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EXERGAMES E ADAPTAÇÕES CARDIOVASCULARES E MOTORAS: UM ESTUDO DE INTERVENÇÃO COM ADOLESCENTES FEMININAS COM PESO ADEQUADO E EXCESSO DE PESO

Adriana Lucas Louro[1]

Hugo Tourinho Filho[2]

Paulo Roberto Pereira Santiago[2]

Luiz Antonio Del Ciampo[3]

1. Doutor em Saúde da Criança e do Adolescente - Faculdade de Medicina de Ribeirão Preto - USP

2. Escola de Educação Física e Esportes de Ribeirão Preto - USP

3. Faculdade de Medicina de Ribeirão Preto - USP

Resumo

Objetivo: analisar a contribuição de um programa de condicionamento físico com exergames no controle postural e comparar a função autonômica cardiovascular em adolescentes do sexo feminino. Métodos: estudo longitudinal com adolescentes do sexo feminino, com e sem excesso de peso, com idade entre 10 e 16 anos, submetidas a duas avaliações, quando foram investigadas a variabilidade da frequência cardíaca (VFC) e o controle postural durante a participação no programa de condicionamento com exergames. Resultados: os índices de VFC para o domínio do tempo (RMSS e SDNN), apresentaram diferenças significativas entre os momentos pré e pós do programa com exergames (14,67 [5,86; 22,72]; 12,38 [4, 82; 20,88]), respectivamente. Em condições posturais BPA/AO base aberta com pés paralelos e olhos abertos (0,19 [0,05; 0,32]), BTD/AO (base semi-tandem com pé reto para frente e olhos abertos) (-0,17 [-0,32; -0,01]), BTD/OF (base semi-tandem com pés retos à frente e olhos fechados) (-0,21 [-0,38; -0,04]) e BTE/OF (base semi-tandem com pé esquerdo à frente e olhos fechados) (-0,2 [- 0,38; -0,02]) foram encontradas diferenças entre os momentos pré e pós dos valores de ativação muscular dos músculos flexores e extensores do tornozelo. Os mesmos ajustes não foram identificados para o grupo com excesso de peso. O deslocamento total do centro de pressão nas posturas BTD/AO (0,19 [0,02; 0,36]) no grupo com peso adequado, e no BTE/OF (0,77 [0,18; 1,41]) no grupo com sobrepeso, nas comparações pré e pós foram encontradas diferenças estatisticamente significativas. Conclusão: os exergames podem contribuir para adaptações fisiológicas a nível cardiovascular e motor em adolescentes.

Palavras-chave: Videogames, Atividade Física, Excesso de Peso, Adolescência.

EXERGAMES AND CARDIOVASCULAR AND MOTOR ADAPTATIONS: AN INTERVENTION STUDY WITH ADEQUATE WEIGHT AND OVERWEIGHT FEMALE ADOLESCENTS

Adriana Lucas Louro[1]
Hugo Tourinho Filho[2]
Paulo Roberto Pereira Santiago[2]
Luiz Antonio Del Ciampo[3]
1. PhD in Child and Adolescent Health at the Faculty of Medicine of Ribeirão Preto - USP
2. School of Physical Education and Sport of Ribeirão Preto, University of São Paulo
3. Faculty of Medicine of Ribeirão Preto, University of São Paulo

Abstract

Objective: to analyze the contribution of a physical conditioning program with exergames on postural control and to compare cardiovascular autonomic function among female adolescents.

Methods: longitudinal study with overweight and non-overweight female adolescents, aged between 10 and 16 years, submitted to two assessments, when heart rate variability (HRV) and postural control were investigated during participation in the conditioning program with exergames

Results: HRV indices for the time domain (RMSS and SDNN), showed significant differences between the pre and post moments of the program with exergames (14.67 [5.86; 22.72]; 12.38 [4, 82; 20.88]), respectively. In postural conditions BPA/AO open base with parallel feet and open eyes (0.19 [0.05; 0.32]), BTD/AO (semi-tandem base with straight forward foot and open eyes) (-0.17 [-0.32; -0.01]), BTD/OF (semi-tandem base with straight forward feet and eyes closed) (-0.21 [-0.38; -0.04]) and BTE/OF (semi-tandem base with left foot forward and eyes closed) (-0.2 [-0.38; -0.02]) differences were found between the pre and post moments of the muscle activation values of the flexor and extensor muscles of the ankle. The same adjustments were not identified for the overweight group. The total displacement of the pressure center in the BTD/AO postures (0.19 [0.02; 0.36]) in the eutrophic group (with adequate weight), and in the BTE/OF (0.77 [0.18; 1.41]) in the overweight group, in pre and post comparisons, statistically significant differences were found.

Conclusion: exergames can contribute to physiological adaptations to cardiovascular and motor levels in adolescents.

Keywords: Video games, Physical Activity, Overweight, Adolescence.

Introduction

Adolescence is a phase influenced by phylogenetic, ontogenetic, and cultural factors, which stands out for profound physical and emotional changes, leading the individual to seek his personal autonomy, through behaviors and sensations not experienced until then[1]. During this period there is a reduction in physical activity (PA) practices which, in addition to increasingly sedentary forms of behavior, contribute significantly to a wide range of physical and emotional diseases. The lack of regular exercise is considered by the World Health Organization as one of the important factors contributing to obesity, imposing itself as one of the most serious threats to public health of the 21st century[2].

Obesity leads to changes in the functions of the autonomic nervous system, which represents an important condition, since this system controls part of the internal functions of the organism. Changes in cardiac autonomic control are described as pathophysiological characteristics of obesity in children and adolescents in whom there was a reduction in heart rate variability (HRV) and vagal modulation and an increase in the simpatovagal balance[3]. This information suggests, at least in part, that cardiac autonomic dysfunction in obese children and adolescents is related to sympathetic hyperactivation to the detriment of vagal[4]. Also associated with obesity has been shown to have an inverse relationship between body mass index (BMI) and performance in balance tests. This integrity may be compromised in obese people since obesity is responsible for affecting large and small joints, since the change in body mass distribution alters the location of the center of mass, with the need to readapt the positioning of other segments and, possibly, postural balance, which may lead to impairment of motor control[5].

To stimulate the practice of PA, the benefits of exergames (EXG) or active video games have been studied, since they are a new modality of leisure activities that have been well received by adolescents[6,7]. EXG are the combination of exercise and electronic play that capture and virtualize the actual movements of users, creating images that can be viewed on the TV screen. This projection allows interaction with the virtual environment through body movement[8,9]. The EXG, besides contributing to increase heart rate and energy expenditure, can also help in learning new movements, sports gestures or simply be used as a tool to stimulate the practice of physical activity, since they provide interactivity and socialization among its practitioners[10]. Also, studies have highlighted the relevant role of exergames in mental health, with improved mood and increased self-esteem, especially among adolescents[11,12].

Some studies report that the EXG demonstrated significant results for energy expenditure and increased heart rate, increasing by three times the energy expenditure in relation to classic video games, which promote the increase in the number of hours in sedentary activities[13-15]. The EXG has become a strong ally in the practice of physical activities[16] and in a pleasurable way[17], requiring users' various forms of movements and body expressions, providing increased muscle strength, improvement of static and dynamic balance and increased level of physical activity[18,19].

The objectives of this study were a) to analyze the effects of a short-term physical conditioning program with EXG on postural control of adolescents with adequate weight and overweight, by applying pre and post tests on a force platform, under alternating visual conditions, b) to compare cardiovascular autonomic function among adolescents participating in the program with adequate weight and overweight, through the analysis of heart rate variability.

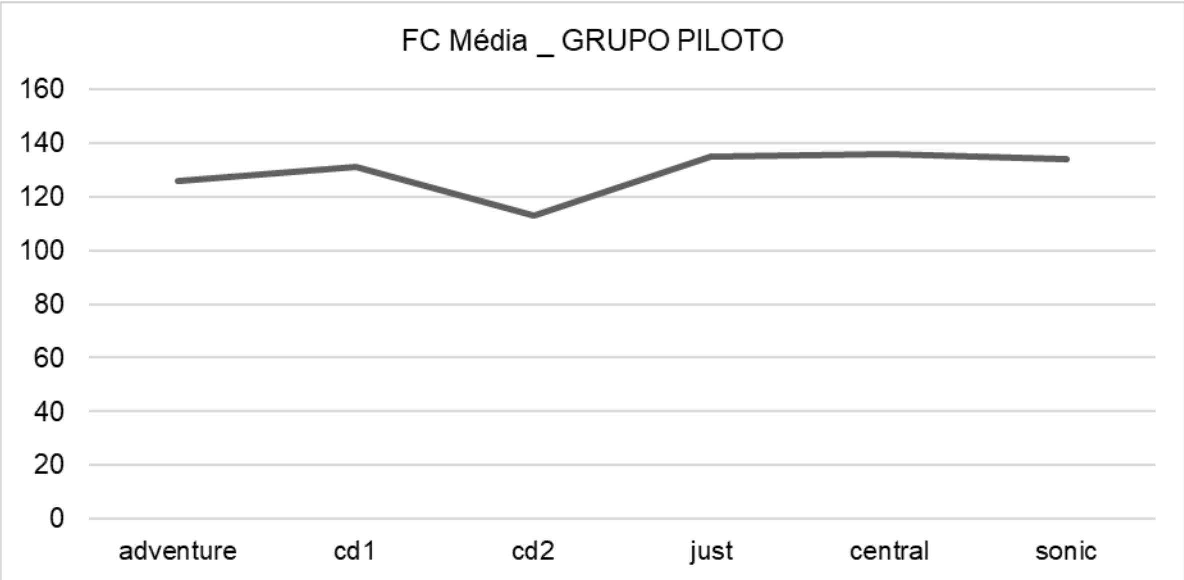
Methods

This is an intervention and longitudinal study in which female adolescents[20] aged between 10 and 16 years, who did not have disabling diseases and/or comprehension deficit, participated in which physical activities were prevented, and duly authorized by medical evaluation carried out to identify possible impediments to the practice of physical activities. Exclusion criteria: non-attendance to the training program with exergames, or non-attendance to previously scheduled assessments (pre and post-tests).

The adolescents participated in an intervention program with EXG held at in one Laboratory of Interactive Media and Physical Exercise. For the study, a pre- and post-intervention evaluation were performed after 2 months of activity. To carry out the activities of the conditioning program, two Target Heart Rate Intensity Zones were defined. In the first month, work was carried out within the light intensity zone, which represents 60% of the maximum heart rate (HRmax). In the second month, activities were within the moderate intensity zone, which represents 70% of HRmax. The conditioning program was performed twice a week, lasting one hour in each class session. The classes were composed of a maximum of five participants per time and there was a rotation between the games selected by equipment. A signal was given to start the activities and the heart rate monitoring was started, and after one hour of activities, this was ended. The following measures were used weight, height, heart rate variability, postural control, strength (maximum voluntary contraction) and muscle activation.

To elaborate the program activity protocol, it was necessary to monitor heart rate using a Polar cardiofrequency meter, model® V800®; and used six games: Just Dance®, Adventure®, Kinect Sport®, Dance Central® and Sonic®, which fall into various activities such as national and international sports, dance, and adventures.

The protocol was established based on the mean values obtained through a pilot study and the mean heart rate for each game was determined, as shown in figure 1. This information was collected during a continuous period of six days of activities, one day for each game.



To perform the activities of the conditioning program, two Target Zones of Heart Rate Intensity were defined. In the first month, studies were performed within the light intensity zone, which represents 60% of the maximum heart rate (HRmax). In the second month, the activities were within the zone of moderate intensity, which represents 70% of the HRmax.[21]

The conditioning program was performed twice a week, lasting one hour in each session. Classes were composed of up to five participants at each time, using Xbox 360 Kinect® consoles equipped with sensors that allow motion interaction while participants play. There was rotation between the games selected by equipment. Heart rate monitoring was performed throughout the activity period, which were always coordinated and supervised by the same

Physical Education professional and creator of the study.

Body weight was measured using a digital scale with a capacity of 150 kg. Height was evaluated by means of a stadiometer with an accuracy scale of 0.1 cm[22]. BMI values were categorized into percentiles according to age and gender using the curve defined by the Centers for Diseases Control and Prevention[23], defining overweight as > percentile 85 and ≤ 95, adequate weight as ≥ percentile 5 and ≤ 85[24]. Resting heart rate was measured in the upper limb after 15 minutes at rest in the supine position, noninvasively, by a cardiofrequency meter[25]. The evaluation of cardiovascular autonomic function was performed with a Polar V800® cardiofrequency meter, and measurements were performed at rest before the beginning of the program (pre-test) and another at its end (post-test), comprising a total period of two months of the training program with interactive media.

The evaluations were performed in an air-conditioned room with a temperature of 25° C. For the analysis of heart rate variability (HRV) the heart rate was captured, beat by beat, by means of a cardiofrequency meter (Polar brand®, model V800®). The adolescents remained in supine position and with spontaneous breathing for 15 minutes, with the appropriate electrode brace positioned at the time of the xiphoid process of the sternum. The clock to capture the information was fixed on the wrist of the evaluated, which was left with the arms extended to the side of the body. All adolescents were instructed to abstain from caffeine and physical activity for 24 hours before the test and during the evaluations[25]. The records obtained by the cardiofrequency meter were transferred and encoded to the computer by polar flow® software and later analyzed by the CardioSeries® software to determine HRV.

For postural control, the participants were instructed to assume the semi-static upright posture and to remain standing as much as possible on the force platform during the attempts in the different experimental conditions: based on bipodal support with open eyes and blindfolded and with semi-tandem support base with open eyes and blindfolded eyes. Two attempts were made with a duration of one minute each, with intervals of 30 seconds. Posture was standardized by foot positioning. For this purpose, a force platform comprising an area of 50 x 50 cm AMTI AccuGait® model with a capacity of 110 was used[25,26].

The variables defined for the investigation of postural control of this study were: the displacement of total oscillation; the average displacement amplitude; the average speed; and the center area of pressure (CP), by the stabilogram and the statokinesiogram. Anthropometric adjustments were made because the individual's height is inversely related to balance[26,27]. The capture and recording of the signals were performed by the Balance Clinics® software and

MATLAB® software was used for the analysis of the calculations.

To obtain the electromyographic data, a Delsys® equipment was used, and the electrodes were positioned on the ankle stabilizing muscles, 4 electrodes in each leg, totaling 8 active electrodes, affixed to the following muscles: medial gastrocnemius, lateral gastrocnemius, anterior tibial and soleus, with a recommended interval of 20 mm between them according to SENIAM recommendations ("Surface EMG for the non-invasive assessment for muscles")[28].

For the recording of the electromyographic signal, a sampling frequency of 2000 Hz was adopted, smoothed by a Butterworth filter of fourth order with a cutoff frequency of 150 to 500 Hz (bandpass). Data were captured by means of a system coupled to the equipment. The data related to electromyography and dynamograph were analyzed through a routine elaborated in the MATLAB program®.

The study was approved by the Research Ethics Committee of the Hospital das Clinicas of the Ribeirão Preto School of Medicine of the University of São Paulo, CAAE 55346616.8.3001.5659. The statistical analysis was performed by the Bayesian model of linear regression of random effect, since each participant had repeated measurements throughout the training program, using, for this purpose, the JAGS package of the Software R 3.5.1.

Results

The study included 17 adolescents who met all inclusion criteria, which were divided into 2 groups according to BMI into: Group 1 (G1) consisting of 10 adolescents with normal weight and Group 2 (G2) composed of 7 overweight adolescents. The anthropometric characteristics of the participants are presented in Table 1.

Table 1: Mean and ± standard deviation of anthropometric measurements, resting heart rate and BMI Z score of participants in groups 1 (eutrophic) and 2 (overweight)

	Group 1 n = 10				**Group 2 n = 7**				
	PRE		POST		PRE		POST		p value
Height (m)	154,8	±8,9	155,6	±9,3	161,3	±3,3	162,1	±2,5	< 0,001
Weight (kg)	46	±8,8	45,8	±8,0	73,1	±8,6	72,6	±9,0	< 0,001
Age (anos)	13,2	±2,0	13,3	±2,1	12,4	±0,5	12,9	±0,7	0,210
BMI (kg/m2)	19,2	±2,5	18,9	±2,0	28,1	±2,7	27,9	±3,1	< 0,001
Z score BMI	-0,1	±0,8	-0,1	± 0,6	1,9	± 0,2	1,8	± 0,3	< 0,001
HRR (bpm)	79,8	±9,1	74,6	±6,45	85,3	±8,2	77,8	±11,35	0,175

BMI: body mass index; HRR: resting heart rate; kg: kilogram; m: meter; bpm: beats per minute.

BMI values (19,2 [± 2,5] vs. 18,9 [± 2,0]; 28,1 [± 2,7] vs. 27,9 [± 3,1]) indicated that body weights, adjusted for age, were different between G1 and G2 justifying the criterion used to divide these groups in the present study. The heart rate (HR) values at rest obtained during the pre and post-tests of both groups are compared in Table 1. In both groups the mean values of resting HR show a decrease, in G1 (79,8 [± 9,1] vs. 74,6 [± 6,45]) and G2 (85,3 [±8,2] vs. 77,8 [±11,35] between pre and post-test moments. However, this difference was not statistically significant.

Figure 1 presents the results obtained from the average HR values of the adolescents during the 8 weeks of practice with EXG. It was observed that the HR of G1 remained within the intensity zone defined for the program. However, in G2, the HR values remained above the established intensities zones.

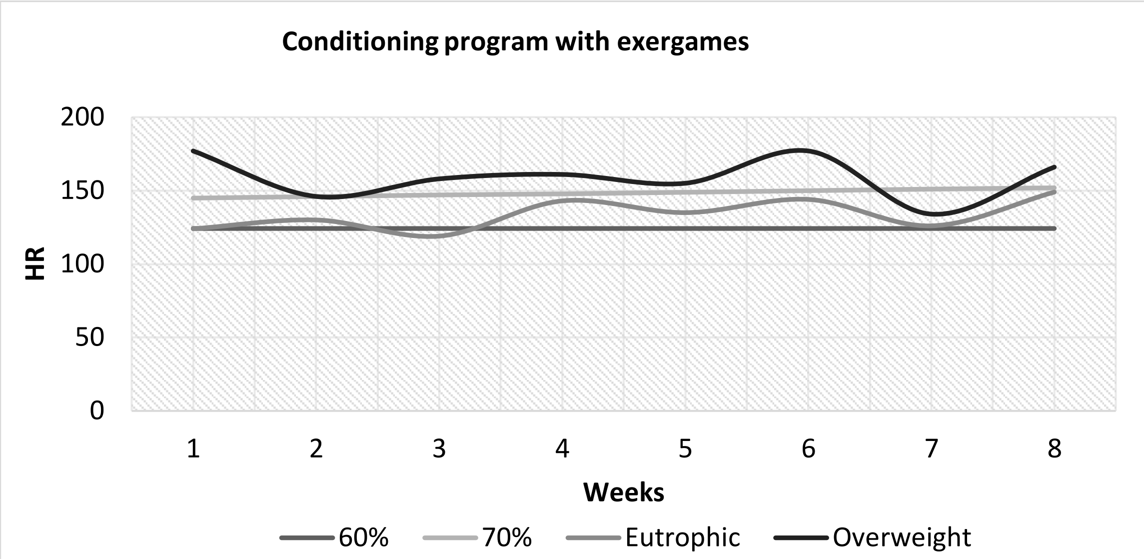


Figure 1. Heart rate values during the exergame conditioning program

Table 2 presents the differences between the means and the 95% confidence intervals (95% CI) for the measures of strength of the ankle extensor and flexor muscles for the two groups, obtained through maximal voluntary contraction. However, there was no difference in the variable strength of the ankle flexor and extensor muscles between the groups in the pre- and post- intervention moments [-0,53 (-1,56; 0,53) vs. 0,1 (-1,16; 1,14)].

Table 2: MVC values - pre and post comparisons between Group 1 (eutrophic) and Group 2 (overweight)

	Pre			Post		
		CI 95%			CI95%	
	Difference (G2 - G1)	LI	UI	Difference (G2 - G1)	LI	UI
MVC	-0,53	-1,56	0,53	0,1	-1,06	1,14

MVC: maximum voluntary contraction; LI: lower limit; UI: upper limit; 95%CI: 95% credibility interval

Table 3 presents the values of the indexes analyzed in the RMSSD time domain: root square of the mean of the square of the differences between RR intervals (signal beats) adjacent normal, in a time interval, expressed in Ms) and SDNN: standard deviation of all normal RR intervals recorded in a time interval, expressed in milliseconds (Ms), and the frequency (LF: low frequency; HF: high frequency and LF/HF ratio) for the study of heart rate variability of both groups. In G1 the RMSS and SDNN indexes present significant differences between the pre and post moments (14,67 [5,86; 22,72]; 12,38 [4,82; 20,88]), respectively, indicating that heart rate variability increased post-intervention in G1, with better response in cardiac autonomic modulation.

Table 3: Heart rate variability indices, pre and post comparisons of groups 1 (eutrophic) and 2 (overweight)

	Group 1 n = 10			Group 2 n = 7		
		CIr95%			CIr95%	
	Difference (post-pre)	Ll	Ul	Difference (post-pre)	Ll	Ul
RMSS (Ms)	**14,67**	**5,86**	**22,72**	25,53	-5,84	55,82
SDNN (Ms)	**12,38**	**4,82**	**20,88**	15,32	-2,77	32,72
LF (s.u)	1,21	-13,73	16,31	-3,23	-24,43	18,3
HF (s.u)	-1,03	-16,88	13,94	3,89	-18,78	25,37
LF/HF	-0,11	-0,51	0,28	0,38	-0,89	1,7
iRR (Ms)	46,9	-3,35	96,11	68,64	-20,31	151,6

*Values highlighted in bold infer a possible difference between pre and post moments, adjusted for Bayesian models of linear regression on 95% credibility intervals (95%CIr); Ll: lower limit; Ul: upper limit. RMSSD: square root of the mean square of the differences between adjacent normal RR intervals; SDNN: standard deviation of all normal RR intervals recorded in a time interval; LF: low frequency component; HF: high frequency component; LF/HF: difference between low and high components frequency; iRR: cardiac intervals; Ms: Millisecond; S.u: standardized units.

Table 4 shows the differences between the means and the 95% confidence intervals (CI 95%) for RMS values, obtained through muscle activation in the different postures of study of postural control. In the postural conditions BPA/AO open base with parallel feet and eyes open (0,19 [0,05; 0,32]), BTD/AO (semi tandem basis with straight foot forward and eyes open) (-0,17 [-0,32; -0,01]), BTD/OF (semi tandem base with straight foot and eyes closed) (-0,21 [-0,38; -0,04]) and BTE/OF (semi tandem base with left foot forward and eyes closed) (-0,2 [-0,38; -0,02]) indicated a difference between the pre- and post-intervention moments. These results point to an increase in the activation of the extensor and flexor muscles of the ankle at the time post-intervention G1. The same adjustments were identified with lower effect on G2.

In the same table, differences were also observed between the means and intervals of 95% confidence for the study variables of the center of pressure (CP) in the BTD/AO postures (base semi tandem with straight foot forward and eyes open) (0,19 [0,02; 0,36]) in G1, and in posture BTE/OF (semi tandem base with left foot forward and eyes closed) (0,77 [0,18; 1,41]) at G2, in pre- and post-intervention comparisons. Such values infer a possible difference between the pre and post moments, adjusted by the Bayesian linear regression models, of the intervention with EXG in G1 and G2.

Table 4: Differences between means and credibility intervals of total CP displacement and RMS values of muscle activation, pre- and post-comparisons of groups 1 and 2

	Group 1 n = 10			Group 2 n = 7		
		CI 95%			WHOCI 95%	
	Difference (pós-pré)	LI	UI	Difference (pós-pré)	LI	UI
BPA/AO	0,02	-0,1	0,16	0,08	-0,43	0,57
RMS 1	**0,19**	**0,05**	**0,32**	-0,11	-0,33	0,1
BTD/AO	**0,19**	**0,02**	**0,36**	-0,1	-0,33	0,14
RMS 2	**-0,17**	**-0,32**	**-0,01**	-0,14	-0,29	0,005
BTE/AO	-0,14	-0,31	0,03	0,001	-0,2	0,21
RMS 3	-0,14	-0,29	0,03	-0,02	-0,31	0,26
BPA/OF	-0,06	-0,22	0,11	-0,06	-0,39	0,27
RMS 4	-0,01	-0,19	0,16	0,04	-0,23	0,32
BTD/OF	-0,03	-0,25	0,2	0,55	-0,13	1,2
RMS 5	**-0,21**	**-0,38**	**-0,04**	0,03	-0,19	0,25
BTE/OF	0,31	-0,16	0,81	**0,77**	**0,18**	**1,41**
RMS 6	**-0,2**	**-0,38**	**-0,02**	0,07	-0,15	0,31

* Values highlighted in bold infer a possible difference between pre and post moments, adjusted for Bayesian models of linear regression at 95% credibility intervals (95%CI). RMS: root mean square of muscle activation; BPA/AO: open base with parallel feet and open eyes; BTD/AO: semi tandem base (straight foot forward) and eyes open; BTE/AO: semi tandem base (foot front left) and eyes open; BPA/OF: open base with parallel feet and closed eyes; BTD/OF: semi tandem base (straight foot the front) and eyes closed; BTE/OF semi tandem basis (left foot forward) and eyes closed. LI: lower limit; UI: upper limit; CP: center of pressure.

Discussion

The present study sought to analyze the contribution of a conditioning program physical exercise with interactive media on postural control and cardiovascular autonomic function among adolescents with adequate weight and overweight. The results revealed that the adolescents with adequate weight showed significant responses between the variables of study. However, in the overweight group, a statistically significant difference was identified. significant difference in a motor variable between the pre- and post-intervention phases.

For the adolescent to participate in the study, it was essential that she fulfill some requirements. The first criterion was the classification, by BMI, to determine the groups overweight or eutrophic. This assessment followed the World Health Organization[29] guidelines for children and adolescents and has been used in the world literature due to its practicality, ease of obtaining and speed, presenting an association with the risk of several diseases, mainly cardiovascular ones[30].

In this study, the mean value of resting systolic and diastolic blood pressure of adolescents was 116±12/64±7 mmHg, classifying all of them as normotensive. the groups had different resting heart rate values. However, both were within the normal range at the post-intervention moment (77.8±11.35 and 74.6±6.45) respectively. Such findings were like those found by Baum et al.[31], from 78±11 bpm, who measured the heart rate with the electrocardiogram in a group of children and adolescents with adequate weight and overweight/obese aged between 7 and 18 years.

In the analysis by the time domain method, it was observed that the overweight group showed a reduced parasympathetic modulation at rest compared to the eutrophic group, and the resting RMSSD and SDNN indices of the overweight group were decreased in compared to the eutrophic group. However, by the frequency domain method, overweight is not influenced the parasympathetic modulation, since the high frequency component did not showed differences between the groups. The same happened with the low component. frequency, estimating that sympathetic modulation was similar between groups.

The intensity of physical activities in adolescents is an important factor for physiological factors, as it was observed that 15 minutes of vigorous-intensity physical activity performed for three days a week, for 12 weeks, was able to produce results concerning a better cardiovascular health condition in adolescents aged between 12 and 15 years old and with appropriate weight for their age[32].

The present study showed that at the intensity and frequency proposed in the conditioning with EXG for overweight adolescents there was a reduction in the frequency heart rate at rest, but that was not sufficient to indicate a positive change in the condition of cardiovascular health in this group, as presented by the eutrophic group. The same changes were observed in their cardiac autonomic modulations. Usually, cardiovascular changes in response to physical activity in overweight people were observed in longer programs and, in general, performed with greater intensity[33].

The non-change in cardiac autonomic modulation observed in the group of overweight adolescents may mean that they have a reduced modulation cardiac autonomic dysfunction or inability of the parasympathetic nervous system to respond, in short term, to certain adaptive mechanisms of physical activity.

In a study carried out with 971 Brazilian adolescents aged between 11 and 17 years, with HR at rest of 82.7±12.5 beats/min, it was observed that the practice of physical activities was related to the decrease in resting HR values, regardless of the body composition and the amount of fat[34]. However, the group of a study considered eutrophic showed a significant difference in resting HR values.

There are several considerations that can be explored to explain the non-existence of bradycardia after a short intervention period. Among them, the time of practice, the intensity of activities and the overweight itself, which is recognized in the literature as a factor that may limit the magnitude of the expected cardiac response[35].

In a study involving sedentary children and adolescents, with ages ranging from 9 and 12 years old, submitted to 12 aerobic training sessions of 40 minutes, with equivalent to 65% of submaximal heart rate, no changes were observed in cardiac parasympathetic autonomic modulation in the obese group after physical training[33].

Regarding balance, a significant and inverse correlation with BMI has been observed and, indicating that the higher the body mass index, the worse the performance in tasks that require[36].

Conclusions

The results described above allow us to conclude that the proposed intervention model with EXG for overweight adolescents did not change the variability indicators of heart rate established for this study, showing that there was no change in the cardiac autonomic responses; and, for the studied conditions of postural control, there was a slight change in the overweight group. However, it is possible to say that EXG causes physiological adaptations in the study variables such as the decrease in resting HR, changes in the indexes indicating better cardiovascular condition of the variability of heart rate and motor responses to activity levels like conventional practice of physical activity in adolescents with adequate weight. With this, it is concluded that the EXG can be used to obtain a better conditioning in sedentary young people who do not adhere to conventional physical activity practices, promoting physiological responses and improving its physical aptitude.

The study has some limitations. The first is the small number of participants in each group and only female participants. Furthermore, the determination of the practice time of 8 weeks, determined by the researchers, allowed to obtain parameters that can be compared with future studies with populations of adolescents with and without overweight. If modifications in CF, of intrinsic or extrinsic cardiac order, were documented in this short exposure to the intervention with EXG, new methodology proposals could emerge and would be indicated in various situations. With respect to the intensity of the exercise performed, the choice of an effort considered moderate was intentional to allow sedentary volunteers to exposed to the conditioning program for 60min, thus expressing a physical activity with predominant characteristic of aerobic resistance.

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