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Measurement of Medication Adherence Behavior in Type 2 Diabetes Mellitus Patients Using Probabilistic Medication Adherence Scale (ProMAS)

Dini Ayu Rahmawati[1], Anna Wahyuni Widayanti[2*], Susi Ari Kristina[2]
[1] Magister Management Pharmacy, Faculty of Pharmacy, Universitas Gadjah Mada
[2] Department of Pharmaceutics, Faculty of Pharmacy, Universitas Gadjah Mada
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Corresponding : Anna Wahyuni Widayanti; Email : wahyuni_apt@ugm.ac.id

ABSTRACT

Diabetes mellitus is a chronic disease that requires long-term treatment, which affects medication adherence. Adherence measurement can be done using a questionnaire like the Probabilistic Medication Adherence Scale (ProMAS). This study aims to determine the relationship between demographic factors and medication adherence scores in patients with diabetes mellitus. The research uses a quantitative research approach with a cross-sectional design. The convenience sampling method was used to select 112 respondents between January-April 2023 at various primary healthcare facilities in the Special Region of Yogyakarta. The ProMAS scoring results were based on the highest rankings, with 42.8% of respondents having a moderate-to-high adherence level, 41.1% of respondents having a high adherence level, 15.2% of respondents having a moderate-low adherence level, and 0.9% of respondents having a low adherence level. Diabetes mellitus patients in Yogyakarta show a high level of medication adherence. The most frequent non-adherent behaviour was found in 4 questions: respondents forgot to take or inject medication (61.61%); respondents took or injected medication (one of them) slower than usual schedule (55.36%); respondents did not always take or inject medication at the same time every day (62.5%); and respondents forgot to take or inject medication at least once in the past month (58.04%). The statistical analysis indicates no relationship between demographic characteristics, the total number of medications, and the total frequency of medication with adherence levels. This indicates that diabetes mellitus patients with low or high adherence levels are unaffected by the above factors.
Keyword: Diabetes Mellitus; Medication Adherence; Probabilistic Medication Adherence Scale

INTRODUCTION

Diabetes is a chronic metabolic disease characterized by an increase in blood glucose levels. Over time, this disease can cause serious damage to the heart, blood vessels, eyes, kidneys, and nerves. The most common type of diabetes for adults is type 2 diabetes, where the body becomes resistant to insulin or does not produce enough insulin[1]. According to Basic Health Research (Riskesdas) in 2013, the prevalence of chronic diseases such as diabetes mellitus in Indonesia was 6.9%, which increased to 10.9% in 2018. Meanwhile, the prevalence of diabetes mellitus in Special Region of Yogyakarta according to Riskesdas 2018 was 4.5%, which ranked third in Indonesia with a population of people with diabetes[2].

Diabetes mellitus is a chronic disease that requires long-term treatment. A study has shown that the main problem with long-term use of medication cause the low level of patient adherence[3]. WHO has reported that the adherence rate in patients with chronic diseases who undergoing long-term therapy in developed countries is only 50%. It is reported that adherence is lower in developing countries[4].

Low adherence to diabetes treatment leads to worse treatment outcomes and can cause damage to vital organs. Treatment failure will result in a lack of treatment benefits and negative impacts in the form of a cost burden on individual patients and the wider community[5]. There are factors that influence non-adherence, including patient characteristics, socioeconomics, morbidity, therapy, and healthcare systems[6]. A study has shown that diabetes patients feel bored due to long-term use of medication, large number of

medications, medication size, experienced side effects, and feeling that treatment does not cure the disease[7].

Identifying non-adherent patients in outpatient treatment is important to effectively implement therapy. There are various approaches that can be used to describe patient adherence[8]. There are several types of instruments used to measure medication adherence in patients, including MARS (Medication Adherence Rating Scale)[9], MMAS-8 (Morisky Medication Adherence Scale)[10], ARMS (Adherence Refill Medication Scale)[11], ProMAS (Probabilistic Medication Adherence Scale), and others[12]. In this study, the ProMAS questionnaire was used to measure the level of medication adherence. The ProMAS questionnaire was developed in 2015 by Kleppe et al. to address the problem of measuring adherence that cannot capture several specific behavioral aspects where non-adherence occurs. The ProMAS questionnaire measures adherence by looking at the patient's habits or behaviors in using medication which not only at a particular time but also in previous times. The questionnaire consists of 18 items with different levels of difficulty. The results of several studies indicate that measuring adherence using the ProMAS questionnaire is more accurate than the MARS-5 instrument and shows more alignment with objective data on adherence levels (such as clinical data of respondents)[13]. This study aims to measure the medication adherence behavior of patients with type 2 diabetes and analyze the differences in adherence between different sociodemographic characteristics that are almost similar to those used in previous studies, namely looking at the pattern of antidiabetic use with adherence in patients with diabetes mellitus in Bali. The ProMAS questionnaire was used in this study, which discovered that a combination of two antidiabetic medicines (53.3%) dominated the pattern of antidiabetic use. Most diabetes mellitus patients (42.2%) had moderate-high medication adherence, and statistical tests revealed no significant relationship between the pattern of antidiabetic usage and medication adherence (p=0.275). According to the findings of this study, patients who received a lower number of antidiabetics, namely a combination of two antidiabetics, had a higher degree of medication adherence than patients who received a combination of three or four antidiabetics[14]. In the previous study, statistical tests were carried out on the correlation between adherence and patterns of antidiabetic use variables. However, in this study, statistical tests were carried out on the correlation between adherence and the characteristics of the respondent's variables.

METHODS

Research Design

This study used a quantitative research approach with a cross-sectional design. The study was conducted from January 2023 to April 2023 in various community health centers (Puskesmas) in the Special Region of Yogyakarta. The community health center (Puskesmas) chosen for the study were located in Yogyakarta City (Puskesmas Jetis and Puskesmas Tegalrejo), Bantul district (Puskesmas Sewon I, Puskesmas Jetis I, and Puskesmas Piyungan), Gunung Kidul district (Puskesmas Paliyan), Sleman district (Puskesmas Godean I, Puskesmas Mlati II and Puskesmas Ngemplak 1), and Kulonprogo district (Puskesmas Temon I). The target population in this study was people who have been diagnosed with type 2 diabetes mellitus.

Data Collection

The data were collected with the ProMAS (Probabilistic Medication Adherence Scale) questionnaire to measure the level of adherence[15]. This questionnaire was originally in English and have been translated into Bahasa Indonesia with backward and forward translation process by Widayanti et al. This translated questionnaire have also shown to be valid and reliable to be used in people with type 2 diabetes in Indonesia[16]. The questionnaire was interviewed to the respondents by the researcher. The process of collecting data was carried out after obtaining the patient's consent (informed consent).

This study obtained ethics approval from the Ethics Committee of Gadjah Mada University (KE/FK/0078/EC/2023).

The samples of the respondents were selected conveniently based on the inclusion criteria including aged 18-65 years old, have been diagnosed with type 2 diabetes mellitus and taking the medication for at least 1 year. The exclusion criteria were respondents who were medical professionals or have an educational background from the medical field. The minimum sample size was calculated with the Slovin formula with 90% confidence level. The method used to determine the minimum number of respondents is using the Slovin formula with 90% confidence level, and the number of population was 174.703[2]. The minimum number of sample size calculates was 100 respondents. About 10% respondents were added, resulting in the total number of participant 112.

Data Analysis

The data obtained from the questionnaire was through scoring process, with correct answers receiving a score of 1 and incorrect answers receiving a score of 0. There are 4 categories of scoring results, such as low adherence (scores 0-4), moderate-low (scores 5-9), moderate-high (scores 10-14), and high adherence (scores 15-18)[15]. The dependent variable in this study was the ProMAS adherence scores, while the independent variables were factors that may affect adherence (e.g.frequency of medication use, type of medication, gender, employment status, age, education, and whether someone helps the patient to use medication). Data analysis was performed using JAMOVI (version 2.3.21 solid). Based on the Shapiro-Wilk normality test, a p-value of <0.001 was obtained, indicating that the data is not normally distributed, therefore, the researcher used the Spearman-rho test for correlation analysis. Descriptive analysis was used to describe the demographic characteristics of patients with diabetes mellitus who involved in this study. One-Way ANOVA test was used to determine the relationship between respondent demographic factors and medication adherence. If the p-value is <0.05, there is a significant difference between two variables, while if the p-value is >0.05, there is no significant difference between the two variables. Data that did not meet the One-Way ANOVA requirements were analyzed using the Spearman rho-test.

RESULT AND DISCUSSION

Characteristics of Respondents

The characteristics of the respondents in this study showed that from 112 respondents are 75% female with 57.58 years old as the average age. This is consistent with previous study which showed that 54.2% of diabetes mellitus patients are female and aged between 56-65 years old. Generally, the increased risk of diabetes is caused by lifestyle changes that lead to decreased physical activity and increased obesity. This is potentially more likely to affect female as they are less physically active than male, with a proportion of 27% for female and 20% male which categorized physically inactive and more likely to increase their body mass index[17]. One of the reasons why female are at higher risk of developing diabetes is due to hormonal changes, which are more common in female, especially related to premenstrual syndrome and post-menopause[17]. The majority of respondents (91.91%) with diabetes had an education level of elementary to high school graduates. Education is one of the important factors for understanding diabetes management, compliance with blood sugar control, managing symptoms with proper treatment, and preventing complications. Patients with higher education have better knowledge about diabetes and its effects on health, thus they will respond positively and make an effort to manage the disease[18]. Respondents who are grouped as a worker has a bigger portion (55.4%) compare to other characteristics. A number of 107 respondents (95.5%) received treatment with tablets or capsules compared to those who received insulin treatment. The average frequency of medication intake among the respondents was two times a day (50.9%). Almost all

Table I. Characteristics of Respondents with Diabetes Mellitus (n=112)

Characteristics of Respondents	N	%
Age		
Mean	57.58	
<60 years old	64	57.14%
≥60 years old	48	42.86%
Gender		
Female	84	75.0%
Male	28	25.0%
Education Level		
Elementery/Middle School	102	91.1%
College	10	8.9%
Employment Status		
Employed	50	44.6%
Unemployed	62	55.4%
Type of Medication		
Tablet/Capsule	107	95.5%
Insulin	5	4.5%
Medication frequency/day		
One time a day	51	45.5%
Two times a day	57	50.9%
≥3 times a day	4	3.6%
Payment		
BPJS	107	95.5%
Personal Payment	5	4.5%
Someone assists the patient in taking medication		
No	92	82.1%
Yes	20	17.9%

respondents (95.5%) paid for their treatment using the national health insurance (BPJS). After undergoing treatment for a considerable period and becoming accustomed to taking medication, the majority of respondents (82.1%) did not require assistance in taking their medication. The description of the characteristics of respondents with diabetes mellitus is shown in Table I.

Medication Adherence

The ProMAS instrument has been widely used to measure medication adherence, both in the general population and directly in patients. Table II shows the number and percentage of respondents answering each question of the questionnaire. It can be seen that the majority of diabetes mellitus patients complied or adhered with the treatment. However, in 4 out of 18 questions (question number 1, 2, 6, and 8), more respondents showed non-compliance. These items include they have forgotten to take or inject medication (61.61%); they take or inject (one of) the medication later than their usual schedule (55.36%); they do not always take or inject the medication at the exact same time every day (62.5%); and in the last month, they have forgotten to take or inject medication at least once (58.04%). Besides the four questions mentioned earlier, some respondents were non-compliant in using their medication not

Table II. Probabilistic Medication Adherence Scale (ProMAS) Evaluation

Item	Question	Yes n (%)	No n (%)
1	It has happened at least once that I forgot to take (one of) my medicines.	69 (61.61%)*	43 (38.39%)
2	It happens occasionally that I take (one of) my medicines at a later moment than usual.	62 (55.36%)*	50 (44.64%)
3	I have never (temporarily) stopped taking (one of my) medicines	70 (62.5%)	42 (37.5%)
4	It has happened at least once that I did not take (one of) my medicines for a day.	42 (37.5%)	70 (62.5%)
5	I am positive that I have taken all the medication that I should have taken in the previous year.	85 (75.89%)	27 (24.11%)
6	I take my medicines exactly at the same time every day.	42 (37.5%)	70 (62.5%)*
7	I have never changed my medicine use myself.	89 (79.46%)	23 (20.54%)
8	In the past month, I forgot to take my medicine at least once.	65 (58.04%)*	47 (41.96%)
9	I faithfully follow my doctor's prescription concerning the moment of taking my medicines.	110 (98.21%)	2 (1.79%)
10	I sometimes take (one of) my medicines at a different moment than prescribed (eg, with breakfast or in the evening)	6 (5.36%)	106 (94.64%)
11	In the past, I once stopped taking (one of) my medicines completely.	40 (35.71%)	72 (64.29%)
12	When I am away from home, I occasionally do not take (one of) my medicines.	23 (20.54%)	89 (79.46%)
13	I sometimes take less medicine than prescribed by my doctor.	21 (18.75%)	91 (81.25%)
14	It has happened (at least once) that I changed the dose of (one of) my medicines without discussing this with my doctor.	5 (4.46%)	107 (95.54%)
15	It has happened (at least) once that I was too late with filling a prescription at the pharmacy.	16 (14.29%)	96 (85.71%)
16	I take my medicines every day.	111 (99,11%)	1 (0,89%)
17	It has happened (at least once) that I did not start taking a medicine that was prescribed by my doctor.	7 (6.25%)	105 (93.75%)
18	I sometimes take more medicines than prescribed by my doctor.	3 (2.68%)	109 (97.32%)

Note: * indicates a value with a percentage of incorrect answers where respondents were non-adherent to the medication.

because they stopped using it, but because they changed the dosage without informing their doctor, either by reducing, temporarily stopping, or a few respondents increasing the dosage.

The total score of adherence was then categorized into four categories based on previous study[15]. The findings showed that 42.8% of respondents had a moderate-to-high level of adherence and 41.1% had a high level

Table III. Adherence Level of Diabetes Mellitus Medication

Adherence Level Category	Total n (%)
High (Score 15-18)	46 (41.1%)
Medium-High (Score 10-14)	48 (42.8%)
Low-Medium (Score 5-9)	17 (15.2%)
Low (Score 0-4)	1 (0.9%)

of adherence (Table III). This finding was consistent with previous research which found that about 81.7% diabetes mellitus patients were included in the compliant category in carrying out treatment[19].

Association of Adherence Score with the Characteristic of the Respondents

Table IV shows the mean score of adherences based on each group of sociodemographic characteristics and their p-values of mean differences. It can be seen that the characteristics of the respondents including the number of medications and total frequency of medications did not correlate with the adherence behavior of the respondents, as indicated by the p-values which are all >0.05. This suggests that the medication adherence behavior does not differ across any particular characteristic categories of the respondents.

These findings are consistent with other studies showing that characteristics such as age, employment status, duration of medication use, and type of medication do not affect adherence in patients with diabetes mellitus. A previous study also found that characteristics such as age group, education level, employment status, type of medication received, duration of diabetes mellitus, or presence of complications did not affect medication adherence[20]. Other studies found that age, medication knowledge scores, and type 2 diabetes mellitus (T2DM) with comorbidities were predictors of adherence in T2DM patients. As age increases, adherence improves. Noncompliance is more common among younger patients, who may need to know about their disease. Comorbidities, such as multiple medications, can also contribute to non-adherence. Medication knowledge is another factor determining adherence, with only 2.5% of patients reporting perfect scores. Healthcare professionals should disseminate appropriate information to improve treatment outcomes and patient education on medication regimens[21]. In another study, the dominant factors associated with adherence were employment status and the number of medications taken daily. Employment status, frequency of medication more than once, and number of medications more than two were associated with low adherence in this study[22]. The varied outcomes are likely attributed to sociodemographic background variations and cultural contexts.

Limitations of this study include a very limited sample size. Therefore, it may not fully represent the medication adherence of diabetes mellitus patients in Special Region of Yogyakarta, and the results of this study cannot generalize to the population in Indonesia with different characteristics. However, the results of this study may provide a more detailed information on diabetes patients' behavior in using medicines.

CONCLUSION

Overall, most respondents showed moderate-to-high adherence (42.8%) and high adherence (41.1%). Among the behavior items that contribute to non-adherence included forgotten to take or inject medication (61.61%), took or injected their medication later than usual (55.36%), not always take or inject their medication at the exact same time every day (62.5%), and forgotten to take or inject their medication at least once in the past month

Table IV. Mean±Standard Deviation and p-value by category

Category	Total participation per-sub group	Total *ProMAS Score* (*Mean±Standard Deviation*)	P-Value
Total number of medications			
1-3 medication	69	13.5±3.70	p = 0.472[b]
≥4 medication	43	13.0±3.20	
Medication frequency/day			
One time a day	51	13.2±3.74	
Two times a day	57	13.5±3.32	p = 0.485[b]
≥3 times a day	4	11.5±3.42	
Age			
Mean = 57.58 years old			
37-65 years old	112	13.3±3.51	p = 0.059[a]
Gender			
Female	84	13.5±3.30	p = 0.422[c]
Male	28	12.9±4.12	
Employment Status			
Unemployed	50	13.6±3.21	p = 0.521[c]
Employed	62	13.1±3.75	
Someone assists the patient in taking medication			
No	92	13.2±3.64	p = 0.597[c]
Yes	20	13.7±2.92	
Payment			
Personal Payment	5	13.3±3.48	p = 0,937[c]
BPJS	107	13.2±4.60	
Type of Medication			
Tablet/Capsule	107	13.4±3.51	p = 0.467[c]
Insulin	5	12.2±3.77	
Education Level			
Elementery/Middle	102	13.4±3.56	
School			p = 0.251[c]
College	10	12.1±2.88	

Note: "a" was analyzed using Spearman-rho test; "b" was analyzed using One-Way ANOVA (non-parametric); "c" was analyzed using Independent t-test.

(58.04%). Other behavior that came up from the results were that some respondents also altered the medicines instruction without consulting their health care professionals. There was no correlation or relationship between the total adherence score and the demographic characteristics of the respondents in this study, so that respondents' characteristics do not correspond with a person's adherence to take their medication.

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