Acute and subacute evaluation of plasma glucose with circuit strength training in young adults: Study protocol

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Abstract:

Background: Strength training with physical exercise improves glycemic stability during exercise and reduces the duration and severity of post-exercise hypoglycemia in individuals with type 2 diabetes. Even though the effects of exercise on health are vast in the literature, the acute and sub-acute response of plasma glycemia with circuit strength training (CST) in young individuals is very scarce. **Objectives:** Develop a study protocol to evaluate plasma glycemic behavior in healthy young adults before, during and after CST with active rest. **Methods:** This is a cross-sectional study. Participants will be selected based on certain variables of interest, informed about the study, and signing the informed consent. Participants will undergo anamnesis, anthropometric assessment collection, in order to outline the physical-functional profile, taken to the weight room, where they will spend 10 minutes in a sitting position to collect pre-protocol capillary blood, one group will carry out a session with control protocol without exercise and another, a session with an experimental protocol with CST and will have plasma glucose collected between and post-protocols. **Results:** This cross-sectional study protocol is expected to contribute additional information on understanding the acute and subacute effects of plasma glycemia with CST, with active rest, in young individuals.

Keywords: Strength training; circuited; acute effect; subacute effect; physical exercise; plasma glycemia.

BACKGROUND

Maintaining a normal plasma glucose concentration requires an accurate match between glucose utilization and endogenous glucose production or dietary glucose distribution[1]. Glucose is derived from intestinal absorption that follows the digestion of die-tary carbohydrates, glycogenolysis, and gluconeogenesis[2]. Glucose is transported into cells[3] through multiple metabolic pathways, can be stored as glycogen and, can undergo gly-colysis to pyruvate[4]. Finally, it can be released into the circulation by the liver and kidneys, the only organs that contain glucose-6-phosphatase, the enzyme required for the release of glucose into the circulation[5-6].

Insulin is the dominant glucoregulatory hormone[7]. In the fasting state, it regulates plasma glucose concentration mainly by restricting hepatic glucose production. Higher concentrations, such as those found after meals, are necessary to stimulate glucose utilization[8-9]. Glucagon is a potent hyperglycemic hormone[10] that acts almost exclusively in the liver to increase hepatic glucose production within minutes[11]. Carbohydrate ingestion causes an immediate increase in insulin concentration and a decrease in glucagon concentration. The increase in insulin concentrations, which occurs before the increase in arterial glucose concentrations, is believed to be mediated largely by hormonal signals arising in the gastrointestinal tract (boosting effect)[12].

Unhealthy diets and lack of physical activity have contributed to a worldwide increase in the prevalence of obesity, type 2 diabetes (T2D), and metabolic syndrome[13]. But this epidemic is not inevitable. We know that lifestyle intervention can dramatically reduce the incidence of diabetes and slow the rise in blood glucose levels in both non-diabetic and diabetic people[14].

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Studies have suggested that training supervision and participant adherence to physical exercise programs ultimately influence the desired results. However, to the best of our knowledge, they have not investigated training volume based on frequency and hours of activity in combined circuit exercise programs performed by people with glycemic responses[15].

Circuited strength training (CST) combined with aerobic exercises is a strategy to alter indicators of improved plasma glycemic control, increase energy expenditure and responses to exercise in each training session, in addition to being well tolerated by people with excess body mass [16]. CST has demonstrated the potential to contribute to better glycemic control in people with T2D, however, there are contradictory results in this regard and the need to clarify the effects of training on glycemic control in diabetes[4-12].

Regular CST is associated with greater longevity and lower frequency and severity of plasma complications[17]. The type of exercise recommended for potential improvements in blood glucose in this population is varied, with an emphasis on circuit training[14-16]. Including brief periods of intense activity, where anaerobic metabolism plays an important role in providing fuel, may help prevent hypoglycemia during and up to 2 hours after exercise in individuals with T2D[13].

Traditionally, the treatment and control of plasma glycemia includes lifestyle changes[18], such as increased daily training[19], but despite several strategies, there is still a challenge for behavioral re-education programs to maintain high adherence of participants to the circuited physical exercise program[20-22].

Our hypothesis is that the CST method promotes positive responses in individuals with anthropometric and biochemical risk to indicators of plasma conditions. Furthermore, those participants who have a higher frequency of CST may experience more beneficial effects. Thus, the objective of this research is to develop a study protocol on the assessment of plasma glycemic behavior in healthy young adults before, during and after CST with active rest, through a cross-sectional study.

METHODS

This protocol was developed using the cross-sectional study method. Participants are selected based on the inclusion and exclusion criteria defined for the study. Once participants are selected for the study, the investigator monitors the study to evaluate exposure and results. The sample will consist of 30 male individuals, higher education students, who were divided by draw into 2 groups with equal numbers: Control Protocol (n=15) and Experimental Protocol (n=15). After these procedures, the individuals performed one-repetition maximum tests (1RM), alternating between the upper and lower limbs on the following weight training equipment: bench press, front pull-down, flexor table and leg extension. 1RM test defined the load used in the exercises of the experimental protocol. The sample was subjected to study sessions: Experimental or Control, with blood glucose measurements before, during and after.

Inclusion criteria

The inclusion criteria will be male volunteers will be included in the study, with at least 6 months of experience with strength training, age 20 to 30 years, do not have a chronic illness and, not be a smoker.

Exclusion Criteria

According the exclusion criteria, patients who do not have at least 6 months of experience with strength training, be under 20 and over 30, have a recent cardiovascular

event (last 3 months), and present any physical or mental limitation that prevents the performance of study procedures will not be included in the study.

Procedures

After signing the informed consent in accordance with Resolution 510/2016 of the National Health Council (CNS), and inclusion in the research, individuals will be submitted to an anamnesis with a view to whether or not they fit into the project, according to the inclusion criteria and exclusion, and physical assessment. After such procedures, individuals will perform 1RM, alternating between the upper and lower limbs on the following weight training equipment: bench press, front pull-down, flexor table and leg extension. 1RM test will define the load used in the exercises of the experimental protocol. The sample will be subjected to study sessions: Experimental or Control group, with blood glucose measurements before, during and after.

The anamnesis will be carried out in the format of a semi-structured interview in which questions will be asked about the individual, physical exercise habits, experience or not with strength exercise, among other approaches. Being part of the criteria used for inclusion/exclusion of the research. The physical assessment of individuals will consist of anthropometric measurements (height and weight) to calculate the body mass index (BMI) using a Welmy brand electronic scale, precision 0.2 kg electronic scale, with a precision of 0.1 kg (Filizola Ltda, São Paulo, Brazil). Height will be assessed using a stadiometer graduated in centimeters and accurate to 1mm of body mass (Sanny). The calculation of the percentage of lean mass and fat mass will be carried out with the bioimpedance equipment using electrodes Maltron BF-906 Body Fat Analyzer (Maltron International Ltd, 20 Sirdar Road, Rayleigh, Essex, SS6 7XF, UK).

Study protocol

The 1RM test will follow the Baechle and Earle protocol[19]. Resistance exercise promotes muscular fitness (i.e., increased muscular strength and labor economy, and improved power and speed during daily life or sporting tasks), which is undoubtedly accompanied by physiological and morphological muscular adaptations. However, muscular adaptation to resistance training requires variables to be planned (exercise choice, exercise order, load, volume, rest, repetition frequency and speed) to match a specific goal. In which the individual will mobilize a load that will enable them to perform 1RM in a regime of voluntary concentric muscle failure, making it impossible to perform the second repetition. For those who exceeded 1 repetition, a time of 3 to 5 minutes will be adopted for a new test, with a maximum of 4 tests.

Aiming to reduce the margin of error, will be adopted the strategies, standardized instructions were offered before the test, so that the person being evaluated is aware of the entire routine that will involve data collection.

1. The person being evaluated will be instructed on the technique for performing the exercise;

2. The evaluator will be aware of the position adopted by the practitioner at the time of the measurement. Because, small variations in the positioning of the joints involved in

the action can recruit other muscles, causing distance from the specific focus of the research and allowing erroneous interpretations of the obtained scores;
3. A fixed position for the foot will be stipulated, thus avoiding differentiation in the angle of the ankle of the same individual in the two tests.

Measurement of plasma glycemia

Plasma blood glucose will be measured using a blood glucose monitor (Accu-Chek Go, Roche Group, Germany). For the operation of this device it will be necessary to use an automatic and disposable looper (Accu-chek Uno, Roche Group, Germany) and test strips (Accu-chek Go, Roche Group, Germany). All researchers will be trained to collect capillary blood, where there will be an aseptic process to avoid contamination and risks among those involved. Gloves will be used to handle the subject and the blood glucose analysis strips. The lancet will be a single-use type, from Accu Check Uno. The used lancets and strips will be disposed of in appropriate specific waste (discard). The Accu-chek Go blood glucose monitor will allow you to check your plasma glucose level directly. The blood will be aspirated, using a lancet, onto a test strip. Each test strip will have a test zone containing detection reagents. When blood is applied to this area, a chemical reaction will occur that will cause a change in color in the test area. The Accu-Chek Go device will record this color change, and from it, the blood glucose value will be calculated. The measurement will be carried out at 6 moments. Before training (Pre Moment), during circuit strength training after circuit 1 (Moment 1), after circuit 2 (Moment 2), after circuit 3 (Moment 3), 15 minutes after training (Moment 4) and 30 minutes after training (Moment 5).

Intervention Protocols

Participants will be taken to a weight room, where they will remain in a sitting position for 10 minutes to collect capillary blood. Soon after, in the strength training protocol using circuit methodology, exercises will be performed in sequence and without rest. Individuals will warm up for 5 minutes with stretching of the regions that will be trained. The circuit will consist of 7 exercises: front pull with supinated grip, bench press on the machine, biceps curl, triceps on the pulley, LegPress, chair extension and chair flexor. The individualized load will be according to the 1RM test. In sequence, 3 circuits will be performed following the exercises mentioned above. Each circuit will involve 12 to 15 repetitions at 70% of the 1RM. After completing each circuit, blood will be collected, with collections at the end, at minutes 0, 15 and 30 after the end of the last exercise circuit. With complete training, individuals will sit down to wait for collection at the respective times mentioned above. In the protocol, the intake of any type of food will be prohibited. Individuals will be allowed to talk to each other and drink water.

In the protocol without training, participants will also be taken to a weight room, where they will remain in a sitting position for 10 minutes to collect capillary blood and will not perform training. Again, they will have their blood glucose measured after 10 minutes, and after 20 minutes (2 measurements corresponding to the period during the protocol with circuited strength training). After the end of this period, participants will

remain seated for post-protocol measurements, at 0 minutes after, 15 minutes after and 30 minutes after. In the protocol without training, the intake of any type of food and strength training will be prohibited. Individuals will be allowed to talk, stand, sit and drink water if they wish.

Statistical analysis

Data will be presented using mean and standard deviation. The statistical treatment will be carried out using the SPSS 18 program. The Kolgomorov Smirnov test will be applied to evaluate the data distribution. For the analysis of intra and intergroup means, the t-student test for paired samples will be used. Therefore, it will be adopted with a significant value, $p<0.05$.

Data collection

In this research, the pre- and post-intervention assessments will be carried out in the same location along with the physical exercise sessions and their assessments, the weight room of the multi-sport center and the Exercise Physiology Laboratory/LAFEX of the Es- Higher Education School of Physical Education and Physiotherapy of Goiás (ESEFFEGO) of the State University of Goiás (UEG), Goiânia (GO), Brazil.

Ethical statements

The authors certify that this study received ethical approval from the appropriate ethics committee, was submitted and approved by the ethics committee under protocol number CAAE-0055.0.171.000-11-FR-461825-SISNEP. Informed consent to participate in the study will be obtained from all participants. All data collected will be confidential, seeking to help participants in this and other health research experiences, ensuring that the benefit is greater or at least equal to the alternatives already established for prevention, diagnosis and treatment. Therefore, all information will be confidential, the participant's name will be kept confidential and the data obtained will only be used for academic purposes. All data will be archived for five years and after this period, they will be incinerated, per SNC Resolution 466/12.

Risks and benefits

This research presents the risk of restrictions on the questionnaire, which could contain some questions interpreted as invasive, but necessary for the progress of the research. Risks of dizziness, nausea, and discomfort caused by possible hypotension, discomfort with the holes with the lancet, which promotes the collection of material for measuring plasma glucose, as well as possible infection and, finally risks of minor injuries caused by exercising, as well as discomfort in some people.

However, these risks will decrease with monitoring, support, instruction and asepsis of the place/sterilized/disposable materials, by experienced researchers who undergo courses/continuing training. However, the study may contribute additional information on understanding the acute and subacute effects on plasma glycemia with circuit strength training, with active rest, in young individuals.

Individuals will have all their test results that will be developed into the research. Therefore, they will be together with researchers, seeking to improve access to alternative treatments, with regard to circuit strength training; providing specialized training monitoring, with immediate results on plasma glycemic behavior; also working on the collaboration of therapies to better offer more effective and safe treatments in the future.

RESULTS

Therefore, the present protocol was intended to ensure that the described intervention can contribute information that will help professionals when indicating or contraindicating effective circuit strength training alternatives for young patients.

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