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# Comparison of cardiometabolic and psycho-affective responses in individual and small group aerobic training with prescribed and self-selected intensity

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*Article*

# Comparison of Cardiometabolic and Psycho-Affective Responses in Individual and Small Group Aerobic Training with Prescribed and Self-Selected Intensity

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**Abstract:** Self-selecting the intensity of aerobic training is a perspective that allows practitioners to develop autonomy (choice of pace), improve physical fitness and achieve weight loss. To compare the effect of four aerobic training protocols on cardiometabolic and psycho-affective responses in physically inactive adult men and women. The sample consisted of 11 individuals aged  $56 \pm 10$  years and BMI  $29.2 \pm 2.4$  kg/m<sup>2</sup> performed four different treadmill aerobic training protocols, including: 1-individual with self-selected intensity (ISS), 2-individual with prescribed intensity (IPI) (64-76% of HR max), 3-small group with self-select. selected intensity (SGS) and 4-small group prescribed intensity (SGP) (64-76% of HR max). Heart rate (HR), lactate (LACT), perceived exertion (RPE), affective response (FS), activation scale (FAS), enjoyment (PACES) and intention to repeat the session (INT) were analyzed. Statistical analysis used ANOVA with Tukey's post hoc test ( $p < 0.05$ ). HR, LACT and RPE analyzes did not show significant differences between protocols. The FS showed a smaller decline in the SI protocol ( $p < 0.05$ ), and the intention to repeat the training session was greater in the SI protocol ( $p < 0.05$ ). Conclusion: The data allow us to conclude that the SI training protocol produced superior results in affective response, pleasure and intention to repeat the session.

**Keywords:** self-selection; small group; affect; enjoyment

## 1. Introduction

Physical inactivity is a risk factor for premature mortality and the development of non-communicable chronic diseases. Globally, 7.2% of death are related to all causes and 7.6% to cardiovascular diseases, respectively. Both conditions are attributable to physical inactivity [15]. Obesity-related mortality followed for 12 years in 300,000 Europeans demonstrated a 30% reduction in moderately active individuals [9]. Regular physical exercise is considered a determining factor in health due to the reduction of clinical risks at all age, although the likelihood of discontinuing regular exercise is 63% in the first three months and 96% at the end of 12 months [27].

Benefits of individualized training in adherence to an exercise program following the small group methodology have been investigated, demonstrating greater program retention over 24 months [28]. Perspective of small group exercise is a fitness trend, highlighted in 2022 and among the top 20 in 2023. It is related to aspects of greater socialization, motivational conditioning without losing the condition of personalized and individualized training prescription, which are relevant factors [17].

Historically, training prescription has been determined based on international guidelines, but researchers have suggested changing from a bipartite model in exercise prescription, which considers only efficacy and safety, to a tripartite model that emphasizes participation associated with perceived enjoyable experiences during the exercise session. This factor correlates with the intention to repeat the training experience, which could contribute to long-term adherence [19]. The perception of

pleasure and displeasure during the training session can be expressed through affective responses. Sensations perceived as pleasant or unpleasant without cognitive processing are called central affect and can be defined in two dimensions: positive valence (pleasure) and negative valence (displeasure), and low activation (relaxation) and high activation (excitement). It is an elementary feeling and consciously accessible, which does not need to be directed towards an automatic brain pattern at that precise moment [8].

Hedonic Theory suggests that a pleased individuals experience in an activity or a sense of vigor/energy, subjects are likely to repeat and increase, or prolong the pleasure feeling, avoiding or minimizing pain. This is often referred to a hedonic principle [21]. In recent years, affective responses have been identified as predictors of future involvement in exercise programs based on behavior change strategies [3,6,24,29], encouraging the maintenance of physically active behavior that is beneficial to adherence [4,8].

Enjoyment in the exercise program is defined as a positive response to the movement experience that reflects pleasure feelings, pleasant sensations, and joy. It represents an emotional experience perceived from cognitive evaluation processes. The positive feelings reported after exercise, is a strong psychological predictor for exercise behavior the maintenance [18,24,29].

A higher perception of pleasure and enjoyment during physical exercise seems to be associated with self-selected training intensity. It is a suitable stimulus for beneficial organic modifications for health, allowing individuals to feel the sense of choice about their behavior contributing to more enjoyable exercise experiences [7,20]. Thus, the present study compared cardiometabolic and psychoaffective responses in individual and small group training model with self-selected and prescribed intensity in sedentary adults.

## 2. Procedures

Eleven adults (9 women and 2 men) not engage in regular physical exercise were evaluated ( $56 \pm 10$  years;  $76.1 \pm 9$  kg;  $1.61 \pm 4.5$  cm;  $29.2 \pm 2.4$  kg/m<sup>2</sup> and  $34.5 \pm 8.8\%$  body fat). The sample was recruitment through social media publications (explanatory posts and videos) emphasizing the importance of exercise for health and daily life. The inclusion criteria were: physical activity level below 150 minutes per week; no previous experience with small group training methodology; absence of cardiovascular, neurological, musculoskeletal impairments, medical clearance and absence of any injuries.

Participants underwent 5 visits with a 72-hour interval between each visit. The first visit all procedures were explained with anamnesis and pre-participation questionnaire as well anthropometric evaluation, and equipment familiarization. The second visit, consisted of sample randomization in four different aerobic training protocols.

The individually prescribed protocol (IPI): participants performed 30 minutes of aerobic training on a treadmill at a prescribed intensity (64%-76% of maximum heart rate), only in the presence of the participant and the researcher.

The individually self-selected protocol (ISS): participants performed 30 minutes of aerobic training on a treadmill with self-selected intensity. At ISS subject and researcher were together. The treadmill speed was autonomously choosing by volunteer that could feel most suitable for completing the training. Only participant and the researcher were together.

Small group prescribed protocol (SGP): 3 participants simultaneously performed 30 minutes of aerobic training with prescribed intensity (64% to 76% of maximum heart rate). The treadmills were positioned to do not allow visual the intensity data, avoiding external influence on individual intensity choices.

Small group self-selected protocol (SGS): 3 participants simultaneously performed 30 minutes of aerobic training with self-selected intensity, at a pace that subjects felt most comfortable during training.

We did not find similar methodology in the literature.

Psychometric scales: subjective perceived exertion (RPE); feeling scale (FS); feeling of activation scale (FAS); physical activity enjoyment scale (PACES); and intention to repeat the training (INT)

were chosen to indicate the avoidance influence on subject's choices. Participants were instructed to do not talk about their protocol and choices perceptions on psychometric scales.

In all protocols, participants did not have access to physiological and psychosocial information.

The ISS and SGS training protocols, the standard phrase was used: "choose the intensity that you understand that is the best for your health". All protocols were performed at the same times (8:00 AM-12:00 PM), respecting 72 hs interval between sessions.

In both prescribe (PR) and self-selected (SS) intensity protocols, heart rate (HR), lactate (LACT), RPE, FS, and FAS were determined. Psychophysiological and psychosocial measures were taken at rest, 5th, 15th, and 25th minutes of training.

At the end of each protocol, subjects remained seated for 15 minutes in recovery, and HR, LACT, PSE, FS, FAS, and INT were collected. HR, RPE, FS, and FAS measurements were performed without verbal perceptions expressions, to avoid interpersonal decision interference of the psychometric measure (vicarious experience, fear of judgment, and anxiety).

## 2.1. Instruments

### Heart Rate Assessment (HR)

The HR was determined throughout the protocol using the POLAR H7 heart rate monitor connected via Bluetooth to the POLAR TEAM APP. Relative intensity was calculated based on the predicted maximum heart rate (HRmax) for each participant,  $HR_{max} = 220 - \text{age}$  [15].

### Blood Lactate Assessment (LACT)

LACT was assessed using the Accutrend Plus Roche Portable Monitor at rest during the 5th, 15th, and 25th minutes of the protocol.

### Subjective Perception of Effort (RPE)

RPE was assessed using the Borg Rating of Perceived Exertion scale [1], ranging from 6 to 20 points, where 6 represents "no effort" and 20 represents "maximum effort".

### Affective Response to Exercise (FS)

The affective response to exercise was assessed using the Feeling Scale with an 11-point bipolar affective scale, ranging from +5 ("very good") to -5 ("very bad"), as pleasure and displeasure respectively [10]. At the beginning of each protocol, participants were given the following instructions: "Some individuals experience pleasure during exercise, while others experience displeasure. This perception can vary among individuals. How do you evaluate your perception of pleasure or displeasure at this moment during exercise?"

### Exercise Activation Response (FAS)

The perception of activation during exercise was measured using the Felt Arousal Scale, ranging from 1 ("low activation") to 6 ("high activation"). Activation at the level of subjective experience refers to a sense of mobilizing energy, summarizing the physiological state [24]

### Physical Activity Enjoyment Scale (PACES)

Consists of an 18-item scale that assesses the perception of enjoyment during exercise or physical activity. The PACES consists of an inverted score (12 negative items) and 6 positive items on a 1-7 bipolar scale based on the instruction "How do you feel right now about the exercise or physical activity?" [16]

### Intention to Repeat Exercise Session (INT)

Participants' intention to engage in the exercise performed during the next week and the next month was assessed using a 2-item scale. Participants were asked: "I intend to perform this exercise that I performed today at least 3 times in the next week" (Intention 1). "I intend to perform this exercise that I performed today at least 3 times per week during the next month." Responses were determined on a 7-point scale with anchors ranging from 1 - "very unlikely" to 7 - "very likely" [12].

## 2.2. Statistical Analysis

Statistical analyses were performed using SPSS version 25.0, with means and standard deviations for all variables studied and percentage difference. Normality and homoscedasticity were assessed using the Shapiro-Wilk test and Levene's test.

Comparison of dependent variables (HR, LACT, FS, FAS, and PACES) was performed using repeated measures ANOVA, with Tukey's pairwise comparisons post hoc. The intention to repeat exercise session analysis used a paired t-test for pre- and post-protocol comparisons.

Comparisons between protocols used Cohen's d (1988) for effect size observations (small effect = 0.20, medium effect = 0.50, large effect = 0.80). Differences and changes between different protocols were expressed in  $\Delta\%$  values. Significance was set at 5% ( $p < .05$ ).

## 3. Results

The aim of the study was to compare the cardiometabolic and psychoaffective responses in four different aerobic training protocols.

We considered the ISS protocol as the baseline in all comparisons. One-way ANOVA indicated that HR remained similar in all protocols. LACT concentration was 10.6% higher in the SGS protocol compared to ISS, although the values did not show significant differences between protocols ( $p > .05$ ). The RPE was 7.1% small in SGS than ISS, without significant differences ( $p > .05$ ).

**Table 1.** Comparison of cardiometabolic responses in different aerobic training protocols.

HEART RATE							
PROTOCOL	N	X	S	$\Delta\%$	ES – r	Cohen d	P Value
ISS	55	108.2	27.4	100%			0.141
IPI	55	107.6	24.1	-0.5%	0.011	0.023	
SGS	55	98.8	22.7	-8.7%	0.184	0.374	
SGP	55	106.6	21.6	-1.4%	0.031	0.061	
LACTATE							
PROTOCOL	N	X	S	$\Delta\%$	ES – r	Cohen d	P Value
ISS	44	2.9	1.1	100%			0.819
IPI	44	2.9	1.6	0.7%	0.007	0.014	
SGS	44	3.2	2.5	10.6%	0.081	0.162	
SGP	44	3.1	1.2	4.3%	0.058	0.117	
RPE							
PROTOCOL	N	X	S	$\Delta\%$	ES – r	Cohen d	P Value
ISS	55	10.0	3.4	100%			0.335
IPI	55	9.6	3.1	-3.3%	0.051	0.019	
SGS	55	9.3	2.7	-7.1%	0.116	0.233	
SGP	55	10.3	3.1	3.3%	0.051	0.101	

\* $p < .05$ .

ONE-WAY ANOVA showed that the affective response was 16.8% and 26.8% lower in IPI and SGP, suggesting that the prescribed intensity reduces pleasure compared to ISS. A significant difference was found between the ISS protocol and the other protocols ( $p < .05$ ). Activation did not show a significant difference among groups. On the other hand, SGP group showed higher activation compared to ISS.

Enjoyment with training was 2.7% and 6.4% higher in ISS compared to IPI, SGS, and SGP, without statistical difference ( $p>.05$ ).

**Table 2.** Comparison of psycho-affective responses in different aerobic training protocols.

FS							
PROTOCOL	N	X	S	$\Delta\%$	ES – r	Cohen d	P Value
SI	55	4.0	1.2	100%			0.006*
PI	55	3.3	2.0	-16.8%	0.20	0.41	
SGS	55	3.7	1.6	-7.7%	0.10	0.21	
SGP	55	2.9	1.8	-26.8%	0.33	0.71	
FAS							
PROTOCOL	N	X	S	$\Delta\%$	ES – r	Cohen d	P Value
SI	55	3.7	1.5	100%			0.276
PI	55	3.5	1.6	-5.9%	0.07	0.14	
SGS	55	3.5	1.5	-5.4%	0.07	0.13	
SGP	55	3.9	1.4	7.4%	0.09	0.19	
PACES							
PROTOCOL	N	X	S	$\Delta\%$	ES – r	Cohen d	P Value
SI	11	113.1	13.0	100%			0.775
PI	11	105.8	23.8	-6.4%	0.18	0.38	
SGS	11	110.0	17.4	-2.7%	0.10	0.20	
SGP	11	106.6	16.9	-5.7%	0.21	0.43	

\* $p<.05$ .

Table 3 demonstrate the intention to repeat (INT) the training protocols. Results suggest that self-selected training is strongly associated with satisfaction and intention to repeat the training. The ISS pre compared to post protocol, showed 9.7% ( $p<.05$ ) higher INT, as well as in SGS (6.8%), compared to PR protocols.

**Table 3.** Comparison of intention to repeat the training session in different aerobic training protocols.

INTEN							
PROTOCOL	N	X	S	$\Delta\%$	ES – r	Cohen d	P Value
ISS – BEFORE	11	5.6	1.1				0.025*
ISS – AFTER	11	6.2	0.8	9.7%	0.28	0.77	
IPI – BEFORE	11	5.5	1.2				0.176
IPI – AFTER	11	5.1	1.6	-8.2%	0.06	0.11	
SGS – BFORE	11	5.5	1.5				0.167
SGS – AFTER	11	5.8	1.1	6.8%	0.14	0.27	
SGP – BFORE	11	5.5	1.0				0.821
SGP – AFTER	11	5.6	1.4	1.6%	0.04	0.07	

\* $p<.05$ .

#### 4. Discussion

The present study analyzed the cardiometabolic and psychosocial behavior in individual aerobic training and small group with prescribed (PR) and self-selected (SS) intensities. Consistent with our hypotheses, no significant differences were found between the protocols in the variables HR, LACT, and RPE ( $p>.05$ ).

ISS showed smaller decline ( $p<.05$ ) in FS among IPI, SGS, and SGP and higher scores to INT ( $p<.05$ ), PACES scores did not present significant differences among protocols, with tendency to higher scores to ISS. We believe that self-selected intensity allows practitioners to subjectively choose

the intensity to be able to sustain exercise length. Data suggested that ISS could contribute to higher pleasure perception (16.8% compared to IPI; 7.7% compared to SGS; 26.8% compared to SGP). The enjoyment was 6.4% higher compared to IPI, and 9.7% higher INT [5]. Our results are in line with the hedonic theory of behavior, which points out that individuals have a greater intention of repeating behaviors that they consider more pleasurable or less unpleasant [21].

Contradicting our results, no significant differences were found in affective response between PR and SS intensities. Our hypothesis is that protocol length, number of times that affective was assessed during the protocol could influence the results, considering that subjects were asked in two moments the affective perception it could [14]. In our study we measured the affective response at more moments: beginning, 5,15,25, at the end of the protocol and also after 15 minutes of recovery.

As well as our study, HR and LACT responses showed similarity between PR and SS. However, this same study contradicts our results in the affective response variable, as no statistical differences were found between PR and SS intensity protocols. The use of a screen showing a virtual cyclist may possibly result in less attention, focus on physical sensations, and greater attentional focus on non-exercise-related stimuli [22].

Corroborating our data, no significant differences were found in the HR response between PR and SS protocols in adult males [26]. The psychosocial and cardiometabolic responses in young men at PR and SS intensities, presenting that SS intensity is effective for improving cardiovascular conditioning with positive scores in FS and FAS compared to PR intensity [11]. As well as in our results showed a smaller decline in affective response in the ISS protocol ( $p < 0.05$ ), indicating that the possibility in choosing intensity can result less displeasure in aerobic training practice, sustaining intensity HR was higher in SI. We found that participants performed ISS and IPI at similar intensities although the perception of pleasure was higher in ISS.

We emphasize that IPI led to decrease in pleasure perception (16.8% higher in SGP and 26.8% higher in ISS). Thus, our data suggest that ISS was associated with higher enjoyment [23]. Suggesting that enjoyment during training practice is key point to long-term exercise programs adherence.

The ISS and SGS protocols suggest higher enjoyment scores, which could be explained by autonomy in choosing the pace, what is a positive perception of affect in untrained individuals. On the other hand, IPI may promote negatively enjoyment. The IPI showed 6.4% less enjoyment, while SGP was 5.7% less enjoyable than ISS. We suggest that the choice of pace is an important factor to be considered when prescribing aerobic exercise for sedentary individuals.

The comparison between individual and small group conditions showed higher pleasure perception scores in small group, that is opposite to our initial hypothesis that considered higher scores to positive affective, enjoyment, and intention in small group protocols.

We understand that lower intention to repeat exercise session in SGS and SGP is associated to the cross-sectional design of the present study, allowing us to consider that longitudinal analysis would allow participants experience in repeating protocols. We hypothesize that repeating protocols would be more feasible and effective to demonstrate the interpersonal perceptions and relationship, especially in small groups. A longer relationship between participants could promote better socialization.

## 5. Conclusions

The results of the study demonstrated that positive affective response during the exercise session in the ISS protocol was related to higher scores in the intention to repeat the training session based on the Hedonic Theory. Further studies are needed to determine the effectiveness of small group training model, especially the self-selected intensity on pleasure, enjoyment, and intention to repeat the exercise session. Based on hedonic assumptions, evidence suggests that people tend to engage in activities that they consider pleasurable and fun, trying to avoid pain and discontent. The dynamics between positive and negative affect can influence current behavior and intentions to continue regular exercise.

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