Immunity to rhythm: Visual or auditory stimuli during intense aerobic exertion do not modulate the mood of young adults

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ABSTRACT

Background: High-intensity aerobic exercise can promote higher energy expenditure when compared to low and moderate-intensity exercise. However, vigorous exercise can negatively influence mood responses related to adherence. Auditory and audiovisual resources have been used to improve psychological variables during and after exercise.

Objectives: To analyze the influence of listening to music and watching video clips on mood responses of young adults after a high-intensity aerobic exercise session.

Methods: This is a Cross-Sectional Randomized Controlled Study in which fourteen male participants (23.4 ± 3.1 years; 26.2 ± 3.4 kg/m²) randomly performed exercise sessions on a cyclergometer, at an intensity of 10% above anaerobic threshold, in three situations: control (C), listening to music (M), and watching video clips (VC). At the end of each session, participants underwent 30 min of passive recovery. Mood responses were measured using Brunel's Mood Scale (BRUMS) before exercise, immediately after exercise, and after recovery. Friedman's and Wilcoxon's tests were used, with a significance level of 5%.

Results: No statistical differences were found between conditions (C, C, and VC) for the dimensions confusion, fatigue, anger, tension, and vigor ($p>0.05$). A statistically significant difference was found for depression before exercise, with M higher than C and VC ($p<0.05$); however, no differences were observed after exercise or recovery.

Conclusions: Listening to music and/or watching video clips does not influence mood responses in young adults after high-intensity aerobic exercise on a cyclergometer.

Keywords: adherence, affect, audiovisual resources, exercise, mood.

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INTRODUCTION

Exercising for maintaining health and preventing diseases is well documented in the literature (Pedersen & Saltin, 2015). Moreover, physical activity is an important variable for public health economics, since it is inversely associated with the costs of health procedures, drug prescriptions, and chronic diseases (Bueno et al., 2016).

In this scenario, an important aspect for the success of intervention programs aimed at promoting physical activity is the identification of factors that can limit participation and adherence. Lack of time and motivation are frequently mentioned barriers among adults (Rech et al., 2018). Therefore, adherence to exercise should be considered when planning actions based on the characteristics of the programs offered (Lovato et al., 2015). Thus, investigating different intervention strategies with a better time/efficiency ratio, such as high-intensity aerobic exercise, seems relevant.

It is known that affective responses to exercise are relevant to increasing adhesion. However, the intensity of exercise can modulate these responses, with low- and moderate-intensity exercise generating positive affective responses, while intensities above the second metabolic threshold are associated with negative affective responses (Camacho et al., 2014; Ekkekakis et al., 2011). It is possible that activities that cause high negative affect increase the risk of discontinuity in exercise programs.

Moreover, mood state can be directly associated with quality of life, and this quality of life can be improved with exercise. Since exercise, when performed at a controlled intensity, has an important role in the control and improvement of mood state (Laux et al., 2018).

The literature indicates that audiovisual stimuli, such as videos and music, can positively influence affective responses to exercise (Almeida et al., 2021; Bird et al., 2019; Stork et al., 2015). Music can hold attention and unlock several emotions that alter or regulate mood state (Thakare et al., 2017).

Despite the presence of audiovisual stimuli in exercise spaces, no studies have investigated effective responses to high-intensity aerobic exercise when combined with audiovisual stimuli. This investigation can provide new perspectives by examining the comparative effects of auditory (music) and audiovisual (music video) stimuli on mood responses following high-intensity aerobic exercise. This context has received little or no empirical attention to date.

Therefore, the present study aimed to analyze the influence of listening to music and watching video clips on mood responses among young adults following a high-intensity aerobic exercise session. The results of this study may inform intervention strategies to preserve engagement in physical exercise programs, guide health professionals in implementing more effective aerobic training programs, and potentially reduce the risks associated with physical inactivity and non-communicable chronic diseases. Thus, exercise physiologists, physical education professionals, and sports scientists whose research focuses on investigating psycho-affective responses to aerobic exercise may benefit. Furthermore, endurance sports enthusiasts may also benefit from the information this research may produce, given the known difficulties of engaging in physical exercise programs.

METHODS

Study Design and Participants

The present study has a quasi-experimental design and aimed to observe changes in mood responses among physically active young male adults across three conditions: control (C), listening to music (M), and watching musical video clips (VC). In all sessions, participants performed a high-intensity exercise on a cyclergometer (10% above the anaerobic threshold).

The sample size was determined using G*Power 3.0, with an alpha level of 0.05, a statistical power of 0.80, and an effect size of 0.41 based on previous research on mood responses using the BRUMS instrument (Rohlfs et al., 2008). The analysis, based on a repeated-measures ANOVA with three conditions (control, music, and video clips), indicated a minimum sample size of 12 participants.

A total of 19 participants were initially recruited using a convenience sampling approach. However, five participants withdrew from the study before completing all experimental sessions, resulting in a final sample of 14 participants included in the analysis. The inclusion criteria were: (a) aged between 18 and 30 years; (b) physically active, as determined by self-report; (c) free from known cardiovascular, musculoskeletal, or neurological disorders; and (d) not using medications that could affect autonomic nervous system responses. Exclusion criteria included: (a) failure to complete all experimental sessions; (b) non-compliance with study procedures; and (c) withdrawal of informed consent at any stage of the study.

Ethical approval statement

The study was approved by the Research and Ethics Committee of the Federal University of Vale do São Francisco (Univasf) (CAAE: 57443216.7.0000.5196). The participants were informed about all procedures and signed an informed consent form agreeing to participate in the study, as required by the Resolution n. 466/12 of the Brazilian National Health Council.

Procedures

Participants were invited to attend the laboratory for five visits to perform the research procedures. During the first visit, the volunteer completed the Physical Activity Readiness Questionnaire (PAR-Q) (Chisholm et al., 1975), the Brazilian short version of the International Physical Activity Questionnaire (IPAQ) (Matsudo et al., 2001), underwent anthropometric evaluation, and was familiarized with the cyclergometer. During the second visit, the participants performed a submaximal incremental test to identify the anaerobic threshold. In the third, fourth, and fifth sessions, the participants performed, in a randomized order (simple draw), the three experimental conditions on a cyclergometer: control (C), music (M), and video clip (VC). An interval of at least 48 hours was given between sessions. All sessions were carried out at the same time of day and under the same environmental conditions (Figure 1).

Aerobic Test and Experimental Sessions

The participants' anaerobic threshold was identified using the Borg Scale of RPE values. According to Scherr et al. (2013), values between 13 and 14 points on the scale are consistent with the anaerobic threshold. The incremental test was performed on a cyclergometer (Cefise Biotec, Model 2100). Before the test, a 2-minute warm-up

(without load) was performed at 50 rpm. At the beginning of the test, the load was increased by 25 W every minute, maintaining a speed of 50 rpm. The test was interrupted when the participant reached 16 points on the RPE scale or when he was unable to maintain the cyclergometer rotation at 50 rpm.

In the experimental sessions (C, M, and VC), before beginning exercise on the cyclergometer, participants remained seated for 10 minutes in silence, without sudden movements (rest). Afterward, the participants were placed on the cyclergometer and performed a 2-minute warm-up (without load). Then, the participants began exercise with a load corresponding to 10% above the anaerobic threshold, until voluntary exhaustion or until they could no longer maintain a rotation of 50 rpm. Brunel's mood scale (BRUMS) was administered at rest, immediately after exercise, and after 30 min of post-exercise recovery.

In the M session, the participants performed exercise listening to songs from a pre-established playlist. During VC, participants performed exercises and listened to and watched video clips of songs from the same playlist. Lastly, in Control, participants performed exercise wearing headphones; however, they did not listen to or watch anything.

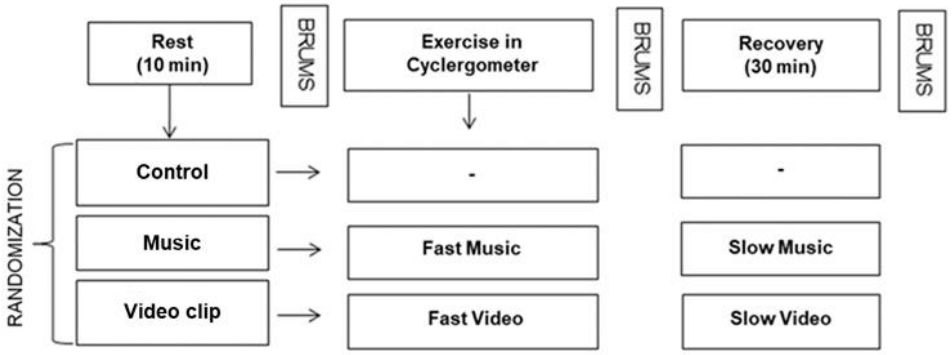

Figure 1. Fluxogram of the Study

Playlists and Video Clips

Two playlists were developed, one with fast songs and another with slow songs. The fast song playlist was composed of songs between 125 and 145 bpm, as proposed by Terry et al. (2020). These songs were used during the experimental sessions, while the slow songs were used post-exercise. The researchers created the playlists; however, the songs used during and after the experimental sessions, and their order, were chosen by the participants. The video clips featured the same songs from the playlist. Additionally, the same songs (and their respective video clips) were used in M and VC in the same order.

To avoid gaps between songs, the playlists were edited using Free MP3 Cutter (version 2014 for M) and Windows Movie Maker (version 2012 for VC). All participants wore the same headphones (Sony model MDR-ZX110) plugged into a television set (55" Toshiba Regza). During the recovery period (post-exercise), participants wore the same set of headphones; however, they listened to songs and watched video clips on a laptop (HP 14-ap000). The participant set the volume; nonetheless, it did not exceed 85 decibels.

Measurement Protocols

Brunel's mood scale (BRUMS) was applied at three time points (at rest, immediately after exercise, and after 30 min of post-exercise recovery). BRUMS was

adapted from the Profile of Mood States (POMS) questionnaire and validated to evaluate participants' mood states in the Brazilian context (Rohlfs et al., 2008). This scale contains 24 mood indicators and is divided into six subscales: anger, confusion, depression, fatigue, tension, and vigor. Participants answered questions regarding how they felt in that exact moment using a Likert scale from 0 (nothing) to 4 (extremely).

Data Analysis

Data was collected and stored in a spreadsheet using Microsoft Excel 2010®. Afterward, the data were exported to SPSS 22.0 for Windows®. A descriptive analysis of the data was performed, and values were expressed as mean ± standard deviation. Normality was verified using Shapiro-Wilk's test. Because the data were not normal, nonparametric tests were used (Friedman's and Wilcoxon's tests for repeated measures). The level of significance adopted was $p<0.05$, and the software used to perform analysis was SPSS 22.0 for Windows®.

The data used in the present study were derived from the same experimental protocol previously published by Almeida et al. (2021), which investigated perceptual and performance variables. However, the present analysis focuses specifically on mood responses measured using the Brunel Mood Scale (BRUMS).

RESULTS

Table 1 presents the age and anthropometric characteristics of the participants, expressed as mean ± standard deviation. All participants reported engaging in more than 150 minutes of moderate-to-vigorous physical activity per week.

Table 1. Main Characteristics of the Participants (n=14)

Variable	Mean ± standard deviation
Age (years)	23.4 ± 3.1
Weight (kg)	78.3 ± 12.3
Height (cm)	170 ± 6.0
Body mass index (kg/m²)	26.2 ± 3.4
Body fat (%)	17.8 ± 5.8

The comparisons between conditions (C, M, and VC) showed no significant differences for confusion (A), fatigue (C), anger (D), tension (E), and vigor (F) ($p>0.05$). Regarding depression (B), a statistically significant difference was found only at rest (pre-exercise), with M showing significantly higher values than C and VC ($p<0.05$).

On the other hand, comparisons within sessions revealed statistical differences at several points. Fatigue (C) was significantly higher after exercise in all three conditions compared with pre-exercise and after recovery ($p<0.05$). This also occurred with confusion (A), which remained high after exercise compared with after recovery in C and VC ($p<0.05$). Tension (E) was significantly lower after recovery, in VC, when compared to pre-exercise and after exercise ($p<0.05$), and significantly lower, in M, after recovery when compared to pre-exercise.

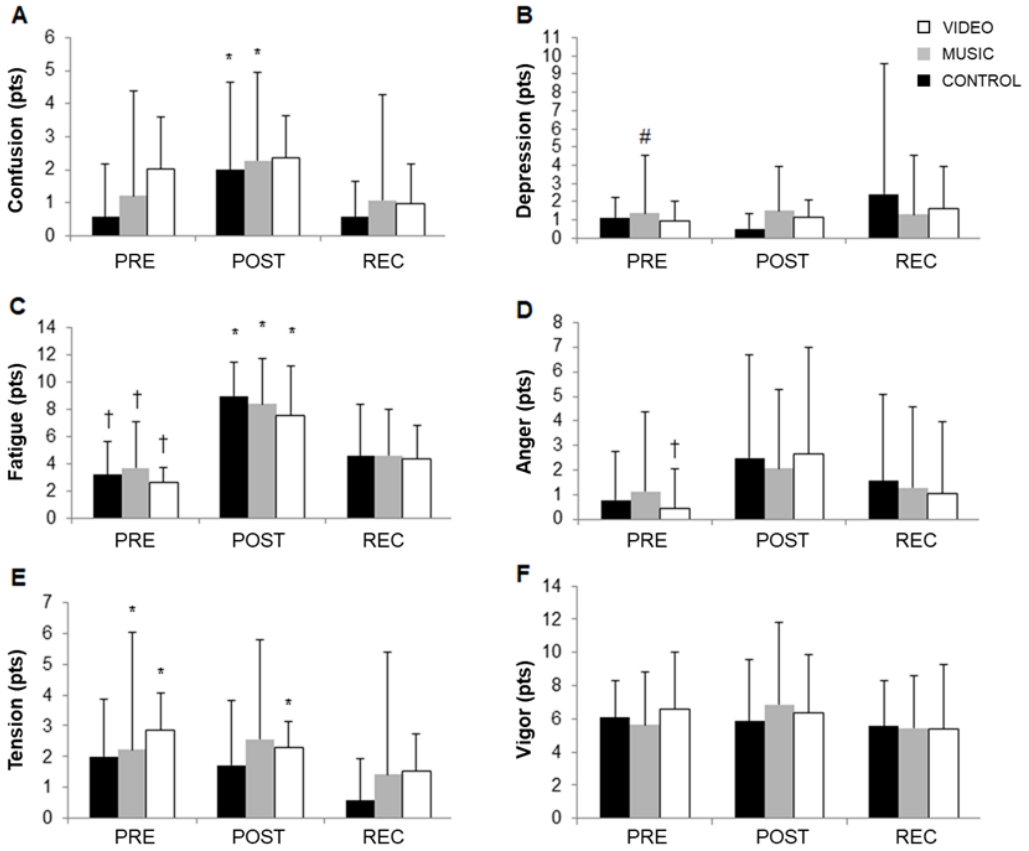

Figure 2. Mean ± standard deviations of the responses of mood state: confusion (A), depression (B), fatigue (C), anger (D), tension (E), and vigor (F). Pre-exercise (PRE), immediately after exercise (POST), and after 30 min of recovery (REC). *p<0.05 to REC in the same condition. †p<0.05 to POST in the same condition. #p<0.05 to C and VC in PRE.

DISCUSSION

The present study aimed to analyze the influence of listening to music and watching video clips on mood responses among young adults following a high-intensity aerobic exercise session. The main findings indicate that there were no differences among conditions (control, music, and video clips) for confusion, fatigue, anger, tension, and vigor (p>0.05). Specifically, for depression, a statistical difference was found in pre-exercise (rest) values, with M showing higher values than C and VC. However, this effect did not persist after exercise nor after recovery.

The literature indicates an association between physical activity and mood, suggesting that the intensity of exercise can modulate this response. It is speculated that moderate intensity exercise improves mood state. In contrast, high-intensity exercise can lead to negative responses, and this variation can be more related to the construct of depression than anxiety (Peluso & Andrade, 2005).

The association between mood state and exercise has been approached in some studies. Laux et al. (2018), for instance, examined the effects of a high-intensity, strength-and-metabolic-functional training session on the mood state of young adults. The results showed improvements in aspects related to tension and anger in both training models, as well as in depression during the strength session, when comparing pre- and post-training moments. This does not corroborate the present study's

findings. On the other hand, Bigliassi et al. (2012) investigated the effects of music on psychophysiological variables in adults during exercise on a cyclergometer at 60% of heart rate reserve. They reported that at this intensity, music was unable to influence variables such as rate of perceived exertion and mood state.

It is considered that music can exert an ergogenic and distractive effect during exercise, mainly at moderate intensities, with adequate intervals, and self-selection (Thakare et al., 2017). Bird et al. (2019) found that audiovisual stimuli can improve affect, perception, and exercise performance at the ventilatory threshold on a cyclergometer. Almeida et al. (2021) found that watching video clips while exercising attenuated displeasure after a high-intensity cyclergometer session (10% above anaerobic threshold). Beyond the insertion of audiovisual stimuli, it is important to analyze that the type of exercise can also be considered an intervening factor in positive affect and in the identification of the individual with the exercise, and that positive affect is inversely associated with the regulations of motivation (da Cruz Silva et al., 2019).

From a physiological standpoint, acute aerobic exercise demonstrates a clear intensity-dependent response, where high-intensity exercise typically causes greater acute physiological stress (lower heart rate variability, higher lactate) and potential temporary reductions in mood (tension/fatigue), while moderate- to low-intensity exercise often produces immediate improvements in mood (vigor) and faster post-exercise autonomic recovery (Zhang & Wang, 2025; Steptoe & Cox, 1988; Mazzeo & Marshall, 1987; Urhausen et al., 1994). In the present study, this may be overlapping with the potential modulating effects of auditory and audiovisual stimuli on mood responses.

From a psychophysiological point of view, at exercise intensities exceeding the ventilatory threshold, for example, attentional resources are progressively allocated to interoceptive signals, including respiratory effort, muscle pain, and fatigue, thus reducing the cognitive regulation capacity of affective responses. Consequently, as exercise intensity increases, individuals tend to shift from dissociative to associative attentional strategies, directing their focus to bodily sensations such as muscle fatigue and respiratory effort (Ekkekakis, 2003; Ekkekakis et al., 2011). Furthermore, the influence of music appears to diminish at higher exercise intensities, as physiological signals, including fatigue and shortness of breath, increasingly dominate attentional capacity (Karageorghis & Priest, 2012).

Consequently, at high exercise intensities, attentional resources are increasingly guided by interoceptive signals associated with physiological effort, such as fatigue, dyspnea, and muscle discomfort, thereby limiting the effectiveness of external stimuli, including music or video, in modulating affective responses.

Despite not finding differences between conditions, it is important to note that immediately after exercise, fatigue was higher in all three conditions than pre-exercise and post-recovery (Figure 2C). Exercise-induced acute fatigue is a multifactorial phenomenon involving peripheral and central mechanisms that emerge in response to increased physiological exertion. At the muscular level, the accumulation of metabolites such as inorganic phosphate, hydrogen ions, and adenosine diphosphate during high-intensity exercise impairs excitation-contraction coupling and reduces force production. Furthermore, alterations in calcium metabolism, including reduced release from the sarcoplasmic reticulum and

decreased myofibrillar sensitivity to calcium, further compromise contractile function. Concomitantly, central mechanisms also contribute to fatigue, as the progressive reduction of voluntary neural impulses from the central nervous system limits the recruitment of motor units. This process is partially mediated by the activation of muscle afferents from groups III and IV, which respond to metabolic and mechanical disturbances and exert an inhibitory influence on central motor output. Moreover, the depletion of high-energy substrates, such as phosphocreatine and glycogen, exacerbates the decline in performance. Collectively, these peripheral and central factors interact to induce acute fatigue during exercise, ultimately reducing the ability to maintain muscle work (Gandevia, 2001; Enoka & Duchateau, 2008; Amann, 2011; Spriet, 2014).

This also occurred with confusion (Figure 2A), which was significantly higher immediately after exercise in C and M, compared to post-recovery, a difference that did not occur in VC. Moreover, in VC, tension (Figure 2E) was lower after recovery than pre-exercise or immediately after exercise. Such analysis suggests that the audiovisual response can specifically influence variables such as confusion and tension.

This effect can be partially explained by the fact that exercising while watching music videos can generate lower levels of tension and confusion than listening to music alone, due to greater attentional distraction and multisensory engagement. Audiovisual stimuli simultaneously engage visual and auditory pathways, promoting the dissociation of interoceptive signals such as fatigue, discomfort, and respiratory effort. This greater capacity for dissociation can improve affective responses and reduce negative mood states during exercise. Furthermore, visual content can increase emotional engagement and perceptual absorption, thus reducing cognitive load and limiting attentional focus on physiological effort. Consequently, the integration of visual and auditory stimuli appears to increase attentional dispersion and improve psychological responses during exercise compared to isolated auditory stimulation (Jones et al., 2014; Hutchinson et al., 2015; Bigliassi et al., 2019; Terry et al., 2020).

The type and intensity of the exercise used in the present study differ from those reported in the literature (Hayakawa et al., 2000; Laux et al., 2018; Bird et al., 2019; Geraldes et al., 2019). Stork et al. (2015) examined whether listening to self-selected music could reduce the adverse effects of performing a sprint interval training session. The authors observed performance improvement, but not in perceptions of affect or motivation. Another factor that modifies mood responses to exercise is the physiological induction of hypoxia, as well as the acute effect of moderate exercise performed in hypoxia. Souza et al. (2015) verified that moderate exercise, performed in hypoxia, increased post-exercise anxiety and aggravated mood state. In this scenario, Giampá et al. (2018) reported changes in the dimensions of the BRUMS during hypoxia, including increases in fatigue and mental confusion and a decrease in vigor.

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Limitations of the study

Even though the present study contributes to the literature on mood responses to high-intensity exercise, it is not without limitations. First, the choice of songs and video clips was not entirely voluntary, since participants chose from a pre-established playlist. Moreover, imposing a specific cycling speed (50 rpm) could be a limitation.

CONCLUSION

It is concluded that listening to music and/or watching video clips did not affect the mood state of young adults after a high-intensity cycle ergometer aerobic exercise session. The characteristics of high-intensity exercise and its physiological demands outweigh the effects of audiovisual distractions on focus transfer during this exercise modality.

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No.

AI DISCLOSURE STATEMENT

During the preparation of this manuscript, the authors used Google Translate to assist in translation. All outputs were thoroughly reviewed and revised by the authors to ensure accuracy, clarity, and compliance with academic standards. The authors assume full responsibility for the content of this manuscript.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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This research does not receive external funding.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

Almeida, C. M. M., Araujo, F. D. S., Lima, E. V. D. C., De Souza, M. F., Sales, M. M., & De Moraes, J. F. V. N. (2021). Acute effects of listening to music and/or watching video clips on perceptual variables and performance during a high intensity exercise session. *Journal of Physical Education and Sport*, *21*(6), 3455-3463. http://doi.org/10.7752/jpes.2021.06468

Amann, M. (2011). Central and peripheral fatigue: interaction during cycling exercise in humans. *Medicine & Science in Sports & Exercise*, *43*(11), 2039-2045. https://doi.org/10.1249/MSS.0b013e31821f59ab

Bigliassi, M., Greca, J. P., Barreto-Silva, V., Chierotti, P., Oliveira, A. R. D., & Altimari, L. R. (2019). Effects of audiovisual stimuli on psychological and psychophysiological responses during exercise in adults with obesity. *Journal of sports sciences*, *37*(5), 525-536. https://doi.org/10.1080/02640414.2018.1514139

Bigliassi, M., Santos, E., Kanthack, T., Bortolotti, H., & Altimari, L. (2012). Influência da música em variáveis psicofisiológicas durante um exercício submáximo em ciclossimulador. *Revista Brasileira de Atividade Física & Saúde*, *17*(6), 532-542. http://dx.doi.org/10.12820/2317-1634.2012v17n6p532

Bird, J. M., Karageorghis, C. I., Baker, S. J., & Brookes, D. A. (2019). Effects of music, video, and 360-degree video on cycle ergometer exercise at the ventilatory threshold. *Scandinavian journal of medicine & science in sports*, *29*(8), 1161-1173. https://doi.org/10.1111/sms.13453

Bueno, D. R., Marucci, M. D. F. N., Codogno, J. S., & Roediger, M. D. A. (2016). Os custos da inatividade física no mundo: estudo de revisão. *Ciência & saúde coletiva*, *21*, 1001-1010. https://doi.org/10.1590/1413-81232015214.09082015

Camacho, J. M., Oliveira, B. R. R., & Maranhão, G. A. (2014). Efeito de dois tipos de prescrição de exercício físico aeróbio sobre variáveis relacionadas à adesão. *Rev. bras. ciênc. mov*, 22-29. https://doi.org/10.18511/rbcm.v22i1.3943

Chisholm, D. M., Collis, M. L., Kulak, L. L., Davenport, W., & Gruber, N. (1975). Physical activity readiness. *BC Med J*, *17*(2), 375-8.

da Cruz Silva, T., Freire, G. L. M., Morais, O. S. G., & do Nascimento, J. R. D. A. (2019). Motivação, bem-estar e autoestima de praticantes de diferentes modalidades de exercício físico. *Saúde e Pesquisa*, *12*(2), 359-366. https://doi.org/10.17765/2176-9206.2019v12n2p359-366

Ekkekakis, P. (2003). Pleasure and displeasure from the body: Perspectives from exercise. *Cognition and Emotion, 17*(2), 213–239. https://doi.org/10.1080/02699930302292

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: decennial update and

progress towards a tripartite rationale for exercise intensity prescription. *Sports medicine*, *41*(8), 641-671. https://doi.org/10.2165/11590680-000000000-00000

Enoka, R. M., & Duchateau, J. (2008). Muscle fatigue: what, why and how it influences muscle function. *The Journal of physiology*, *586*(1), 11-23. https://doi.org/10.1113/jphysiol.2007.139477

Gandevia, S. C. (2001). Spinal and supraspinal factors in human muscle fatigue. *Physiological reviews*, *81*(4), 1725-1789. https://doi.org/10.1152/physrev.2001.81.4.1725

Geraldes, A. A. R., Silva, W. B. D., Balikian, P., & Pereira, P. M. G. (2019). Effects of walking on the mood of physically active older people. *Revista Brasileira de Medicina do Esporte*, *25*(1), 63-66. https://doi.org/10.1590/1517-869220192501193620

Giampá, S. Q. D. C., Souza, J. F. T. D., Mello, M. T. D., Tufik, S., Santos, R. V. T. D., & Antunes, H. K. M. (2018). Maximum effort training performed in hypoxia alters the mood profile. *Revista Brasileira de Medicina do Esporte*, *24*, 440-445. https://doi.org/10.1590/1517-869220182406133712

Hayakawa, Y., Takada, K., Miki, H., & Tanaka, K. (2000). Effects of music on mood during bench stepping exercise. *Perceptual and motor skills*, *90*(1), 307-314. https://doi.org/10.2466/pms.2000.90.1.307

Hutchinson, J. C., Karageorghis, C. I., & Jones, L. (2015). See hear: Psychological effects of music and music-video during treadmill running. *Annals of Behavioral Medicine, 49*(2), 199–211. https://doi.org/10.1007/s12160-014-9647-2

Jones, L., Karageorghis, C. I., & Ekkekakis, P. (2014). Can high-intensity exercise be more pleasant? Attentional dissociation using music and video. *Journal of Sport and Exercise Psychology*, *36*(5), 528-541. https://doi.org/10.1123/jsep.2013-0251

Karageorghis, C. I., & Priest, D. L. (2012). Music in the exercise domain: a review and synthesis (Part I). *International Review of Sport and Exercise Psychology, 5*(1), 44–66. https://doi.org/10.1080/1750984X.2011.631026

Laux, R. C., Mattiello, G. F., & Corazza, S. T. (2018). Efeitos dos treinamentos metabólico e de força no estado de humor. *ConScientiae Saúde*, *17*(3), 286-292. https://doi.org/10.5585/conssaude.v17n3.8275

Lovato, N., Loch, M., González, A., & Lopes, M. (2015). Assiduidade a programas de atividade física oferecidas por Unidades Básicas de Saúde: o discurso de participantes muito e pouco assíduos. *Revista Brasileira de Atividade Física & Saúde*, *20*(2), 184-184. https://doi.org/10.12820/rbafs.v.20n2p184

Matsudo, S., Araújo, T., Matsudo, V., Andrade, D., Andrade, E., & Braggion, G. (2001). Questinário internacional de atividade f1sica (IPAQ): estudo de validade e reprodutibilidade no Brasil. *Rev. bras. ativ. fis. saúde*, 05-18. https://doi.org/10.12820/rbafs.v.6n2p5-18

Mazzeo, R. S., & Marshall, P. E. T. E. R. (1989). Influence of plasma catecholamines on the lactate threshold during graded exercise. *Journal of applied physiology*, *67*(4), 1319-1322. https://doi.org/10.1152/jappl.1989.67.4.1319

Pedersen, B. K., & Saltin, B. (2015). Exercise as medicine–evidence for prescribing exercise as therapy in 26 different chronic diseases. *Scandinavian Journal of Medicine & Science in Sports*, *25*, 1-72. https://doi.org/10.1111/sms.12581

Peluso, M. A. M., & De Andrade, L. H. S. G. (2005). Physical activity and mental health: the association between exercise and mood. *Clinics*, *60*(1), 61-70. https://doi.org/10.1590/S1807-59322005000100012

Rech, C. R., Camargo, E. M. D., Araujo, P. A. B. D., Loch, M. R., & Reis, R. S. (2018). Perceived barriers to leisure-time physical activity in the Brazilian population. *Revista Brasileira de Medicina do Esporte*, *24*, 303-309. https://doi.org/10.1590/1517-869220182404175052

Rohlfs, I. C. P. D. M., Rotta, T. M., Luft, C. D. B., Andrade, A., Krebs, R. J., & Carvalho, T. D. (2008). A Escala de Humor de Brunel (Brums): instrumento para detecção precoce da síndrome do excesso de treinamento. *Revista Brasileira de Medicina do esporte*, *14*(3), 176-181. https://doi.org/10.1590/S1517-86922008000300003

Scherr, J., Wolfarth, B., Christle, J. W., Pressler, A., Wagenpfeil, S., & Halle, M. (2013). Associations between Borg's rating of perceived exertion and physiological measures of exercise intensity. *European Journal of Applied Physiology*, *113*(1), 147-155. https://doi.org/10.1007/s00421-012-2421-x

Souza, J. F. T. D., Giampá, S. Q. D. C., Lemos, V. D. A., Santos, S. A. D., Silva, E. T. D., De Mello, M. T., ... & Antunes, H. K. M. (2015). Exercise performed at hypoxia influences mood state and anxiety symptoms. *Motriz: Revista de Educação Física*, *21*, 177-184. https://doi.org/10.1590/S1980-65742015000200008

Spriet, L. L. (2014). New insights into the interaction of carbohydrate and fat metabolism during exercise. *Sports medicine*, *44*(Suppl 1), 87-96. https://doi.org/10.1007/s40279-014-0154-1

Steptoe, A., & Cox, S. (1988). Acute effects of aerobic exercise on mood. *Health Psychology*, *7*(4), 329. https://doi.org/10.1037//0278-6133.7.4.329

Stork, M. J., Kwan, M. Y., Gibala, M. J., & Martin Ginis, K. A. (2015). Music enhances performance and perceived enjoyment of sprint interval exercise. *Medicine & Science in Sports & Exercise*, *47*(5), 1052-1060. https://doi.org/10.1249/MSS.0000000000000494

Terry, P. C., Karageorghis, C. I., Curran, M. L., Martin, O. V., & Parsons-Smith, R. L. (2020). Effects of music in exercise and sport: A meta-analytic review. *Psychological Bulletin*, *146*(2), 91. https://doi.org/10.1037/bul0000216

Thakare, A. E., Mehrotra, R., & Singh, A. (2017). Effect of music tempo on exercise performance and heart rate among young adults. *International Journal of Physiology, Pathophysiology and Pharmacology*, *9*(2), 35. https://pubmed.ncbi.nlm.nih.gov/28533890/

Urhausen, A., Weiler, B., Coen, B., & Kindermann, W. (1994). Plasma catecholamines during endurance exercise of different intensities as related to the individual anaerobic threshold. *European journal of applied physiology and occupational physiology*, *69*(1), 16-20. https://doi.org/10.1007/BF00867921

Zhang, Y., Li, J., & Wang, Y. (2025). Effects of acute exercise programs on heart rate variability and vascular function in sedentary college students: A randomized controlled trial. *Medicine*, *104*(19), e42346. https://doi.org/10.1097/MD.0000000000042346