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Effectiveness of Pharmacist Interventions in Improving Medication Adherence and Clinical Outcomes in Patients with Diabetes Mellitus: A Meta-Analysis

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ABSTRACT

Introduction: Efforts to control and prevent complications of diabetes mellitus require optimal therapeutic outcomes, which are strongly influenced by patient adherence to antidiabetic therapy. Non-adherence remains one of the main causes of inadequate glycemic control in individuals with type 2 diabetes.
Objective: This study aims to evaluate the effectiveness of pharmacist-led interventions in improving medication adherence and clinical outcomes among diabetic patients through a systematic review of randomized controlled trial (RCT) articles.
Methods: A systematic search was conducted using PubMed and PMC databases, and eligible studies were assessed for methodological quality using the Jadad Scale. Articles that obtained scores of 3 to 5 were included in a quantitative meta-analysis using RevMan, with interpretation focused on forest plots, confidence intervals, heterogeneity, and statistical significance. From 325 articles initially identified, six studies met all inclusion criteria and were eligible for analysis.
Results: The meta-analysis demonstrated that pharmacist interventions consistently improved medication adherence, as indicated by a heterogeneity p-value of 0.69, showing similarity across studies. Positive effects were also observed on key clinical outcomes such as reductions in HbA1C and fasting blood glucose levels. However, no significant effects were found on triglyceride levels or body mass index, as the analyzed studies displayed a consistent tendency that these parameters were not influenced by pharmacist interventions.
Conclusions: Overall, the findings indicate that pharmacist-led interventions play an important role in enhancing adherence and improving essential clinical outcomes in patients with type 2 diabetes mellitus.

Keywords : adherence, diabetic patient, clinical outcome, pharmacist intervention

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INTRODUCTION

The prevalence of diabetes mellitus (DM) continues to increase significantly in Indonesia, including in Central Java, which recorded an increase of more than 2% during the period 2020–2025 (Riskesdas, 2025). DM is a chronic disease characterized by hyperglycemia due to impaired insulin production or function (WHO, 2023). WHO and IDF predict that the number of people with diabetes in Indonesia will sharply increase to 21–30 million by 2030–2035 (Perkeni, 2025). This condition is primarily experienced by the age group of 45 years and older, who are also at higher risk for metabolic and vascular complications.

Although DM control needs to be carried out thru pharmacological and non-pharmacological therapy, many patients still show poor glycemic control. Research shows that 67% of outpatient type 2 diabetes patients have uncontrolled glucose levels, largely influenced by non-adherence to medication, diet, and other clinical recommendations (Astuti & Setiarini, 2023). Non-compliance is triggered by various factors such as complex medication regimens, limited knowledge, costs, psychosocial issues, and lack of family support (Rasdianah *et al*., 2026; Rapoff *et al*., 2021). The impact is very serious, as non-compliance contributes to the increase in chronic complications including atherosclerosis, neuropathy, kidney failure, and retinopathy (ADA, 2024).

Identification and management of non-compliance are important aspects in the success of DM therapy. Pharmacist interventions—through education, counseling, therapy monitoring, medication management, home pharmacy care, and provision of educational tools—have been reported to improve both compliance and clinical outcomes (Lazuardi, 2024; Morello *et al*., 2021). Several studies have shown the success of interventions in improving HbA1C, random blood sugar, and quality of life, although the results are not always consistent across studies (Rohman *et al*., 2025; Septiar & Utami, 2025; Utami *et al*., 2026).

The diversity of these findings indicates the need for a more comprehensive study to understand the effectiveness of pharmaceutical interventions, especially in type 2 DM patients in the Asian region, which has different demographic characteristics and healthcare systems. Therefore, this study was conducted in the form of a systematic review–meta-analysis of RCT articles published from 2016 to 2026 to assess the impact of pharmacist interventions on medication adherence and clinical outcomes.

MATERIALS AND METHODS

This research was conducted using the systematic review-meta analysis method aimed at analyzing the effectiveness of pharmacist interventions, both in single groups and in collaboration with other medical professionals, to improve adherence and clinical outcomes for patients with type 2 diabetes mellitus in Asian countries. The databases used in the article search were from PubMed and PMC, utilizing keywords that align with PICO (patient intervention comparison outcome).

The search strategy was limited by several filters such as the selection of articles classified as Randomized Controlled Trials (RCT), publication years between 2016 and 2026, full text, and in English. Inclusion criteria for article searches include, among others, articles discussing intervention models by either single pharmacist groups or pharmacist groups collaborating with other medical professionals, articles discussing outpatient type 2 diabetes patients, articles with complete data on adherence using the MMAS score and clinical outcome data, and research conducted for a minimum of 1 month.

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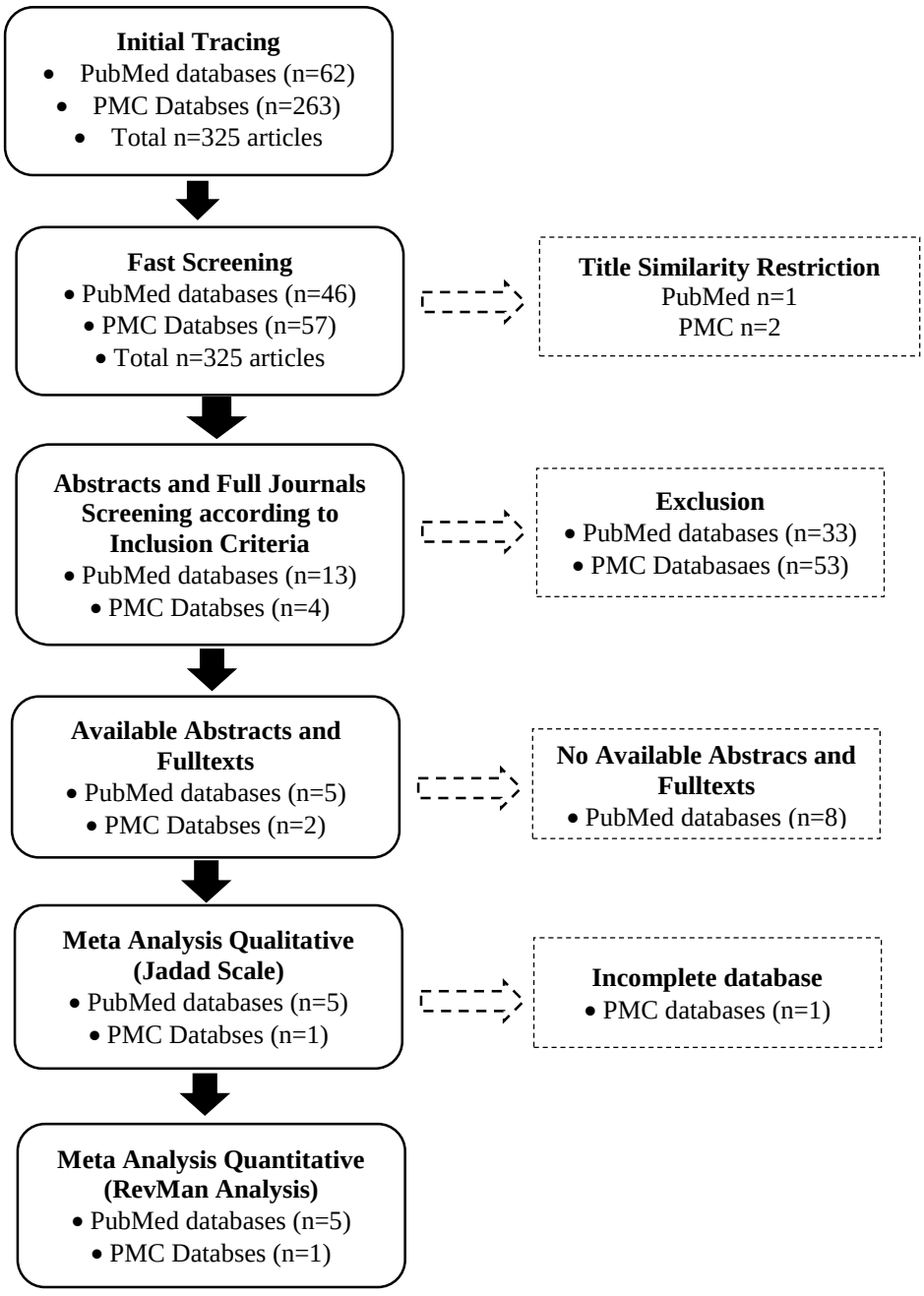
RESULTS

Articles Tracing Process



Picture 1. Articles Tracing Diagram

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Articles Extraction Process

Table 1. Articles Extraction

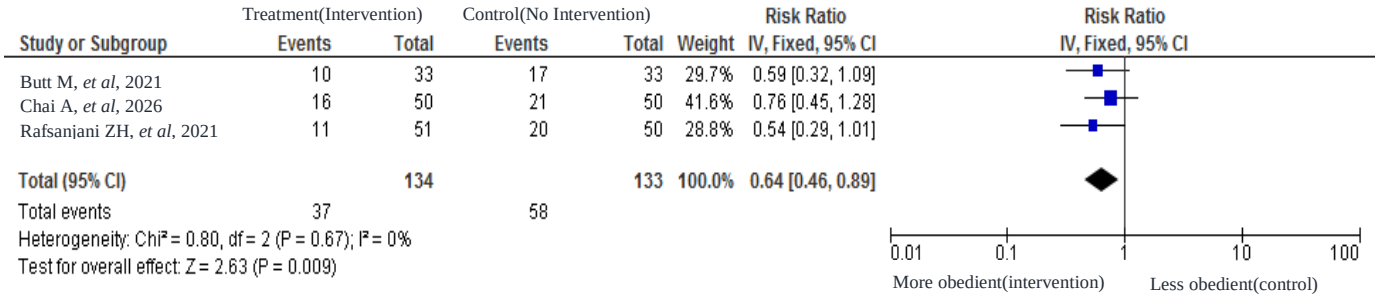
Author & Year	Country	Sample	Pharmacist Intervention Forms	Main Outcomes
Butt *et al*., 2021	Malaysia	73	DM Education, periodic counseling, 6-month monitoring	HbA_1C ↓, fasting blood sugar (FBS) ↓, adherence ↑
Chai *et al*., 2026	Malaysia	100	Colaborative DMTAC, counselling 4×/9 month	HbA_1C ↓, adherence ↑
Ting *et al*., 2026	Malaysia	142	Group intervention by MEDIHEALTH	HbA_1C ↓, SEAMS score ↑
Withidpanyawong *et al*., 2024	Thailand	180	Family based education, 4×/9 month education	HbA_1C ↓, BMI constan, TG ↓ less
Rafsanjani *et al*., 2020	Iran	101	Community pharmacist support programs	HbA_1C ↓, adherence ↑
Wishah *et al*., 2020	Yordania	106	Intensive counselling, 5-month monitoring	HbA_1C ↓, FBS ↓, TG ↓

Samples Description of Articles

Table 2. Samples Description of Articles

Authors Year		Rafsanjani ZH., *et al*, 2020	Wishah RA., *et al*, 2020	Butt M., *et al*, 2021	Withidpanyawong U., *et al*, 2024	Chai A., *et al*, 2026	Ting CY., *et al*, 2026
Samples (C;T)		101 (50;51)	106 (54;52)	73 (36;36)	212 (108;104)	100 (50;50)	142(71;71)
Dropout	Control	10	3	3	6	5	8
	Treatment	6	2	3	10	9	3
Genders	Women	51	60	39	133	62	84
	Men	34	46	27	47	38	47
Ages		55.9–57.3	52.9 53.2	57.12–57.42	58.13–60.53	52.38–52.66	51.5-52.2

Level of Adherence (Acording to the Number of Respondents)



Picture 2. Level of Adherence According to The Number of Respondents by RevMan Analysis

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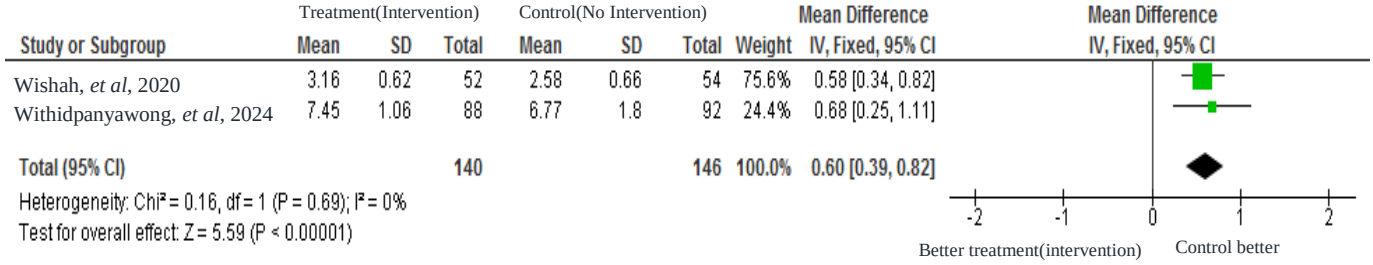
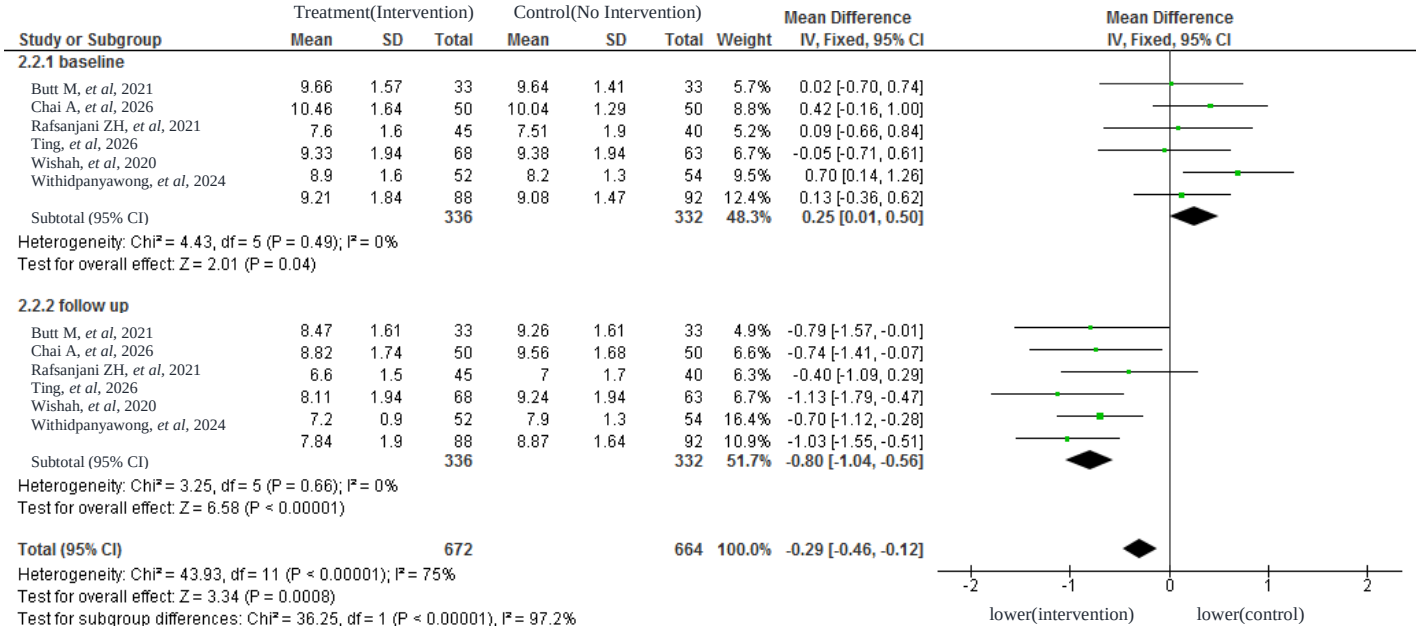
Level of Adherence (According to the Scores)



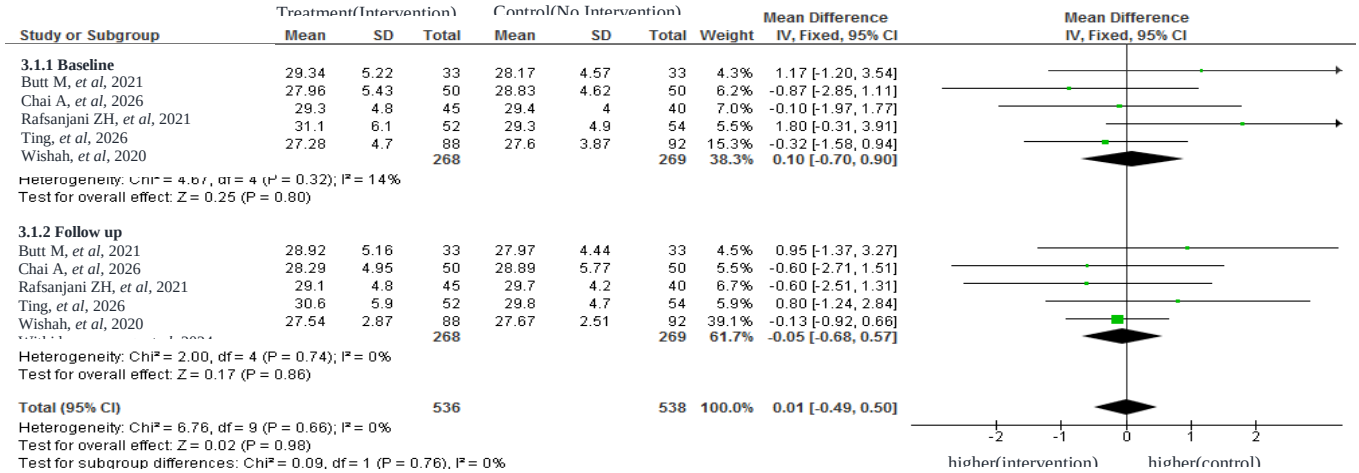
Picture 3. Level of Adherence According to Scores MMAS by RevMan Analysis

HbA$_1$C Scores Outcome



Picture 4. HbA$_1$C Scores Outcome by RevMan Analysis

BMI Scores Outcom



Picture 5. BMI Scores Outcome by RevMan Analysis

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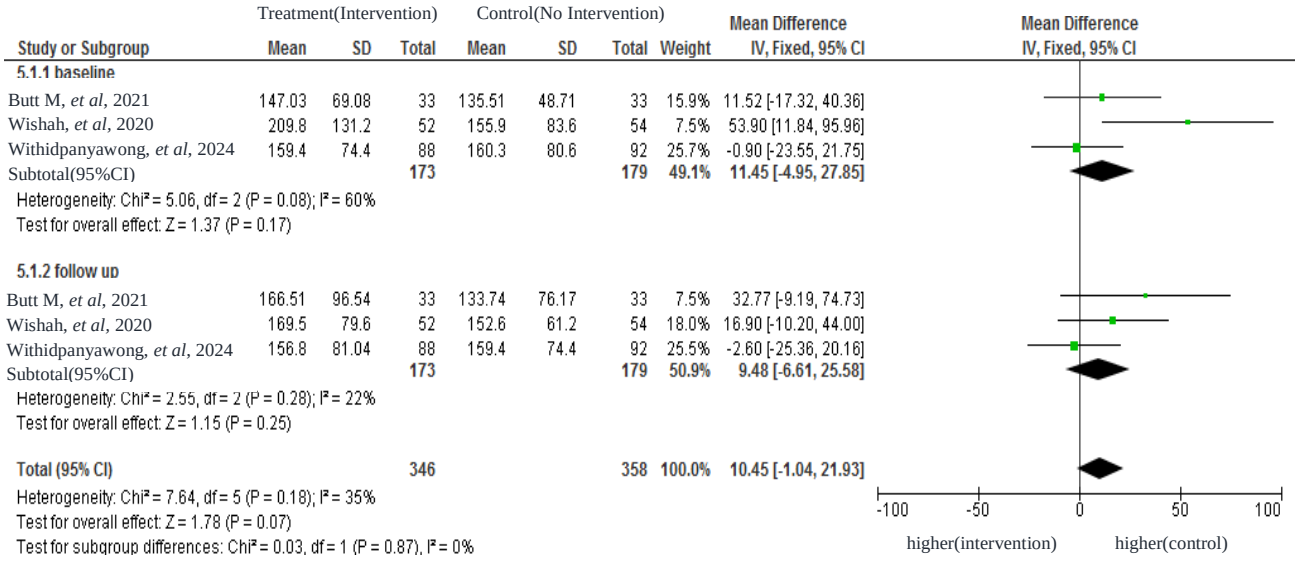
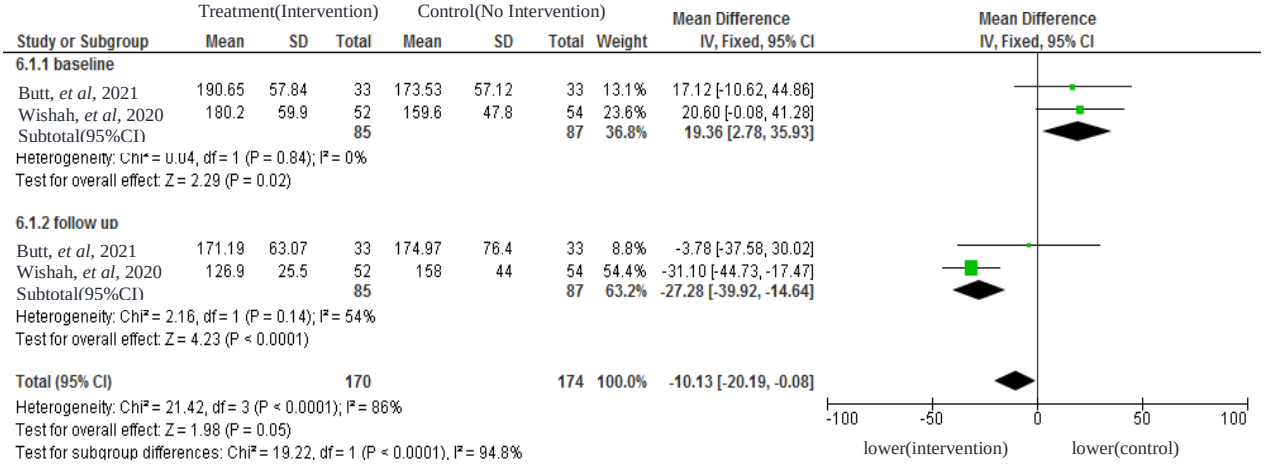
Triglyceride Scores Outcome



Picture 6. Triglyceride Scores Outcome by RevMan Analysis

Fasting Blood Sugar Scores Outcome



Picture 7. Fasting Blood Sugar Scores Outcome by RevMan Analysis

DISCUSSION

The results obtained from the initial article search using the database with several keyword models on the PMC database thru NCBI access yielded 263 articles, and the articles searched using the PubMed database yielded 62 articles. The total results of the article search using these three databases were 325 articles. The article search continued by meeting the established inclusion criteria and excluding articles that could not be accessed in full text. A total of 3 articles were obtained from the PubMed database and 26 articles from the PMC database, making a total of 29 articles. Then, the selection was based on the type of article, specifically randomized controlled trials (RCTs). The results

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showed 2 articles from the PMC database and 5 articles from the PubMed database, resulting in a total of 7 articles selected based on the RCT inclusion criteria.

The results of a series of searches and article selection restrictions, both according to inclusion criteria and the analysis results from the meta-analysis scoring based on the Jadad Scale criteria, yielded the flowchart Picture 1. The results of the literature search were then extracted. The extraction or overview contains the names of the researchers, the title of the research, the research design, the form of intervention, the sample size, control and treatment, duration of observation, location, and main findings/outcomes. The extraction results or overview of the 6 articles obtained from the qualitative meta-analysis are in accordance with Table 1.

The articles that were selected and analyzed both qualitatively and quantitatively originate from and represent Asian countries. The articles used are from Southeast Asia and the Middle East, namely Malaysia, Thailand, Iran, and Jordan. The method used in the studies within the articles is a randomized controlled trial, where sampling is conducted randomly with a specific method, there is blinding, and there is an explanation regarding dropout. The similarities of the articles used in this study can be seen in Table 2.

In several analyzed articles, the majority of diabetes mellitus patients are aged 50–70 years, an age range vulnerable to degenerative diseases due to the aging process, decreased cell function, glucose intolerance, and reduced insulin secretion (Srikartika *et al*., 2026; Kirkman *et al*., 2025). WHO (2023) reported an increase in the prevalence of adult diabetes from 4.7% to 8.5% since 2020, and 43% of diabetes-related deaths occur in individuals under 70 years old. The study by Bird *et al*. (2025) also showed that the incidence of diabetes is higher in the age group over 60 years. In addition to age factors, the prevalence of diabetes mellitus in those articles is higher in women (58.45%), influenced by lifestyle, low physical activity, and hormonal changes such as menopause (Lazuardi, 2024; Kautzky-Willer *et al*., 2026; Ambachew *et al*., 2025).

As a chronic disease that requires long-term therapy and often involves more than one medication, diabetes is prone to causing non-compliance, especially in the geriatric population (Lazuardi, 2024). Pharmacist interventions have become an important strategy to improve adherence through counseling, therapy problem identification, education, medication and diet management, and monitoring.

Various studies show the diversity of pharmacist intervention models. Butt *et al*. (2021) implemented the Patient Education by Pharmacist Program (PEPP) which focused on education, counseling, and monitoring three times over six months. Rafsanjani *et al*. (2020) provided a similar intervention with additional intensive training for pharmacists and the provision of blood glucose monitoring tools. Wishah *et al*. (2020) emphasized collaborative interventions between pharmacists and medical staff through face-to-face counseling, written education, and follow-up phone calls. Withidpanyawong *et al*. (2024) involved families as part of the intervention through continuous education and social support. Ting *et al*. (2026) used a group-based approach in the MEDIHEALTH community, while Chai & Ting-Su (2026) developed a multidisciplinary collaborative intervention at the DMTAC clinic in Malaysia.

Overall, the variation in intervention forms indicates that the role of pharmacists whether individually, in groups, with families, or through multidisciplinary collaboration plays an important part in improving adherence and diabetes management. The results of the analysis of the above articles regarding the effectiveness of interventions on the increased adherence of diabetes mellitus patients are as Picture 2 and 3.

The results of the analysis in Figure 2 show that the prevalence of increased adherence among diabetes mellitus patients is higher in the intervention group compared to the control group, as seen from the forest plot with the confidence interval (CI) shifting toward the treatment side. The heterogeneity test showed a p-value of 0.67 and $I^2 = 0\%$, indicating homogeneity among the studies. Specifically, the studies by Butt *et al*. (2021), Chai *et al*. (2026), and Rafsanjani *et al*. (2020) showed a significant difference in the increase in the number of compliant respondents, with a p-value of 0.009.

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Pharmacist interventions in the form of education, counseling, accompaniment, and monitoring resulted in a compliance increase of 0.64 times higher compared to the control group.

Figure 3 also shows that the adherence scores based on the MMAS instrument in the studies by Wishah *et al*. (2020) and Withidpanyawong *et al*. (2024) indicate a significant difference between the treatment and control groups ($p < 0.00001$). Additionally, the analysis of changes in clinical outcomes—including HbA1C, fasting blood sugar, BMI, and triglycerides—was used to evaluate the extent to which pharmacist interventions impact key clinical parameters in diabetes mellitus patients.

The results of the analysis from the above articles regarding the effectiveness of interventions on changes in clinical outcomes including HbA1C, Fasting Blood Sugar (FBS), Body Mass Index (BMI), and triglycerides in diabetes mellitus patients are illustrated in figures 4-7. Figure 4 shows that at baseline, there is a significant albeit small difference between the control and treatment groups, indicated by a 95% CI value of 0.25 (0.01 – 0.5) not crossing zero, reinforced by a p-value of 0.04 ($p<0.05$). The treatment group after the intervention shows a significant difference indicated by a 95% CI value of -1.04 – (-0.56), reinforced by a p-value of <0.00001. The overall effect between the treatment and control at baseline and after follow-up (intervention) in the six articles is significantly different. This is indicated by the CI95% value of -0.46 – (-1.12) and a p-value of 0.0008 ($p<0.05$). From the above description, the intervention by pharmacists in the treatment group caused a decrease in HbA1C levels in diabetic patients, while the control group also experienced a decrease but not as significant as in the treatment group.

The results of the forest plot in Figure 5 show no difference between baseline and post-intervention, as indicated by a p-value of 0.98 ($p>0.05$). This means that the intervention by pharmacists did not significantly affect the change in BMI in diabetes mellitus patients, both in the control group and the treatment group. The results of the forest plot in Figure 6 show no difference between baseline and post-intervention, as indicated by a p-value of 0.07 ($p>0.05$). This means that the intervention by pharmacists did not significantly affect the change in triglyceride levels in diabetes mellitus patients, both in the control group and the treatment group.

In the above analysis, a random effects analysis was used because the heterogeneity value at baseline (I2 value) was above 50%, necessitating an analysis based on random effects. The difference in the average value between the treatment group and the control group was 12.72, with a 95% CI value between -1.93 and 23.37. Therefore, the average difference is very small with a very wide confidence interval, indicating that the intervention had almost the same effect on both the control and treatment groups.

The analysis results show that at baseline there is a significant albeit small difference between the control and treatment groups, as indicated by CI95% = 19.36 (2.78–35.93) and $p = 0.02$. After the intervention, the treatment group experienced a significant decrease in fasting blood sugar with a CI95% = –39.92 to –14.64 ($p < 0.0001$). Overall, the comparison between the treatment and control groups before and after the intervention also showed a significant difference (CI95% = –20.19 to –0.08; $p = 0.05$). These findings indicate that pharmacist intervention has a significant impact on reducing fasting blood sugar levels, although the control group also experienced a smaller decrease.

These results are consistent with the study by Septiar and Utami (2025), which reported that pharmacist counseling can improve glycemic control, medication adherence, and reduce HbA1C. Other research (Garcia-Perez *et al*., 2023; Kirkman *et al*., 2025) also shows that increased adherence plays a crucial role in achieving therapy targets and preventing complications. Morello *et al*. (2021) also emphasized that patient education and family involvement are important components in improving adherence and overall clinical outcomes.

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CONCLUSIONS

The presence of pharmacist interventions, whether conducted by pharmacist groups or in collaboration with other medical personnel, has been effective in influencing and improving the adherence of type 2 diabetes mellitus patients. The presence of pharmacist interventions, whether conducted by pharmacist groups or in collaboration with other medical personnel, has been effective in influencing and reducing clinical outcomes in diabetes mellitus patients, particularly in HbA1C and random blood sugar levels, but not in body mass index and triglycerides.

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This section is mandatory. Grants, financial support, and technical or other assistance should be acknowledged at the end of the text, before the references. Any financial support received for the project must be stated. If no financial assistance was provided, this should be explicitly mentioned. The role of the funding organization, if applicable, in data collection, analysis, interpretation, and its authority over the publication approval process should be detailed in the Methods section.

Funding Source

Independently funding source

Availability of data and materials

The "Availability of Data and Materials" section is essential for maintaining transparency, reproducibility, and credibility in scientific research. It specifies the accessibility of raw data, datasets, or materials used in the study, enabling other researchers to verify findings, replicate experiments, or expand upon the research.

Authors' contributions

The "Authors' Contributions" section details the specific roles of each author in conducting the research and preparing the manuscript. It enhances transparency, promotes accountability, and properly acknowledges each contributor's efforts.

Conflict of Interest

Confirming no financial or other interest in the product or its distributor

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