACKGROUND**

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by various etiologies, marked by elevated blood glucose levels beyond normal limits.<sup>1</sup> Type 2 DM occurs due to an increase in blood glucose, even though insulin secretion may be normal or even increased.<sup>2</sup> In 2019, the International Diabetes Federation (IDF) reported that 463 million people in the age group of 20-79 years suffer from DM. Indonesia is ranked 7th with the largest number of sufferers. Basic health research (Riskesmas) 2018 shows that the prevalence of DM in Central Java is around 2.1%. This result has increased when compared to 2013, which was around 1.6%, and Semarang City was ranked 13th out of 34 cities/regencies in Central Java.<sup>3</sup>

The elderly population refers to individuals aged 60 years or older.<sup>4,5</sup> In 2016, the number of elderly reached 8.17% and then increased to 9.29%, or 170 thousand people, in 2020.<sup>5</sup> The prevalence of DM in Indonesia shows an increase in line with the

increasing age of the patient. The peak of DM prevalence is at the age of 55-64 years.<sup>1</sup> Fasting blood glucose (FBG) is a person's blood glucose level assessed after fasting for 8 hours. FBG levels can be used as one of the guidelines in diagnosing DM.<sup>6</sup> Research by Fahmiyah (2016) shows that the amounts of high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, and triglycerides in the blood can greatly influence FBG levels in patients with diabetes mellitus (DM).<sup>6</sup>

Triglycerides are formed by glycerol and fatty acids.<sup>7</sup> An increase in serum triglyceride levels above normal, or hypertriglyceridemia, is a serum lipid disorder. HDL is a lipoprotein in the body that has a heterogeneous size and composition. HDL has an important role in the reverse transportation of cholesterol, which has a role as a carrier of cholesterol back to the liver.<sup>9</sup> Increased catabolism of HDL cholesterol causes a decrease in serum HDL cholesterol in patients with type 2 DM.<sup>10</sup>



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Research by Purwanti (2016) showed a negative correlation between serum HDL cholesterol levels and FBG in 35 outpatients at Sanglah General Hospital.<sup>11</sup> Arifin AY (2019) found that there was a significant correlation between blood glucose levels and increased levels of total cholesterol, HDL, LDL, and triglycerides in residents in Central Bogor.<sup>10</sup> To date, discrepancies exist in the research findings from previous studies concerning the correlation between FBG levels and both triglyceride levels and serum HDL cholesterol levels. In addition, there are no specific research results aimed at the elderly. This suggestion motivates researchers to investigate the correlation between FBG levels and serum triglyceride and HDL cholesterol in elderly people with type 2 diabetes.

## METHODS

This study was conducted at Diponegoro National Hospital from July to November 2022 using medical records of elderly patients with type 2 DM from January 2019 to December 2021. Data was taken in the form of secondary data regarding FBG levels, serum triglycerides, serum HDL cholesterol, and research subject data in the form of age, gender, and disease diagnosis.

This study employed a consecutive sampling method using medical record data from elderly people

with type 2 diabetes mellitus (DM) at the Diponegoro National Hospital Medical Record Installation. The sample consisted of 46 individuals who met the inclusion criteria, and the study employed a cross-sectional design.

Data analysis using SPSS software. Data normality was tested using the Shapiro-Wilk test, and all variables were found to be normally distributed. Correlation testing was performed using the Pearson test ( $p < 0.05$ ).

The research has obtained ethical clearance from the Health Research Ethics Commission (KEPK) of the Faculty of Medicine, Universitas Diponegoro with No. 175/EC/KEPK/FK-UNDIP/VI/2022. The subject's identity will be kept confidential and will not be published for any purpose. The researcher bears all research costs.

## RESULT

Based on the Pearson correlation test, the results showed the value of  $p = 0.076$  and  $r = 0.264$  for the test of the correlation between FBG levels and serum triglyceride levels and  $p = 0.270$  and  $r = -0.166$  for the test of the correlation between FBG levels and serum HDL cholesterol levels. This result showed that there was no correlation between FBG levels and triglyceride levels and serum HDL cholesterol levels in elderly people with type 2 diabetes.

**Table 1.** Characteristics of Subjects

| Variable                      | n  | %    | Mean $\pm$ SD      | Median (min-max) |
|-------------------------------|----|------|--------------------|------------------|
| Age (year)                    |    |      | 65.02 $\pm$ 4.68   | 64.50 (60-80)    |
| 60-74                         | 44 | 95.7 |                    |                  |
| 75-80                         | 2  | 4.3  |                    |                  |
| Sex                           |    |      |                    |                  |
| Male                          | 29 | 63   |                    |                  |
| Female                        | 17 | 37   |                    |                  |
| Systolic BP (mmHg)            |    |      | 130.00 $\pm$ 8.42  | 120 (100-133)    |
| Diastolic BP (mmHg)           |    |      | 73.57 $\pm$ 7.21   | 71 (57-90)       |
| Fasting Blood Glucose (mg/dL) |    |      | 112.75 $\pm$ 23.53 | 112 (71-176)     |
| <100                          | 7  | 15.2 |                    |                  |
| 100-125                       | 9  | 19.6 |                    |                  |
| $\geq$ 126                    | 30 | 65.2 |                    |                  |
| Triglycerides (mg/dL)         |    |      | 183.51 $\pm$ 81.61 | 163.00 (90-366)  |
| Normal (<150)                 | 19 | 41.3 |                    |                  |
| Borderline (150-199)          | 10 | 21.7 |                    |                  |
| High ( $\geq$ 200)            | 17 | 37   |                    |                  |
| HDL Cholesterol (mg/dL)       |    |      | 39.56 $\pm$ 8.11   | 37.50 (18-71)    |
| Low (<40)                     | 28 | 60.9 |                    |                  |
| Normal (40-60)                | 15 | 32.6 |                    |                  |
| High (>60)                    | 3  | 6.5  |                    |                  |



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**Table 2.** Correlation of FBG Levels with Serum Triglyceride and HDL Cholesterol Levels

| Variable        | Fasting Blood Glucose (FBG) |       |
|-----------------|-----------------------------|-------|
|                 | p                           | r     |
| Triglycerides   | 0.076                       | 0.264 |
| HDL cholesterol | 0.270                       | 0.166 |

## DISCUSSION

The distribution of research subjects (Table 1) indicates that there are 29 male subjects (63%), which is more than the 17 female subjects (37%). This study shows that elderly patients with type 2 DM at Diponegoro National Hospital are more male than female. Research conducted by Siorcani (2020) reported similar findings, indicating that the prevalence of type 2 DM sufferers was predominantly male, with a percentage of 69.6% compared to 30.4% for females.<sup>12</sup>

The age distribution of the research subjects shown in Table 1 ranged from 60 to 80 years. The majority of research subjects were ages 60 to 74 (91.3%). Research by Isnaini (2018) states that age is a factor that can affect the degeneration of all body systems, including the endocrine system. The older a person is, the more the condition of insulin resistance will increase, resulting in blood glucose instability. This makes increasing age one of the risk factors for type 2 DM.<sup>13</sup>

The blood pressure of the research subjects has an average of  $130 \pm 8.42$  mmHg in systole and  $73.57 \pm 7.21$  in diastole, indicating that it is within normal limits. The American Heart Association (AHA) recommends that elderly individuals maintain a blood pressure reading below 130/80 mmHg. This finding is also in accordance with the study's results and the inclusion criteria outlined by the author.<sup>14,15</sup>

The distribution of FBG levels in the research subjects, as shown in Table 1, ranges from 71 to 356 mg/dL, with a mean value of 177.96 mg/dL. A total of 30 research subjects, or 65.2% of subjects, had FBG levels greater than 125 mg/dL. This result shows that the majority of them have high FBG levels. The distribution of serum triglyceride levels in this study ranged from 90 to 366 mg/dL, with a mean of approximately 185.91 mg/dL.

The distribution of subjects' HDL cholesterol levels in serum (Table 1) ranged from 10 to 71 mg/dL with an average of 39.59 mg/dL. A total of 28 research samples (60.9%) showed low serum HDL

cholesterol levels. This finding aligns with Cherifa's (2021) research, which indicates that age and insulin resistance are risk factors for decreased HDL cholesterol levels.<sup>16</sup>

In Table 2, the significance value for the correlation between FBG levels and serum triglyceride levels was  $p = 0.076$ , with a correlation coefficient of  $r = 0.264$ . This evidence shows there is no correlation between FBG levels and serum triglyceride levels in the elderly with type 2 DM. The results of this study are similar to research by Suhaimi (2017), with a significance value of  $p = 0.257$  and a correlation coefficient value of  $r = 0.315$ , which means there is no significant correlation between FBG levels and serum triglyceride levels in patients with type 2 DM.<sup>17</sup> The results of this study also show results that are in accordance with research by Malau (2014) with  $p = 0.694$  and  $r = 0.063$ , which shows that there is no significant correlation between FBG levels and serum triglyceride levels in patients with type 2 DM.<sup>18</sup>

Based on existing theory, triglyceride levels are expected to increase in line with the worsening of a person's diabetes. This effect is explained by the pathogenesis of type 2 DM during the advanced phase. In the advanced phase, excess glucose levels in the blood are stored as fat, primarily in the form of triglycerides. If glycemic control worsens, glucose in the blood will increase and then be converted into triglycerides, leading to an increase in blood triglyceride levels.<sup>19</sup>

Many factors can influence the results of this study, including unhealthy lifestyles such as a diet high in fat, carbohydrates, protein, and low in fiber, in addition to obesity and physical activity, which can also have an effect because excess carbohydrate and fat intake will be stored under the skin in the form of fat.<sup>20,21</sup> Triglyceride levels can also decrease due to malnutrition, changes in dietary patterns within three weeks, weight loss, increased physical exercise, and the use of drugs such as alpha-1 receptor blockers, thiazolidinedione, and metformin.<sup>22</sup>

In obesity, excessive fat accumulation can increase free fatty acid levels, inhibit lipogenesis, and reduce serum triglyceride clearance, leading to elevated blood triglyceride levels.<sup>21</sup> Excessive alcohol consumption can affect the metabolism of HDL cholesterol, LDL cholesterol, and triglycerides.<sup>23</sup> In addition, smoking activity and history can also affect



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triglyceride levels. Cigarettes contain nicotine, a chemical compound that can increase the concentration of free fatty acids and lipolysis. The increase in lipolysis that occurs can affect the fat profile in the blood, one of which is triglycerides.<sup>24</sup>

The significance value of the correlation between FBG levels and serum HDL cholesterol levels, as shown in Table 2, is  $p = 0.270$ , with a correlation coefficient of  $r = -0.166$ . This evidence shows that there is no correlation between fasting blood glucose levels and serum HDL cholesterol levels in elderly people with type 2 DM. The results of this study are in accordance with those of Rahayu (2020) with  $p$  value of 0.245, indicating no significant correlation between fasting blood glucose levels and HDL cholesterol levels.<sup>19</sup> The results of this study also show similar results to research conducted by Siorcani (2022), which states that there is no significant correlation between FBG levels and HDL cholesterol levels, with  $r = 0.101$  and  $p = 0.253$ .<sup>12</sup>

Based on existing theories, there is often a decrease in HDL levels in patients with type 2 diabetes mellitus, which refers to dyslipidemia. A decrease in serum HDL cholesterol levels in patients with type 2 diabetes can be caused by an increase in the exchange of triglyceride-rich lipoproteins to cholesterol from HDL or vice versa.<sup>19</sup>

This unrelated result can be influenced by several factors, such as physical activity, obesity, medication use, other disease complications, and the length of time a person suffers from type 2 DM.<sup>19</sup> In addition, several factors can also influence the study's results, including genetic factors, a family history of low HDL cholesterol levels, a high-carbohydrate, low-fiber diet, obesity, age, and lifestyle factors such as physical inactivity, as well as a history of cigarette and alcohol consumption.<sup>16,19,25,26</sup> In addition, HDL cholesterol can also be increased by physical exercise, increased triglyceride clearance, moderate alcohol consumption, insulin therapy, and oral estrogen therapy.<sup>22</sup>

Serum HDL cholesterol levels can increase by 3-9% in healthy, sedentary individuals through physical activity. This increase depends on the frequency and intensity of exercise and is associated with stimulation of HDL cholesterol beta and RCT (reverse cholesterol transport) production.<sup>16</sup> Regular physical activity can increase lipoprotein lipase enzyme activity so that hepatic lipase enzyme activity

will decrease. Lipoprotein lipase will hydrolyze VLDL and triglycerides, resulting in increased conversion of IDL and VLDL. The increase in IDL will partly be converted into LDL and the rest through the intermediary of LDL receptors, will be taken back to the liver and peripheral tissues. This makes LDL cholesterol decrease and HDL levels increase when there is an increase in physical activity.<sup>27</sup>

Cherifa (2021) states that the effect of smoking on serum HDL cholesterol levels depends on the dose and reverses after stopping smoking. Male and female smokers have significantly lower HDL cholesterol than non-smokers. Moderate alcohol consumption can increase HDL cholesterol concentrations by increasing cellular cholesterol efflux and plasma cholesterol esterification.<sup>16</sup>

The majority of patients with type 2 DM will receive pharmacological therapy with the use of drugs, such as metformin or thiazolidinedione. Metformin can reduce insulin resistance, thereby improving insulin's function in the body. This drug also has an effect in reducing cholesterol and triglyceride levels.<sup>28</sup> Thiazolidinedione is a type 2 diabetes medication that helps the body use insulin better in muscles and fat by attaching to and activating PPAR-gamma, a receptor involved in how cells develop. Thiazolidinedione also works on PPAR-alpha receptors, which can then increase HDL cholesterol levels and decrease triglyceride levels in the blood.<sup>22</sup>

The results of this study did not show a correlation between FBG levels and HDL cholesterol levels in elderly people with type 2 diabetes. However, from a clinical perspective, the majority of subjects in this study had low levels of HDL cholesterol. This is in line with research by Rasyid (2018), which showed decreased serum HDL cholesterol levels in 42.85% of DM patients. This is due to hyperglycemia, which progressively increases the transfer of HDL cholesterol esters to LDL particles. Insulin deficiency, which also occurs in type 2 DM can damage lipoprotein activity, thereby reducing HDL levels.<sup>29</sup>

Although there is no direct correlation, the findings of this study can serve as a reference for elderly individuals with type 2 DM to continue taking regular medication, maintain a low-fat and high-fiber diet, and engage in physical activities to prevent the



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progression of type 2 DM from worsening, thereby improving their quality of life.

#### LIMITATION

This study is limited to one hospital. This study should be supported by several laboratory results, such as total cholesterol, LDL cholesterol levels, and HbA1c levels, to provide a basis for understanding the patient's condition, particularly regarding the patient's experience with dyslipidemia and the control of type 2 diabetes.

This investigation also lacks data regarding numerous risk factors that could influence the study's outcomes, including the patient's weight and height, medical history, and lifestyle history, including diet and cigarette consumption.

#### CONCLUSION

There is no correlation between FBG levels and serum triglyceride and HDL cholesterol levels in elderly patients with type 2 DM.

#### SUGGESTION

Based on these conclusions, the researcher suggests to future researchers to conduct research by paying attention to several other risk factors, such as history of cigarette consumption, history of alcohol consumption, physical activity, obesity conditions, use of drugs, and intake obtained by the subject.

#### REFERENCES

1. Pusat Data dan Informasi Kementerian Kesehatan RI. Infodatin 2020 Tetap Produktif, Cegah, dan Atasi Diabetes Melitus. Jakarta; 2020.
2. Sherwood L. Introduction to Human Physiology. 8th ed. Brooks/Cole Cengage Learning; 2012. 748–754 p.
3. Rahmahida G. Profil Lansia Kota Semarang 2020. Megasanti NE, editor. Semarang: Badan Pusat Statistik Kota Semarang; 2020. 0–40 p.
4. Fahmiyah I, Latra IN. Faktor yang memengaruhi kadar gula darah puasa pasien diabetes mellitus tipe 2 di Poli Diabetes RSUD Dr. Soetomo Surabaya menggunakan regresi probit biner. *J Sains Seni ITS*. 2016;5(2):456-61. doi:10.12962/j23373520.v5i2.17384.
5. Kshanti IAM, Wibudi A, Sibarani RP, Saraswati MR, Dwipayana IM, Mahmudji HA, et al. Pedoman Pemantauan Glukosa Darah Mandiri 2021. PB PERKENI; 2021. 2–15 p.
6. Kusuma R, Dian Saraswati L, Sakundarno M, Alhanif R, Chasanah M. Factors Associated with Fasting Hyperglycemia. *KnE Life Sciences*. 2018 May 17;4(4):71–8.
7. Pipin K, Soethama R, Herawati S, Subawa N. Hubungan antara kadar gula darah puasa dengan kadar trigliserida pada penderita diabetes melitus tipe 2 di Rumah Sakit Umum Pusat Sanglah Bali. *J Med Udayana* [Internet]. 2020;9(5):53-7. Available from: <https://ojs.unud.ac.id/index.php/eum53>
8. Erizon, Karani Y. HDL dan aterosklerosis. *J Human Care*. 2020;5(4):1123–31.
9. Ouimet M, Barrett TJ, Fisher EA. HDL and Reverse Cholesterol Transport. *Circ Res*. 2019 May 10;124(10):1505-1518. doi: 10.1161/CIRCRESAHA.119.312617. PMID: 31071007; PMCID: PMC6813799.
10. Arifin A, Ernawati F, Prihatini M. Hubungan kadar glukosa darah puasa terhadap peningkatan kadar lemak darah pada populasi studi kohor Kecamatan Bogor Tengah 2018. *J Biotek Medisian Indones*. 2019;8(2):87–93.
11. Purwanti WNA, Jirna IN, Arjani IAMS. Analisis hubungan kadar gula darah puasa dengan kadar kolesterol high density lipoprotein (HDL) pada pasien diabetes melitus tipe 2 di RSUP Sanglah. *J Meditory*. 2016;4(2):65-72.
12. Siorcani PT, Suastika K, Gotera W, Made I, Dwipayana P. Profil lipid pada pasien diabetes melitus tipe 2 di RSUP Sanglah Denpasar tahun 2019. *J Med Udayana*. 2022;11(1):95–100. Available from: <https://ojs.unud.ac.id/index.php/eum95>
13. Isnaini N, Ratnasari R. Faktor risiko mempengaruhi kejadian Diabetes mellitus tipe dua. *JKK* [Internet]. 2018 Jun. 12 [cited 2025 Sep. 11];14(1):59-68. Available from: <https://ejournal.unisayogya.ac.id/index.php/jkk/article/view/550>
14. Benetos A, Petrovic M, Strandberg T. Hypertension Management in Older and Frail Older Patients. *Circ Res*. 2019 Mar 29;124(7):1045-1060. doi: 10.1161/CIRCRESAHA.118.313236. PMID: 30920928.



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15. WHO (World Health Organization). Hypertension. 2021 [cited 2022 Oct 13]. Available from: <https://www.who.int/news-room/fact-sheets/detail/hypertension>
16. Ben Cherifa F, El Ati J, Doggui R, El Ati-Hellal M, Traissac P. Prevalence of High HDL Cholesterol and Its Associated Factors Among Tunisian Women of Childbearing Age: A Cross-Sectional Study. *Int J Environ Res Public Health*. 2021 May 20;18(10):5461. doi: 10.3390/ijerph18105461. PMID: 34065252; PMCID: PMC8160772.
17. Suhaimi A. Hubungan kadar trigliserida serum dengan kadar glukosa darah puasa pada penderita diabetes melitus tipe 2 di RSUP Dr. M. Djamil Padang [Thesis]. Padang: Universitas Andalas; 2017;1-3.
18. Malau SR. Hubungan kadar glukosa darah puasa dengan profil lipid pada diabetes melitus tipe 2 [Skripsi]. Medan: Universitas HKBP Nommensen; 2014.
19. Rahayu PN. Hubungan Kadar Gula Darah Puasa dan Profil Lipid Pada Penderita Diabetes Melitus Tipe 2 dengan Kejadian Stroke Iskemik di RSUD R.A Basoeni Mojokerto. *JBP*. 2020 Dec. 1;22(2):50-62. Available from: <https://ejournal.unair.ac.id/BIOPASCA/article/view/23372>
20. Salim BRK, Wihandani DM, Dewi NNA. Obesitas sebagai faktor risiko terjadinya peningkatan kadar trigliserida dalam darah: tinjauan pustaka. *Intisari Sains Medis*. 2021 Jul 31;12(2):519.
21. Farizal J, Marlina L. Hubungan Kadar Trigliserida dengan Mahasiswa Obesitas. *Avicenna*. 2019 Sep. 18;14(02):42-6. Available from: <https://jurnal.umb.ac.id/index.php/avicenna/article/view/391>
22. Setiati S, Alwi I, Sudoyo AW, K MS, Setiyohadi B, Syam AF. *Buku Ajar Ilmu Penyakit Dalam*. 6th ed. Vol. 2. Jakarta: Interna Publishing; 2017. 2315-2420 p.
23. Cora DI, Engka JN, Pangemanan D. Hubungan konsumsi alkohol dengan kadar trigliserida pada mahasiswa. *JMR*. 2019;1(3):1-4. Available from: <https://ejournal.unsrat.ac.id/v3/index.php/jmr/article/view/22513>
24. Wowor FJ, Ticoalu SHR, Wongkar D. Perbandingan kadar trigliserida darah pada pria perokok dan bukan perokok. *Jurnal e-Biomedik (eBM)*. 2013;1(2):986-90. doi:10.35790/ebm.1.2.2013.3252.
25. Ge P, Dong C, Ren X, Weiderpass E, Zhang C, Fan H, et al. The High Prevalence of Low HDL-Cholesterol Levels and Dyslipidemia in Rural Populations in Northwestern China. *PLoS One*. 2015 Dec 7;10(12):1-13.
26. Mamat, Sudikno. Faktor-faktor yang berhubungan dengan kadar kolesterol HDL (Analisis Data of The Indonesian Family Life Survey 2007/2008). *Gizi Indon*. 2010;33(2):143-9.
27. Nurul Agustiyanti P, Fatimah Pradigdo S, Aruben R. Hubungan Asupan Makanan, Aktivitas Fisik dan Penggunaan Kontrasepsi Hormonal dengan Kadar Kolesterol Darah (Studi pada Wanita Keluarga Nelayan Usia 30-40 Tahun di Tambak Lorok, Semarang Tahun 2017). *Jurnal Kesehatan Masyarakat [Internet]*. 2017;5(4):737-43. Available from: <http://ejournal3.undip.ac.id/index.php/jkm>
28. Roro R, Irawati D, Meikawati W, Astuti R. Faktor-Faktor yang Berhubungan dengan Kadar Trigliserida dalam Darah (Studi Pada Penderita Diabetes Mellitus Di Rumah Sakit Bhakti Wira Tamtama Semarang). *J Kesehat Masy Indones*. 2013;8(1):36-46.
29. Rasyid NQ, Muawanah, Rahmawati. Gangguan Dislipidemia Pada Pasien Diabetes Mellitus. Vol. 3: Prosiding Seminar Nasional Hasil Penelitian. 2018;149-52. Available from: <https://jurnal.poliupg.ac.id/index.php/snp2m/article/view/836>