

# Comparison Of Glycemic Behavior Between Strength Training, High Intensity Resistance Training (Hirt), High Intensity Interval Training (Hiit): A Case Study

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## ABSTRACT

Type 2 Diabetes Mellitus (DM 2) is generally a defect in insulin action and secretion and in the regulation of hepatic glucose production. Exercise to treat type 2 diabetes has had positive impacts on the lives of diabetics. The aim of this study is to analyze the effects of the glycemic curve in three different types of training: Strength Training (TF), High Intensity Resistance Training (HIRT) and Interval High Intensity Training (HIIT). The participant is a 57-year-old, sedentary type 2 diabetic who underwent the training method - Strength Training (ST) 60% of repetition maximum (RM), 8 to 12 repetitions, cadence 2010, the 2-minute rest interval. High Intensity Resistance Training (HIRT) protocol consisted of three sets with six repetitions at 80% of 1RM followed by rest for 20 seconds, the individual performs another series with the same load until reaching the point of failure again. The rest of one exercise and another is 2'30", and High Intensity Interval Training (HIIT) a 5-minute warm-up moderate load - 4 shots of 30 seconds of high intensity duration separated by 4 minutes of rest, once a week at night. Pre-study anamnesis, pre- and post-exercise glycemia were performed. The overall results were satisfactory presenting HIIT as the most effective method for acute post-exercise blood glucose reduction (reducing 29.62%, 34.25%, 38.89 and 36.11% immediately at 10, 20, 30 minutes after exertion respectively). It was concluded that physical training positively influenced the reduction of blood glucose as an acute effect, but HIIT was the most effective method.

**Keywords:** Diabetes mellitus; Blood glucose; High intensity; Physical exercise

## INTRODUCTION

Diabetes mellitus (DM) is a chronic non-communicable disease (NCD) that affects about 425 million adults worldwide [1], 90% of diabetics are type 2 (DM2). Therefore, DM2 is characterized by the fact that insulin is unable to perform its functions normally. Evidence suggests that type 2 diabetes can often be prevented, while early diagnosis and access to appropriate care for all types of diabetes can prevent or delay complications in people living with the disease [1].

Physical exercise brings several benefits to diabetics, this is due to the improvement in blood glucose uptake, increase in muscle mass, improvement in body composition, biochemical aspects (cholesterol, glycated hemoglobin). Some authors such as Maiorana et al., [2] present in their study the relationship of

glycemic control and physical exercise (circuit combining aerobic and resistance training) in diabetic individuals.

High-intensity interval training (HIIT) refers to training that involves alternating periods between vigorous (intense) exercise and rest for recovery. According to Lanzi et al., [3] HIIT quickly induces adaptations that are linked to improved aerobic fitness and health-related outcomes in sedentary and overweight/obese individuals

As it is a growing chronic disease in the world population, further studies on training methods, physical exercise related to chronic diseases, especially DM2, are needed. This article is relevant for comparing and discussing methods that are still little used in DM2 people. The aim of this study is to analyze the effects of the glycemic curve in three different types of training: Strength Training (ST),

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High Intensity Resistance Training (HIRT) and High Intensity Interval Training (HIIT)

## MATERIAL AND METHODS

In this case study, a type 2 diabetic adult man (C.C.S) was selected, with (Table-1). After being informed about the objectives and possible risks, benefits and discomforts of the study, the volunteer signed the term informed consent (TIC). This study was approved by the Research Ethics Committee of the Federal University of Goiás (CAAE: 50717115.4.0000.5083).

The volunteer performed three training sessions with a week recovery between each one as described in [Table-2]. Muscle strength measurements were performed using a 10 RM strength test on the Leg 45° and the bench press [4]. The execution techniques for the Leg 45° and bench press exercises followed the guidelines of the NSCA (National Strength and Conditioning Association) [5].

## EXERCISES PROTOCOL

The resistance exercise protocol consisted of three sets at 60% of RM, 8 to 12 repetitions, cadence 20/10, the 2-minute rest interval [6], for Legpress, stiff, bench press exercise (free bar), supine and abdominal pull.

The HIIT protocol training sessions involved a 5-minute warm-up moderate load – 4 shots of 30 seconds of high intensity duration separated by 4 minutes of rest or light cycling, for a total time of 23 minutes per training session [7].

The HIRT protocol consisted of three sets with six repetitions at 80% of 1RM followed by rest for 20 seconds, the individual performs another series with the same load until reaching the point of failure again. The rest of one exercise and another is 2'30" [8]. Leg press, stiff, bench press, supine pull exercises were used.

## MATERIALS USED

To assess blood glucose, the glucometer (Accu Check Active, mod. 18946, Brazil) was used to measure body mass using an analog scale (Filizola®, mod. Personal 7708, Brazil) Height was obtained using a stadiometer (Seca®, Brazil) with an accuracy of 0.1 cm, respectively according to the procedures described by Lohman, Roche and Martorell [9]. From the division of body mass by the square of height, the body mass index (BMI) was obtained [10].

## RESULTS

The behavior of glycemia was observed pre and post effort in ST, HIRT and HIIT training and the [Table- 3] show the results obtained in each of the methods used.

**Table 1:** Participant Characteristics.

Age (years)	57	
Body Mass (kg)	83	
Height (m)	1,72	
BMI (kg/m <sup>2</sup> )	26,2	
Years Diabetics	32	
Medicines	Period	Dosage
Enalapril Maleate	Morning and night	10 mg
Nesina Pio	Night	25 + 30mg
Simvastatin	Night	10 mg
Xigdu XR	Morning and night	5mg

**Table 2:** Study Design.

VISIT	PROCEDURE
1ª VISIT	TIC/Anamnesis/Anthropometric Assessment/10 RM test
2ª VISIT	Test Protocol HIIT
3ª VISIT	Assessment ST
4ª VISIT	Assessment HIRT
5ª VISIT	Assessment HIIT
6ª VISIT	Anthropometric Reassessment

TIC: Term Informed Consent; RM: Maximum Repetition; HIIT: High Intensity Interval Training HIRT: High Interval Resistance Training

**Table 3:** Glycemic behavior in situations and moments measurement.

Moment	Situation		
	TF	HIRT	HIIT
T0 x T1	↓ 18,78%	↓ 0,93%	↓ 29,62%
T0 x T10	↓ 18,78%	↓ 12,14%	↓ 34,25%
T0 x T20	↓ 19,39%	↓ 14,95%	↓ 38,89%
T0 x T30	↓ 23,63%	↓ 7,94%	↓ 36,11%

T0: Moment before effort; T1: Immediately after; T10: 10 minutes after; T20: 20 minutes after; T30: 30 minutes after; HIIT: High Intensity Interval Training; HIRT: High Intensity Resistance Training; ST: Strength Training

## DISCUSSION

The aim of this study was to analyze the effects of the glycemic curve in three types of training: ST, HIRT and HIIT, from the evaluations of the three methods, HIIT was the training that had a greater reduction in blood glucose of 38.8% before and after.

The ST showed reductions in post-physical exertion assessments even with a single training session. A study by Castaneda [11], with the objective of verifying the effectiveness of resistance training in the glycemic control of DM2 adults, performed in 16 weeks with 62 adults of both sexes, resulted in the reduction of plasma levels of glycated hemoglobin and increased lean mass

In this case study, HIRT was not very efficient in reducing post-exercise blood glucose, despite an assessment of the acute effect, but a study by Dunstan [12] for 6 months showed that HIIT was effective in improving other aspects such as muscle strength. Probably this difference between the studies occurred due to the time of training, the first being only one session and the second for 6 months.

The HIIT was the most effective method among the three methods used, with the highest levels of reduction compared to pre-effort, some studies also point out the effectiveness of HIIT in more training sessions and also an assessment over 30 minutes. In the study by Francois and Little [13], it shows that training HIIT for two weeks, with three weekly sessions were effective in reducing the average of 24 hours of blood glucose.

Despite the different data for each training method the three caused changes in blood glucose levels corroborating with the studies previously presented, in which regardless of the method directly influences blood glucose homeostasis, in addition, insulin promotes the uptake of glucose by cells of muscle and adipose tissue, that is, when the individual performs the exercise of the cells increase the uptake of circulating glucose, transforming the min to energy that will be used by the muscle and improving glycemic rates and insulin metabolism that is increasing muscle mass, the better the use of glucose and the lesser the use for adipose tissue [14].

As a limitation of the study we had only one sample, short duration and there was no greater control over the eating plan, as this study is a case study and uses only one sample the results are restricted due to the number of individuals evaluated. For future research it is interesting to evaluate a larger number of people to obtain results at a macro level of the Evolution of the disease and how exercise can assist to or not in the treatment and control of DM2.

With this work it can be concluded that the physical exercise being resisted and the high intensity exercise has a positive effect

on the blood glucose of an individual with DM2, promoting the reduction of blood glucose, but this case study showed that HIIT was more beneficial in reducing blood glucose compared to HIRT and strength training.

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