



AFFECTIVITY DURING WARM-UP IN BOXING TRAINING: A COMPARISON BETWEEN GENERAL AND SPECIFIC WARM-UP

AFETIVIDADE DURANTE O AQUECIMENTO EM TREINOS DE BOXE: UMA COMPARAÇÃO ENTRE AQUECIMENTO GERAL E ESPECÍFICO

AFFECTIVIDAD DURANTE EL CALENTAMIENTO EN ENTRENAMIENTOS DE BOXEO: UNA COMPARACIÓN ENTRE CALENTAMIENTO GENERAL Y ESPECÍFICO

Gabriel da Silva Pinto • Jonatas Deivysen Reis da Silva Duarte • Michelle Jalousie Kommers •
Matheus de Sena Ferreira Arbuez • Carlos Alexandre Fett

Abstract

Boxing sessions and other combat sports traditionally begin with low- to moderate-intensity exercises aimed at body warm-up. In this context, the aim of this study was to compare ratings of perceived exertion (RPE) and enjoyment, measured by the Physical Activity Enjoyment Scale (PACES) during general and specific warm-ups. This was a quantitative, quasi-experimental, crossover study with a repeated-measures design. A total of 27 recreational boxing practitioners of both sexes participated and underwent two distinct warm-up conditions: (1) general warm-up and (2) specific warm-up, performed at the beginning of non-consecutive training sessions. The PACES and RPE were applied immediately after each session, considering only the warm-up period. Comparisons between conditions were performed using the paired Student's *t*-test, and effect sizes were calculated using Cohen's *d*, with a significance level of 5%. The specific warm-up elicited greater enjoyment compared to the general warm-up (106 ± 18.4 vs. 85 ± 32.2 ; $p < 0.001$; $d = 0.80$), while RPE was significantly lower during the specific warm-up (3.7 ± 1.8 vs. 5.4 ± 2.6 ; $p < 0.001$; $d = 0.76$). The results indicate that a specific warm-up is more effective in enhancing enjoyment and reducing perceived exertion at the start of training in our sample universe, and can be used as a strategy to optimize the quality of boxing sessions.

Keywords: Martial Arts; Combat Sports; Sport Psychology; Sports Science.

Resumo

As sessões de boxe e de outros esportes de combate tradicionalmente se iniciam com exercícios de baixa a moderada intensidade, voltados ao aquecimento corporal. Nesse contexto, o objetivo deste estudo foi comparar a percepção subjetiva de esforço (PSE) e o prazer, mensurado pelo Physical Activity Enjoyment Scale (PACES) durante o aquecimento geral e o aquecimento específico. Trata-se de um estudo quantitativo, quase-experimental, cruzado, com delineamento de medidas repetidas. Participaram 27 praticantes recreativos de boxe, de ambos os sexos, submetidos a duas condições distintas: (1) aquecimento geral e (2) aquecimento específico, realizados no início de sessões de treino não consecutivas. As escalas PACES e PSE foram aplicadas imediatamente após cada sessão, considerando apenas o período de aquecimento. Para comparação entre as condições, utilizou-se o teste *t* de Student, e o tamanho de efeito foi calculado pelo *d* de Cohen, adotando-se nível de significância de 5%. O aquecimento específico proporcionou maior sensação de prazer em comparação ao aquecimento geral ($106 \pm 18,4$ vs. $85 \pm 32,2$; $p < 0,001$; $d = 0,80$); e a PSE foi significativamente menor no aquecimento específico ($3,7 \pm 1,8$ vs. $5,4 \pm 2,6$; $p < 0,001$; $d = 0,76$). O aquecimento específico demonstrou ser mais eficaz para aumentar o prazer e reduzir a percepção de esforço no início do treinamento no nosso universo amostral, podendo ser utilizado como estratégia para otimizar a qualidade das sessões de boxe.

Palavras-chave: Artes Marciais; Esportes de Combate; Psicologia do Esporte; Ciência do Esporte.

Resumen

Las sesiones de boxeo y otros deportes de combate tradicionalmente comienzan con ejercicios de baja a moderada intensidad destinados a calentar el cuerpo. En este contexto, el objetivo de este estudio fue comparar la percepción del esfuerzo (RPE) y el disfrute, medido por el Physical Activity Enjoyment Scale (PACES) durante calentamientos generales y específicos. Se trató de un estudio cuantitativo, cuasi-experimental, cruzado con un diseño de medidas repetidas. Participaron un total de 27 practicantes recreativos de boxeo, hombres y mujeres, quienes realizaron dos condiciones de calentamiento distintas: (1) calentamiento general y (2) calentamiento específico, al inicio de sesiones de entrenamiento no consecutivas. La Escala de Disfrute de la Actividad





Física (PACES) y la RPE se aplicaron inmediatamente después de cada sesión, considerando solo el período de calentamiento. Las comparaciones entre condiciones se realizaron mediante la prueba t de Student para muestras pareadas, y el tamaño del efecto se calculó utilizando d de Cohen, con un nivel de significancia del 5%. El calentamiento específico generó mayor disfrute en comparación con el calentamiento general ($106 \pm 18,4$ vs. $85 \pm 32,2$; $p < 0,001$; $d = 0,80$), mientras que la RPE fue significativamente menor durante el calentamiento específico ($3,7 \pm 1,8$ vs. $5,4 \pm 2,6$; $p < 0,001$; $d = 0,76$). Los resultados indican que un calentamiento específico es más efectivo para aumentar el disfrute y reducir la percepción de esfuerzo al inicio del entrenamiento en nuestro universo muestral, y puede utilizarse como estrategia para optimizar la calidad de las sesiones de boxeo.

Palabras clave: Artes Marciales; Deportes de Combate; Psicología del Deporte; Ciencias del Deporte.

INTRODUCTION

Boxing has been an Olympic combat sport for over 119 years, and in the last decade, it has shown a significant increase in popularity (Kim *et al.*, 2024). Archaeological evidence indicates that boxing was practiced in Mesopotamia centuries before Ancient Egypt, making it one of the oldest sports in the world (Mohammed, 2020). The discipline is characterized by punches directed at the torso and head, above the waistline, excluding the back and the nape. The main strikes include the jab, straight, hook, uppercut, and cross (Ashker, 2011; Kapo *et al.*, 2021). Boxing can be practiced for different purposes, such as self-defense, competition, and health promotion (Pekel *et al.*, 2025).

Traditionally, both boxing sessions and other combat sports begin with body warm-up exercises (Costa *et al.*, 2011; Cunniffe *et al.*, 2017; Duarte *et al.*, 2023). Warm-up is a fundamental practice in sports, recognized for optimizing athletic performance and for physically and mentally preparing the body for the subsequent main activity (Fujii *et al.*, 2023). Furthermore, the same authors add that warming-up routines traditionally included general components, such as low-intensity aerobic activities, and specific components consisting of exercises that mimic the skills of the target activity.

Warm-up is directly associated with an increase in body temperature, resulting from elevated metabolic activity and the hydrolysis of adenosine triphosphate (ATP), a process in which part of the released energy is dissipated as heat (Périard; Eijsvogels; Daanen, 2021). During this process, the neuromuscular system is prepared through the progressive recruitment of motor units responsible for activating the muscle fibers required during exercise (Lee *et al.*, 2024). Additionally, warm-up represents an important phase of the class, as it may capture students' attention and positively or negatively influence their motivation to engage in physical training activities (Nulhakim; Sumpena; Gumilar, 2025).

Given the existing gaps in the literature regarding the optimal contribution of different warm-up strategies (general versus specific), the present study aimed to compare the acute effects of general and specific warm-ups on ratings of perceived exertion (RPE) and exercise enjoyment in boxing practitioners. Enjoyment experienced during physical exercise has been recognized as an important





determinant of long-term adherence to training programs (Tavares *et al.*, 2021). Therefore, understanding how different warm-up approaches influence perceptual responses may provide relevant insights for optimizing training strategies. It is expected that the findings of this study will contribute to improving both physical and psychological readiness, thereby enhancing training effectiveness and promoting long-term adherence. The central hypothesis is that participants will report greater enjoyment and lower perceived exertion following the specific warm-up compared with the general warm-up.

METHODS

Sample

The minimum sample size calculation for this study was performed using G*Power software (version 3.1.9.4; University of Düsseldorf, Düsseldorf, Germany). Dependent t-tests were employed, considering the following parameters: significance level (α) = 0.05, effect size = 0.50, and statistical power ($1-\beta$) = 0.80. The analysis indicated a minimum requirement of 27 volunteers in each condition (general warm-up and specific warm-up) to detect statistically significant differences.

Thus, the final sample consisted of 27 volunteers (9 women and 18 men), all recreational boxing practitioners. The participants' mean age was 27 ± 7.8 years, with an average height of 1.70 ± 0.09 m, body mass of 79 ± 10.9 kg, and an average boxing practice time of 8 ± 22.5 weeks.

Inclusion and Exclusion Criteria

Men and women with at least one month of boxing practice were included. Participants were excluded if they had medical restrictions (injuries or health conditions) preventing the execution of exercises, or if they were engaged in rapid weight-loss processes for competition purposes. According to Franchini, Cormack and Takito (2019), four weeks of training are sufficient to induce substantial physiological and performance adaptations in combat sport practitioners.

Procedures

This was a quantitative, quasi-experimental, crossover study with a repeated-measures design, in which participants served as their own controls. Participant recruitment was conducted through invitations made by an experienced boxing instructor, who also provided detailed explanations of the





study procedures at the beginning of a class. The intervention consisted of two distinct warm-up conditions. In the first session, participants performed a specific warm-up with movements characteristic of boxing (Figure 1). In the second session, held seven days later, participants completed a general warm-up using non-sport-specific exercises (Figure 2).

On the first day of the intervention, the Informed Consent Form was provided to all volunteers prior to the beginning of the study. The study was conducted in two private gyms. In case of refusal to participate, individuals continued their regular training sessions without completing the questionnaires. For underage participants, the consent form was provided to parents or legal guardians. At the end of each session, participants completed the Physical Activity Enjoyment Scale (PACES) and the RPE scale. Additionally, anthropometric data (body mass, height, age, sex, and training experience) were collected. More specifically, the questionnaires were administered at the end of the training session, but only the warm-up was taken into account. The ethics committee of the Federal University of Mato Grosso - Brazil under number 5.709.528, approved the study.

Training Session

Each boxing training session lasted a total of 60 minutes, with the initial minutes dedicated to warm-up exercises. The warm-up portion of the training session lasted approximately ten minutes. In the first session, participants performed specific warm-up movements, while in the second session, held seven days later, they followed a general warm-up protocol (as described in Table 1). The condition of the first session was randomized by artificial intelligence. Each exercise was performed twice. During the warm-up periods, no verbal encouragement or auditory stimuli (such as music) were used to avoid influencing participants' responses.



Table 1 – Specific and general warm-up protocol

Specific warm-up	Repetitions	General warm-up	Repetitions
Entry and exit in fighting stance (orthodox stance)	20 rep	Lateral jumping Jacks	20 rep
Entry and exit in fighting stance (southpaw stance)	20 rep	Front jumping Jacks	20 rep
Step forward with jab and return (orthodox stance)	20 rep	Running in place with knee lifts	20 rep
Step forward with jab and return (southpaw stance)	20 rep	Countermovement jump	20 rep
Rest	10 seg	Rest	10 seg
Step forward with jab and cross, then return (orthodox stance)	20 rep	Burpee	20 rep
Step forward with jab and cross, then return (southpaw stance)	20 rep	High plank with knee lifts	20 rep

Note: rep = repetitions; sec = seconds

Source: original formulation.

During the specific warm-up, participants were instructed to perform the movements in both stances, alternating the leading leg and hand, in accordance with the recommendations of Fett & Fett (2009). Figure 1 provides a detailed illustration of the exercises included in the specific warm-up, while Figure 2 depicts the movements corresponding to the general warm-up. These general exercises are frequently used in boxing warm-up sessions (Blower, 2012).

Figure 1 – Specific warm-up movements



Note: A) hopping in fighting stance; B) hopping forward while performing a jab and returning to stance; C) advancing while performing a jab followed by a straight punch.

Source: original formulation.

Figure 2 – General warm-up movements



Note: A) lateral jumping jacks; B) frontal jumping jacks; C) running in place with knee lifts; D) countermovement jumps; E) burpees; F) high plank with knee lifts.

Source: original formulation.



Physical Activity Enjoyment Scale (PACES)

The PACES was originally proposed by Kendzierski & DeCarlo (1991) and consists of 18 items. Each item presents two opposite (bipolar) statements, separated by a 7-point scale (1 = “I enjoy it”; 7 = “I hate it”; 4 = “neutral”). The values of all items are summed, resulting in a total score ranging from 18 to 126 points, which provides a unidimensional measure of enjoyment in physical activity, the higher the score, the greater the enjoyment. This type of scale is based on the importance of language in expressing feelings. Some items of the scale are reverse-scored. The questionnaire has been translated and validated for the Brazilian population (Alves *et al.*, 2019).

Rating of Perceived Exertion (RPE)

The RPE was recorded at the end of each training session, considering only the warm-up period. The Borg Scale (Borg, 1990) was used, ranging from 0 to 10, with descriptors that progressively increase according to the perceived intensity of physical effort (0 = Nothing at all; 0.5 = Extremely weak; 1 = Very weak; 2 = Weak; 3 = Moderate; 5 = Strong; 7 = Very strong; 10 = Extremely strong). During the sessions, participants had visual access to a printed version of the scale, displaying the scores and their corresponding descriptors. At the end of the warm-up, they were instructed to independently and honestly indicate their perceived level of exertion.

Statistical Analysis

Data normality was verified using the Shapiro–Wilk test. As the data showed a normal distribution, comparisons between the two conditions (general warm-up and specific warm-up) were performed using the paired Student’s t-test. The data from the present study were expressed as mean and standard deviation. The level of significance was set at 5% ($p < 0.05$). Additionally, effect size was calculated using Cohen’s d coefficient, with the following reference values: small ($d = 0.2$), medium ($d = 0.5$), and large ($d = 0.8$), in order to assess the magnitude of the differences observed between conditions (Cohen, 1992). Statistical analyses were performed using SPSS software, version 25.

RESULTS

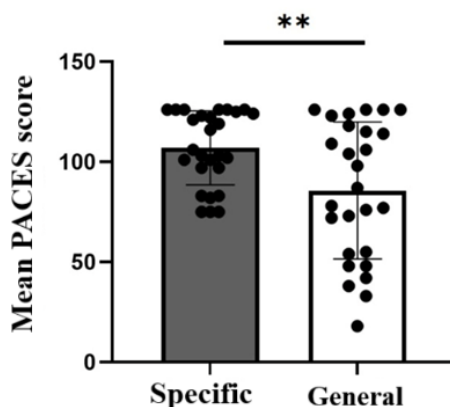
The pleasure scores were significantly higher during the specific warm-up compared to the general warm-up (106 ± 18.4 vs. 85 ± 32.2 ; $p < 0.001$; $d = 0.80$), indicating a large effect size. These results





suggest that the specific warm-up elicited greater enjoyment among participants. Additional information can be found in Figure 3.

Figure 3 – Comparison of the Physical Activity Enjoyment Scale (PACES) scores during specific and general warm-up sessions

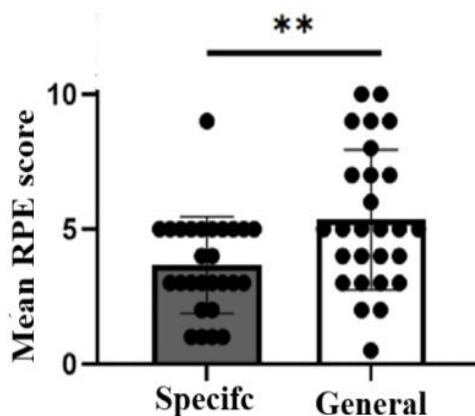


Note: (** = $p < 0.001$).

Source: original formulation.

The RPE values were significantly higher in the general warm-up session compared to the specific warm-up (3.7 ± 1.8 vs. 5.4 ± 2.6 ; $p < 0.001$; $d = 0.76$), indicating a medium effect size. These findings suggest that the general warm-up was perceived as more demanding by the participants. Additional information can be viewed in Figure 4.

Figure 4 – Comparison of the Rating of Perceived Exertion (RPE) during the specific and general warm-up sessions



Note: (** = $p < 0.001$).

Source: original formulation.



DISCUSSION

To the best of our knowledge, this is the first study to investigate affective differences between general and specific warm-ups in combat sports. The results indicated that pleasure scores were significantly higher during the specific warm-up compared to the general warm-up in our sample universe. Moreover, the perceived exertion during the specific warm-up was significantly lower, supporting our initial hypothesis. These findings are consistent with previous studies showing that different warm-up protocols can influence both affective responses and perceived exertion (Eken, 2022; Melki *et al.*, 2024; van den Tillaar *et al.*, 2019).

In a study comparing short or long specific warm-ups with a long general warm-up (10 to 20 minutes of low-intensity running), experienced soccer players who engaged in specific warm-ups reported lower RPE values, indicating a reduced perception of effort during subsequent exercise and improved performance (van den Tillaar *et al.*, 2019). Another study found that a specific warm-up based on opposition games significantly enhanced technical performance and mental well-being, leading to increased motivation and reduced stress levels, which may correlate with lower RPE and greater enjoyment during exercise among physical education students (Melki *et al.*, 2024). In strength training, participants reported feeling more engaged and prepared when performing specific warm-ups, contributing to a more positive exercise experience (Eken, 2022).

Regarding psychological effects, participants who performed specific warm-ups reported higher levels of enjoyment and motivation compared to those who did not warm up (Ladwig, 2013). That is, the incorporation of enjoyable activities, such as opposition games, in warm-ups has been associated with increased intrinsic motivation and reduced stress levels (Melki *et al.*, 2024). In line with this premise, when comparing short games to high-intensity interval training (HIIT), studies indicate that physiological responses were similar, yet exercise modalities that incorporate specific and playful elements in sports such as basketball and soccer are perceived as more enjoyable than general conditioning exercises like running or HIIT (Selmi *et al.*, 2020). Moreover, in judo, specific conditioning training (Randori and Uchi-komi) led to greater physical enjoyment and better recovery quality compared to general running sessions (Ouergui *et al.*, 2020). On the other hand, although specific warm-ups provide higher enjoyment and performance, some studies suggest that general warm-ups can still be effective, particularly in increasing muscle temperature and preparing the body for exercise, albeit with less subjective pleasure (Neves *et al.*, 2024).





In summary, the positive psychological effects of specific warm-ups may contribute to better adherence to exercise programs, as individuals are more likely to engage in activities they find enjoyable (Ladwig, 2013). This suggests that specific warm-ups not only enhance performance but also promote a more positive exercise experience, potentially leading to long-term commitment to physical activity (Melki *et al.*, 2024). This may be explained by greater motor fluency, as increased familiarity with movement patterns can reduce perceived effort and discomfort during exercise (Goushe *et al.*, 2025).

The lower RPE values observed in the group performing the specific warm-up may be explained by participants' preference for exercises characteristic of their sport (Ouergui *et al.*, 2020). Additionally, affective responses to exercise can contribute to a reduction in perceived exertion (Winchester *et al.*, 2012). It is also possible that the general warm-up, which included exercises such as burpees, jumping jacks, and high planks with knee lifts, required greater recruitment of muscle groups in addition to greater intensity compared to the specific warm-up, which focused on jab and straight punches. Considering that involving a larger number of muscle groups tends to increase RPE levels (Halperin & Vigotsky, 2024), this difference in muscle recruitment may help explain the observed results. However, the scarcity of studies on this topic limits more direct comparisons.

Limitations

Despite the practical relevance of this study, we acknowledge several potential limitations. The sample size was sufficient to detect statistical differences but not large enough to allow generalization of the results. In this context, the study involved only recreational practitioners; therefore, the results cannot be extrapolated to competitive athletes. Additionally, the instruments used are subjective, which introduces the possibility of response bias (Duarte, 2023). However, the PACES and RPE questionnaires are scientifically validated and widely used (Alves *et al.*, 2019; Borg, 1990). It is worth noting that RPE is positively correlated with heart rate and lactate levels, making it a low-cost instrument recommended for assessing intensity in combat sports (Slimani *et al.*, 2017).

Furthermore, it was not possible to compare the sexes due to the small number of women in the study. Body composition analyses (e.g., body fat percentage) were also not performed, which could have provided more details about the sample. Although general exercises commonly used in boxing general warm-up sessions were applied (Blower, 2012), differences in exercise intensity may represent a confounding factor. Thus, it is not possible to determine whether the observed effects were attributable





to the type of exercise itself or to differences in intensity. Finally, the study did not include randomization or counterbalancing of the conditions, which may have introduced potential expectation bias and making it increasingly difficult to establish causality. This limitation was primarily due to the operational constraints of private gym settings in Brazil, which made random allocation and experimental control unfeasible.

CONCLUSION

Although most combat sports coaches use general warm-up routines, our findings based on our sample population showed that sport-specific warm-ups resulted in greater enjoyment and a lower RPE compared to general warm-ups. Therefore, sport-specific warm-ups should be taken into account when planning boxing training.

PRACTICAL APPLICATIONS

The results of this study are valuable to professionals and coaches in designing more effective warm-up strategies aimed at maximizing performance and improving the quality of training during boxing practice. By understanding that different warm-up approaches elicit distinct psychophysiological responses, coaches can tailor the type of warm-up to the individual needs of their athletes, thereby increasing engagement and performance.

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Gabriel da Silva Pinto

<https://orcid.org/0009-0005-5439-5663>

<http://lattes.cnpq.br/0431843542453042>

Universidade Federal de Mato Grosso (Cuiabá, MT – Brasil)

gabrielsilva.p127@gmail.com

Jonatas Deivyson Reis da Silva Duarte

<https://orcid.org/0000-0001-9938-6043>

<http://lattes.cnpq.br/1715413441907784>

Universidade Federal de Mato Grosso (Cuiabá, MT – Brasil)

jonatas00013@hotmail.com

Michelle Jalousie Kommers

<https://orcid.org/0000-0001-8677-1786>

<http://lattes.cnpq.br/4743649641882420>

Universidade de Araraquara (Araraquara, SP – Brasil)

michellejkommers@gmail.com

Matheus de Sena Ferreira Arbuez

<https://orcid.org/0000-0002-2247-1810>

<http://lattes.cnpq.br/8918007924733379>

Universidade Federal de Mato Grosso (Cuiabá, MT – Brasil)

matheussena714@gmail.com

Carlos Alexandre Fett

<https://orcid.org/0000-0002-7522-7985>

<http://lattes.cnpq.br/1802404946212461>

Universidade Federal de Mato Grosso (Cuiabá, MT – Brasil)

fettcarlos@gmail.com

CONTRIBUIÇÃO DOS AUTORES

Autor 1: concepção e desenho da pesquisa, coleta dos dados e escrita conjunta do texto.

Autor 2: construção e processamento dos dados; análise e interpretação dos dados; escrita conjunta do texto.

Autora 3: concepção e desenho da pesquisa e escrita conjunta do texto.





Autor 4: concepção e desenho da pesquisa e coleta dos dados.

Autor 5: concepção e desenho da pesquisa; supervisão e escrita conjunta do texto.

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