Correlation of Healthy Living Behavior with HbA1c Value and Increasing Creatinine Levels in Diabetes Melitus

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Abstract. Diabetes mellitus can cause both acute and chronic complications, one of which is diabetic nephropathy. Therefore, it is necessary to look for problem solving with healthy living behaviors. The purpose of implementing healthy lifestyle behavior of people with diabetes mellitus is to slow the occurrence of complications. Healthy life behaviors that are implemented by people with diabetes mellitus are knowledge, dietary rules, physical exercise, drug therapy, to monitoring glucose levels. The purpose of this study was to determine the relationship between healthy living behavior with HbA1c values and increased creatinine levels in people with diabetes mellitus. The research method used was observational with cross sectional approach. The number of samples used was 54 people with diabetes mellitus. This research was conducted by distributing questionnaires and examining HbA1c levels and creatinine levels by using a statistical spearmen test to determine the relationship. Statistical test results show the relationship between healthy behavior with HbA1c is $0,224 > 0.05$ which means there is no relationship between healthy living behavior with HbA1c value and there is no direct relationship between HbA1c value with increased creatinine levels. While the value of the relationship between healthy behavior with an increase in creatinine levels is $0.021 < 0.05$ and has a strength of 313 and the direction of a negative relationship, which means there is a negative relationship between healthy behavior with an increase in creatinine levels in patients with diabetes mellitus. This indicates that the better the healthy living behavior, the lower creatinine levels in diabetics even though there is no direct relationship with HbA1c values with creatinine levels, so that healthy living behavior can be one way to prevent complications of diabetes mellitus.

Keywords: Diabetes mellitus · Healthy behavior · HbA1c · Creatinine

1   Introduction

Diabetes melitus (DM) is a metabolic disorder with significantly increased prevalence. Based on WHO (2010), type 2 DM has increased in Indonesia up to 21,3 millions in

2030 [1]. In other hand, Barriga [2] estimated DM type 2 prevalence in 2030 around 450 millions all around the world [1]. This increase will absolutely impact the complications of DM [3].

Complications of DM can be acute or chronic in relations to hypertension, hypercoagulation, dyslipidemia and renal dysfunction. In Indonesia at least 1785 people with DM that having neuropathy (63,5%), retinopathy (42%), nefropathy (7,3%), macrovascular (16%), microvascular (6%) and diabetic foot ulcers (15%) [4].

Renal dysfunction or renal failure is one of complications of DM that included in microvascular complications, a complications that occur in fine blood vessels. It happens because of damage on renal fine blood vessels. Damage of blood vessels can cause damage on glomerulus that function as blood filters. High level of blood glucose will change the structure of renal and its function. Under normal circumstances the protein is not filtered and does not pass through the glomerulus because the large size of the protein cannot pass through the small openings of the glomerulus. But, glomerulus damage makes albumin can pass the glomerulus filters so we can detect protein in urine that we call as microalbuminuria. Renal failure also can be detected from creatinine assessment in blood to asses glomerulus filtration rate [5].

As many complications caused, it is necessary to take a preventive to avoid the DM complications. One of the preventive actions is healthy life style, such as doing blood glucose control continuously, adhere to a low-sugar diet, physical exercise, consumption of anti-diabetic drugs, and diabetic foot care [6]. The healthy lifestyle carried out by the two subjects who are patients with type 2 DM is through exercise (exercise), regulation of diet (diet) and drugs (insulin) and added knowledge (education) about diabetes. These three things, coupled with knowledge, cannot be separated and must be done in a balanced way [7]. In general, people with diabetes mellitus have poor practices in the management of diabetes mellitus, including not following a diet that is not recommended, not controlling blood sugar levels, and rarely exercising. The results of Diabetes Control And Complication Tial (DCCT) show that good DM control can reduce chronic complications of DM between 20–30% [8]. Paying attention to healthy living behavior by people with diabetes mellitus is the same as preventing the occurrence of complications as a whole, because when people with diabetes mellitus already know and apply healthy lifestyle behaviors, the risk for complications to occur is smaller. Therefore, researchers want to conduct research on the relationship between healthy living behavior with HbA1c values and increased blood creatinine levels in people with diabetes mellitus. The purpose of this study was to determine the relationship between healthy living behavior with HbA1c levels and increased creatinine levels in people with diabetes mellitus.

2 Methods

This is an observational analytics research with cross sectional approach where data collections was done in a time [9]. We were look a correlations between dependent and independent variables. The method used is the method of collecting data using a healthy lifestyle questionnaire and measuring the value of HbA1c and blood creatinine levels in people with diabetes mellitus. The place of research was carried out at Permata Gerung Clinic from June to August 2019.

2.1 Populations and Sample

Populations on this research are patients who came to medcheck and diagnosed as DM by clinicians Klinik Permata Gerung. The samples are populations that meet the criteria as research samples. The sampling method in this study is purposive sampling using inclusion and exclusion criteria [10]. The inclusion criteria in this study were people with diabetes mellitus, willing to be research subjects by signing an informed consent. Exclusion criteria in this study were patients with diabetes mellitus who were not willing to be research subjects. Patients with diabetes mellitus who became respondents in this study were given counselling about healthy living behaviors that need to be carried out by people with diabetes mellitus.

Samples was calculations by analytics corelative pattern [11]:

$$n = \left\{ \frac{Z_\alpha + Z_\beta}{0,5 \ln[(1 + r)/(1 - r)]} \right\}^2 + 3$$

Descriptions:

$Z\alpha$ = standard derivative alpha, with type 1 error of 5% and hypothesis 2 so that the value is 1,96.

$Z\beta$ = standard derivative beta, with a type 2 error of 20% so that the value is 0.84.

r = the minimum correlation that is considered significant is 0.4.

n = number of samples.

After calculating, obtained a minimum sample of 49 people with diabetes mellitus added with an estimated drop out of 10% so that a minimum sample of 54 people with diabetes mellitus is needed.

2.2 Data Collection Techniques

Data collection techniques in this study were recording patient status information, namely to obtain information about the characteristics, general condition, and diagnoses of research subjects, distributing questionnaires on healthy lifestyles for people with diabetes mellitus, laboratory examinations, namely to obtain information about HbA1c values and blood creatinine levels. The data processing technique was carried out by entering the results of the questionnaire and the results of the HbA1c examination and blood creatinine levels so that it became the master data.

2.3 Analysis Data Techniques

The data analysis technique used in this study used a statistical program (SPSS). Statistical methods used are descriptive and analytical methods. Descriptive method is done by calculating the median value, the mean value. The analytical method was carried out using the spearmen test or the Pearson test, which had previously been tested for normality of the data using the Kolmogorov Smirnov test so that it was known that the data was normally distributed or not normally distributed. The results of statistical tests are considered to have a significant relationship if the p value < 0.05.

Table 1. Subject's Demographic Characteristics.

Demographic Characteristics	(n = 54)	Percentage (%)
Gender		
Male	20	37.1
Female	34	62.9
Age		
≤45	2	3.7
≥46	52	95.3

3   Result and Discussions

3.1   Result

1) *Research Characteristics*

Demographic characteristics that need to be known are gender and age of people with diabetes mellitus which can be seen in Table 1.

Based on Table 1, it is stated that the number of people with diabetes mellitus who are male is 20 people (37.1%) and women are 34 people (62.9%). The number of people with diabetes mellitus aged less than or equal to 45 years was 2 people (3.7%) and 52 people (95.3%) were aged greater than or equal to 46 years.

2) *Test the Validity and Reliability of the Questionnaire*
a. *Validity of the Questionnaire Test*

The results of the questionnaire validity test of healthy living behavior in patients with diabetes mellitus can be seen in Table 2.

Based on Table 2 that the results of the validity test of the healthy living behavior questionnaire get the results that all data have valid results so that these statements can be used to measure the healthy living behavior of people with diabetes mellitus.

b. *Questionnaire Reliability Test*

The results of the questionnaire reliability of healthy living behavior in patients with diabetes mellitus can be seen in Table 3.

Based on Table 3 that the results of the questionnaire reliability test of healthy living behavior get the results that all data have reliable results so that these statements can be used to measure healthy living behavior of people with diabetes mellitus.

3) *The Relationship between Healthy Living Behavior and Increased Creatinine Levels in Diabetes Mellitus Patients*
a. *Normality Test*

The results of the normality test of the relationship between healthy behavior and increased creatinine in people with diabetes mellitus can be seen in Table 4.

Table 2. Healthy Life Behavior Questionnaire Validity Test Results.

Variable	Questions	Cronbach's Alpha.	Descriptions
Healthy Life Behavior	1	0.759	Valid
	2	0.759	Valid
	3	0.759	Valid
	4	0.786	Valid
	5	0.788	Valid
	6	0.804	Valid
	7	0.737	Valid
	8	0.736	Valid
	9	0.750	Valid
	10	0.789	Valid

Table 3. Test Results of the Validity of the Healthy Life Behavior Questionnaire

No	Variable	Cronbach's Alpha.	Description
1	Health Life Behavior	0.787	Reliable

Table 4. Normality Test Results.

One-Sample Kolmogorov-Smirnov Test	
	Asymp. Sig. (2-tailed)
Healthy Life Behavior	.000[c]
Creatinine	.002[c]
HbA1c	.009[c]

Based on Table 4, the results of the normality test of the relationship between healthy living behavior and HbA1c ksdr and an increase in creatinine levels showed that all data had a healthy lifestyle result of 0.000 and a creatinine of 0.002 which indicated the value was < 0.05, which means the data is said to be not normally distributed so that the test is the relationship between healthy living behavior and increased creatinine levels using non-parametric statistical tests in this case the spearmen test.

Table 5. Test Results of the Relationship of Healthy Lifestyle with HbA1c Values and Increased Creatinine Levels in Patients with Diabetes Mellitus

Spearmen Test			
		HbA1c	Creatinins
Healthy Life Behavior	Correlation Coefficient	−.168	−.313*
	Sig. (2-tailed)	.224	.021
	N	54	54
HbA1c	Correlation Coefficient		−.188
	Sig. (2-tailed)		.173
	N		54

b. *Test the Relationship of Healthy Lifestyle With HbA1c Value and Increased Creatinine Levels in Diabetes Mellitus Patients*

Table 5 states that the results obtained from the relationship between healthy living behavior and the HbA1c value are 0.224, which means > 0.05 and this indicates that there is no significant relationship between healthy living behavior and the high HbA1c value of people with diabetes mellitus. The same results were obtained from the relationship between the HbA1c value and creatinine levels, which showed a value of 0.173, meaning that the value was > 0.05 which indicated that there was no relationship between the HbA1c value and creatinine levels. In contrast to the results obtained from the relationship between healthy living behavior and increased creatinine levels in diabetics, there is a relationship between healthy living behavior and increased creatinine levels in people with diabetes mellitus with a significance value of 0.021, which means less than 0.05. Healthy living behavior has a weak relationship with increased creatinine levels in patients with diabetes mellitus with a value of 313 and has a negative relationship direction.

3.2 Discussions

This research held on Klinik Permata Gerung, June to august 2019 with 54 diabetic respondent. This research was conducted by distributing questionnaires to the respondents and examining the HbA1c and creatinine levels. Based on demographic characteristics, the number of people with diabetes mellitus is divided into several characteristics, namely gender and age. The number of people with diabetes mellitus who are male as many as 20 people (37.1%) and women as many as 34 people (62.9%). The number of people with diabetes mellitus with female gender is more than male gender. This can be because women have risk factors for type 2 diabetes such as obesity, diet and physical activity, increasing age, insulin resistance, family history of diabetes, and ethnicity. Changes in diet and physical activity associated with rapid urbanization have led to a sharp increase in people with diabetes mellitus. These results are in accordance with research conducted by Wahyuni and Alkaff [12] which states that the percentage of

diabetes mellitus in women of reproductive age is 3.6%, therefore it is necessary to be concern in order to prevent DM in women as a risk factors [12].

Demographic characteristics based on age obtained the number of people with diabetes mellitus aged 45 years as many as 2 people (3.7%) and those aged 46 years as many as 52 people (95.3%). This can be proven by increasing age, the greater the risk factor for the occurrence of a disease caused by decreased body function. Changes due to old age itself such as reduced muscle mass and vascular changes are associated with peripheral insulin retention in Type II diabetes mellitus. Decreased glucose tolerance in the elderly is associated with reduced sensitivity of peripheral cells to insulin, causing an increase in blood sugar levels in the elderly. This study is in line with research conducted by Betteng et al. which stated that the number of people with diabetes mellitus aged 46 years was 31 people (56.4%) more than those aged 45 years were 24 people (43.6%) [13]. Apart from demographic characteristics, this study looked at the pattern of the relationship between healthy living behavior with HbA1c values and increased creatinine levels.

The results of the study on the relationship between healthy living behavior and the HbA1c value showed that there was no significant relationship between healthy living behavior and the HbA1c value. This indicates that the healthy lifestyle applied by people with diabetes mellitus does not necessarily reduce the HbA1c value and explains that there are other factors that influence the decrease in the HbA1c value apart from healthy living behavior. Several factors that can affect the value of HbA1c are age, obesity, duration of suffering from diabetes mellitus but obesity and duration of DM were not carried out in this study. This is in accordance with the results of the study that aged >46 years there were 95.3% of the total respondents. These results were also obtained by Sarifah [14] who stated that the factors that influence the high blood sugar levels in diabetes mellitus patients undergoing diabetes mellitus therapy include age and adherence to light physical exercise14. While the factors of knowledge, obesity, dietary compliance, adherence to medication consumption and stress did not affect the high blood sugar levels in diabetes mellitus patients undergoing diabetes mellitus therapy [14].

Research conducted by Dewi [15] stated that dietary knowledge, exercise knowledge, medication knowledge and dietary attitudes could not affect the increase in blood sugar levels of people with diabetes mellitus [15]. In this study, there are several indicators that become a benchmark for healthy living behavior in people with diabetes mellitus, namely adherence to medication, physical activity, type of food, regular exercise. The indicator was developed using the validity and reliability test of the questionnaire before being used as a measuring tool in measuring the relationship between healthy living behavior with HbA1c values and blood creatinine levels in people with diabetes mellitus with reference to the Data and Information Center of the Ministry of Health of the Republic of Indonesia in 2018. According to research conducted by Naglaa and Mohamed in 2010 is health education about knowledge, attitudes will change HbA1c levels in people with diabetes mellitus [16]. Meanwhile, according to Kirsten et al., 2010 that a strict diet can affect glycemic control but hypoglycemic drug therapy has not been able to optimally affect the HbA1c value [17].

In contrast to the results of the relationship between healthy living behavior and creatinine levels, which states that there is a relationship between healthy lifestyle behaviors and increased creatinine levels in people with diabetes mellitus. The relationship has a weak value and the direction of the relationship is negative. This indicates that the better the behavior of healthy living, the lower the creatinine levels in people with diabetes mellitus. Patients with diabetes mellitus if they can carry out a healthy lifestyle such as eating healthy foods, doing good physical activity, following regular exercise and taking regular medications can prevent complications, both macrovascular complications and microvascular complications, especially kidney complications.

Complications in diabetes mellitus occur due to many things such as the duration of diagnosis of diabetes mellitus, age, gender, and healthy living behavior. Healthy lifestyle is one of the biggest risk factors that cause complications in people with diabetes mellitus. This study is in line with research conducted by Anani et al. which states that there is a relationship between the habit of taking medication, physical activity, exercise and eating habits with blood glucose conditions. While the regularity of glucose examination is not related to the blood glucose condition of DM patients at Arjawinangun Hospital, Cirebon Regency [18].

The results of research conducted by Sartika et al. at Prof. Hospital. Dr. R. D. Kandou Manado in June 2013 is that there is a relationship between diet and the incidence of Type-2 Diabetes Mellitus at the BLU Interna Polyclinic RSUP. Prof. Dr. RD Kandou Manado, the type of food that is preferred and often consumed by respondents with type 2 DM is that it contains a lot of sugar and can increase blood glucose levels such as cakes, tarts, lunkhead, and cakes that are too sweet, syrup drinks, soft drinks, ice sweet tea and sweetened condensed milk, irregular eating frequency in respondents with type 2 DM and untimely eating habits due to their busy work and often uncontrolled eating. So that the respondent's diet is not good and causes type-2 Diabetes Mellitus [19].

Healthy living behaviors that can be carried out according to the questionnaire in this study include, among others, applying proper eating patterns by paying attention to the type, amount, and meal schedule; doing sports regularly with the type and rhythm set for a short duration; take medication from the doctor regularly; controlling checks with doctors to treat DM and doctors to treat diabetes complications on a regular basis; stress management by getting closer to God; and pay attention to sleep patterns and limiting excessive physical activity so as not to trigger an increase in blood sugar levels and prevent complications [20]. While the relationship between HbA1c values and creatinine levels is greater than 0.05, which means that there is no significant relationship between HbA1c values and creatinine levels. This indicates that a high HbA1c value does not directly affect the increase in creatinine levels, so it can be said that an increase in creatinine levels is not always caused by a high HbA1c value. This is evidenced by research conducted by Sri Septi Maulina [21] the relationship between blood sugar levels and serum creatinine levels in type 2 diabetes mellitus patients that there is no correlation between blood sugar levels and serum creatinine [20]. The increase in creatinine levels in people with diabetes mellitus can occur due to long suffering from diabetes mellitus, age suffering from diabetes mellitus, gender of people with diabetes mellitus and healthy living behavior of people with diabetes mellitus.

4   Conclusions

Based on the results of the study, it can be concluded that there is no relationship between healthy living behavior and HbA1c values and there is no direct relationship between HbA1c values and creatinine levels. Meanwhile, the relationship between healthy living behavior and increased creatinine levels in patients with diabetes mellitus has a significant relationship with a value of $0.021 < 0.05$ and has a weak relationship with a negative relationship. This indicates that the better the behavior of healthy living, the creatinine levels will decrease. Suggestions from the results of this study are as follows: Further researchers can perform or see other factors that are risk factors for complications of diabetes mellitus. Patients with diabetes mellitus; in order to pay attention to a healthy lifestyle so that it can avoid complications of diabetes mellitus, especially kidney complications. Researcher; in order to be able to provide counseling to the community how the role of healthy living behavior in preventing the occurrence of kidney complications in particular.

References

1. Suci, D. P. Herlina Wungouw, "Kadar Glukosa Darah Sewaktu Pada Pasien Diabetes Melitus Tipe 2 Di Puskesmas Bahu Kota Manado." J e-Biomedik. 3(1):32-40. 2015. doi:https://doi.org/10.1093/nq/s6-VIII.184.7-b

2. J. J. Sánchez-Barriga, "Mortality trends from diabetes mellitus in the seven socioeconomic regions of Mexico, 2000-2007." Rev Panam Salud Pública. 28(5), pp. 368-375. 2010. doi:https://doi.org/10.1590/S1020-49892010001100007

3. L. Guariguata, D. R. Whiting, I. Hambleton, Beagley J, Linnenkamp U, Shaw JE. Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes Res Clin Pract. 2014;103(2):137–149. doi:https://doi.org/10.1016/j.diabres.2013.11.002

4. O. S. Purwanti, "Hubungan Faktor Risiko Neuropati Dengan Kejadian Ulkus Kaki Pada Pasien Diabetes Mellitus Di Rsud Moewardi Surakarta." 130–134. 2010. https://publikasiilmiah.ums.ac.id/bitstream/handle/11617/3403/19.OKTI.pdf?sequence=1.

5. H. N. Reich, G. Y. Oudit, J. M. Penninger, J. W. Scholey, A. M. Herzenberg, "Decreased glomerular and tubular expression of ACE2 in patients with type 2 diabetes and kidney disease." Kidney Int. 74(12): 1610-1616. 2008. doi:https://doi.org/10.1038/ki.2008.497

6. E. Decroli, "Diabetes Melitus Tipe 2." Padang: Pusat Penerbitan Bagian Ilmu Penyakit Dalam Fakultas Kedokteran Universitas Andalas Padang, 2019. http://repo.unand.ac.id/21867/1/BukuDiabetesMelitus%28Lengkap%29.pdf.

7. N. Sundari, F. S. T. Dewi, M. R. Ikhsan, "Perilaku gaya hidup dan obesitas sebagai faktor risiko kejadian diabetes melitus tipe 2 di RSUD. Aji Batara Agung Dewa Sakti Samboja Kabupaten Kutai Kartanegara." Ber Kedokt Masy. 32(12): 461. 2016. doi:https://doi.org/10.22146/bkm.8337

8. N. Ramadhan, S. Hanum, "Kontrol Glikemik Pada Penderita Diabetes Mellitus Tipe 2 Di Puskesmas Jayabaru Kota Banda Aceh." Sel J Penelit Kesehat. 3(1): 1-9. 2017. doi:https://doi.org/10.22435/sel.v3i1.6376.1-9

9. W. Purnama, "Metode Penelitian. Skripsi". 53(1): 16. 2013. doi:https://doi.org/10.1017/CBO9781107415324.004

10. J. Oliver, "Metode Penelitian. Metod Penelit." 34–46. 2013. doi:https://doi.org/10.1017/CBO9781107415324.004

11. M. S. Dahlan, "Besar Sampel Dan Cara Pengambilan Sampel Dalam Penelitian Kedokteran Dan Kesehatan" Edisi 3 Seri Evidence Based Medicine 2. 2010.

12. S. Wahyuni, R. N. Alkaff, "Diabetes Mellitus Pada Perempuan Usia Reproduksi di Indonesia Tahun 2007." J Kesehat Reproduksi. 3(1): 46 – 51. 2013.

13. R. Betteng, "Analisis Faktor Resiko Penyebab Terjadinya Diabetes Melitus Tipe 2 Pada Wanita Usia Produktif Dipuskesmas Wawonasa." J e-Biomedik. 2(2). 2014. doi:https://doi.org/10.35790/ebm.2.2.2014.4554

14. Sarifah, "Faktor-Faktor Yang Mempengaruhi Masih Tingginya Kadar Gula Darah Pada Pasien Diabetes Mellitus Yang Menjalani Terapi Diabetes Mellitus Di Poliklinik Penyakit Dalam Rsup Dr. Sardjito Yogyakarta." 2012. https://ejournal.stikespku.ac.id/index.php/mpp/article/view/3/1.

15. R. P. Dewi, "Faktor Risiko Perilaku yang Berhubungan dengan Kadar Gula Darah pada Penderita Diabetes Melitus Tipe 2 di RSUD Kabupaten Karanganyar." J Kesehat Masy. 2(1): 1-11. 2013. doi:https://doi.org/10.1037/h0077896

16. N. M. Abdo, M. E. Mohamed, "Effectiveness of health education program for type 2 diabetes mellitus patients attending zagazig university diabetes clinic, Egypt." J Egypt Public Health Assoc. 85(3–4): 113–130. 2010. http://www.ncbi.nlm.nih.gov/pubmed/21244813.

17. K. J. Coppell, M. Kataoka, S. M. Williams, A. W. Chisholm, S. M. Vorgers, J. I. Mann, "Nutritional intervention in patients with type 2 diabetes who are hyperglycaemic despite optimised drug treatment - Lifestyle over and above drugs in diabetes (LOADD) study: Randomised controlled trial." BMJ. 341(7766): 237. 2010. doi:https://doi.org/10.1136/bmj.c3337

18. S. Anani, "Hubungan Antara Perilaku Pengendalian Diabetes dan Kadar Glukosa Darah Pasien Rawat Jalan Diabetes Melitus (Studi Kasus di RSUD Arjawinangun Kabupaten Cirebon)." J Kesehat Masy Univ Diponegoro. 1(2). 2012.

19. S. Sumangkut, W. Supit, F. Onibala, "Hubungan Pola Makan Dengan Kejadian Penyakit Diabetes Melitus Tipe-2 di Poli Interna BLU.RSUP. Prof. Dr. R. D. Kandou Manado." ejournal keperawatan. 1(1): 1–6. 2013.

20. A. Warapsari, K. S. Dewi, "Perilaku Sehat Pada Penderita Diabetes Melitus Tipe II Yang Telah Mengalami Retinopati Diabetika." J Empati. 2(3): 1-13. 2013.

21. S. S. Maulina, "Korelasi antara Kadar Glukosa Darah dengan Kadar KreatininDarah pada Penderita Diabetes Melitus Tipe 2 di RSUD Dr. Moewardi Surakarta." Tugas Akhir: Universitas Setia Budi Surakarta. 2016.