






Impact of Ramadan Fasting on Medication Adherence in Patients with Diabetes Mellitus: Evidence from Indonesia

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Background: Diabetes mellitus is a chronic disease that requires long-term drug use and medication compliance to achieve optimal disease control. Indonesia's population is predominantly muslim. Fasting during Ramadan presents unique challenges for patients with diabetes mellitus in maintaining medication adherence due to lifestyle changes, such as mealtimes and medication schedules.

Objective: This study aimed to compare the medication adherence levels among diabetes mellitus patients in Indonesia who fast during the month of Ramadan with those in other regular months.

Methods: A longitudinal study was conducted using a survey of patients with diabetes at the Central Naval Hospital (RSPAL) Dr. Ramelan Surabaya. Data were collected from February to March 2024 using the picture pill count method. Data were analyzed using the chi-square test to determine the differences in medication adherence between the groups recruited during Ramadan and the other months.

Results: In both groups, there was a predominance of single-drug and two-drug combination therapies, with metformin being the most widely used drug. The level of adherence to treatment during Ramadan was significantly lower than that during the regular month ($p=0.005$). In total, 96.5% of patients showed high levels of compliance during the regular month compared to 89% during Ramadan.

Conclusion: The level of adherence to diabetes treatment among patients with diabetes mellitus during Ramadan was lower than during regular months.

Keywords: diabetes mellitus, medication adherence, Ramadan, Indonesia, pill count

Introduction

Diabetes mellitus is a chronic disease that poses a major challenge to global health systems. The International Diabetes Federation reports that the number of people with diabetes mellitus increases annually and is estimated to reach 643 million in 2030.¹ In Indonesia, the prevalence of diabetes mellitus shows a similar trend; the Indonesian Health Survey states that the prevalence of diabetes mellitus in the adult population reaches 10.9%.² This condition requires serious attention, particularly its management, to prevent long-term complications that can affect the quality of life of the patient.^{3,4}

One critical factor in managing diabetes mellitus is medication adherence, which refers to the extent to which a patient follows the therapeutic recommendations given by health workers concerning drug use, diet, and physical activity, among other aspects.^{4,5} Low medication adherence can lead to poor glycemic control, increased risk of complications, and, ultimately, increased economic burden on the health system. Unfortunately, various factors influence medication adherence, including social, cultural, and lifestyle factors.^{6,7}

Indonesia's population is predominantly Muslim. For Muslims, Ramadan is a period with unique characteristics during which they are required to fast from dawn to sunset for a month. Changes in lifestyle, such as diet, sleep, and daily activities,

during Ramadan can affect the management of diabetes mellitus. Patients with diabetes mellitus who fast often have to adjust their medication schedule to the time of the Iftar and Suhoor, which can pose challenges in maintaining adherence to medication.^{8,9} In addition, the understanding of the patient regarding the risk of hypoglycemia, hyperglycemia, and dehydration during fasting is an important factor for the success of diabetes mellitus management during this month.^{10,11}

Several previous studies have explored the impact of Ramadan fasting on glycemic control.¹² For example, studies show that changes in diet and medication schedules during Ramadan can cause fluctuations in blood glucose levels.^{13–16} However, there was no published research found on medication adherence during Ramadan, especially in Indonesia. To date, also no studies have specifically evaluated the differences in medication adherence levels between Ramadan and other months in the context of Indonesian society. As the country with the largest Muslim population in the world, Indonesia has unique cultural and social characteristics that can provide a new perspective for understanding the dynamics of medication adherence during Ramadan.¹⁷

This study aimed to compare the medication adherence levels among diabetes mellitus patients in Indonesia who fast during the month of Ramadan with those in other regular months. This study was conducted in a hospital in Surabaya City, where the majority of the population is Muslim. The results of this study are expected to guide health practitioners, especially pharmacists, in providing pharmaceutical care services that are adapted to the needs of patients during Ramadan. Through this study, we aimed to identify effective strategies for improving medication adherence in patients with diabetes mellitus during Ramadan. In addition, the results of this study are expected to serve as a foundation for the development of evidence-based health policies that are relevant to the sociocultural context of Indonesian society.

Materials and Methods

This study used a longitudinal design with a survey approach. The study sample included patients with diabetes mellitus undergoing treatment in an outpatient clinic at the Central Naval Hospital (RSPAL) Dr. Ramelan Surabaya, Indonesia. The hospital is a tertiary referral hospital, where the diabetes mellitus outpatients are those that have more complicated condition than secondary hospital and primary care center. The sample size was calculated with alpha 0.05, beta 0.2 and power 0.8. The sample was selected using consecutive sampling technique. The study sample was divided into two groups: one included patients who were recruited in other months besides Ramadan and were not fasting, and the other included those who fasted and were recruited during Ramadan.

The medication adherence data for the sample of diabetes mellitus patients who fasted during Ramadan were collected during the month of Ramadan 2024, from March 12 to April 9, 2024. The medication adherence data for the sample of diabetes mellitus patients who did not fast were collected during the one month prior to Ramadan, from February 11 to March 11, 2024. To assess medication adherence, data were collected using the picture pill count method. Picture pill count method was done by asking the patient to send picture of their medicine through their mobile phone (from home) in two different time during the study period. This method involves calculating the number of pills received by the patient and the number of pills remaining at the end of the assessment period to estimate the number of pills consumed. The ratio of pills received to pills consumed is used as the medication adherence score.

Descriptive statistical analysis was used to describe the demographic characteristics of the respondents, the type of therapy, and the drugs used. Inferential statistical analysis using the chi-square test was performed to examine significant differences in respondent demographic data, type of therapy, drugs used, and level of medication adherence between the two research groups. This study also considered the ethical aspects of the research and obtained approval from the Health Research Ethics Committee of Dr. Ramelan Central Naval Hospital Surabaya (No: 15/EC/KEP/2024). Informed consent was obtained from each respondent and, all collected data were kept confidential.

Results

In total, 346 patients with diabetes mellitus participated in the study. Of these, 201 were included in group 1, where medication compliance was measured in months other than Ramadan, and 145 were included in group 2, where medication compliance was evaluated during Ramadan. The demographic data of the respondents are shown in [Table 1](#).

The type of diabetes mellitus drug therapy varied between patients. Data on the type of therapies administered in both groups were compared using statistical tests, the results of which are shown in [Table 2](#).

Table 1 Demographics of the Research Sample

Demography		Group 1, n (%)	Group 2, n (%)	p
Age	18–39	9 (4.5)	10 (6.9)	0.002*
	40–64	139 (69.2)	115 (79.3)	
	≥65	53 (26.4)	20 (13.8)	
Sex	Male	95 (47.3)	70 (48.3)	0.852
	Female	106 (52.7)	75 (51.7)	
Education	Elementary School	28 (14.0)	13 (8.9)	0.000*
	Junior High School	58 (28.9)	12 (8.3)	
	Senior High School	63 (31.3)	66 (45.5)	
	University	52 (25.9)	54 (37.2)	
Marital Status	Married	177	122 (84.1)	0.293
	Unmarried	24	23 (15.9)	
Occupation	Unemployed	11 (5.5)	6 (4.1)	0.176
	Student	1 (0.5)	2 (1.4)	
	Housewife	56 (27.9)	34 (23.4)	
	Private Employee	32 (15.9)	23 (15.9)	
	Public servant	52 (25.9)	55 (37.9)	
	Other	49 (24.4)	25 (17.2)	
Health Insurance	Government health insurance	199 (99.0)	145 (100.0)	0.228
	Private Health Insurance	2 (1.0)	0 (0.0)	
Duration of Illness	1–5 years	142 (70.6)	73 (50.3)	0.005*
	6–10 years	38 (18.9)	72 (49.7)	
	11–15 years	21 (10.4)	0 (0.0)	

Notes: *Significantly different; The chi-square test was used to analyze data related to sex, marital status, occupation, and health insurance, whereas Mann–Whitney’s test was used for data on age, education, and duration of illness.

Table 2 Diabetes Mellitus Drug Therapy

Type of Therapy	Group 1, n (%)	Group 2, n (%)	p
Singular	70 (34.8)	53 (36.6)	0.559
Combination of 2 Drugs	67 (33.3)	49 (33.8)	
Combination of 3 Drugs	52 (25.9)	39 (26.9)	
Combination of 4 Drugs	12 (6.0)	4 (2.8)	
Total	201 (100.0)	145 (100.0)	

Notes: Mann–Whitney test.

Table 3 Diabetes Drugs

Drug Used	Group 1	Group 2	p
Acarbose Tablets	9 (2.2)	6 (2.1)	0.060
Dapagliflozin Tablets	1 (0.2)	0 (0.0)	
Gliclazide Tablets	6 (1.5)	0 (0.0)	
Glimepiride Tablets	78 (19.2)	62 (22.0)	
Gliquidone Tablets	2 (0.5)	0 (0.0)	
Metformin Tablets	134 (32.9)	110 (39.0)	
Pioglitazone Tablets	84 (20.6)	46 (16.3)	
Sitagliptin HCl Tablets	22 (5.4)	23 (8.2)	
Vildagliptin Tablets	71 (17.4)	35 (12.4)	
Total	407 (100.0)	282 (100.0)	

Notes: Chi-square test.

Table 4 Medication Adherence

Group	Level of Compliance		p
	High	Low	
Group 1 (n=201)	194	7	0.005*
Group 2 (n=145)	129	16	

Notes: Chi-square test; *Significantly different.

As shown in Table 2, there was no significant difference between the two groups in terms of the type of diabetes mellitus drug therapies used. Most patients were receiving single-drug therapy or a combination of two drugs. The diabetes mellitus drugs used by patients in both groups were also compared using statistical tests, the results of which are provided in Table 3.

As shown in Table 3, metformin was the most widely used drug in both groups. Other commonly used drugs include glimepiride and pioglitazone tablets. Overall, the diabetes mellitus drugs used did not significantly differ between the two groups.

Adherence to diabetes mellitus treatment based on pill count calculations in both groups was statistically analyzed. The test results for the two groups are listed in Table 4.

The chi-square test comparing the level of adherence to treatment between groups 1 and 2 showed a statistically significant difference. The proportion of patients with diabetes mellitus who adhered to treatment in the regular month was larger than that during Ramadan.

Discussion

Medication adherence is necessary for the treatment of diabetes mellitus, the main goal of which is to achieve optimal glycemic control to prevent acute and chronic complications.^{18–20} Good adherence helps maintain blood sugar levels under control, preventing complications such as hyperglycemia, hypoglycemia, and disorders of target organs such as the kidneys and heart. Adherence also plays an important role in improving the overall quality of life in patients. Conversely, non-adherence can lead to serious health-threatening complications and worsen patient prognosis.^{21,22}

Maintaining medication adherence during Ramadan presents a challenge for patients with diabetes mellitus in Indonesia, where most of the population is Muslim. During Ramadan, Muslims fast for approximately 12–13 hours a day for an entire month,²³ which can lead to changes in diet. Additionally, the limited mealtimes and fasting habits can affect medication adherence and the stability of blood sugar levels. Hence, patients must carefully manage their medication schedules and monitor their blood sugar levels more frequently to prevent extreme fluctuations. However, a lack of understanding of how to adjust the treatment regimen during Ramadan can compromise the efficacy of diabetes mellitus treatment. Patients who do not know the best time to take their diabetes mellitus drugs or how to adjust the dose to fit their new diet during Ramadan may potentially experience treatment failure.^{24,25}

In this study, adherence to diabetes mellitus medication was evaluated using the pill count method which was selected because it can be simply and objectively used to measure adherence by counting the remaining unused tablets or capsules. This method allows researchers to obtain direct data on the use of drugs by patients based on the number of pills consumed or remaining.^{26–28} Medication adherence levels determined by pill count calculation are categorized into low (<80%) and high (≥80%).^{26,29}

Evaluation using the pill count method showed differences in the medication adherence of patients with diabetes mellitus between the regular month and the month of Ramadan. The level of medication adherence in patients with diabetes mellitus during Ramadan was lower than that in the regular month, likely due to changes in diet and mealtimes during Ramadan, which affect the drug intake habits of the patient according to a predetermined schedule. There was no other study found on comparing adherence during Ramadan fasting and other month. During fasting, patients tend to take their drugs only at the Suhoor and Iftar times, which may lead to dose neglect or a delay in treatment. In addition, other factors such as Busyness during fasting, fatigue, and a lack of understanding of how to manage medication during Ramadan can contribute to decreased levels of adherence.^{30,31} Further research also can be done in finding out the impact of non-adherence during Ramadan fasting towards the period after Ramadan.

A lower level of medication adherence in patients with diabetes mellitus during Ramadan needs to be anticipated by health workers, especially pharmacists and doctors.^{32,33} Strategies that can help patients with diabetes mellitus maintain adherence during Ramadan include regulating the schedule of drug use before Suhoor and after breaking the fast, paying attention to balanced food intake, and monitoring blood sugar levels more often to promptly detect any changes. In addition, patients should be made aware of the signs of hypoglycemia or hyperglycemia that can occur during fasting, as well as the steps to be taken if such conditions occur. This approach allows patients to fast safely without compromising their health.^{34–36}

In addition to the aforementioned strategies, good communication between patients and health workers is essential to ensure proper treatment management during Ramadan.^{37–39} Providing clear information on how to adjust drug schedules and the potential risks of not following treatment instructions may help patients who feel anxious or doubtful about their treatment. Pharmacists can educate patients regarding safe drug selection or dose adjustments according to the need of each patient during the fasting month. This not only helps patients maintain their glycemic control but also increases their confidence in following treatment regimens more consistently and adhering to medication during Ramadan.^{40,41} Furthermore, the improvement of patient medication adherence during Ramadan fasting can benefit through the establishment of guidelines on diabetes management during Ramadan.

The study has its limitations. Results showed that in the demographic data of the sample (Table 1), age, education and duration of illness differed between the two groups, while sex, marital status, occupation and health insurance were homogeneous across the two groups. Hence, it may affect patient medication adherence. In addition, the study was done in one tertiary hospital in Surabaya, which may limit the generalizability of the findings to other regions or healthcare settings in Indonesia.

Conclusion

The level of medication adherence in patients with diabetes mellitus who fast during Ramadan was lower than that in the regular month, highlighting the challenges experienced by patients with diabetes mellitus in managing their treatment during Ramadan.

Ethics Approval and Informed Consent

This study was approved by the ethics committee of from the Health Research Ethics Committee of Dr. Ramelan Central Naval Hospital Surabaya [approval No: 15/EC/KEP/2024]. Written informed consent was obtained from all study participants before data collection. All methods and procedures were carried out in accordance with relevant guidelines and regulations and in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration.

Acknowledgments

We extend our sincere appreciation to the participants in this study sample for their valuable contributions. Their willingness to take part has been essential in facilitating this research. No individuals or organizations outside the research group and authors have contributed to this study.

Author Contributions

All authors have made substantial contributions to this work, whether in conceptualization, study design, execution, data acquisition, analysis, interpretation, or multiple aspects of the research. They have been involved in drafting, revising, or critically reviewing the manuscript, provided final approval for the version to be published, agreed to the journal submission, and accepted responsibility for all aspects of the work.

Disclosure

The authors declare that they have no financial conflicts of interest or personal relationships that could have influenced the research presented in this paper.

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