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Effect of Sociodemographic Factors on Self-Monitoring of Blood Glucose Behavior of People with Type 2 Diabetes Mellitus

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ABSTRACT

Self-monitoring of blood glucose (SMBG) is important in diabetes self-management to achieve better HbA1c control and decrease complications, morbidity, and mortality in people with type 2 diabetes mellitus (T2DM). SMBG behavior can be influenced by various factors, one of which is sociodemographic factors. This study aimed to analyze the sociodemographic factors that influence the behavior of self-monitoring blood glucose in patients with T2DM. The cross-sectional study was conducted in ten health centers in Jember Regency with a sample size of 130 respondents using multistage random sampling. The independent variable is sociodemographic factors (age, gender, marital status, education level, income level, family type, and ethnicity), while the dependent variable is SMBG behavior. The instrument used was the Self-Monitoring Blood Glucose Questionnaire (SMBG-Q). Data were analyzed by multiple logistic regression. Most respondents had SMBG behavior in the good category (64.6%). Sociodemographic factors simultaneously influenced SMBG behavior ($p = 0.001 < \alpha = 0.05$; $R^2 = 0.324$). The sociodemographic factor that significantly affects SMBG behavior partially is ethnicity ($p = 0.001 < \alpha = 0.05$). Meanwhile, age, gender, marital status, education level, income level, and family type did not have a significant partial effect ($p = 0.095$; $p = 0.149$; $p = 0.083$; $p = 0.359$; $p = 0.507$; $p = 0.152 > \alpha = 0.05$). The sociodemographic factor that influences SMBG behavior is ethnicity. Therefore, efforts to improve SMBG behavior must pay attention to values and culture to improve the self-monitoring blood glucose behavior of people with T2DM.

Keyword: Type 2 diabetes mellitus; self-monitoring blood glucose behavior; sociodemographic

ABSTRAK

Pemantauan kadar glukosa darah mandiri (PGDM) merupakan komponen penting dalam manajemen diri diabetes untuk mencapai kontrol HbA1c yang lebih baik dan mengurangi komplikasi, morbiditas, dan mortalitas pada penderita diabetes mellitus tipe 2 (DMT2). Perilaku PGDM dapat dipengaruhi oleh berbagai faktor, salah satunya adalah faktor sosiodemografi. Penelitian ini bertujuan untuk menganalisis faktor sosiodemografi yang mempengaruhi perilaku PGDM pada penderita DMT2. Studi cross-sectional dilakukan di sepuluh puskesmas di Kabupaten Jember dengan jumlah sampel 130 responden menggunakan multistage random sampling. Variabel penelitian ini terdiri dari faktor sosiodemografi (umur, jenis kelamin, status perkawinan, tingkat pendidikan, tingkat pendapatan, jenis keluarga, dan etnis) sebagai variabel independen, dan perilaku PGDM sebagai variabel dependen. Instrumen yang digunakan adalah Self-Monitoring Blood Glucose Questionnaire (SMBG-Q). Data dianalisis dengan regresi logistik berganda. Hasil penelitian menunjukkan bahwa sebagian besar perilaku PGDM dalam kategori baik (64,6%). Faktor sosiodemografi secara simultan berpengaruh terhadap perilaku PGDM ($p = 0.001 < \alpha = 0.05$; $R^2 = 0.324$). Faktor sosiodemografi yang berpengaruh signifikan terhadap perilaku SMGD secara parsial adalah etnisitas ($p = 0.001 < \alpha = 0,05$). Sedangkan umur, jenis kelamin, status perkawinan, tingkat pendidikan, tingkat pendapatan, dan tipe keluarga tidak berpengaruh signifikan secara parsial ($p = 0,095$; $p = 0,149$; $p = 0,083$; $p = 0,359$; $p = 0,507$; $p = 0,152 > \alpha = 0,05$). Faktor sosiodemografi yang mempengaruhi perilaku PGDM adalah etnisitas. Oleh karena itu, upaya peningkatan perilaku PGDM harus memperhatikan nilai dan budaya untuk meningkatkan perilaku pemantauan gula darah mandiri penderita DMT2.

Kata Kunci: Diabetes melitus tipe 2, pemantauan kadar glukosa darah mandiri, sosiodemografi

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Introduction:

Type 2 diabetes mellitus (T2DM) is a non-communicable disease that requires appropriate medical management and continuous self-management of people with T2DM. T2DM is the most common type of diabetes worldwide, including in Indonesia (Indonesian Endocrinology Society, 2021b; International Diabetes Federation, 2021). The number of people with T2DM in the world in 2021 is 536.6 million (10.5%), an increase compared to 2019, which was only 463 million people. This number is estimated to increase to 642.7 million people (11.3%) in 2030 and 783.2 million people (12.3%) in 2045. Indonesia is one of the countries with the highest number of T2DM, namely 19.5 million people in 2021, an increase compared to 2019, which was only 10.7 million people and is estimated to increase to 24.6 million people in 2045 (International Diabetes Federation, 2021).

Self-monitoring blood glucose (SMBG) behavior is essential in diabetes self-management (American Diabetes Association, 2020b; Ong et al., 2014). SMBG results provide information about daily blood glucose variability, such as blood glucose before each meal, one or two hours after eating, or at any time under particular conditions. SMBG can improve the achievement of blood glucose control, reduce morbidity and mortality, and save long-term health costs associated with acute and chronic complications (Indonesian Endocrinology Society, 2021a). Several previous studies stated that most people with T2DM had poor SMBG behavior. Only 40% of people with T2DM do SMBG regularly (Iwuala et al., 2015). 59% of people with T2DM reported not following instructions regarding SMBG (Ji et al., 2016)(Iwuala et al., 2015)(Iwuala et al., 2015)(Iwuala et al., 2015). Even the results of other studies showed that 83.5% of people with T2DM do not do SMBG regularly (Bonger et al., 2018; Ugwu et al., 2018).

Various factors can affect the non-adherence of people with T2DM to SMBG behavior. One of these factors is the sociodemographic factor. Based on the results of the literature review, it was found that several sociodemographic factors could influence SMBG

behavior. These factors include age (Bonger et al., 2018), gender (Mogre et al., 2017; Wang et al., 2019), marital status (Bonger et al., 2018; Mogre et al., 2017), and education level (Bonger et al., 2018; Iwuala et al., 2015; Mak & Lau, 2021), income level (Levine et al., 2009; Wang et al., 2019), ethnicity (Assari et al., 2017; Levine et al., 2009; Peyrot et al., 2018) and family types (Levine et al., 2009; Mak & Lau, 2021). The results of several previous studies showed inconsistent results. Until now, studies in Indonesia on how sociodemographic factors influence the behavior of monitoring blood glucose levels are still rarely done and only focus on psychosocial aspects, such as knowledge, motivation, family support, and others. Therefore, the purpose of this study was to analyze the effect of sociodemographic factors on the self-monitoring blood glucose behavior in people with T2DM in Indonesia.

Methods:

The analytic observational study with a cross-sectional design approach was conducted in ten public health centers (PHC) in Jember Regency from April to July 2022. The population in this study were people with T2DM in Jember Regency. Based on health profile data for the Jember Regency, the number of people with T2DM in the Jember Regency was 37,786 people (Dinas Kesehatan Kabupaten Jember, 2022). The sample in this study was people with T2DM in Jember Regency with inclusion criteria: (1) age 40-65 years; (2) have T2DM for more than one year; (3) have health insurance; (4) there are no communication barriers such as blind, deaf, and speech impaired; and (5) not currently undergoing hospitalization at a hospital or public health center. The sample size was 130 respondents which are calculated using G*Power with $f^2 = 0.15$, $\alpha = 0.05$, and β power = 0.95. The sampling technique used is multistage random sampling. Multistage random sampling was carried out by dividing the area of the Jember Regency into five regions, namely north, east, center, south, and west using a map of the Jember Regency. Researchers then randomly selected two PHCs in each region. From each PHC, the researcher randomly selected five villages, then

randomly selected 2-3 respondents from each village.

Table 1. Multistage Random Sampling Procedures

No	Region	PHC	Village
1	North	Arjasa	Biting, Kemuning Lor, Arjasa, Kamal, Darsono
		Jelbuk	Jelbuk, Sugerkidul, Sukowiryo, Panduman, Sukoember
2	East	Mayang	Mrawan, Tegalrejo, Tegalwaru, Mayang, Seputih,
		Kalisat	Plalangan, Sumberjeruk, Patempuran, Glagahweru, Kalisat
3	Center	Sumbersari	Wirolegi, Karangrejo, Summersari, Tegalgede, Antirogo
		Patrang	Patrang, Baratan, Jemberlor, Slawu, Gebang
4	South	Umbulsari	Mundurejo, Sukoreno, Umbulsari, Gunungsari, Tanjungsari
		Kencong	Kencong, Kraton, Wonorejo, Paseban, Cakru
5	West	Bangsalsari	Tisnogambir, Tugusari, Bangsalsari, Petung, Langkap
		Tanggul	Krama, Patemon, Manggisian, Tanggung Wetan, Tanggul Kulon

The study variable consists of two, namely the variable independent (sociodemographic factors, which consist of age, gender, marital status, education level, income level, family type, and ethnicity), and the dependent variable SMBG behavior. The instrument used a sociodemographic questionnaire (age, gender, education level, income level, marital status, ethnicity, and family type) and the Self-Monitoring Blood Glucose Questionnaire (SMBG-Q). The SMBGQ questionnaire was originally developed in English. The SMBQ consists of 26 items (13 items favorable and 13 items unfavorable) with a Likert scale of 1 – 5. The researcher translated the questionnaire into Indonesian and tested the validity and reliability again with the results $r = 0.424-0.913 > r \text{ table} = 0.361$; $n=30$ and Cronbach alpha = 0.967, so the instrument was valid and reliable. Data were analyzed in descriptive and inferential statistics using multiple logistic regression tests with SPSS V.23 software.

Data were collected by conducting direct interviews with respondents. Before data collection, the researcher explained to prospective respondents about the objectives, benefits, risks of harm, and study procedures (informed), then asked the prospective respondents for approval to become research respondents by signing a consent letter (consent). There is no coercion on prospective respondents to become respondents, and respondents are free to withdraw from the research at any time. The Research had approved by The Health Research Ethics Committee, Faculty of Nursing, Universitas Jember with Number 039/UN25.1.14/KEPK/2022.

Results:

The results showed that most of the respondents were aged 56-65 years (54.6%), female (75.4%), and married (83.8%). In addition, most respondents had a basic education level (elementary and junior high school) (44.6%), an income level less than the regency minimum wage (64.6%), Javanese (57.7%), with family type is *nuclear family* (46.9%). The results also showed that most of the respondents had self-monitoring behavior of blood glucose levels in the good category (64.6%) (Table 1). The results of the multiple logistic regression analysis (Table 2). Based on the results of the *Hosmer Lemeshow Tests*, it can be seen that this regression model is feasible to use ($X^2 = 7.673$; $p = 0.466 > \alpha = 0.05$). Based on the results of the *Omnibus Tests of Model Coefficients*, it can be seen that there is a simultaneous effect of sociodemographic factors (age, gender, education level, income level, marital status, family type, and ethnicity) on self-monitoring of blood glucose behavior the behavior of 32.4% ($X^2 = 34.989$; $p = 0.001 < \alpha = 0.05$; $R^2 = 0.324$). Based on the partial test results, the sociodemographic factor that influences blood glucose monitoring behavior is ethnicity ($p = 0.001 < \alpha = 0.05$). Meanwhile, age, gender, marital status, education level, income level, and family type had no partial effect on blood glucose monitoring behavior ($p = 0.095$; $p = 0.149$; $p = 0.083$; $p = 0.359$; $p = 0.507$; $p = 0.152 > \alpha = 0.05$).

Table 1. Characteristics of Respondents (n=130)

Characteristics	n (%)	Self-Monitoring Blood Glucose Behavior	
		Poor n (%)	Good n (%)
Age (years)			
40-45	11 (8.5%)	7 (5.4%)	4 (3.1%)
46-55	48 (36.9%)	16 (12.3%)	32 (24.6%)
56-65	71 (54.6%)	23 (17.7%)	48 (36.9%)
Gender			
Male	32 (24.6%)	8 (6.2%)	24 (18.5%)
Female	98 (75.4%)	38 (29.2%)	60 (46.2%)
Marital status			
Married	110 (84.6%)	34 (26.2%)	76 (58.5%)
Widow/widower	20 (15.4%)	12 (9.2%)	8 (6.2%)
Education			
No school	14 (10.8%)	4 (3.1%)	10 (7.7%)
Basic	58 (44.6%)	26 (20%)	32 (24.6%)
Middle	44 (33.8%)	14 (10.8%)	30 (23.1%)
High	14 (10.88%)	2 (1.5%)	12 (9.2%)
Income			
< Regency Minimum Wage	84 (64.6%)	27 (20.8%)	57 (43.8%)
≥ Regency Minimum Wage	46 (35.4%)	19 (14.6%)	27 (20.8%)
Family Type			
Nuclear family	61 (46.9%)	16 (12.3%)	45 (34.6%)
Extended family	48 (36.9%)	24 (18.5%)	24 (18.5%)
Single parent family	1 (0.8%)	1 (0.8%)	0 (0%)
Nuclear dyed family	1 (0.8%)	0 (0%)	1 (0.8%)
Blended family	1 (0.8%)	0 (0%)	1 (0.8%)
Middle age family	18 (13.8%)	5 (3.8%)	13 (10%)
Ethnic group			
Madurese	55 (42.3%)	32 (24.6%)	23 (17.7%)
Javanese	75 (57.7%)	14 (10.8%)	61 (46.9%)

Table 2. Result of Multiple Logistics Regression Test (n=130)

Variable	Hosmer Lemeshow Tests		Omnibus Tests of Model Coefficients		R ²	B	SE	Wald	p	Exp (B)	95% CI
	X ²	p	X ²	p							
Constant						-0.991	1.994	0.247	0.619	0.371	
Age						0.627	0.375	2.795	0.095	1.873	0.897 – 3.908
Gender						-0.781	0.541	2.085	0.149	0.458	0.159 – 1.322
Marital status						-1.037	0.599	2,996	0.083	0.355	0.110 – 1.147
Education level	7.673	0.466	34.989	0.001	0.324	0.284	0.309	0.840	0.359	1,328	0.724 – 2,435
Income level						-0.306	0.461	0.440	0.507	0.736	0.298 – 1.819
Family Type						-0.237	0.165	2.053	0.152	0.789	0.571 – 1.091
Ethnicity						1.903	0.427	16.253	0.001	6.708	2.659 – 16.921

Discussion :

The results showed that most of the respondents were in the age range of 56-65 years, female, and married. In addition, most respondents have low socioeconomic status (basic education and income below the regency

minimum wage). The type of family is a nuclear family and Javanese (Table 1). Our study follows previous studies, namely that most people with T2DM were over 50 years old (Bonger et al., 2018), with an average age of 54.83 years (Mogre et al., 2017). Our study is also consistent with a

report from the *International Diabetes Federation*, which states that the largest percentage of people with T2DM were in the 55-65 year age range (International Diabetes Federation, 2021). A person over the age of 40 years tends to experience a decrease in the function of pancreatic beta cells in producing insulin (American Diabetes Association, 2020a). Aging will change the body's metabolism, especially changes in glucose metabolism, which can increase the risk of diabetes (Indonesian Endocrinology Society, 2021b; International Diabetes Federation, 2021).

The results study are consistent with the report RISKESDAS 2018, which states that the prevalence of T2DM in Indonesia is more in women than in men, which is 2.4% compared to 1.7% of the population (Ministry of Health Indonesia, 2019). The study's result also follows previous studies, which stated that most people with T2DM were women (Bonger et al., 2018; Mogre et al., 2017; Rondhianto et al., 2019). Women are more at risk of developing T2DM due to low physical activity and obesity. It can trigger insulin resistance, so it impacts the emergence of T2DM (American Diabetes Association, 2021). In addition, women with a married status will also experience pregnancy which can increase the risk of T2DM due to an increase in the hormone human placental growth and human placental lactogen or human chorionic somatomammotropin, which causes an increase in blood glucose levels. In addition, pregnant women also experience an increase in estrogen and progesterone hormones, which triggers an increase in insulin resistance, causing gestational diabetes, which increases the risk of T2DM (Indonesian Endocrinology Society, 2021b).

Most respondents have a basic education level (elementary school to junior high school) and a low-income level, which is less than the district's drinking wage (Table 1). The results of this study follow previous research; namely, most people with T2DM have a low level of education and income (Assari et al., 2017; Bonger et al., 2018; Rondhianto et al., 2019). Low socioeconomic status is a risk factor for T2DM. Low socioeconomic status has low purchasing power, so healthy food choices are limited, even the

tendency for consumption to be dominated by carbohydrates to meet energy needs. Excessive intake of carbohydrates can increase the risk of diabetes (Indonesian Endocrinology Society, 2021b). In addition, low socioeconomic status can also lead to an increased risk of complications and premature death due to insufficient ability to access health services. Low income can cause a person with type 2 DM to limit themselves in visiting health services because it requires additional costs. On the other hand, diabetes that is not well controlled can lead to disability, resulting in a decrease in work productivity, which in turn reduces family income and healthcare costs (International Diabetes Federation, 2021).

The results showed that most respondents were married. This study's results align with previous studies, which explained that most people with T2DM were married (Bonger et al., 2018; Mogre et al., 2017; Rondhianto et al., 2019). The presence of a partner in marital status can also be a risk factor for T2DM because a life partner can be someone who supports or does not in terms of a healthy lifestyle to prevent T2DM (Indonesian Endocrinology Society, 2021b; International Diabetes Federation, 2021). The results showed that most of the respondents had a nuclear family type, and the ethnicity of most of the respondents was Javanese. This study's results align with previous studies that most people with T2DM have a *nuclear family type* (Khan et al., 2020). The study results also align with reports of ethnic diversity in the Jember Regency, which is dominated by Javanese and Madurese (Nalendra, 2021). Ethnicity can also influence a person's search for healthcare facilities (Assari et al., 2017; Peyrot et al., 2018). Ethnicity can also be an obstacle for health workers. Communication barriers can occur between the community and health workers, so health information can also be hampered (Zacarias et al., 2016).

The results showed that most of the respondents had blood glucose monitoring behavior in the good category. Our study is inconsistent with previous studies, which stated that most respondents did not comply with self-monitoring of blood glucose (Bonger et al., 2018; Iwuala et al., 2015; Ji et al., 2016; Ugwu et al.,

2018). However, the results of this study are consistent with a previous study, which stated that more than half of the study respondents adhered to self-monitoring of blood glucose (Hu et al., 2017). This difference is probably because all respondents in this study had health insurance from the government, making it easier for respondents to get health services, including free blood glucose check services. Other factors, such as psychosocial factors, can also affect the behavior of people with T2DM, including hypoglycemic experiences, family motivation, and desire to see the effects of dietary changes. In addition, the desire to please doctors when approaching the appointment date is a factor that affects their adherence to SMBG (Mak & Lau, 2021).

The results of the multiple logistic regression test showed that the sociodemographic factor that had a significant influence on the self-monitoring blood glucose behavior was ethnicity. Meanwhile, age, gender, marital status, education level, income level, and family type do not affect SMBG behavior. The study's results which showed no influence of age, gender, marital status, education level, income level, and family type on SMBG behavior, were not in line with some previous studies. The results of previous studies stated that age differences determine SMBG behavior. Younger ages have better adherence to medication regimens and blood glucose monitoring than older (Bonger et al., 2018), and the male gender showed better SMBG behavior than women in SMBG behavior (Mogre et al., 2017; Wang et al., 2019). Differences in marital status determine SMBG behavior. T2DM patients with a life partner show better SMBG behavior than T2DM patients who do not have a life partner (Bonger et al., 2018; Mogre et al., 2017). A previous study shows that socioeconomic level determines SMBG behavior; higher education levels that show high socioeconomic status influence SMBG behavior (Bonger et al., 2018; Iwuala et al., 2015; Lv et al., 2021; Mak & Lau, 2021). Likewise, high-income levels indicate better SMBG behavior (Levine et al., 2009; Wang et al., 2019).

There is no influence of age, gender, marital status, and family type on SMBG

behavior, probably because the respondents in this study, both young and old, received support from their families and received adequate information from health workers. Older people with T2DM may have better knowledge and experience regarding the time they have had diabetes. However, they may get information from health professionals regarding the therapeutic relationship during the treatment period and support from family members (Wang et al., 2019). In addition, the family support provided to respondents also did not show any differences based on gender. This study follows a previous study that stated that gender differences did not affect SMBG practices (Hu et al., 2017). The absence of differences in marital status may be because even though people with T2DM do not have a life partner, they still receive support from other family members who act as family caregivers (Rondhianto et al., 2019).

There is no difference in the type of family on SMBG behavior probably because, in general, most people with T2DM from various types of families show good SMBG behavior. The lack of influence of education level and income level on SMBG behavior is probably due to people with T2DM with low education also getting sufficient information about the importance of SMBG from health workers every time they do monthly health check-ups. In addition, the whole family gets health insurance funded by the government—the existence of health insurance can be used to carry out treatment and regular health checks. The study results showed that ethnicity significantly influences SMBG behavior following several previous studies (Assari et al., 2017; Levine et al., 2009; Peyrot et al., 2018; Zacarias et al., 2016). The results showed that the Javanese had better SMBG behavior than Madurese. It is shown that most of the Javanese respondents show SMBG behavior in the good category while the Madurese mostly have SMBG behavior in the poor category. The existence of racial and ethnic differences can be an obstacle for the community in obtaining health information, access to health services, and health care. So that this may contribute to differences in the behavior of SMBG people with T2DM.

This study has several limitations, including the research design using a cross-sectional study and using a questionnaire, so there may be bias in the assessment of blood glucose self-monitoring behavior. Another limitation is that researchers only analyzed sociodemographic factors, and did not analyze other factors that influence blood glucose self-monitoring behavior, such as knowledge, motivation, coping, family support, support from health workers, and others. The next researcher can conduct research by conducting further analysis of the influence of other factors on blood glucose self-monitoring behavior or conducting modeling research on blood glucose self-monitoring behavior in people with T2DM.

Conclusions:

Sociodemographic factors that have a significant influence on the behavior of SMBG patients with T2DM are ethnic groups. Meanwhile, other factors such as age, gender, marital status, education level, income level, and family type did not have a significant effect. Ethnic differences in people with T2DM determine the behavior of SMBG people with T2DM. Efforts to improve diabetes self-management, especially SMBG behavior, must pay attention to sociodemographic factors, especially ethnicity. Preventive promotive interventions carried out by health workers should be structured in such a way by taking into account the unique characteristics, namely the values, and culture possessed by people with T2DM.

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