International Journal of Medical and Pharmaceutical Research
Website: https://ijmpr.in/ | Print ISSN: 2958-3675 | Online ISSN: 2958-3683
NLM ID: 9918523075206676
Volume: 4 Issue:6 (Nov-Dec 2023); Page No: 208-213

Original Article

Corelation of Giving Dha (Docosahexaenoic Acid) Supplements to Underweight Pregnant Women On Hba1c

Salsabila Ulinnuha Zaman[1], Salmon Charles P.T. Siahaan[1*], Rahajoe Imam Santosa[1]

[1]Departement Of Medicine, School Of Medicine Universities Ciputra, Surabaya, Indonesia

ABSTRACT

Background: Pregnancy is a physiological process in which the fetus develops in the body. Where underweight pregnancies are those with a Body Mass Index of <18.5kg/m^2. In pregnant women there will be many changes in the systems in the body. Apart from that, pregnant women need sufficient nutrition to consume. Nutritional status in the body can be obtained and obtained from food intake, and apart from food intake, pregnant women also need additional nutrition in the form of macronutrients and micronutrients such as omega 3 fatty acids, namely DHA. This research aims to find out whether there is an influence between HbA1c and DHA administration to pregnant women.

Method: This research uses an experimental type of research with a cohort research design, using one group pretest-posttest. By providing treatment to pregnant women at community health centers who meet the inclusion and exclusion criteria.

Results: Underweight pregnant women who were researched at the Made Surabaya Community Health Center with an age range of 21 to 36 years and a Body Mass Index ranging from 17.3 kg/m^2 to 18.80 Kg/m^2 were given supplementation in the form of DHA in this study. (Docosahexanoid acid) for one full month to be consumed by pregnant women.

Conclusion: this study was that there was a decrease in HbA1c levels in underweight pregnant women

Key Words: *DHA supplementation, pregnant women, HbA1c*

***Corresponding Author**
Salmon Charles P.T.Siahaan
Department Of Medicine, School Of Medicine Universitas Ciputra, Surabaya, Indonesia

INTRODUCTION

Pregnancy is the physiological process of developing a fetus inside the mother's body. Normal pregnancy is a pregnancy that occurs when the baby and mother and the gestational age are within the proper time period, namely 280 days or 40 complete weeks of pregnancy. Nutritional status in the body can be obtained from daily food intake. And it can have a big influence on the health conditions of the mother and fetus at the time of birth[1] Pregnant women with CED (Chronic Energy Deficiency) are pregnant women who experience nutritional deficiencies such as calories and protein. So it has an influence on the health of the mother and baby. Pregnant women can be said to have CED by looking at the LILA (Upper Arm Circumference) value < 23.5cm[2]. In short, CED in pregnant women is a status of malnutrition due to an imbalance between intake to meet needs and energy expenditure[3].

HbA1c examination is recommended as the gold standard for long-term blood glucose monitoring in diabetes sufferers. Based on research that has been carried out regarding diabetes in pregnant women conducted in Japan, there is increasing evidence and research regarding the correlation or relationship between high HbA1c levels in normal pregnancies, including premature pregnancies, and fairly old gestational age values[4]. Hemoglogbin A1C (HbA1c) merupakan protein yang timbul karena tingginya glukosa darah pada tubuh manusia, sehingga glukosa tersebut terglikasi menjadi suatu protein yang salah satunya berjenis Hb[5]. The ratio of HbA1c to non-glycated hemoglobin is the ratio used to diagnose diabetes. A healthy person has an Hba1c blood glucose of around 6.0%. Meanwhile, people suspected of suffering from diabetes mellitus (prediabetes) have between 42-47 mmol/mol, which is equivalent to 6.0-6.4%. And if it is above 6.5%, then this is a characteristic of diabetes sufferers.

Type 2 diabetes is closely linked to symptoms of obesity. In type 2 DM sufferers, the pancreas is able to maintain normal blood sugar levels, but insulin cannot work optimally to move glucose into cells. This is because someone who is overweight or suffers from obesity has very high cholesterol and triglyceride levels[6].

Decosahexaenoic Acid (DHA) is also an important component of cell membranes, especially in brain cells, which occurs during pregnancy. Pregnant women with low DHA levels experience depression, there will be many risks felt after giving birth, or they will even experience premature birth. During the embryonic stage, maternal DHA is very high and can reduce oxidative stress that can affect neutrophism. The human body cannot produce this substance itself, so it must be supplied from outside the body. Experts say that the human body needs about 300 mg of omega-3 per day[7], administration of omega 3 fatty acids can have the effect of reducing blood glucose levels as well as HbA1c on glycemic control in patients diagnosed with type 2 diabetes mellitus. Judging from the results of this study, HbA1c levels can actually decrease significantly ($p<0.01$) or from 11 .36 to 9.53 with the administration of omega 3 fatty acids[8].

METHODS

This research was conducted using experimental research with an experimental research design with a cohort research design. We used one group pretest-posttest. This research was conducted in Made sub-district. This research aims to study the correlation of giving treatment in the form of DHA supplementation to underweight pregnant women on HbA1c levels as research within a one month period of consuming DHA supplementation. Using a prospective approach to clearly see the effect of administering DHA (Omega 3) on HbA1c levels in patients with Underweight pregnant women in Made sub-districtIn the population and sample of this study, the research subjects were pregnant women in the underweight category and registered at the Made Community Health Center. The research subjects were pregnant women with underweight conditions characterized by a BMI <18.5 kg/m2

In this research, sampling was carried out using a non-probability sampling technique using quota and purposive sampling methods, so that the sample consisted of 21 underweight pregnant women who would be given treatment. The experimental group will receive treatment in the form of DHA supplementation. HbA1c levels will be checked before the treatment is given and also after the treatment is given. So, checking HbA1c levels will also be carried out before giving the DHA supplementation treatment and after giving the treatment. So in this technique, research will evaluate the impact of DHA supplementation on HbA1c levels in underweight pregnant women. From the results of sample calculations, it was found that there were 21 pregnant women using the calculation formula according to Lwamga and Lesemshow (1991)

The independent variable of this research is the provision of DHA supplementation, and the dependent variable is HbA1c levels, for the control variable, namely pregnant women diagnosed as underweight using a weight scale, no other comorbid diseases such as diabetes mellitus, kidney and heart disease and chronic hypertension were found. In the research, researchers need research instruments in the form of experiments or trials that will be carried out in the laboratory to collect data regarding changes in HbA1c levels in underweight pregnant women. The material used in this experiment is venous blood, and the tools used include a 3 cc syringe, alcohol swab. , tourniquet for taking blood The research was carried out in the period 1 June to 31 August 2023, then a normality test was carried out on all samples obtained and then data processing was carried out using SPSS.

RESULT

Weight body test

Based on the weight test analysis graph, it can be seen that the final body weight is higher than the initial body weight, which explains that there is a change in body weight. The test used in body weight analysis is the paired t-test because normality in body weight is in the normal distribution category (>0.05). The analytical result of body weight is 0.000 (0 <0.05) (Table 1.). So there is a significant difference between the initial and final BB.

Table 1. Weight body test

	N	Minumum	Maximum	Mean	Median	Std. deviation	T-test
BB. before	21	38.0	47.0	42.381	42.000	3.1855	0.000
BB.after	21	38.0	49.0	44.524	45.000	3.2805	

Height body test

In the height test, researchers used a paired t-test because the normality of the data could be said to be normal (>0.05). Based on the height t-test table, it can be seen that giving DHA has no effect on body height. This is supported by the results of the paired t-test which shows 0.840 (not <0.05) (Table 2.).

Table 2. Height body test

	N	Minumum	Maximum	Mean	Median	Std. deviation	T-test
Height before	21	144.5	161.0	152.129	152.000	5.4651	0.840
Height after	21	144.5	161.0	151.962	153.000	5.2125	

Body Mass Indeks test

In the BMI test, the data analysis used was a paired t-test because the normality of the BMI data was included in the normal category, namely > 0.05. It can be seen from the graph of the analysis results that there are changes in initial BMI and final BMI, which means that there is a change in BMI if pregnant women are given DHA. This is also supported by the results of the paired t-test which shows 0.000 (< 0.05) (Table 3.). In conclusion, giving DHA to pregnant women will result in the pregnant mother's BMI increasing.

Table 3. Body Mass Index

	N	Minumum	Maximum	Mean	Median	Std. deviation	T-test
BMI Before	21	17.33	18.80	18.3138	18.3000	31627	0.000
BMI After	21	18.30	21.70	19.3238	19.1000	87858	

***Upper arm circumference* test**

In the upper arm circumference test, researchers used a paired t-test because the final and initial upper arm circumference data were in the normal category (>0.05). Based on the analysis test graph, it can be seen that giving DHA will increase upper arm circumference in pregnant women (Table 4.). This is also supported by the t-test results, namely 0.003 (<0.05).

Table 4. Upper arm circumference test

	N	Minumum	Maximum	Mean	Median	Std. deviation	T-test
Upper arm circumference before	21	21.5	28.0	24.571	24.500	1.7413	0.003
Upper arm circumference after	21	20.6	29.0	25.571	25.800	2.2976	

Systolic pressure blood test

The normality of the final systolic BP data is 0.037 which is declared abnormal (not > 0.05) therefore the test used is non-parametric. So the test result obtained was 0.111 (not < 0.05), this explains that giving DHA has no effect on systolic blood pressure (Table 5.).

Table 5.Systolic pressure blood test

	N	Minumum	Maximum	Mean	Median	Std. deviation	T-test
Systolic before	21	90	128	103.38	101.00	9.041	0.111
Systolic After	21	85	140	106.48	105.00	12.898	

Diastolic pressure blood test

Researchers in conducting distolic BP tests use non-parametric analysis tests, this is because the normality of the data is not normal (not >0.05). This is supported by the Wilcoxon test results which produced 0.887 (not <0.05) so it can be concluded that giving DHA has no impact on distolic blood pressure (Table 6.).

Table 6. Diastolic pressure blood test

	N	Minumum	Maximum	Mean	Median	Std. deviation	T-test
Diastolic before	21	59	80	66.76	64.00	7.361	0.887
Diastolic After	21	51	94	67.43	63.00	11.479	

Height of the uterine fundus test

In the analysis test, the height of the uterine fundus was 0.001 (< 0.05), which means that this test is significant. Therefore, it can be said that giving DHA can increase the height of the uterine fundus in underweight pregnant women (Table 7.). Researchers in this test used non-parametric methods because the normality of the data was in the abnormal category.

Table 7. Height of the uterine fundus test

	N	Minumum	Maximum	Mean	Median	Std. deviation	T-test
Uterine fundus height before	21	6	33	15.95	14.00	7.460	0.001
Uterine fundus heightafter	21	10	35	18.52	17.00	7.366	

Hba1C Test

Researchers in carrying out analytical tests for Hba1C use non-parametric methods. This is done because the normality of the final Hba1C data is in the abnormal category (not> 0.05), it can be seen from the diagram of the results of the analytical tests carried out that there are changes, this is supported by the results of non-parametric statistical tests test is 0.031 (< 0.05) (Table 8.). So it can be concluded that giving DHA to underweight pregnant women can reduce Hba1c levels.

Table 8. Hba1C Test

	N	Minumum	Maximum	Mean	Median	Std. deviation	T-test
Hba1C before	21	3.99	5.79	4.7238	4.6200	0.58358	0.031
Hba1C After	21	3.99	5.39	4.4586	4.0100	0.55177	

DISCUSION

Docosahexaenoic Acid (DHA) is an essential fatty acid from the group of long chain fatty acids that are not saturated or known as omega-3 fatty acids. This fatty acid is said to be essential because the human body cannot physiologically synthesize DHA, so DHA must be obtained from food intake. DHA can be synthesized from vegetable intake that contains α-linoleic acid (ALA) or obtained directly from foods that contain DHA such as fish, fish oil, eggs, crab, shrimp and meat[9].

Effect of DHA Supplementation on Body Weight

In a study conducted by AASP. Chandradewi, explained that giving additional food containing DHA to pregnant women can increase body weight. This can happen because there are main factors, namely providing nutritious food containing DHA and sufficient protein[10]. This is in line with research conducted by researchers in Made and Simomulyo districts that giving DHA to underweight pregnant women can increase the weight of the pregnant woman herself. Siregar, et al.[11], in their research showed that there is a significant influence of omega-3 administration on a person's body weight. This also supports the researcher's opinion [12], explained that giving DHA supplements to a person can increase the person's weight because DHA supplements consumed for 3 weeks will indirectly increase the consumer's appetite[12].

Effect of DHA Supplementation on Body Mass Indeks

There is no strong evidence to show that DHA supplements directly affect increasing BMI. BMI is influenced by various factors such as diet and nutritional intake. In research conducted by Valverde, et al.[13], it was explained that intake of omega-3 polyunsaturated fats had an effect on BMI depending on the dose given. However, researchers explain that there is a possibility that increasing a high dose of omega-3 can increase a person's body mass index. So this supports the current research, namely that giving DHA supplements to pregnant women can increase the body mass of pregnant women. Another study found that giving DHA omega-3 supplements proved effective in controlling the development of obesity in mice by reducing the accumulation of body fat by limiting hypertrophy and hyperplasia of fat cells in mice[14].

Effect of DHA Supplementation on upper arm circumference

Salmon, et al experimented with providing micronutrient supplementation repeatedly. So this can change the upper arm circumference of CED pregnant women to increase and be equivalent to normal pregnant women. Thus, giving these supplements has an effect on increasing the upper arm circumference of a pregnant woman[2]. This strengthens research conducted by researchers which explains that giving DHA supplements to underweight pregnant women can also increase the upper arm circumference of underweight pregnant women. Hylde, et al. conducted similar research, namely omega-3 fatty acid therapy. In her research, Hylde found that the effect of this therapy was related to an increase in a person's body mass, so this also referred to an increase in the circumference of the person's upper arms[15].

Effect of DHA supplementation on Systolic and Diastolic Blood Pressure

Research conducted by Mega Lucyta Sari, et al. found that giving omega-3 supplements of 1.3 grams/day had no relationship with a person's blood pressure[16], so this can support the results of this research. However, research conducted by[17] explains that based on clinical trials, it shows that DHA is useful in reducing a person's blood pressure and heart rate. Although not all trials produced conclusive results, researchers succeeded in conducting a double-blind, controlled study for 3 months which resulted in a reduction in the blood pressure of patients treated with DHA and managed to drop 3.3mmHg[17].

Effect of DHA supplementation on height of the uterine fundus

(Salmon Charles, et al. 2021) Analyzing the uterine fundal height of CED pregnant women with normal pregnant women, the research results were 22.4+0.828 vs 18.8+1.014(95%Cl; p<0.0001), so according to these results it can be concluded that CED pregnant women have a smaller uterine fundal height compared to normal pregnant women, this can affect the size of the pregnant woman's fetus. The results of this research are directly proportional to the results of research conducted by researchers. Underweight pregnant women who are given DHA supplements can increase their

TFU. This is supported by analysis tests from data taken by researchers which show figures below 0.05 (0.01). This research is also supported by research conducted by Faradina which explains that indirectly there is a correlation with the provision of sufficient nutrition and supplements to the height of the uterine fundus in pregnant women so that this is also related to the baby's weight . Thus, Aghadiati[18], explains that providing nutritional intake such as DHA supplements can increase the height of the uterine fundus in pregnant women DHA supplements can increase uterine fundal height in pregnant women. Scientific research conducted by febryanti also explains that fetal growth in pregnant women is also influenced by the weight of the pregnant woman, underweight pregnant women tend to have a smaller uterine size so this explains the relationship with nutrition and the provision of DHA to the mother. pregnant to get the adjusted body weight[19].

Effect of DHA supplementation on Hba1C

Omega 3 fatty acids (DHA) can control glycemic and lipid profiles, where omega 3 fatty acids can cause a significant decrease in blood glucose. This is of course related to a person's Hba1c. Research conducted by Wang et al proves that omega 3 DHA supplementation can effectively reduce hba1c levels where omega 3 supplementation can inhibit gluconeogenesis by inhibiting the activity of the Alanine transaminase enzyme in the liver[20], citing previous research by Giron in 1999, which explained that consumption of omega 3 can reduce blood sugar levels by increasing the GLUT-4 transporter which will induce muscle. This is of course also in line with a decrease in a person's Hba1c levels[21]. So that this research can strengthen the results of research that has been carried out by researchers which resulted in a relationship between giving DHA and a person's Hba1c level, giving DHA supplements can reduce the person's Hba1C level.

CONCLUSION

The Utilization of DHA supplements can be considered as one of the alternatives to lower HbA1c levels in underweight pregnant women, There are several effects of DHA supplementation on various factors in underweight pregnant women, including weight, systolic blood pressure, diastolic blood pressure, body mass index, and also on HbA1c levels. The provision of DHA supplements (omega-3) is essential for individuals because the body cannot produce this substance independently, this requiring external supply. Administering omega-3 supplements to underweight pregnant women leads to an increase in body weight, aligning with the findings of the researcher's analysis and supported by previous studies

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to God almighty who has given his grace, apart from that I also express my deepest gratitude to the parties involved in this research, we I would like to express my thanks to the team from the Faculty of Medicine, Ciputra University, who have supported and have high expertise in improving the quality of this researd. We would also like thanks to Dr. Salmon Charles P.T. Siahaan, dr.,Sp.OG. and dr. Rahajoe Imam Santosa,Sp PK (K) who has provided very useful guidance and input for this research as well as the laboratory team at Ciputra University Surabaya who have also helped facilitate the implementation of this research of this research. We would also like to thanks the participants who took the time to take part in this research.

DECLARATION

Funding: This research was conducted using personal founs.

Conflict of interest : there are no conflicts that clould influence the results or interpretation of this research.

Ethical approval : This research has obtained a research clearance letter from the National Unity and politics Body with approval number 070/7040/209/2023. All producers involving research subject were carried out in accordance of the Faculty of Medicine, Ciputra University, with approval number 046/EC/KEPK-FKUC/VI/2023. All participants provided written consenst before participating in this research

REFERENCE

1. Ningrum, E. W., & Cahyaningrum, E. D. (2018). Status gizi pra hamil berpengaruh terhadap berat dan panjang badan bayi lahir. *MEDISAINS: Jurnal Ilmiah Ilmu-Ilmu Kesehatan*, *16*(2), 89–94. https://doi.org/10.30595/medisains.v16i2.3007
2. Siahaan, S. C., Henderi, H., Sudibjo, Safitiri, N. P. D., Berlian Ester Wakas, & Pratama, M. F. I. (2021). Intervensi Ibu Hamil Dengan Kurang Energi Kalori Melalui Suplementasi Mikronutrien Di SurabayaTahun 2019. *Majalah Kedokteran Andalas*, *44*(1), 17–27.
3. Fitrianingtyas, I., Pertiwi, F. D., & Rachmania, W. (2018). Faktor-Faktor Yang Berhubungan Dengan Kejadian Kurang Energi Kronis (KEK) Pada Ibu Hamil Di Puskesmas Warung Jambu Kota Bogor. *HEARTY : Jurnal Kesehatan Masyarakat*, *6*(2 SE-Artikel). https://doi.org/10.32832/hearty.v6i2.1275
4. Lu, Y., Huo, Z., Ge, F., & Luo, J. (2022). Pregnancy Status Is Associated with Lower Hemoglobin A1c among Nondiabetes Women in the United States from NHANES 2005–2016. *International Journal of Endocrinology*, *2022*, 4742266. https://doi.org/10.1155/2022/4742266
5. Amran, P., & Rahman. (2018). Ensiklopedia Keperawatan Edisi Bahasa Indonesia. *Jurnal Media Analis Kesehatan*, *9*(2), 149–155. https://doi.org/https://doi.org/10.32382/mak.v9i2.686

6. Sartika, F., & Hestiani, N. (2019). Kadar HbA1c pada Pasien Wanita Penderita Diabetes Mellitus Tipe 2 di Rsud Dr. Doris Sylvanus Palangka Raya: HbA1c Levels in Patients Female with Type 2 Diabetes Mellitus in RSUD Dr. Doris Sylvanus Palangka Raya. *Borneo Journal of Medical Laboratory Technology*, *2*(1 SE-Articles), 97–100. https://doi.org/10.33084/bjmlt.v2i1.1086
7. Suhendra, Zahro, H., Sulistiawati, E., Neubauer, P., & Hutari, A. (2019). Kajian Singkat Potensi Rancang Bangun Pabrik Omega-3 (DHA) Kemurnia Tinggi Berbahan Baku Spesies Aurantiochytrium dari Hutan Bakau Indonesia Untuk Menunjang Ketahanan Pangan Nasional. *Jurnal KONVERSI*, *8*(1), 10.
8. Latifa, K., Sanjiwani, M., & Mulyani, W. (2019). Potensi Asam Fatty Omega 3 Dalam Perlindungan Retinal Melalui GPR120 / Arrestin2 Tanda Tanda Aktivasi Pathway Sebagai Sebuah Preventif Inovatif Dan Terapi Katatif Terapi Diabetik Retinopati Diabetik. *Al-Iqra Medical Journal : Jurnal Berkala Ilmiah Kedokteran*, *2*(1), 38–49. https://doi.org/10.26618/aimj.v3i1.2748
9. Asifa, C., & Rodiani, R. (2021). Suplementasi Docosahexaenoic Acid (Dha) Sebagai Usaha Preventif Ibu Hamil Dengan Risiko Preeklampsia. *Jurnal Kesehatan*, *14*(1), 78–85. https://doi.org/10.24252/kesehatan.v14i1.15442
10. Chandradewi, AASP. (2015). Pengaruh Pemberian Makanan Tambahan Terhadap Peningkatan Berat Badan Ibu Hamil KEK (Kurang Energi Kronis) di Wilayah Kerja Puskesmas Labuan Lombok. *Jurnal Kesehatan Prima*, *9*(1), 1391–1402.
11. Siregar, M. H., & Koerniawati, R. D. (2022). Analisis Asupan Omega-3 Pada Ibu Hamil Di Wilayah Puskesmas Cadasari, Pandeglang. *Jurnal Kesehatan Medika Udayana*, *6*(2), 66–78. https://doi.org/10.47859/jmu.v6i2.167
12. Alipoor, B., Moradi, S., M, A. J., Khajebishak, Y., M, A., & M, A. (2020). Is Omega-3 Supplementation Changes the Body Weight, Fat Mass, and Fat-Free Mass? A Systematic Review and Meta-Analysis of Rcts. *Korean Journal of Clinical Medicine*, *01*. https://doi.org/10.47829/KJCM.2020.1202
13. Valverde, L., Elodia, G.-C., Eduardo, P.-G., Hau, L., rosas nexticapa, M., Virginia, M.-A., Parra Galindo, P., & Cauich, R. (2018). Biological activity exerted by omega-3 fatty acids on body mass index, glucose, total cholesterol and blood pressure in obese children. *Integrative Obesity and Diabetes*, *4*. https://doi.org/10.15761/IOD.1000199
14. Salman, H. B., Salman, M. A., & Yildiz Akal, E. (2022). The effect of omega-3 fatty acid supplementation on weight loss and cognitive function in overweight or obese individuals on weight-loss diet. *Nutricion Hospitalaria*, *39*(4), 803–813. https://doi.org/10.20960/nh.03992
15. Zirpoli, H., Chang, C. L., Carpentier, Y. A., Michael-Titus, A. T., Ten, V. S., & Deckelbaum, R. J. (2020). Novel Approaches for Omega-3 Fatty Acid Therapeutics: Chronic Versus Acute Administration to Protect Heart, Brain, and Spinal Cord. *Annual Review of Nutrition*, *40*, 161–187. https://doi.org/10.1146/annurev-nutr-082018-124539
16. Sari, M. L., Probosari, E., & Wijayanti, H. S. (2017). Hubungan Asupan Asam Lemak Omega-3 Dan Omega-6 Dengan Tekanan Darah Wanita Usia 30 – 50 Tahun. *Journal of Nutrition College; Vol 6, No 4 (2017): Oktober*. https://doi.org/10.14710/jnc.v6i4.18668
17. Cabo, J. V., Alonso, R., & Mata, P. (2012). Omega-3 fatty acids and blood pressure. *British Journal of Nutrition*, *107*, S195–S200.
18. Aghadiati, F. (2019). Hubungan Asupan Gizi, Tinggi Fundus Uteri dan Sosial Ekonomi dengan Berat Bayi Lahir. *Scientia Journal*, *8*(1), 338–347.
19. Benu, F. D. (2016). *Asuhan Kebidanan Komprehensif Pada Ny."S" G1P000 Usia Kehamilan 29 Minggu Dengan Masalah Janin Letak Lintang, Anemia, TFU Tidak Sesuai Usia Kehamilan, Riwayat Keputihan Patologis, dan Alergi Makanan Laut Di Wilayah Kerja Baru Tengah Kota Balikpapan Tahun* . Politeknik Kesehatan Kemenkes Kalimantan Timur.
20. Wang, L. Z., Cheung, C. Y., Tapp, R. J., Hamzah, H., Tan, G., Ting, D., Lamoureux, E., & Wong, T. Y. (2017). Availability and variability in guidelines on diabetic retinopathy screening in Asian countries. *The British Journal of Ophthalmology*, *101*(10), 1352–1360. https://doi.org/10.1136/bjophthalmol-2016-310002
21. Caressa, D. A., Adi, A. C., Adiningsih, S., Purwoto, S. P., & Pranoto, A. (2022). Pengaruh Pemberian Minyak Ikan Lemuru Terhadap Kadar Glukosa Darah Puasa Pada Tikus Wistar Hiperglikemia. *Indonesian Journal of Human Nutrition*, *9*(1 SE-Articles), 25–39. https://doi.org/10.21776/ub.ijhn.2022.009.01.3