

1 Article

2 **IS PERCEIVED EXERTION AN USEFUL**
3 **INDICATOR OF METABOLIC AND**
4 **CARDIOVASCULAR RESPONSE TO METABOLIC**
5 **CONDITIONING OF FUNCTIONAL-FITNESS**
6 **SESSION? A RANDOMIZED CONTROLLED**
7 **TRIAL.**

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21 Received: date; Accepted: date; Published: date

22 **Abstract:** The purpose of this study was to assess if self-regulation of intensity based on rating of
23 perceived exertion (RPE) is a reliable method to control the intensity of metabolic conditioning of
24 functional-fitness session. In addition, the relationship between RPE and changes in heart rate and
25 lactate responses was also analyzed. Eight male participants (age 28.1 ± 5.4 years; body mass $77.2 \pm$
26 4.4 kg; VO_2max : 52.6 ± 4.6 mL·(kg·min)⁻¹) completed three randomly sessions (5 to 7 days apart)
27 under different conditions: (1) all-out (ALL); (2) self-regulation of intensity based on a RPE of 6
28 (hard) on the Borg CR-10 scale (RPE6); and (3) a control session. Rate of perceived exertion, LAC
29 and HR response were measured pre, during and immediately after the sessions. The RPE and
30 LAC during the ALL-OUT sessions were higher ($p \leq 0.05$) than the RPE6 and control sessions for all
31 the analyzed time points during the sessions. Regarding HR, the 22 min area under the curve of HR
32 during ALL-OUT and RPE6 sessions were significantly higher ($p \leq 0.05$) than the control session.
33 The average number of repetitions was lower ($p \leq 0.05$) for the RPE6 session (190.5 ± 12.5
34 repetitions) when compared to the ALL session (214.4 ± 18.6 repetitions). There was a significant
35 correlation between RPE and LAC ($p = 0.001$; $r = 0.76$; very large) and number of repetitions during
36 the session ($p = 0.026$; $r = 0.55$; large). No correlation was observed between RPE and HR ($p = 0.147$;
37 $r = 0.380$). These results indicate that self-regulation of intensity of effort based on RPE may be a
38 useful tool to control exercise intensity during a metabolic conditioning session of
39 functional-fitness.

40 **Keywords:** CrossFit; High-intensity functional training; Extreme conditioning programs;
41

42 **1. Introduction**

43 Functional-Fitness (FFT), also known as CrossFit, high-intensity functional training (HIFT), or
44 extreme conditioning programs (ECP), is an exercise modality that contemplates a variety of training

45 methods. Sessions are often classified as weightlifting (W), metabolic (M), or gymnastics (G), and
46 utilize weightlifting/powerlifting (e.g. clean and jerk, snatch, squat, deadlift, push press, bench
47 press, and power clean), calisthenic bodyweight exercises (e.g. pull-ups, dips, push-ups,
48 handstands, presses to handstands, pirouettes, kips, cartwheels, muscle-ups), cardiovascular
49 exercises (e.g. row, bike, run), sprints, and flexibility exercises, depending on the goal of the session
50 and the fitness components that are to be targeted [1,2]. Metabolic training sessions are often
51 performed either as a single mode of exercise focusing on a cardiovascular exercise or utilizing a
52 combination of exercise methods in order to maximize physiological stress and the purported
53 training adaptations [3].

54 Previous research has shown that a metabolic conditioning session of functional-fitness resulted
55 in increased acute oxidative stress [4], high metabolic, inflammatory [5], and cardiovascular
56 responses, elevated perceived exertion [6] and increased sympathetic nervous system markers (i.e.,
57 plasma Epinephrine and Norepinephrine) [7]. However, due to increases in oxidative and
58 inflammatory markers [4,5] and the extreme effort associated with FFT, some studies have raised
59 concerns about a tendency for the development of symptoms of overtraining in functional fitness
60 practitioners [8,9]. For example, Drake, et al. [8] found that four weeks of FFT, led to a state of
61 functional overreaching in some participants, and that non-functional overreaching could be
62 developed if the high intensity associated with FFT was maintained after the four weeks of study.
63 Similarly, Drum, et al. [9] demonstrated a high presence of severe post-exercise symptoms during a
64 CrossFit program, such as excessive fatigue, muscle soreness, muscle swelling, and limited muscle
65 movement during workouts due to the extreme intensity of the workout. Thus, despite evidence that
66 finds extreme metabolic conditioning leads to severe post exercise symptoms of fatigue, the current
67 literature regarding methods of monitoring and controlling training intensity during these sessions
68 in functional-fitness is limited.

69 In this context, a correct control and prescription of training intensity can minimize the
70 deleterious effects that have been shown to occur following metabolic sessions or periods of intense
71 training. Considering the wide variety of exercises used during such sessions (strength/power,
72 gymnastics, and endurance), controlling training intensity is a challenge. The Borg CR-10 scale,
73 called the rate of perceived exertion (RPE) scale [10] has been widely used to determine the intensity
74 during different modalities of exercise, including resistance training [11], high-intensity interval
75 exercise [12] and swimming [13]. The use of RPE has been shown to be related to physiological
76 markers, such as maximal oxygen consumption (VO_{2max}), lactate and ventilatory thresholds, and
77 can be used as a surrogate of heart rate to understand the heart rate response to a specific exercise
78 intensity. However, the validity and utility of RPE for prescribing and self-regulating training
79 intensity during the metabolic conditioning of FFT has not been studied. Furthermore, the
80 relationship between metabolic and cardiovascular responses and RPE to metabolic conditioning of
81 FFT have not been established.

82 Thus, the aim of the present study was to examine whether RPE could be used as a method to
83 prescribe exercise intensity during extreme type metabolic conditioning. Secondly, we aimed to
84 assess and compare the physiological responses of the RPE-prescribed session to that of the typical
85 all out conditioning and what the difference in total work performed. It was hypothesized that
86 participants would be able to self-regulate intensity when a target RPE was prescribed and that the
87 metabolic and cardiovascular response as well as total work done would be lower when intensity is
88 regulated via RPE.

89 2. Materials and Methods

90 2.1. Participants

91 Eight members of the functional fitness community (age 28.1 ± 5.4 years; body mass 77.2 ± 4.4 kg;
92 VO_{2max} : 52.6 ± 4.6 mL·(kg·min)⁻¹) were recruited through advertisements. All subjects were free of
93 injury and known illness, were not using drugs to enhance performance, and had a minimum of six
94 months of FFT experience. The subjects were advised to sleep between six and eight hours the night

95 before each experimental session, to maintain their regular hydration and food consumption habits,
96 to avoid any exercise in the 48 h before the experimental sessions, and to avoid smoking, alcohol and
97 caffeine consumption 24 h before the experimental session. All subjects signed an informed consent
98 document and the study was approved by the University Research Ethics Committee for Human
99 Use (2.698.225/Universidade Estácio de Sá/ UNESA/RJ) and conformed to the Helsinki Declaration
100 on the use of human participants for research.

101 2.2. *Experimental Design*

102 Subjects completed a metabolic conditioning session (5 to 7 days apart) in randomized fashion
103 under two different conditions: (1) all-out (ALL); (2) self-regulation of intensity based on a RPE of 6
104 (hard) on the Borg CR-10 scale (RPE6). A control session (CONT) consisting of 22 minutes in the
105 sitting position without any type of exercise was also performed. The all-out and RPE-based
106 autoregulation sessions were as follows: 4 min of as many rounds as possible (AMRAP) of 5
107 thrusters (60 kg) and 10 box jump over (round 1); 2 min of rest; 4 min of AMRAP of 10 power clean
108 (60 kg) and 20 pull-ups (round 2); 2 min of rest; 4 min of AMRAP of 15 shoulder to overhead (60 kg)
109 and 30 toes to bar (round 3); 2 min of rest; 4 min of AMRAP of 20 calories of row and 40 wall ball (9
110 kg) (round 4). During the all-out workout, subjects were instructed to complete the maximum
111 number of repetitions possible for each round. The RPE-based autoregulation session consisted of
112 performing the same activity, but with participants told to self-regulate the intensity of their session
113 based on a perception of effort of 6 (hard) on the Borg CR-10 scale. During the session, the subjects
114 were instructed to take more breaks if needed or just “slow down” the execution of their exercises to
115 keep the perception of effort of 6 (hard). No changes of the weights were performed during the
116 sessions. The Borg CR-10 scale was printed and available to the participants as a visual reminder of
117 the prescribed target intensity.

118 2.3. *Blood Lactate*

119 Capillary blood samples were collected through transcutaneous puncture on the medial side of
120 the tip of the middle finger using a disposable hypodermic lancet. Blood lactate (LAC)
121 concentrations were measured before and immediately after 4, 10, 16, and 22 minutes in each
122 protocol of exercise and control session. LAC was determined by photometric reflectance on a
123 validated Portable Accutrend Plus system (Roche, Sao Paulo, Brazil).

124 2.4. *Heart Rate (HR)*

125 The continuous monitoring of HR during the experimental sessions was done with the use of a
126 Polar H10 HR-monitor (Polar Electro Oy, Kemple, Finland), with a recording interval of 1 s. Maximal
127 heart rate was obtained in the 2 km row test that was used for indirect assessment of maximal
128 oxygen uptake [14] of the subjects. The 2 km row test consisted in rowing 2 km with the maximal
129 effort (power) as possible. During the test, continuous monitoring of HR was done and the
130 maximum HR during the test was used as the maximum HR of the subject. The values of HR
131 obtained during the protocols of the present study were normalized as percentual values using the
132 maximum HR obtained during the 2 km row test.

133 2.5. *Rating of Perceived Exertion (RPE)*

134 Data were collected as previously described by Tibana, et al. [15]. The RPE was measured
135 before, during and immediately after exercise by the RPE CR10 Borg scale adapted from Foster, et al.
136 [16], an instrument composed by a Likert type scale of 11 points, varying from 0 to 10, initiated with
137 “very, very light” and terminated with “very, very hard “. The following instructions were used to
138 ensure each participant clearly understood what the RPE scale was and how it was to be used to
139 regulate their exercise intensity. First, RPE was explained to the subjects individually according to
140 the recommendations from Foster, et al. [16]. Secondly, the following information was verbally
141 provided: “The perceived exertion is defined as the effort intensity, stress, discomfort, and fatigue

142 felt during exercise. Utilize the numbers of this scale to report how your body feels during exercise.
143 The number zero in the scale describes “minimal effort” and represents your lowest imaginable
144 effort. The number 10 described “maximum effort” and represents the highest imaginable effort. If
145 you feel an exertion between extremely easy and maximum effort indicate a number between 0 and
146 10. There are no right or wrong numbers. The verbal descriptors may help you to choose a number”
147 [16].

148 During the sessions, a printed version of the RPE scale (large scale) was fixed in a wall so that
149 the subjects could visualize at all time the scale. During the anchoring procedure, the subject was
150 instructed by another evaluator that was presented in the testing room to describe their effort using
151 the RPE scale. Subjects also received a copy of the scale with the respective instructions for
152 anchorage. This was provided for subjects to read during the general warm-up for each session [16].

153 2.6. Statistical analysis

154 Data are expressed as mean \pm standard deviation (SD). Shapiro–Wilk test was used to check for
155 normal distribution of study variables (all variables presented normal distribution). A two-way
156 repeated measures ANOVA (sessions \times time) was used to compare the LAC, HR and RPE between
157 REP6, ALL-OUT and CONT sessions. Sphericity assumption was verified by Mauchly’s test. When
158 the assumption of sphericity was not met, a Greenhouse-Geiser adjustment was used to determine
159 the significance of the ANOVA tests. Tukey’s post-hoc test with Bonferroni correction was applied
160 in the event of significance. One-way repeated measures ANOVA was used to compare the area
161 under the curve of LAC, HR and RPE generated during the 22 min of the RPE6, ALL-OUT and
162 CONT functional fitness sessions. The Pearson product moment correlation was used to evaluate the
163 relationship between RPE and LAC and RPE and HR. Instead of a fixed time point of the study
164 variables, it was used the area under the curve for all correlations (RPE, LAC and HR) during the
165 ALL-OUT and RPE6 sessions. The magnitude of the correlations was classified as: $r \leq 0,1$ trivial; $0,1 <$
166 $r \leq 0,3$ small; $0,3 < r \leq 0,5$ moderate; $0,5 < r \leq 0,7$ large; $0,7 < r \leq 0,9$ very large; $> 0,9$ almost perfect
167 (Hopkins, 1996). The achieved power of the sample size was calculated based on the interaction of
168 RPE between ALL-OUT, RPE6 and CONT sessions. The effect size f was 0.312 and the achieved
169 power was 0.810. The level of significance was $p \leq 0.05$ and all analyses were performed using SPSS
170 version 20.0 (Somers, NY, USA).

171 3. Results

172 3.1. Number of repetitions performed

173 The average number of repetitions was significantly lower ($p \leq 0.05$) for the RPE6 session ($190.5 \pm$
174 12.5 repetitions) than for ALL-OUT session (214.4 ± 18.6 repetitions) however as shown in Table 1 the
175 differences in work completed in each set varied. Specifically, as shown in Table 1 more reps were
176 completed in the ALL-OUT condition for R1 and R2 however in R3 the RPE6 condition had more
177 reps completed compared and in R4 the average difference was less than 2 reps. Table 1 presents the
178 results of the functional-fitness sessions each round as well as the percentage change in work done
179 between sets overall and the frequency of participants whom completed more reps in the ALL-OUT
180 condition compared to the RPE6 condition.

181 3.2. Rating of perceived exertion

182 A significant two-way interaction between functional fitness sessions and time on RPE ($p <$
183 0.005 ; Figure 2) was found. The RPE during the ALL-OUT session was significantly higher ($p \leq 0.05$)
184 than the RPE6 and CONT sessions at each time point. The RPE during the RPE6 session was also
185 significantly higher ($p \leq 0.05$) than the CONT session. There was a significant increase in RPE from
186 rest to R1, R2 and R3 in the ALL-OUT condition (Figure 2) and from rest to R1 and R2 during the
187 RPE6 session (Figure 2). There were no differences in RPE between R1, R2, R3 and R4 for either
188 ALL-OUT or RPE6 conditions. However, the global RPE as determined via the 22 min area under the

189 curve for RPE during ALL-OUT was significantly higher ($p \leq 0.05$) than during RPE6 and CONT
190 sessions and RPE6 was greater than CONT.

191 3.3. Blood lactate concentration

192 There was a statistically significant two-way interaction between session and time on LAC ($p <$
193 0.0005 ; Figure 3). The LAC during the ALL-OUT session was significantly higher ($p \leq 0.05$) than the
194 RPE6 and CONT sessions at each time point (R1, R2, R3 and R4). The LAC during the RPE6 session
195 was also significantly higher ($p \leq 0.05$) than the CONT session. LAC increased until R3 during the
196 ALL-OUT and RPE6 sessions, where R1 was different than Rest, R2 was greater than R1 and R3 was
197 greater than R2 for both ALL-OUT and RPE6. The LAC area under the curve during ALL-OUT and
198 RPE6 sessions were significantly higher ($p \leq 0.05$) than CONT sessions and ALL-OUT significantly
199 higher ($p \leq 0.05$) than during RPE6.

200 3.4. Heart rate

201 Figure 4 shows the % of HRmax during the functional fitness sessions. There was a significant
202 interaction between functional fitness sessions and time for % of HRmax ($p = 0.048$). The % of
203 HRmax during the ALL-OUT and RPE6 sessions were significantly higher ($p \leq 0.05$) than during the
204 CONT session for all time points. However, there was no difference in % of HRmax at any time point
205 for ALL-OUT compared to RPE6 ($p > 0.05$). Within condition time point comparisons found that % of
206 HRmax at R4 was greater than R1 and R3 for RPE6 ($p \leq 0.05$). During the ALL-OUT the % of HRmax
207 was greatest at R1 ($p \leq 0.05$) compared to R2, R3 and R4. Area under the curve for % of HRmax
208 during ALL-OUT and RPE6 sessions were significantly higher ($p \leq 0.05$) than CON sessions. No
209 statistically significant differences ($p > 0.05$) were observed between ALL-OUT and RPE6 sessions
210 (Figure 4).

211 3.5. Correlations between RPE and physiological variables

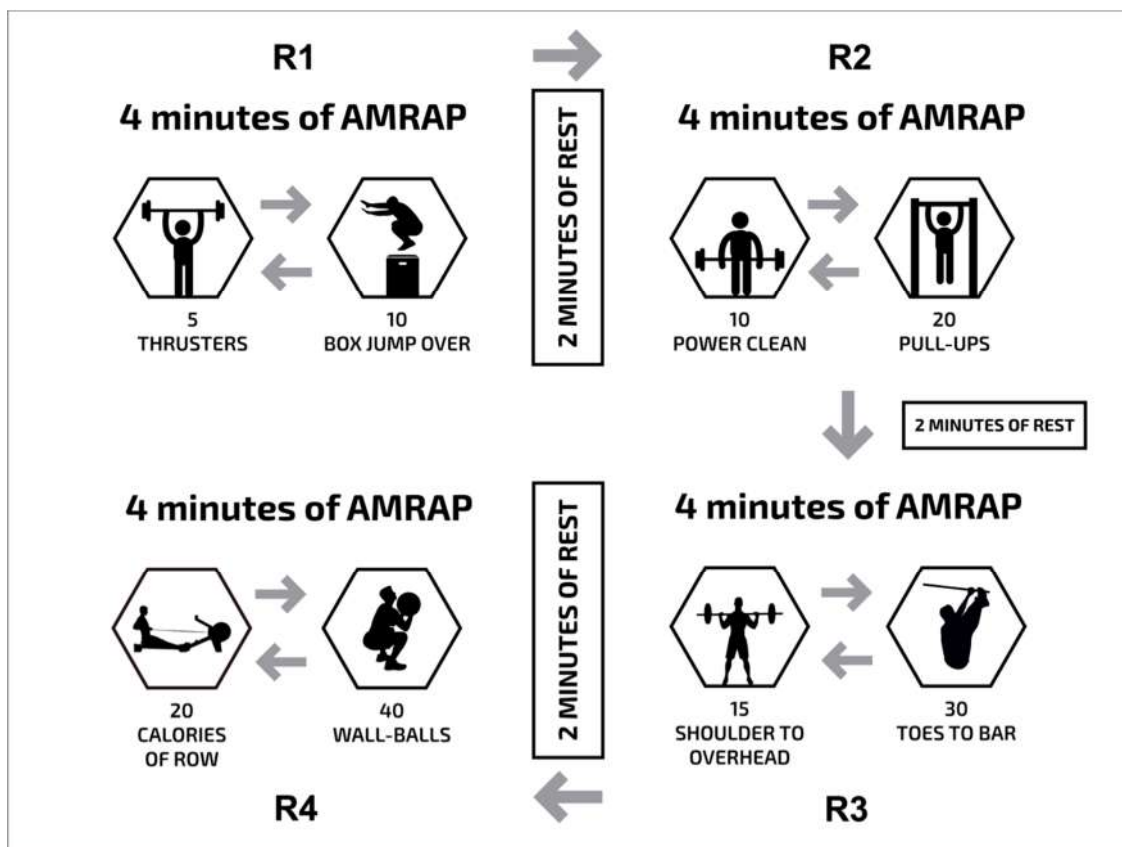
212 Figure 5 shows the correlations between the area under the curve of RPE and LAC, HR and
213 number of repetitions. It was observed a statistically significant correlation between RPE and LAC (p
214 $= 0.001$; $r = 0.757$; very large) and number of repetitions during the session ($p = 0.026$; $r = 0.555$; large).
215 No correlation was observed between RPE and HR ($p = 0.147$; $r = 0.380$).

Table 1 – Mean \pm SD of number of repetitions for ALL-OUT and RPE6 sessions

	ALL-OUT	RPE6	Δ (%)	p-value	ES
Set 1	63.9 \pm 4.4	46.6 \pm 5.8*	27.1%	≤ 0.0005	3.36
Set 2	58.0 \pm 7.7	46.4 \pm 7.0*	20%	0.006	1.58
Set 3	41.9 \pm 6.6	48.0 \pm 1.9*	14.5%	0.049	1.26
Set 4	50.6 \pm 6.5	49.5 \pm 4.0	2.2%	0.663	0.20
Total	214.4 \pm 18.6	190.5 \pm 12.5*	11.1%	0.020	1.51

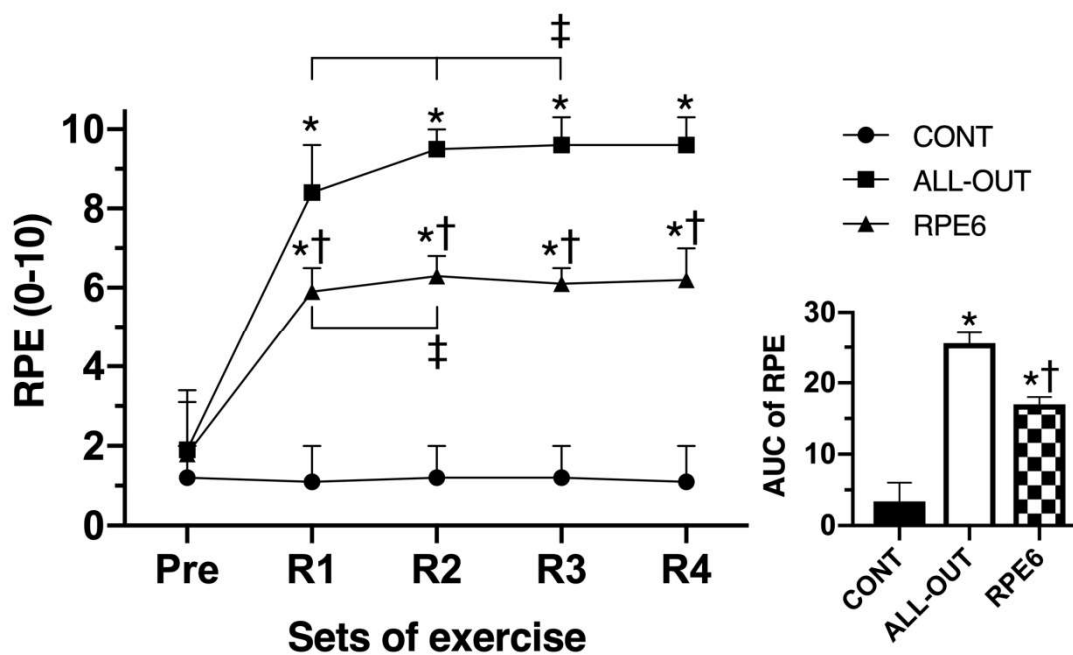
ES, effect size. * $p \leq 0.05$ for ALL-OUT session

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218 **Figure 1.** Metabolic conditioning: 4 min of as many rounds as possible (AMRAP) of 5 thrusters and 10
 219 box jump over (round 1); 2 min of rest; 4 min of AMRAP of 10 power clean and 20 pull-ups (round 2); 2
 220 min of rest; 4 min of AMRAP of 15 shoulder to overhead and 30 toes to bar (round 3); 2 min of rest; 4 min
 221 of AMRAP of 20 calories of row and 40 wall ball (round 4).

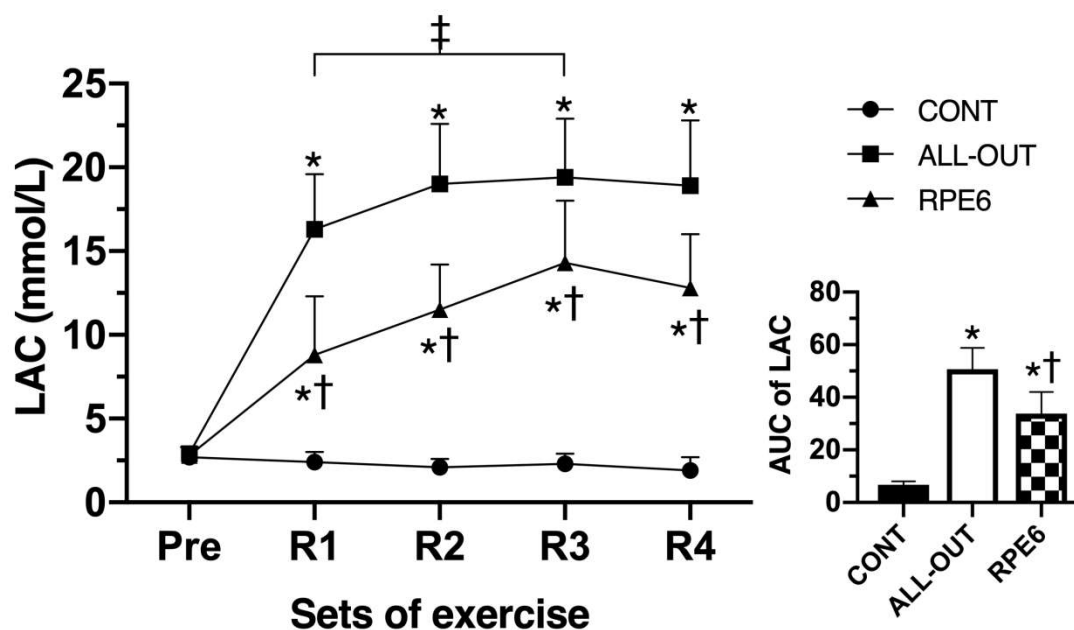


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223 **Figure 2.** Ratings of perceived exertion (RPE) pre and at the end of round 1 (R1), R2, R3 and R4 and
 224 area under the curve (AUC) of RPE during functional fitness and control (CONT) sessions.

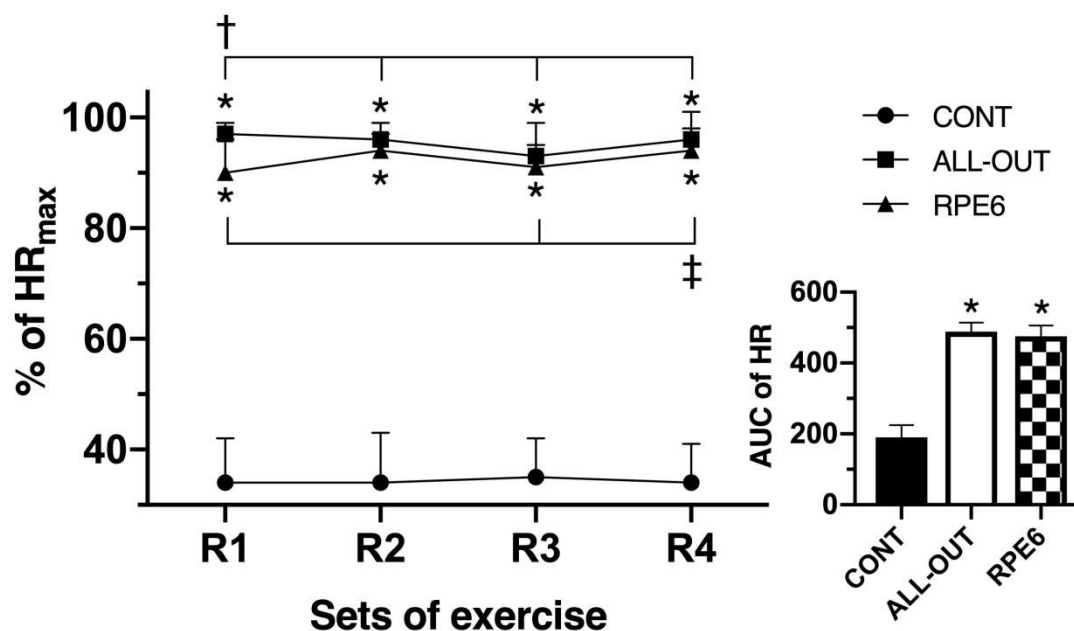
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Differences between sessions: * $p \leq 0.05$ for CONT; † $p \leq 0.05$ for ALL-OUT; Differences between time: ‡ $p \leq 0.05$ for R1 and R2 in ALL-OUT and R1 in RPE6



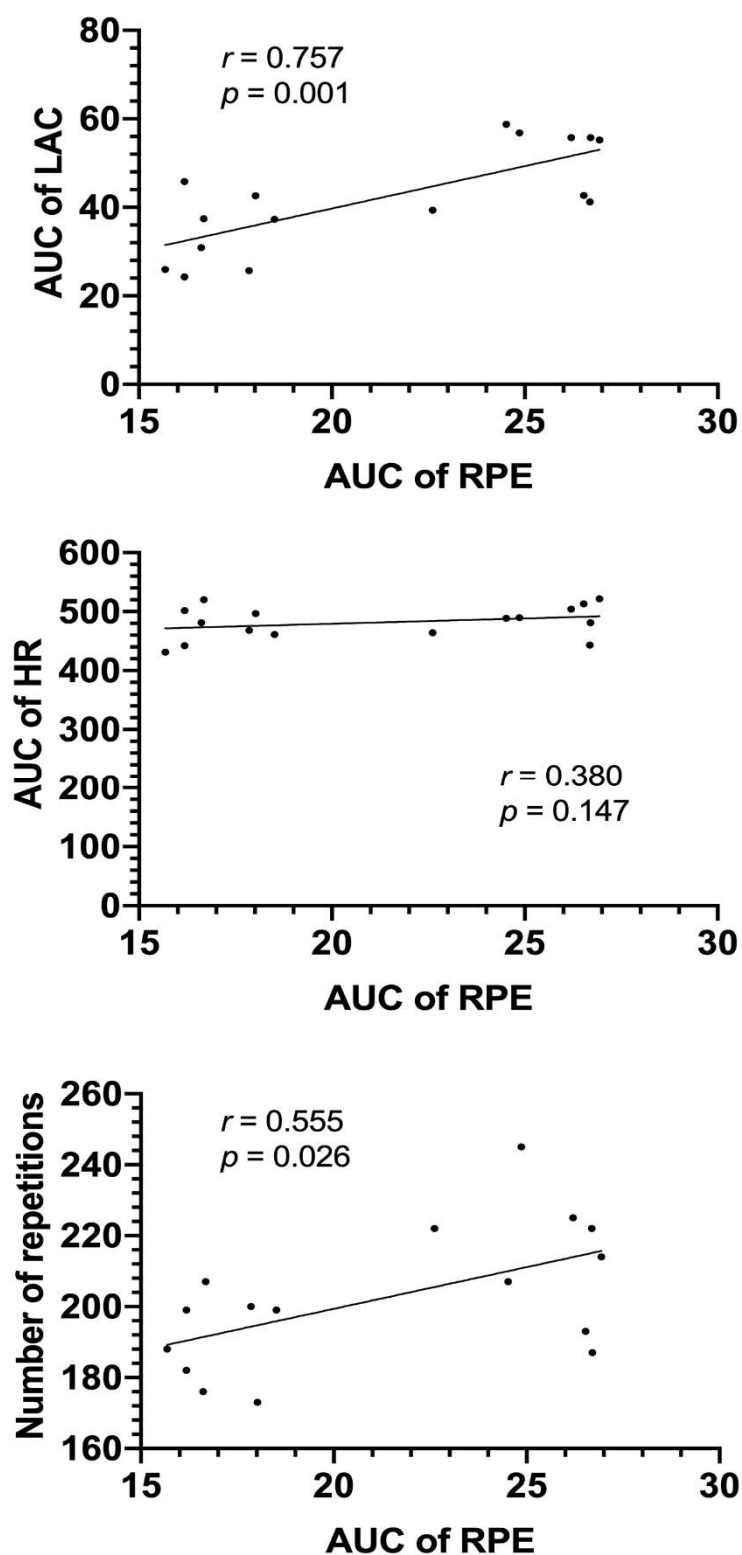
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Figure 3. Blood lactate concentration (LAC) pre and at the end of round 1 (R1), R2, R3 and R4 and area under the curve (AUC) of LAC during functional fitness and control (CONT) sessions. Differences between sessions: * $p \leq 0.05$ for CONT; † $p \leq 0.05$ for ALL-OUT; Differences between time: ‡ $p \leq 0.05$ for pre, R1 and R2 in both ALL-OUT and RPE6



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Figure 4. Percentage of maximal heart rate (HR_{max}) at the end of round 1 (R1), R2, R3 and R4 and area under the curve (AUC) of HR_{max} during functional fitness and control (CONT) sessions. Differences between sessions: * $p \leq 0.05$ for CONT; Differences between time: † $p \leq 0.05$ for R1, R2, R3 and R4 in ALL-OUT; ‡ $p \leq 0.05$ for R1 and R3 in RPE6.



237

238 **Figure 5.** Correlations between the area under the curve (AUC) of ratings of perception exertion
 239 (RPE) and blood lactate concentration (LAC), heart rate (HR) and number of repetitions.

240 4. Discussion

241 These results support the hypothesis that RPE could be used to regulate intensity during high
 242 intensity metabolic conditioning in trained men. Moreover, the results demonstrated that: (1) the

243 RPE and LAC during the ALL-OUT session were higher than the RPE6 at all time points; (2) the
244 ALL-OUT condition leads to too much undue fatigue in latter portion of the workout when the
245 number of repetitions drops dramatically; (3) the HR response is similar during ALL-OUT and RPE6
246 conditions and (4) there was correlation between RPE, LAC and number of repetitions.

247 Functional-Fitness has been increasingly growing in popularity as it is considered a more
248 enjoyable form of exercise when compared with traditional aerobic and resistance training [17]. In
249 addition, it is done in a shorter period of time inducing similar positive outcomes reported in
250 strength [18], performance [19] and body composition [20] compared to longer duration more
251 traditional type resistance and aerobic type workouts. To the best of our knowledge, this is the first
252 study designed to examine RPE as a viable tool for controlling the intensity of a metabolic training
253 session in trained men. The findings in this study corroborate what has been reported in other
254 investigations that showed the viability of this method in several exercise methods and sporting
255 disciplines, including resistance training [11], high-intensity interval training [12] and swimming
256 [13]. For example, Ciolac, et al. [12] found that HR response and walking/running speed were not
257 different between high-intensity interval training sessions prescribed and regulated by HR or RPE in
258 young individuals. Similarly, Ceci and Hassmen [21] analyzed two testing sessions consisting of
259 both treadmill and track exercise at three different intensities: at RPE 11 (light exertion), followed by
260 a RPE 13 (somewhat hard) trial and, a RPE 15 (hard) trial. The authors showed significant different
261 values of HR, blood lactate, and velocity at the three RPE zones, and concluded that the RPE method
262 functioned well as a means of monitoring and regulating exercise intensity in physically active
263 males.

264 However, our study provides new insight into the perceptual and physiological responses of an
265 all-out exercise bout. First, we assumed that RPE would be maximum (RPE of 10) but it was only
266 rising to 10 in all participants by R3. This indicates that even in all-out exercises some regulation still
267 occurs. It makes sense that the LAC response was very large and is associated with values similar to
268 other all-out style assessments such as a 90 second Wingate or events such as all-out flat-water
269 kayaking races or track cycling. Furthermore, an all-out strategy does lead to greater repetitions
270 (Table 1) overall when compared to a sub- maximal intensity prescription of "hard to very hard" as
271 prescribed in the RPE-6 session. However, as shown in Table 1, if the session had gone longer it is
272 likely that the RPE6 session may have resulted in greater total reps completed compared to the
273 all-out condition. This is because by R3 the RPE6 condition was completing more reps and this trend
274 would likely continue to additional rounds of work due to less accumulated fatigue in the early part
275 of the workout compared to an all-out strategy.

276 Although HR has been shown to a reliable tool for use during cardiovascular exercise due to its
277 close relation with oxygen consumption, the use of HR as a way of estimating levels of intensity of
278 training during strength exercises or involving intense participation of the upper limbs has been the
279 subject of controversy. It has been shown that HR has a low correlation with VO_2 during weight
280 training [22,23], especially because the number of repetitions and work duration plays a central role
281 in the increase of HR during exercise. In addition, specific exercises that require a high level of
282 contractions in the upper limbs, solicits a greater HR compared to VO_2 [23] and the presented
283 exercise protocol had at least one upper body exercise every round. This cannot be discounted in this
284 study, meaning the high heart rate response might be a combination of true O_2 demand by working
285 muscle as well as additional heart rate response due to breath holds and thoracic pressure changes
286 causing changes in the sinus rhythm and heart rate response. Yet, these results also point to the
287 value of FFT as being more advantageous to aerobic conditioning compared to more traditional
288 intermittent traditional resistance training and that a hard RPE intensity can produce similar HR
289 response as an all-out intensity.

290 Regardless of the training method, a correct application of training intensity is one of the
291 fundamental factors for positive physiological adaptations to occur leading to a concomitant
292 improvement in performance [24,25]. On the other hand, excessive training performed at a high
293 intensity will result in negative adaptations, including non-functional overreaching and/or
294 overtraining. In this context, studies have shown that functional fitness practitioners have a

295 tendency to develop symptoms of overtraining [8,9]. This tendency to develop symptoms of
296 overtraining can be explained by the fact that a single session of metabolic conditioning of
297 functional-fitness leads to increased acute oxidative stress [4], metabolic and inflammatory stress [5],
298 high cardiovascular and RPE responses [6] and elevated sympathetic nervous system markers (i.e.,
299 plasma Epinephrine and Norepinephrine) [7]. As participation in Functional-Fitness programs often
300 involve multiple training sessions in a week, it is possible that the frequent performance of metabolic
301 sessions at a high intensity does not allow for recovery to occur between sessions. Seiler, et al. [26]
302 demonstrated that training at higher intensities leads to higher levels of autonomic nervous system
303 fatigue, that can often take up to 72 hours to recover. In line with these findings, it has been
304 suggested that two to three high intensity training sessions might be the limit to what can be
305 performed on a weekly basis, to allow for proper recovery between such sessions.

306 The use of RPE as a method to control training intensity could provide an alternative for
307 participants and coaches to reduce the training intensity and thus, provide a training stimulus from
308 which recovery will not be impaired. As the use of the CR-10 RPE scale is an inexpensive,
309 non-invasive method of self-monitoring training intensity during metabolic conditioning of FFT that
310 correlates with LAC, and with the number of repetitions completed, practitioners are encouraged to
311 adopt it.

312 5. Conclusions

313 This study demonstrates that RPE may be a useful tool to prescribe and control training
314 intensity during metabolic conditioning sessions of functional fitness due to its large correlation
315 with lactate and number of repetitions completed. These findings are of importance in a practical
316 setting, suggesting that coaches could use this method to prescribe training intensity in a practical,
317 inexpensive way. This allows coaches and practitioners to better manipulate training loads and
318 therefore, obtain better results and avoid negative outcomes, such as excessive fatigue and
319 non-functional overreaching, by controlling their training sessions with a costless and practical
320 approach.

321 **Author Contributions:** Conceptualization, R.A.T. and F.A.V.; methodology, R.A.T. and N.M.F.d.S.; formal
322 analysis, R.A.T., N.M.F.d.S., D.C.N. and C.F.; writing—original draft preparation, R.A.T. and N.M.F.d.S.;
323 writing—review and editing, J.P., J.H.F.N and M.K; supervision, F.A.V.

324 **Funding:** This research received no external funding.

325 **Acknowledgments:** The authors thank the subjects of the current study for their availability before, during and
326 after the experimental sessions.

327 **Conflicts of Interest:** The authors declare no conflict of interest.

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