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COMPARISON OF ADDITION OF BLOOD FLOW RESTRICTION TRAINING TO AEROBIC TRAINING IN $Vo_{2\ máx}$ CHANGES IN YOUNG INDIVIDUALS

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ABSTRACT

The aim of the study is to make a comparison between Aerobic Training with Blood Flow Restriction and Aerobic Training in Vo2max change in young individuals. From a randomized clinical trial, from the study "Physiotherapeutic performance in orthopedic and sports dysfunctions", approved by the Ethics Committee in Bahia, where sedentary and inactive participants, randomly distributed in two groups, one performs the aerobic training and the other a training with restriction of blood flow to verify the increase in Vo2max. They were evaluated before and after the intervention through the Cooper test and thigh circumference in 12 sessions. The data tabulated and analyzed in the statistical package for the social sciences, using the T-student test, checking the pre and post averages and the nonparametric U-test, established the correlation between the results by group with a significance level of 95%. ($\alpha = 0.05$). The variable Vo2 shows significant in both groups, but the aerobic is more effective than the training with blood flow restriction in the perimetry evaluation. The aerobic has better evaluation than the restriction of blood flow, both showed effective in increasing Vo2max, for the gain of hypertrophy, the aerobic has comparative relevance.

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INTRODUCTION

The continuous practice of physical exercises promotes several improvements to health such as increased maximum oxygen absorption, hypertrophy, lowering blood pressure, increased LEVELS of HDL cholesterol, lowering LDL cholesterol levels and increasing LDL cholesterol levels and increasing LDL cholesterol levels and increasing LDL cholesterol levels and increased LDL cholesterol levels and increased glucose tolerance. Among the singularities that physical exercise proposes, we have strength training and aerobic resistance training (OLIVEIRA, 2012). In the American Heart Association 2002, some studies were conducted suggesting that individuals perform physical exercises on most days of the week, if possible every day, with intensity ranging from moderate to high, according to each other's physical fitness, for a period of time equal to or greater than 30 minutes (ARAÚJO, 2003). It is considered as aerobic exercise any and all effort that is maintained for an extended period of time. They are mild, moderate or high intensity, varying according to the capacity of each individual. Walking is an example, leading to a great cardiac and muscular effort, in a beneficial way and can be performed continuously. And for an even more significant gain, training should not have interruptions, and adequate pace, intensity and frequency should always be maintained (MOURA, 2014). According to studies conducted by Gueths (2003), aerobic training should occur at least 3 to 5 times a week, since less than 2 times a week, will not potentiate the results in relation to vo2max gain. It is recommended that it not exceed the duration of 40 minutes, maintaining a maximum heart rate of 60% to 90% and 50% to 85% of VO2max, and these values are sufficient for an improvement

in both the cardiovascular and muscle system. According to Loenneke (2012), studies report that aerobic exercises such as walks associated with blood flow restriction causes increases in hypertrophy and leg muscle strength, as well as better aerobic capacity. It is important to note that HR measurements during exercise sessions are used to evaluate exercise intensity, as well as changes in cardiovascular response. Aerobic training is designed to stimulate improvements in cardiovascular fitness, such as maximum oxygen consumption (VO2max) and anaerobic threshold (TAKASHI, 2010). Proof of this is treatment through the Vo2max method is one of the physiological variables that best portrays the functional capacity of the cardiorespiratory system. It is an index that represents the maximum capacity of the body to capture, transport and use oxygen for aerobic processes of energy production during muscle contraction (ALMEIDA, 2012). This regular practice of physical exercises provides several improvements to health, among the modalities are strength training and aerobic resistance training. In this method, some theorists in the area already stand out in their studies as Costa (2012), it is assumed that by restricting blood flow during low intensity exercise, increased resistance, phosphorylation and muscle protein synthesis may occur, in addition to promoting increased strength. Occlusion training is also applied during low intensity walking, presenting significant results in lower limb strength and hypertrophy.

Therefore, low intensity walking combined with vascular occlusion is an interesting tool, as it can improve both muscle strength and hypertrophy and cardiorespiratory fitness (JUNIOR, 2017). At this very point, Thomas in his article published in 2018 makes it clear that the use of blood flow restriction during low intensity aerobic training, promotes significant increases in aerobic (Vo2max) and anaerobic capacity. Training with vascular occlusion can be defined as an alternative method that makes the use of specific devices to restrict blood flow of the upper and/or lower limbs, and can be performed in isolation or in combination with low intensity exercises causing changes in the physiological system (JUNIOR, 2017). It is a method that has been widely used by physiotherapy professionals, because it has as its primary function the gain of strength and muscle hypertrophy, therefore, it is of great value for individuals who need rehabilitation, and who have some muscle impairment related to strength and trophism. In view of this, it is believed that low intensity walking training combined with vascular occlusion is of extreme relevance, since several studies bring evidence that correlate this association for the improvement of both muscle strength and hypertrophy and cardiorespiratory fitness. As we can observe in the studies studied by Júnior (2017), where it presupposes the use of this method associated with vascular occlusion, which can lead to the occurrence of cardiorespiratory changes, such as decreased resting heart rate, an increase in Vo2max and kinetic improvement of Vo2, associated with increased muscle hypertrophy strength.

This continuous restriction applied during low intensity aerobic exercise may be conducive to populations unable to perform exercises that offer a high degree of mechanical tension in joints and muscles, such as the elderly, individuals in rehabilitation and athletes who wish to reduce external training loads (THOMAS, 2018). Therefore, the aim of this study is to analyze the difference between aerobic training with and without vascular occlusion in vo2max alteration in young individuals, considering the risks and benefits for the health of the population. Therefore, it is noteworthy the importance of investigating the effects generated from training methods aimed at both muscle strength and hypertrophy and also the improvement of cardiorespiratory function.

MATERIALS AND METHODS

This is a randomized, analytical clinical trial with a quantitative approach, which is a subproject of the main research entitled "Physical therapy performance in orthopedic and sports dysfunctions", sent to cep and approved through (Opinion: 2,418,872) and CAAE: 80624617.9.0000.5578). The research was conducted in the health laboratory of the physiotherapy course of a private college located in the municipality of Vitória da Conquista, Bahia, a city that is located in the semi-arid northeast. Its population in 2010 is 306,866 people, and an estimated 338,885 people in 2018. (IBGE, 2010). The study population was recruited from spontaneous demand, targeting individuals aged between 18 and 40 years, of both sexes, sedentary or who performed less than 150 minutes of physical activity per week, according to IPAQ (VESPASIANO, 2012), and who were in the intermediate category of the VO2max classification (Pitanga, 2001). Those individuals who were under the use of antibiotics, dietary supplements, had some type of lesion that could be aggravated with aerobic exercise, or some cardiovascular pathology, were excluded from the study. Thus, adopting the above criteria, the study population was composed of 10 individuals, who were informed about the research procedures and intervention protocol, and then signed the free and informed consent form, so only then the data were investigated.

All individuals in the sample were passed by an initial evaluation, composed of a structured questionnaire, anthropometry, circumference of the medial region of the thigh, of the dominant limb, using a measuring tape with the patient in orthostasis and with the limb relaxed. At the end the Cooper test, which has as main objective to evaluate cardiorespiratory fitness, being indicated to go 300 meters within the shortest possible time using an exercise mat, and the distance traveled during this time is recorded, then the calculation of Vo2 max of each individual, following the formula proposed by Pitanga (2001): VO2 MAX (ml/kg/min)= 132,853 – (0.0769 x PC/0.454) – (0.3877 x age) + (6.3150 x gender) – (3.2649 x time) – (0.1565 x HR). After these procedures, the individuals were randomized into two groups, the first group that would perform aerobic training with Flow Restriction (ART) and the second group that would perform aerobic training (TA). The study intervention protocol was initiated after 48 h of each individual's evaluation. The individuals who composed the ART group performed the following protocol, after entering, vital signs (blood pressure, heart rate and oxygen saturation) were measured and soon after the occlusor devices (Model - Scientific Pro) were measured by applying the pneumatic cuff in the inguinal region of the lower limbs, with the pressure calculated for each individual, through the formula proposed by Thomas, 2015. POT= 0.5 (Systolic blood pressure) + 2 (Thigh circumference) + 5. Then, walking or running was performed on the treadmill for 30 minutes, where every 15 minutes, heart rate and oxygen saturation were checked using the pulse oximeter, and at the end of the training, the vital signs were again measured and the patient was released.

The TA group performed the same procedure, but without the use of the occlusor device. Both performed this process three times a week in four weeks. The two groups went through 12 sessions, and each week, 3 sessions were held. At the end of the 12 sessions, the individual was asked to return after 48 hours for a new evaluation to be performed, in order to verify the variables of interest such as Vo2 max and hypertrophy.

Descriptive statistics (distribution of absolute, medium and standard deviation) and analytical frequencies (t-Student for paired test) were used for data analysis. Mann Whitney U test both under reliability of 95%) in the Statistical Package software for the Social Sciences version 22.0. The tables were plotted in Microsoft Excel.

RESULTS

The analysis performed with 10 individuals divided equally between control and experimental group, revealed that these are classified predominantly with an age group of 18 - 20 years 5 (50.0%), weight of 72.9 - 84.0 kilos 5 (50.0%), height between 1.58 – 1.65 meters 4 (40.0%). BMI was classified as adequate 5 (50.0%) and the predominant sex was female 7 (70.0%), as shown in table 1.

Table 1. Anthropometric characteristics of the sample. Vitória da Conquista - BA, 2019

Variables	N	%
Age group, *years*		
18 – 20	5	50,0
21 – 24	4	40,0
25 – 28	1	10,0
Weight, *kg*		
49,9 - 61,3	4	40,0
61,4 - 72,7	1	10,0
72,9 - 84,0	5	50,0
Height, *m*		
1,49 - 1,57	1	10,0
1,58 - 1,65	4	40,0
1,66 - 1,73	2	20,0
Over 1,73	3	30,0
BMI		
Thinness grade I	1	10,0
Suitable	5	50,0
Pre-Obesity	3	30,0
Obesity grade I	1	10,0
Sex		
Male	3	30,0
Female	7	70,0

Source: Search data.

With the result contained in table 2 it is possible to infer that the variation of VO2 after treatment presents statistically significant difference both by the control group (p = 0.027) and for the experimental group (p = 0.044).

Tabela 2. Evaluation and reassessment of VO2 of the sample. Vitória da Conquista - BA, 2019

Groups	Mean ± dp[1]		*p**
	Before	After	
Control	43,0 ± 10,07	52,2 ± 6,91	0,027
Experimental	44,8 ± 5,72	50,8 ± 8,76	0,044

[1]Sample standard deviation; *Paired t-student test; Source: Search data.

The evolution of the sample, in the parameters of VO2, is contained in table 3. In view of these results, there was a greater increase for the control group (21.30%) that for the experimental group (13.3%). This mean difference was statistically significant (p = 0.047).

Tabela 3. Evolution of the VO2 of the sample. Vitória da Conquista - BA, 2019

Groups	Dif[1]. Average	% gain	*p**
Control	9,20	21,30	0,047
Experimental	6,00	13,30	

[1] Average pre-post difference; *Mann-Whitney U test; Source: Search data.

DISCUSSION

According to Almeida (2012), studies show that individuals whose cardiorespiratory fitness exhibit higher levels of Vo2max, usually have greater effectiveness in daily activities and have a greater ability to recover more quickly after have made some more intense physical exertion. Undoubtedly, good cardiorespiratory performance decreases the demands of our heart, enabling a better performance of daily activities and also more intense exercises. Thus, the present study made it possible to make a comparison between the ART and THE, exposing the percentages of evolution between techniques under which it is statistically more effective in the increase in VO2max. In view of these objectives, the study presented relevant results for the scientific and clinical community on AD to increase the maximum respiratory capacity of each individual. Among the results found, in relation to the Vo2max variable, it was possible to verify that both groups presented gains and that, regardless of the method, there was improvement through the isolated aerobic exercise. This can be explained through the process of physiology that is offered by this type of activity, where according to Chaves (2007), the exercises performed continuously, have as main energy source, oxygen, in the face of the form of adenosine triphosphate-ATP, in which muscle work generates, thus leads to increased Vo2max, reducing the production of exertion-induced lactic acid and increasing the oxidative capacity of skeletal muscles. Aerobic exercises also directly influence decreasing the limitations of individuals and increasing safety in performing daily activities. Therefore, it is noted the importance of prescribing aerobic exercise as an efficient and relatively simple therapeutic form that should be included in the treatment. When comparing the isolated values of the two groups, THE presented to be more effective for the increase in VO2max, when compared with the ART (Table 2). These findings in relation to ART, corroborate the junior study (2017) that after 6 weeks of study using walking training combined with vascular occlusion, it was possible to observe that there was an increase in maximum respiratory capacity, but not there was a difference when compared to the group that trained without occlusion. This can be explained, due to the adaptations that are promoted through the supply and use of muscle oxygen through improvements in blood flow, in which they generate an increase in oxidative enzymes, also causing changes in the composition of muscle fibers.

The study by Silva, *et al* 2008, has strengthened the idea above, he brings that through the regular practice of aerobic physical exercises, as soon as the first few weeks can be perceived the physiological adaptations such as significant improvement in VO2max, reduction of resting HR and during exercise. Also promoting biological adaptations correlated to the transport and use of oxygen, which are the increase in mitochondrial capacity in generating ATP, increased oxygen

uptake, increased size and number of mitochondria and increased capacity of muscle oxidize fats. Following the thought of Thomas, et, al 2018, during the restriction of blood flow in exercise, a tissue hypoxia occurs, in which they improve the oxidative capacity of skeletal muscle and angiogenesis through the increase of growth factor vascular endothelial, concomitantly leads to increased anaerobic capacity promoting the improvement of muscle buffering. And therefore, blood flow restriction increases cardiovascular stress through systemic vascular resistance and increased acute heart rate during exercise, leading to beneficial cardiac adaptations. However, the literature is still very lacking in relation to muscle physiology with the restriction of blood flow applied to aerobic exercise. Another result that the study presented was the increase in Vo2max in THE, which can be explained by the fact that the race is a dynamic characteristic exercise, requiring the recruitment of large muscle groups, and causing blood pressure and HR to increase in direct proportions, with the increased intensity of the effort, according to Silva, et, al, 2015. It can be noted that THE showed greater effectiveness when compared to the ART group, since the use of the occlusion cuff generated discomfort during aerobic exercise, which can be considered as a limiting factor during the race, reducing the possible gains in Vo2max. Regarding the evolution of Vo2max during the intervention (Table 3), the present study showed similar resutaldos with what was discussed previously with the findings of table 2, where it was possible to verify that in the TA the evolution of Vo2max was better when compared with the TARF group. This given may be related to the theory mentioned in advance in relation to the discomfort generated by the occlusor and its limitation during the race. This theory of difference between the groups, also based on the participants' reports, it is noteworthy that the members of the ART group reported that during the increase in the peak of racing there was also an increase in the feeling of discomfort and paresthesia in the limbs which theoretically forced them to reduce running effort and consequently decrease cardiac demand. However, these theories cannot be scientifically based due to the limitation of studies that reinforce this thought. The present study presented some limitations such as the loss of some participants by starting physical activities during the study, some who did not attend the laboratory during the three times a week to perform the protocol, others who gave up during the research, which resulted in a reduction of the sample, however the necessary limitations did not hinder the execution or progress of the study. Another limitation that was found in this study is in relation to the lack of studies focused on occlusion in aerobic training.

Conclusion

It can be concluded that TA is more effective than TARF with regard to increased VO2max. We can see the importance of this study to the scientific community, professionals working in Physiotherapy, Physical Education, in addition to various areas of health care where the objective is to increase capacity maximum respiratory. It is increasingly recommended the use of aerobic training, to improve Vo2max, and the elaboration of new studies aimed at expanding knowledge on the subject.

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