

Relationship of Medication Adherence to Clinical Outcome in Patients Type 2 Diabetes with Modified Morisky Adherence Scale 8 (MMAS 8)

Niken Luthfiyanti^{1*}, Ardi Setyawan², Kharisma Jayak Pratama³

^{1,2,3} Bachelor of Pharmacy Education Program, Faculty of Health Sciences, Universitas Duta Bangsa Surakarta, Indonesia.

niken_luthfiyanti@udb.ac.id¹, kharisma_jayakpratama@udb.ac.id³

Address: Jl. Bhayangkara No.55, Tipes, Serengan District, Surakarta City, Central Java 57154

Author correspondence : niken_luthfiyanti@udb.ac.id*

Abstract. *Diabetes melitus is a chronic condition disease that requires continued use of medication. High adherence to treatment will produce good clinical results and play a role in improving the quality of life of diabetes melitus sufferers. The following research aims to assess the relationship between adherence to medication use and clinical outcomes for patients with type 2 diabetes mellitus at RSUD DR. Moewardi Surakarta which was conducted in the period April – June 2024. This research used a cross sectional method with a total of 98 patients as respondents who met the inclusion and exclusion criteria. Adherence data was assessed using the Modified Morisky Adherence Scale 8 (MMAS 8) questionnaire, and clinical outcomes were assessed from fasting or fasting blood glucose values and %HbA1C from medical record data. Analysis of the relationship between adherence and clinical outcomes using chi-square. The results of the level of treatment compliance can be divided into 3 categories, namely: high treatment compliance has a percentage of 24.5%, moderate treatment compliance has a percentage of 46.9%, and low treatment compliance has a percentage of 28.6%. Clinical outcomes were achieved by 38.8% and not achieved by 62.2%. There is a relationship between adherence medication and therapeutic outcomes in type 2 diabetes melitus patients with a Pearson chi square value of 0.011. Based on these data, pharmacist professionals need to place greater emphasis on adherence with medication use in type 2 diabetes mellitus patients to obtain good clinical outcomes.*

Keywords: *Type 2 diabetes; Medication adherence; Clinical outcome*

1. INTRODUCTION

An increase in blood sugar levels that above the usual range as determined by fasting blood sugar, 2-hour postprandial blood sugar, quick blood sugar testing, and HbA1c is known as hyperglycemia, and it is a symptom of diabetes (Soelistijo, 2021). The prevalence of type 2 diabetes mellitus has significantly increased; in the population aged ≥ 15 years, it was 6.9% in 2013 and 8.5% in 2018 (Kemenkes, 2018). Blood glucose management is a measure of the effectiveness of diabetes mellitus treatment, which aims to lower the risk of complications, get rid of complaints, and enhance the patient's quality of life (Adi, 2019).

According to research by (García-Pérez et al., 2013) and (Saleh et al., 2014), non-adherence to treatment will have an impact on poor clinical outcomes, risk of complications and poor quality of life. Treatment compliance can be influenced by gender and the main reason for non-compliance is that patients receive medication late and forget to take medication (Srikartika et al., 2016). Treatment compliance is the patient's attitude in receiving treatment within a certain time, as well as complying with advice from health workers. Adhering to treatment and maintaining an ideal body weight is positively related to clinical outcomes

(McAdam-Marx et al., 2014). According to Islam's research, (2017) comorbidities, education, age and physical activity have a significant relationship to clinical outcomes. The description of the compliance of DM patients at the Surakarta Community Health Center shows a low level of compliance and the relationship between sociodemographics and compliance is not significant (Rasdianah et al., 2016). Therefore, researchers are interested in examining the relationship between medication adherence and clinical outcomes in type 2 DM patients.

2. LITERATURE REVIEW

Hyperglycemia brought on by insulin resistance and insufficient insulin production is a hallmark of Type 2 Diabetes Mellitus (Type 2 DM), a chronic metabolic illness. In order to avoid long-term consequences that could harm the heart, kidneys, eyes, nerves, and other body organs, diabetes treatment entails regulating blood glucose levels. One of the key elements affecting blood glucose management in individuals with Type 2 DM is treatment adherence. In order to effectively manage diabetes, it is crucial to gauge the degree of treatment adherence.

One tool that is often used to measure treatment adherence is *Morisky Medication Adherence Scale* (MMAS), especially MMAS-8, which has been widely used in research related to diabetes treatment. MMAS-8 is an instrument consisting of 8 questions designed to evaluate patient medication adherence behavior to prescribed drug therapy. Higher scores on the MMAS-8 indicate better levels of adherence.

Using the MMAS-8 as a measuring tool, this study intends to investigate the association between clinical outcomes and the degree of medication adherence in individuals with Type 2 DM. To give a general overview of the connection between Type 2 DM patients' clinical outcomes and medication adherence, a number of pertinent studies will be presented. Medication Adherence and Its Impact on Clinical Outcomes in Type 2 Diabetes.

Adherence to treatment among Type 2 DM patients has a significant impact on blood glucose control and prevention of complications. Decreased medication adherence is associated with poor blood sugar control, which increases the risk of long-term complications, such as retinopathy, nephropathy, neuropathy, and heart disease.

1. Relationship of Adherence to Glycemic Control
Research conducted by (Ghosh et al., 2023) showed that higher adherence to treatment was associated with better blood glucose control, which was reflected in reduced HbA1c levels in Type 2 DM patients. In this study, MMAS-8 was used to assess the level of adherence, and patients with high MMAS-8 scores have better glycemic control and fewer diabetes-related complications.

2. Effect of Compliance on Diabetes Complications
Zhao *et al.*, (2021) in his study showed that patients with a high level of adherence to antidiabetic treatment had a lower risk of experiencing diabetes complications such as neuropathy and retinopathy. This study also confirmed that poor adherence was associated with an increased risk of cardiovascular events in Type 2 DM patients. MMAS-8 was used to assess adherence, and the results showed that poor adherence increased the prevalence of vascular complications.
3. Compliance and Quality of Life in Type 2 DM Patients
Research by (Mishra *et al.*, 2021) found that high levels of adherence were not only associated with better blood glucose control, but also with improved patient quality of life. Patients with good adherence tend to report fewer diabetes symptoms and feel more positive about their treatment. This study used the MMAS-8 as an instrument to assess the level of compliance.

The Role of MMAS-8 in Measuring Medication Adherence

The MMAS-8 has been proven to be an effective tool for assessing medication adherence in the management of Type 2 DM. The MMAS-8 consists of 8 questions covering various aspects, such as the patient's attitude towards treatment, problems related to side effects, and resistance to treatment. MMAS-8 scores range from 0 to 8, where higher scores indicate better compliance.

1. Accuracy of the MMAS-8 in Assessing Compliance
Morisky (Zhang *et al.*, 2021) in their study confirmed that the MMAS-8 has high validity and reliability in measuring adherence to treatment in patients with chronic diseases, including Type 2 DM. This tool is often used because of its ease of application in various clinical settings and its effectiveness in identifying patients who may have problems compliance.
2. MMAS-8 Validation Study in Type 2 DM Patients
Research by (Martinez-Perez *et al.*, 2021) confirmed that the MMAS-8 is reliable for assessing treatment adherence in Type 2 DM patients in various countries, including in countries with diverse economic status. This study also shows that MMAS-8 can be used to predict the risk of complications and glucose control in Type 2 DM patients.

Factors Influencing Medication Adherence in Type 2 Diabetes

Several factors may influence treatment adherence in Type 2 DM patients, which in turn impacts clinical outcomes. Some of the main factors include:

1. Patient Knowledge of Disease and Treatment
Research by (Muhammad Haskani et al., 2022) showed that patients who have a good understanding of the importance of medication in the management of Type 2 DM are more likely to adhere to therapy. Effective education about the disease and the benefits of treatment can increase patient compliance.
2. Side Effects of Treatment
Some patients report side effects from diabetes treatment, such as nausea, diarrhea, or weight loss, which may decrease their motivation to continue treatment. (Piragine et al., 2023) found that drug side effects can be a major inhibiting factor in medication adherence, even though the medication is important for blood sugar control.
3. Socio-Economic Factors and Social Support
(Zhang et al., 2021) showed that socio-economic factors, such as income level and accessibility to medications, play an important role in treatment adherence. Patients with economic limitations are more likely to experience difficulty in meeting treatment costs, which impacts their levels of compliance.
4. Comorbidity and Polypharmacy
Patients with multiple medical conditions that require additional treatment (polypharmacy) often have difficulty adhering to complex treatment regimens. (Indu et al., 2018) noted that Type 2 DM patients with comorbidities, such as hypertension or dyslipidemia, often have lower levels of compliance.

Adherence to treatment is a key factor in the management of type 2 diabetes mellitus and has a significant impact on clinical outcomes, such as blood glucose control, prevention of complications, and improvement of quality of life. The use of the MMAS-8 as a tool to assess adherence has been shown to be effective and reliable in a variety of clinical settings. The results showed that good compliance was associated with better glucose control, reduced risk of complications, and improved patient quality of life. Therefore, it is important to continuously monitor and improve treatment adherence through patient education, management of side effects, and socio-economic support.

3. METHODS

This research was observational with a cross sectional design conducted at RSUD DR. Moewardi Surakarta in April-June 2024. The number of respondents involved in this research was 98 with a confidence level of 95%. The inclusion criteria were patients diagnosed with type 2 DM, aged ≥ 18 years, and regularly receiving antidiabetic medication for at least 6 months before the research period, while the exclusion criteria were patients who were uncooperative, pregnant and breastfeeding patients.

Data Collection

Medication adherence data from interviews and clinical outcome data from medical records, namely fasting blood glucose (GDP) or instantaneous blood glucose (GDS) and %HbA1C.

Measuring instrument

Compliance level Modified Morisky Adherence Scale 8 is a questionnaire that has been validated in the Indonesian version and has been validated with a Cronbach Alpha value of 0.806 (Lita, 2017). MMAS-8 consists of 8 question items. The respondent's level of compliance was assessed by looking at the frequency of answers to each question, where a score of 8 was a high level of compliance, a score of 6-7 was a moderate level of compliance and a score of <6 was a low level of compliance.

Sociodemography

The sociodemographics of the patients in this study consisted of gender, age, education level, employment status, duration of illness. Patient sociodemographic data was obtained during direct interviews or by looking at the patient's medical records.

Clinical Outcome

Clinical outcome is a description of the patient's clinical response related to the success of antidiabetic therapy, namely in the form of instant blood glucose levels (GDS) or fasting blood glucose levels (GDP) and HbA1C values. Clinical outcomes are obtained from patient medical record data, GDS is said to be achieved if the patient's GDS level ranges between 100-199 mg/dl. Meanwhile, GDP is said to be achieved if the GDP level ranges between 100-125 mg/dl, and the HbA1C value is $<7\%$ (Soelistijo, 2021)

Data Analysis

The relationship between the level of adherence and clinical outcomes was analyzed using Chi-Square.

4. RESULTS

Table 1. Sociodemography of Type 2 DM Patients

Characteristics	Number of subjects (n=98)	Percentage (%)
Gender		
Man	43	43,9
Woman	55	56,1
Age		
18 – 59 years	77	78,6
≥60 years	21	21,4
Level of education		
Low (Not attending school/elementary school/middle school/high school)	83	84,7
High (College)	15	15,3
Employment Status		
Work	62	63,3
Doesn't work	36	36,7
Duration of DM disease		
<5 years	51	52
>5 years	47	48
Disease complications		
With complications	28	28,6
Without complications	70	71,4

This study involved 98 type 2 DM patients, dominated by female patients (56.1%) and those aged 18-59 years were (78,6%). Judging from the level of education, the majority of patients had the highest level of elementary school education (84,7%). The percentage of patients working is (63,3%). Patients at RSUD DR. Moewardi Surakarta is dominated by patients with disease duration <5 years (52%) so that the majority of patients are without complications (71,4%) (Table I).

Treatment adherence was measured using the MMAS-8 questionnaire. The MMAS-8 questionnaire consists of 8 question items which are conducted in direct interviews with patients and patients can ask researchers if there are questions that are not clear. The level of adherence is divided into 3 groups, namely high adherence, medium adherence and low adherence. Patients are said to have high adherence if the MMAS-8 total score is equal to 8, patients with moderate adherence if the total score is 6-7 and patients with low adherence if the score is <6. Adherence Assessment is an assessment of patients that is used to determine whether a patient has followed the prescribed medication therapy regimen. In table II it can be seen that patients with a low level of adherence (28.6%) are greater than patients with a high level of adherence (24.5%).

Tabel 2. Results of assessing the level of adherence with the MMAS-8 questionnaire

Adherence	Frequency (f)	Percentage (%)
Low MMAS-8 Score (8)	28	28,6
Moderate MMAS-8 Score (6-7)	46	46,9
High MMAS-8 Score (<6)	24	24,5

Based on table III, The clinical outcome of patients who were not achieved (68%) was greater than the clinical outcome of patients who were achieved (32%).

Tabel 3. Results of achieving clinical outcomes (blood glucose levels and HbA1C) of patients

Clinical Outcome	Number of patients (n=98)	Percentage (%)
Achieved (GDS 100-199mg/dL or GDP 100-125 mg/dL or HbA1C <7%)	37	37,8
Not achieved (GDS≥200 mg/dL or GDP≥126 mg/dL or HbA1C>7%)	61	62,2

Table 4. Results of analysis of the relationship between the level of adherence and clinical outcomes

Adherence	N (%)	Clinical Outcome		P Value
		Achieved (GDS 100-199mg/dL or GDP 100-125 mg/dL or HbA1C <7%)	Not achieved (GDS≥200 mg/dL or GDP≥126 mg/dL or HbA1C>7%)	
Low MMAS-8 Score <6	28	5 (17,9%)	23 (82,1%)	0,011*
Moderate MMAS-8 Score 6-7	46	18 (39,1%)	28 (60,9%)	
High MMAS-8 Score 8	24	14 (58,3%)	10 (41,7%)	

Analysis of the relationship between the level of compliance and clinical outcomes uses Chi Square statistical analysis. The level of compliance was divided into two groups, namely patients with high adherence, moderate adherence and low adherence. Meanwhile, the clinical outcome group was divided into two, namely achieved and not achieved. The results of the

analysis showed that patients with a high level of compliance had a better percentage of achieving clinical outcomes (58.3%) than patients with a low level of compliance (17.9%). There is a relationship between adherence to type 2 DM treatment and clinical outcomes (achievement of blood glucose levels or HbA1C) with a P value = 0.011.

5. DISCUSSION

Based on table II above, it is known that the research results of respondents who had a high level of medication adherence had a percentage of 24.5% with 24 respondents, moderate medication adherence had a percentage of 46.9% with 46 respondents and low medication adherence had a percentage of 28.6% with 28 respondents. The results of this level of compliance are in accordance with previous research conducted by (Bulu et al., 2019) that in this study the majority fell into the moderate level of adherence category at 47.3%.

Obedience can be described as a disciplined attitude or obedient behavior towards an order or rule that has been set or given which is accepted with full awareness (Fitri & Fanny, 2022). Adherence is one way that someone can get maximum therapeutic results. Especially in the treatment of type 2 diabetes mellitus which must be carried out continuously and over a long period of time because this disease cannot be cured. The importance of compliance with taking anti-diabetic medication or using insulin medication aims to control blood sugar levels in the body so that it does not cause comorbidities which can worsen the patient's condition and can even cause death (Muhaymin & Andini, 2023).

The clinical outcomes in Table III show that patients who were not achieved (62.2%) were greater than the clinical outcomes of patients who were achieved (37.8%). In line with research, that 69% of patients did not reach the fasting blood glucose target. In another study in India, respondents dominated with poor glycemic control (Kakade et al., 2016). Poor glycemic control in patients is generally caused by non-compliance with dieting, not exercising, not adhering to taking medication, not controlling glucose well, and the level of knowledge about diabetes. Patient clinical outcomes are influenced by age, education, employment, treatment patterns, duration of suffering from DM, presence of complications, BMI, comorbidities such as hypertension, non-compliance with medication, and non-compliance with self-management such as diet, exercise, and self-monitoring of glucose (Kassahun et al., 2016).

Analysis of the relationship between the level of adherence and clinical outcomes uses Chi Square statistical analysis. The level of adherence was divided into 3 groups, namely patients with high adherence, moderate adherence and low adherence. Meanwhile, the clinical

outcome group was divided into two, namely achieved and not achieved. The results of the analysis showed that patients with a high level of compliance had a better percentage of achieving clinical outcomes (58.3%) than patients with a low level of adherence (17.9%). There is a relationship between adherence to type 2 DM treatment and clinical outcomes (achievement of blood glucose levels) with a P value = 0.011. Research by (McAdam-Marx et al., 2014) using the Medication Adherence Report Scale (MARS) questionnaire stated that weight loss and medication adherence were positively related to clinical outcomes, namely HbA1c <7%, so it is important to consider weight loss and medication adherence in controlling blood glucose. type 2 DM patients. Compliance with drug therapy is important to control blood glucose levels, DM patients must always be given optimal health services and cooperation between health workers is needed. According to research (Lee et al., 2017), patients with low levels of adherence to oral anti-diabetic drugs have high HbA1c levels, so that non-adherence to oral anti-diabetics is a factor that can strongly influence the magnitude of the treatment effect, resulting in low achievement of clinical outcomes. According to (García-Pérez et al., 2013), non-compliance will have an impact on low quality of life, risk of complications and poor outcomes for diabetes mellitus sufferers. The aim of type 2 DM therapy is to eliminate complaints, improve and improve quality of life and reduce the risk of complications. The success of therapy can be seen from the control of blood glucose levels which is used as a clinical outcome in this study (“Standards of Medical Care in Diabetes-2018 Abridged for Primary Care Providers,,” 2018).

6. CONCLUSION

The results of the level of treatment compliance can be divided into 3 categories, namely: high treatment compliance has a percentage of 24.5%, moderate treatment compliance has a percentage of 46.9%, and low treatment compliance has a percentage of 28.6%. Clinical outcomes were achieved by 38.8% and not achieved by 62.2%. There is a relationship between medication adherence and therapeutic outcomes in type 2 diabetes mellitus patients with a Pearson chi square value of 0.011. Based on these data, pharmacist professionals need to place greater emphasis on adherence with medication use in type 2 diabetes mellitus patients to obtain good clinical outcomes.

LIMITATION

In this study there are shortcomings or weaknesses, so the researcher realizes that there are limitations during this research, including: Respondents who still have difficulty understanding the questions and statements in the questionnaire, and when conducting research, there were still respondents who refused to be interviewed on the grounds of fear, embarrassment and privacy reasons.

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