



REVIEW

Exercises and Cognition in Type 2 Diabetes Mellitus: An updated literature review

Ejercicios y Cognición en la Diabetes Mellitus Tipo 2: Una revisión actualizada de la literatura

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ABSTRACT

Type 2 Diabetes Mellitus (T2DM) is increasingly associated with cognitive impairment, which represents a significant public health problem. Evidence suggests that people with T2DM are at increased risk of developing cognitive deficits, including mild cognitive impairment (MCI) and dementia. This relationship can be attributed to multiple factors such as hyperglycemia, insulin resistance, and vascular dysfunction. Regular physical activity has emerged as a promising intervention to improve cognitive function in individuals with T2DM. Physical exercise can increase insulin sensitivity, reduce inflammation, and promote neurogenesis. In addition, it contributes to the improvement of cardiovascular health, a critical aspect for brain health.

Keywords: Diabetes; Cognition; Exercise; Physical Activity.

RESUMEN

La Diabetes Mellitus Tipo 2 (DMT2) se asocia cada vez más con el deterioro cognitivo, lo cual representa un problema significativo de salud pública. La evidencia sugiere que las personas con DMT2 tienen un mayor riesgo de desarrollar déficits cognitivos, incluyendo deterioro cognitivo leve (DCL) y demencia. Esta relación puede atribuirse a múltiples factores como la hiperglucemia, la resistencia a la insulina y la disfunción vascular. La actividad física regular ha emergido como una intervención prometedora para mejorar la función cognitiva en individuos con DMT2. El ejercicio físico puede incrementar la sensibilidad a la insulina, reducir la inflamación y promover la neurogénesis. Además, contribuye a la mejora de la salud cardiovascular, un aspecto fundamental para la salud cerebral.

Palabras clave: Diabetes; Cognición; Ejercicio; Actividad Física.

INTRODUCTION

Type 2 Diabetes and Cognition

Diabetes is a chronic metabolic disorder which commonly occurs when the pancreas is not able to release a sufficient amount of insulin or the body is not responding to use the insulin released.⁽¹⁾ The World Health Organization (WHO) reports that approximately 77 million individuals aged 18 years and above in India are diagnosed with type 2 diabetes, with an additional 25 million identified as pre-diabetic.⁽¹⁾ Diabetes impacts multiple organ systems, causing a range of complications and contributing to premature morbidity and mortality. This, in turn, reduces life expectancy and imposes substantial financial and social costs, exacerbating the

economic burden of diabetes.⁽²⁾

As neurons are metabolically active and heavily reliant on glucose metabolism in the brain, hyperglycaemia and insulin resistance, the principal pathological characteristics of Type 2 Diabetes Mellitus (T2DM), may lead to cognitive dysfunction associated with diabetes.⁽³⁾ Cognitive functioning is of significant concern for public health, as it directly influences an individual's capacity to maintain independent living and plays a critical role in determining quality of life.⁽⁴⁾

The existing literature on the relationship between cognitive decline and diabetes mellitus remains inconclusive, with findings varying across studies. These inconsistencies in findings may be attributable to differences in study design, study subjects, duration or severity of diabetes, and the tools used to assess cognitive impairment.⁽⁵⁾

T2DM is increasingly associated with cognitive decline, posing a significant public health challenge. Research indicates that individuals with T2DM are more susceptible to cognitive impairments such as mild cognitive impairment (MCI) and dementia. The mechanism behind this association includes hyperglycemia, insulin resistance, and vascular dysfunction, which negatively affect brain health and cognitive functioning. Given these concerns, regular physical activity has emerged as a potential intervention to enhance cognitive function in individuals with T2DM. Exercise is known to improve insulin sensitivity, reduce inflammation, support neurogenesis, and bolster cardiovascular health, all of which are essential for maintaining cognitive function.

The objective of this updated literature review is to evaluate the role of physical activity in mitigating cognitive decline associated with T2DM. Specifically, this study investigates the types of exercise most beneficial for individuals with T2DM and identifies gaps in current research to inform future investigations.

METHOD

This updated literature review included the articles published between 2019 -2024, which were searched using the keywords "Diabetes Mellitus", "Cognition", "Exercise", and "Rehabilitation" from PubMed, Google Scholar, Cochrane Library, Scopus databases, and other sources. The updated literature review included randomised clinical trials, review articles, reports, editorial papers, and field updates written in the English Language. 26 relevant articles in total were included in this study.

DEVELOPMENT

Physical activity is vital for managing Type 2 Diabetes Mellitus (T2DM) by regulating blood glucose, enhancing insulin sensitivity, and reducing risk factors. Aerobic exercises, such as walking and swimming, and resistance training are particularly effective, with flexibility and balance activities like Tai Chi and Yoga being beneficial for older adults. These exercises improve mobility, stability, and overall health, potentially enhancing lipid profiles and immune function. PA also supports cognitive function, combating age-related decline and T2DM-related cognitive impairment, through mechanisms like improved cardiovascular health and neurogenesis. However, more research is needed to establish long-term effects and specific protocols tailored to individual needs.

Type 2 Diabetes and Exercises

Physical activity (PA) plays a vital role in preventing and managing diabetes, offering significant benefits such as improving blood sugar control, reducing risk factors of co-morbidities, and promote overall health and well-being.^(6,7,8,9,10,11,12) Tailored exercise plans are recommended, taking into account the type of diabetes and any associated complications.^(6,7,8,9,10,11,12) Research supports that different exercise protocols can effectively reduce the risk of diabetes-related complications.^(6,7,8,9,10,11,12)

Aerobic exercises, such as walking, cycling, jogging, and swimming, are characterized by continuous movement of large muscle groups.⁽¹³⁾ Strength or Resistance training involves the use of free weights, weight machines, body weight, or elastic resistance bands to improve muscle strength. In contrast, flexibility exercises focus on joint mobility,⁽¹⁴⁾ and balance exercises which enhance stability and prevent falls.⁽¹⁵⁾ Activities like tai chi and yoga combine elements of flexibility, balance, and resistance activities to improve overall fitness and fall prevention.

For individuals, particularly older adults with T2DM who are at greater risk of falls, incorporating flexibility exercises is essential to increase the range of motion and reduce the likelihood of injury. Though research on the effectiveness of yoga for managing T2DM is limited, some studies suggest that it may improve blood sugar control and lipid profile and reduce blood pressure, heart rate, oxidative stress, and body mass. Additionally, tai chi has been shown to improve blood sugar levels, walking velocity, and immune function. Moreover, combined aerobic and resistance training may have a more positive effect on blood sugar control and modestly improve insulin sensitivity compared to aerobic or resistance exercise alone.⁽¹⁶⁾

Exercises and Cognition

Cognitive functioning encompasses various mental abilities, including thinking, learning, language, reasoning,

attention, concentration, and visuospatial skills.⁽¹⁷⁾ Numerous theoretical and empirical studies indicate that cognitive functioning tends to decrease with age, making the older population more susceptible to cognition-related issues such as cognitive impairment.^(18,19) As the global population ages, age-related cognitive decline and dementia, such as Alzheimer's disease become prominent health concerns.⁽²⁰⁾ Cognitive impairment is generally assessed across five broad domains: memory, orientation, arithmetic skills, executive function, and object naming. In diverse cultural settings, especially where lifestyle habits such as diet and physical activity differ from those in wealthier nations, the relationship between physical activity and cognition is expected to vary.⁽²¹⁾

Research has consistently demonstrated that older adults who engage in regular PA tend to exhibit better cognitive functioning than those who lead sedentary lifestyles, even when accounting for individual health, lifestyle, and household factors.⁽²¹⁾ This positive association between PA and cognitive functioning holds true for older men and women. These results underscore the potential benefits of regular PA in promoting healthy cognitive ageing. Therefore, regular physical activity can be seen as an effective lifestyle factor in promoting healthy cognitive ageing.⁽²¹⁾ Due to its cardio-protective effects, physical activity may stimulate brain activity and enhance cognitive functioning in older adults. It is, therefore, an essential component of active ageing interventions.⁽²¹⁾ For Healthcare practitioners aiming to improve the cognitive functioning of older patients, the development of physical activities-based intervention can be valuable in mitigating the decline of cognitive resources. However, more longitudinal studies are needed to explore the role of behavioural interventions in enhancing cognitive enrichment, particularly in older populations and women, to promote successful ageing.⁽²¹⁾

Patients with T2DM are more likely to experience cognitive decline, especially older patients with T2DM, compared to those without the disease.^(22,23) Prolonged high blood sugar levels can impair brain function and lead to complications, resulting in cognitive dysfunction like MCI in patients with T2DM.^(22,23) Cognitive decline is more severe in older patients with T2DM and should be prevented or treated effectively.^(24,25) Exercise has been shown to improve cognitive function in patients with T2DM, but more research is needed.^(24,25) Studies suggest that regular exercise for more than 3 months can enhance global cognitive function in older patients with T2DM, regardless of cognitive impairment.⁽²⁶⁾ Further research is required to examine the impact of exercise on specific cognitive function domains in older patients with T2DM.

Future Scope of Research

Future research should focus on identifying age-specific cognitive domains impacted by T2DM and establishing evidence-based, individualised exercise protocols. Longitudinal studies on physical activity's impact on neurogenesis and vascular health will further refine strategies to manage diabetes-related complications and improve overall quality of life.

CONCLUSION

Physical activity serves as a vital intervention to address both T2DM and its associated cognitive impairments. By enhancing insulin sensitivity, reducing systemic inflammation, improving blood flow, and supporting neuronal health, tailored exercise regimens have the potential to mitigate cognitive decline effectively.

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None.

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