2024, Retos, 58, 12-19

Intensity level in crosstraining sessions in obese women: a real-world study
Nivel de intensidad en sesiones de crosstraining en mujeres obesas: un estudio del mundo real

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Abstract. Objective: The objectives were to measure psychophysiological responses during crosstraining sessions in obese women, focusing on heart rate (HR), blood pressure (BP), caloric expenditure, and perceived effort (RPE). Additionally, it examined the relationship between caloric expenditure and effort intensity. Methods: This real-world observational study involved ten obese women (average age: 31.5 ± 6.2 years, BMI: 34.2 ± 3.7 kg/m², crosstraining experience: 5.3 ± 3.4 months). Participants underwent three individual crosstraining sessions. Each session's training type and duration were recorded. BP was measured before and after, along with HR at rest, average HR, peak HR, and RPE post-workout. Internal load and caloric expenditure were calculated. Results: Among 30 observed sessions, there were no significant differences in training duration by type. Caloric expenditure averaged 272.3 ± 76 kcal. Systolic BP increased significantly (from 129 ± 8 mmHg to 160 ± 16.5 mmHg), as did diastolic BP (from 90.3 ± 6.7 mmHg to 113.6 ± 14.9 mmHg, $p < 0.001$). Mean HR was 136.9 ± 14.8 bpm (73.6 ± 7.3% of HRmax), and peak HR reached 181.9 ± 12.1 bpm (97.8 ± 6.1% of HRmax). Participants spent more time at or above 80% of predicted HRmax. Mean RPE was 5.7 ± 2.2 a.u., significantly correlating with exercise time above ≥90% of HRmax ($r = 0.37$; $p = 0.046$, effect size = 0.39). Conclusions: Crosstraining sessions in obese women raised BP, induced high caloric expenditure, and imposed significant cardiorespiratory demands, classifying these sessions as high-intensity. This intensity closely correlates with energy expenditure.
Keywords: Heart Rate; Aortic Pressures; High-Intensity Interval Training; Sport; Obesity; Crosstraining.

Resumen. Objetivo: Los objetivos fueron medir las respuestas psicofisiológicas durante las sesiones de entrenamiento cruzado en mujeres obesas, centrándose en la frecuencia cardíaca (FC), la presión arterial (PA), el gasto calórico y el esfuerzo percibido (RPE). Además, examinó la relación entre el gasto calórico y la intensidad del esfuerzo. Métodos: Este estudio observacional del mundo real involucró a diez mujeres obesas (edad promedio: 31,5 ± 6,2 años, IMC: 34,2 ± 3,7 kg/m², experiencia en entrenamiento cruzado: 5,3 ± 3,4 meses). Los participantes se sometieron a tres sesiones individuales de entrenamiento cruzado. Se registraron el tipo de entrenamiento y la duración de cada sesión. Se midió la PA antes y después, junto con la FC en reposo, la FC promedio, la FC máxima y el RPE post-entrenamiento. Se calculó la carga interna y el gasto calórico. Resultados: Entre las 30 sesiones observadas, no hubo diferencias significativas en la duración del entrenamiento por tipo. El gasto calórico promedió 272,3 ± 76 kcal. La PA sistólica aumentó significativamente (de 129 ± 8 mmHg a 160 ± 16,5 mmHg), al igual que la PA diastólica (de 90,3 ± 6,7 mmHg a 113,6 ± 14,9 mmHg, $p < 0,001$). La FC media fue de 136,9 ± 14,8 lpm (73,6 ± 7,3% de la FCmáx) y la FC máxima alcanzó 181,9 ± 12,1 lpm (97,8 ± 6,1% de la FCmáx). Los participantes pasaron más tiempo en o por encima del 80% de la FCmáx prevista. El RPE medio fue de 5,7 ± 2,2 au, lo que se correlaciona significativamente con el tiempo de ejercicio por encima de ≥90% de la FCmáx ($r = 0,37$; $p = 0,046$, tamaño del efecto = 0,39). Conclusiones: Las sesiones de entrenamiento cruzado en mujeres obesas elevaron la PA, indujeron un alto gasto calórico e impusieron demandas cardiorrespiratorias significativas, clasificándose estas sesiones como de alta intensidad. Esta intensidad se correlaciona estrechamente con el gasto energético.
Palabras clave: Frecuencia Cardiaca; Presiones Aórticas; Entrenamiento de Intervalos de Alta Intensidad; Deporte; Obesidad; Crosstraining.

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Introduction

Obesity management requires multidisciplinary efforts, including surgeries, drug treatments, and therapy for lifestyle changes (Lopes et al., 2021). Physical exercise stands out as one of the most effective means to instigate lifestyle changes aimed at controlling unhealthy weight gain and addressing the epidemic of overweight and obesity (Leitzmann, 2017). Among the various training programs, concurrent training, which combines strength and aerobic stimuli, has been recognized as an efficient approach (Schroeder, Franke, Sharp, & Lee, 2019). This method can be implemented in several ways, either by alternating resistance and aerobic training in separate sessions or by combining both in a single session (Schroeder et al., 2019). The former is efficient for improving and preserving muscle mass, while the latter is effective for enhancing aerobic efficiency and reducing fat mass (Khalafi et al., 2023). However, it is essential to investigate the effects of concurrent training on aspects related to exercise adherence, as well as the limitations of studies in less controlled environments that reflect the real-world scenario.

Despite the proven effectiveness of concurrent training, individuals with obesity often cite a lack of motivation and time as the primary barriers to regular exercise (Baillot et al., 2021). This suggests a need for alternative training models characterized by dynamic sessions and longer durations to address these challenges. Short training sessions could be one effective approach to overcome such obstacles. In this context, crosstraining involves integrating various activities and muscle groups, optimizing energy expenditure and calorie utilization by increasing metabolic demand (Batrakoulis et al., 2018). This dynamic approach not only promotes improved cardiovascular fitness and muscular strength but also prevents physiological adaptation, contributing to improved fat oxidation (Feito, Heinrich, Butcher, & Carlos Poston, 2018). In a recent study, 200 obese college students were divided into two groups: a control group that performed traditional aerobic training and an experimental group that underwent cross-training. Both groups were trained for eight weeks. Following the intervention, greater effectiveness was observed in the experimental group, displaying a significant reduction in body mass and skinfolds (Zhang & Jiang, 2023). In another investigation, sedentary obese individuals engaged in crosstraining for 6 weeks, with three training sessions per week, yielding exciting results. The findings included a statistically significant increase in insulin sensitivity and fat oxidation rate, a decrease in diastolic blood pressure, and a clinically relevant reduction in body fat (Fealy et al., 2018).

Furthermore, physical exercise can influence energy balance through various mechanisms, ranging from energy expenditure during physical activity to post-activity effects and changes in resting metabolism (Donnelly et al., 2004). For example, individuals maintaining a daily calorie deficit of 500 to 700 kcal experienced weight losses of 7.5 kg (8%) for men and 5.9 kg (6.5%) for women (Robert Ross, Pedwell, & Rissanen, 1995). There is evidence that regular physical exercise of moderate to vigorous intensity, totaling 150 to 250 minutes per week, with an approximate caloric expenditure of 1,200 to 2,000 kcal per week, can effectively prevent weight gain in most adults (Donnelly et al., 2009).

Notably, the majority of studies examining the impact of high-intensity training on obesity control are experimental, often conducted in controlled environments (Du & Wang, 2023; Smith-Ryan, Trexler, Wingfield, & Blue, 2016). While this research is for a better understanding of the effects of concurrent training and crosstraining on obesity control, it is equally critical to comprehend what occurs 'in the real world' (Lunt et al., 2014; Wu, Davis-Ajami, & Lu, 2019). Observing and analyzing results in less controlled and more diverse environments can provide a complete picture of the actual impact of crosstraining and its contributions to the management of body mass and physical fitness in individuals with obesity. This approach allows us to offer more accurate and practical recommendations, addressing the demands and challenges of everyday life. Therefore, our study aimed to describe the psychophysiological responses of women with obesity in crosstraining sessions.

Materials and methods

Type of study and characterization of variables

The present investigation is characterized as a real-world observational descriptive study. As dependent variables, consider heart rate at rest, mean and peak, diastolic and systolic blood pressure, caloric expenditure, subjective perception of effort, and duration. As independent variables, heart rate intensity ranges were considered.

Population and sample

In Brazil, the frequency of obese adults is around 22%, similar to men and women(Casas, Bernal, Jorge, Melo, & Malta, 2018). In the state of Rio Grande do Sul, it was observed that 56.8% of adults were overweight, and 15.9% were obese(Carvalho & Rosa, 2018). In the city of Pelotas, a 2022 study found that 16.2% of adults were obese(Weisshahn, Oliveira, Wehrmeister, Gonçalves, & Menezes, 2022). The town has only six gym clubs dedicated to crosstraining, with approximately 1,000 clients. In this sense, assuming an expected frequency of 16%, an acceptable margin of error of 10%, and a confidence level of 95%, 33 observations would be required.

To address the access limitations, since, exploratively, this number of obese people practicing crosstraining was not found, the sample consisted of 10 women who were followed during three different training sessions. They should have a BMI equal to or greater than 30(Di Angelantonio et al., 2016), be over 18 years old, live in an urban area, and practice crosstraining for over one month. As exclusion criteria were respected, a history of injury in the last two months, the use of medication to control blood pressure, and any osteoarticular limitations for exercise. After being informed about the procedures they would be submitted, all participants read and signed the Free and Informed Consent Form.

Observational design

The collections were in the city's three gyms/crosstraining boxes. Regarding training sessions, all facilities receive the workout from the central manager, and they are divided into three main types(Da Silva-Grigoletto, Heredia-Elvar, & de Oliveira, 2020): "As Many Rounds (or Repetitions) as Possible" (AMRAP), "Rounds For Time" (RFT) and "Every Minute On the Minute" (EMOM). The first one is a type of workout format where participants have a set amount of time to complete a specific sequence of exercises as often as possible within that timeframe. The goal is to complete as many rounds or repetitions of the given exercises as possible before the time runs out. AMRAP workouts are designed to challenge an individual's endurance, strength, and conditioning, and they are commonly used to push participants to their limits and measure their progress over time. The RFT denotes a workout format where the primary objective is expediting the specified exercises' completion. Participants endeavor to conclude the entire workout within the shortest duration possible while adhering to proper form and technique. RFT workouts typically encompass a specific sequence of exercises or movements arranged in a prescribed order. Participants commence timing at the commencement of the workout and terminate it promptly upon completing the final repetition of the last exercise. The EMOM is a type of workout format where participants perform specific exercises or repetitions at the start of every minute for a predetermined duration. After completing the prescribed activities within the minute, any remaining time is used for rest before starting the next set of exercises on the next minute.

The following instructions were given to the subjects 24 hours before the session: They should sleep six hours or more the day before and stay adequately feed and hydrated. The registered sessions had an interval of at least 24 hours.

Data collection procedures

For each woman, three training sessions were observed, organized, initiated, and applied by the practice sites without any interference from the researcher to ensure a real-world research condition. The first session was divided into three moments: In the first moment, the researcher explained how the data collection would be carried out. Then, he delivered the Free and Informed Consent Form for the participant to read and sign, and as soon as she signed, the researcher carried out an anamnesis.

In a second moment, the equipment for heart rate (HR) collection (Polar® H10, Kempele, Finland) was placed on the participant to measure heart rate. Bluetooth™ captured the data from the Polar Beat® application. After this step, the participant stayed 5 minutes in absolute rest to measure resting HR and blood pressure (BP) before the session. Systolic and diastolic blood pressure were recorded before and shortly after the intervention using an aneroid sphygmomanometer and a calibrated stethoscope with an appropriately sized cuff. In the third moment, at the end of the session, the evaluator asked the participant to respond to a scale from 0 to 10 for subjective perception of exertion(Borg, 1982). After collecting the RPE, the evaluator collected the post-session BP. The other sessions, 2 and 3, were identical to the first; however, without the first step.

Heart rate (HR) intensity ranges and energy expenditure

The maximum heart rate (HRmax) was estimated with the equation HRmax = 208 - 0.7*age(Tanaka, Monahan, & Seals, 2001). The peak and mean HR, as well as the time in each HR range during the session, were registered, namely: < 60% of HRmax, ≥ 60% of HRmax, ≥ 70% of HRmax, ≥ 80% of HRmax, and ≥ 90% of HRmax.

Energy expenditure (EE) was determined using the data provided by the Polar Beat™ (version 3.5.6, Polar Electro Oy, Kempele, Finlândia) application after each session. For the EE calculation, the application considers some characteristics of the subject, such as body mass, height, age, sex, HR at rest, and maximum, in addition to the activity's intensity. Notably, the application's EE estimation algorithm agrees with data derived from a spirometer (MetaMax 3B), with r = 0.892 and a systematic error of 3.3%(Gilgen-Ammann, Schweizer, & Wyss, 2019).

Internal load calculation

The post-session RPE collection occurred individually immediately after the session, without contact with colleagues/partners. The internal training load was calculated using the session RPE score multiplied by the session time (Tibana, Almeida, & Prestes, 2015).

Statistical analysis

Descriptive and inferential analyses were performed. Mean and standard deviation were used as the primary measures of centrality and dispersion, respectively. Data distribution was analyzed using the Shapiro-Wilk test, and the results showed a normal Gaussian distribution. Comparisons between types of training were performed using one-way analysis of variance (ANOVA) with Tukey's post-hoc. Pre- and post-training blood pressure measurements were performed using the paired t-test. Comparisons considering the time (in minutes and percentage) in each of the five intensity ranges were performed with ANOVA of repeated measures in the heart rate factor. Mauchly's sphericity test was used to test this assumption, and the Greenhouse-Geisser correction was used where necessary. As for the effect size, the eta squared (η^2) was used for the ANOVA, which can be classified as small (0.1), medium (0.24), or large (0.37)(Cohen, 2013). In comparisons between intensity ranges, after applying Bonferroni's *posthoc*, the magnitude of the difference was calculated using Cohen's d, which can be classified as small (d = 0.20), medium (d = 0.50) and large (d = 0.8) and very large, when d = 1.2(Sawilowsky, 2009). Pearson's bivariate correlations were performed between variables of interest. The significance level was set at 5%.

Results

In the present investigation, the participants were 31.5±6.2 years old (HRmax = 186 ± 4 bpm) and had 5.3±3.4 months of experience in crosstraining. They had a height of 166 ± 6 cm, body mass of 94.6 ± 13.9 kg, and a BMI of 34.2 ± 3.7 kg/m², eight of which were classified as grade 1 obesity, one with grade 2 and another with grade 3. Only one had suffered a previous injury, an ankle sprain for over three months, and fully recovered; another used a bronchodilator (Aerolin 100mcg).

Of the 30 sessions recorded, 15 were AMRAP (37.6 ± 5.1 min), 11 RFT (38.5±2.3 min), and 4 EMOM (39.8 ± 4, 7 min), with no significant difference in training duration according to (p = 0.44). Overall, the sessions lasted 38.2 ± 4.2 min and provided a subjective perception of post-effort-training of 5.7 ± 2.2 a.u.

The caloric expenditure was 7.1±1.5 kcal/kg/min, totaling 272.3 ± 76 kcal per training session. Regarding HR, mean values were 136.9 ± 14.8 bpm (73.6±7.3% of HRmax), and peak values were 181.9 ± 12.1 bpm (97.8± 6.1% of HRmax). There were also significant increases in systolic and diastolic blood pressure, with pre-training values of 129 ± 8 mmHg and 90.3 ± 6.7 mmHg. After the sessions, they rose to 160 ± 16.5 mmHg and 113, 6 ± 14.9 mmHg ($p<0.001$).

The time that the participants spent in each of the five intensity ranges, absolutely (in minutes) and relative (about the total session time), are presented in Table 1, and statistical differences are observed ($F (4;166) = 10.9$; $p<0.001$; $n^2 = 0.27$). It is indicated that the participants spent more time in the intensity range equal to or greater than 80% of the estimated HRmax compared to the fields related to

2024, Retos, 58, 12-19

<60% HRmax, ≥60%, and ≥90% of HRmax, as well as spending more time in the intensity ≥70% HRmax compared to ≥60% HRmax (Figure 1).

The RPE correlated statistically significantly with the effort time above ≥90% of HRmax ($r = 0.37$; $p = 0.046$, effect size = 0.39) and with the total energy expenditure of the session ($r = 0.42$; $p = 0.019$, effect size = 0.45). Total caloric expenditure also positively correlated with the time (in minutes, $r = 0.65$; $p < 0.001$, effect size = 0.77) and with the percentage of time ($r = 0.66$; $p < 0.001$, effect size = 0.78) at ≥90% HRmax.

Table 1.
Distribution of time (in minutes and percentage) in different intensity ranges in Crosstraining sessions (n = 30)

				CI 95%			Extremes	
Variables	Mean	±	SD	Inferior Limit		Upper Limit	Minimum	Maximum
Duration at Intensity (in min)								
< 60% da HR_{max}	6.1	±	3.8*	4.7	-	7.4	0.3	15.0
≥ 60% da HR_{max}	5.4	±	2.5*#	4.5	-	6.3	0.6	10.7
≥ 70% da HR_{max}	8.9	±	4.5	7.2	-	10.5	1.0	19.6
≥ 80% da HR_{max}	12.6	±	5.1	10.7	-	14.4	3.3	24.0
≥ 90% da HR_{max}	5.2	±	7.0*	2.7	-	7.7	0.0	24.9
Duration at Intensity (% of the total)								
< 60% da HR_{max}	16.0	±	10.1*	12.3	-	19.6	1.1	39.5
≥ 60% da HR_{max}	14.6	±	7.1*#	12.1	-	17.2	1.3	28.3
≥ 70% da HR_{max}	23.4	±	12.0	19.1	-	27.7	2.4	50.4
≥ 80% da HR_{max}	33.6	±	15.0	28.3	-	39.0	8.5	66.8
≥ 90% da HR_{max}	13.5	±	17.6*	7.2	-	19.8	0.0	63.9

* = statistically different from ≥80%, # = statistically different from ≥70%. CI = Confidence Interval

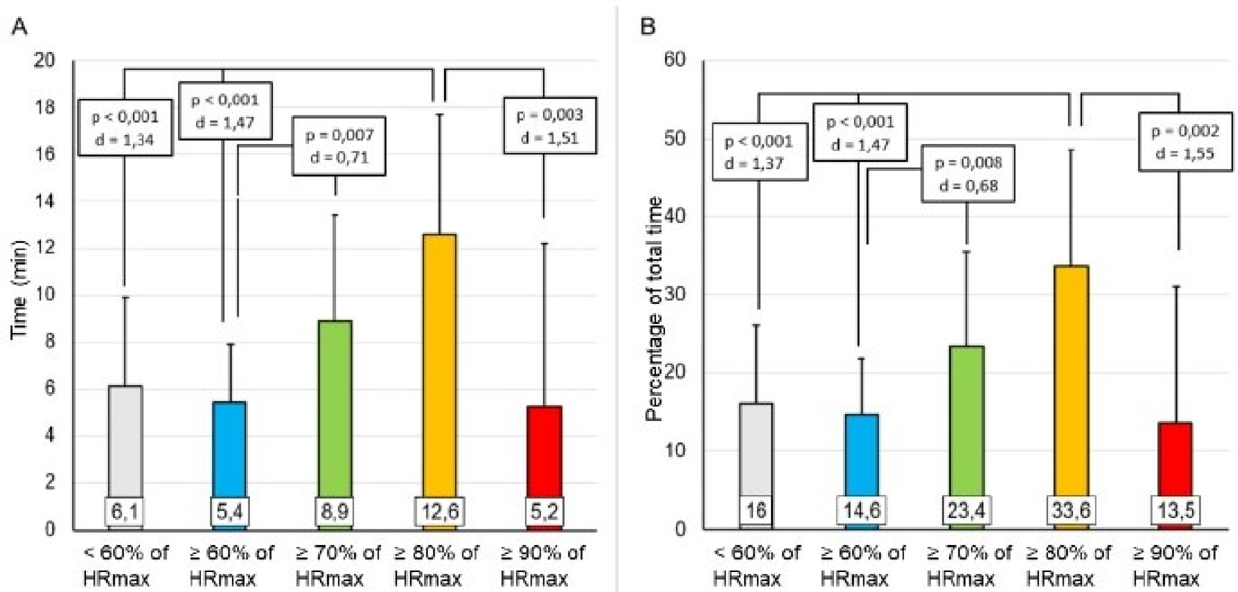

Figure 1. Comparison of time and percentage in heart rate intensity ranges in crosstraining sessions (n = 30).

Discussion

The study aimed to measure the characteristics of crosstraining sessions in a real-world scenario through heart rate and subjective perception of effort from women with obesity. Our main findings were: i) the participants spent more time in the intensity range equal to or greater than 80% of the estimated HRmax, ii) the subjective perception of effort had an average of 5.7 au; iii) the RPE was correlated to the effort time above ≥90% of HRmax.

Nowadays, it is essential to highlight that crosstraining is one of the most common training methods used to promote physical fitness to non-athlete population(Feito et al., 2018), and uses exercises, for the most part, without machines, using a few small implements, such as boxes, kettlebells, and naval ropes(Da Silva-Grigoletto et al., 2020). It is characterized by high intensity and the involvement of large muscle groups seeking to work on different physical capacities; high intensity requires a high cardiovascular and energy demand due to the participation of several muscle groups in a very dynamic workout(Feito et al., 2018). Compared with other forms of resistance training, the motivational characteristics of individuals engaged in crosstraining are elevated, with a high level of self-determination and a greater sense of satisfaction and pleasure(Dominski, Matias, Serafim, & Feito, 2020).

Our research suggests that obese women follow crosstraining sessions, nearly half of training sessions, within high-intensity HR ranges. In obese women (47% body fat), high-intensity circuit training was shown to cause an average HR of 72% to 87% of HRmax and effectively reduced body fat and waist and thighs. affected affected(Batrakoulis et al., 2018). In another study(Toledo et al., 2021), women and men underwent different CrossFit®, AMRAP, and For Time workouts. The study outcomes indicated no significant differences in mean heart rate between the different types of training (170.7 ± 9.1 bpm versus 170.4 ± 6.7 bpm, corresponding to 91.4% and 91.7% maximum heart rate, respectively). In overweight middle-aged women, 16 weeks of crosstraining showed changes in resting heart rate (pre-intervention: 77.80 ± 3.69 bpm vs post-intervention: 74.87 ± 3.50 bpm)(Soyler & Zileli, 2022). However, it is pertinent to point out that the scientific literature still lacks comprehensive investigations focusing on obese women and their possible benefits from crosstraining.

Of the sessions recorded in our study (AMRAP, RFT, and EMOM), the participants spent most of the sessions (17 min and 46%) above or equal to 80% of HRmax. It is essential to highlight that, as previously recognized, participation in high-intensity training is directly correlated with a notable increase in VO2max compared to lower-intensity protocols(Helgerud et al., 2007). In addition, high-intensity exercise favors less body fat deposition, which may be related to an increase in post-exercise energy metabolism(Yoshioka et al., 2001). Additionally, the American College of Sports Medicine suggests that, for sessions with the same total caloric expenditure, those in which the expenditure occurs vigorously are likely to yield superior health benefits, with more significant risk reductions for cardiovascular diseases and all-cause mortality(Garber et al., 2011).

It is known that HR and systolic blood pressure (SBP) increase during and immediately after muscle work(Comess & Fenster, 1981), and the increase in SBP is usually accompanied by a reduction or no change in diastolic blood pressure (DBP). In our study, SBP and DBP values were higher after the session when compared to pre-values ($p<0.001$). In a previous study(Alencar, Sodré, & Rosa, 2018), a single CrossFit® training session demonstrated a statistically significant difference in SBP when comparing values before and after training (128.00 ± 9.33 mmHg versus 169.25 ± 18.07 mmHg). However, it is pertinent to observe that no significant difference was evidenced in DBP. Differences in the results between our study and the previous study can be attributed to discrepancies in the characteristics of the participant samples, the intensity and format of the training employed, the duration of the sessions, and the levels of physical conditioning of the individuals involved. However, it is relevant to emphasize that the temporary increase in blood pressure during exercise increases blood flow to meet metabolic demands(Nystoriak & Bhatnagar, 2018). This phenomenon stimulates an adaptation of the heart, improving the efficiency in pumping blood and, consequently, the cardiovascular capacity(Nystoriak & Bhatnagar, 2018).

Since 1995, it has been recognized that exercises that provide less than 4 kcal/min should be considered light, from 4 to 7 kcal/min as moderate, and heavy or vigorous if the energy expenditure is greater than 7 kcal/min. In a previous study carried out with crosstraining, physically active men and women underwent two types of training: one following the traditional pattern and another adopting the CrossFit® method, both lasting 60 minutes. Caloric expenditure was significantly higher in CrossFit®-based training (468 ± 116 vs. 431 ± 96 kcal, $p<0.001$), corresponding to a 7.8 kcal/min rate(Brisebois, Biggerstaff, & Nichols, 2016). In an additional study, individuals of both sexes with a history of physical activity underwent crosstraining sessions lasting 72 minutes. During the session, an average energy expenditure of 605 ± 219 kcal was observed, corresponding to a rate of 8.4 kcal/min(Schubert, Palumbo, Schubert, & Palumbo, 2019). In this sense, our findings revealed caloric expenditure of 7.1 ± 1.5 kcal/min, totaling 272.3 ± 76 kcal per training session. Differences in previous studies can be explained by the duration of the training session since, in our research, it did not exceed 40 minutes. In addition, a weekly energy expenditure with exercises of 3000 to 3500 kcal/week is recommended(R. Ross & Janssen, 2001). In the present study, the average caloric expenditure per session was 272.3 ± 76 kcal, promoting a weekly caloric expenditure of approximately 1361 kcal, considering 5 weekly sessions. Thus, the energy expenditure suggested by the authors cited above could not be reached with these exercises, and adding a restricted diet becomes an essential part of the weight loss process(Clark, 2015).

Although HR increases linearly with workload intensity and has the potential to be used in conjunction with RPE to identify risk factors, there are only a limited number of indicators about a specific HR that make it a preferable parameter for measuring internal workload. This is just one of the many factors that must be considered during a training session, along with harmful physical and emotional aspects. The RPE method for evaluating the session load was introduced to quantify the training intensity. The methodology is based on a direct question. Thirty minutes after the end of the training session, the athlete must answer the following question: "How was your training session?(FOSTER et al., 2001). This method has been considered one of the main techniques to quantify the internal training load, standing out mainly for its low financial cost and its practicality.

The product of the RPE score multiplied by the session duration in minutes reflects the magnitude of the internal load in arbitrary units(FOSTER et al., 2001). Intensity categorization for training sessions can be described as follows: light = RPE < 3; moderate = PSE between 3-5; intense = RPE > 5(Inoue, dos Santos Bunn, do Carmo, Lattari, & da Silva, 2022), and the RPE registered a mean of 5.7 ± 2 a.u in the present study. According to this classification, the training sessions in question are highly intense. Also, in the present study, RPE correlated statistically significantly with the effort time above ≥90% of the HRmax and with the total energy expenditure of the session. This association between RPE, effort time above ≥90% of Fcmax, and total energy expenditure emphasizes the importance of RPE as a helpful indicator of the exercise intensity perceived by the individual. This reinforces the notion that RPE is a valuable tool for assessing training intensity in addition to physiological metrics such as heart rate.

In this sense, it is essential to emphasize that the present study has limitations. We recognize that the lack of control over the participants' routines may have influenced the results obtained despite the guidelines for individuals to maintain their routines. Another point was the lack of blood collection to carry out additional analyses, whose inclusion could provide a deeper understanding of the physiological changes during the training sessions. We did not directly measure variables such as body composition, VO2max, or specific health-related indices like BMI, ICC, or waist circumference. At the same time, it is essential to highlight the strong points of the study; in this sense, the fact that the research took place entirely in the academy's facilities, in a non-laboratory environment, deserves to be highlighted. This design provides a genuine representation of the daily routine of the individuals involved in the practice of the modality. Furthermore, we stress the importance of the sample comprising women, which seems less common in scientific studies. Another point to be highlighted is the fact that more than one training session was analyzed in different types of training sessions, allowing a new understanding of these efforts for planning and controlling the intensity of classes, thus filling a gap in the scientific literature and giving support for professionals in the fitness area.

Practical applications

Os resultados deste estudo podem ajudar profissionais de saúde e treinadores que trabalham com mulheres obesas e desejam otimizar suas sessões de crosstraining. Esses achados têm implicações importantes para o planejamento de programas de exercícios para essa população. Os profissionais de saúde podem considerar a inclusão de sessões de crosstraining em programas de exercícios para essa população, especialmente aqueles que visam melhorar a saúde cardiovascular e promover a perda de peso. Além disso, os profissionais podem adaptar e personalizar programas de crosstraining para atender às necessidades específicas de mulheres obesas, visando otimizar os benefícios do exercício físico enquanto garantem a segurança e a eficácia do treinamento.

Conclusions

The results of this study indicated that there was no difference between the length of the observed sessions. Additionally, an increase in blood pressure was observed after the training sessions, along with a positive correlation between the rating of perceived exertion (RPE) and the duration of the effort performed above 90% of HRmax. Furthermore, based on caloric expenditure and activity time in the intensity range corresponding to 80% of HRmax, it is possible to infer that, in the context of obese individuals, crosstraining sessions can be categorized as high intensity. However, additional research is needed to understand cardiorespiratory responses and load control during crosstraining sessions in obese women.

Conflicts of interest

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Authors' contributions

Author DEL VECCHIO has contributed substantially to the conception or design of the manuscript, SCHMALS, SIQUEIRA, SOUZA, and DEL VECCHIO to the data's acquisition, analysis, and interpretation. All authors have participated in drafting the manuscript, and author DEL VECCHIO revised it critically. All authors read and approved the final version of the manuscript.

All authors contributed equally to the manuscript and read and approved the final version of the manuscript.

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