

Original Article

A study on the effects of pill card implementation on patient adherence and blood glucose levels in type 2 diabetes at A PRIMARY health care center in Padang City

Elsa Badriyya¹, Jihan Syidda Aufa¹, Dian Ayu Juwita^{1*}

¹ Department of Pharmacology and Clinical Pharmacy, Faculty of Pharmacy, Universitas Andalas, Padang, West Sumatra, Indonesia

* Correspondence to: Dian Ayu Juwita, Department of Pharmacology and Clinical Pharmacy, Faculty of Pharmacy, Universitas Andalas, Padang, West Sumatra 25163, Indonesia. Phone: +62 813-6300-1618; E-mail: dianayujuwita@phar.unand.ac.id

Received: 20 February 2025 / Accepted: 6 May 2024

Abstract

Type 2 diabetes mellitus is caused by the body's inability to produce and use insulin efficiently, which can increase blood glucose levels. Patient treatment adherence plays a crucial role in managing this disease. This research aims to evaluate the effect of providing Pill Cards on adherence and blood glucose levels in type 2 diabetes mellitus patients. This study used a One Group Pretest-Posttest Design from February to March 2023, with a purposive sampling technique to select the sample. Patient adherence and changes in blood glucose levels were measured before and after administering the pill card. Adherence was assessed using the Medication Adherence Report Scale-5 (MARS-5) and the Pill Count method. The Wilcoxon Signed Ranks Test was used to analyze patient adherence before and after the intervention, while the McNemar Test was used to analyze fasting blood glucose categories. Statistical analysis indicated a significant difference in the adherence level of respondents after the provision of Pill Cards, both through the MARS-5 questionnaire and the Pill Count method ($P < 0.001$). The analysis of fasting blood glucose levels also showed a significant difference after the Pill Card intervention ($P < 0.001$). Pill Cards effectively improve medication adherence and fasting blood glucose control.

Keywords: glycemic control, medication adherence, medication compliance, health education

Introduction

Diabetes mellitus is one of the chronic diseases that is increasingly concerning globally [1]. Approximately 98% of diabetes diagnoses patients worldwide are for type 2 diabetes mellitus. However, this percentage can vary between nations [2]. This disease is characterized by the body's inability to efficiently produce and use insulin, ultimately leading to elevated blood glucose levels. This condition has become a significant challenge in the field of public health, with the number of diabetes mellitus patients continuously rising worldwide [3, 4]. An estimated 530 million people worldwide are expected to have diabetes, with a global incidence of 10.5% among adults between the ages of 20 and 79 [5].

Patient adherence to the treatment plan is crucial in the management of type 2 diabetes mellitus. Main-

taining high patient compliance with medication intake is critical to achieving effective blood sugar control [6]. Diabetes patients who do not adhere to their treatment regimen are at risk of serious complications, such as heart disease, eye disorders, nerve damage, and other health issues. According to research, adherence rates among individuals with chronic conditions like diabetes mellitus range from 17 to 80%, with an average of 50% not adhering to treatment [7]. Therefore, increasing patient compliance rates is a priority in managing diabetes mellitus effectively [6, 8].

Moreover, interventions in the primary healthcare system are needed to increase patient adherence. A review study conducted by Kini identified six categories of interventions. These include patient education with health educators, medication regimen control using combination pills, clinical pharmacy consultation,



including frequent follow-up visits or phone calls to remind the patient, cognitive behavioral approaches, adherence-promoting incentives, and reminders to take medicine [9]. The choice of adherence-promoting intervention will be determined by its practicality and accessibility within a medical facility or system.

Pill Cards are one effective method to enhance patient adherence to medication among individuals with diabetes mellitus [10]. Based on a study, reminders to take their medications are effective and therapeutically valuable strategies to increase patient adherence [9]. Pill Cards are simple tools designed to assist patients in organizing and remembering their medication schedules [10, 11]. These cards contain information about the medication dosages and schedules patients should adhere to. Additionally, this tool also promotes a better understanding of the importance of maintaining stable blood glucose levels. Utilizing Pill Cards can offer the benefit of visual reminders that assist patients in adhering more effectively to their treatment plans [10–12]. Previous research has shown that the use of reminder aids can increase patient adherence to their medications [4, 7, 12, 13].

By understanding the positive impact of using Pill Cards in improving patient compliance and controlling blood glucose levels, this research is expected to significantly contribute to enhancing the management of type 2 diabetes mellitus. The findings of this study can serve as a foundation for healthcare professionals and authorities to design more effective and efficient strategies for addressing this disease and improving the quality of life for diabetes mellitus patients.

Material and methods

Research design

This research was conducted at the Lubuk Buaya Primary Health Care Center in Padang, Indonesia. This study employs the One Group Pretest-Posttest Design. This method was selected to assess patient compliance and measure blood glucose levels before and after the administration of the Pill Card. The pharmacist provides the Pill Card to patients while dispensing medication, inserting it into each package.

Population and sampling

The study population was Chronic Disease Management Program (Prolanis) Patients at Lubuk Buaya

Primary Health Care Center. The research sample is purposively chosen by sampling patients who meet the inclusion and exclusion criteria. The inclusion criteria are: i) type 2 diabetes mellitus patients visiting the community health center in February–March 2023; ii) aged 19 and above; iii) having good communication skills; iv) not using injection therapy; v) having undergone oral antidiabetic treatment at least twice; vi) not pregnant, vii) willing to provide informed consent; and viii) open to home visits for medication remaining calculation. The exclusion criteria are: i) patients who moved from Lubuk Buaya health center facilities; and ii) patients with incomplete data.

Measurement

Sociodemographic information

During the study, information about patients' gender, age, level of education, and antidiabetic therapy received was also collected.

Medication Adherence Report Scale (MARS-5) Questionnaire

Patient adherence is evaluated twice, before (pre-test) and after (posttest) administering the Pill Card, using two methods. The first method is the Medication Adherence Report Scale (MARS-5) questionnaire. MARS-5 is a self-report questionnaire to measure the level of patient adherence to treatment. The MARS-5 questionnaire is available in the Indonesian version and has been validated by Alfian. The validity and reliability test of the questionnaire was done by the Pearson product-moment correlation test and the Cronbach alpha coefficient test with a Cronbach Alpha value of 0.80315 [14].

MARS-5 questionnaire comprises five questions: forgetting, altering dose, stopping, skipping, and taking less medicine. The responses to the questions are always (score=1), often (score=2), sometimes (score=3), rarely (score=4), and never (score=5). The total score of patient adherence is categorized as follows: scores <6 (low adherence), scores 6 to 24 (moderate adherence), and scores 25 (high adherence) [14, 15].

The pill count method

The Pill Count Method measures patient adherence by counting the remaining medication after the patient undergoes treatment for a certain period, then calculates the percentage of adherence using the Grymonpre formula. If the percentage value is $\geq 80\%$, it is

considered adherence, while a value <80% is considered non-adherence [11, 16].

Blood glucose measurement

Patients' fasting blood glucose levels are measured twice before and after administering the Pill Card. Blood glucose levels of 70 to 125 mg/dL are categorized as normal, while values above 125 mg/dL are categorized as abnormal [6].

Data analysis

Descriptive analysis was done to describe the frequency and percentage of sociodemographic data, blood glucose levels, antidiabetic therapy received, patient adherence before and after giving the Pill Card with the MARS-5 and Pill Count questionnaires, and fasting blood sugar levels of respondents with type 2 diabetes mellitus.

The data on patient adherence levels and fasting blood glucose levels before and after administering the pill card were analyzed statistically using SPSS for Windows 27th version. The level of patient adherence is statistically analyzed using the Wilcoxon Signed Ranks Test, while the fasting blood sugar categories are analyzed using the McNemar Test. If the P value is <0.05, it indicates a significant difference between before and after administering the Pill Card intervention.

Results

One hundred ninety-five diabetes mellitus patients met the inclusion and exclusion criteria as samples in this study. The sociodemographic data of the patients can be seen in Table 1.

In order to assess the impact of the intervention, the patient adherence levels were measured before (pretest) and after delivering the pill card (posttest). The research results indicate increased patient adherence levels after the Pill Card intervention. Patients' adherence measurement was measured using the MARS-5 questionnaire before they were provided with the Pill Card, which showed that there were 18 patients with high adherence levels and 177 patients with moderate adherence levels. After the Pill Card intervention, there was an increase in patient adherence levels, where the number of patients with high adherence levels increased to 57. In contrast, the number of patients with moderate adherence levels decreased to 138 (Figure 1).

The improvement in patient adherence levels, measured using the Pill Count method, is also reflected in the increased number of respondents in the complaint category (Figure 2). Before the Pill Card intervention (pretest), there were 153 patients classified as adherence, and this number increased to 190 respondents after the Pill Card intervention (posttest). The findings of this

Table 1: Sociodemographic characteristics data of type 2 diabetes mellitus patients (n=195).

| Sociodemographic characteristics | n (%) |
|----------------------------------|------------|
| Gender | |
| Male | 54 (27.7) |
| Female | 141 (72.3) |
| Age | |
| Adults | 11 (5.6) |
| Pre-elderly | 87 (44.6) |
| Elderly | 97 (49.7) |
| Level of education | |
| Low | 40 (20.5) |
| Medium | 84 (43.1) |
| High | 71 (36.4) |
| Antidiabetic therapy | |
| Monotherapy | 116 (59.5) |
| Combination therapy | 79 (40.5) |

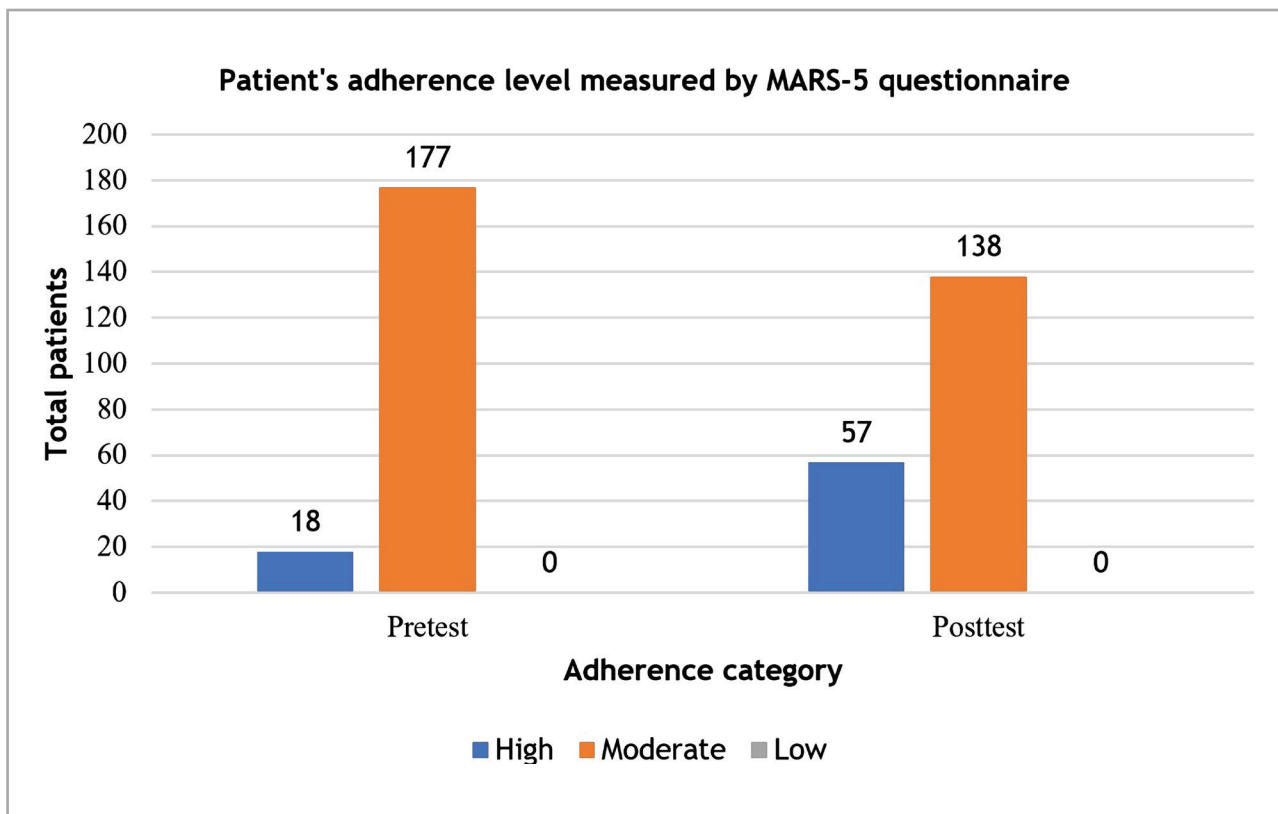


Figure 1: Patient's adherence level before (pretest) and after (posttest) pill card intervention measured by MARS-5 questionnaire.

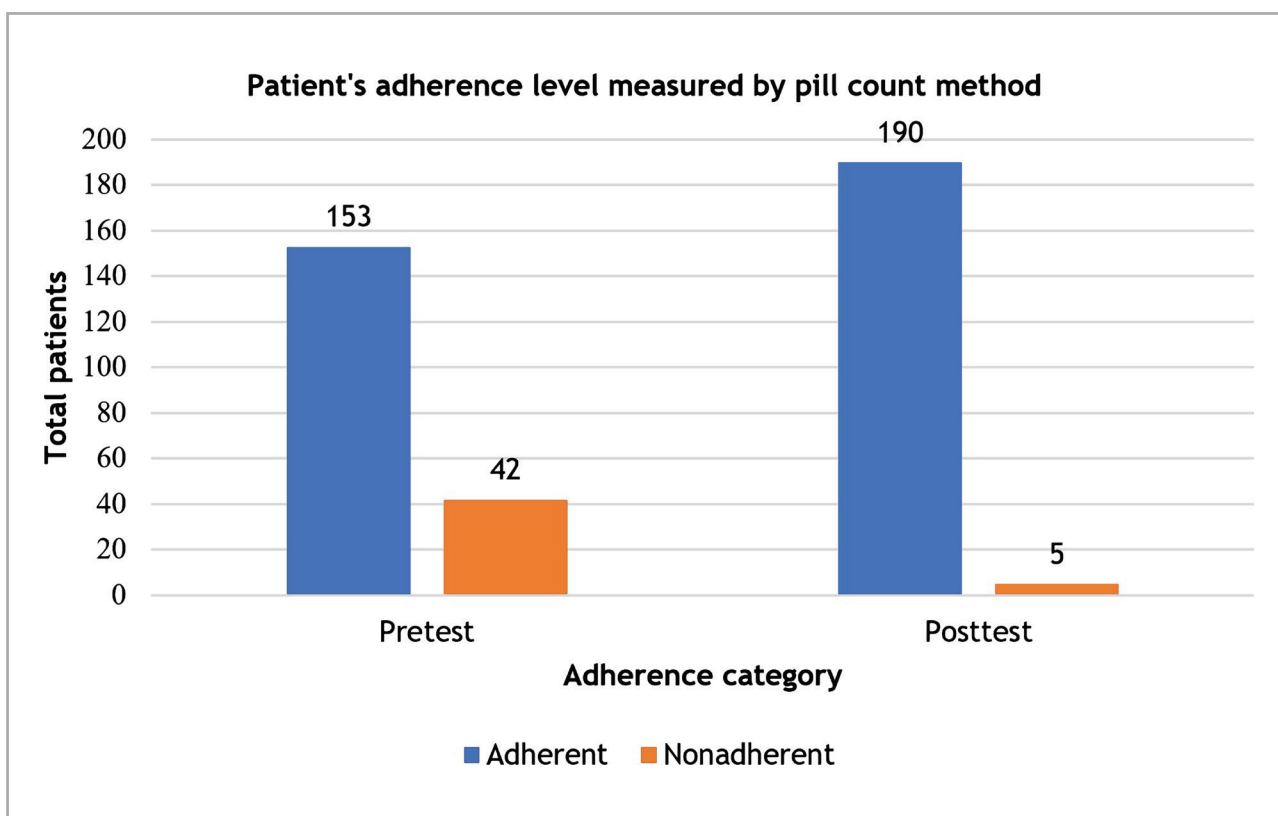


Figure 2: Patient's adherence level before (pretest) and after (posttest) pill card intervention measured by pill count method.

Table 2: Analysis of pill card intervention effect on patient’s therapy adherence measured by MARS-5 questionnaire and pill count method.

| Adherence variable | Number of patients | Z-value | P-value |
|-----------------------------|--------------------|---------|---------------------|
| MARS-5 | | -8.82 | <0.001 ^a |
| Negative ranks ^b | 1 | | |
| Positive ranks ^c | 97 | | |
| Pill count | | -11.74 | <0.001 ^a |
| Negative ranks ^b | 1 | | |
| Positive ranks ^c | 185 | | |

Note: ^a – Statistical analysis showed a significant difference (P<0.05) based on the Wilcoxon Signed Ranks Test; ^b – Negative ranks are samples with the posttest group adherence level lower than the pretest group; ^c – Positive ranks are samples with the posttest group adherence level higher than the pretest group.

Table 3: Fasting blood glucose levels of type 2 diabetes mellitus patients (n=195).

| Fasting blood glucose category | n (%) |
|--------------------------------|------------|
| Pretest | |
| Normal | 30 (15.4) |
| Abnormal | 165 (84.6) |
| Posttest | |
| Normal | 72 (37.0) |
| Abnormal | 123 (63.0) |

research are consistent with those of several previous studies, indicating that providing a Pill Card effectively enhances patient compliance with their treatment therapy. Based on the Wilcoxon signed ranks test showed that patient compliance, measured both by the MARS-5 method and the Pill Count method, yielded a P<0.001 (Table 2). This signifies a significant difference in the level of compliance between the Pill Count and MARS-5 methods during the pretest and posttest stages.

Fasting blood glucose level was also used to determine the effect of the pill card on the patient. Based on the data presented in Table 3, before the Pill Card intervention, the number of patients with abnormal fast-

ing blood glucose levels was more dominant, reaching 165 people (84.6%). However, after the intervention, there was a decrease in the number of patients with abnormal blood glucose levels to 123 people (63.1%). To evaluate the changes in respondents’ fasting blood glucose levels between the pretest and posttest, an analysis was conducted using the McNemar test, as shown in Table 4. The analysis results indicated a significant difference between the normal and abnormal fasting blood glucose levels in the pretest and posttest, with P<0.001.

Table 4 shows that 27 patients had normal blood glucose levels during the pretest. When data was collected

Table 4: Analysis of pill card intervention effect on patient’s fasting blood glucose level.

| Fasting blood glucose category (pretest) | Fasting blood glucose category (posttest) | | n | P-value |
|--|---|----------------|-----|---------------------|
| | Normal n (%) | Abnormal n (%) | | |
| Normal | 27 (13.9) | 3 (1.5) | 195 | <0.001 ^a |
| Abnormal | 45 (23.1) | 120 (61.5) | | |

Note: ^a – statistical analysis showed a significant difference (P<0.05) based on the McNemar test.

in the posttest, these 27 patients remained in the normal blood sugar category. Additionally, 45 patients initially had abnormal blood glucose levels during the pretest but successfully became normal in the posttest. These findings suggest that the provision of the Pill Card positively impacts adherence to oral antidiabetic medication.

Most patients who initially had normal blood glucose levels successfully maintained this condition after receiving the Pill Card. Furthermore, the Pill Card also successfully improved the normal blood glucose levels in most patients who initially had abnormal blood glucose levels. There was a significant increase in the number of respondents who achieved normal blood glucose levels after receiving the Pill Card and a significant decrease in the number of respondents with abnormal fasting blood glucose levels after receiving the Pill Card. This indicates that the Pill Card provision effectively enhances control over respondents' fasting blood glucose levels.

Discussion

Diabetes mellitus is a non-communicable chronic disease characterized by increased blood glucose levels. Patients with diabetes mellitus cannot take glucose into cells and utilize it as energy [17]. Uncontrolled diabetes mellitus can cause serious complications, initiating damage to various organs and body tissues such as the heart, kidneys, eyes, and nerves [18]. Patients with diabetes mellitus must modify their lifestyle and take medicine to regulate their blood glucose levels [17].

The success of diabetes mellitus medication is greatly influenced by patient compliance. However, many studies have implied that diabetes mellitus patient medication adherence is still low. Poor medication adherence is caused by treatment complexity and convenience, medication side effects, and long-term medication and is mainly caused by forgetting to take medication [17, 19, 20]. To increase patient adherence, our research was conducted to determine the effect of giving pill cards on diabetes mellitus patient compliance.

Based on the research, almost half of the patients belong to the elderly age category, comprising 49.74%. These results align with an earlier study by Andanalusia et al. in Mataram, which found that the highest number of DM patients was 46–55 years [8]. The occurrence of type 2 diabetes mellitus is more dominant in this age group. Individuals aged over 45 years have a 1.4 times

higher risk of experiencing uncontrolled fasting blood glucose levels compared to those under 45 years old. This is attributed to a decline in insulin function in elderly patients due to the aging process, leading to progressive shrinkage of pancreatic beta cells [4, 21].

Most individuals with diabetes mellitus in this study are women (72.31%) (Table 1). This finding is consistent with the previous study by Mihardja et al., which found that women are more likely to have DM than males in Indonesia [22]. Women exhibit a 2.39 times higher risk of developing type 2 diabetes mellitus compared to men [22–24]. This is associated with the positive effects of estrogen and progesterone hormones in enhancing insulin responsiveness in the blood. However, upon entering menopause, insulin responsiveness tends to decrease due to low levels of estrogen and progesterone hormones [23]. Additionally, women tend to have an inclination towards an unhealthy weight, which can reduce the sensitivity of insulin response [23, 25, 26].

The research results reveal that a significant portion of patients hold a moderate educational background, comprising 43.08% (Table 1). Previous research has shown that low socioeconomic status increases the risk factors of diabetes mellitus [8, 27]. An individual's education level can influence their behavior towards a healthy lifestyle [21, 28]. Patients with higher education levels are more likely to access health information and have a heightened awareness of the importance of a healthy lifestyle, such as adopting a healthy diet and regular exercise [29]. These measures can reduce the risk of diabetes mellitus complications and maintain controlled blood glucose levels [16].

In this study, the percentage of respondents utilizing monotherapy is higher compared to those using combination therapy (Table 1). In the majority of cases, monotherapy proves to be sufficiently effective in controlling blood glucose levels [30]. Monotherapy offers a more straightforward approach to diabetes management, especially in the early stages, as patients and healthcare providers can more easily monitor drug therapy [30, 31]. Administering an excessive number of drugs or combinations of drugs can heighten the risk of drug interactions and side effects, increase the financial burden on patients, and complicate treatment [8, 31].

To evaluate the level of patient adherence, the MARS-5 questionnaire and Pill Count method were used. The use of two adherence measurement methods in this study aims to obtain more accurate information about patients' adherence levels to medication. The MARS-5 questionnaire is employed to collect data on

patients' self-reported adherence behaviors. Patients are asked to respond to questions related to their adherence to taking medication, providing an overview of patients' perceptions and attitudes toward medication usage [21, 32].

Meanwhile, the Pill Count method involves counting the remaining medication held by respondents, offering insight into the extent to which patients follow the predetermined medication schedule. The Pill Count method's measurement results can provide information about the patient's adherence level. By combining both methods, the weaknesses of each method can be minimized. The Pill Count method can help overcome shortcomings in patients' self-reporting, while the MARS-5 questionnaire can assist in addressing weaknesses in objective measurement. Therefore, combining these two methods can yield better and more representative data regarding patients' adherence levels to medication [11, 33].

A pill Card is a reminder card designed to enhance patient compliance in taking medications for therapy success [10]. The advantages of using the Pill Card are not only in its user-friendly but also in its simplicity, which can improve understanding of the necessary treatment. This tool is highly effective for patients who tend to forget or have complex medication regimens, such as in cases of diabetes mellitus [10].

Pill Card is assessed as effective in improving patient adherence to medication. It contains the medication's name, dosage, indications, and dosing instructions for morning, noon, afternoon, and evening [10, 11]. Some opinions suggest that the Pill Card provides a simple visual representation of all the medications someone needs to take regularly. The use of the Pill Card is considered more easily understandable than the complex information and instructions usually found on medication packaging [11, 12]. The images and phrases within it are highly beneficial for enhancing memory due to the superior impact of visuals [34].

Based on our study, there was also an increased number of patients with normal fasting blood glucose after the Pill Card intervention, and there was a significant difference between the normal and abnormal categories of fasting blood glucose levels in the pretest and posttest, with a p -value < 0.001 . The findings of this study align with a previous research study by Ariyani *et al.*, which found that Pill Cards can improve the clinical symptoms of the respondents [35].

Blood glucose levels are influenced not only by the extent to which patients adhere to the use of antidiabetic medications but also by unhealthy eating habits,

lack of physical activity, and an imbalanced diet [34, 35]. While patients with diabetes mellitus may be compliant in taking prescribed antidiabetic medications, the lack of physical activity and the adoption of unhealthy eating patterns can complicate the control of blood glucose levels [36]. Therefore, patients must consider these lifestyle factors to achieve therapeutic goals more effectively [37].

The results of this study provide an overview of how the adherence level of type 2 diabetes mellitus patients can be significantly improved through the use of Pill Card. This, of course, has a positive impact on the management of type 2 diabetes mellitus, specifically in increasing the consistency of medication use by patients. These findings align with the previous study by Fandinata *et al.*, that Pill card was effective in raising the level of patient adherence in Surabaya, Indonesia ($P < 0.001$) [38]. Furthermore, patients using the Pill Card also experienced a significant decrease in their blood glucose levels, a key aspect in managing type 2 diabetes mellitus. The use of the Pill Card proves to be an effective tool in enhancing patient adherence and the control of their blood glucose levels.

Despite the findings, there are some limitations of the research. First, other factors can influence patient compliance and glucose levels, which can be the bias in the study. Second, the standard parameter for blood glucose examination is HbA1C. However, the examination carried out by our Community Health Center still uses fasting blood glucose due to the high cost of HbA1C examination and laboratory testing standards.

Conclusion

Based on the study, there was a significant difference in the adherence level ($P < 0.001$) both through the MARS-5 questionnaire and the Pill Count method, and fasting blood glucose levels ($P < 0.001$) of respondents after the provision of Pill Cards. It can be concluded that the administration of the Pill Card intervention can enhance patient adherence and have a positive impact on the blood glucose levels of type 2 diabetes mellitus patients.

Acknowledgments

The authors would like to thank the Rector of Universitas Andalas through the Institute for Research and Community Service for the financial support provided for this research.

Conflict of interest

The authors declare no conflict of interest.

Ethics approval

Ethical clearance was obtained from the Research and Ethics Committee of the Faculty of Pharmacy, Andalas University, No. 24/UN.16.10.D.KEPK-FF/2-2023.

Consent to participate

Written informed consent was obtained from all the participants.

Funding

The research was financially supported in the scheme of “Riset Publikasi Terindeks Universitas Andalas” (RPT UNAND), Batch IV, the Year 2023, with Contract Number. 79/UN16.19/PT.01.03/KO-RPT/2023 sign on August 3rd, 2023.

References

- Sarovina I, Mayasari S. Profil Penggunaan Obat Antidiabetes Pada Pasien Diabetes Melitus Tipe 2 Di Rs Citra Husada. Universitas dr. Soebandi; 2023.
- Green A, Hede SM, Patterson CC, Wild SH, Imperatore G, Roglic G, et al. Type 1 diabetes in 2017: global estimates of incident and prevalent cases in children and adults Abbreviations CM Child mortality rate EURODIAB Europe and Diabetes GBD Global Burden of Disease HIC High-income country LIC Low-income country. Available from: <https://doi.org/10.1007/s00125-021-05571-8>.
- Jaam M, Mohamed Ibrahim MI, Kheir N, Hadi MA, Diab MI, Awaisu A. Assessing prevalence of and barriers to medication adherence in patients with uncontrolled diabetes attending primary healthcare clinics in Qatar. *Prim Care Diabetes* 12(2):116–25, 2018.
- Andanalusia M, Nita Y, Athiyah U. The effect of pillbox use and education by pharmacist toward medication adherence in diabetes mellitus patients in a Primary Health Care Center in Mataram. *J Basic Clin Physiol Pharmacol* 32(4):577–82, 2021.
- International Diabetes Federation. *IDF Diabetes Atlas*. 10th edition. 2021.
- American Diabetes Association. *Standards of medical care in diabetes-2014*. Vol. 37, *Diabetes Care*. 2014.
- Hilbink M, Lacroix J, Bremer-van der Heiden L, van Halteren A, Teichert M, van Lieshout J. Effectiveness of a medication-adherence tool: Study protocol for a randomized controlled trial. *Trials* 3;17(1), 2016.
- Andanalusia M, Athiyah U, Nita Y. Medication adherence in diabetes mellitus patients at Tanjung Karang Primary Health Care Center, Mataram. *J Basic Clin Physiol Pharmacol* 30(6), 2019.
- Kini V, Ho PM. Interventions to Improve Medication Adherence. *JAMA* 320(23):2461, 2018.
- Jacobson KL, Kripalani CHESS, Julie A, Gazmararian MPH, Karen J, McMorris BA. How to Create a Pill Card. AHRQ Publication No 08-M016 [Internet]. 2008;1–10. Available from: www.ahrq.gov
- Ulfa NM, Lubada EI, Darmawan R. The Effect of Medication Picture Method with Pill Count Method on Elderly Patient Compliance with Oral Antidiabetic and Oral Antihypertension. *Pharmaceutical Journal of Indonesia*. 31;18(2):238, 2021.
- Yeung DL, Alvarez KS, Quinones ME, Clark CA, Oliver GH, Alvarez CA, et al. Low-health literacy flashcards & mobile video reinforcement to improve medication adherence in patients on oral diabetes, heart failure, and hypertension medications. *Journal of the American Pharmacists Association* 57(1):30–7, 2017.
- Nieuwlaat R, Wilczynski N, Navarro T, Hobson N, Jeffery R, Keenanasseril A, et al. Interventions for enhancing medication adherence. *Cochrane Database of Systematic Reviews* 11, 2014.
- Alfian R, Maulana Perdana Putra A. Uji Validitas dan Reabilitas Kuesioner Medication Adherence Report Scale (MARS) terhadap Pasien Diabetes Mellitus. *Jurnal Ilmiah Ibnu Sina* 2(2):176–83, 2017.
- Wibowo MINA, Setiawan D, Ikhwaniana ND, Sukma FA. The Effect of Counseling and Treatment Reminder Tool to Adherence with Drug and Outcome Clinic Patients with Diabetes Mellitus and Hypertension. *Indonesian Journal of Pharmaceutical Science* 18(2):169–72, 2020.
- Shiomi M, Kurobuchi M, Tanaka Y, Takada T, Otori K. Pill Counting in the Determination of Factors Affecting Medication Adherence in Patients with Type 2 Diabetes: A Retrospective Observational Study. *Diabetes Therapy* 13;12(7):1993–2005, 2021.
- Alshehri KA, Altuwaylie TM, Alqhtani A, Albawab AA, Almalki AH. Type 2 Diabetic Patients Adherence Towards Their Medications. *Cureus* 10, 2020.
- Papatheodorou K, Banach M, Bekiari E, Rizzo M, Edmonds M. *Complications of Diabetes 2017*. Journal of Diabetes Research. Hindawi Limited, 2018.
- Polonsky WH, Henry RR. Poor medication adherence in type 2 diabetes: Recognizing the scope of the problem and its key contributors. *Patient Preference and Adherence*. Dove Medical Press Ltd. 10; p. 1299–306, 2016.
- Mannan A, Hasan MM, Akter F, Rana MM, Chowdhury NA, Rawal LB, et al. Factors associated with low adherence to medication among patients with type 2 diabetes at different healthcare facilities in southern Bangladesh. *Glob Health Action* 14(1), 2021.
- Wibowo MINA, Setiawan D, Ikhwaniana ND, Sukma FA. The Effect of Counseling and Treatment Reminder Tool to Adherence with Drug and Outcome Clinic Patients with Diabetes Mellitus and Hypertension. *Indonesian Journal of Pharmaceutical Science* 18(2):169–76, 2020.
- Mihardja L, Soetrisno U, Soegondo S. Prevalence and clinical profile of diabetes mellitus in productive aged urban Indonesians. *J Diabetes Investig* 5(5):507–12, 2014.
- Escobar Florez OE, Aquilera G, De la Roca-Chiapas JM, Macías Cervantes MH, Garay-Sevilla ME. The Relationship Between Psychosocial Factors and Adherence to Treatment in Men, Premenopausal and Menopausal Women with Type 2 Diabetes Mellitus. *Psychol Res Behav Manag* 14:1993–2000, 2021.

24. Rouyard T, Kent S, Baskerville R, Leal J, Gray A. Perceptions of risks for diabetes-related complications in Type 2 diabetes populations: a systematic review. *Diabetic Medicine* 29;34(4):467–77, 2017.
25. Huxley R, Barzi F, Woodward M. Excess risk of fatal coronary heart disease associated with diabetes in men and women: meta-analysis of 37 prospective cohort studies. *BMJ* 14;332(7533): 73–8, 2006.
26. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013;2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet* 30;384(9945):766–81, 2014. Available from: [https://doi.org/10.1016/S0140-6736\(14\)60460-8](https://doi.org/10.1016/S0140-6736(14)60460-8)
27. Min H, Chang J, Balkrishnan R. Sociodemographic risk factors of diabetes and hypertension prevalence in Republic of Korea. *Int J Hypertens*, 2010.
28. Al-Rasheedi AAS. The Role of Educational Level in Glycemic Control among Patients with Type II Diabetes Mellitus. *Int J Health Sci (Qassim)* 8(2):177–87, 2014.
29. Yan W, Maung M, Tiraphat S, Puckpinyo A. Factors associated with medication adherence among type 2 Diabetes patients in a private clinic in Yangon, Myanmar. *Journal of Public Health and Development* 15(1):1–18, 2017.
30. Melikian C, White TJ, Vanderplas A, Dezii CM, Chang E. Adherence to oral antidiabetic therapy in a managed care organization: A comparison of monotherapy, combination therapy, and fixed-dose combination therapy. *Clin Ther* 24(3):460–7, 2002.
31. Ibrahim OA, Olaniyan FA, Sule AG, Ibrahim BY. Sociodemographic and clinical factors affecting adherence to antihypertensive medications and blood pressure control among patients attending the family practice clinic in a tertiary hospital in northern Nigeria. In 2018. Available from: <https://api.semanticscholar.org/CorpusID:80297032>
32. Darmada PD, Catur Wulandari D. Relation of Medication Adherence to the Incidence of Complications in Type 2 Diabetes Mellitus Patients. *Asian Journal of Pharmaceutical and Clinical Research* 7;177–81, 2020.
33. Agus SL, Ahmad AH. Patient Compliance Evaluation in the Use of Oral Antidiabetic Drugs Using Pill-Count and MMAS-8 Methods at PMI Hospital in Bogor City. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi* 6(1):32–45, 2022.
34. Ariyani H, Hartanto D, Lestari A. Adherence Of Hypertensive Patients After Giving Pill Card In Hospital X Banjarmasin. *Journal of Current Pharmaceutical Sciences* 1(2):81–8, 2018.
35. Sumedh MA. Correlation of Disease Knowledge with Adherence to Drug Therapy, Blood Sugar Levels and Complications Associated with Disease among Type 2 Diabetic Patients. *J Diabetes Metab* 05(05), 2014.
36. Yosef T, Nureye D, Tekalign E, Assefa E, Shifera N. Medication Adherence and Contributing Factors Among Type 2 Diabetes Patients at Adama Hospital Medical College in Eastern Ethiopia. *SAGE Open Nurs* 20(9), 2023.
37. Adikusuma W, Qiyaam N. Adherence level and blood sugar control of type 2 diabetes mellitus patients who gets counseling and short messages service as reminder and motivation. *Asian Journal of Pharmaceutical and Clinical Research* 1;11(2):219–22, 2018.
38. Fandinata SS, Ernawati I. The effect of self-reminder card to the level of adherence of hypertension patients in community health center in surabaya. *Open Access Maced J Med Sci* 2;8(E):647–52, 2020.