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Association of medication adherence with clinical outcomes and quality of life in type 2 diabetes mellitus patients: a cross-sectional study

Hubungan Kepatuhan Minum Obat terhadap Outcome Klinik dan Kualitas Hidup Pasien Diabetes Mellitus Tipe II: Studi Cross-sectional

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ABSTRACT

Background: *Type 2 diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels. Patient adherence to medication is a critical factor in effective management, as it can reduce morbidity and mortality while improving health-related quality of life (HRQoL). Digital interventions, such as smartphone-based medication reminder applications, represent a promising strategy to enhance adherence.*
Objective: *This study aimed to examine the relationship between medication adherence and clinical outcomes, specifically fasting blood glucose levels and HRQoL, among patients with type 2 diabetes in primary health care settings.*
Methods: *A cross-sectional pre–post test design was employed involving 96 respondents, divided equally into control and intervention groups, selected through convenience sampling. Primary data were collected using the MARS-10 adherence questionnaire and the DQOL Brief Clinical Inventory, while secondary data were obtained from pre– and post–fasting blood glucose measurements.*
Results: *Results showed no significant relationship between medication adherence and fasting blood glucose levels ($p > 0.05$), nor between adherence and HRQoL ($p > 0.05$), even with the implementation of the Drug Reminder App intervention.*
Conclusion: *These findings highlight the need for additional interventions or further innovations in digital adherence support to improve clinical and quality-of-life outcomes in type 2 diabetes management.*

Keywords: *digital health interventions, health-related quality of life, medication adherence, type 2 diabetes mellitus*

ABSTRAK

Latar Belakang: Diabetes melitus tipe 2 adalah gangguan metabolik kronis yang ditandai dengan peningkatan kadar glukosa darah. Kepatuhan pasien terhadap pengobatan merupakan faktor penting dalam pengelolaan diabetes karena dapat menurunkan morbiditas dan mortalitas serta meningkatkan kualitas hidup terkait kesehatan (HRQoL).
Tujuan: Penelitian ini bertujuan untuk menilai hubungan antara kepatuhan minum obat dengan kadar glukosa darah puasa dan HRQoL pada pasien diabetes tipe 2 di layanan kesehatan primer.
Metode: Desain penelitian yang digunakan adalah cross-sectional pre–post test, melibatkan 96 responden (48 kontrol, 48 intervensi) dengan teknik convenience sampling. Data dikumpulkan melalui kuesioner MARS-10 dan DQOL Brief Clinical Inventory serta pengukuran kadar glukosa darah puasa pre–post. Hasil menunjukkan

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tidak ada hubungan signifikan antara kepatuhan dengan kadar glukosa darah puasa (p > 0,05) maupun HRQoL (p > 0,05), meskipun intervensi Drug ReminderApp diterapkan. **Hasil:** Temuan ini menunjukkan bahwa kepatuhan saja tidak cukup untuk mencapai luaran klinis optimal, sehingga diperlukan intervensi tambahan dan inovasi digital yang lebih komprehensif dalam pengelolaan diabetes tipe 2. inovasi terbaru pada aplikasi yang diberikan pada penelitian ini.
Kata kunci: digital application, diabetes melitus, kepatuhan dan kualitas hidup, kepatuhan obat

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by elevated blood glucose levels due to impaired insulin production or ineffective insulin utilization. Insulin, produced by the pancreas, regulates blood glucose by facilitating its uptake into cells, where it is metabolized into energy in the form of ATP[1]. Type 1 DM results from an absolute deficiency of insulin due to autoimmune destruction of pancreatic β-cells, whereas type 2 DM is primarily caused by insulin resistance combined with impaired insulin secretion. Type 2 DM is more prevalent, and Indonesia ranks among the countries with the highest number of cases, with approximately 19.5 million people affected[2]. Type 1 DM results from an absolute deficiency of insulin due to autoimmune destruction of pancreatic β-cells, whereas type 2 DM is primarily caused by insulin resistance combined with impaired insulin secretion. Type 2 DM is more prevalent, and Indonesia ranks among the countries with the highest number of cases, with approximately 19.5 million people affected [3], [4].

The goal of treatment for DM patients is to prevent complications and increase the success of therapy. The success of therapy includes dosage accuracy, drug selection accuracy, and medication adherence [5]. However, DM patients include individuals who don't take their medications as prescribed [6]. Treatment adherence is one of the important factors that strongly influence blood glucose control [7]. Adherence with taking medication and the success of therapy on blood glucose levels have a negative impact both economically, clinically, and affecting the patient's quality of life as a result of repeated hospitalizations and relapses [8]. Reduced quality of life can have a substantial impact on the rise in mortality and the life expectancy of DM patients [9]. Diabetes mellitus is an incurable disease, making proper management and treatment essential to preserve patients' quality of life. Several interventions can improve medication adherence, thereby positively influencing quality of life. One promising approach is the use of smartphone-based digital reminder applications to enhance medication adherence [10],[11].

In a study by Hasina et al. (2014), the quality of life, therapy satisfaction, and adherence level among elderly patients with type 2 diabetes mellitus at Dr. Sardjito Hospital in Yogyakarta were categorized as satisfactory (7.10 ± 1.05) and adherent (81.7%). The study demonstrated a significant correlation between quality of life and adherence (p = 0.012)[12]. Numerous studies have examined the relationship between quality of life, clinical outcomes, and medication adherence. While some investigations reported modest effects, the overall evidence suggests a strong association among these variables. However, debate remains regarding the nature of the relationship between quality of life and treatment adherence. Therefore, this study aimed to evaluate the association of quality of life, clinical outcomes, and medication adherence in patients with type 2 diabetes mellitus [13].

As first-level healthcare facilities, primary care centers play a pivotal role in preventive and promotive initiatives that support patients in achieving successful therapeutic outcomes. In Surabaya, this role is particularly significant, as the city has 61 health

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centers distributed across various regions. Therefore, it is essential to investigate the relationship among fasting blood glucose levels, medication adherence, and quality of life in patients with type 2 diabetes mellitus within primary care. The findings of this study may serve as a reference to improve pharmaceutical services in public health centers and to advance pharmaceutical knowledge, particularly regarding strategies to enhance medication adherence in patients with type 2 diabetes mellitus.

METHODS

Study design

This study employed a cross-sectional analytical design to examine the relationship among quality of life, medication adherence, and fasting blood glucose levels in patients with type 2 diabetes mellitus receiving primary healthcare services. The study was conducted at two community health centers in Surabaya, with prospective data collection carried out from January to March 2023.

Data source and sampling procedure

A convenience sampling method was applied. The study population consisted of outpatients diagnosed with type 2 diabetes mellitus at primary healthcare centers in Surabaya who met the inclusion criteria. Sample size was calculated using the cross-sectional formula [14]:

$$\mathrm{n} = \frac{(Z\,\frac{a}{2})^2 \,.\, p \,.\, (1 - p)}{e^2}$$

Where n is the minimum required sample size, Zα/2 is the Z-value at the desired confidence level (1.96 for 95%), p is the estimated proportion (0.5 was used to obtain the maximum sample size), and e is the margin of error (0.1). All parameters were defined according to standard epidemiological calculation methods.

Eligible participants were: (1) outpatients aged >18 years with a confirmed diagnosis of type 2 diabetes mellitus, (2) patients receiving anti-diabetic medication either as monotherapy or in combination, (3) patients with access to communication devices, including a smartphone with WhatsApp, Playstore, and the Medisafe application, (4) patients attending routine follow-up visits during the study period, and (5) patients who provided informed consent.

Exclusion criteria included pediatric patients and individuals with physical or mental limitations (e.g., severe psychiatric disorders or illiteracy). Drop-out criteria were applied to participants who were referred to another healthcare facility, failed to attend follow-up within one month, or died during the study period.

Variables of the study

The independent variables in this study were medication adherence and quality of life. The dependent variable was blood glucose level, including random and fasting blood glucose measurements.

Data Collection

Primary data were collected through questionnaires administered via a Google Form and direct interviews at baseline (day 1) and follow-up (day 30). Secondary data were obtained from medical records, including random and fasting blood glucose levels. Data collection was conducted at two time points to assess changes over time.

Measurement and instruments

Medication adherence was assessed using the MARS-10 questionnaire, while quality of life was measured using the DQOL Brief Clinical Inventory. Both instruments underwent back-translation and were validated and proven reliable ($p < 0.05$; KR-20 ≥

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0.70)[15],[16]. Blood glucose levels were obtained from medical records, including both random and fasting measurements

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Commission of the University of Muhammadiyah Lamongan (No. 323/EC/KEPK-S1/07/2023). Written informed consent was obtained from all participants prior to data collection.

Data Analysis

Data were analyzed using descriptive statistics to summarize sociodemographic characteristics. The paired t-test was used to assess differences between baseline and follow-up measurements, while the chi-square test was applied to examine associations among quality of life, medication adherence, and clinical outcomes.

RESULTS

Respondents were selected using convenience sampling based on predefined inclusion and exclusion criteria. The study population consisted of outpatients with type 2 diabetes mellitus who received care at primary healthcare centers between January and March 2023. A total of 96 respondents were enrolled, comprising 48 in the control group and 48 in the intervention group. The characteristics of the study participants are presented in Table 1

Table 1. Baseline Characteristic

Patient characteristics		Intervention Group		Control group	
		n	Percentage	n	Percentage
Sex	Male	23	48%	22	46%
	Famale	25	52%	26	54%
	Total	48	100%	48	100%
Age (years)	Early adulthood (18 - 25 years)	3	6%	2	4%
	Early Adult (26-35 years)	0	0%	1	2%
	Late Adult (36-45 years)	17	35%	15	31%
	Early Elderly (46-55 years)	19	40%	22	46%
	Late Elderly (55-65) years	9	19%	8	17%
	Total	48	100%	48	100%
Education	No Formal Education	0	0%	1	2%
	Elementary school	7	15%	7	15%
	Junior High School	2	4%	3	6%
	Senior High School	17	35%	20	42%
	Diploma III	12	25%	8	17%
	Bachelor	9	19%	9	19%
	Master	1	2%	0	0%
	Total	47	100%	48	100%
Occupation	Employee	14	29%	9	19%
	Homemaker	20	42%	24	50%
	Self-employed	7	15%	8	17%
	Retired	2	4%	1	2%
	Government employee	3	6%	3	6%
	Unemployed	2	4%	2	4%
	Physician	0	0%	1	2%

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Patient characteristics		Intervention Group		Control group	
		n	Percentage	n	Percentage
	Total	48	100%	48	100%
Duration of Diabetes Mellitus (years)	< 5	21	44%	33	69%
	5-10	23	48%	14	29%
	>10	4	8%	1	2%
	Total	48	100%	48	100%
Number of Medication (drug)	1	21	44%	29	60%
	2	21	44%	14	29%
	3	6	13%	1	2%
	4	0	0%	4	8%
	Total	48	100%	48	100%
Initial fasting blood sugar level	< 126 mg/dL	11	23%	18	38%
	> 126 mg/dL	37	77%	30	63%
	Total	48	100%	48	100%

Table 1 presents the demographic and clinical characteristics of the 96 respondents, comprising 48 participants in the intervention group and 48 in the control group. The majority were female (n = 51, 53.1%). Most respondents were aged 36–45 years (n = 42, 43.8%) or 46–55 years (n = 41, 42.7%). Educational attainment was predominantly at the senior high school level (n = 36, 37.5%). In terms of occupation, homemakers constituted the largest group (n = 44, 45.8%). More than half of the respondents (n = 54, 56.3%) had been diagnosed with diabetes mellitus for less than five years.

Table 2. Distribution of Adherence with Taking Medication (DM) Patients measured by the pre post MARS-10 questionnaire in the control and intervention groups

Group	Medication adherence	*Pre*		*Post*	
		n	Percentage	n	Percentage
Control	Adherence	35	58.30%	41	91.70%
	Non Adherence	13	41.70%	7	8.30%
Intervention	Adherence	37	70.80%	44	95.80%
	Non Adherence	11	95.80%	4	4.20%

According to the descriptive findings in Table 2, medication adherence among patients with type 2 diabetes mellitus improved in both the control and intervention groups. In the control group, 35 respondents (58.3%) were adherent at baseline, increasing to 41 respondents (91.7%) at follow-up. In the intervention group, 37 respondents (70.8%) were adherent at baseline, increasing to 44 respondents (95.8%) at follow-up. Table 3 presents the statistical analysis results comparing changes in adherence levels between the control and intervention groups.

Table 3. Results of the Paired T-test on Adherence to Taking Medication Pre-Post Test in the Control and Intervention Groups

Group	N	Medication adherence	*Mean±SD*	*Correlation*	*T*	*Sig. (2-tailed)*
Control	48	*Pre-Post Test*	0.417±1.686	0.668	-1.712	0.094
Intervention	48	*Pre-Post Test*	1.396±2.403	0.347	-4.024	0.000

Paired T-test

The paired t-test (Table 3) was used to assess differences in medication adherence between pre- and post-intervention in both groups. A p-value < 0.05 indicated statistically significant improvements in adherence. The mean difference in adherence scores was greater in the intervention group (1.396) compared to the control group (0.417). Figure 1 shows changes in fasting blood glucose levels in both groups. In the control group, values ranged from 97–367 mg/dL at baseline to 90–230 mg/dL at follow-up, with mean levels decreasing from 148 mg/dL to 131 mg/dL. In the intervention group, values ranged

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from 96–458 mg/dL at baseline to 91–298 mg/dL at follow-up, with mean levels decreasing from 164 mg/dL to 142 mg/dL. These descriptive findings indicate a reduction in fasting blood glucose levels in both groups.

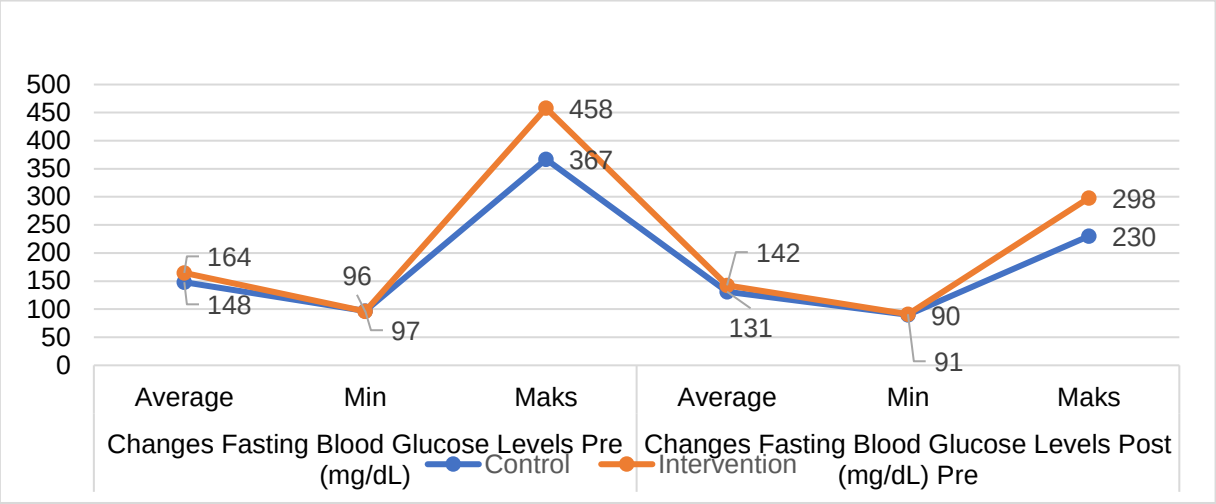

Figure 1. Profile Changes in Clinical Outcome of Fasting Blood Glucose Levels Pre-Post in the Control and Intervention Groups

Description: GDP 100-125 mg/dL

The clinical outcome profile of fasting blood glucose level changes was also assessed.

Table 4. Results of the Paired t-test on Clinical Outcomes of Pre-Post Test Blood Sugar Levels in the Control and Intervention Groups.

Group	N	Clinical Outcome of Blood Sugar Levels	Mean±SD	*Correlation*	T	*Sig. (2-tailed)*
Control	48	*Pre-Post Test*	16.917±25.967	0.885	4.513	0.000
Intervention	48	*Pre-Post Test*	22.042±38.597	0.793	3.957	0.000

*Paired T-test..test

Table 4 shows that clinical outcomes for fasting blood glucose levels differed significantly between the control and intervention groups ($p < 0.05$). The mean reduction in fasting blood glucose was greater in the intervention group (22.042 mg/dL) compared to the control group (16.917 mg/dL), indicating that the pharmacist-supported digital smartphone application 'Drug ReminderApp' was effective in lowering blood glucose levels among outpatients with type 2 diabetes mellitus. Since medication adherence is a key determinant of therapeutic effectiveness in diabetes management, both descriptive and statistical analyses were conducted to examine the relationship between adherence and clinical outcomes (fasting blood glucose levels) within the intervention group.

Table 5. Relationship Between Medication Adherence and Clinical Outcome (Blood Sugar Levels) in the Intervention Group

Medication adherence	N (%)	*Clinical Outcome of Blood Sugar Levels*		
		Achieved	Not Achieved	p-value
Adherence	44 (95.80)	11	31	0.614
Non Adherence	4 (4.20)	1	5	
Total	48 (100)	12 (25)	36 (75)	

*Chi-Square test

Table 5 shows that the majority of participants demonstrated medication adherence, with 44 respondents (95.8%) classified as compliant. However, most respondents (n = 36, 75%) did not achieve clinical outcomes within the normal fasting blood glucose range,

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indicating relatively low therapeutic success. Consistent with this finding, chi-square test results showed no significant correlation between medication adherence and fasting blood glucose outcomes in the intervention group ($p > 0.05$).

Poor adherence is known to contribute to treatment failure and may increase morbidity in patients with diabetes mellitus. As adherence influences quality of life and may reduce morbidity and mortality, the distribution and analysis of patients' quality of life in this study are presented in Tables 6 and 7.

Table 6. Distribution of Patients' Quality of Life in the control and intervention groups

Patient Quality of Life Category	Good	Poor
Control	21	27
Intervention	22	26

According to Table 6, most participants demonstrated high medication adherence (44 respondents, 95.8%). However, the majority reported a poor quality of life (26 respondents, 54%).

Table 7. The connection between the intervention group's quality of life and medication adherence

Medication adherence	N (%)	Patient Quality of Life		
		Good	Poor	p-value
Adherence	44 (95.80)	19	23	0.827
Non Adherence	4 (4.20)	3	3	
Totale	48 (100)	22 (46)	26 (54)	

*Chi-Square test

Table 7 shows that, according to the chi-square test, there was no significant correlation between medication adherence and quality of life in the intervention group ($p > 0.05$).

DISCUSSION

A person who receives treatment, adheres to a diet, and lives their life in line with a health care provider's advice is said to be exhibiting adherence [16]. The treatment and prevention of type II diabetes serve as the foundation for the idea of diabetes mellitus [18]. Diabetes is a serious chronic illness that arises when the body is unable to use the insulin generated by the pancreas or when the hormone that controls blood sugar or glucose is not produced in adequate amounts [3]. Patients who use medications for an extended period of time may face psychological issues, such as boredom. This is the reason why people stop taking their medications as prescribed. Achieving therapeutic effectiveness requires patient compliance, particularly when treating non-communicable disorders like hypertension [17], [18] Medication adherence is one of the key factors influencing treatment effectiveness in hypertensive patients, as it helps maintain blood pressure within normal ranges.

One approach for tracking a patient's compliance with their prescription schedule is a questionnaire. The use of a questionnaire to assess medication adherence has the advantages of being practical, economical, and successful [19], [20]. The Medication Adherence Rating Scale-10 (MARS-10) was employed in this study's adherence measuring investigation. This instrument contains 10 questions that have good validity and reliability for patients with chronic diseases. The MARS-10 instrument is translated into Indonesian using the forward-backward translation method. Translations are carried out by two nationally qualified English language institutions, namely the English Language Training International (ELTI) Purwokerto and Muhammadiyah University Purwokerto's Language Development Center (LDC UMP). One instrument that may be used to assess the level of patient medication adherence is the MARS-10 (Medication Adherence Rating Scale-10) questionnaire, which has been translated into Indonesian

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and validated and reliability-tested [21].

Diabetes will develop problems that could harm life and health if it is not adequately managed. Acute complications play a major role in poor quality of life, cost losses, and mortality [3]. Diabetes patients' quality of life, which is described as their physical, psychological, social, and well-being functions, can be impacted by the condition they have and the length of their treatment. A person's perception of their position in life in respect to their goals, norms, expectations, and worries as well as the culture and values in which they live is what the WHO refers to as their quality of life [22]. The patient's quality of life can be assessed using a questionnaire. Burroughs' (2004) DQOL Brief Clinical Inventory quality of life questionnaire, which has been back translated, was utilized to gauge the study's subject [15].

This study included 96 respondents, equally divided into control and intervention groups (n=48 each). Most participants were women (53.12%), aligning with evidence that females have a higher risk of T2DM due to higher BMI and hormonal changes, especially post-menopause, which increase insulin resistance [23]. Women also tend to show better medication adherence than men [24].

Most respondents were aged 36–55 years, an age group with increased T2DM risk due to reduced physical activity, weight gain, and declining muscle mass. Previous studies confirm a significant association between age and diabetes incidence (p=0.010). Younger patients tend to be more adherent, while older individuals often demonstrate better self-care due to greater health awareness [25].

In both the intervention and control groups, the majority of respondents had completed senior high school as their highest level of education, accounting for 36 individuals (37.5%). Although education does not directly affect glycemic control, patients with higher educational levels have better knowledge, attention, and adherence to the therapy they are currently undergoing [26]. Education is an important factor influencing knowledge, which in turn affects medication adherence. Although knowledge can also be acquired through family and community, higher levels of formal education are generally associated with better health literacy and treatment compliance. Respondents with higher education were reported to be up to 20 times more likely to adhere to treatment compared to those with lower education levels [27].

The characteristics of the respondents' work were dominated by housewives, namely 44 respondents (45.83%). Work is something that must be done to support life and family [28]. Based on research Mirnawati et al., (2021), there is a relationship between employment status and adherence to taking hypertension medication. Several social aspects that affect a person's health status include age, gender, occupation, and socioeconomic status [29]. Social factors also influence respondents' health status, particularly medication adherence. Previous studies have shown that unemployed respondents demonstrated higher adherence (31.9%, n = 69) compared to employed respondents (9.3%, n = 20). This difference may be attributed to the greater likelihood of employed individuals forgetting or skipping their medication due to busy schedules, whereas those who are no longer working have fewer distractions. Thus, individual activity levels may act as a barrier to consistent medication adherence, potentially preventing patients from achieving optimal treatment outcomes [30].

In this study, more than half of the respondents (n = 54, 56.25%) had been diagnosed with diabetes mellitus for less than five years. Previous studies have shown that longer disease duration is often associated with lower adherence, partly due to treatment fatigue or perceived lack of recovery. In chronic cases, physicians may increase dosages or add medications as complications develop, which can further reduce adherence [33]. In this study, the majority of patients received monotherapy (n = 50, 52.08%) and most (n = 67,

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69.80%) had abnormal baseline fasting blood glucose levels (>126 mg/dL). These findings reflect that patients managed in primary healthcare were generally in a stable condition.

The digital intervention 'Reminder ObatApp' was monitored over the one-month period. In the questionnaire, 'yes' responses to items 1–6, 9, and 10 were scored as 0, while 'no' responses were scored as 1. Conversely, for items 7 and 8, 'yes' responses were scored as 1 and 'no' responses as 0. Respondents were categorized as non-adherent if their total score ranged from 1–5 and adherent if their score was 6–10 [21]. Descriptive analysis of medication adherence (Table 2) showed an increase in both groups. In the control group, adherence rose from 35 respondents (58.3%) at baseline to 41 respondents (91.7%) post-measurement. In the intervention group, adherence increased from 37 respondents (70.8%) to 44 respondents (95.8%). These results indicate greater improvement in the intervention group. However, low medication adherence can still lead to poorer health outcomes despite appropriate therapeutic management[18].

Descriptive analysis showed no substantial difference in medication adherence outcomes between the control and intervention groups. However, paired t-test analysis of pre–post measurements (Table 3) revealed a statistically significant difference in adherence scores ($p < 0.05$). The mean change in adherence scores was greater in the intervention group (1.396) compared with the control group (0.417). These results suggest that the Reminder ObatApp digital smartphone application was more effective in improving medication adherence among patients with type II diabetes mellitus. This finding aligns with previous studies conducted in Indian hospitals, which demonstrated that reminder-based interventions significantly enhance patient adherence ($\beta = 0.637$, $e = 0.055$, $p = 0.001$) [31]. Medication adherence refers to the extent to which individuals follow prescribed instructions and restrictions based on their own willingness. Adherence to primary healthcare center programs reflects patients' compliance with the recommendations, instructions, and restrictions provided by healthcare staff to support recovery. The level of patient adherence to medication is a key determinant of the therapeutic success of diabetes mellitus management [32].

Persistent hyperglycemia can worsen the prognosis of diabetes mellitus, leading to complications such as nephropathy, cerebrovascular disease, and cardiovascular disease. One of the primary therapeutic goals in diabetes management is the reduction of blood glucose levels. The achievement of this goal is influenced by multiple factors, including lifestyle modification, patient adherence to therapy, and the appropriateness of anti-diabetic drug selection based on individual patient conditions [33]. Type 2 diabetes mellitus is diagnosed by looking at fasting blood sugar levels ≥ 126 mg/dl, in accordance with Indonesia's consensus on its care and prevention [33].

A descriptive analysis showed a reduction in fasting blood glucose levels in both groups. In the control group, the mean decreased from 148 mg/dL (range: 97–367) to 131 mg/dL (range: 90–230), while in the intervention group it declined from 164 mg/dL (range: 96–458) to 142 mg/dL (range: 91–298). Paired t-test results (Table 4) indicated statistically significant reductions in both groups ($p < 0.05$), with a greater mean decrease in the intervention group (22.04 mg/dL) compared to the control group (16.92 mg/dL). These findings suggest that the Reminder Obat App intervention was effective in improving glycemic control among outpatients with type II diabetes mellitus, consistent with previous studies reporting similar outcomes[34]. Although some post-test values increased, the overall average blood glucose levels decreased but remained above normal. This indicates that glycemic control was not optimal. Given that high glycemic index foods can raise blood sugar, adherence to a strict diabetes diet is essential.

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Consuming low glycemic index foods can help improve blood glucose control and support better clinical outcomes in patients with diabetes mellitus [35].

One of the elements that affects the effectiveness of treatment, particularly for chronic conditions like diabetes mellitus, is the degree of patient adherence to taking medicine [11]. Analysis in the intervention group (Table 5) showed that most respondents were adherent (95.8%), yet 75% still had uncontrolled blood sugar levels, indicating low therapeutic success. Chi-square analysis also found no significant relationship between adherence and fasting blood glucose ($p > 0.05$). These results are consistent with Fandinata (2020), which reported no association between medication adherence and blood sugar control. However, this differs from the authors' previous study without intervention, which found a significant relationship between adherence and changes in blood glucose in type II diabetes patients. [18]. According to Rasdiana et al. and Srikartika et al., factors causing patient non-adherence to DM therapy being undertaken are busy activities, running out of medication, forgetting to take medication, and feeling healthy, so there is no need to take medication [36]. This is because there are still multiple factors that cause unattainable blood sugar levels to respond, such as lifestyle, which cannot be controlled in this study.

Uncontrolled fasting blood glucose (FBG) levels in patients with diabetes mellitus can lead to various disease complications, which in turn negatively impact the patient's quality of life. Failure to maintain FBG within normal limits increases the risk of vascular complications such as cardiovascular disease, kidney disorders, and stroke. In addition, uncontrolled FBG can trigger several clinical symptoms, including dizziness, tingling, pain, fatigue, and blurred vision, all of which further impair daily functioning and overall well-being [37].

Findings The majority of respondents in this study demonstrated medication adherence, with 44 respondents (95.80%) classified as adherent; however, 26 respondents (54%) still reported a poor quality of life. This is supported by the analysis of the relationship between medication adherence and quality of life in the intervention group (Tables 6 and 7). Consistent with the results of the Chi-Square test, no significant association was found between adherence and quality of life among patients in the intervention group (p-value > 0.05). The findings of this investigation are inversely correlated with those of earlier studies [12], that quality of life is significantly impacted by compliance. A DM patient's quality of life will improve with greater adherence to therapy. Numerous research continue to yield conflicting findings about the relationship between adherence and DM patients' quality of life. During a systematic review [38], The patient's quality of life is not directly impacted by the degree of treatment adherence, but according to [39] Although there is no substantial correlation between adherence level and quality of life, it can enhance quality of life when combined with trigger variables like positive conduct and good knowledge.

Diabetes patients often experience reduced quality of life due to multiple interrelated factors, including obesity, physical inactivity, and comorbidities such as hypertension, coronary heart disease, and hypercholesterolemia, which make their health status comparable to older adults. This decline is further exacerbated by complications such as hyperglycemia, hypoglycemia, retinopathy, nephropathy, neuropathic pain, gastrointestinal disorders, impotence, and amputation. In addition, the economic burden is substantial, as the cost of managing diabetes is nearly twice that of non-diabetic patients, mainly due to complication-related expenses [40].

CONCLUSION

This study found that although most respondents were adherent to medication, glycemic control and quality of life were not achieved, and no significant relationships

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were found between these variables. The Reminder Obat App also showed no significant effect. These results suggest that adherence alone is insufficient, and diabetes management requires a comprehensive approach integrating digital support, patient education, lifestyle modification, and routine HbA1c monitoring. Clinically, healthcare providers should adopt a multidisciplinary approach rather than relying solely on adherence. At the policy level, structured programs combining technology, lifestyle, and clinical interventions are needed to improve long-term outcomes in type II diabetes patients.

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