

Integrating mindfulness and physical activity for diabetes prevention and management: systematic review

Integración de la atención plena y la actividad física para la prevención y el tratamiento de la diabetes: revisión sistemática

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Abstract. Background: Urgent need lies in the development of more effective and holistic interventions that encompass both the physical and psychological dimensions of diabetes. The aim of this study was to investigate the effectiveness of integrating mindfulness and physical activity in the prevention and management of diabetes. Method: The systematic review of existing literature aims to highlight the importance of a deeper understanding of the relationship between mindfulness and physically active activities in the context of diabetes prevention and managing. Result: The results of this systematic review highlight multiple beneficial outcomes, including improvements in psychological well-being and diabetes management, holistic care, parasympathetic activity, insulin resistance, stress reduction, self-management, and mindful eating. Conclusion: The findings advocate for the adjunctive use of mindfulness-based interventions like mindfulness based stress reduction (MBSR), MBCT, and MB-EAT in diabetes care, offering avenues to mitigate stress, bolster self-management, and potentially augment diabetes care through enhanced self-efficacy, knowledge, and communication.

Keywords: Self-Management, Mindfulness, Insulin Resistance, Psychological Well-Being, Self Efficacy, Exercise, Aging

Resumen. Antecedentes: La necesidad urgente radica en el desarrollo de intervenciones más efectivas y holísticas que abarquen las dimensiones física y psicológica de la diabetes. El objetivo de este estudio fue investigar la eficacia de integrar la atención plena y la actividad física en la prevención y el tratamiento de la diabetes. Método: La revisión sistemática de la literatura existente tiene como objetivo resaltar la importancia de una comprensión más profunda de la relación entre la atención plena y las actividades físicamente activas en el contexto de la prevención y el control de la diabetes. Resultado: Los resultados de esta revisión sistemática destacan múltiples resultados beneficiosos, incluidas mejoras en el bienestar psicológico y el control de la diabetes, atención holística, actividad parasimpática, resistencia a la insulina, reducción del estrés, autocontrol y alimentación consciente. Conclusión: Los hallazgos abogan por el uso complementario de intervenciones basadas en la atención plena, como la reducción del estrés basada en la atención plena (MBSR), MBCT y MB-EAT en la atención de la diabetes, ofreciendo vías para mitigar el estrés, reforzar el autocontrol y potencialmente aumentar la atención de la diabetes a través de una mejor atención. Autoeficacia, conocimiento y comunicación.

Palabras clave: Autocuidado, Mindfulness, Resistencia a la Insulina, Bienestar Psicológico, Autoeficacia, Ejercicio, Envejecimiento

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Introduction

Diabetes prevention and management is the lack of effective and comprehensive interventions that address both the physical and psychological aspects of the disease (Jiang et al., 2024). While numerous studies have explored the effects of mindfulness interventions on glycemic control and psychological outcomes in individuals with diabetes, the overall quality of these studies is often subpar, leaving the true effectiveness of mindfulness in diabetes management uncertain (Humiston et al., 2024). Moreover, the rising prevalence of obesity and sedentary lifestyles has contributed to the increasing incidence of type 2 diabetes, underscoring the urgent need for interventions that promote healthy lifestyles and enhance overall well-being. Integrating mindfulness with physical activity offers a promising approach to addressing this challenge, as these components can synergistically improve glycemic control, alleviate stress and depression, and enhance self-management skills among individuals with diabetes (Cangelosi et al., 2024). However, the scarcity of high-quality randomized controlled trials (RCTs) hampers the ability to draw definitive conclusions regarding the efficacy of mindfulness for diabetes management, highlighting the

imperative for further research in this domain (Zeinabeh et al., 2023). In summary, the pressing need lies in the development of more effective and holistic interventions that encompass both the physical and psychological dimensions of diabetes, with a particular emphasis on integrating mindfulness and physical activity to optimize glycemic control and overall health outcomes (Hamasaki, 2023).

The global prevalence of diabetes is projected to reach 780 million by 2045, with significant implications for public health and healthcare systems worldwide. In Asia, the number of people with diabetes is expected to increase by 70% by 2030, and in Indonesia, the prevalence of diabetes has more than doubled in the past decade. Given these trends, there is an urgent need for innovative and effective strategies to address the challenges posed by diabetes in these regions. This research contributes to the ongoing discourse on the potential benefits of combining mindfulness and physical activity in the context of diabetes prevention and management, with implications for both clinical practice and public health policy in Asia and Indonesia (Patra et al., 2023). Previous research has highlighted the effectiveness of mindfulness interventions in improving blood sugar control and well-being in diabetes

patients. A recent study showed that a mindfulness intervention integrated into a diabetes self-management education and support program can improve diabetes distress and reduce body weight in patients with prediabetes (Fisher et al., 2023). In addition, other studies have shown that mindfulness training combined with aerobic exercise has a significant therapeutic effect in patients with type 2 diabetic peripheral neuropathy, improving neurological function and quality of life of patients. These findings provide a strong basis for considering the integration of mindfulness and physical activity in diabetes prevention and management efforts, highlighting the potential of this holistic intervention in improving the physical and mental health of diabetes patients (Weng et al., 2022).

Additionally, bibliometric research shows that interest in mindfulness interventions in diabetes management is increasing, with an increase in the number of publications between 2011 and 2023. These studies highlight the importance of developing holistic and sustainable interventions to improve the quality of life of diabetes patients (Koerner & Rechenberg, 2022). The results of this study provide a strong basis for considering an integrated approach between mindfulness and physical activity in diabetes prevention and management efforts. By focusing on the effectiveness of mindfulness interventions in improving blood sugar control, reducing diabetes distress, and improving patient quality of life, these studies provide valuable insights for the development of comprehensive and sustainable care programs for individuals with diabetes (Inverso et al., 2022).

Previous research also shows that mindfulness interventions integrated with physical activity can help improve the well-being of patients with diabetes. A study shows that a mindfulness intervention integrated with physical activity can help improve well-being (Yeo et al., 2022). The aim of this study was to investigate the effectiveness of integrating mindfulness with physical activity in the prevention and management of diabetes (Bao, 2022). By conducting a systematic review of existing literature, this research also aims to highlight the importance of a deeper understanding of the relationship between mindfulness and physical activity in the context of diabetes prevention and management, as well as providing guidance for health practitioners in developing more effective strategies in overcoming the challenge of diabetes which continues to increase. By strengthening existing scientific evidence, it is hoped that this research will pave the way for the development of more innovative and effective interventions in fighting the global diabetes epidemic.

Method

The PRISMA guidelines for systematic reviews were employed for the conduct of the literature search following a systematic and structured approach. The Population -

intervention-comparison-outcome (PICO) strategy was used to identify the key words used (Table 1) The article search strategy utilizes databases accessible through the National Library of Indonesia's electronic resources, such as SportDiscus, Scopus, Web of Science, EBSCO, Google Scholar, PubMed, Research Gate, and Springer Link. Athlete Performance and Mental Toughness, Mental Toughness and Mindfulness are search terms for articles. "AND" is used as a Boolean operator by researchers. The purpose of using "AND" as a boolean operator is to combine various concepts and aspects as search keywords in order to narrow down the searchable documents.

Inclusion criteria

1. Studies evaluating the effectiveness of integrating mindfulness (either in the form of mindfulness meditation or mindfulness-based therapy) with physical activity (such as aerobic exercise, resistance training, or a combination of both) in the prevention or management of diabetes.
2. Studies that include participants who are at high risk for developing diabetes (for example, prediabetic individuals or with a family history of diabetes) or those who have been diagnosed with type 2 diabetes.
3. Studies that present results related to clinical parameters of diabetes, such as reduced blood sugar levels, improved insulin sensitivity, reduced body weight, or lifestyle changes that support diabetes management.
4. Research with an experimental design (e.g., randomized clinical trials, cohort studies) or quasi-experimental design that allows evaluation of the effectiveness of mindfulness and physical activity interventions.
5. Studies published in peer-reviewed scientific journals.

Exclusion criteria

1. Studies that are not relevant to the integration of mindfulness and physical activity in the context of diabetes prevention or management.
2. Studies that did not have an intervention group that used a combination of mindfulness and physical activity or did not present evaluable outcomes related to the intervention.
3. Studies that only consider one aspect, be it mindfulness or physical activity, without integrating the two.
4. Reviews, editorials, or other writings that are not the result of primary research.
5. Studies that are not available in English.

To preserve the quality of the systematic review, the authors mention ethical considerations, such as avoiding duplicate publications, avoiding plagiarism, maintaining transparency, and ensuring accuracy. The search for articles utilized multiple databases and e-resources of the National Library of Indonesia (176), EBSCO (67), Google Scholar (589), PubMed (144), Research Gate (149), and Springer

Link (49). 732 articles were retrieved at the outset of the search that matched the specified keywords. Non-full-text articles that discussed topics other than the use of mental fortitude in performance athletes, respondents in the study who were less than three years old or older than eighteen years old, and English-language articles. Consequently, 160 articles met the exclusion criteria. In addition, of the remaining 13 articles, The data analysis employed in this systematic review is a streamlined method. Data analysis is simplified by compiling each obtained article and simplifying each finding.

The steps of the Simplified approach analysis include summarizing each critical appraisal/critical review conducted concurrently to determine the strengths and weaknesses of the literature and to determine the relationship between one piece of literature and another, identifying themes from the results of each research in the literature, with the resulting themes being reflective of the research questions posed in the systematic review. Theme development by combining all the same themes and discussing the strengths of the findings by considering research results with stronger evidence or weaker evidence

by conducting critical appraisal at the outset, naming each theme taking into consideration the naming right on each theme by understanding the literature so that the names on the themes are closer to the results of the research on the literature, comparing and reviewing each theme (Table 3)

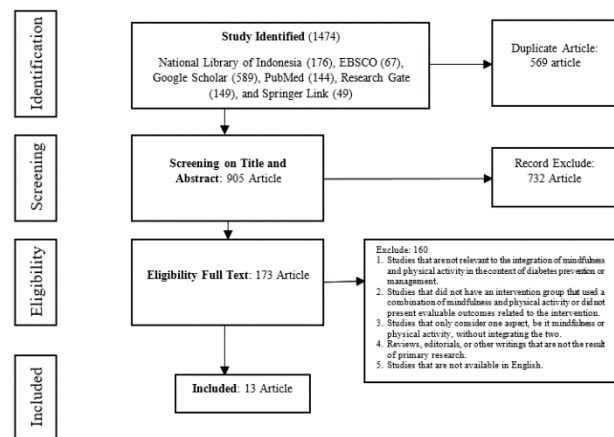


Figure 1. Flow Chart for Study based on PRISMA

Table 1.

Population, intervention, comparison, outcome (PICO) strategy and algorithms used for the systematic review

Population	Individuals at high risk for developing diabetes (e.g., prediabetic individuals or with a family history of diabetes) or those who have been diagnosed with type 2 diabetes.
Intervention	Integration of mindfulness with physical activity. This may include mindfulness meditation, mindfulness-based therapy, aerobic exercise, resistance training, or a combination of both.
Comparison	Standard of care policies or other interventions that do not involve the integration of mindfulness and physical activity, such as pharmacological treatment alone or lifestyle interventions that do not involve aspects of mindfulness.
Outcome	Clinical parameters of diabetes, such as reduced blood sugar levels, increased insulin sensitivity, weight loss, or lifestyle changes that support diabetes management.

Result

Integrating mindfulness practices with physical activity for diabetes prevention and management, the physiological mechanisms through which mindfulness and physical activity impact diabetes prevention and management, the

psychological effects of combining mindfulness and physical activity in the context of diabetes prevention and management, and the best practices for integrating mindfulness and physical activity into diabetes prevention and management programs.

Table 2.

Data analysis matrix table for articles used in the Systematic Review

Author, Title	Method Design	Variable being investigated	Sample size	Population	Results
Gagan Priya and Sanjay Kalra. Mind–Body Interactions and Mindfulness Meditation in Diabetes. <i>European Endocrinology</i> 2018 April, 14 (1): 35-41	A Literature Review	Mindfulness-based stress reduction and Diabetes	15+ articles	The terms 'meditation', 'mindfulness meditation', 'mindfulness', 'mindfulness-based stress reduction', from January 1984 to November 2017	Mindfulness-based strategies are simple and easy to grasp than physical activity. It offer positive benefits to help improve self-care behaviour, self-reliance and self-control, it would result in better quality of life in patients with diabetes
Wilson L. Medina, et al. Effects of Mindfulness on Diabetes Mellitus: rationale and overview. <i>Current Diabetes Reviews</i>	A narrative review	Mindfulness and diabetes mellitus	82 articles	The terms 'mindfulness' and 'diabetes mellitus' from January until September 2015	Mindfulness-based interventions can be as preventive and complementary interventions in DM, for the relief of depression and anxiety and also in the management for mindful eating, physical exercises, and their adherence so reduction in cortisol, albuminuria (renal), and improvement on HbA1c
Nikkhah Ravari, et al. Evaluation of	Randomized	Mindfulness-based stress	108 patients with	Patients with diabetes	The mindfulness meditation could

the Effects of 12 Weeks Mindfulness-Based Stress Reduction on Glycemic Control and Mental Health Indices in Women with Diabetes Mellitus Type 2. <i>Advanced Biomedical Research</i>	controlled clinical trial study	reduction on glyceimic control (fasting blood sugar and HbA1c) and mental health indices (anxiety, depression, and stress)	diabetes mellitus type 2	mellitus type 2	be helpful in improving the quality of mental health indices and lowering glyceimic control patients
Cheryl L, et al. A Mixed-Method, Randomized Clinical Trial to Examine Feasibility of a Mindfulness-Based Stress Management and Diabetes Risk Reduction Intervention for African Americans with Prediabetes. <i>Hindawi Evidance-Based Complementary and Alternative Medicine, Vol 2019; 1-16</i>	Quantitative and qualitative methods with randomized controlled clinical trial	Mindfulness-based diabetes risk-reduction education program (MPD), conventional diabetes risk-reduction education program (CPD), metabolic variables, stress, health behaviors, quality of life (spiritual well-being)	68 people	Patients with (pre)diabetes	Increased knowledge about strategies to improve health, including diet and exercise, changing their behaviors, incorporating new exercises, and stress reduction, reductions in BMI, increases in spiritual well-being, but no significant change in cortisol, waist-to-hip ratio, physical activity levels
Seongkum Heo et al. Effects of Meditation Intervention on Self-management in Adult Patients With Type 2 Diabetes. <i>The Journal of Cardiovascular Nursing</i>	-	Meditation interventions with self magement (control of glucose, blood pressure, cholesterol, obesity and self-management) among adults patients wit type 2 diabetes in randomized controlled trials	6	self-management during March 2022	Meditation improved hemoglobin but not fasting blood glucose and diabetes self-management
Sasikumar S & Padmapriya S, Beneficial effects of mindfulness based stress reduction (MBSR) on biophysiological and psychological parameters among type 2 diabetics, <i>Indian Journal of Traditional Knowledge</i>	True experiment with pre-test, post-test design	MBSR therapy, biophysiological and psychological	138 person with type 2 diabetics	Person with type 2 diabetes	MBSR had beneficial effect on HbA1C, blood pressure, BMI, stress, depression and mindfulness among participants in the intervention group
Dalpatadu et al. Effects of meditation on physiological and metabolic parameters in patients with type 2 diabetes mellitus "MindDM": study protocol for a randomized controlled trial. <i>Trials (2022) 23:821</i>	Open-label, Randomized control parallel group explanatory clinical trial	Meditation physiologicaland glycaemic control in patient with type 2 diabetes	172 patients	Patient with type 2 diabetes who are attending the professorial unit medical clinic at the National Hospital of Sri Lanka (NHSL)	Meditation intervention effect on glycaemic control (autonomic function and gut transit time)
Cynthia R Gross, Diane K, Reibel. Mindfulness: A Nonpharmacological Approach to Diabetes Management. <i>The Wiley Blackwell Handbook of Mindfulness (pp.898-912)</i>	Randomized trial	Mindfulness training and diabetes management (self-regulate emotions)	-	Patients with diabetes	Mindfulness training builds the capacity to self-regulate emotion (negative moods), gain self-compassion and openness, and increase their motivation to maintain healthful coping behaviors
SuvariPatra et al, Relationship of Mindfulness with Depression, Self-Management, and Quality of Life in Type 2 Diabetes Mellitus: Mindfulness is a Predictor of Quality of Life, <i>Indian Journal of Social Psychiatry</i>	Randomized controlled trial	Five Facets Mindfulness Questionnaire, Diabetes Self-Management Questionnaire, and World Health Organization QOL BREF questionnaire and Hamilton Rating Scale for depression	99 patients with type 2 diabetes	Patients with type 2 diabetes mellitus	Describing, acting with awareness, and nonjudging facets of mindfulness showed a negative correlation with depression ($P < 0.05$). Acting with awareness and nonreactivity to inner experience were positively correlated with the physical activity domains of self-management ($P < 0.05$). All facets of mindfulness showed a positive correlation with four domains of QOL. Mindfulness predicted the psychological domain of QOL, explaining 31% of the variance ($P \leq 0.001$).
Carla K. Miller. Mindful Eating With Diabetes. <i>Spectrum Diabetes Journals, Vol 30, Number 2, Spring 2017.</i>	Descriptive research	Mindfulness-Based Eating Awareness Training (MB-EAT) and diabetes self-management (habitual patterns of eating and behavior)	5 articles	People with type 2 diabetes who inconsistent with their goals and health needs	Mindful eating effective in improvement in dysregulated eating and dietary patterns, interrupt habitual eating behaviors and provide greater regulation of food-choice
Jan Novac et al, Participatory development of an mHealth intervention delivered in general practice to increase physical activity and reduce sedentary behaviour of patients with prediabetes and type 2 diabetes (ENERGISED). <i>BMC Public Health</i>	Randomized controlled trial	Mhealth intervention, physical activity, sedentary behaviour, diabetes mellitus	31 patients with (pre)diabetes patients	Patients with (pre)diabetes	The final intervention comprises six types of text messages, each embodying different behaviour change techniques. Some of the messages, such as those providing interim reviews of the patients' weekly step goal or feedback on their weekly performance, are delivered at fixed times of the week. Others are triggered just in

					time by specific physical behaviour events as detected by the Fitbit activity
Tomas Vetrovsky, mHealth intervention delivered in general practice to increase physical activity and reduce sedentary behaviour of patients with prediabetes and type 2 diabetes (ENERGISED): rationale and study protocol for a pragmatic randomized controlled trial, BMC Public Health	Randomized controlled trial	mHealth intervention, physical activity, sedentary behaviour, prediabetes and type 2 diabetes (ENERGISED)	340 patients with (pre) diabetes	Patients with (pre)diabetes	Based on recent evidence and harnessing the latest technology advances, we have developed an mHealth intervention based on JITAI principles to be introduced to the patients by their GPs with initial lead-in support by trained phone counsellors
Nittaya Sukchaisong et al. Effectiveness of the Mindfulness-Based Diabetes Self-and Family Management Support Program among Adults with Uncontrolled Diabetes: A Randomized Controlled Trial. Pacific Rim International Journal of Nursing Research, Vol. 26 No.3, July-September 2022	Randomized controlled trial	Mindfulness-based Diabetes Self and Family Management Support Program, glycated hemoglobin, fasting blood glucose, mindful-eating, self-efficacy, dietary consumption, physical activity, medication adherence	80 participants	Thai adults with uncontrolled diabetes (who had poorly controlled diabetes and their family members)	Participants improved in fasting blood glucose and HbA1c, appropriate dietary consumption, amount of physical activity, medication adherence, mindful eating, and self-efficacy

Table 3.
Theme and Sub Theme

Theme	Sub theme
Benefits	<ul style="list-style-type: none"> - Psychological Wellbeing: Mindfulness-based interventions (MBIs) have been associated with improvements in psychological distress, depression, anxiety, and stress in individuals with diabetes - Glycemic Control: Studies have demonstrated modest improvements in body weight, glycaemic control, and blood pressure in diabetic individuals following mindfulness-based stress reduction programs - Holistic Care: Mindfulness meditation-based interventions can lead to improvements across all domains of holistic care - biological, psychological, and social
Physiological Mechanisms	<ul style="list-style-type: none"> - Parasympathetic Activity: Mindfulness practices have been associated with increased parasympathetic activity, reduction in sympathetic vascular tone, stress hormones, and inflammatory markers, which can impact diabetes prevention and management - Glycemic Control: Mindfulness meditation has been shown to reduce hemoglobin A1c levels in adult patients with type 2 diabetes, indicating a direct impact on glycemic control - Insulin Resistance: Mechanisms of bio-physiological effects of meditation include reduction of stress hormones, improvement of insulin resistance, and improvement of autonomic dysfunction, all of which are relevant to diabetes management
Psychological Effects	<ul style="list-style-type: none"> - Stress Reduction: Mindfulness training promotes glycemic control and facilitates effective diabetes self-management by building the capacity to self-regulate emotions, mitigate stresses that cause harmful shifts in blood glucose, and limit negative moods that trigger unhealthy habits and non-adherence. - Self-Management: Dispositional mindfulness is a strong predictor of quality of life in type 2 diabetes mellitus and can be targeted with interventions to improve psychological outcomes. - Depression and Anxiety: Mindfulness interventions have shown improvement in depression, self-management, and quality of life in patients with type 2 diabetes mellitus.
Best Practices	<ul style="list-style-type: none"> - Mindful Eating: Mindful eating interventions have been effective in facilitating improvement in dysregulated eating and dietary patterns, which are important aspects of diabetes management. - mHealth Interventions: Integrating mHealth tools into routine practice of general practitioners has the potential to significantly impact (pre)diabetes patient care through increased physical activity and reduced sedentary behavior, with implications for broader applications in primary care. <ul style="list-style-type: none"> - Mindfulness-Based Diabetes Self-Management Support Program: The Mindfulness-Based Diabetes Self-and Family Management Support Program has been shown to improve glycated hemoglobin among adults with uncontrolled diabetes, indicating its potential effectiveness in diabetes management.
Recommended Doses	<ul style="list-style-type: none"> - Mindfulness-based interventions, such as mindfulness-based stress reduction (MBSR) programs, have been implemented for 12 weeks and have shown significant improvements in glycemic control and mental health in patients with type 2 diabetes - For physical activity, current guidelines recommend long-term weight loss of 5% to 7% of body weight and 150 minutes of at least moderate-intensity physical activity per week for most patients with prediabetes and diabetes - The combination of aerobic and resistance exercise has been recommended to maximize the benefits of daily training for individuals with diabetes

Discussion

The integration of mindfulness and physical activity in diabetes management shows promise in improving psychological well-being and glycemic control among individuals with diabetes. Mindfulness-based interventions (MBIs) have been associated with reductions in psychological distress and improvements in stress management, which are crucial factors in diabetes self-management (DiNardo et al., 2022). Additionally, studies have demonstrated modest enhancements in body weight, glycemic control, and blood pressure following mindfulness-based stress reduction programs, highlighting the potential of mindfulness practices in promoting healthier lifestyle choices and better adherence to treatment regimens. Integrating mindfulness into diabetes care offers a comprehensive approach to addressing the complex nature of the condition, fostering holistic well-being and improving overall health outcomes for individuals living with diabetes (Irwin et al., 2022). Continued research efforts are necessary to further elucidate the benefits of mindfulness and physical activity integration in diabetes management and to develop more effective interventions for enhancing diabetes prevention and care (Saito & Kumano, 2022).

Mindfulness practices exhibit beneficial effects on various physiological markers relevant to diabetes prevention and management (Xia et al., 2022). These practices are associated with increased parasympathetic activity, decreased sympathetic vascular tone, and reduced levels of stress hormones and inflammatory markers, all of which play pivotal roles in diabetes management. Furthermore, mindfulness meditation demonstrates a direct impact on glycemic control, as evidenced by reductions in hemoglobin A1c levels among adult patients with type 2 diabetes (Ajele et al., 2021). Additionally, the bio-physiological effects of meditation include mitigating insulin resistance and ameliorating autonomic dysfunction, thus offering potential avenues for enhancing diabetes care and treatment outcomes (Guo et al., 2022).

The integration of mindfulness and physical activity in diabetes prevention and management has demonstrated positive impacts on psychological well-being, glycemic control, and overall holistic care for individuals with diabetes (Abujaradeh et al., 2021). Mindfulness training contributes to glycemic control and effective diabetes self-management by fostering emotional self-regulation, reducing stress-induced fluctuations in blood glucose, and minimizing negative moods that trigger unhealthy behaviors and non-adherence to treatment (Shukla et al., 2021). Dispositional mindfulness emerges as a strong predictor of quality of life in type 2 diabetes mellitus, suggesting potential interventions to enhance psychological outcomes. Additionally, mindfulness interventions exhibit improvements in depression, self-management, and overall quality of life among patients with type 2 diabetes mellitus, highlighting their potential as valuable additions to

traditional diabetes management strategies (Chen et al., 2021). By addressing psychological and emotional aspects of diabetes, such interventions promote stress reduction, self-management skills, and overall well-being, facilitating better disease management and enhanced quality of life for individuals with diabetes (Chandra et al., 2020).

Several innovative approaches hold promise for enhancing diabetes management. Mindful eating interventions have proven effective in improving dysregulated eating and dietary patterns, essential components of diabetes care (Ravari et al., 2020). Integrating mobile health (mHealth) tools into general practitioners' routine practice offers potential benefits for (pre)diabetes patient care by promoting increased physical activity and reduced sedentary behavior, particularly in primary care settings. Additionally, the Mindfulness-Based Diabetes Self-and Family Management Support Program has demonstrated efficacy in improving glycated hemoglobin levels among adults with uncontrolled diabetes, underscoring its potential as an effective tool for diabetes management. These findings highlight the importance of integrating innovative strategies into diabetes care to optimize outcomes and improve the overall well-being of individuals with diabetes (Ngan et al., 2021).

The search results provide compelling evidence supporting the implementation of mindfulness-based interventions, such as mindfulness-based stress reduction (MBSR) programs, over a 12-week duration, showcasing significant enhancements in both glycemic control and mental health among individuals with type 2 diabetes (Ee et al., 2020). Current guidelines advocate for sustained weight loss ranging from 5% to 7% of body weight and engaging in at least 150 minutes of moderate-intensity physical activity weekly for most patients with prediabetes and diabetes (Ni et al., 2021). Additionally, combining aerobic and resistance exercises has been endorsed to maximize daily training benefits for diabetes management (Medina et al., 2017). Research indicates that MBSR interventions can foster a nonreactive, nonjudgmental approach to thoughts and emotions, aiding in stress management and diabetes adaptation (Priya & Kalra, 2018). Moreover, integrating mindfulness into diabetes self-management education has demonstrated improvements in glycemic control (Nikkhah Ravari et al., 2020). While MBSR shows promise in positively influencing blood pressure and glucose control, further research is warranted to elucidate its broader applications in diabetes care (Heo et al., 2023). Furthermore, mindfulness-based cognitive therapy (MBCT) and mindfulness-based eating awareness training (MB-EAT) have exhibited efficacy in enhancing psychological health and coping skills across various clinical populations, including those with chronic diseases (Sasikumar & Padmapriya, 2022). In summary, the findings advocate for the adjunctive use of mindfulness-based interventions like MBSR, MBCT, and MB-EAT in diabetes management, offering avenues to mitigate stress, bolster self-management, and potentially augment diabetes care

through enhanced self-efficacy, knowledge, and communication (Dalpatadu et al., 2022).

However, as with many studies, there are several limitations that need to be considered in interpreting the results of this review (Miller, 2017). First, variations in study design, sample populations, and interventions reported in the literature may influence the level of confidence in the resulting findings (Leischik et al., 2021). Second, because of the focus on the integration of mindfulness with physical activity, it is possible that other factors that also play a role in diabetes prevention and management may not have been fully investigated (Morowatisharifabad et al., 2021). Third, most of the studies included in this review may have certain methodological limitations, such as small sample sizes or lack of appropriate control groups, which may affect the internal validity and generalisability of the findings. Finally, as this review only considered published studies, the possibility of publication bias should also be considered, where significant results are more likely to be published than nonsignificant results. Keeping these limitations in mind, interpretation of the findings of this review should be done with caution, and it should be acknowledged that the findings may not be directly applicable universally in clinical practice.

Conclusion

The integration of mindfulness practices with physical activity holds immense promise for enhancing diabetes prevention and management efforts. Evidence from this systematic review highlights multiple beneficial outcomes, including improvements in psychological wellbeing, glycemic control, holistic care, parasympathetic activity, insulin resistance, stress reduction, self-management, and mindful eating. Mindfulness-based interventions have demonstrated their efficacy in improving various aspects of diabetes care, from psychological outcomes to glycemic control and dietary patterns. Furthermore, the incorporation of mindfulness into diabetes self-management programs, such as the Mindfulness-Based Diabetes Self-and Family Management Support Program, has shown promising results in improving glycated hemoglobin levels. Alongside physical activity recommendations, integrating mindfulness practices offers a holistic approach to diabetes care, addressing both physical and mental health aspects for comprehensive patient support. These findings underscore the importance of further research and implementation of mindfulness-based interventions as integral components of diabetes care strategies, aiming to optimize outcomes and enhance the quality of life for individuals affected by diabetes.

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