Contents lists available at iocspublisher

Science Midwifery

journal homepage: www.midwifery.iocspublisher.org

THE BLOOD GLUCOSE CONTROL AND THE RISK OF DIABETIC FOOT ULCER IN TYPE 2 DIABETES MELLITUS

T.Eltrikanawati

Institut Kesehatan Mitra Bunda, Jl.Seraya No.1 Batam-Kepulauan Riau 29424 Indonesia

A R T I C L E I N F O

Keywords:

Blood Glucose Control,
Diabetic Foot Ulcer,
Type 2 Diabetes Mellitus.

ABSTRACT

Uncontrolled diabetes mellitus can cause complications. One of the complications that is often encountered are diabetic foot ulcers. Diabetic foot ulcers are a common complication in people with Type 2 Diabetes Mellitus.The purpose of this study was to determine the relationship between blood glucose levels and the risk of diabetic ulcers in people with type 2 diabetes mellitus. Methods: This research is a type of analytical research used cross sectional design and Hypothesis test used Chi Square test. The results showed that from the results of the chi square statistical test, it was obtained that the value of = 0.000 (<0.05); OR= 4.2; 95%. The conclusion of the study showed that there was a significant relationship obtained from 52 people with type 2 diabetes mellitus, 17 respondents at risk of ulcers with uncontrolled blood glucose levels.The implication of this research is that it is hoped that health workers can schedule blood glucose level checks in type 2 Diabetes Mellitus patients and for Type 2 Diabetes Mellitus patients to be able to obediently control blood glucose levels to health services because regular blood glucose control can prevent complications of Type 2 Diabetes Mellitus, such as diabetic foot ulcers. Another very important factors about blood glucose control in people with diabetes mellitus for health workers is to pay more attention to adequate family support factor, psychological factor, social stigma factor, and cultural beliefs factor.

E-mail:
eltryikha@gmail.com

1. Introduction

Diabetes Mellitus (DM) will increase drastically in 2045 and is predicted to reach 629 million people with diabetes mellitus. Based on the World Health Organization (WHO) report [1], it is a known fact that the number of people with diabetes continues to increase worldwide, and experts predict that by 2045 there will be at least 629 million people living with the disease. It also means an increase in the number of people affected by its chronic complications. Indonesia is the country with the highest number of people with diabetes mellitus number 6 with a total of 10.3 cases. This figure is predicted to continue to increase and reach 16.7 million in 2045. This figure is predicted to continue to increase and reach 16.6 million in 2045 [2]. Diabetes mellitus was recorded at 1.3% in 2013 and increased by 0.4% in 2018 with a percentage of 1.7% (8060 peoples) of all people with diabetes mellitus in Indonesia [3]. Based on data [4], it reports data that the prevalence of Diabetes Mellitus is 10.8%.

In the Kepulauan Riau province, diabetes mellitus data was obtained in 2013 with a percentage of 1.3% and increased in 2018 with a percentage of cases of 1.7% [5]. Diabetes mellitus is included in the 10 biggest diseases in Batam city with a percentage of 21.99% and ranks second from other diseases. Diabetes mellitus in 20 public health centers in the city of Batam is a non-communicable disease which ranks second from non-communicable diseases with a percentage of 21.99%. Data from 20 health centers obtained 23623 cases of diabetes mellitus, and for the second

highest diabetes mellitus was at the Sekupang Health Center as many as 3009 people with diabetes mellitus [6].

Patients with diabetes mellitus experience disorders of the pancreas gland that is unable or only slightly to produce the hormone insulin which functions to enter glucose into cells so that insulin cannot meet the body's needs. This is the beginning of damage to all organs of the body. The higher the consumption of carbohydrates, the higher the blood glucose level. Uncontrolled blood glucose levels can cause various complications both acute and chronic due to poor blood glucose control (Ernawati, 2013).

Poor blood glucose control can lead to elevated blood glucose levels (hyperglycemia). The state of increased blood glucose levels can cause the risk of diabetic foot ulcers that are difficult to heal, including a decrease in the ability of blood vessels to contract and relax as a result of poor tissue perfusion of the distal part of the leg and hyperglycemia is a fertile environment for the proliferation of anaerobic pathogens because blood plasma of patients with type 2 diabetes mellitus that is not well controlled and has a high viscosity, resulting in slowed blood flow and reduced oxygen supply [7].

Patients with diabetes mellitus have a 29 times higher risk of developing ulcers than non-diabetics. The number of new cases of diabetes mellitus in the world is very worrying. Diabetes mellitus has become a health problem in the 21st century, where about 15% of people with diabetes mellitus are diagnosed to be at risk of developing diabetic ulcers [8].

The high incidence of type 2 diabetes mellitus causes complications. One of the most common complications of type 2 diabetes is diabetic foot ulcers. Diabetic foot ulcers are diseases of the feet of diabetics with the characteristics of sensory, motor, autonomic neuropathy and/or vascular disorders of the legs. Ulcers, infections, gangrene, amputations, and death are serious complications and require high costs and a longer treatment period. Amputation is a serious consequence of diabetic foot ulcers [9].

Good blood glucose control is closely related to a reduced incidence of retinopathy, nephropathy, and neuropathy and can reduce the incidence of complications in DM [10]. The problem of diabetic foot ulcers can cause long treatment time, increased treatment costs, increased disability, decreased quality of life, and increased risk of death (Kale, 2016). Diabetic ulcer factors in DM patients can be reduced by 44% -85%, through prevention efforts that are focused on controlling blood glucose levels to reduce the occurrence of neuropathy, early detection, and proper treatment in patients with very risky foot conditions, education about foot care, use of appropriate footwear and measures to improve care. Patients with diabetic foot ulcers have reached 15%, the amputation rate has reached 30%, the mortality rate has reached 32%, and diabetic foot ulcers are the cause of the most patient care in hospitals which have reached 80% [10].

Efforts to prevent and control Diabetes Mellitus have formed an Integrated Development Post (Posbindu) to facilitate public access in conducting early detection of Diabetes Mellitus. The community needs to take CERDIK action, namely by conducting regular health checks to control and check blood pressure, blood glucose and cholesterol. Get rid of cigarette smoke and don't smoke. Diligently do 30 minutes of physical activity a day. A balanced diet by consuming healthy and nutritionally balanced foods such as consuming at least 5 portions of fruit and vegetables a day, reducing sugar consumption and others. Get enough rest and manage stress properly [5]. One of the nurse's roles is to prevent the occurrence of diabetic ulcers, by controlling the blood glucose levels of people with Type 2 Diabetes Mellitus.

2. Method

This research is a type of analytical research with a cross sectional approach. Research with a case-control approach is research that concerns how risk factors are studied using a retrospective approach. In other words, the effect of the disease or health status is identified for the time being, then the risk factors are identified as existing or occurring in the past [11]. The affordable population in this study were all patients with Type 2 Diabetes Mellitus (DM) who live in the working area of the Sekupang Health Center with a total of 1813 patients. The inclusion criteria in this study were type 2 DM patients aged 40 years, long suffering from type 2 DM > 2 years, controlled type 2 DM patients and stable blood glucose levels. Meanwhile, the exclusion criteria were patients with type 2 diabetes who were uncontrolled and had unstable blood glucose levels. The instrument used to measure blood

Contents lists available at iocspublisher

Science Midwifery

journal homepage: www.midwifery.iocspublisher.org

glucose levels is a glucometer. The instrument used to measure the risk of diabetic foot ulcers was using an observation sheet of 12 statements grouped into two categories according to the Inlow's 60-Second Diabetic Foot Screen Screening Tool. No Ulcer risk with a score of 0-12, and ulcer risk with a score of 13-25. Analysis of the data used in this study is univariate analysis, namely by distributing the characteristics of the respondents including gender, age, occupation, education level, duration of suffering from blood glucose levels and risk of ulcers in people with diabetes mellitus. Bivariate analysis to determine the relationship between blood glucose control and the risk of diabetic foot ulcers in the working area of the Sekupang Health Center. Statistical calculations for this research data use computerized data processing, namely the SPSS for Windows program using the chi square test.

3. Results and Discussion

Based on table 1, it is known that from 52 people with Type 2 DM who became the majority of respondents experienced the category of uncontrolled blood glucose levels, namely 27 respondents (51.9%). The results of this study are the same as the research conducted by [12] the majority of patients with diabetic foot ulcers showed that 75,8% had uncontrolled blood control levels. The other study showed that the respondents (50%) had poor blood glucose controls [13]. The conditions of hyperglycemia, blood vessels cannot perform vasodilation ideally due to the presence of reactive oxygen species (ROS) which stimulate the production of oxidative free radicals. This responsive oxygen species (ROS) causes vascular endothelial damage and neutralizes nitric oxide (NO) which has the effect of blocking microvascular vasodilation [14]. Researchers concluded that poor blood glucose control can lead to elevated blood glucose levels (hyperglycemia).Self-monitoring of blood glucose is part of diabetes self management education which is a major component in comprehensive DM management [15]. In theory, if patients can cut down on carbohydrates, they will be able to control the rise in blood glucose levels

TABLE 1
FREQUENCY DISTRIBUTION BASED ON THE BLOOD GLUCOSE CONTROL WITH TYPE 2 DIABETES MELLITUS

Blood Glucose Control	Frequency	Percentage (%)
- Control	25	48,1
- Uncontrolled	27	51,9
Total	52	100

Based on table 2, it is known that from 52 people with type 2 DM who became respondents (50.0%), and the risk of diabetic ulcers were 26 respondents (50.0%).. The results of this study are the same as the research conducted [13] by the respondents who experienced ulcer as much as 25 respondents (85.3%). The conditions of high blood glucose levels occurs in patients with diabetes mellitus affects the occurrence of flexibility of red blood cells that release O2, so that O2 in the blood is reduced and occurs peripheral hypoxia leading to tissue perfusion peripheral ineffective. When the peripheral tissue perfusion inadequate then the supply of nutrients and oxygen levels will decrease so that the condition will exacerbate the occurrence of tissue ischemia to eventually tissue death or necrosis occurs [16]. The researcher concluded that most of the respondents experienced the survival rate. The survival rate of patients with diabetic foot ulcer was decreased compared to diabetes patients without diabetic foot ulcer.

TABLE 2
FREQUENCY DISTRIBUTION OF FOOT ULCER RISK IN TYPE 2 DIABETES MELLITUS PATIENTS

Risk Foot Ulcer	Frequency	Percentage (%)
Risk	26	50.0
Not Risk	26	50.0
Total	52	100

Based on table 3, it is known that from 52 people with type 2 DM, most of them experienced the risk of diabetic foot ulcers with uncontrolled blood glucose as many as 18 respondents (66.7%), and

17 respondents (68.0%) who were not at risk of ulcers with controlled blood glucose. The other study has produced evidence of moderate quality that tight blood glucose control may be beneficial for ulcer healing [17]. Based on the results of the chi square statistical test, it was obtained that the value of = 0.012 or the value of <0.05 and OR 4.2. So it can be concluded that type 2 DM patients who have uncontrolled blood glucose levels have a 4.2 times greater risk of developing diabetic foot ulcer. Hyphothesis alternative (ha) is accepted while Hyphothesis Null (H0) is rejected, this shows that there is a significant relationship between blood glucose control and the risk of diabetic ulcers in type 2 DM patients. This may be due to low blood glucose control and dyslipidemia which can increase the occurrence of diabetic neuropathy or in patients who have symptoms of complications before being diagnosed with diabetes mellitus [18].

TABLE 2
FREQUENCY DISTRIBUTION BASED ON THE RELATIONSHIP BETWEEN ULCER RISK AND BLOOD GLUCOSE CONTROL IN TYPE 2 DIABETES MELLITUS

Blood Glucose Control	Diabetic Foot Ulcer Risk				Total		*ρ value*	OR
	Not Risk		Risk					
	Σ	%	Σ	%	Σ	%		
Controlled	17	68,0	8	32,0	25	100	0,012	4,2
Uncontrolled	9	33,3	18	66,7	27	100		
Total	26	27,6	26	50,0	52	100.0		

Diabetes mellitus patients with regular blood glucose control can detect early in the opportunity to reduce the risk and prevent complications effectively [19], and the results of this study are the same with [20] with the results that 31 respondents (93.9%). The patients with diabetes mellitus with a duration of 5 years did not experience peripheral neuropathy, because some respondents were obedient in controlling blood glucose with regular medication, diet and regular physical activity. Therefore, the patients with diabetes mellitus obliged to maintain a pattern of daily life such as physical activity, diet, and regularity in taking medication to reduce the risk of peripheral neuropathy [21]. The discharge planning is an important opportunity to address blood glucose control, medication adherence, and outpatient follow-up[22]. It can be concluded that the diabetic foot ulcer carries a high risk of proximal or distal amputation. The researcher concluded that based on the results of the study, this risk can occur due to uncontrolled blood glucose levels, therefore people with diabetes mellitus are strived to be able to prevent increasing blood glucose levels with regularity in taking drugs, eating patterns according to the diet of people with diabetes mellitus, and regular activity patterns.

3.1 Discussion

Based on the results of the study, data obtained that patients with Type 2 DM who had uncontrolled blood glucose levels were 27 people with type 2 DM (51.9%). This is due to lifestyle factors such as an unbalanced diet and lack of physical activity in patients with Type 2 DM. In addition, there is a link between stress factors, genetic disorders and age. Based on the results of blood glucose levels, 25 people with type 2 DM (50.0%) experienced controlled blood glucose levels. This can happen because people with type 2 DM maintain their diet and control blood glucose according to the advice and instructions of health workers when visiting health services regularly. Type 2 DM sufferers in this category have family or life partners who always provide support and motivation to control blood glucose levels either independently or to health services. The results of this study are in line with the results of research [12] which states that the majority of patients with Type 2 DM have uncontrolled blood glucose levels as many as 25 people (75.8%), due to an unhealthy lifestyle. Blood glucose level is the level of glucose in the blood which is formed from carbohydrates in food and stored as glycogen in the liver and skeletal muscles. Blood glucose levels are the main source of energy for body cells in muscles and tissues. A sign that a person has diabetes mellitus is when the blood glucose level is equal to or more than 200 mg/dl and the fasting blood glucose level is above or equal to 126 mg/dl [9].

Uncontrolled blood glucose levels have increased because most people with type 2 diabetes mellitus at the Sekupang Health Center do not maintain their diet and control blood sugar levels regularly to health services. Patients with Type 2 Diabetes Mellitus will experience disturbances in

Contents lists available at iocspublisher

Science Midwifery

journal homepage: www.midwifery.iocspublisher.org

the pancreas gland, which is unable or only slightly to produce the hormone insulin, which functions to enter glucose into cells so that insulin cannot meet the body's needs. This is the beginning of damage to all organs of the body. The higher the consumption of carbohydrates, the higher the blood glucose level. Uncontrolled blood glucose levels can cause various complications both acute and chronic due to poor blood glucose control [9]. The state of elevated blood glucose levels can lead to the risk of foot ulcers which are difficult to cure include a decrease in the ability of blood vessels to contract and relax as a result of poor tissue perfusion of the distal part of the leg and hyperglycemia is a fertile environment for the proliferation of anaerobic pathogens because blood plasma is not well controlled and has viscosity. As a result, blood flow is slowed and oxygen supply is reduced [8].

Patients with type 2 Diabetes Mellitus who have uncontrolled blood glucose levels will have a higher risk diabetic foot ulcer. This has a significant relationship between controlled glucose levels and the risk of developing diabetic foot ulcers, so it can be concluded that people with type 2 diabetes mellitus who have uncontrolled blood glucose levels are at risk of 4.2 times greater risk of developing diabetic foot ulcers. Based on this, it is highly recommended for people with diabetes mellitus to have regular health control and education to prevent further complications and more attention to adequate family support factor, psychological factor, social stigma factor, and cultural beliefs factor.

4. Conclusion

Based on the results of the study, data showed that people with diabetes mellitus had a risk category of diabetic ulcers as many as 26 respondents (50.0%). Research conducted at the Sekupang health center contained 26 respondents at risk for ulcers because most of them were not routinely controlled for blood glucose, unbalanced diets, in fact there were 26 respondents who were not at risk for ulcers because people with diabetes mellitus were diligent in controlling blood glucose levels. health centers and maintain a healthy lifestyle. This study is in same with the other research results showing that uncontrolled blood glucose levels have a 6.2 times greater risk of developing diabetic ulcers [23]. The results of this study agree with the results of research which states that people with diabetes mellitus who have uncontrolled blood glucose levels can have a 40 times greater risk of developing diabetic foot ulcers.

References

[1] WHO, World Health Statistics 2020, vol. 3, no. 2017. Geneva: World Health Organization, 2020.
[2] International Diabetes Federation, IDF Diabetes Atlas 2019, 9 th edition. Belgium: International Diabetes Federation, 2019.
[3] Kemenkes RI, Profil Kesehatan Indonesia 2018 [Indonesia Health Profile 2018]. 2019.
[4] K. Riskesdas, “Hasil Utama Riset Kesehata Dasar (RISKESDAS),” J. Phys. A Math. Theor., vol. 44, no. 8, pp. 1–200, 2018, doi: 10.1088/1751-8113/44/8/085201.
[5] Kemenkes RI, Profil Kesehatan Indonesia Tahun 2019. Jakarta: Kemenkes RI, 2020.
[6] Dinas Kesehatan Kota Batam, “Laporan Kinerja Instansi Pemerintah Tahun 2020,” Dialog, vol. 44, no. 1, pp. i–Vi, 2021, doi: 10.47655/dialog.v44i1.470.
[7] D. A. Ernawati, I. M. Harini, N. S. A. Gumilas, and Ayugita, “Faktor yang Mempengaruhi Tingkat Kepatuhan Diet pada Pasien Diabetes Melitus Tipe 2 di Kecamatan Sumbang Banyumas,” J. Bionursing, vol. 2, no. 1, pp. 63–67, 2020.
[8] American Diabetes Association, “Glycemic targets: Standards of medical care in diabetes–2021,” Diabetes Care, vol. 44, no. January, pp. S73–S84, 2021, doi: 10.2337/dc21-S006.
[9] A. Maryunani, Perawatan luka (Modern Woundcare) terkini dan terlengkap : Sebagai bentuk tindakan keperawatan mandiri. Jakarta: In Media, 2015.
[10] E. Decroli, Diabetes Melitus Tipe 2, 1st ed. Padang: FK Universitas Andalas, 2019.
[11] American Diabetes Association, “Standards of medical care in diabetes: Response to position statement of the American Diabetes Association [20],” Diabetes Care, vol. 29, no. 2, p. 476, 2020, doi: 10.2337/diacare.29.02.06.dc05-1593.
[12] A. Rastogi et al., “Intensive Glycemic Control for Diabetic Foot Ulcer Healing: A Multicentric, Randomized, Parallel Arm, Single-Blind, Controlled Study Protocol (INGLOBE Study),” Int. J. Low. Extrem. Wounds, pp. 1–7, 2020, doi: 10.1177/1534734620952245.
[13] Notoatmodjo and Soekidjo, “Metodologi penelitian kesehatan / Soekidjo Notoatmodjo,” Koleks. Buku UPT Perpust. Univ. Negeri Malang, vol. 0, no. 0, pp. 2–7, 2018.
[14] N. Shabira, Dionissa ; Harjona, Yanti; Bustamam, “Hubungan Antara Derajat Merokok Dan Kadar Gula

Darah Terhadap Resiko Terjadinya Kaki Diabetik Pada Pasien Diabetes Mellitus Pria," Bina Widya, vol. 25, no. 4, pp. 162–167, 2014.
[15] O. S. Purwanti, K. Yetti, T. Herawati, A. Sudaryanto, and Daryani, "Study on the relationship between blood glucose control and diabetic foot ulcers at Dr . Moewardi Hospital of Surakarta," Iseth, pp. 296–301, 2016.
[16] T. Arif, E. Sudjarwo, P. Kesehatan, and K. Malang, "Hubungan Kadar Glukosa Dengan Tingkat Diabetic Foot Ulcers Berdasarkan Bates-Jensen Wound Assessment-Tools," J. Ilm. Media Husada, vol. 9, no. 2, pp. 60–66, 2020.
[17] Perkeni, Pedoman Pengelolaan dan Pencegahan Diabetes Melitus Tipe 2 Dewasa di Indonesia. Jakarta: PB.Perkeni, 2021.
[18] K. L. Lane et al., "Glycemic control and diabetic foot ulcer outcomes: A systematic review and meta-analysis of observational studies," J. Diabetes Complications, vol. 34, no. 10, 2020, doi: 10.1016/j.jdiacomp.2020.107638.
[19] A. Dissanayake et al., "Does intensive glycaemic control promote healing in diabetic foot ulcers? -a feasibility study," BMJ Open, vol. 10, no. 1, pp. 1–8, 2020, doi: 10.1136/bmjopen-2019-029009.
[20] M. Jaiswal et al., "Prevalence of and risk factors for diabetic peripheralneuropathy in youth with type 1 and type 2 diabetes: Search for diabetes in youth study," Diabetes Care, vol. 40, no. 9, pp. 1226–1232, 2017, doi: 10.2337/dc17-0179.
[21] Perkeni, Pedoman Pemantauan Glukosa Darah Mandiri. Jakarta: PB. PERKENI, 2019.
[22] Suyanto and A. Susanto, "Faktor - Faktor Yang Berhubungan Dengan Kejadian Neuropati Perifer Diabetik," NURSCOPE J. Penelit. dan Pemikir. Ilm. Keperawatan, vol. 2, no. 1, pp. 1–7, 2016.
[23] T. Eltrikanawati, "The Relationship Of The Duration Of Type 2 Diabetes Mellitus With Peripheral Neuropathy," Sci. Midwifery, vol. 10, no. 1, pp. 145–150, 2021.
[24] C. Kodner, L. Anderson, and K. Pohlgeers, "Glucose Management in Hospitalized Patients," Am. Fam. Physician, vol. 96, no. 10, pp. 648–654, 2017.
[25] R. T. Hastuti, "Faktor-Faktor Resiko Ulkus Diabetika pada Penderita Diabetes Mellitus (Study sasus di RSUD Dr. Moewardi Surakarta," Univ. Diponegoro, 2008.
[26] I. A. H. Mustafa, W. Purnomo, C. U. W, J. Wiyata, and V. N. Tahun, "Determinan Epidemiologis Kejadian Ulkus Kaki Diabetik Pada Penderita Diabetes Mellitus di RSUD dr.Chasan Boesoirie dan Diabetes Centre Ternate," J. Wiyata, vol. 3, no. 1, pp. 54–60, 2016.