

A Comprehensive Review of Psychological and Educational Approaches to Enhancing Adherence in Diabetes and Depression Management

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Abstract

Diabetes is a chronic condition that significantly increases the risk of developing comorbid depression, which can negatively impact adherence to treatment regimens. Psychological and educational interventions are effective in addressing depression in individuals with comorbid conditions, according to the National Institute for Health and Care Excellence (NICE). Since depression is often linked to poor adherence to treatment plans, improving depression outcomes may lead to better adherence and, consequently, improved glycemic control. This review focuses on RCTs (randomized controlled trials) that examine psychological and educational interventions, exploring their effects on depression and diabetes management, and assesses the practical feasibility of this approach. A comprehensive search was conducted across Cochrane Library, Google Scholar, and PubMed for relevant clinical trials. Ten RCTs involving a total of 5759 participants were selected, focusing on the impact of interventions on Type 2 diabetic patients with comorbid depression. The results showed that while depression outcomes improved significantly (SMD = -0.39, 95% CI -0.62, -0.15; I² = 81%; P < 0.001), diabetes-related outcomes did not exhibit significant changes (SMD = -0.14, 95% CI -0.32, 0.03; I² = 44%; P = 0.12). These findings suggest interventions are beneficial in alleviating depression symptoms and may contribute to better glycaemic control. However, further research with larger sample sizes is needed to improve the generalizability and representativeness of the findings.

Keywords: Psychological intervention, Type 2 diabetes, Educational intervention, Non-adherence, Collaborative care, Depression

Introduction

Diabetes is a common condition affecting approximately 4.7 million people in the United Kingdom, with type 2 diabetes accounting for 90% of these cases [1]. Type 2 diabetes occurs when the body becomes resistant to insulin or is unable to produce enough of it [2, 3]. This condition impairs the body's ability to process glucose, resulting in elevated blood sugar levels.

Effective management of diabetes is a lifelong commitment that requires active participation from patients, as the majority of treatment focuses on self-

management. Both the patient and the family play a crucial role in maintaining control over the disease. Failure to manage diabetes properly can lead to severe complications, such as diabetic foot disease and diabetic retinopathy [4].

Depression is characterized by a prolonged low mood and a diminished interest in most activities, accompanied by a range of cognitive, emotional, and behavioral symptoms. It affects 4.5% of the population in the United Kingdom and is the first reason for disability and early death [5]. Various factors contribute to depression, including genetic predisposition, life events, medications, and underlying medical conditions [5].

Pharmacists' role in the management of diabetes and depression

Pharmacies have become integral in managing both diabetes and depression, offering a range of services such as screening, foot health assessments, influenza

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vaccinations for diabetic patients, and providing general wellness advice for those dealing with depression. Early identification of these conditions can help lower both mortality and morbidity rates. Pharmacists are especially valuable in addressing depression, as they are trained to recognize the early signs and symptoms of the disorder [6]. Those with chronic conditions, such as diabetes, are at a higher risk of experiencing mental health challenges [7].

Adherence and non-adherence

Adherence refers to how well a patient follows the prescribed recommendations from their healthcare provider, emphasizing the patient's autonomy in making decisions about their treatment [8]. Since patients have the freedom to choose, they are primarily responsible for adhering to the treatment plan. Non-adherence, on the other hand, occurs when patients fail to follow their prescribed treatment regimen. This can manifest in various ways, such as missing doses, skipping regular appointments, or completely neglecting to take their medication [9]. Non-adherence can be categorized into two types: unintentional, which may be due to factors like forgetfulness or physical limitations beyond the patient's control, and intentional, where the patient purposely chooses not to follow the prescribed treatment [10]. Recent studies indicate that less than half of patients with chronic conditions adhere to long-term treatment plans [11], a trend that is also seen in diabetes, where neglecting treatment is a common issue.

Psychological and educational intervention

Cognitive behavioral therapy (CBT) is a therapeutic approach designed to assist individuals in managing their challenges by altering their thought patterns and behaviors and teaching them essential coping mechanisms [12]. Educational interventions vary based on the specific needs of the patient as determined by the healthcare professional, often incorporating counseling and personalized guidance to help patients understand and manage their treatment plans [13]. These interventions have been shown to enhance medication adherence, particularly when tailored strategies are identified and effectively implemented for each individual [14]. According to the NICE CG91 guideline (2009), treating depression in individuals with chronic conditions can significantly improve their quality of life (QoL), and it recommends a stepped-care model to help healthcare professionals choose the most efficient

interventions, including psychological therapies like CBT and educational support [15]. Since diabetes is a long-term chronic condition, a clear link has been found between diabetes and the onset of comorbid depression. Depression can negatively impact a person's mental well-being, which in turn affects their ability to care for themselves. Depressed individuals often neglect their treatment plans and may resist taking their medications. Additionally, depression and some antidepressant medications contribute to weight gain, which can increase blood sugar levels, or cause reduced appetite, leading to hypoglycemia, all of which can compromise diabetes management. This relationship creates challenges in treating diabetes effectively. Moreover, both depression and diabetes exhibit overlapping symptoms, such as fatigue and excessive sleep, making it difficult to differentiate between the two, which could result in undiagnosed depression. This connection suggests that managing depression in patients with diabetes could significantly enhance their ability to control diabetes [16, 17].

There is a lack of extensive research exploring the relationship between these two conditions. While randomized controlled trials have investigated the effect of interventions on alleviating depressive symptoms, there is limited evidence to suggest that these interventions lead to better diabetes control when compared to standard care [18-21]. This review focuses on RCTs that examine psychological and educational interventions, exploring their effects on depression and diabetes management, and assesses the practical feasibility of this approach.

Materials and Methods

Study overview

This meta-analysis evaluates the results of existing randomized controlled trials (RCTs) to determine if interventions like cognitive behavioral therapy (CBT) and educational programs lead to improvements in clinical outcomes for patients with diabetes and comorbid depression.

Study aim

Individuals with diabetes are at a higher risk of developing depression compared to those without the condition. When depression coexists with diabetes, it often leads to a reduced quality of life (QoL), worsened hyperglycemia, and an increase in depressive symptoms.

The goal of this review is to explore how psychological interventions targeting depression symptoms can positively influence both diabetes management and depression outcomes. To achieve this, RCTs involving patients with diabetes and comorbid depression were analyzed, comparing the effects of treatment interventions versus standard care, with a focus on how these interventions impact treatment adherence.

Objectives

The main objectives of this study include utilizing RevMan 5 software to analyze the data from the selected RCTs. A critical appraisal of the RCT papers will be performed using the Critical Appraisal Skills Programme (CASP) (2021) to evaluate their reliability and validity. Suitable RCTs for the analysis will be identified through various search engines. Additionally, the PRISMA (2021) guidelines will be applied to document the search strategy used to select the studies for this review. Finally, the relationship between the treatment interventions and clinical outcomes in the context of both depression and diabetes will be examined and discussed in detail.

This research employed a meta-analysis approach, integrating both quantitative and qualitative data from multiple studies to assess the impact of depression and diabetes treatments on adherence and clinical outcomes. The PICO framework was utilized to guide the analysis and streamline the paper search, ensuring the inclusion of relevant factors.

The population or problem focused on diabetic patients with comorbid depression, particularly those with type 2 diabetes. The intervention involved examining whether psychological and educational treatments could enhance adherence and subsequently improve both diabetes and depression outcomes. The comparison involved contrasting the effects of these interventions on adherence with those of standard care, which did not include any specific intervention. The outcomes measured were related to diabetes control through glycaemic levels and the assessment of depressive symptoms, evaluated using various psychometric tools.

Keywords

The following terms were utilized in the search process: Type 2 diabetes, Adherence, Psychological intervention, Collaborative care, Randomized controlled trial, and Comorbid depression.

Selection criteria

A comprehensive literature review was performed to identify relevant RCTs on the subject. The search was conducted between December 2020 and March 2021, utilizing databases such as Google Scholar®, PubMed®, and Cochrane® Library. The search focused on RCTs published between 2000 and 2021. The specific inclusion and exclusion criteria are outlined in **Figure 1**.

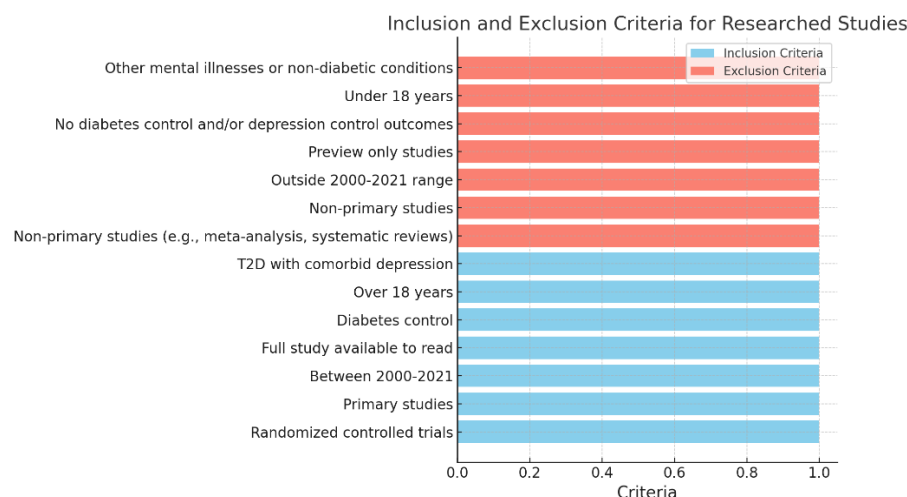


Figure 1. The specific inclusion and exclusion criteria.

For this meta-analysis, the studies included were randomized controlled trials (RCTs) published between

2000 and 2021, which were fully accessible for review. Only primary studies were considered, while non-

primary studies such as meta-analyses and systematic reviews were excluded. The research focused on studies that assessed both diabetes control and depression control outcomes, as well as treatment adherence. Studies were eligible if they involved individuals aged 18 years and older with type 2 diabetes (T2D) and comorbid depression. Any studies involving other mental health conditions or non-diabetic disorders were excluded from the analysis.

Search strategy

A total of 1725 papers were initially identified through the search strategy, with 1329 duplicates removed. The remaining 396 articles were evaluated based on their titles and PICO criteria. After this initial screening, 202 papers were deemed irrelevant to the study's focus and were excluded. This left 125 papers, which were then assessed based on their measured outcomes. Ultimately, 10 studies were selected for quality assessment using the CASP (2021) framework. The process flow is illustrated in **Figure 2**, which presents the PRISMA (2021) flow diagram.

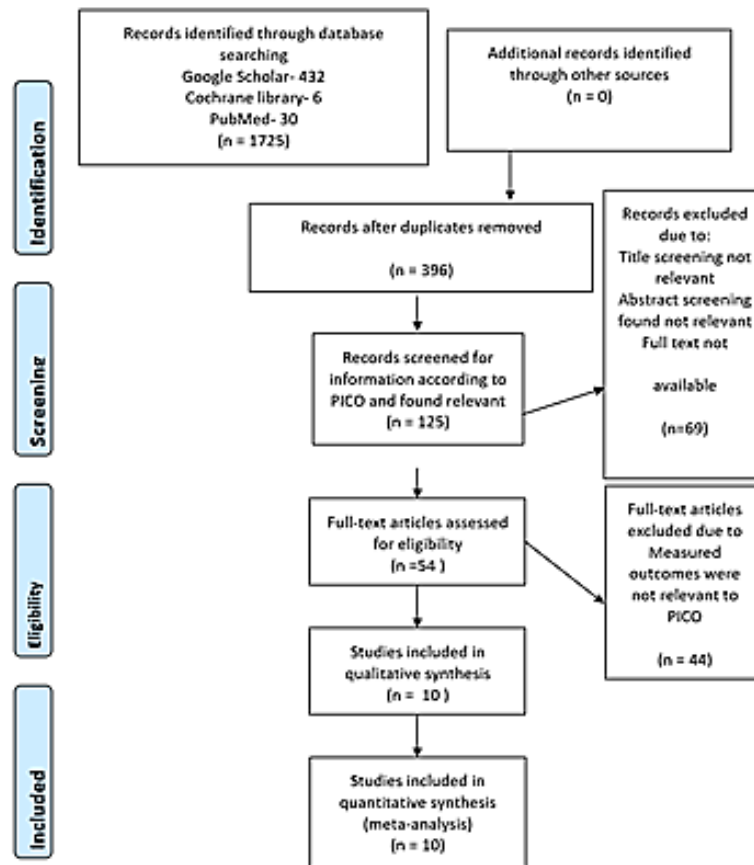


Figure 2. PRISMA diagram showing search strategy

Risk of bias

To understand potential variations in the results, a risk of bias assessment was conducted. This analysis was carried out using RevMan© version 5.3 software [22]. For each study, individual tables were created, outlining the study

characteristics and the authors' assessments of bias across different areas. The risk levels were categorized as "High risk," "Low risk," or "Unclear risk" based on the labels provided by RevMan©. The graphs generated from this analysis are displayed in **Figure 3**.

Williams <i>et al.</i> , 2004	+	+	+	+	+	+	+	+	+
Weinger <i>et al.</i> , 2011	+	+	+	+	+	+	+	+	+
Sharif <i>et al.</i> , 2014	+	+	+	+	+	+	+	+	+
Piette <i>et al.</i> , 2011	?	+	+	+	+	+	+	+	+
Newby <i>et al.</i> , 2017	+	+	+	+	+	+	+	+	+
Lauffenburger <i>et al.</i> , 2019	+	+	+	+	+	+	+	+	+
Huang <i>et al.</i> , 2016	+	+	+	+	+	+	+	+	+
Eli <i>et al.</i> , 2010	+	+	+	+	+	+	+	+	+
Cummings <i>et al.</i> , 2019	+	+	+	+	+	+	+	+	+
Bogner <i>et al.</i> , 2012	+	+	+	+	+	+	+	+	+
	Random sequence generation (selection bias)								
	Allocation concealment (selection bias)								
	Blinding of participants and personnel (performance bias)								
	Blinding of outcome assessment (detection bias)								
	Incomplete outcome data (attrition bias)								
	Selective reporting (reporting bias)								
	Other bias (self reported HbA1c)								

Figure 3. Risk of bias summary: review authors' judgments about each risk of bias item for each included study.

Here's a paraphrased version of the summary with the rows rearranged (**Table 1**).

Table 1. Summary of studies analyzed

Study	Study design	Number of patients	Summary of results	Measured outcomes	Type of intervention	Conclusion
Williams <i>et al.</i> , 2004	RCT	1801	The intervention did not affect HbA1c levels ($P > 0.2$), but it led to lower depression severity ($P < 0.001$) and improved functional outcomes ($P < 0.001$).	Depression, functional impairment, diabetes self-care behaviors	Education, problem-solving treatment, or support for antidepressant management	Collaborative care enhances affective and functional status in older patients with depression and diabetes but has minimal impact on glycemic control for those with good initial levels.
Lauffenburger <i>et al.</i> , 2019	RCT	6000	Insulin persistence did not differ across study arms, though better glycemic control was observed in one of the arms ($P < 0.05$).	Insulin persistence, changes in hba1c levels, healthcare utilization	High-intensity intervention: weekly text messages, tailored pharmacist assistance, follow-up calls	A high-intensity intervention improved glycemic control but did not enhance insulin persistence.
Newby <i>et al.</i> , 2017	RCT	96	iCBT showed significant improvement in depression, diabetes-related stress, and well-being, but no difference in self-reported HbA1c levels.	Depression (PHQ-9), diabetes-related stress, self-reported glycemic control	iCBT with therapist support (Phone & Email)	iCBT is an effective and accessible treatment for depression in people with diabetes, offering lasting improvements in mental health.
Bogner <i>et al.</i> , 2012	RCT	1801	The intervention group showed greater improvements in HbA1c levels and depression remission compared to usual care ($P < 0.001$).	Glucose control (HbA1c), depression (PHQ-9 Score)	Integrated care intervention with care manager	An integrated approach to managing type 2 diabetes and depression improves patient outcomes in primary care settings.

Cummings <i>et al.</i> ,	RCT	139	The intervention group showed improvements in RRD, depressive symptoms, self-care behaviors, and medication adherence, with marginal HbA1c improvements.	Glucose control (HbA1c), depressive symptoms, self-care behaviors, medication adherence	CBT + lifestyle counselling	Tailored CBT with lifestyle counseling improves behavioral outcomes and may improve HbA1c in rural patients with T2D and comorbid depressive symptoms.
Shariff <i>et al.</i> , 2014	RCT	60	Depression scores were significantly reduced in the experimental group ($P \leq 0.001$), with HbA1c changes significant in both groups ($P \leq 0.001$).	Depression scores, HbA1c change	CBT	CBT was effective in reducing depression in diabetes patients and can be recommended as a treatment for this population.
Ell <i>et al.</i> , 2010	RCT	387	The intervention group showed greater improvements in depression (50% reduction), but no significant effects on HbA1c or self-care management.	Depression (SF-12), financial situation, social stressors, diabetes (HbA1c)	Problem-solving therapy and/or antidepressants	A culturally adapted collaborative care approach improved depression and treatment receipt but did not impact diabetes control.
Weinger <i>et al.</i> , 2011	RCT	222	The structured behavioral arm showed greater HbA1c improvement compared to the control arms. No difference was found in quality of life or diabetes self-care.	HbA1c, depression, coping style, quality of life, self-efficacy	CBT with educator-led structured group intervention	A structured CBT program was more effective than control interventions in improving glycemic control in adults with long-duration diabetes.
Lauffenburger <i>et al.</i> , 2019	RCT	6000	Insulin persistence did not differ between arms, but there was a significant improvement in glycemic control in one of the groups.	Insulin persistence, HbA1c Levels	High-intensity intervention with texts, calls, and counseling	Despite improving glycemic control, the intervention did not affect insulin persistence.
Huang <i>et al.</i> , 2016	RCT	61	The experimental group showed significant reductions in HbA1c and depressive symptoms, with improvements in both physical and mental quality of life.	Depressive symptoms, diabetes control (HbA1c), mental and physical quality of life	Motivational enhancement therapy with CBT	The intervention helped improve both psychological adjustment and glycemic control, suggesting it could be a feasible method for diabetes management.

Summary of selected studies

Table 1 presents an overview of the selected 10 studies in this analysis. All the studies were randomized controlled trials (RCTs), collectively involving 5,759 participants diagnosed with diabetes and comorbid depression. Among these studies, 6 focused on cognitive behavioral therapy (CBT) as the intervention, while the remaining 4 investigated the effects of educational and collaborative care approaches.

Results and Discussion

The analysis of the 10 RCTs was carried out using RevMan© software, which generated forest plots to determine the SD difference for depression. The collected data was continuous and assessed using various psychometric tools, such as the PHQ-9 score [23], BDI® (Becks Depression Inventory) score [24], and QoL© index score, ensuring that the results could be standardized and effectively compared [25]. For diabetes outcomes, the mean difference effect measure was applied, as data was recorded in HbA1c (%) values. Due to the heterogeneity exceeding 50%, a random-effects

model was applied to analyze both depression and diabetes.

Measurable outcomes

The outcomes evaluated in the studies included depression control, assessed through the PHQ-9©, QoL© scores, and BDI® scores. Diabetes was monitored using HbA1c (%) values.

Diabetes clinical outcome

All 10 studies assessed diabetes control based on HbA1c (%) values, as shown in **Figure 4**. Six of these studies [26-31] focused on type 2 diabetes mellitus (T2DM), while the remaining four examined both type 1 and type 2 diabetes (T1DM and T2DM) [32-36]. To investigate the impact of this difference on the results, a subgroup analysis was performed, separating the studies based on T1DM and T2DM. Only T2DM data was included in this analysis.

The overall results for HbA1c values did not show significant differences ($P = 0.12$), with an SD difference of -0.14 (95% CI -0.32, 0.04). Among the 10 studies, only two crossed the null effect threshold: Huang *et al.* [26]

with a mean difference (MD) of -1.33 (95% CI -2.03, -0.63), and Lauffenburger *et al.* [27] with an MD of -0.14 (95% CI -0.23, -0.05), the latter of which had the highest weighting at 28.8%. The remaining 8 studies displayed confidence intervals (CIs) that crossed the null effect line, indicating no significant difference between the usual care groups and intervention.

Two trials [29, 30] showed confidence intervals that were evenly distributed between the usual care groups and intervention, as the HbA1c values did not change significantly between these groups in all four studies. This indicates that the results were not significant. The average results, represented by the diamond on the forest plot, also reflect no significant effect.

The heterogeneity for the T2DM subgroup was calculated at $I^2 = 64\%$, which exceeds the recommended threshold of 50%, indicating moderate variability. For the combined T1DM and T2DM subgroups, the heterogeneity was 0%. In total, the overall heterogeneity was 44% with a p-value of 0.06, suggesting no significant differences. This indicates that the studies are relatively consistent, with minimal bias, and any observed differences can likely be attributed to random variation.

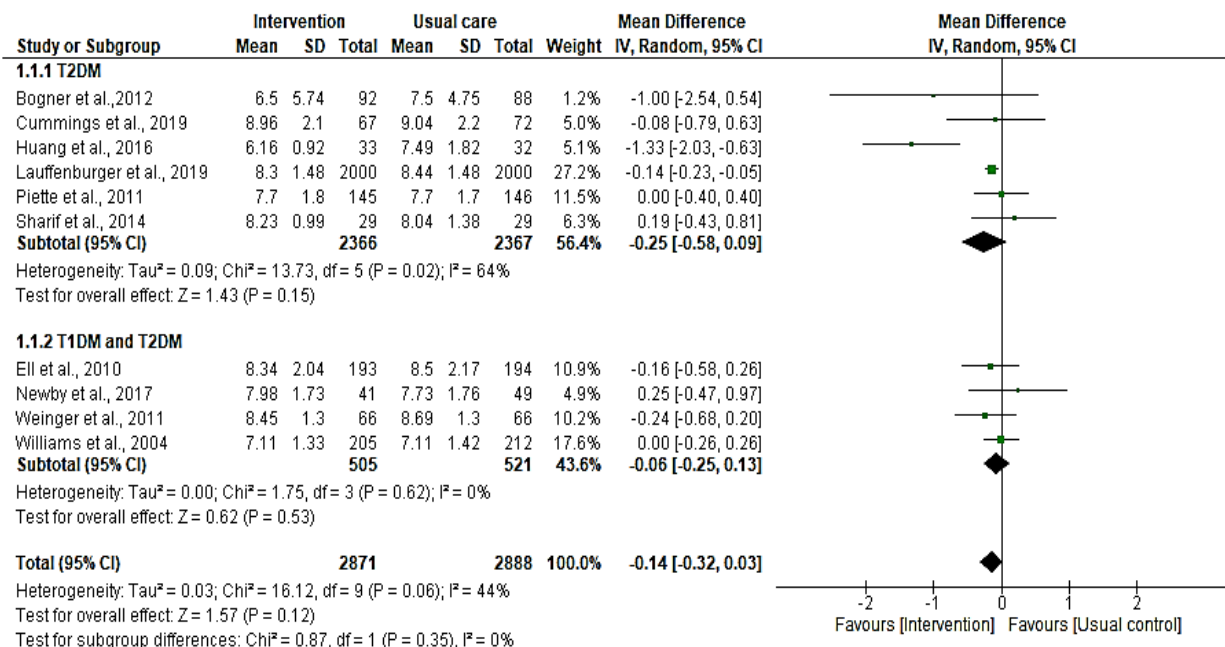


Figure 4. Forest plot showing diabetes clinical outcomes (HbA1c values) intervention versus usual care [24-29].

Depression clinical outcomes

Of the 10 studies, nine evaluated depression outcomes that could be measured using RevMan©. A subgroup analysis was performed, as 4 studies used PHQ-9©

scores, 4 utilized QoL© scores, and 1 employed the BDI® score. This analysis aimed to explore whether variations in heterogeneity had an impact.

Figure 5 displays the SD difference for depression outcomes between the usual care groups and intervention. The forest plot reveals that interventions involving CBT [37] or education significantly improved depression outcomes, particularly in the PHQ-9© score subgroup (SMD -0.63, 95% CI -1.05, -0.21, $p=0.003$). The results favored the intervention side, indicating strong support for the hypothesis that these interventions lead to better depression outcomes. The effect was SMD -0.39 (95% CI -0.62, -0.15, $P = 0.001$) overall, which was highly significant.

In the QoL© subgroup, a higher score was expected to indicate an improved quality of life concerning depression [25]. However, the forest plots from RevMan© showed the opposite—higher scores in the intervention group suggested that usual care was more effective. To provide a clearer interpretation, the results were reversed to better align with the expected outcomes. This adjustment revealed that 3 studies favored the intervention group [27-29], while only one study supported the usual care group [30].

Interestingly, five trials [26, 31-34] demonstrated a clear positive effect for the intervention, as their results were far left of the null effect line. Weinger *et al.* [35] was the sole trial where the result crossed the null effect line completely.

The heterogeneity for this outcome was notably high at 81%, which indicates substantial variability between studies. This value exceeds 50%, suggesting that factors other than chance may have influenced the differences. Consequently, a subgroup analysis was conducted to assess its impact on heterogeneity, revealing a smaller difference of 43.5% ($P = 0.17$) which was not statistically significant. This variation could be attributed to the differing methodologies used across studies, including variations in psychometric measurements for depression, as well as differences in participants' baseline characteristics and depression outcomes. Given the high heterogeneity, it's plausible that bias may have affected these results, including potential publication bias and inconsistencies in randomization procedures across the trials.

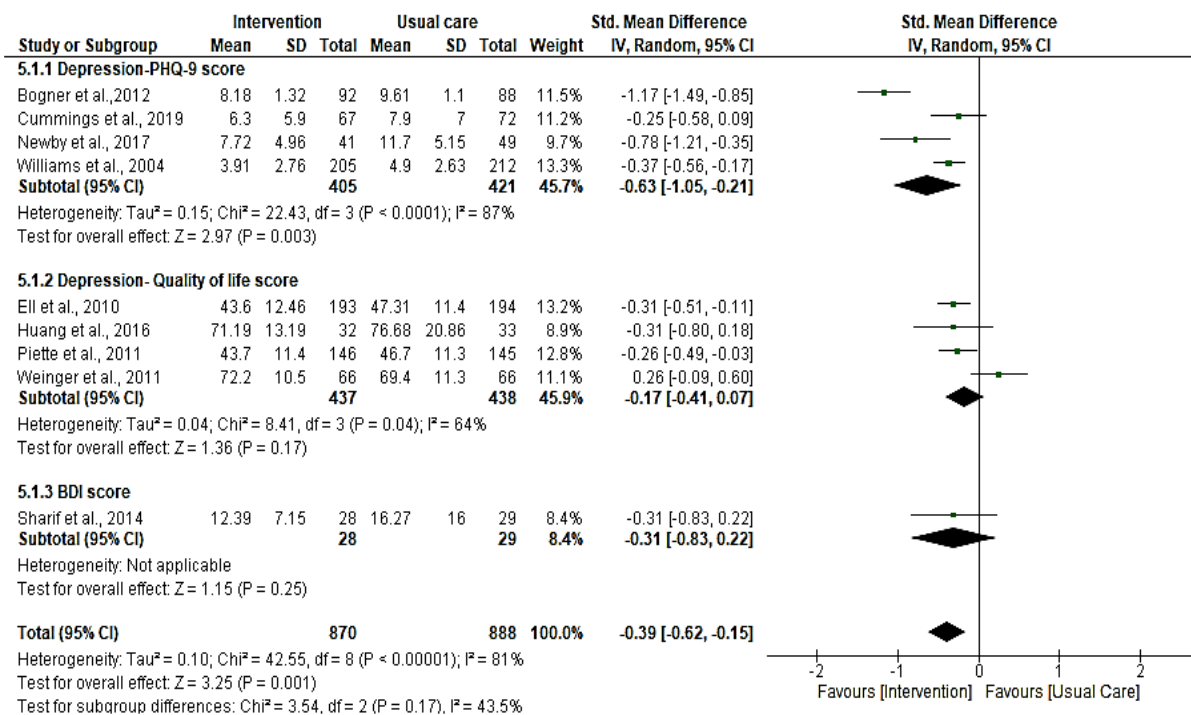


Figure 5. Forest plot showing depression outcomes (PHQ-9© score, QoL©score, and BDI® score) intervention vs usual care [24, 28, 33-35].

Collaborative care, which combines psychological interventions and educational programs for patients dealing with both diabetes and comorbid depression, remains a relatively under-explored area. There is limited

research on its impact on clinical results and patient adherence. This meta-analysis indicates that multiple interventions are essential for sustaining adherence to long-term treatments in chronic conditions like diabetes.

Diabetes control

All 10 RCTs measured diabetes control through HbA1c levels, assessing changes between baseline and after the interventions. The central goal of the studies was to evaluate the efficiency of care interventions in improving adherence, as reflected in the outcomes related to both depression and diabetes control.

Out of the 10 studies, 6 reported improvements in HbA1c levels. Bogner *et al.* [28] observed that patients who were assigned to the integrated care intervention displayed better adherence to diabetes medication, and glycaemic control also improved, highlighting a connection between adherence and better diabetes management. In a similar vein, Cummings *et al.* [29] mentioned that participants in the intervention groups had an average reduction of 1.0% in HbA1c, aligning with the results of Lauffenburger *et al.* [27], who also concluded that high-intensity interventions were more effective than usual care in improving glycaemic control. Sharif *et al.* [30] and Weinger *et al.* [35] both noted significant changes in HbA1c within the intervention groups, with Sharif *et al.* [30] acknowledging uncertainty about the factors influencing these changes, such as patients' prior knowledge of the levels of their blood glucose due to ethical considerations. Similarly, Huang *et al.* [26] found statistically significant improvements in HbA1c ninety days post-intervention, suggesting both short- and long-term benefits of the intervention.

In contrast, four out of the 10 studies did not show any improvements in diabetes control after the interventions. Piette *et al.* [31] explained that while no changes were seen in HbA1c values, the baseline values were already relatively good, meaning they were unlikely to be affected by the intervention. The finding was similar to that of Williams *et al.* [33], who noted that patients had good glycaemic control at the start, so there was insufficient power to notice small changes in HbA1c, resulting in no observed improvement in either study. Similarly, Newby *et al.* [32] and Ell *et al.* [34] found no effects on HbA1c levels, with the intervention group showing a rise in levels compared to the usual care group. Both of the studies used patient self-reporting to measure HbA1c, which could have contributed to the lack of observed improvements.

Depression control

Out of the 10 studies, 8 demonstrated a reduction in depressive symptoms after the intervention. Bogner *et al.* [28] found that individuals with diabetes who also suffer

from depression are more likely to be non-adherent to their medication regimens, including both antidepressants and diabetes medications, compared to non-depressed patients. Cummings *et al.* [29] proposed that individuals with T2DM are twice as likely to experience depressive symptoms, and suggested that the relationship between diabetes and depression might be bidirectional. Similarly, Shariff *et al.* [30] and Newby *et al.* [32] emphasized the importance of proactively identifying and treating depression in patients with T2DM, noting that untreated depression can worsen diabetes control, leading to poor blood glucose management. These studies all found improvements in depressive symptoms after the interventions. Two studies [26, 28] reported reductions in depression marks and improvements in quality of life immediately following the intervention, with Huang *et al.* [26] observing sustained improvements at a 90-day follow-up. Newby *et al.* [32] and Williams *et al.* [33] reported similar findings, where patients showed less severe depression and notable improvements in overall functioning when compared to usual care, with significant progress from baseline to post-intervention. In contrast, Weinger *et al.* [35] found no improvement in depression outcomes. As this discrepancy was not observed in the other studies, it may be attributed to factors unrelated to the intervention's effectiveness.

Adherence

Adherence is consistently recognized as a critical factor influencing clinical outcomes in chronic diseases [37]. Whole studies examined the effect of depression interventions on medication adherence and overall improvements in clinical results. Weinger *et al.* [35] highlighted that one of the key reasons for poor glycaemic control is patients' difficulty in adhering to treatment and self-management guidelines. This challenge is closely tied to adherence, as a patient's inability to follow their treatment plan directly impacts their disease management. Lauffenburger *et al.* [27] suggested that focusing on adherence for patients who are most likely to benefit from interventions could enhance treatment efficacy, though this approach has not been extensively studied.

Newby *et al.* [32] proposed that depression might be a significant contributor to reduced adherence, while Ell *et al.* [34] examined how integrating care for both depression and diabetes might improve adherence for patients with both conditions. Bogner *et al.* [28] also

supported this view, emphasizing that while pharmacological treatments are effective, many patients fail to adhere to them—especially those with comorbid diabetes and depression, hypothesizing that integrating care for both conditions through interventions could improve adherence.

Cummings *et al.* [29] proposed that depression symptoms contribute to poor adherence, and the findings indicated significant reductions in depression symptoms, which led to improvements in medication adherence. In a similar vein, Huang *et al.* [26] observed that the intervention group experienced increased adherence rates, as significant improvements in psychological well-being helped enhance diabetes management, reflected in better glycemic control. Sharif *et al.* [30] noted that while CBT has shown effectiveness in treating depression, it remains underutilized in cases of depression linked to physical health conditions. However, it is beneficial for diabetic patients, with improvements in adherence evident in this study's results.

On the other hand, Piette *et al.* [31] saw considerable improvement in depression symptoms, but this did not translate into better medication adherence, as no significant differences were noted. Medication adherence was evaluated using the Morisky© medication adherence scale. This raises the question of whether improving depression symptoms directly impacts medication adherence, especially since there was no observed change in glycemic control. Similarly, Williams *et al.* [33] hypothesized that treating depression could improve adherence to self-care routines, leading to better diabetic control. While patients reported almost perfect medication adherence, they showed lower adherence to glucose testing and foot inspections. The discrepancy might be explained by the measurement for these behaviors, which exhibited ceiling effects, suggesting that participants already had high adherence scores for medication, leaving less room for improvement.

Cognitive Behavioral Therapy (CBT) is a well-established psychological treatment known for its effectiveness in treating depression by helping individuals alter their thinking and behaviors [38]. Among the 10 studies included, 6 utilized CBT as an intervention to evaluate its impact on improving adherence and, consequently, clinical outcomes. Cummings *et al.* [29] highlighted that an integrated care model combining CBT with lifestyle counseling for patients with type 2 diabetes (T2D) is practical in primary care settings and holds significant potential for positive

outcomes. Newby *et al.* [32] examined the effectiveness of online CBT (iCBT), noting that it is just as effective as face-to-face CBT while being more cost-efficient and requiring less clinical time. CBT has been shown to improve patients' well-being by encouraging them to engage in enjoyable activities and discuss their mental health, enabling them to apply self-management strategies to enhance adherence and reduce depressive symptoms [29].

The remaining studies focused on educational interventions, using counseling and collaborative care approaches. These studies emphasized the importance of physicians providing education and personalized guidance to participants. For instance, Bogner *et al.* [28] concentrated on addressing subjective factors that might influence adherence, ensuring these were incorporated into the intervention. Additionally, Piette *et al.* [31] found that telephone-based CBT led to higher depression remission rates (58%) compared to usual care (39%).

Risk of bias and study outcomes

The bias risk was assessed with 4 studies identified as having a higher risk of bias [26, 31, 35, 36]. These studies displayed inconsistencies in their findings. For instance, Piette *et al.* [31] and Williams *et al.* [33] were the only studies where no improvement, or even a decline, in glycemic control was observed. Both studies recorded a Standardized Mean Difference (SMD) of less than 0.01. Additionally, Weinger *et al.* [35], which had the highest risk of bias, was the one study that did not show any improvement in depression outcomes.

Huang *et al.* [26] suggested that combining motivation enhancement therapy with Cognitive Behavioral Therapy (CBT) could improve both HbA1c levels and depressive symptoms. Their intervention aimed at enhancing patients' motivation for self-care and introduced coping strategies to deal with hyperglycemia and other symptoms. The results showed significant improvements in both diabetes and depression management.

Lauffenburger *et al.* [27] focused on delivering high-intensity insulin adherence interventions for individuals with type 2 diabetes. These interventions included a weekly text message program and regular phone consultations aimed at reminding patients to take their medication. Their findings indicated that intensive interventions led to better glycemic control compared to less intense approaches.

Limitations

There were several limitations in this analysis. Firstly, the use of combined data from multiple RCTs revealed inconsistencies in the outcomes, particularly in measuring depression. Different psychometric tools were employed across studies to assess depression in participants, which may have contributed to the observed high heterogeneity.

Another limitation stemmed from the variety of interventions used across studies. Some studies focused on collaborative care, while others examined psychotherapy. Although the goal was to assess these different interventions, the approaches varied widely—some involved nurses conducting counseling and educational sessions, while others used doctors and pharmacists. Additionally, the number of intervention sessions differed across studies, potentially introducing bias into the results.

This review included just 10 RCTs, with a total of 5759 participants, but all studies—except for Lauffenburger *et al.* [27]—had relatively small sample sizes, and most were conducted in the USA. As a result, the findings may not be generalizable to the broader population. Furthermore, many of the studies used in this analysis were behind paywalls, and no funding was available to access them.

Four studies included data for both Type 1 and Type 2 diabetes, which might have diluted the focus on Type 2 diabetes, the primary subgroup of interest. Additionally, some studies relied on self-reported data for measuring depression symptoms and HbA1c levels, which could have introduced detection bias, as noted in the bias summary (Figures 3 and 4).

Finally, the lack of subgroup analysis comparing short-term versus long-term effects is another limitation. Only long-term effects were analyzed, and exploring both could have helped identify how interventions perform over time and when their effects typically begin to show.

Conclusion

This study aimed to evaluate the impact of psychological (CBT) and educational interventions on clinical outcomes related to depression and diabetes, with a focus on adherence, as measured by improvements in both conditions. The results for diabetes control were mixed, with six out of ten studies showing improvements in HbA1c levels in the intervention groups compared to usual care. However, four studies did not show any

significant change, with some even reporting an increase in HbA1c values in the intervention groups.

Regarding depression, eight out of the nine studies demonstrated notable improvements in depression symptoms in the intervention groups when compared to the control groups, with only one study showing no change.

These results suggest that interventions involving psychological and educational approaches can have a positive effect on depression, which in turn appears to improve diabetes management, as indicated by the improvements in HbA1c control. This supports a connection between better mental health and improved adherence to diabetes management.

Future research should focus on evaluating the cost-effectiveness of these interventions by comparing the costs and outcomes of the psychological and educational approaches to usual care. Additionally, it would be beneficial to study the long-term effects of consistent CBT or educational programs to better understand their impact over time. Another important recommendation is to implement regular depression screenings for all diabetic patients to detect and manage early signs of depression, which may help prevent the development of more severe symptoms that could hinder treatment adherence.

In conclusion, adherence is a multifaceted process and should not be treated as a one-time event. Therefore, adherence support should be integrated into all healthcare consultations for diabetic patients, whether or not they have comorbid depression.

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