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COMPARISON OF ENERGY EXPENDITURE AND OTHER METABOLIC PARAMETERS IN TWO FITNESS ACADEMY TRAINING ACTIVITIES: JUMP CLASS TRAINING AND JUMP-CIRCUIT CLASS TRAINING

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ABSTRACT

One of the leading incubators for physical activity (PA) are the fitness academy's, with a variety of appealing options. Indeed, in 2013, 61.1% of PA population chosen Fitness Sports among all others, and people with more than 25 years choose workout in fitness classes as the top 10 sports choices. Thus, the aim of this study was to characterize the intensity of effort analyzing and comparing two training fitness options, Jump (JCT) and Jump-Circuit (JCCT) class training, regarding their metabolic and energetic demands in non-laboratory environment, checking if they comply with moderate to vigorous physical activity intensity recommendations. Therefore, we used a sample of 42 regular participants of JCT and JCCT (31.52 ± 8.80 years). Study involved the completion of a class of JCT or JCCT, with participants equipped with a portable gas analyzer COSMED ® K4b2. Statistical procedures contemplated the comparison between groups by independent Student T-test and Analysis of Covariance with adjustment for age, with the significance level set at 5%. We found that, on average, the Jump group (JG) achieved higher values in absolute VO_2, relative VO_2, MET and Energy Expenditures variables, with significant differences ($P<0.05$) in comparison with the Jump-Circuit group (JCG), even after adjustments for age. Regarding the RER, HR and substrate utilization percentages, there were no significant differences. From the data obtained, both options have a similar recruitment of energy substrates, with small differences of intensity between them, and achieving the moderate to vigorous physical activity recommendations.

Key words: Jump. Jump-Circuit. Indirect Calorimetry. Energy Expenditure. K4b2. Physical Activity.

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RESUMO

Comparação do dispêndio energético, e outros parâmetros metabólicos em duas atividades de fitness: jump e jump-circuit

Uma das principais incubadoras de atividade física são os ginásios e academias, com uma variedade de modalidades apelativas. Em 2013, as modalidades classificadas como Desporto Fitness assumiram 61,1% da escolha entre os indivíduos com mais de 25 anos. O objetivo deste estudo foi, caraterizar a intensidade de esforço e analisar os substratos energéticos recrutados durante duas aulas distintas em minitrampolim (Jump e Jump-Circuit), em ambiente não laboratorial, verificando se a aula de Jump exige um maior dispêndio energético e maior intensidade de treino, comparativamente com o Jump-Circuit. Para tal, utilizamos uma amostra de 42 indivíduos praticantes de Jump e Jump-Circuit (31,52 ± 8,80 anos). O estudo implicou a realização de uma aula de Jump ou Jump-Circuit, equipados com o ergoespirómetro portátil COSMED® K4b2. Os procedimentos estatísticos contemplaram a comparação entre grupos, através do teste-T independente de Student, e a Análise de Covariância com ajustamento para a idade, com o nível de significância estabelecido em 5%. Constatamos que em média, o grupo que realizou a aula de Jump obteve valores mais elevados nas variáveis VO_2 absoluto, VO_2 relativo, MET e Dispêndios Energéticos, com diferenças estatisticamente significativas ($P<0.05$) em comparação ao grupo Jump-Circuit, mesmo com ajuste para a idade. Em relação ao RER, FC e percentagens de utilização de substratos, não se verificaram diferenças estatisticamente significativas. Pelos dados obtidos, podemos considerar a aula de Jump como aquela que exige maior dispêndio energético e intensidade de treino, no entanto, ambas as modalidades têm um recrutamento de substratos energéticos semelhante.

Palavras-chave: Calorimetria Indireta. Gasto Energético. K4B2. Minitrampolim. Fitness.

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INTRODUCTION

Health-related physical activity (PA) and physical fitness (PF) benefits has been widely described in literature (ACSM, 2011; Scully and collaborators, 1998).

Therefore, several organizations have established guidelines and recommendations for different age groups and/or populations.

For instance, for the improvement of cardiorespiratory fitness (CRF) the American College of Sports Medicine (ACSM) and the American Heart Association (AHA) recommend a weekly frequency of three to five times, with training length between twenty and thirty minutes daily, and training intensities greater than 60% VO2R or between 40-60% VO2R, depending on vigorous or moderate training intensity (ACSM, 2010; USDHHS, 2008).

In addition, regarding the muscular fitness/strength and endurance exercises it is recommended to workout weekly for two to three days, with intensities of 20-50% of 1 repetition maximum (RM) to improve endurance and muscle power or 60-70% of 1RM to improve strength, with two to four sets of eight to twelve repetitions for each major muscle group, to improve muscle strength and power (Haskell and collaborators, 2007; NSCA, 2008; Pollock and collaborators, 2000).

The National Strength and Conditioning Association (NSCA) also pointed-out the flexibility training and neuromotor development, thru functional movements, as an important achievement regarding performance objectives in training, since collectively, these functional movements comprise the skills that an athlete uses to perform a wide range of tasks and maneuvers, improving skill and motor recruitment (NSCA, 2004, 2008).

Fitness industry is one of the most emergent commercial activities, comprising several forms and facilities where one may be able to engage on active living. Due to a local concentration of numerous activities, with promises of more or less realistic results, fitness activities had been set as an important research field related to exercise and health (Anjos and collaborators, 2006; Lemos and collaborators, 2008; Perantoni and collaborators, 2009).

Within the several activities, some studies focused on training in reactive elastic surfaces, in class configuration, of a mini trampoline have been carried-out. They usually, analyzed heart rate response (HR), maximal oxygen consumption (VO2máx), perceived exertion (PE), energy expenditure (EE), changes in body composition and lipid profile, among other issues (Lemos and collaborators, 2008; Ribeiro and Tumelero, 2011).

However, only few addressed the complete class on a mini trampoline in longitudinal studies (Furtado, Simão and Lemos, 2004; Moraes and collaborators, 2012), but none have addressed these parameters in real life context (a fitness class environment).

Although Jump class training (JCT) is relatively documented, the Jump-Circuit class training (JCCT) (cardio training in mini trampoline intercalated with muscular endurance training) has fewer studies and, at the best of our knowledge, no data has been published so far.

Moreover, this is a type of activity that combines cardiorespiratory and neuromotor training (with the use of an unstable surface), muscular endurance training, and flexibility exercises, and may play a role with regard the accomplishment of PA guidelines.

Thus, the main goal of this study was to analyze and compare two training fitness options, such as Jump class training and Jump-Circuit class training with regard their metabolic and energetic demands.

As stated in the literature, these training methods are considered as vigorous efforts, and confirming this fact, with 2 classes per week, easily achieve most of the recommendations for health-related fitness benefits with vigorous physical activity.

MATERIALS AND METHODS

Participants

Overall the sample comprised 42 individuals divided into JCT group (n= 23; 20 females and 3 males) and JCCT group (n=19; 14 females and 5 males) recruited in Fitness Centers of Porto, Portugal.

All participants attended regularly this type of fitness classes and provided written consent for testing. The study was carried out following the Declaration of Helsinki guidelines for human research. Data were collected from the same fitness coach classes, to minimize

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the aspects related to motivation, interaction, anticipation, class preparation and other relevant parameters, intrinsic to the professional profile. The institutional ethics committee approved all procedures.

Oxygen Consumption (VO_2) and Energy Expenditure

Data collection of oxygen consumption (VO2), carbon dioxide production (VCO2) and ventilation (VE) were measured on a breath-by-breath indirect calorimetry system (COSMED K4b2, Rome, Italy) that has been validated over different intensities and types of physical activities (Duffield and collaborators, 2004; Keefer, 2013).

The K4b2 unit was used in accordance with manufacturer's standard protocols (COSMED), regarding the procedures for measuring and calibrating the unit. An individual calibration was performed before each evaluation.

Fitness Training Classes

The elastic implement used in JCT and JCCT was a specific mini trampoline, designed and studied to achieve the objectives proposed for these type of classes (FitPro, 2004; Promofitness, 2010).

They consist on a circular metal frame, with 6 massive feet with corresponding non-slip rubber shoe, 32 metal springs with 16 connecting whiskers to the 78 cm canvas. These equipment's were designed to withstand a static load capacity of 110 kg (FitPro, 2004; Promofitness, 2010).

In addition, for the JCCT, we also used bars and dumbbells for the muscular strength segment of the class. Thus we used vinyl coated iron dumbbells of 1,25 kg, 2,5 kg and 5 kg, that were used with a 50mm bar or, due to its gaps in the center, were also used as free dumbbells.

Procedure

To participate in this study, each participant signed the consent declaration form and then each participant was assigned to one of the 2 groups, JG or JCG.

Before the evaluation with the COSMED K4b2, height, using a wall stadiometer, and the body mass, using the Tanita BF-522W body composition monitor, were collected. Based upon the collected data the COSMED K4b2 was configured and calibrated, according to manufacturer's guidelines.

Each class has a different structure, with different intervals of work and rest, concerning the differences between the types of training objectives. Figure 1 compares Jump and Jump-Circuit class structure.

	Training time		Pause time		BPM's		Training Objective	
	Jump	Jump-Circuit	Jump	Jump-Circuit	Jump	Jump-Circuit	Jump	Jump-Circuit
Track 01	5'00''	3'51''	00'30''	00'30''	142	132	Warm-up	Warm-up
Track 02	4'00''	3'48''	00'30''	00'30''	145	138	Cardio 1	Cardio 1
Track 03	5'18''	3'50''	01'30''	00'30''	142	128	Cardio 2	Local 1
Track 04	3'10''	5'05''	00'30''	00'30''	138	128	Cardio 3	Cardio 2
Track 05	5'44''	3'27''	00'30''	00'30''	143	85	Cardio 4	Local 2
Track 06	4'40''	3'45''	00'30''	00'30''	142	140	Cardio 5	Cardio 3
Track 07	3'25''	3'33''	00'30''	00'30''	144	130	Cardio 6	Local 3
Track 08	4'00''	5'22''	00'15''	00'30''	151	145	Cool Down	Cardio 4
Track 09	3'30''	3'21''	00'00''	00'10''	128	125	Abdominal	Abdominal
Track 10		3'23''		00'00''		85		Cool Down

Figure 1 - Structural differences between Jump and Jump-Circuit class.

During the course of the class, subjects performed exercises front to the mirror, and also facing front to the fitness instructor, who performed all the movements back to the mirror (left side as leading leg of the fitness coach, were the right side leading leg of the subjects).

The fitness coach executed the entire class choreography anticipating the movements before participants performing it.

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Because it is a choreographed class, we choose to use the same class for all evaluations, to minimize the differences between moves and combinations, or beats per minute in different songs.

Since Jump-Circuit class has a muscular component, it was instructed to subjects that weight would have to be challenging, but without explicit indication of how much weight to put on different segments of work.

According to the fitness trainer instructions, the pauses between songs were used to prepare materials for each next track. In this sense, subjects used a bar with dumbbells (for back workout), free dumbbells (for biceps, triceps and shoulders) and body weight (for chest and abdominal).

There was no need to instruct subjects about safety instructions or materials preparation regarding the class, as they were all regular participants on this type of class. However, the study's purpose, nature, benefits and risks, and the permission to end the test at any time were recalled.

Statistical Analyses

Data from the k4b2 were treated in specific software from Cosmed (version 9.1b) and processed in a three step filtering procedure to discard invalid steps, averaging the steps in 5 seconds samples, and to smooth the curve in three points.

Descriptive statistics were used to provide anthropometric and physiological characteristics of the participants (expressed as mean ± SD).

To compare the proportions of men and women between the Jump and Jump-Circuit groups, we've used the Chi-square test.

For comparisons of continuous variables between groups, we've used the independent Student T-test and Analysis of Covariance, with adjustment for age.

All statistical procedures were completed with SPSS v.21 (SPSS Inc., Chicago, United States), with a significance level of 0.05.

RESULTS

Participant's characteristics are described in Table 1. Jump testing group (JG) subjects were significantly older than Jump-Circuit (JCG).

No other statistical significant difference was found. In addition, no significant differences were found (χ^2=1.189, P=0.276) regarding proportions of men and women between groups.

Table 2 describes the mean values for metabolic and energy expenditure parameters, according to the fitness class group.

The results showed that, on average, the values were higher for JG compared to their JCG peers. This was highlighted on absolute VO_2 variables, MET and Energy Expenditures.

However, regarding the RER, HR, percentages of utilization of fat and carbohydrate substrates, there were no statistically significant differences between groups.

Table 3 presents the estimated values of metabolic and energy expenditure parameters, adjusted for age, according to the fitness class group. Even after this adjustment we found that significant differences remained for all parameters under study.

Table 1 - Descriptive values (mean ± SD) for participant's characterizations in the study, according to Jump (JG) and Jump-Circuit (JCG) group type.

Variable	All	JG	JCG	T-test of Student	
	(n=42)	(n=23)	(n=19)	t	Effect (η^2)
Age (years)	31.52 ± 8.80	35.00 ± 8.36*	27.32 ± 7.54	3.097	0.210
Height (cm)	165.90 ± 6.02	165.22 ± 6.08	166.74 ± 5.99	-0.811	0.019
Body Mass (kg)	63.87 ± 11.25	62.93 ± 11.45	65.00 ± 11.21	-0.587	0.010
Fat Mass (%)	23.84 ± 7.67	24.88 ± 7.16	22.68 ± 8.23	0.902	0.021
BMI (kg/m^2)	23.10 ± 2.98	22.92 ± 2.74	23.31 ± 3.31	-0.421	0.005

Legends: * P<0.05 for differences between groups.

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Table 2 - Descriptive values (mean ± SD) to characterize metabolic and energy parameters according to Jump (JG) and Jump-Circuit (JCG) group type.

Variable	All	JG	JCG	T-test of Student	
	(n=42)	(n=23)	(n=19)	t	Effect (η^2)
VO_2 (ml/min)	1603.9 ± 378.9	1731.1 ± 424.3*	1449.9 ± 247.6	2.674	0.128
VO_2 (ml/kg/min)	25.19 ± 4.40	27.43 ± 4.18**	22.47 ± 2.92	4.362	0.306
RER (ml/min)	1.01 ± 0.04	1.00 ± 0.04	1.01 ± 0.05	0.600	0.005
HR (bpm)	146.58 ± 11.08	148.89 ± 11.87	143.79 ± 9.62	1.506	0.046
MET	7.20 ± 1.26	7.84 ± 1.20**	6.42 ± 0.84	4.362	0.306
EE (kcal/min)	8.05 ± 1.92	8.69 ± 2.17*	7.28 ± 1.23	2.647	0.126
EE (kcal/h)	483.11 ± 115.44	521.45 ± 130.30*	436.70 ± 73.81	2.647	0.126
EE Total (kcal)	196.44 ± 50.72	213.51 ± 58.22*	175.78 ± 29.92	2.705	0.128
Fat (%)	12.00 ± 7.60	11.41 ± 8.11	12.73 ± 7.09	0.554	0.013
CHO (%)	88.27 ± 7.51	88.88 ± 8.00	87.54 ± 7.01	0.571	0.013

Legends: * P<0.05 for differences between groups; ** P<0.001 for differences between groups.

Table 3 - Estimated values [Mean (SE)] to characterize metabolic and energy parameters, adjusted to age, acc -ording to Jump (JG) and Jump-Circuit (JCG) group type.

Variable	JG	JCG	ANCOVA	
	(n=23)	(n=19)	F	Effect (η^2)
VO2 (ml/min)	1753.52 (78.26)*	1422.84 (86.99)	7.220	0.156
VO2 (ml/kg/min)	27.77 (0.80)**	22.06 (0.89)	20.753	0.347
RER (ml/min)	1.00 (0.01)	1.02 (0.01)	2.629	0.063
HR (bpm)	149.88 (2.37)	142.60 (2.64)	3.808	0.089
MET	7.94 (0.23)**	6.30 (0.25)	20.752	0.347
EE (kcal/min)	8.79 (0.40)*	7.16 (0.44)	6.780	0.148
EE (kcal/h)	527.46 (23.94)*	429.43 (26.61)	6.780	0.148
EE Total (kcal)	217.40 (10.40)*	171.07 (11.56)	8.036	0.171
Fat (%)	12.51 (1.61)	11.39 (1.79)	0.196	0.005
CHO (%)	87.79 (1.59)	88.85 (1.77)	0.181	0.005

Legends: * P<0.05 for differences between groups; ** P<0.001 for differences between groups; covariable: Age =31.52.

DISCUSSION

Although the JCT has been targeted in some studies (Furtado and collaboratos, 2004; Grossl and collaboratos, 2008; Ribeiro and Tumelero, 2011), at the best of our knowledge, this is the first study that used the portable system for pulmonary gas exchange (Cosmed K4b2) allowing to measure activity intensity and physiological variables based on performance during field activity, ie, covering an entire class in mini trampoline on a regular gym schedule comprising the JCCT as well.

This seems an important field of study, since gyms and health and fitness centers are becoming regular training centers. Indeed, in 2013, 61.1% of PA population chooses Fitness Sports among all others, and people with more than 25 years choose workout with weights, workout with machines, or workout in fitness classes as the top 10 sports choices (Ekkekakis and collaboratos, 2008; SFIA, 2013; Walsh, 2012). These facts turn gym activities as an important field for health and fitness improvement and helping the achievement of usual PA recommendations.

In general, our data agree with previous studies targeting Jump classes (Furtado and collaboratos, 2004; Grossl and collaboratos, 2008; Rocha and collaboratos, 2010). Our average, MET data of 7.84 in JCT and 6.42 in JCCT suggested that the participants were vigorously active with highly demanding energy expenditure per hour (about 520kcal for JCT and 430 kcal for JCCT).

Therefore, given the current guidelines for PA that recommend at least 30 minutes of daily PA at intensities between 3.0 and 6.0 MET (ACSM, 2011; Haskell and collaboratos, 2007) both JCT and JCCT sessions allow to accomplish the recommendations. In addition, considering that usually participants attended twice a week, at least 50 min session, we may realize the importance of both types of training to the PA level.

Furthermore, it should also be highlighted that JCCT has a muscle endurance training component coupled with increased

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cardiorespiratory training, enhancing the muscular endurance, flexibility and neuromuscular adaptation (ACSM, 2011; USDHHS, 2008).

Indeed, the characterization of elastic surfaces relevance and the physiological adaptations arising from the use of this equipment's in resistance exercises take some pertinence.

For instance, it was presented in another study, an improvement of 35% in stability, and 10% increased muscle strength of the triceps sural, as well as improved ability to regain balance after a frontal unbalance (Leite and collaboratos, 2009).

The fact that the canvas and the spring assembly provides a shock absorption around 34 to 56% of the peak force (Schiehll, Loss, 2002), makes comparison with other sports that not use this equipment more difficult.

However, a NASA study comparing a treadmill protocol with mini trampoline protocol showed that what contrasts between protocols was not the intensity of effort but the magnitude of biomechanical stimulation that was higher in the case of mini trampoline (Bhattacharya and collaboratos, 1980).

Thus, this findings support the idea that for the same training intensity there is a lower risk of lesions when comparing with high impact activities, like running/jogging, and therefore mini trampoline is a better alternative for the untrained participants.

In addition, another issue that should be acknowledged is the affective response to training.

For those who engage on moderate to vigorous intensity activities, the affective responses, or the pleasure to take part into that activity and maintain it in the future, were substantially higher in trampoline users comparing to another types of exercise not using trampoline that are to light or to vigorous (Walsh, 2012).

As the freedom to choose exercise intensity positively influences affective response to exercise, which positively influences exercise adherence (Ekkekakis and collaboratos, 2008), the JCT and JCCT may be a positive activity choice, because participants are encouraging to developed their skills, respecting their motivations.

This study has some limitations that should be acknowledge. The first was the impossibility that the same groups of participants take part in both activities.

Secondly it was not possible to perform an initial assessment of VO2max. This would let us describe the relative intensity (percentages) during activities.

There are some practical applications to be retained from this study. The training efficiency in mini trampoline is well justified, and the fact that the elasticity of the surface protects the joints of greater magnitude of impacts make JCT and JCCT a safe, fun and effective training method. Due to vigorous exertion and highly demanding energy expenditure during class, and the fact that the class usually lasts at least 50 minutes, with 2 or 3 times per week, it can be achieved most of the recommendations for vigorous physical activity for health-related fitness.

The JCCT proposal also induces improvement in muscle resistance and strength, due to its interval sequence of cardiorespiratory and resistance work, demanding a vigorous type of exertion as well (MET>6).

Moreover, the unstable surface also requires a constantly adaptation from proprioceptive body sensors, and with this neuromuscular training approach, preventing the risk of injury due to falls or sprains.

In conclusion, JCT and JCCT are demanding fitness activities, with moderate to vigorous intensity's of training, witch may improve the cardiorespiratory fitness, influencing and improving the cardiovascular factors.

With small differences between them, both assume a great choice of training as in 2 to 3 times per week they can accomplish the 30 min of moderate to vigorous physical activity recommendations.

Therefore, it is recommended for low and medium trained persons, that want to engage on a demanding health and fitness related work.

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