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RESEARCH ARTICLE

Factors affecting self-care behaviours of ulcer prevention and glycemic control among diabetes mellitus patients at type A hospital in Yogyakarta

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Abstract

Background: One of the most detrimental complications of diabetic foot ulcers is largely influenced by glucose levels. To prevent diabetes-related complications and injuries, diabetic patients have to possess all the knowledge and behaviours required to perform regular self-care. **Objective:** This study aimed to identify factors that influence the behaviour of diabetic patients to prevent diabetic foot ulcers. **Method:** The study design was a cross-sectional survey of 57 outpatients with all criteria. The self-care knowledge and behaviour were measured by filling out questionnaires. A chi-square statistical test and multiple logistic regression were used to assess the magnitude of the predictor variables in behaviour and glycemic control. Moreover, difference tests were performed to assess differences between groups according to the level of behaviour. **Result:** Out of 57 participants, 29 patients were having poor self-care behaviour. Of the 28 patients with uncontrolled glycemic, 12 had poor behaviour. The knowledge scores between poor and moderate behaviour showed a statistically significant difference ($p = 0.046$). Knowledge had a 2-fold impact on behaviour ($p = 0.025$). Additionally, the type ($p = 0.011$) and the number ($p = 0.040$) of anti-diabetic medications in prescriptions affected glycemic control. **Conclusion:** Knowledge and behaviour of foot self-care and glycemic control are the key preventive factors.

Introduction

Since 2006, there has been a significant rise in the prevalence of clinically diagnosed diabetes in a limited number of populations, with distinctions made by gender and ethnicity (Magliano *et al.*, 2019). According to the findings of the International Diabetes Federation (IDF), it is estimated that the prevalence of diabetes in Southeast Asia will grow to a rate of 8.7% in 2021 (IDF, 2021). There is a correlation between inadequately managed blood glucose levels and raised rates of morbidity and mortality (American Diabetes Association Professional Practice Committee, 2022). Foot issues represent a significant contributor to both morbidity and mortality rates among individuals with diabetes, hence leading to increased use of healthcare services and associated expenses (McEwen *et al.*, 2016; Diabetes Canada Clinical Practice Guidelines Expert Committee *et al.*, 2018). Identifying diabetes patients at risk of developing foot complications, when accompanied by proactive preventive treatment measures, can minimise the occurrence of lower extremity amputations (LEA) (Falanga *et al.*, 2022). Patients diagnosed with diabetes who are under the care of managed-care institutions, such as primary care, outpatient clinics, and hospitals, are provided with opportunities to get preventative treatment.

Additionally, these patients experience positive outcomes regarding diabetes-related treatments and intermediate care results (McAdam-Marx *et al.*, 2014; McEwen *et al.*, 2016).

The key preventive measures include foot care, blood glucose testing, and consistent use of anti-diabetic medication. In secondary prevention, comprehensive wound or diabetic gangrene management, metabolic control, vascular control, risk factor reduction, pharmaceutical therapy, and revascularisation are employed to prevent disability and recurring injuries. Self-care directly impacts glucose regulation (Gao *et al.*, 2013; Saad, 2018). The lack of self-care can impact blood sugar levels (Padma *et al.*, 2012; Saad, 2018). All people with diabetes are advised to undergo a thorough foot examination to identify risk factors for ulcers and amputation (American Diabetes Association, 2017).

Knowledge influences the skills to carry out the treatment instructed so that therapy goals are easily achieved (Powers *et al.*, 2016; ElSayed *et al.*, 2023). Besides knowledge, perception, and self-care behaviour, medication type and complexity were correlated with glycemic control (de Pablos-Velasco *et al.*, 2014; Haghighatpanah *et al.*, 2018).

Additional research has found that the duration since an individual has been diagnosed with diabetes, their perspective of the potential outcomes associated with the condition, and their perception of their ability to manage the disease are all factors that might predict the behaviour of diabetes patients (Indrayana *et al.*, 2019). However, the influence of clinical and therapeutic factors such as diabetes complications, medication administration, and blood sugar levels regarding behaviour and glycemic control has not yet been established. It is necessary to evaluate the impact of demographic, clinical, and therapeutic characteristics on behaviour and glycemic control as ulcer-prevention factors in diabetic patients. This study aims to determine the effect of demographic characteristics, diabetes complications, glycemic control, the type and the quantity of anti-diabetic medications, and foot care knowledge on self-care behaviour.

Methods

Design

The study employed a quantitative analysis method and utilised a cross-sectional research design. This research was conducted at an endocrinology clinic of a General Hospital in Yogyakarta between November and December 2022. Before beginning the study, proper permission was obtained from the hospital and ethical approval from the Ethics Committee with reference number KE/FK/1434/EC/2022. The patients who agreed to participate in this study confirmed that they were informed of the purpose of the research.

The participants of this study were obtained using a total sampling technique. They were included by all these criteria i.e.: (1) diagnosed with diabetes mellitus type 1 or type 2; (2) aged 18-60 years; (3) no history of foot ulcers; (4) receiving anti-diabetic medications by prescription; (5) available blood glucose examination results; and (6) capable of reading and writing. The participants were excluded if they met any of the following criteria: (1) receiving steroids by prescription; (2) having an end-stage disease or terminal illness; (3) having previously completed a similar questionnaire; (4) possessing both visual and auditory impairments; (5) experiencing a psychiatric or a cognitive disorder; and (6) being a health practitioner (nurse, doctor, or pharmacist).

Assessment

The Foot Care Knowledge (FCK) and The Modified Diabetes of Foot Care Behaviour (MDFCB) questionnaires, derived from prior studies and translated by Sulistyo and colleagues (2018) and Indrayana et. al (2019), respectively, were used to evaluate the levels of knowledge and behaviour related to foot care among diabetic patients. The questionnaire was utilised with the permission of the study's author. This study also collected secondary data from patients' electronic medical records, including the type and number of anti-diabetic medications, medical conditions, and blood glucose levels.

The data were entered into Microsoft Excel and subsequently subjected to statistical analysis. Comparative statistical tests were used to determine the differences in numerical variables, while the Chi-square assessed the association between categorical variables. Multivariate logistic regression was utilised to calculate the effect of variables on foot self-care and glycemic control. Statistical significance was determined by considering p-values that were less than 0.05.

Results

Characteristics of study participants

This research involved 57 participants, all observed visiting the endocrinology clinic in December 2022; thus, a total sampling technique was employed. The exclusion criteria were confirmed before informed

consent was obtained, and information from the medical records was collected after the doctor's visit. Table I illustrates that most participants with diabetes mellitus in this study were aged 45-60 years (n = 45), female (n = 33), had completed primary education (n = 32), and were employed (n = 35). Most participants had clinical characteristics of controlled glycemic conditions (n = 29) and had no micro and macrovascular complications (n = 28). Anti-diabetic medications in the form of insulin were most commonly prescribed (n = 27) compared to oral preparations (n = 19) or a combination of oral hypoglycemics and insulin (n = 11). Additionally, only one type of anti-diabetic medication was most frequently received by patients (n = 35).

Table I: The comparison of patient's characteristics toward the behaviour and the glycemic control

No	Characteristics	Poor behaviour (mean 24.84)		Moderate behaviour (mean 33.30)		*p*-value	Uncontrolled glycemic		Controlled glycemic		*p*-value
		n	%	n	%		n	%	n	%	
1.	Age (mean±SD)	47.62± 12.88		50.57± 9.19		0.620[b]	49.32± 11.43		48.93± 11.40		0.935[b]
	Age (categorical)					0.561[c]					0.561[c]
	Adult 18-44	7	12.3	5	8.8		5	8.8	7	12.3	
	Pre-elderly 45-60	22	38.6	23	40.4		23	40.4	22	38.6	
2.	Knowledge	8.38± 1.26		9.04± 0.92		0.046[b*]	8.79± 1.03		8.61± 1.28		0.760[b]
3.	Glycemic level	177.68± 96.69		178.07± 68.58		0.528[b]	177.68± 96.69		178.07± 68.58		0.528[b]
4.	**Gender**										0.280[c]
	Male	12	21.1	12	21.1		10	17.5	14	24.6	
	Female	17	29.8	16	28.1		18	31.8	15	26.3	
5.	**Education**					0.337[c]					0.337[c]
	School	16	28.1	16	28.1		17	29.8	15	26.3	
	University	13	22.8	12	21.1		11	19.3	14	24.6	
6	**Occupation**					0.839[d]					0.938[d]
	Un-employed	13	22.8	6	10.5		13	22.8	6	10.5	
	Employed	16	28.1	19	33.3		16	28.1	19	33.3	
	Professionals	0	0	3	5.3		0	0	3	5.3	
7.	**Glycemic control**					0.234[c]					
	Uncontrolled	12	21.1	16	28.1						
	Controlled	17	29.8	12	21.1						
8.	**Behaviour**										0.528[b]
	Poor						12	21.1	17	29.8	
	Medium						16	28.1	12	21.1	
9.	**Complications**										
	No Complications	14	24.6	14	24.6	0.763[d]	15	26.3	13	22.8	0.763[d]
	Microvascular	6	10.5	9	15.8		8	14	7	12.3	
	Macrovascular	6	10.5	1	1.8		2	3.5	5	8.8	
	Micro- and macrovascular	3	5.3	4	7		3	5.3	4	7	
10.	**Blood Pressure**										
	Systolic	128.83 (21.469)		135 (21.506)		0.760[a]	132.50 (21.20)		129.79 (21.12)		0.657[a]
	Diastolic	71.72 (14.308)		76.93 (9.289)		0.080[a]	73.46 (13.73)		74.82 (10.99)		0.277[a]
11.	**Type of anti-diabetic medications**					0.077[d]					0.167[d]
	Oral Hypoglycemics	7	12.3	12	21.1		6	10.5	13	22.8	
	Insulin	18	31.6	9	15.8		16	28.1	11	19.3	
	OH-Insulin	4	7	7	12.3		6	10.5	5	8.8	
12.	**Number of Anti-diabetic medications**					0.054[d]					0.452[d]
	1	22	38.6	13	22.8		15	26.3	20	35.1	
	2	5	8.8	13	22.8		11	19.3	7	12.3	
	3	2	3.5	2	3.5		2	3.5	2	3.5	

*Significant at 0.05; [a]Parametric test (t-independent); [b]Non-parametric test (Mann-Whitney); [c]Chi-square test; [d]Kolmogorov-smirnov test; OH: Oral Hypoglycemics

Comparisons of participants' characteristics in relation to behaviour and glycemic control

This study (see Table I) revealed that 29 subjects exhibited poor self-care behaviour and 28 exhibited moderate behaviour, with no patients achieving a good behaviour score (greater than 80). Additionally, 29 subjects had regulated glycemic levels, while 28 had uncontrolled levels. Those with low self-care behaviour were younger (average age 47.62 years) compared to those with moderate behaviour (50.57 years). Uncontrolled hyperglycemia patients were slightly older (48.93 years) than those with controlled levels (49.32 years). Moderate self-care behaviour was more common in women. Among primary education participants, most (n = 16) demonstrated moderate behaviour, while many primary school graduates (n = 17) had poor glycemic control. Employed participants were often in the moderate behaviour group (n = 17) but also included those with low glycemic control (n = 20). Most patients with poor glycemic control exhibited low self-care behaviour (n = 17), and only 21.1% with moderate behaviour achieved reasonable glycemic control. Interestingly, 14 individuals with both poor and moderate self-care did not experience microvascular or macrovascular complications. Mean blood pressure was 135/76.93 mmHg for those with moderate self-care and 132.50/72.46 mmHg for those with poor glycemic control. Most patients with inadequate glycemic control were treated with insulin-type medications (n = 16), while 15 received a single type of antidiabetic medication.

The categorical variables—age, gender, education level, occupation, glycemic control, complications, and types of anti-diabetic medications—showed no significant differences between patients with poor and moderate self-care behaviour (see Table I). However, knowledge scores differed significantly between those with low and moderate self-care behaviour ($p = 0.046$), with the low behaviour group scoring lower (8.38 *vs* 9.04). Additionally, patients with controlled glycemic conditions had slightly lower knowledge scores than those with poor control (8.61 *vs*. 8.79). Overall, factors like age, knowledge, education, occupation, behaviour level, complications, and anti-diabetic medications did not significantly affect glycemic control ($p > 0.05$).

The education level variable was included in the model due to its theoretical influence on behaviour (Bains & Egede, 2011). The bivariate test showed that behaviour level, occupation, and the number and type of anti-diabetic medications had a p-value of less than 0.250 for glycemic control (Bursac *et al*., 2008). Complication variables were also included in the multivariate model for theoretical reasons (Gao *et al*., 2013; Saad *et al*., 2018). Multivariate tests (Tables II and III) indicated that knowledge is the strongest factor related to self-care behaviour ($p = 0.025$). Additionally, the type ($p = 0.011$) and number ($p = 0.040$) of anti-diabetic medications significantly influence glycemic control.

Table II: Multivariate logistic regression test results of behaviour factors

Variables	OR	SE	*p*	95% CI	
				Lower	Upper
Knowledge	1.918	0.290	0.025*	0.849	2.630
Education	0.528	0.639	0.317	0.151	1.846
Occupation	2.978	0.574	0.057	0.966	9.181
Glycemic control	0.527	0.616	0.298	0.158	1.763
Number of anti-diabetic medications	1.932	0.526	0.211	0.688	5.421

*$p < 0.05$; CI: Confidence Interval

Table III: Multivariate logistic regression test results of glycemic control factors

Variables	OR	SE	*p*	95% CI	
				Lower	Upper
Behaviour	0.696	0.849	0.670	0.132	3.680
Education	1.730	0.798	0.492	0.362	8.265
Occupation	0.358	0.836	0.470	0.070	1.843
Type of anti-diabetic medications	0.003	2.017	0.011*	<0.0001	0.153
Number of anti-diabetic medications	0.176	0.846	0.040*	0.034	0.926
Complications	1.715	0.938	0.274	0.273	10.775

*$p < 0.05$; CI: Confidence Interval

Discussion

The characteristics of study participants

This study included diabetes mellitus patients aged 18-60 years. More participants aged 45-60 than those under 45 participated in the survey. Following Indrahadi *et al*. (2021), approximately 70% of diabetic study participants were over 45. The International Diabetes Federation (IDF) projects a 4% difference in diabetes prevalence between individuals under 45 and those over 45, increasing prevalence up to age 60 (IDF, 2021). Diabetes risk factors include age, gender, family history, weight, and inactivity (Roglic, 2016). Ismail *et al*. (2021) revealed that 73% of 256 Yogyakarta diabetic patients were women. This study stated that it captures 80% of diabetes patients in Indonesia due to the similar relation in demographic variables between the study sample and the overall population.

Based on their last blood sugar examination results, almost half of the participants were classified as having poor glycemic control (n = 28). However, there are still outpatient diabetics who have not achieved the glycemic target. A total of 26.3% and 12.3% of patients (Tables I and II) experienced microvascular and macrovascular complications, similar numbers to the study by Soewondo and colleagues (2010), which reported 27.6% and 16% of diabetes mellitus outpatients who had microvascular and macrovascular complications, respectively (Soewondo *et al.*, 2010).

Comparison of participants' characteristics related to behaviour and glycemic control

This study found more participants with poor self-care behaviour (score < 60). Sulistyo (2018) found that diabetes patients in the baseline group had low behaviour scores using the same form. This indicates that diabetes foot self-care is still low. No patient scored above 80 in this study, supporting Sulistyo's findings that no patient had good self-care behaviour. In addition, the control group participants in that study averaged 59.97 years, still in the same age range as this study and not elderly. Health literacy improved self-care, especially diabetes knowledge. The ability to comprehend diabetes relates to effective self-care and positive results (Shojaeezadeh, 2012; Saad, 2018; Marciano *et al.*, 2019). The logistic regression test (Tables II and III) shows that knowledge affects self-care. Women are more compliant with health-related activities; hence, they dominate moderate self-care behaviour (Rossaneis *et al.*, 2016). However, Indrayana and colleagues (2019) observed no significant gender differences in behaviour. Even though women's self-care was better than males, they had higher glucose levels. Women presumably exercised enough to regulate blood sugar (Padma *et al.*, 2012; Roglic, 2016). The increased number of employed individuals with poor glycemic control shows that working cannot ensure frequent exercise. In diabetics, lifestyle factors affect blood glucose levels (Powers *et al.*, 2016).

Most patients did not have microvascular or macrovascular problems, and the number of participants with poor care behaviour was the same as moderate care behaviour participants. Adequate self-care reduces disease progression. Chronic hyperglycemia promotes abnormal glucose metabolism and microvascular or macrovascular problems (Haghighatpanah *et al.*, 2018). Unfortunately, poor and moderate self-care issues affected almost the same number of individuals (Table I).

Insulin was the most prescribed diabetes treatment. Poor glycemic control patients received the most insulin or a combination of oral antidiabetics and insulin. Fasil *et al*. (2019) found 62.1% of single-insulin DM patients with poor glycemic control. Most patients (34.3%) with suboptimal glycemic control received insulin, according to Haghighatpanah (2018). Diabetes patients who don't take oral drugs or change their lifestyle may need insulin. Diabetes patients who used insulin, with or without oral antidiabetic drugs, were more likely to have poor glycemic control. Thus, poor glycemic control increases treatment demands rather than vice versa, explaining the connection between them. Modifying the treatment plan is primarily performed by the prescriber and may not enhance glycemic control (Lima *et al.*, 2016). The highest number of antidiabetics received by participants in prescriptions was one antidiabetic drug. In line with previous research, patients with poor glycemic control also receive 1-2 antidiabetic medications per prescription (Haghighatpanah *et al.*, 2018). More specifically, those who have diabetes and use insulin, either alone or in combination with other oral antidiabetic drugs, have a significantly higher probability of experiencing inadequate glycemic control (Table II). If the patient has poor glycemic control, they will likely receive a prescription for more than 1 type of antidiabetic medication.

The knowledge was likely to influence self-care behaviour almost 2 times (Table II). Moreover, there was a correlation between glycemic control and type of medication ($p = 0.011$) (Table III). The number of antidiabetic medications prescribed at discharge was also significantly associated with glycemic control ($p = 0.040$). The type of therapy, whether mono or combination therapy, was found to have a significant association with glycemic control in the final multivariate analysis, even after adjusting for other variables in the model. Oral diabetic medications and

insulin are typically prescribed when the glucose level worsens. It is reasonable to expect an important correlation between the intensity of therapy needed and the level of HbA1C (Al-Qazaz *et al.*, 2011).

The number of participants was limited because the participants were Social Security Provider (*Badan Penyelenggara Jaminan Sosial/BPJS*) members who visited the clinic only once a month. However, the results depicted the knowledge, behaviours, and glycemic control amongst diabetics in a type A hospital, which requires a program to prevent diabetic ulcers, according to the research results and the risk of ulcer incidence.

Conclusion

The inadequate self-care behaviour of diabetes patients remains prevalent, and uncontrolled blood glucose levels are common. Self-care behaviour is certainly affected by patients' knowledge. The variables of the therapeutic regimen, including the type and number of antidiabetic medications, were found to directly affect glycemic control. Utilising indicators of patients' self-care behaviours and glycemic conditions for healthcare professionals' decisions as diabetes control measures is essential to preventing diabetic ulcers.

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