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A study to evaluate effectiveness of calf muscle exercise on postprandial blood sugar level among types 2 diabetes mellitus patients in selected hospitals

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Abstract
Postprandial hyperglycemia plays a major role in the progression of type 2 diabetes mellitus (T2DM) and related metabolic complications. This study aimed to assess postprandial blood sugar levels and evaluate the effectiveness of calf muscle exercise in reducing postprandial glucose among patients with T2DM. A quasi-experimental design was adopted with 50 participants, equally divided into experimental and control groups. Demographic data and postprandial blood sugar levels were assessed using a structured tool. The experimental group performed planned calf muscle exercises, while the control group received routine care. Results showed a marked improvement in postprandial blood sugar levels in the experimental group, with most participants shifting to the 100–140 mg/dL category after intervention, whereas no such improvement was observed in the control group. Statistical analysis revealed a significant reduction in postprandial blood glucose in the experimental group ($t = 5.09$, $p < 0.05$). The study concludes that calf muscle exercise is a simple, cost-effective, and beneficial strategy for improving postprandial glycemic control in patients with T2DM.

Keywords: Calf muscle exercise, type 2 diabetes mellitus (T2DM), post prandial blood sugar

Introduction

Blood glucose control, especially after meals (postprandial period), is critical in the prevention and management of hyperglycemia and related metabolic disorders, such as Type 2 diabetes mellitus (T2DM). Physical activity — including aerobic exercise, resistance training, and muscle-targeted exercises — has been shown to improve glycemic responses and reduce post-meal glucose spikes.

Muscle contraction activates glucose uptake mechanisms independent of insulin by stimulating translocation of glucose transporters (e.g. GLUT-4) to muscle cell membranes, increasing glucose utilization by skeletal muscles.

In this context, targeted activation of the calf muscle — in particular the deep oxidative muscle group (e.g. the Soleus muscle) — may represent a simple, low-cost and accessible intervention. A pilot study showed that performing the so-called "soleus push-up" after a glucose challenge resulted in a substantial (~ 32%) reduction in post-meal glucose excursion in individuals with impaired glucose tolerance (prediabetes).

Postprandial hyperglycemia is a major contributor to metabolic dysfunction, and repeated glucose spikes significantly increase the risk of type 2 diabetes and cardiovascular disease. Studies show that post-meal glucose excursions account for up to 70% of total daily hyperglycemia in individuals with impaired glucose tolerance (IGT). Aerobic activity performed after meals has demonstrated a 3.4% to 26.6% reduction in postprandial glucose area-under-curve (AUC), highlighting the importance of muscle activity in regulating post-meal glycemia. (Reference: Erickson *et al*., 2017, PubMed ID: 29396781) [6]

Emerging evidence indicates that low-intensity, localized muscle activation—particularly involving the calf and soleus muscles—may significantly influence blood glucose uptake. A recent experimental study on the "soleus push-up" reported a 32% decrease in postprandial glucose excursion in participants with prediabetes following controlled glucose intake. This effect was achieved without whole-body aerobic exercise, demonstrating that isolated calf-muscle contractions can enhance oxidative metabolism and stimulate insulin-independent glucose uptake. (Reference: Hamilton *et al*., 2024, PubMed ID: 40137805) [7]

Despite promising results, existing research on muscle-specific exercises remains limited, with most studies focusing on walking or whole-body resistance exercise. Resistance-based postprandial activity has shown reductions of ~30% in glucose AUC and a 35% decrease in time spent in hyperglycemia, but such protocols may be difficult for sedentary, elderly, or mobility-limited populations. Calf-muscle exercises, which can be performed while sitting, offer a simple and accessible alternative with potentially comparable benefits. This creates a strong need to evaluate their effectiveness systematically. (Reference: Erickson *et al*., 2017, PubMed ID: 29396781) [6]

Methods & Tools Used

1. **Research Approach:** Quantitative Research Approach
2. **Research design**: Quasi experimental – Non-Randomised control group design
3. **Sampling technique**: Non-probability purposive sampling technique
4. **Samplingsize**: 50
5. **Research setting**: selected hospitals of Ahmedabad.

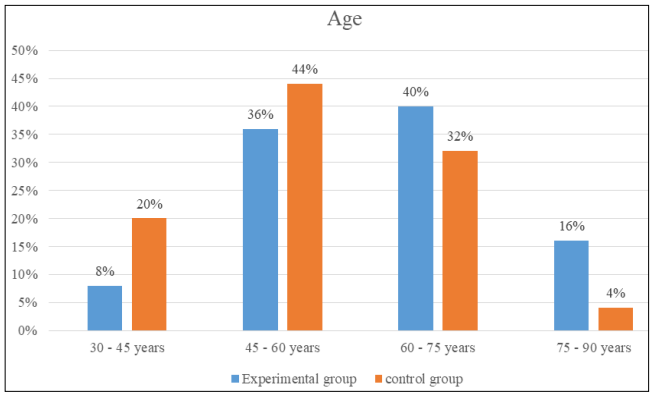
Tool Used

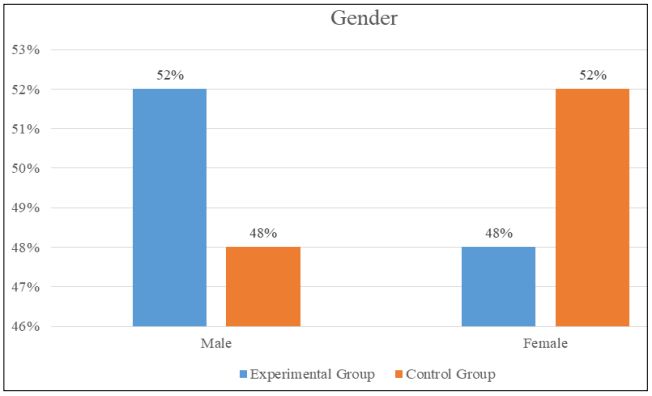
Glucometer for checking the post prandial blood sugar level.

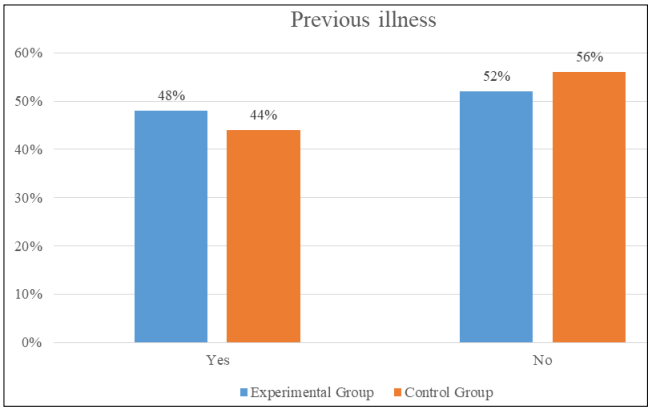
Results

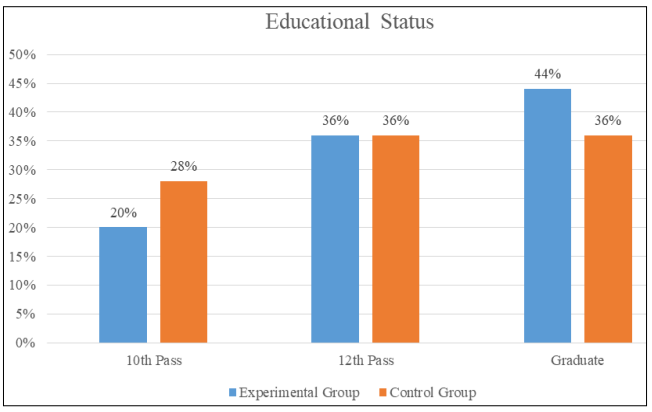
Section-I: Frequency and percentage distribution of demographic variables. N=50

Sr. No.	Demographic Variables	Experimental group		Control group	
		F	(%)	F	(%)
1	Age:				
	30-45 years	2	8%	5	20%
	45-60 years	9	36%	11	44%
	60-75 years	10	40%	8	32%
	75-90 years	4	16%	1	4%
	Total	25	100%	25	100%
2	Gender:				
	Male	13	52%	12	48%
	Female	12	48%	13	52%
	Total	25	100%	25	100%
3	Previous illness:				
	Yes	12	48%	11	44%
	No	13	52%	14	56%
	Total	25	100%	25	100%
4	Educational Status:				
	10^{th} pass	5	20%	7	28%
	12^{th} pass	9	36%	9	36%
	Graduate	11	44%	9	36%
	Total	25	100%	25	100%









Interpretation

Above table of experimental group shows that 8% of sample (2) were in the age group of 30-45 years, 36% of samples (9) were in the age group of 45-60 years, 40% of samples (10) were in the age group of 60-75 years and 16% of samples (4) were in the age group of 75-90 years.

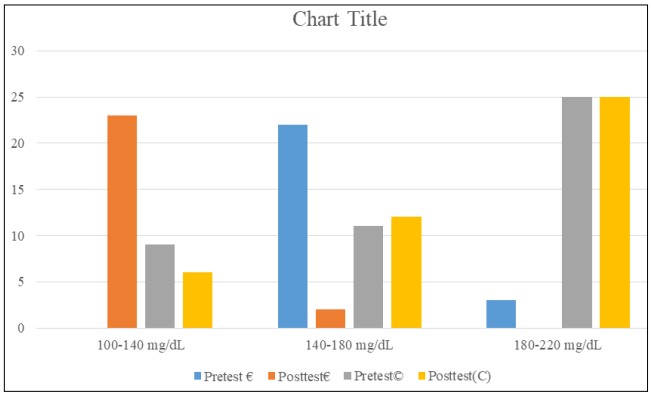
52% of sample (13) were male and 48% of sample (12) were female. 48% of sample (12) were suffering from previous illness and 52% of sample (13) were not suffering previous samples. 20% of sample (5) were 10^{th} pass, 36% of sample (9) were 12^{th} pass and 44% of sample (11) were graduated.

Also, above table of control group says that 20% of sample (5) were in the age group of 30-45 years, 44% of sample (11) were in the age 45-60 years, 32% of sample (8) were in the age group of 60-75 years and 4% of sample (1) were in the age group of 75-90 years.

48% of sample (12) were male and 52% of sample (13) were female. 44% of sample (11) were suffering previous illness and 56% of sample (14) were not suffering from any previous illness. 28% of sample (7) were 10^{th} pass, 36% of sample (9) were 12^{th} pass and 36% of sample (9) were graduated.

Section-II: Assessment of Postprandial Blood Sugar Level in Experiment and Control Group

Sr. No.	Categories	Experimental group		Control group	
	Blood sugar level (mg/dL)	Pretest	Posttest	Pretest	Posttest
1	100-140	0	23	9	6
2	140-180	22	2	11	12
3	180-220	3	0	5	7
Total		25	25	25	25



Interpretation

Above mentioned table signifies that shows that in the experimental group before providing the intervention there were 0 samples in the category 100-140, 22 in category 140-180 and 3 in category 180-220 and after providing the intervention 23 samples in category 100-140, 2 in category 140-180 and 0 in category 180-220.

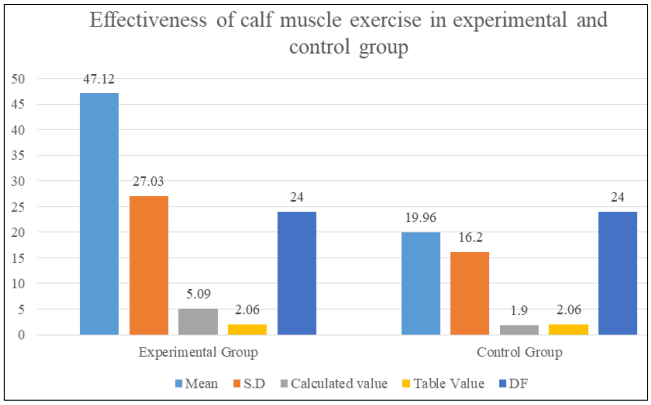
While in the control group in the pretest 9 samples were in the category 100-140, 11 in the category 140-180 and 5 in the category 180-220 and while in the posttest 6 samples in the category of 100-140, 12 in the category 140-180 and 7 in the category of 180-220.

In the experimental group posttest there is improvement seen in the postprandial blood sugar level after providing planned intervention and while in the control group there is no such improvement seen in the posttest as no such intervention was provided so the H_1 hypothesis is accepted.

Section-III: Effectiveness of calf muscle exercise in experimental and control group.

Mean and standard deviation, t-test

Group	Mean	SD	Calculated value	Table value	df	significance
Experimental group	47.12	27.03	5.09	2.06	24	Significance
Control group	19.96	16.2	1.9	2.06	24	Not significant



Interpretation

Above table signifies that for the experimental group having 25 samples the mean is 47.12, standard deviation 27.03 and calculated value 5.09 whereas the table value is 2.06.

And for the control group mean is 19.96, standard deviation 16.2 and calculated value is 1.9.

The calculated value of the experimental group is 5.09 which is more that table value and for the control group it is 1.9 which is less that the table value at 0.05 level of significance so the H_2 hypothesis is accepted.

Discussion

The present study demonstrated that calf muscle exercise significantly reduced postprandial blood sugar levels among patients with type 2 diabetes mellitus. A marked improvement was observed in the experimental group, with most participants shifting to the normal postprandial range (100–140 mg/dL), while the control group showed no improvement. These findings support the hypothesis that localized muscle activity can enhance glucose uptake and improve glycemic control through insulin-independent mechanisms.

The results are consistent with previous studies. Erickson *et al*. (2017) [6] reported that post-meal physical activity reduced postprandial glucose area under the curve by 3.4%–26.6%, emphasizing the importance of muscle contraction in glucose regulation. Similarly, Hamilton *et al*. (2024) [7] demonstrated a 32% reduction in postprandial glucose excursion using the soleus push-up exercise in individuals with impaired glucose tolerance, highlighting the role of calf and soleus muscles in oxidative glucose metabolism.

Unlike whole-body aerobic or resistance exercises, calf muscle exercise is simple, low-intensity, and feasible for elderly or mobility-limited individuals. Thus, the present study adds evidence that calf muscle exercise is an effective, accessible, and practical intervention for postprandial glycemic control in patients with type 2 diabetes mellitus.

Conclusion

The study shows that calf muscle exercises effectively lower postprandial blood sugar in Type 2 diabetes mellitus patients. This easy, accessible activity can be used as a practical method to improve daily blood glucose control.

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