International Journal of EXERCISE SCIENCE

Original Research

The Acute Effect of a Single Resistance Training Session on the Glycemic Response among Women with HIV/AIDS

DAYANE C. SOUZA†1, POLLYANA M. NUNHES†1, WAGNER J. R. DOMINGUES‡2, KAUANA MARCHINI†1, LUCAS HEY†1, JAIRO A. BERTI‡3, MICHELE C. C. TRINDADE‡1, and ADEMAR AVELAR‡1

[1]Department of Physical Education, State University of Maringa, Maringa, PR, BRAZIL; [2]Collegiate of Physical Education, Institute of Social Sciences, Education and Zootechnics, Federal University of Amazonas, Parintins, AM, BRAZIL, [3]Department of Physiology, State University of Maringa, Maringa, PR, BRAZIL

†Denotes graduate student author, ‡Denotes professional author

ABSTRACT

International Journal of Exercise Science 13(2): 319-328, 2020. The purpose of this study was to investigate the effect of a single resistance training session on the glycemic and lipid response of women with Human Immunodeficiency Virus (HIV)/Acquired Immunodeficiency Syndrome (AIDS) treated with Antiretroviral Therapy (ART). The sample consisted of 10 female subjects who underwent one resistance training session involving different muscle groups, that is, three sets of 8-12 repetitions with an interval of 90 seconds between the sets, and 120 seconds between exercises. The loads used in each exercise corresponded to an intensity equivalent to the interval of 5-7, which was in accordance with the OMNI-RES scale. The capillary glycemic levels were evaluated under the fed state before (Pre) and immediately after (Post) the exercise session. In order to evaluate the total cholesterol, HDL, and triglycerides (TG), blood samples were collected before (Pre) and one hour after the experimental protocol (Post). Non-HDL values were obtained using the Friedewald formula. The results showed that after a single resistance training session, alterations occurred in the glycemic response ($p = 0.03$), with a decrease of 11.4% in the values when comparing Pre and Post workout moments (99.8 ± 14.3 mg/dL vs. 87.3 ± 11.3 mg/dL, respectively). However, no significant result was observed regarding lipid response. In conclusion, a single resistance training session can reduce glycemic response in HIV positive people treated with ART without interfering with the lipid response.

KEY WORDS: Exercise, cholesterol, blood glucose, HIV infections, acquired immunodeficiency syndrome

INTRODUCTION

Acquired immunodeficiency syndrome (HIV/AIDS) is associated with several pathologies due to low immune system activity. Antiretroviral therapy (ART) is a strategy used to minimize the deleterious effects of the disease, especially opportunistic diseases. However, in the case of a set of drugs, the presence of side effects compromises the quality of life of these individuals (1).

Some of the effects caused by ART include increased dyslipidemia, which is characterized by low levels of High-Density Lipoprotein Cholesterol (HDL) and increased levels of total cholesterol, triglycerides, and Low-Density Lipoprotein Cholesterol (LDL) (11, 25). In addition, there are other important metabolic alterations, such as insulin resistance, which increases the risk factors for the development of Diabetes Mellitus (3).

Studies have shown an increase in the rate and risk of HIV patients developing diabetes after the introduction of ART (9, 19). Researchers also point out that there is an association between the drugs used to treat these individuals, especially protease inhibitors, with hyperglycemic changes, glucose intolerance, and insulin resistance, however, the mechanism by which this occurs is still not well established in the literature (29).

Considering the importance of ART for the survival of this population, investigations seeking alternatives capable of mitigating the side effects of treatment are necessary to provide these subjects with a better quality of life. Thus, exercise programs have been shown to be able to attenuate and control the deleterious effects caused by therapy (5). In addition, studies have shown that acute and/or chronic aerobic and/or resistance exercise has improved the quality of life of these patients (12, 27, 30, 38, 10, 39).

However, concerning this population, the workout potential on glycemic and lipid control is unclear. What is known is that isolated sessions of physical activities of different modalities are able to intervene in the glycemic control of non-HIV infected individuals (17, 22). Regarding changes in the lipid profile, the literature is still divergent about the effect of physical exercise on people living with HIV (23, 29). Therefore, the purpose of this study was to investigate the acute effect of a single resistance training session on the glycemic and lipid response of people living with HIV and treated with ART.

METHODS

Participants

The sample consisted of 10 HIV-positive women. The inclusion criteria included the regular use of ART for more than six months, in addition to having a stable clinical condition, not having participated in physical training programs in the previous six months, not presenting acute or chronic inflammations capable of affecting the practice of physical activity, and not being pregnant. The clinical evaluation of each patient to determine their suitability to participate in the study was carried out by the infectious disease specialist responsible for the treatment of these patients.

All the subjects participated in the study as volunteers. After being informed about the research proposal and procedures they would be required to perform during the study, the women signed the Informed Voluntary Consent Form. This study was submitted to the Standing

Committee on Ethical Research with Humans of the State University of Maringa (UEM) and approved under Opinion nº. 1.245.413. This research was carried out fully in accordance with the ethical standards of the International Journal of Exercise Science (24).

Protocol
The female subjects were characterized according to their anthropometric profile based on their weight (kg), height (cm), and Waist Circumference (WC) measured at the umbilical scar. Data on body weight and height were used to calculate the Body Mass Index (BMI), that is, the ratio between body weight in kg and height in squared meters (kg/m^2). In addition, information on the period of time they had been using ART were obtained based on each participant's medical record. Access to this information was authorized by the patients.

In order to perform the glycemic analysis, blood was collected from the finger and placed on test strips in the Accu-Chek Active® blood glucose monitor apparatus before (Pre) and immediately after (Post) the resistance training session. The collections were performed by a qualified professional, following the manufacturer's recommendations.

The lipid profile was determined by means of blood collections (5 ml), carried out before (Pre) and one hour after the experimental protocol (Post) to evaluate total cholesterol, HDL, and triglycerides, which were determined using the enzymatic colorimetric method following the manufacturer's instructions (Labtest®). Non-HDL values were obtained by applying the Friedewald formula.

The experimental session consisted of seven exercises involving different muscle groups for the whole body, which were performed by alternating workouts for lower and upper limbs, according to the following order: chest press, leg press 45°, lat pull down machine, leg extension, triceps pulley, leg curl machine, and Scott curl. Three sets per exercise were accomplished with a recovery interval of 90 seconds between each set and 120 seconds between exercises. From 8 to 12 repetitions were performed in each of the sets. The Guidelines for the prescription of exercises for people living with HIV/AIDS (15) were used. Prior to the experimental protocol, the participants were given a week of familiarization with the exercises, during which the load to be used was also determined. Subsequently, all women had one week of rest before performing the experimental resistance training protocol. With respect to the perceived subjective resistance, the OMNI Resistance Exercise Scale (OMNI-RES) (21) was used to determine the load of each physical exercise, so that the loads used during the experimental session corresponded to an intensity equivalent to the range between five and seven of the scale.

Statistical Analysis
Descriptive statistics were applied to characterize the sample. The Shapiro-Wilk test was used to verify data normality, followed by the Wilcoxon test in the Pre versus Post physical exercise comparisons. The data were assessed using the statistical software SPSS, version 22. A p value < 0.05 was considered significant.

RESULTS

Table 1. Sample characterization (*n* = 10).

Variable	Mean ± SD
Age (years)	45.00 ± 12.43
BMI (kg/m²)	27.38 ± 3.90
WC (cm)	84.87± 7.47
ART period of time (years)	6.75 ± 5.47

BMI = Body Mass Index; WC = Waist circumference; ART = Antiretroviral therapy.

Table 1 presents data related to the sample characterization, and Table 2 shows the comparison of the lipid profile data under the fed state, Pre and Post the resistance training session. No significant changes were observed for these parameters.

Table 2. Lipid profile, Pre and Post resistance training session (n=10)**.**

Variable	Pre (Mean ± SD)	Post (Mean ± SD)	*p* value
Total Cholesterol (mg/dL)	159.07 ± 33.76	152.10 ± 35.62	*p* = 0.44
HDL (mg/dL)	41.40 ± 9.03	43.30 ± 9,29	*p* = 0.14
Non-HDL (mg/dL)	117.67 ± 34.38	108.50 ± 32.65	*p* = 0.31
Triglycerides (mg/dL)	127.20 ± 42.88	112.10 ± 48.86	*p* = 0.26

HDL = High-density lipoprotein cholesterol.

Figure 1 shows the result of the glycemic response in the Pre vs. Post comparison with regard to the resistance training session (*n* = 10). A statistically significant difference (*p* = 0.03) was observed, with a decrease of 11.4% in the comparison of values Pre and Post the exercise session.

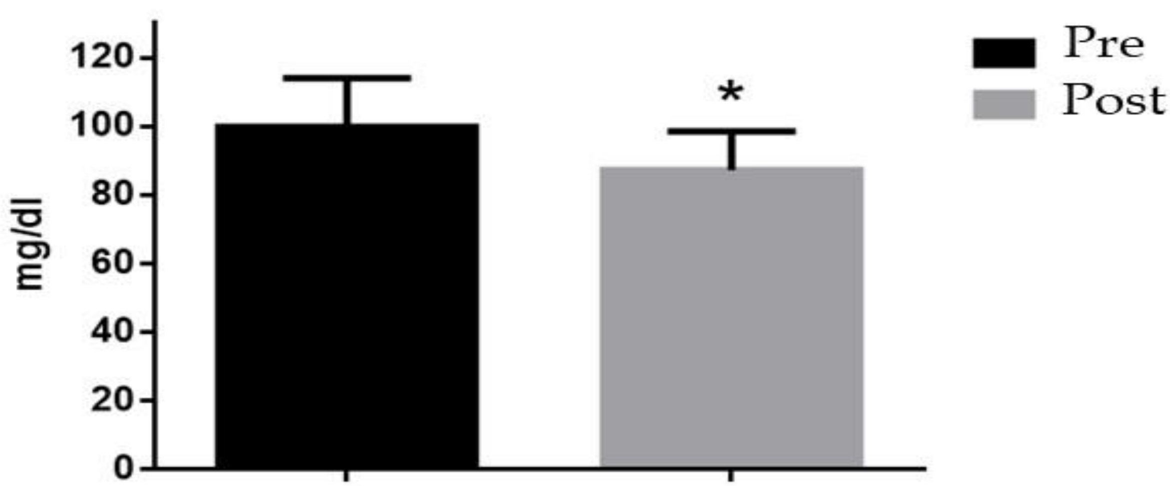

Figure 1. Acute glycemic response to single resistance training session (*n* = 10).
Note: (*) Statistically significant difference Post vs. Pre.

The results indicated a decrease in blood glucose after an acute resistance training session. This finding may be linked to the mechanisms involved in glucose uptake. The lipid profile parameters presented normal values, except for non-HDL.

DISCUSSION

The purpose of this study was to investigate whether a single resistance training session is able to intervene in the glycemic and lipid response of people living with HIV and treated with ART. The hypothesis of reduced glucose levels was based on investigations carried out in different populations, which showed the workout potential for modulating the glycemic response, basically by favoring glucose transport, increasing glucose permeability, and improving the sensitivity of insulin action in active muscle cells during physical activity (6, 32). Therefore, the results confirmed the initial hypothesis, that is, after a single resistance training session a change ($p = 0.03$) was observed in the glycemic response, with a decrease of 11.4% in the values when comparing Pre and Post exercise, that is, (99.8 ± 14.3 mg/dl vs. 87.3 ± 11.3 mg/dl). This finding corroborates other studies carried out in women with excess body mass (34) and sedentary young individuals (16), which reported a reduction in glycemic response and improvement in glucose tolerance, respectively, after a single resistance training session.

Both acute and chronic resistance training models (33, 18) have already been reported in the literature as being able to promote an increase in glucose uptake, similar to aerobic exercises, in addition to increasing the activity and intracellular expression of insulin signaling molecules in non-HIV infected individuals (28).

According to Broholm et al. (6), the fact that people living with HIV become adapted to physical activity might be more related to the improvement in glucose phosphorylation capacity than changes in the insulin signaling markers, glucose uptake, or glycogen synthesis. However, the results of the present study could be related to the classic findings in the literature (26, 36), which reports the immediate effect of gene and protein expression of the insulin receptors on the membrane of the exercised myocytes, regardless of insulin. Considering that the glycolytic/lactic energy transfer system is predominant for the workout model used, it can be expected that blood glucose would decrease, even under the possible hepatic compensations of glucose production.

Moreover, the subjects of the present study were under a fed state, which suggests that insulin was high and they had muscular glycogen stores. Therefore, gluconeogenesis would be stimulated and might have been inhibited by the action of the adrenaline released during workout, and, consequently, a decrease in blood glucose occurred shortly after the resistance training.

A study by Gidlund et al. (14) has recently shown that resistance training for pre-diabetic people (with impaired glucose regulation) can promote increased concentrations of Humanin (HN) in skeletal muscle. HN is a mitochondrial peptide and has been reported as having a significant correlation with improved glucose testing, which suggests that this protein plays an important role in glucose metabolism after resistance training protocols. However, these statements concern a longer period of intervention with this workout model, and it is unclear whether this can also occur acutely.

The result of the present study with regard to the glycemic response suggests that, as reported in other populations, the resistance training model is also capable of promoting significant changes, although in an acute way, positively influencing the glycemic control of people living with HIV/AIDS. Thus, the relevance of this finding for HIV/AIDS carriers is related to the fact that in this particular population there is a need to consider some particularities in the association mechanism of metabolic changes with the drugs used in ART. Thus, alterations in glucose homeostasis and the lipid profile in people living with HIV/AIDS are closely related to treatment, especially the use of protease inhibitors at the time of infection, in addition to the mechanism of the direct action of the virus on beta-pancreatic cells (2, 20). It is worth mentioning that all the female subjects of the present investigation used some protease inhibitors, that is, Atazanavir (ATV), Darunavir (DRV), and Ritonavir (RTV), or a combination of two of these drugs, which leads to high risk factors with regard to changes in glucose and lipid metabolism (7).

Considering the lipid profile of the sample, the results show that the evaluated patients presented reference values for total cholesterol, HDL, and triglycerides; however, the non-HDL cholesterol values were above the recommended values (8). It is worth mentioning that this population has a high risk of developing cardiovascular diseases (7), and that a single resistance training session was not able to promote significant changes in these variables. Regarding the effect of the workout on the lipid profile of this population, the literature is still divergent on the subject; while some research shows indications of alterations in the lipid profile with the practice of physical activity (23), other data suggest that workout does not seem to modulate these parameters (29). However, the studies corroborate on the fact that there seems to be a strong influence of ART on these variables.

An acute transient lipid response, with reduction in TG levels in the blood and increase in HDL (4), has been reported in the literature. However, these findings are related to aerobic exercise sessions in non-HIV infected individuals. This lack of investigations on the acute effect of resistance training sessions and the findings of the present study can be justified when considering the metabolic system used in this workout model, that is, glucose as the predominant energy substrate, and, thus, the TG that would be metabolized was not changed. Therefore, changes in lipoproteins are expected to be imperceptible, since their metabolism is very dynamic and slow. This lipid behavior might differentiate between people submitted to ART and those who do use this therapy.

The present study has some limitations. The small sample size and lack of a control condition (without exercise) are factors that might limit the interpretations of the results, since blood glucose can be changed due to factors other than the workout (35). Another point worth mentioning is the sample homogeneity regarding sex, that is, only women were assessed in the present investigation. As the metabolic responses seem to be influenced by sex (13), this fact increases the strength of the findings, but restricts extrapolation for men living with HIV/AIDS. Finally, the time interval between measurements before and after exercise seems to be another limiting factor, since lipids are metabolized very slowly (between 8 and 12 hours). This possibly explains the lack of any alterations in these parameters.

This study is promising, since it points out that the acute glycemic response to a single resistance training session in people living with HIV/AIDS strongly resembles the acute response found in individuals with diabetes, thus reinforcing the importance of physical exercise practice as a possible non-drug strategy in the treatment of these subjects. Based on the present results, it can be concluded that a single resistance training session can intervene in the glycemic response, significantly reducing capillary glycemic levels in HIV-infected individuals treated with ART.

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