

Research Article

# Dynamics of Anti-Diabetic Medication Adherence and the Influence of Side Effects: A Study on Patients with Type 2 Diabetes Mellitus in Bandung Regency and Bandung City

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**Abstract:** Type 2 Diabetes Mellitus (T2DM) is a chronic condition that requires optimal adherence to pharmacological treatment to prevent disease progression and complications. This study aims to analyze the level of adherence to anti-diabetic medication among T2DM patients and to explore the association between the experience of medication side effects and adherence levels. A descriptive-analytic cross-sectional design was employed, involving 97 T2DM patients in Bandung Regency and Bandung City, Indonesia. Data were collected through structured questionnaires and analyzed using descriptive statistics and the Chi-Square test. The results revealed that 53.6% of respondents exhibited low medication adherence. The majority reported having diabetes-related complications (88.7%) and experiencing medication side effects (57.7%). A significant positive association was found between medication side effects and adherence level ( $p = 0.039$ ), indicating that patients who experienced side effects tended to be more adherent. Demographic factors such as place of residence, gender, and age showed no significant association with adherence. The findings suggest that side effects may hinder adherence; however, awareness of the body's response to medication, including side effects, may also serve as a motivator for adherence.

**Keywords:** Clinical Interventions; Drug Side Effects; Medication Adherence; Pharmacological Management; Type 2 Diabetes Mellitus.

## 1. Introduction

Type 2 Diabetes Mellitus (T2DM) is a progressive metabolic disorder characterized by chronic hyperglycemia, resulting from insulin resistance or relative insulin secretory deficiency (American Diabetes Association, 2017). The global burden of this disease continues to rise, with projections estimating 783 million cases by 2045 (International Diabetes Federation (IDF), 2021). Poor glycemic control in T2DM is directly correlated with an increased risk of microvascular complications (nephropathy, retinopathy, neuropathy) and macrovascular complications (cardiovascular disease, stroke), which significantly diminish quality of life and elevate mortality rates (Dimore dkk., 2023; Haghghatpanah dkk., 2018; RiPat dkk., 2023).

Patient adherence to pharmacological treatment regimens is a cornerstone in achieving and maintaining optimal glycemic control (Fajriansyah, 2022; Kawa dkk., 2022). However, low adherence remains a global challenge in T2DM management, frequently leading to therapeutic failure, increased healthcare costs, and a higher incidence of complications (Srikartika dkk., 2016). Multiple factors have been identified as influencing adherence, including patient characteristics (age, gender, educational level), regimen complexity, social support, and perceptions of the disease (Juwariah & Priyanto, 2021).

One factor traditionally considered a barrier to adherence is the occurrence of medication side effects (Yulianto dkk., 2019). The experience of such effects, ranging from mild to severe, can influence patients' perceptions of the benefits of treatment and may prompt them to reduce the dosage or discontinue therapy (Hestiana, 2017). However, several

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studies suggest that patients' perceptions of side effects may be more complex, where awareness of a medication's effects on the body, both positive and negative, can in fact enhance patient engagement in treatment (Broadbent dkk., 2011; Chao dkk., 2007; Lim dkk., 2022).

Given the high prevalence of T2DM and the low adherence rates reported in surveys conducted in various regions, including Bandung Regency and Bandung City, this study aims to explore more deeply the dynamics of medication adherence among T2DM patients. Specifically, it focuses on the hypothesis that the experience of medication side effects may not always correlate negatively with adherence but may instead exhibit a more nuanced relationship. The findings of this study are expected to provide new insights for healthcare professionals and policymakers in designing more effective clinical intervention strategies to improve medication adherence in T2DM management.

## 2. Proposed Method

This study employed a descriptive-analytic cross-sectional design. This approach allowed for the simultaneous collection of data to measure variables related to medication adherence and the factors influencing it, including medication side effects, at a single point in time. Population and Sample (Sugiyono, 2017): The target population comprised T2DM patients residing in Bandung Regency and Bandung City. The study sample was obtained using purposive sampling with the following inclusion criteria: patients diagnosed with T2DM, patients currently undergoing pharmacological anti-diabetic therapy, willingness to participate in the study as indicated by signing an informed consent form, and the ability to communicate effectively. No specific exclusion criteria were stated; however, it was assumed that patients with impaired cognitive function or acute complications affecting communication ability were not included. The total sample successfully collected consisted of 97 respondents (Rivan Virlando Suryadinata dkk., 2024).

The research instrument utilized data collected through a structured questionnaire consisting of the following components: demographic characteristics, including place of residence (Bandung Regency/Bandung City), gender, and age group (productive age 15–64 years / elderly >64 years); clinical characteristics, including the type of anti-diabetic medication used (monotherapy/combination), history of diabetes-related complications, and experience of medication side effects; and medication adherence behavior, measured through a series of yes/no questions addressing aspects such as forgetting to take medication, discontinuing medication when feeling recovered, stopping medication due to the perception of worsening condition, forgetting to bring medication when traveling, adherence on the previous day, discontinuing medication when feeling healthy, discomfort with daily treatment, and difficulty in consuming all prescribed medication. This questionnaire adapted common items used to assess medication adherence. The level of adherence was categorized as “low” or “high” based on the total score derived from the adherence behavior questions (Gumilas dkk., 2021).

Data collection was conducted from 1 June 2025 to 25 June 2025. The researchers approached respondents directly or through structured interviews (survey method) to complete the questionnaire. The collected data were entered and analyzed using SPSS statistical software version 25.0. Data analysis included descriptive statistics to present the frequency and percentage distribution of all study variables (demographic, clinical, and medication adherence behavior). Bivariate analysis (Chi-Square test) was employed to examine the presence or absence of statistically significant associations between each independent variable (place of residence, gender, age, type of medication, complications, medication side effects) and the dependent variable (level of medication adherence). The level of statistical significance was set at  $p$ -value < 0.05 (Creswell & Creswell, 2022). This study adhered to ethical research principles by obtaining informed consent from all respondents

## 3. Results and Discussion

This study involved 97 respondents diagnosed with Type 2 Diabetes Mellitus. The results of the descriptive analysis of respondent characteristics and medication adherence behavior are summarized in tabular form. This section systematically presents the research findings, beginning with an overview of the respondents' demographic, clinical, and medication adherence characteristics through descriptive statistics. Subsequently, the results of the bivariate analysis using the Chi-Square test are presented to examine the associations between the independent variables and the level of medication adherence.

**Table 1. Demographic, Clinical, and Medication Adherence Characteristics of Respondents (n=97).**

Independent Variable	Low Adherence n (%)	High Adherence n (%)	Total n (%)	p-value	Remarks
Place of Residence	43 (82.7%)	39 (86.7%)	82 (84.5%)	0.589	Not Significant
Bandung City	9 (17.3%)	6 (13.3%)	15 (15.5%)		
Gender	34 (65.4%)	25 (55.6%)	59 (60.8%)	0.323	Not Significant
Male	18 (34.6%)	20 (44.4%)	38 (39.2%)		
Age	39 (75.0%)	35 (77.8%)	74 (76.3%)	0.748	Not Significant
Elderly (>64 years)	13 (25.0%)	10 (22.2%)	23 (23.7%)		
Type of Medication	33 (63.5%)	27 (60.0%)	60 (61.9%)	0.726	Not Significant
Combination	19 (36.5%)	18 (40.0%)	37 (38.1%)		
Diabetes Complications	46 (88.5%)	40 (88.9%)	86 (88.7%)	0.947	Not Significant
No	6 (11.5%)	5 (11.1%)	11 (11.3%)		
Medication Side Effects	25 (48.1%)	31 (68.9%)	56 (57.7%)	0.039	Significant
No	27 (51.9%)	14 (31.1%)	41 (42.3%)		

A p-value < 0.05 indicates a statistically significant association between the independent variables and medication adherence level. Conversely, a p-value  $\geq$  0.05 indicates the absence of a significant association.

The predominance of low medication adherence among respondents (53.6%) is a concerning finding, yet it aligns with the global challenges of adherence in chronic diseases (Srikartika, 2016). The various behavioral patterns identified in this study provide a clear illustration of why adherence remains problematic.

Regarding forgetfulness (50.5%): Forgetting to take medication is one of the most common and often unintentional barriers to adherence. This may result from demanding daily routines, the absence of reminder systems, or a high number of prescribed medications.

Discontinuation of medication when feeling recovered (47.4%) and cessation of treatment when feeling healthy (42.3%): These behaviors reflect a misconception among patients regarding the chronic nature of Type 2 Diabetes Mellitus. Patients often assume that the disease can be cured once symptoms subside or blood glucose levels are controlled, whereas therapy must be continued lifelong to prevent relapse and complications.

Discomfort with daily medication use (56.7%): The routine of daily medication intake can be perceived as burdensome, particularly when patients do not experience noticeable symptoms. This underscores the psychological burden associated with long-term pharmacological therapy.

Forgetting to bring medication when traveling (55.7%): Patient mobility can pose an obstacle, as planning to carry medication is often overlooked.

Although the majority of respondents reported ease of obtaining medication (83.5%) and adherence to physician-prescribed regimens (93.8%), these factors alone did not eliminate key behavioral barriers. This finding suggests that medication accessibility and medical supervision are insufficient to ensure optimal adherence; psychological, educational, and behavioral support factors play a pivotal role (Kawa dkk., 2022).

One of the most noteworthy findings of this study is the significant association between the experience of medication side effects and adherence level ( $p = 0.039$ ). Contrary to the common assumption that side effects diminish adherence, the data indicate that respondents who experienced side effects were more likely to adhere to their treatment regimen (68.9% in the high-adherence group vs. 48.1% in the low-adherence group). The interpretation of these results suggests that side effects may function as somatic feedback for patients, whereby the physical experience, although uncomfortable, serves as a tangible reminder that the medication is actively working in the body. This may heighten patients' awareness of their illness and the necessity of adherence to manage the condition effectively. Moreover, patients experiencing side effects may be more motivated to seek additional information about their treatment and strategies for managing these effects, ultimately reinforcing adherence behavior.

Patients experiencing side effects may engage more frequently with healthcare providers to report their concerns. Such increased interaction creates opportunities for ongoing education and reinforcement of adherence motivation by medical personnel. Effective communication between patients and healthcare providers regarding side effects and their management can foster trust and strengthen patients' commitment to therapy. A potential bias may arise in which highly adherent patients are more attentive to and more likely to recall the side effects they experience compared to less adherent individuals. This finding challenges the prevailing perception that side effects are invariably absolute barriers to adherence (Hestiana, 2017). Instead, it highlights the potential to reframe side effects from obstacles into opportunities for patient education and adherence reinforcement. It is essential for healthcare providers not only to inquire about side effects but also to discuss their significance with patients, validate their experiences, and link these experiences to the importance of continued treatment.

Clinical Implications in this study are highly relevant to clinical practice and the management of type 2 diabetes mellitus (T2DM). Patient education should not be limited to dosage and scheduling instructions but must also encompass a comprehensive understanding of the chronic nature of diabetes, the necessity of lifelong therapy, the consequences of premature treatment discontinuation, and behavioral management strategies such as medication reminders and travel planning.

Side Effect Management as an Adherence Strategy requires healthcare professionals to adopt a more proactive approach in discussing side effects with patients (García-Pérez dkk., 2013). Rather than merely downplaying adverse effects, education should emphasize how mild side effects can serve as indicators of therapeutic activity, along with strategies for managing discomfort without discontinuing treatment. This approach can transform negative perceptions into positive motivation (Sims dkk., 2022).

Instrumental and Emotional Support is critical given the high prevalence of forgetfulness and discomfort associated with daily treatment. Supportive programs such as reminder systems (alarms, mobile applications), pill organizers, as well as family and community support (Richardson dkk., 2021) are essential. Primary healthcare staff should strengthen their role in providing instrumental support, for instance, by reminding patients about free routine blood checks, and in fostering effective communication with patients and their families. Public health campaigns and individualized education should actively address the misconception that diabetes can be cured or that medication can be discontinued when symptoms improve. Emphasizing the prevention of severe long-term complications remains a pivotal strategy.

#### 4. Conclusions

Based on the findings from 97 respondents with diabetes mellitus residing in the Bandung Regency and City areas, several key conclusions can be drawn. This study revealed that more than half (53.6%) of patients with type 2 diabetes mellitus (T2DM) in these regions exhibited low medication adherence. Although demographic factors such as residence, sex, age, type of medication, and presence of complications were not significantly associated with adherence, the experience of medication side effects demonstrated a significant positive association with adherence ( $p = 0.039$ ). This suggests that side effects, while often perceived as barriers, may also serve as triggers for increasing patients' awareness of the importance of continued treatment. Behavioral challenges, including forgetfulness in taking medication (50.5%), discontinuation of medication when feeling better (47.4%), and discomfort with daily pharmacotherapy (56.7%), represent major obstacles. Therefore, comprehensive educational strategies are required, incorporating open discussions on side effects and continuous support from healthcare providers, to enhance patient adherence and improve clinical outcomes in T2DM management.

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