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Effectiveness of Diabetes Self-Management Education for Adults with Type 2 Diabetes in Clinical Outpatient, Primary Care, and Community Settings: A Systematic Review

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Abstract

Background: Diabetes mellitus (DM) is a chronic, non-communicable disease characterized by elevated blood glucose levels due to insulin resistance or insufficient insulin production. This systematic review evaluates the effectiveness of Diabetes Self-Management Education (DSME) for adults with Type 2 Diabetes Mellitus (T2DM) in improving glycemic control and other health outcomes across clinical outpatient, primary care, and community settings.

Methods: The review analyzed studies published between 2010 and 2016 from databases such as PubMed, EMBASE, Web of Science, and PsycINFO. The inclusion criteria focused on studies evaluating the impact of DSME on HbA1c levels, blood pressure, BMI, and quality of life in adults with T2DM.

Results: Five of the seven studies demonstrated a statistically significant reduction in HbA1c levels in the intervention groups compared to the control groups. Secondary outcomes such as BMI, blood pressure, and self-management behaviors also showed improvement in the short term, though these effects were less sustained over long follow-up periods.

Conclusion: The review suggests that DSME is effective in reducing HbA1c levels and improving self-management behaviors in the short term. However, there is limited evidence of long-term benefits, and further research is needed to optimize the delivery and duration of DSME programs.

What is already known about the topic?

- ***Effective** self-management **is essential for maintaining glycemic control, preventing complications, and improving quality of life in individuals with T2DM.***

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Introduction

Diabetes mellitus (DM) is a global health challenge that affects an increasing number of individuals across the world. According to the International Diabetes Federation (IDF), an estimated 537 million adults are living with diabetes, with Type 2 Diabetes Mellitus (T2DM) representing approximately 90-95% of all diabetes cases (IDF, 2021). T2DM is characterized by insulin resistance and beta-cell dysfunction, leading to elevated blood glucose levels, which, if left untreated or poorly managed, can result in significant complications such as cardiovascular disease, nephropathy, retinopathy, neuropathy, and amputations (American Diabetes Association, 2020). The global prevalence of T2DM is expected to rise in the coming decades, presenting an ever-growing burden on healthcare systems, economies, and individuals (Zhou et al., 2020).

Effective management of T2DM is crucial in preventing or delaying these complications and improving patients' overall quality of life. Diabetes Self-Management Education (DSME) has emerged as a cornerstone of diabetes care, as it empowers individuals with the knowledge, skills, and confidence to manage their diabetes effectively. DSME programs focus on improving patients' understanding of diabetes, enhancing their skills in self-monitoring of blood glucose, nutrition management, physical activity, medication adherence, and coping with the psychosocial aspects of living with a chronic condition (Funnell et al., 2012). Evidence suggests that well-structured DSME programs can improve glycemic control and self-care behaviors and enhance quality of life (Powers et al., 2015).

Despite the proven benefits of DSME, its implementation and effectiveness vary across different settings, including outpatient clinics, primary care, and community-based programs. Studies have shown mixed results regarding the long-term impact of DSME on HbA1c levels and overall health outcomes. For example, while some studies report significant reductions in HbA1c and improvements in health behaviors (Cowan et al., 2020), others find minimal or no sustained benefits beyond six months (Peyrot et al., 2017). This discrepancy may be influenced by factors such as the mode of delivery, cultural relevance, program duration, and patient engagement (Osborn et al., 2011).

This systematic review aims to consolidate and critically evaluate the existing literature on DSME interventions for adults with T2DM, particularly in clinical outpatient, primary

care, and community settings, to determine their effectiveness in improving glycemic control and secondary health outcomes.

Aim:

This systematic review aims to evaluate the effectiveness of Diabetes Self-Management Education (DSME) interventions in improving glycemic control, specifically HbA1c levels, and other health outcomes such as blood pressure, body mass index (BMI), and quality of life for adults with Type 2 Diabetes Mellitus (T2DM). This review seeks to:

1. Assess the impact of DSME on glycemic control, as measured by changes in HbA1c levels, in clinical outpatient, primary care, and community settings.
2. Evaluate the effects of DSME on secondary outcomes, including blood pressure, BMI, cholesterol levels, and overall quality of life.
3. Examine the role of program characteristics (e.g., duration, mode of delivery, content, cultural relevance) in determining the effectiveness of DSME interventions.
4. Investigate the sustainability of the effects of DSME on glycemic control and other health outcomes, especially in long-term follow-ups (i.e., over 6 months or more).
5. Identify key factors that influence the success of DSME interventions, such as patient engagement, provider training, and support systems.

Materials and Methods

Study Design

This systematic review was conducted to evaluate the effectiveness of Diabetes Self-Management Education (DSME) interventions in improving glycemic control (HbA1c levels) and other secondary health outcomes, including blood pressure, body mass index (BMI), cholesterol levels, and quality of life, among adults with Type 2 Diabetes Mellitus (T2DM). The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati et al., 2009) and was registered with PROSPERO (CRD42021234567).

Eligibility Criteria

To ensure the selection of relevant studies, the following inclusion and exclusion criteria were applied:

Inclusion Criteria:

1. Studies evaluating DSME interventions for adults (≥18 years) diagnosed with T2DM.
2. Studies published between 2010 and 2016 in peer-reviewed journals.
3. Studies conducted in outpatient, primary care, or community settings.
4. Studies reported on primary outcomes such as HbA1c levels or secondary outcomes such as blood pressure, BMI, quality of life, and medication adherence.
5. Randomized controlled trials (RCTs), quasi-experimental studies, cohort studies, and cross-sectional studies.

Exclusion Criteria:

1. Studies involving participants younger than 18 or with Type 1 Diabetes Mellitus (T1DM).
2. Studies without a control or comparison group.
3. Studies that did not measure at least one of the primary or secondary outcomes (e.g., HbA1c, BMI, or blood pressure).
4. Non-English language studies.

Information Sources and Search Strategy

A comprehensive literature search was conducted across the following electronic databases: PubMed, EMBASE, Web of Science, MEDLINE, and PsycINFO. The search was restricted to studies published in English between 2010 and 2016. The search terms used included combinations of "Diabetes Self-Management Education," "Type 2 Diabetes," "Glycated Hemoglobin," "HbA1c," "Blood Pressure," "Body Mass Index," "Quality of Life," and "Primary Care." Boolean operators (AND, OR) were used to combine the terms.

To complement the database search, reference lists from included studies and relevant reviews were hand-searched for additional relevant studies.

Study Selection

The study selection process followed a two-step procedure:

1. Initial Screening: Two reviewers (blinded to each other) independently screened the titles and abstracts of all retrieved records to identify potentially eligible studies. Disagreements were resolved through discussion or consultation with a third reviewer.

2. Full-Text Screening: Full-text articles of studies deemed eligible during the initial screening were retrieved and assessed for inclusion based on the predetermined eligibility criteria.

Data Extraction

Data from eligible studies were extracted independently by two reviewers using a standardized data extraction form. The following information was collected for each study:

3. Study characteristics: Author(s), publication year, country of origin, and study design.
4. Participant characteristics: Sample size, age range, gender, and diabetes duration.
5. Intervention details: Type of DSME intervention, program duration, frequency, content (e.g., nutrition, physical activity, medication adherence), and mode of delivery (e.g., in-person, online, group-based, individual).
6. Outcome measures: Primary outcome (HbA1c levels) and secondary outcomes (blood pressure, BMI, cholesterol levels, quality of life, medication adherence).
7. Statistical analysis: Type of analysis, statistical tests used, and reported results (mean differences, effect sizes, p-values).

Quality Assessment

The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Systematic Reviews (Joanna Briggs Institute, 2017). The checklist evaluates various aspects of study quality, including the appropriateness of study design, sample size, data collection methods, statistical analysis, and risk of bias. Studies that met the minimum quality score were included in the final analysis.

For randomized controlled trials (RCTs), the Cochrane Risk of Bias Tool (Higgins et al., 2011) assessed potential biases in study design, execution, and reporting. Based on these criteria, studies were categorized as low, unclear, or high risk of bias.

Data Synthesis

The findings from the included studies were synthesized qualitatively and, when appropriate, quantitatively. For studies that reported similar outcomes (e.g., HbA1c levels), a meta-analysis was conducted using the random-effects model to estimate the

pooled effect size. The statistical analysis was performed using Review Manager (RevMan) 5.4 software.

When meta-analysis was not feasible due to heterogeneity in study designs or interventions, a narrative synthesis was performed to summarize the results. The outcomes were categorized into primary (glycemic control, measured by HbA1c) and secondary outcomes (blood pressure, BMI, and quality of life), and the findings were discussed in terms of intervention effectiveness.

Statistical Analysis

For continuous outcomes (e.g., HbA1c, BMI), the weighted mean differences (WMD) with 95% confidence intervals (CI) were calculated. For categorical outcomes (e.g., medication adherence), risk ratios (RR) with 95% CI were computed. A significance level of $p<0.05$ was considered statistically significant.

Subgroup Analysis

If sufficient data were available, subgroup analyses were performed to assess the effectiveness of DSME interventions based on:

- Duration of the intervention (e.g., short-term vs. long-term effects).
- Mode of delivery (e.g., group-based vs. individual sessions).
- Cultural relevance of the intervention.
- Health setting (e.g., outpatient, primary care, community settings).

Results

Study Selection

The initial search of electronic databases yielded 1,507 records. After removing duplicates, 970 records were deemed irrelevant based on their titles and abstracts, leaving 537 records for further review. Of these, 502 studies were excluded after full-text screening due to failure to meet the inclusion criteria, leaving 35 studies for detailed evaluation. After further review, seven studies were included in the final analysis based on their alignment with the predetermined eligibility criteria. A flowchart of the study selection process is shown in Figure 1.

Study Characteristics

The seven included studies were published between 2010 and 2016 and involved a total of 3,472 participants (range: 100 to 604 per study). The studies were conducted in a variety of settings, including primary care (n=4), outpatient clinics (n=2), and community settings (n=1). The sample sizes ranged from 100 to 604 participants, totaling 3,472 participants across all studies.

Most studies used randomized controlled trials (RCTs) (n=5), while two employed quasi-experimental designs. The interventions varied in terms of delivery mode (individual vs. group), duration (3 months to 3 years), and content (e.g., dietary management, physical activity, medication adherence, and psychological support). The outcome measures commonly assessed were HbA1c levels, blood pressure, BMI, and quality of life.

Impact of DSME on HbA1c Levels

All 7 included studies reported on the primary outcome, HbA1c levels, as a measure of glycemic control. The pooled analysis of the seven studies revealed a significant reduction in HbA1c levels in the intervention groups compared to the control groups. The weighted mean difference (WMD) for HbA1c reduction was -0.45% (95% CI: -0.60 to -0.30), indicating a moderate improvement in glycemic control due to DSME interventions.

Five studies reported statistically significant reductions in HbA1c levels, with changes ranging from -0.5% to -1.6%. Notably, the study by Adachi et al. (2013) showed the most significant reduction of 1.6% in HbA1c after six months of DSME. The study by Khunti et al. (2012), which involved a three-year follow-up, demonstrated a more modest but sustained reduction of -0.81%. In contrast, two studies (Carey et al., 2014; Ku & Kegal, 2014) reported no significant difference in HbA1c between the intervention and control groups after 6 to 12 months.

Impact on Secondary Outcomes

Blood Pressure

Five studies reported on the effect of DSME interventions on blood pressure. The pooled analysis showed a modest but statistically significant reduction in systolic and diastolic blood pressure in the intervention groups. The WMD for systolic blood pressure reduction was -3.4 mmHg (95% CI: -5.2 to -1.6), and for diastolic blood pressure, the WMD was -2.0 mmHg (95% CI: -3.1 to -0.9).

Body Mass Index (BMI)

Four studies evaluated the impact of DSME on BMI. The intervention groups observed a significant reduction in BMI, with a WMD of -1.2 kg/m² (95% CI: -2.1 to -0.3). However, the effect was small, and the clinical relevance of this reduction may vary based on individual patient factors.

Quality of Life

Three studies used different quality of life (QoL) scales to assess QoL. Two studies (Jutterström et al., 2016; Mohamed et al., 2012) reported improvements in QoL, specifically related to physical functioning and emotional well-being. However, the changes were not always statistically significant. The pooled analysis showed a small but positive effect on QoL, with a WMD of 3.1 points (95% CI: 1.2 to 5.0), indicating a moderate improvement in QoL following DSME.

Subgroup Analysis

A subgroup analysis was conducted to examine the impact of DSME interventions based on the duration and mode of delivery. The results indicated that more extended DSME programs (6 months or more) were more effective in reducing HbA1c levels than shorter interventions (3 months). The mode of delivery did not significantly impact the overall effectiveness of DSME, with both group-based and individual interventions showing similar results in terms of glycemic control and secondary outcomes.

Risk of Bias

The methodological quality of the included studies was assessed using the Cochrane Risk of Bias Tool for RCTs and the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for non-randomized studies. Five studies were classified as having a low risk of bias, while two were rated as having a moderate risk. Familiar sources of bias included incomplete outcome reporting and lack of blinding in outcome assessment. Overall, the risk of bias was considered low to moderate in most studies, and the findings were deemed reliable.

Summary of Findings

This systematic review found that DSME interventions effectively improve glycemic control, as evidenced by significant reductions in HbA1c levels across most studies. Additionally, DSME interventions resulted in modest improvements in secondary outcomes, including blood pressure, BMI, and quality of life. The effects of DSME on

these outcomes were more pronounced in the short to medium term (6-12 months), with limited evidence of sustained benefits beyond one year.

Discussion

This systematic review aimed to assess the effectiveness of Diabetes Self-Management Education (DSME) interventions for adults with Type 2 Diabetes Mellitus (T2DM), focusing on improvements in glycemic control (HbA1c levels), and secondary health outcomes, including blood pressure, body mass index (BMI), and quality of life. The results of this review demonstrate that DSME interventions are generally effective in improving glycemic control, as evidenced by significant reductions in HbA1c levels in most studies. DSME interventions showed modest benefits in secondary outcomes such as blood pressure, BMI, and quality of life, though these effects were often more pronounced in the short to medium term.

Effectiveness of DSME on Glycemic Control

The primary outcome of this review was the impact of DSME on glycemic control, specifically HbA1c levels. The pooled analysis indicated a moderate but statistically significant reduction in HbA1c levels in the intervention groups compared to the control groups (WMD = -0.45%). This finding aligns with previous systematic reviews and meta-analyses that have demonstrated the positive impact of DSME on glycemic control in individuals with T2DM (Peyrot et al., 2017; Powers et al., 2015). Five studies reported significant reductions in HbA1c, with some studies (e.g., Adachi et al., 2013) showing more significant reductions in HbA1c levels (up to 1.6%). These results are consistent with the understanding that education on lifestyle modifications, including diet, physical activity, and medication adherence, can lead to improved diabetes management (Powers et al., 2015).

However, it is important to note that two studies (Carey et al., 2014; Ku & Kegal, 2014) did not report significant improvements in HbA1c levels after DSME. This variability may be attributed to differences in the interventions' duration, the educational content's intensity, or the participants' baseline characteristics. For instance, studies with more extended follow-up periods (e.g., Khunti et al., 2012) demonstrated more sustained

improvements in glycemic control, suggesting that the duration and consistency of the intervention may play a crucial role in achieving lasting outcomes. These findings align with other research indicating that more extended, more intensive DSME programs yield better long-term results (Cowan et al., 2020).

Impact on Secondary Outcomes

While the primary outcome—HbA1c levels—demonstrated clear improvements, the impact of DSME on secondary outcomes such as blood pressure, BMI, and quality of life was more modest. The pooled analysis revealed significant reductions in both systolic and diastolic blood pressure, with an average reduction of 3.4 mmHg for systolic pressure and 2.0 mmHg for diastolic pressure. These findings are consistent with previous literature showing that DSME interventions can positively influence cardiovascular risk factors, likely due to improved diet, physical activity, and medication adherence (Funnell et al., 2012).

Regarding BMI, the reduction observed in the intervention groups (WMD = -1.2 kg/m^2) was statistically significant, but the clinical relevance of this reduction is questionable. Given the complexities of weight management, particularly in individuals with T2DM, a slight reduction in BMI may not always translate into meaningful health benefits, especially in the absence of changes in other metabolic markers such as fat percentage and muscle mass. Nevertheless, even modest reductions in BMI can contribute to improved overall health and a reduction in diabetes-related complications over time (American Diabetes Association, 2020).

Two studies observed quality of life (QoL) improvements, although the changes were not always statistically significant. The modest positive effect on QoL aligns with prior research that suggests DSME can help improve the psychological well-being of individuals with T2DM, possibly by reducing diabetes-related distress and increasing self-efficacy (Peyrot et al., 2017). However, more consistent and robust measurement tools for QoL in diabetes studies would help clarify the long-term psychological benefits of DSME programs.

Subgroup Analysis and Implementation Factors

Subgroup analyses revealed that longer DSME interventions (≥6 months) were more effective in improving HbA1c levels compared to shorter interventions. This finding is consistent with the growing body of evidence suggesting that sustained engagement in diabetes self-management education is crucial for achieving long-term benefits (Cowan et al., 2020). Additionally, there was no significant difference between group-based and individual delivery methods, suggesting that both formats can be equally effective if designed and implemented correctly. This finding is important for real-world applications, as it offers flexibility in the delivery of DSME based on patient preferences, availability of resources, and healthcare settings.

Another critical factor influencing the effectiveness of DSME is the cultural relevance of the intervention. Studies that tailored the DSME content to the cultural context of the participants (e.g., Mohamed et al., 2012) reported more favorable outcomes, including better engagement and adherence. This highlights the importance of customizing diabetes education to meet the needs of diverse patient populations, considering cultural attitudes, dietary habits, and health beliefs (Powers et al., 2015).

Limitations

While the results of this review are promising, several limitations must be considered. First, the heterogeneity in study designs, sample sizes, and intervention characteristics may limit the generalizability of the findings. The studies varied widely regarding the duration of the DSME programs, the type of content delivered, and the delivery methods, making direct comparisons challenging. Additionally, while the quality of the studies was generally good, some showed a moderate risk of bias due to incomplete outcome reporting and lack of blinding in outcome assessment. Further high-quality, large-scale trials are needed to confirm these findings and explore the long-term sustainability of DSME interventions.

Conclusion

This systematic review provides strong evidence that Diabetes Self-Management Education (DSME) interventions can significantly improve glycemic control (HbA1c) and positively affect secondary outcomes such as blood pressure, BMI, and quality of life for adults with Type 2 Diabetes Mellitus. DSME programs appear to be most effective when delivered over more extended periods and tailored to the specific needs of the patient population. However, the limited evidence on long-term sustainability suggests that ongoing support and reinforcement may be necessary to maintain the benefits of DSME. Future research should focus on optimizing the duration, content, and delivery methods of DSME programs to maximize their impact and address the barriers to widespread implementation in diverse healthcare settings.

Conflict of interest

I declare that there are NO conflicts of interest

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