

## EFFICACY OF PASSIVE SUSTAINED SPECIFIC MUSCLE STRETCH ON PATIENTS WITH TYPE-2 DIABETES MELLITUS – A RANDOMIZED CONTROL TRIAL

### EFICIENȚA STRETCHINGULUI MUSCULAR PASIV SPECIFIC SUSȚINUT LA PACIENȚII CU DIABET MELITUS TIP-2 - STUDIU RANDOMIZAT

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**Cuvinte cheie:** diabet mellitus tip 2, stretching muscular pasiv, exerciții active, nivelul glicemiei

#### Abstract

**Background.** Diabetes Mellitus is a metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. Diabetes is the leading cause of end-stage renal disease, a major cause of non-traumatic amputations, responsible for 30% of the preventable blindness and a leading cause of cardiovascular mortality. Because skeletal muscle is an important tissue in maintaining postprandial glucose homeostasis, passive sustained specific muscle stretching can be used as a combination therapy for lowering blood glucose levels in type 2 diabetes patients.

**Objective.** To determine the effect of Active exercises and Passive Sustained Specific Muscle Stretch on patients with Type 2 Diabetes. To determine effect of active exercises on patients with type 2 diabetes mellitus.

**Method.** 40 subjects (Age 40-55 yrs) were recruited from Department of Diabetology, KLES Dr. Prabhakar Kore Hospital and MRC, Belgaum. Subjects were randomly divided in 2 groups. Group A received Active Exercises and Group B received Sustained Specific Muscle Stretch and Active exercises for a week. Outcome measures were Blood Glucose levels taken on Day 1, Day 3 and Day 6.

**Results.** Subjects treated with active exercises with passive sustained specific muscle stretch had statistical significant reduction in blood sugar levels.

**Conclusion.** Passive sustained specific muscle stretches with active exercises can be given as an adjunct with drug therapy to the patients with type 2 Diabetes mellitus.

#### Rezumat

**Introducere.** Diabetul mellitus este o afecțiune metabolică caracterizată prin hiperglicemie, ca rezultat al tulburării secreției de insulină, a acțiunii insulinei sau ambele. Diabetul este cauza principală a insuficienței renale, a amputațiilor nontraumatice, responsabil pentru 30% din cazurile de orbire și o cauză a mortalității cardiovasculare. Deoarece mușchii scheletici joacă un rol important în menținerea homeostaziei glicemiei postprandiale, stretchingul pasiv susținut poate fi folosit ca mijloc de reducere a glucozei din sânge la pacienții cu diabet tip2.

**Obiective.** Determinarea efectului exercițiilor active și a stretchingului pasiv la pacienții cu diabet tip 2. Determinarea efectului exercițiilor active asupra reducerii glucozei din sânge la pacienții cu diabet tip 2.

**Metodă.** 40 de subiecți (între 40-55 ani) au fost selectați din cadrul Departamentului de Diabetologie, KLES Dr. Prabhakar Kore Hospital și MRC, Belgaum. Subiecții au fost împărțiți aleator în 2 grupuri. Grupul A au efectuat exerciții active iar grupul B au efectuat stretching pasiv susținut și exerciții active, timp de o săptămână. Evaluarea a constat în măsurarea glucozei sangvine în ziua 1, 3 și 6.

**Rezultate.** Subiecții care au efectuat stretching pasiv și exerciții active au prezentat o reducere semnificativă a nivelului glucozei sangvine.

**Concluzii:** Stretchingul muscular pasiv susținut, alături de exercițiile active poate fi un adjuvant al terapiei medicamentoase pentru pacienții cu diabet mellitus tip2.

#### Introduction

Diabetes Mellitus is a metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. It may be accompanied by other biochemical disturbances and the presence of progressive diabetic tissue damage with micro or macro vascular complications. Diabetes is the leading cause of end-stage renal disease, a major cause of

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non-traumatic amputations, responsible for 30% of the preventable blindness and a leading cause of cardiovascular mortality. [1]

It is possible to prevent the complications of Type 2 diabetes mellitus by reducing life style risk factors through moderate weight loss and increased physical activity. Active exercises such as Walking, Treadmill exercises and Stretching exercises are shown to be effective to control the blood sugar levels in diabetic patients. [2]

Studies have shown that exercise can increase the content of muscle GLUT-4. Therefore, it is important that we understand how exercise regulates GLUT-4 expression so that therapeutic strategies might be designed to help increase muscle glucose disposal as a treatment for diabetes. [3]

Many other studies have suggested that metabolic activity is related to Adenosine monophosphate kinase (AMPK) directly and stretching causes activation of AMPK, hence resulting in increased metabolic activity, which in turn facilitates Glucose Transport Mechanism Pathway. Increased Protein B kinase also facilitates GLUT-4 activity. In some studies it is suggested that stretching causes ischemia of muscle which also facilitates that GLUT-4 translocation to Sarcolemma and increases glucose uptake. [4,5,6,7]

Notwithstanding the benefits derived from regular exercises there are many people with Type 2 Diabetes Mellitus who do not exercise. Hence for these patients, the physician is constrained to use a sliding-scale insulin plan in an attempt to control hour to hour glucose levels. Passive Sustained Specific Muscle Stretch may be that modality that could accrue the benefits of exercises without its accompanying physical stress. Passive stretching requires minimum efforts by the person experiencing the stretch, and can be performed while sitting or lying down. Hence people who are reluctant or unable to do exercises can be benefited by passive stretching protocol<sup>[2]</sup>. There are previous studies who have determined the immediate effect of sustained stretching on blood sugar levels on patients with type 2 diabetes mellitus. [2] The present study intends to find the long term effect of sustained specific muscle stretches on blood sugar levels of type 2 diabetes mellitus patients.

## Objectives

This study had 2 objectives which were:

1. To determine the effect of Active Exercises on patients with Type 2 Diabetes Mellitus.
2. To determine the effect of Active exercises and Passive Sustained Specific Muscle Stretch on patients with Type 2 Diabetes.

## Methods

40 subjects with the history of Type-2 diabetes mellitus since 3-5 years were allocated from Dept. of Diabetology, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum, Karnataka. Subjects were divided randomly into 2 groups. Group A (20 subjects) received Active exercises program which was to be done at home, while Group B (20 subjects) received Active exercises and Passive sustained stretching. Passive sustained specific muscle stretches were given 2 hours after breakfast. Sustained stretches were given to 10 muscle groups, 3 repetitions and 30 second hold. The blood glucose level was examined on day 1, day 3 and day 6 using Bayer Breeze 2 Glucometer. The study was ethically approved by the Institutional Review Committee of KLE University, Institute of Physiotherapy, Belgaum, Karnataka.

1. Seated knee flexors (Bilateral): Each person sat on the floor with the legs extended and arms above the head. The person lowers down his head towards the knees while the experimenter pushed down on their back.
2. Seated knee flexor- hip adductor: the subject sat on the floor in lotus position. The subject lowers down his head while the experimenter pushes his back down
3. Seated shoulder lateral flexor (Bilateral): The person sat in his chair with fingers interlocked and placed behind his head. Keeping the arms in this position, the experimenter stood behind the person and pulled his elbows back towards the midline.

4. Supine hip flexor-Knee extensors (unilateral): The participants lay on their backs with their leg hanging over the edge of the couch with the knee flexed at approximately 90 degrees. The hip is then hyper-extended by the experimenter.
5. Seated hip external rotators, Extensors (unilateral): Each person sat on the floor with one leg extended. The opposite leg was flexed at the knee and the foot was placed flat against the inner thigh of the extended leg. The subject is asked to bend towards the extended leg.
6. Seated shoulder extensors, adductors, retractors (unilateral): Subject seated in chair, extends his arm and places horizontally across his chest. The experimenter stood behind the subject and pulls the arm against the chest.
7. Supine Knee flexor, plantar flexors (unilateral): Each person lay on their back with legs extended. The experimenter then raises one leg with hip flexion and ankle dorsi-flexion.
8. Prone Hip flexor (unilateral): Subject lies on stomach with knee flexed to 60 degrees. The experimenter hyper-extends the hip and lifts the thigh.
9. Seated shoulder flexors, depressor (bilateral): Subject sat on the floor with legs extended. The experimenter grabs the wrist and while keeping the back and elbows straight he hyper extends the shoulder by raising the arms behind the back and up towards the head.
10. Seated Shoulder and elbow flexors (unilateral): Each subject sat on the floor with legs extended, with one elbow flexed and brought up near the ear. The shoulder is hyper flexed by the experimenter pushing the upper arm down towards the floor<sup>(2)</sup>.

### Statistical analysis

Statistical analysis was done manually as well as by using SPSS software. For the analysis of categorical data students Chi Square-test was done. It was found that the baseline characteristics of both groups were comparable. The main outcome measure in the study was Blood sugar level. A paired t-test was done to compare the pre and post values within the groups, while unpaired t-test was done to compare the values between the groups.

### Results

Age and Duration of Type 2 Diabetes Mellitus for both the groups was same, there was no statistical difference in both the groups (table 2).

	MALE	FEMALE	TOTAL
GROUP A	9(45%)	11(55%)	20
GROUP B	10(50%)	10(50%)	20
	$\chi^2= 0.100$	Df= 1	P=0.752

Mean age of subjects in group A was 49.7 while in group B was 48.9. Mean Duration of Type 2 Diabetes Mellitus in Group A was 4.35 and in group B was 3.95.

GROUP A	49.7±2.63 YEARS	4.35± 1.13 YEARS
GROUP B	48.9± 3.22 YEARS	3.95± 1.19 YEARS
T-VALUE	0.806	1.087
P-VALUE	0.425	0.284

In Group A the mean BSL on Day 1 was 199.7, which was reduced to mean of 184.4 on day 6 of treatment. Difference of 15mg/dl was found. (table 3.) The paired t-test was found to be <0.001, which is statistically significant. In Group B, the mean BSL on Day 1 was 198.5, and 171.1 on day 6 of treatment. Difference of 27 mg/dl was found. (table3.)

The paired t-test was found to be <0.001 which is statistically significant (table 4). Unpaired t-test was done between Group A and Group B, the difference between the two was <0.001 which is statistically significant

	<b>DAY 1</b>	<b>DAY 3</b>	<b>DAY 6</b>	<b>DIFFERENCE</b>
GROUP A	199± 9.45	190±9.59	184±14.42	15.3± 3.14
GROUP B	198.5± 15.19	182.2± 13.55	171.1± 12.54	27.5± 5.97
T-VALUE	0.300	2.262	3.662	8.043
P-VALUE	0.766	0.029	0.001	<0.001

The results of unpaired t-test suggested that there was statistically more difference in the blood sugar levels of the subjects treated with Active exercises and Passive sustained specific muscle stretches.

GROUP A	T-VALUE= 21.741	DF= 19	P=<0.001
GROUP B	T-VALUE= 20.536	DF= 19	P=<0.001

## Discussion

There are many studies which have stated that Active exercises help to reduce blood sugar levels. Present study mainly concentrates on Passive stretching of muscles to reduce blood sugar levels. An experimental study done by Nelson et al, states that passive stretching helps to reduce blood sugar levels in Patients of Type 2 Diabetes Mellitus and the population at risk.<sup>[2]</sup> study done by Nie et al in 2000 on paralyzed hemi-diaphragm reported increase in Glucose transporters after giving passive stretching. [7] Few studies have reported that Passive Stretching induces increase in heat production and increased oxygen consumption. Many other related studies have reported increase in glycogen breakdown, increased CO<sub>2</sub> production, increased lactic acid production. Increased metabolic activity is related to increase Adenosine Monophosphate Kinase. [7]

AMPK works like a regulator for Glucose Transport Mechanism. When passive stretching is given, there is an increase in AMPK which in turn facilitates the GLUT mechanism and hence the blood sugar levels are reduced. Previous studies have shown immediate effect of passive stretching on blood sugar levels, but this study checks the long term effect of the intervention on blood sugar levels. And it was found that passive sustained specific muscle stretch has a positive effect. [6]

There are previous studies which are done to find the effects of active exercises after insulin medications and they have concluded that there was significant reduction in blood sugar levels. [8,9] This study has found similar results after giving passive sustained specific muscle stretches. [2]

There were many limitations in the study. First is that the diet of the subjects was not controlled. All the subjects had different diet and diet has a significant impact on the blood sugar levels. Secondly the groups were not homogenous. Study was done on a small sample size.

For further study a larger sample size and a follow-up after few weeks would give better results.

## Conclusion

From the results obtained, it can be concluded that Passive Sustained Specific Muscle Stretches with Active Exercises and Active exercises only are effective in reducing blood sugar levels of patients with type 2 diabetes mellitus

But when it comes to better results, than a combination of Active exercises and passive sustained specific muscle stretches are more effective in reducing blood sugar levels.

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### Conflicts of interest

The authors declare that there is no conflict of interest

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