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Psychophysiological effects of different execution speeds of single bout exercise in outdoor fitness equipment performed by older men

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Abstract - Aims: This study aimed to investigate the effects of different cadences of movement in ATI equipment on the psychophysiological parameters of older adults during the training session. **Methods:** Fifteen physically independent older men voluntarily participated in this study. Three 30-min exercise sessions were randomly distributed (5 min warm-up, 20 min exercise, 5 min cooldown), comprising exercises with different cadences low (L: 1 movement every 4 s), medium (M: 1 movement every 2 s), and high cadence (H: 1 movement per second); all with 30" of stimulus and 30" recovery using the following devices: elliptical, rower, surf/elliptical and leg press. Heart rate (HR), rate of perceived exertion (RPE), rate of perceived recovery (RPR), and feeling scale (FS) were evaluated before and immediately after the three sessions. The difference between moments was analyzed by analysis of variance with a significance level of $p < 0.0001$). **Results:** Cadence L (56 ± 2 %) showed lower values of relative HR than M (70 ± 5%) and H (85 ± 5%), which also differed from each other. Significant differences ($p < 0.01$) for the area under the curve of RPE (L: 75 ± 26, M: 115 ± 16, H: 154 ± 4) and RPR (L: 173 ± 16, M: 139 ± 12, H: 97 ± 6; UA) were identified among the cadences. Statistical differences ($p < 0.01$) were found on RPE 30 min of the session (L: 4.2 ± 0.7 < M: 5.7 ± 0.7 < H: 7.4 ± 0.5). **Conclusion:** The performance of different cadences induced different psychophysiological responses in older adults undergoing exercise sessions in the ATI. The moderate cadence provided an increase in HR with values considered safe for the exercise and therefore can be recommended for this population when using this equipment.

Keywords: aging, exercise, physical activity, physiological.

Introduction

According to the Brazilian Institute of Geography and Statistics[1], the number of older adults in Brazil is continuously increasing with a projected growth rate of 13.44% in 2030. Due to this increase, in the Brazilian older adult population, Brazil develops a national health policy and strategies to promote health and follow the recommendation of the World Health Organization (WHO) regarding healthy and active aging in accordance with the principles and guidelines of the Brazilian Public Health System[2].

Reducing non-communicable diseases, increasing physical fitness, and maintaining functional capacity is a goal to be achieved in Brazil and several other countries[3-7]. In Brazil, we highlight the Academias da Terceira Idade (ATI) projects, which were implemented in 2005 at the Ministry of Health through the Healthy Brazil program and which aim at expanding public spaces outdoor and equipment for physical activity to promote and prevent diseases in older adults[8,9].

Most of the available studies in the literature are mainly focused on determining the profile of users[10], analysis of the reasons for the practice of physical activity in the ATI[11], improvements in health and motivation[12], ease of access, and greater social support[13].

On the other hand, research[14-16] reporting the use of outdoor equipment in other countries is also inconclusive. Cranney et al.[14] studied the impact of setting up an outdoor gym and found an increase in the frequency of use by the older adults during the 12 months (1.4 to 6%). Chow, Mowen, and Wu[15] demonstrate that users of these spaces do not use them for long enough to reach the recommendations for physical activity, although most users were women and the elderly. To our knowledge, there is only one study that evaluated the effects of an exercise program using the ATI, showing that 12 weeks of training was not able to improve physical fitness in older adults[16].

Due to inconsistency in the literature about the effectiveness of this equipment in promoting improvement in the physical fitness of older adults, new studies should be carried out to improve or indicate new strategies for using these spaces. Thus, this study aimed to investigate the effects of different cadences of movement in ATI equipment on the psychophysiological parameters of older adults during the training session.

Material and methods

Sample

After the research ethics committee approval of the Federal University of Espirito Santo (n° 4.088.540-2020, CAEE: 29949320.1.0000.5542), fifteen older men (≥ 60 years), physically independent and physical inactive according to IPAQ questioner[17,18], voluntarily participated in this study. As exclusion criteria, the following parameters were used: positive clinical diagnosis of cardiometabolic disease, smoker and musculoskeletal complications, inotropic and chronotropic agents, and cognitive alterations confirmed by medical evaluation. The sample size was estimated by a post hoc analysis G * Power software (v. 3.1.9.4). The sample characteristics are described in Table 1.

Experimental protocol

All the older adults were submitted randomly to three sessions of physical exercise with low, moderate, and high cadence movement in four ATI equipment, including elliptical, rowing, surf/elliptical, and leg press machines (Figure 1). The time of each session consisted of 5 min of warm-up (walking at 60% of HR_{max} estimated by the equation suggested by Tanaka et al.[19], 5 min of exercise distributed in blocks with 30 s of execution (movement cadence controlled by a metronome) considering muscle action complete (concentric and eccentric phase) and 30 s of passive recovery between sets (totaling 5 sets) and 5 min of cool down.

Table 1 - Sample characteristics.

Parameters	Mean ± SD
Age (years)	68 ± 2
Body mass (kg)	76 ± 11
Height (cm)	1.70 ± 0.10
BMI (kg/m^2)	27 ± 4
Physical activity per week (min)	113 ± 17
HR (bpm)	81 ± 6

Values expressed in mean ± DP. BMI: body mass index. HR: rest heart rate.

The following cadences were used, low (L: 1 movement every 4 s), moderate (M: 1 movement every 2 s), and high (H: 1 movement per 1s). Additionally, as a way of monitoring, the number of movements was registered in all series in the three experimental conditions.

Anthropometric

Height was measured by a Cardiomed (WCS model) stadiometer, with an accuracy of 115/220 cm. The measurement was performed with the cursor at an angle of 90° with respect to scale, with the patient in a standing position with feet together in contact with Stadiometer. The subjects were instructed to stay in inspiratory apnea and head parallel to the ground. Total body mass was measured by a calibrated Filizola electronic scale (Personal Line Model 150) with a 100 g scale and a maximum capacity of 150 kg. Body mass index (BMI, kg/m^2) was calculated using the equation BMI = body mass/height^2.

Heart rate

Heart rate (HR) was recorded continuously throughout the training session using Polar (model S810). In an attempt to reduce HR recording errors during training, all subjects were asked to check their HR monitors before of session and after the set (~3 and 10 min). The maximal and its percentage of heart rate were estimated using the Tanaka et al.[19] equation.

Rate of perceived exertion and recovery

Subjects reported their rating of perceived exertion (RPE, scale 1-10)[20] and recovery (RPR, scale 1-10)[21] immediately at the end, and before each exercise set. Additionally, the RPE (scale 1-10) was used as an intensity indicator of the exerciser session, briefly, subjects were told to choose a number (the maximum value corresponds to the highest physical exertion experienced by the individual, and the minimum value is the rest condition).

Feeling scale

The feeling scale (FS) is an 11-point bipolar scale ranging from +5 to −5, commonly used to measure the affective response (pleasure/displeasure) during exercise[22], however, in this study, the scale was performed before and after the exercise session. This scale presents the following verbal anchors: −5 = very bad; −3 = bad; −1 = fairly bad; 0 = neutral; +1 fairly good; +3 = good; and +5 = very good. The subjects received standard instructions regarding the use of the FS in the initial screening and before exercise boot.

Total movement capacity

The total exercise movement (repetitions) amount on each set was quantified to use as an external training load.

Figure 1 - Typical images representing the equipment used, including elliptical (Panel A), rowing (Panel B), surf/elliptical (Panel C), and leg press (Panel D) machines.

Statistical analyses

The D'Agostino-Pearson test was applied to distribution analysis. The cadency conditions were evaluated by one-way repeated measures ANOVA followed by Bonferroni's post hoc test was performed considering conditions as factors to analyze responses of heart rate, AUC, PRE of the session, total movements) and time and condition to feeling scale. The area under the curve (AUC) was used to analyze and compare the effect of cadency on HR, RPE, and RPR among the session condition. An alpha of 0.05 was used to determine statistical significance. All data values were expressed as a mean ± standard deviation. All analyses were performed using GraphPad Prism Software (v. 6.01; GraphPad Software, EUA).

Results

No participant reported any complications, whether neuromuscular or cardiometabolic during the procedures. As shown in Figure 2A, no differences were found in moderate cadence, however, significant differences were found in absolute heart rate between the first and seventh series for both moderate and high cadence conditions. Significant differences were found in ($F_{(2,\ 42)} = 172.1$; $p < 0.0001$) in the area under the curve indicating that the high cadence (2594 ± 167) had higher values than the M cadence (2106 ± 145) and L (1682 ± 73) which also differed from each other.

Differences ($F_{(1.906,\ 26.69)} = 208.6$; $p < 0.0001$) were found in the mean absolute heart rate (Figure 2B) between sessions with different cadences (L: 88 ± 4 < M: 110 ± 7 < H: 136 ± 6; bpm). A similar result was found ($F_{(2.42)} = 178.8$; $p < 0.0001$) analyzing the relative heart rate, indicating that L (56 ± 2 %) induced less overload compared to M (70 ± 5 %) and H (85 ± 5%) cadence which also differed from each other (Figure 2C).

As can be seen in Figure 3, the perceptions of effort (Figure 3A) and recovery (Figure 3C) changed throughout the series. No change was found in L cadence, however, statistical differences ($p < 0.05$) were found from the fifth set of M cadence in both perceived exertion ($F_{(19,\ 280)} = 4.133$) and in recovery ($F_{(19,\ 280)} = 8.708$). Considering the H cadence, statistical differences ($p < 0.05$) were found from the fourth and seventh set onwards compared to the first in both RPE ($F_{(19,\ 280)} = 19.17$) and RPR ($F_{(19,\ 280)} = 4.178$).

Significant differences were found in the area under the curve in the perceptions of effort ($F_{(2,\ 42)} = 159.6$; $p < 0.0001$) and recovery ($F_{(2,\ 42)} = 745.5$; $p < 0.0001$) between the cadences. As shown in Figure 3B and 3D respectively, the values of the area under the curve for RPE increased with increasing cadence (L: 73 ± 18 < M: 114 ± 10 < H: 154 ± 3) and decreased in recovery (L: 176 ± 9 > M: 93 ± 9 > H: 58 ± 8) indicating that the increase in cadence induced greater perceived exertion with concomitant impairments in recovery, suggesting a possible effect of accumulated fatigue between sets.

As showed on figure 4 the values of feeling before and after the exercise sessions. Significant effect of time ($F_{(1,\ 42)} = 199.4$ $p < 0.0001$) and interaction ($F_{(2,\ 42)} = 34.08$; $p < 0.0001$) were found. Decrease on the perception of pleasure in L (Before: 4.66 ± 0.48, After: 2.40 ± 0.50; MD [95%CI]: −2.267[1.448 − 3.086]; $p < 0.05$) and H (Before: 4.40 ± 0.50, After: 0.26 ± 1.58; MD [95%CI]: 4.133[3.314 − 4.952]; $p < 0.05$) cadences were found, but not at M (Before: 4.0 ± 0.50, After: 3.86 ± 0.83; MD [95%CI]: 0.7333[−0.085 − 1.552]; $p > 0.05$) cadence.

The perceived exertion values of the session and the total number of movements can be seen in Figure 5. Significant differences ($F_{(1.7455,\ 24.43)} = 145.8$; $p < 0.0001$) were found in the perception of session effort demonstra-

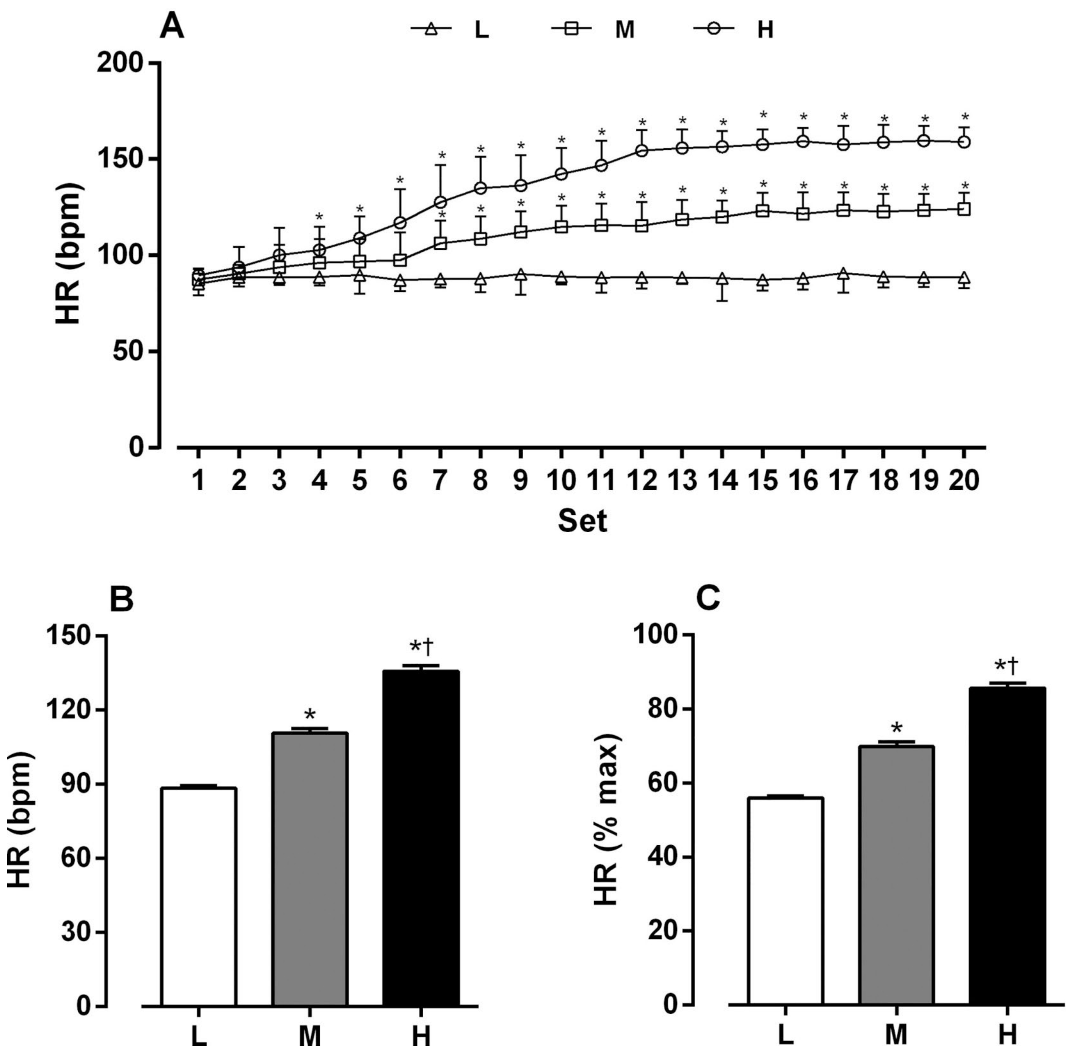

Figure 2 - Values expressed as mean ± standard deviation of feeling scale before and after carrying out the protocols of low (L), moderate (M), and high (H) cadences of the rate of heart rate (HR) in all sets (Panel A), mean of the session (Panel B) and relative (Panel C). *p < 0.01 vs. first set top Panel A. *p < 0.01 vs. L, †p < 0.01 vs. M to Panel B and C.

ting that H (8.06 ± 0.59) cadence promoted greater effort compared to M (6.20 ± 0.86) and L (3.46 ± 1.18) cadences, which also differed from each other. Significant differences were found in the total number of movements ($F_{(1.084,\ 15.18)} = 1588$; $p < 0.0001$) demonstrating that the cadence induced change in the number of movements (L: 145 ± 6 < M: 300 ± 7 < H: 553 ± 33; repetitions).

Discussion

The control of loads during physical exercise is considered a fundamental issue for exercise prescription in several populations, however, it is extremely difficult to objectively adjust external loads to match the target internal load. This study aimed to investigate the effects of different cadences of movement in ATI equipment on elderly men's psychophysiological parameters. The main finding of the present study was that different cadences induce different psychophysiological responses in the older adults performing exercise in ATI community programs.

Currently, the number of repetitions has been considered as an external load parameter in training sessions[23,24]. In strength training[25] it was shown that during conditions of high stress the number of repetitions performed in a subsequent series of strength exercises can be considerably reduced. It is worth mentioning that in this study because all the machines used do not provide an opportunity to increase the external load by adding weight, different cadences were used to promote different external loading. Thus, our results may contribute to the development of a new strategy for the development of exercise programs when the objective is to improve neuromuscular parameters with the use of different cadences of muscle action in several exercise sessions. Indeed, as explained in the present study, the increase in the number of repetitions

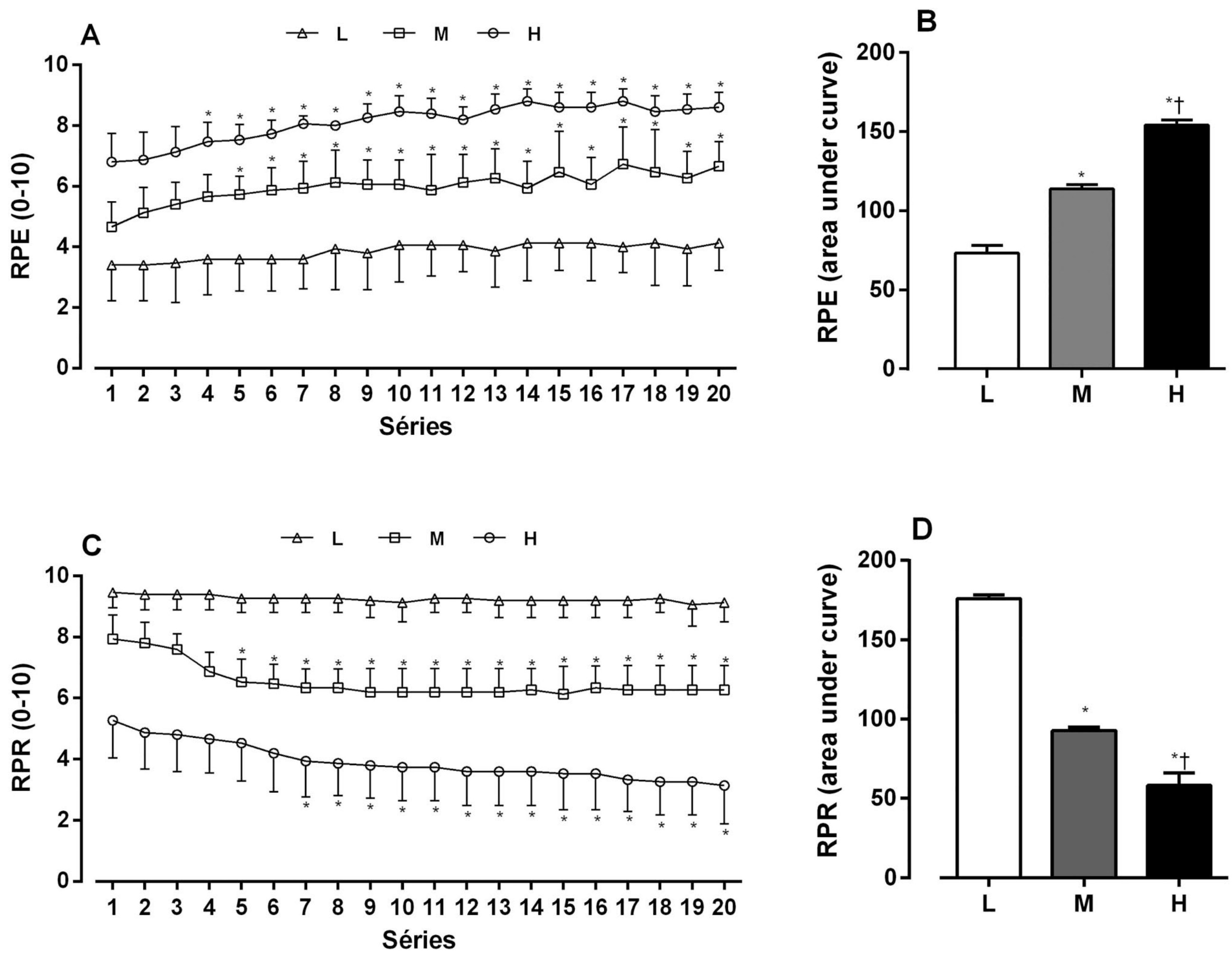

Figure 3 - Values expressed as mean ± standard deviation of feeling scale before and after carrying out the protocols of low (L), moderate (M), and high (H) cadences of the rate of perceived exertion (RPE; Panel A) and recovery (RPR; Panel C) and respective area under the curve of RPE (Panel B) and RPR (Panel D). *$p < 0.01$ vs. first set-top Panel A and C. *$p < 0.01$ vs. L. †$p < 0.01$ vs. M to Panel B and D.

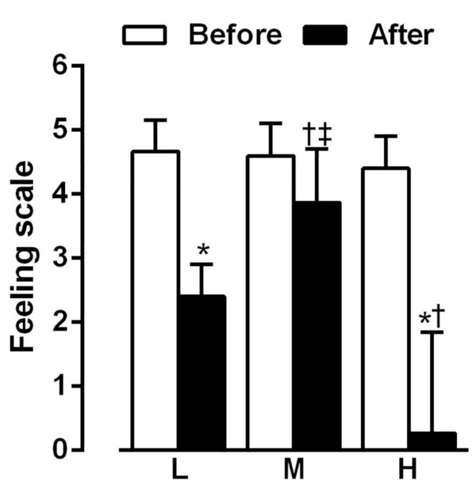

Figure 4 - Values are expressed as mean ± standard deviation of the feeling scale before and after carrying out the protocols of low (L), moderate (M), and high (H) cadences. †$p < 0.01$ vs. L. ‡ $p < 0.01$ vs. H.

promoted a physiological change in heart rate and psychophysiological indicators.

In our study, an increase in the rate of perceived exertion was observed following the increase in cadence. Our findings confirm the hypothesis that higher cadence exercises can promote different physiological responses mobilizing the same amount of muscle mass. A possible explanation for this fact, in addition to the metabolic demand, may be associated with the indication that exercises performed with greater speed, generate greater tension, resulting in occlusion of the capillaries of the muscles used during execution. This response has already been documented in the literature mainly for inducing an increase in peripheral vascular resistance and, consequently, an increase in heart rate[26].

Additionally, the rate of perceived exertion has also been used as a viable measure to control the training load due to its reliability in monitoring the training intensity[27].

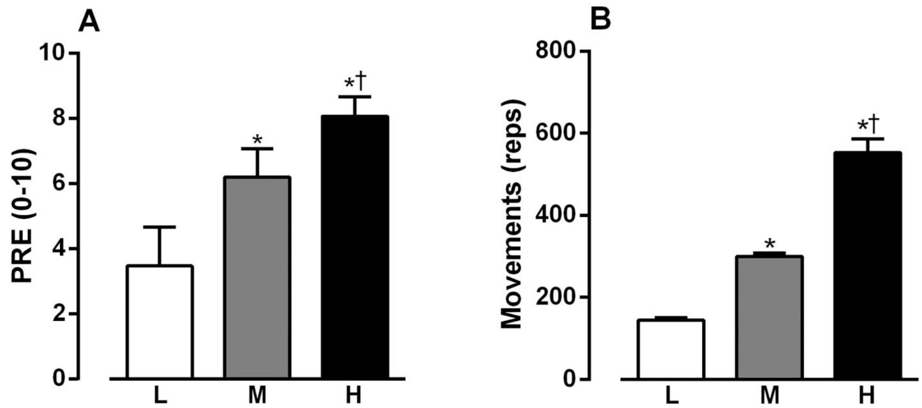

Figure 5 - Values expressed as mean ± standard deviation of carrying out the protocols of low (L), moderate (M), and high (H) cadences of the rate of perceived exertion of the session (Panel A) and total movements (Panel B). *$p < 0.01$ vs. L. $^{\dagger}p < 0.01$ vs. M.

Foster et al.[28] point out that these scales are ideal for controlling the internal load in cyclical activities of high intensity, as they isolate the specific demands of different forms of training. In the current study, although the exercises are performed on various equipment, there is a cyclical use of each movement, which can correspond to the requirements of typical cyclic exercises.

Considering the perception of recovery, it is worth mentioning that only moderate and high cadence exercises ere found a reduction in the perception of recovery, suggesting that the speed requested during muscle actions[29,30], as well as the increase in its demand confirm the idea that these parameters can promote different physiological responses and promote early fatigue[31].

About the feeling scale parameter, our data indicate that L and H cadency induced reduction in perception of pleasure differently from M cadence. There are studies indicating that higher intensities can reduce the sensation of pleasure[22,32], however, the sessions in the current study were not effective in promoting significant changes in the sensation of pleasure, despite the elder were physically inactive. Frazão et al.[22] showed that subjects with higher levels of physical fitness had fewer alterations in relation to pleasure because they had greater tolerance and Ekkekakis[33] showed a better sense of self-efficacy in the practice of exercises. In addition, the environment where the exercises were performed (outdoor park) may have substantially influenced the cognitive process, generating greater affection and pleasure for the exercises performed, regardless of the protocol applied[34].

Another important point that deserves attention is the recovery interval. Taulaniemi et al.[35] demonstrated that physical performance during exercise is influenced by the physical recovery interval. The recovery interval is recognized as the primary determinant of intensity in high-intensity training sessions[36]. Furthermore, psychological interference may occur, as demonstrated in the study by Bourdon et al.[30], in which subjects submitted to the same training session with a similar external load on alternate days, exhibited different internal loads considering different perceptions of the state of fatigue and emotional disturbances.

Thus, although additional studies are needed, the current results indicate that a subjective approach can be an effective means to assess recovery[21]. The execution of movements at high speed can also be associated with fatigue due to the increase in the recruitment of muscle fibers[37] as well as the exercise execution time[38], affecting the perception of recovery.

Some limitations must be presented in this study. The level of previous physical activity of the elderly was low and the failure to perform a maximum incremental test to confirm the maximum heart rate as well as the level of physical fitness may have limited the extent of our findings. It is suggested that further studies be carried out using the maximum test to assess physical fitness to confirm our findings. Finally, in ATIs there is a considerable variety of equipment and therefore our results should not be extrapolated to other exercise/equipment or different exercise session designs.

Conclusion

In conclusion, the use of different exercise cadences induced different responses in psychophysiological measures of elderly individuals undergoing exercise sessions on ATI equipment. Both moderate and high cadence showed higher responses compared with the low cadence. Since the moderate cadence provided an increase in HR with values considered safe for exercise and matching typical guidelines for this subject cohort, we recommend clinical triage before use in this equipment according to our study design. Moreover, the moderate cadence induced perception of effort and viable recovery without promoting changes in the perception of pleasure. Our findings confirm the hypothesis that higher cadence exercises can promote different physiological responses mobilizing the same amount of muscle mass.

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References

1. IBGE. IBGE divulga as estimativas populacionais dos municípios para 2017. Available from http://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-noticias/releases/16131-ibge-divulga-as-estimativas-populacionais-dos-municipios-para-2017.html [Accessed September 2017].
2. World Health Organization. Active ageing: a policy framework. Geneva: World Health Organization; 2002.
3. Chow CK, Teo KK, Rangarajan S, Islam S, Gupta R, Avezum A, et al. Pure (prospective urban rural epidemiology) study investigators. Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries. Jama. 2013;310(9):959-68.
4. Cohen DA, Marsh T, Williamson S, Golinelli D, Mckenzie TL. Impact and cost-effectiveness of family fitness zones: a natural experiment in urban public parks. Health Place. 2012;18(1):39-45.
5. Furber S, Pomroy H, Grego S, Tavener-Smith K. People's experiences of using outdoor gym equipment in parks. Health Promot J Austr. 2014;25(3):211.
6. Mora R. Moving bodies: open gyms and physical activity in Santiago. J Urban Design. 2012;17(4):485-97.
7. Scott A, Stride V, Neville L, Hua M. Design and promotion of an outdoor gym for older adults: a collaborative project. Health Promot J Austr. 2014;25(3):212-4.
8. Salin MS. Espaços públicos para a prática de atividade física: o caso da academia da melhor idade de Joinville-SC. Tese [Pós-Graduação em Ciências do Movimento Humano], Centro de Ciências da Saúde e do Esporte, Universidade do Estado de Santa Catarina, Florianópolis; 2013.
9. Costa BGG, Freitas CR, Silva KS. Atividade física e uso de equipamentos entre usuários de duas academias ao ar livre. Rev Bras Ativ Fís Saúde. 2016;21(1):29-38.
10. Battistel JA, Floss MI, Cruvinel AFP, Barbato PRF, Guerra RC, Henrique P. Perfil dos frequentadores e padrão de utilização das academias ao ar livre: revisão de escopo. Rev Bras Ativ Fis Saude. 2021;26(4):1-8.
11. Silva DE, de Salles B, Senna G, Furtado H, Simão R. Perfil da aptidão física de idosos ingressantes nas academias da terceira idade. Conscientia e Saúde. 2017;16(3):318-26.
12. Mathias NG, Melo Filho J, Szkudlarek AC, Gallo LH, Fermino RC, Gomes ARS. Motivos para a prática de atividades físicas em uma academia ao ar livre de Paranaguá-PR. Rev Bras Ciênc Esporte. 2019;41(2):222-8.
13. Souza CA, Fermino RC, Anez CRR, Reis RS. Perfil dos frequentadores e padrão de uso das academias ao ar livre em bairros de baixa e alta renda de Curitiba-PR. Rev Bras Ativ Fis Saúde. 2014;19(1):86-97.
14. Cranney L, Phongsavan P, Kariuki M, Stride V, Scott A, Hua M, et al. Impact of an outdoor gym on park users' physical activity: a natural experiment. Health Place. 2016;37:26-34.
15. Chow H-W, Mowen AJ, Wu G-L. Who is using outdoor fitness equipment and how? The case of Xihu park. International J Environ Res Public Health. 2017;14(4):448.
16. Liu YC, Yang WW, Fang IY, Pan HL, Chen WH, Liu C. Training program with outdoor fitness equipment in parks offers no substantial benefits for functional fitness in active seniors: a randomized controlled trial. J Aging Phys Act. 2020;29:1-8.
17. Benedetti TRB, Antunes PC, Rodriguez-Añez CR, Mazo GZ, Petroski EL. Reprodutibilidade e validade do questionário internacional de atividade física (IPAQ) em homens idosos. Rev Bras Med Esporte. 2007;13(1):11-6.
18. Mazo GZ, Benedetti TRB. Adaptação do questionário internacional de atividade física para idosos. Rev Bras Cineantropom Desempenho Hum. 2010;12(6):480-4.
19. Tanaka H, Monahan KD, Seals DR. Age - predicted maximal heart revisited. J Am Coll Cardiol. 2001;37:153-6.
20. Borg, GA. Psychophysical bases of perceived exertion. Med Sci Sports Exerc. 1982;14:377-81.
21. Laurent CM, Green JM, Bishop PA, Sjökvist J, Schumacker RE, Richardson MT, et al. A practical approach to monitoring recovery: development of a perceived recovery status scale. J Strength Cond Res. 2011;25:620-8.
22. Frazão DT, De Farias Junior LF, Dantas TCB, Krinski K, Elsangedy HM, Prestes J, et al. Feeling of pleasure to high-intensity interval exercise is dependent on the number of work bouts and physical activity status. Plos One. 2016;11(4):e0153986.
23. Impellizzeri FM, Rampinini E, Coutts AJ, Sassi S, Marcora SM. Use of rpe-based training load in soccer. Med Sci Sports Exerc. 2005;36:1042-7.
24. De Faria BSH, Campos YAC, Toledo H, Miranda R, Vianna JM, Bara Filho MG. Comparison of the training load of professional athletes between specific volleyball and strength training modes. J Phys Educ. 2020;31:e3110.
25. Fink J, Kikuchi N, Nakazato K. Effects of rest intervals and training loads on metabolic stress and muscle hypertrophy. Clin Physiol Funct Imaging. 2016;38(2):261-8.
26. Pollito MDE, Farinatti PTV. Comportamento da pressão arterial após o exercício contra-resistência: uma revisão sistemática sobre variáveis determinantes e possíveis mecanismo. Rev Bras Med Esporte. 2006;12(6):382-92.
27. Eston R, Connolly D. The use of ratings of perceived exertion for exercise prescription in patients receiving beta-blocker therapy. Sports Med. 1996;21:176-90.
28. Foster C, Rodriguez-Marroyo JA, De Koning JJ. Monitoring training loads: the past, the present, and the future. Int J Sports Physiol Perform. 2017;12(suppl 2):s22-8.

29. Scott BR, Duthie GM, Thornton HR, Dascombe BJ. Training monitoring for resistance exercise: theory and applications. Sports Med. 2016;46(5):687-98.
30. Bourdon PC, Cardinale M, Murray A, Gastin P, Kellmann M, Varley MC, et al. Monitoring athlete training loads: consensus statement. Int J Sports Physiol Perform. 2017;12 (suppl 2):s2161-70.
31. Thorpe RT, Atkinson A, Drust B, Gregson W. Monitoring fatigue status in elite team-sport athletes: implications for practice. Int J Sports Physiol Performan. 2017;12(suppl 2): s227-34.
32. Astorino TA, Schubert MM, Palumbo E, Etirling D, Mcmillan DW, Gallant R, et al. Perceptual changes in response to two regimens of interval training in sedentary women. J Strenght Cond Res. 2016;30(4):1067-76.
33. Ekkekakis P. Pleasure and displeasure from the body: perspectives from exercise. Cogn Emot. 2003;17(2):213-39.
34. Rose EA, Parfitt G. Exercise experience influences affective and motivational outcomes of prescribed and self-selected intensity exercise. Scand J Med Sci Sports. 2012;22(2):265-77.
35. Taulaniemi A, Kuusinen L, Tokola K, Kankaanpää M, Suni JH. Bio-psychosocial factors are associated with pain intensity, physical functioning, and ability to work with female healthcare personnel with recurrent low back pain. J Rehabil Med. 2017;49(8):667-76.
36. Seiler S, Sylta Ø. How does interval-training prescription affect physiological and perceptual responses? Int J Sports Physiol Perform. 2017;12(suppl 2):s280-6.
37. Davies TB, Kuang K, Orr R, Halaki M, Mackett D. Effect of movement velocity during resistance training on dynamic muscular strength: a systematic review and meta-analysis. Sports Med. 2017;47(8):1603-17.
38. Halson SL. Monitoring training load to understand fatigue in athletes. Sports Med. 2014;44(suppl 2):139-47.

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