

Effect of Isometric Exercise on Pain in Diabetic Patients and its correlation with HBA1c

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ABSTRACT

Background: Diabetes mellitus (DM) is a chronic condition associated with multiple complications, including generalized body pain. Isometric exercises have been proposed as a simple and effective method for pain reduction in such individuals.

Objective: To analyze the effect of isometric exercise on pain in diabetic patients.

Methodology: A total of 30 diabetic patients with generalized body ache were enrolled. Pain intensity was measured using the Visual Analogue Scale (VAS) before and after a 4-week isometric exercise intervention.

Results: A significant reduction in pain scores was observed post-intervention.

Conclusion: Isometric exercise is effective in reducing pain in diabetic individuals and can be recommended as a non-pharmacological strategy for pain management.

Keywords: Visual Analogue Scale, Diabetes mellitus, Isometric exercise, Intervention.

1. INTRODUCTION

Diabetes mellitus (DM) is a chronic, progressive metabolic disorder characterized by persistent hyperglycemia due to defects in insulin secretion, insulin action, or both. It is widely regarded as one of the fastest-growing non-communicable diseases in the world. According to the International Diabetes Federation (IDF), over 537 million adults globally were living with diabetes in 2021, and this number is projected to rise to 783 million by 2045 [1]. India, in particular, bears a significant portion of this burden and has been referred to as the “diabetes capital of the world.” The increasing incidence of sedentary lifestyles, obesity, urbanization, and aging populations are primary contributors to the diabetes epidemic [2].

There are primarily two types of diabetes; Type 1 and Type 2. Type 1 DM is autoimmune in origin, characterized by destruction of pancreatic beta cells leading to absolute insulin deficiency. Type 2 DM, which accounts for more than 90% of cases, is primarily associated with insulin resistance and relative insulin deficiency. Type 2 diabetes is strongly linked to lifestyle and environmental factors, including diet, physical inactivity, and stress [3].

While much attention is placed on the cardiovascular, renal, ophthalmic, and neurological complications of diabetes, its musculoskeletal manifestations remain underreported and underdiagnosed. Chronic generalized body ache, joint stiffness, limited range of motion, and soft tissue discomfort are common but often overlooked presentations in diabetic individuals [4]. Studies suggest that diabetic patients are more prone to developing conditions such as frozen shoulder, carpal tunnel syndrome, diffuse idiopathic skeletal hyperostosis (DISH), and diabetic muscle infarction [5].

One of the major causes of generalized pain in diabetic patients is chronic systemic inflammation induced by persistent hyperglycemia. This inflammatory state leads to oxidative stress, altered pain thresholds, microvascular dysfunction, and peripheral nerve involvement all contributing to musculoskeletal discomfort [6]. Additionally, prolonged hyperglycemia impairs blood flow and oxygenation to soft tissues, which can lead to muscle fatigue, poor tissue healing, and reduced physical endurance [7].

Another important contributor to pain in diabetics is neuropathy, especially small fiber neuropathy, which can lead to widespread burning or aching sensations in muscles and joints even in the absence of overt nerve damage. Psychological distress such as depression, anxiety, and sleep disturbances more common among individuals with poorly controlled diabetes may also exacerbate pain perception [8].

In this context, physiotherapy plays a vital role in non-pharmacological management of pain and improving functional capacity. Among various physiotherapeutic modalities, isometric exercises have emerged as a safe and effective intervention for patients with generalized musculoskeletal pain and limited physical tolerance. Isometric exercise involves sustained muscle contraction without change in muscle length or visible joint movement. It can improve muscle strength, enhance circulation, and provide analgesic effects through neuromuscular activation and endorphin release [9].

Isometric exercises are particularly beneficial for diabetic individuals as they reduce pain and stiffness without imposing stress on already compromised joints or cardiovascular systems. These exercises also contribute to better posture, muscle coordination, and proprioception, all of which are essential for improving the quality of life in diabetic populations suffering from chronic pain. Moreover, as a static and low-impact form of exercise, isometric routines can be easily modified for home-based rehabilitation and self-care programs [10].

There is growing clinical interest in determining whether pain reduction through physiotherapy correlates with glycemic control, often assessed via HbA1c levels, a reliable indicator of average blood glucose over a 2–3-month period. Some researchers have hypothesized that improving physical activity and reducing pain could indirectly support better glycemic control due to improved metabolic engagement, but the relationship remains unclear and under-researched [11].

This study aims to comprehensively evaluate the effect of isometric exercises on generalized musculoskeletal pain in diabetic patients and explore whether improvements in pain correlate with HbA1c values. Establishing such a correlation could strengthen the argument for including structured physiotherapy in routine diabetic care protocols.

2. METHODOLOGY

Study Design: This was a prospective, interventional study conducted at a clinical physiotherapy setting over a period of 4 weeks. The aim was to evaluate the impact of isometric exercises on generalized body ache in patients with T2DM.

Participants: A total of 30 participants were selected through purposive sampling. All participants were clinically diagnosed with T2DM for at least 5 years and reported persistent, nonspecific, generalized musculoskeletal pain lasting for more than 3 months.

Inclusion Criteria:

- Age between 40–65 years
- Diagnosed case of T2DM (≥ 5 years)
- Generalized body ache without specific musculoskeletal pathology
- Ability to participate in exercise sessions
- Voluntary consent

Exclusion Criteria:

- Known rheumatological disorders (e.g., RA, SLE)
- Severe osteoarthritis or inflammatory joint disease
- Recent fracture, trauma, or orthopedic surgery
- Uncontrolled hypertension, cardiovascular or neurological disease
- Participation in another physiotherapy program

Intervention: The isometric exercise protocol was designed to target major muscle groups including quadriceps, hamstrings, gluteals, abdominal muscles, deltoids, biceps, and triceps. Each muscle group was engaged in static contraction held for 10 seconds, followed by 10 seconds of rest. 10 repetitions per muscle group were performed in each session. Sessions were held around five times per week for 4 weeks.

All exercises were performed under supervision to ensure correct posture, avoid breath-holding (Valsalva), and ensure proper muscle engagement. The intensity was progressively adjusted based on tolerance and comfort.

Outcome Measure: Pain intensity was measured using the Visual Analogue Scale (VAS), a validated tool ranging from 0 (no pain) to 10 (worst imaginable pain). Scores were recorded at baseline and after 4 weeks of intervention.

Statistical Analysis: Data were analyzed using paired t-tests to compare mean pre- and post-intervention VAS scores. A p-value < 0.05 was considered statistically significant.

3. RESULTS

All 30 participants completed the intervention protocol. The mean age of the participants was 54.2 ± 6.3 years. No adverse events or dropouts were reported. Pain levels, as measured by the Visual Analogue Scale (VAS), significantly decreased following the isometric exercise program:

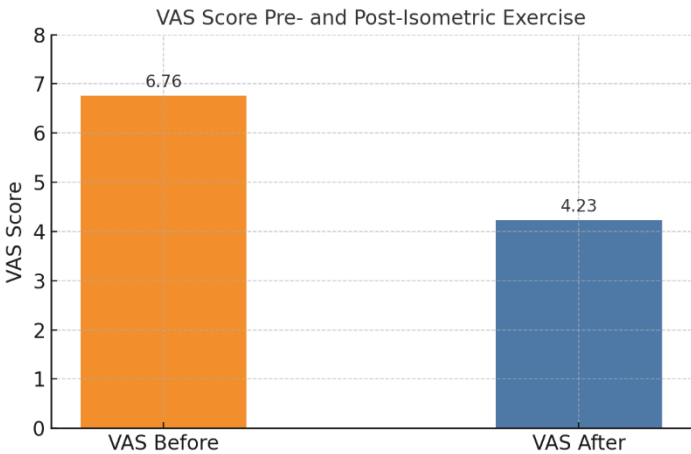
Table 1: Pre- and Post-Intervention VAS Scores

| Participant Group | VAS Before | VAS After | Mean Change |
|---------------------------------|-----------------|-----------------|-------------|
| Isometric Exercise Group (n=30) | 6.76 ± 1.34 | 4.23 ± 1.41 | -2.53 |

Table 2: Paired t-Test for VAS Scores Pre- and Post-Intervention

| Outcome | t-Statistic | p-Value | Interpretation |
|---------|-------------|----------|--------------------|
| VAS | 7.42 | < 0.0001 | Highly Significant |

Figure 1: VAS Score Before and After Isometric Exercise



This indicates that isometric exercise was effective in reducing pain among diabetic individuals.

4. DISCUSSION

This study included 30 diabetic individuals who experienced generalized body pain and were given a structured isometric exercise protocol for 4 weeks. Pain was assessed pre- and post-intervention using the Visual Analogue Scale (VAS). The findings demonstrated a statistically significant reduction in pain intensity, validating the hypothesis that isometric exercise is effective in managing chronic musculoskeletal discomfort in the diabetic population.

This study was conducted to evaluate the effect of isometric exercise on pain intensity in individuals diagnosed with Type 2 Diabetes Mellitus (T2DM) who also presented with generalized body ache. Chronic pain is a prevalent and under-addressed

complication in diabetic individuals, often affecting multiple joints and muscle groups, and contributing significantly to functional limitations, poor physical activity levels, and psychological stress.

Generalized musculoskeletal pain in diabetes is multifactorial in origin. It may arise due to chronic hyperglycemia, leading to the accumulation of advanced glycation end products (AGEs), oxidative stress, low-grade systemic inflammation, and subsequent microvascular changes. These pathophysiological alterations affect the muscles, tendons, and connective tissues, resulting in stiffness, fatigue, reduced flexibility, and persistent pain. Additionally, prolonged sedentary behavior in diabetic patients due to pain or fear of exacerbating symptoms may further lead to muscle deconditioning, altered posture, and loss of joint mobility.

In this study, a 4-week isometric exercise protocol was implemented. Isometric exercises are a form of static muscular activity where the muscle contracts without changing length or moving the joint. These exercises are known to enhance muscle activation, increase localized blood flow, and improve neuromuscular coordination while minimizing mechanical strain on joints. Importantly, isometric exercises can be safely performed by individuals who experience pain during dynamic movements, making them especially suitable for the diabetic population.

Participants were assessed for pain using the Visual Analogue Scale (VAS) at the beginning and at the end of the 4-week intervention period. A significant decrease in VAS scores was observed, indicating that isometric exercise contributed to the alleviation of pain symptoms. This improvement may be attributed to several physiological mechanisms, including activation of descending inhibitory pain pathways, increased endorphin release, and enhanced metabolic efficiency within the muscle tissue. Improved circulation also plays a role in clearing metabolic by-products that contribute to discomfort.

Furthermore, consistent participation in structured isometric exercise may contribute to improved self-efficacy and increased tolerance to physical activity. By reducing pain and stiffness, patients are more likely to resume or maintain daily functional activities, resulting in enhanced mobility, independence, and overall quality of life. Pain relief also reduces psychological stress, which is a known aggravator of insulin resistance, thereby indirectly contributing to better glycemic outcomes, even though HbA1c was not evaluated in this study.

It is also noteworthy that isometric exercises require minimal space and equipment, making them highly feasible for home-based rehabilitation, particularly in rural and low-resource settings where access to physiotherapy centers may be limited. The ease of administration and adaptability to individual tolerance make isometric training a cost-effective and sustainable strategy for long-term pain management.

While the results of the study are encouraging, certain limitations must be acknowledged. The study had a relatively small sample size and lacked a comparative control group. The intervention duration was limited to four weeks, and no follow-up was conducted to evaluate long-term sustainability of the observed benefits. Additionally, the study focused solely on pain levels and did not assess improvements in strength, mobility, functional capacity, or glycemic control.

Despite these limitations, the statistically significant reduction in pain following isometric training reinforces the clinical value of incorporating isometric exercise in physiotherapy management plans for diabetic individuals. The results support the hypothesis that non-pharmacological interventions such as targeted muscle activation can be beneficial in addressing the musculoskeletal complications associated with diabetes.

5. CONCLUSION

This study concludes that isometric exercise is a safe, effective, and accessible intervention for reducing generalized musculoskeletal pain in individuals with Type 2 Diabetes Mellitus. A significant decrease in pain intensity after a 4-week program supports its role as a non-pharmacological strategy. By engaging major muscle groups without stressing the joints, isometric training enhances comfort, promotes functional activity, and may indirectly aid in overall diabetes management. Given its simplicity and adaptability, it holds strong potential for routine physiotherapy care in diabetic populations.

Limitations:

- Small sample size.
- Short duration of intervention.
- No long-term follow-up.
- Did not correlate pain improvement with HbA1c changes

Recommendations:

- Larger sample size and long-term studies are recommended.
- Include HbA1c tracking in future studies.

Compare isometric exercise with other exercise forms

REFERENCES

- [1] International Diabetes Federation. IDF Diabetes Atlas, 10th ed. 2021.
 - [2] American Diabetes Association. Classification and Diagnosis of Diabetes. *Diabetes Care*. 2022;45(Suppl 1):S17–S38.
 - [3] Tripathy JP. Burden and risk factors of diabetes in India. *J Diabetes Metab Disord*. 2018;17(2):101–107.
 - [4] Arora E, et al. Musculoskeletal disorders in type 2 diabetes mellitus. *Int J Diabetes Dev Ctries*. 2015;35(3):401–408.
 - [5] Abate M, et al. Pathogenesis of musculoskeletal disorders in diabetes. *Acta Diabetol*. 2013;50(1):1–9.
 - [6] Kalyani RR, et al. Inflammation and functional decline in diabetic individuals. *J Gerontol A Biol Sci Med Sci*. 2014;69(10):1236–1243.
 - [7] Resnick HE, et al. Lower extremity pain in diabetic adults. *Arch Intern Med*. 2002;162(1):61–68.
 - [8] D’Souza RS, et al. Neuropathic pain in diabetes: diagnostic challenges and management options. *J Pain Res*. 2021;14:237–246.
 - [9] Alghadir A, et al. Isometric exercise for pain reduction: a review. *J Phys Ther Sci*. 2018;30(2):271–275.
 - [10] Kisner C, Colby LA. *Therapeutic Exercise: Foundations and Techniques*. 6th ed. FA Davis; 2012.
 - [11] Chiu CJ, et al. Physical activity and glycemic control in Type 2 diabetes. *J Clin Endocrinol Metab*. 2017;102(10):3600–3608.
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