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El Nostrum al Ejercicio: Cómo la Prescripción de Intensidad de Ejercicio Autoseleccionada e Impuesta se Relaciona con Resultados Afectivos, Cognitivos y Conductuales - Una Revisión Sistemática

The Nostrum to Exercise: How Self-Selected and Imposed Exercise Intensity Prescription Relates to Affective, Cognitive, and Behavioral Outcomes - A Systematic Review

A Panaceia do Exercício: Como a Prescrição de Intensidade de Exercício Autoselecionada e Imposta se Relaciona com Resultados Afetivos, Cognitivos e Comportamentais - Uma Revisão Sistemática

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RESUMEN

Permitir seleccionar la intensidad del ejercicio se ha propuesto como un método para apoyar la adherencia al ejercicio, pero no se encontró ninguna exploración extensa que contrastara este enfoque con un método de intensidad impuesta. Esta revisión sistemática explora la relación entre la intensidad del ejercicio seleccionada por el usuario y los resultados afectivos, cognitivos y conductuales en contextos de actividad física. La búsqueda se realizó en las bases de datos PubMed, SPORTDiscus y PsycINFO con los criterios de inclusión: (1) experimentales y no experimentales; (2) publicados en una revista revisada por pares; (3) escritos en inglés; (4) que exploraran la autoselección de intensidad y/o la autorregulación en contextos de ejercicio; (5) muestras con individuos de entre 18 y 64 años; y (6) centrados en individuos aparentemente sanos. Veintinueve estudios (N = 749 participantes) fueron incluidos para revisión, 25 explorando el ejercicio aeróbico y cuatro de resistencia. En general, la intensidad de ejercicio autoseleccionada mostró mejores resultados afectivos, cognitivos y conductuales positivos en comparación con la prescripción de intensidad de ejercicio impuesta, pero la alta heterogeneidad en los métodos y resultados justifica la precaución al interpretar los resultados. La autoselección de la intensidad puede promover la mejora de las respuestas afectivas, las percepciones de autonomía, la autoeficacia, la intención de ser físicamente activo, y más minutos de participación en el ejercicio. Las discrepancias en los métodos de autoselección de la intensidad, las diferencias en los protocolos de ejercicio y las características de las muestras ponen de manifiesto la necesidad de realizar más estudios.

Palabras clave: ejercicio físico, placer, afecto, hedónico, adherencia.

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ABSTRACT

Allowing to select the exercise intensity has been proposed as a method to support exercise adherence, but no extensive exploration was found contrasting this approach to an imposed intensity method. For this matter, this systematic review aimed to explore the relationship between self-selected exercise intensity and affective, cognitive, and behavioural outcomes in physical activity settings, and whenever possible, compare this approach to other forms of exercise intensity prescription. Search was conducted in the PubMed, SPORTDiscus, and PsycINFO databases (last search date July 2022) with the following inclusion criteria: (1) experimental and non-experimental; (2) published in a peer-reviewed journal; (3) written in English; (4) exploring intensity self-selection and/or self-regulation in exercise settings; (5) samples with individuals aged between 18 and 64 years; and (6) focused on apparently healthy individuals. Twenty-nine studies (N = 749 participants) were included in this review, 25 exploring aerobic exercise and four resistance training activities. Overall, self-selected exercise intensity showed better positive affective, cognitive, and behavioural outcomes compared to imposed exercise intensity prescription, but high heterogeneity on the methods and outcomes warrant caution when interpreting the results. Self-selected intensity may promote improved affective responses, autonomy perceptions, self-efficacy, intention to be physically active, and more minutes of exercise participation. However, discrepancy on the intensity self-selection methods, exercise protocol differences, and samples characteristics, highlight the need for further studies on the topic to better understand the possible magnitude of this effect.

Keywords: physical exercise, pleasure, affect, hedonic, adherence.

RESUMO

Permitir a seleção da intensidade do exercício tem sido proposto como um método para apoiar a adesão ao exercício, mas não foi encontrada nenhuma exploração extensiva que contrastasse esta abordagem com um método de intensidade imposta. Por esta razão, esta revisão sistemática teve como objetivo explorar a relação entre a intensidade do exercício autosselecionada e os resultados afetivos, cognitivos e comportamentais em contextos de atividade física e, sempre que possível, comparar esta abordagem com outras formas de prescrição da intensidade do exercício. A pesquisa foi realizada nas bases de dados PubMed, SPORTDiscus e PsycINFO (última data de pesquisa em julho de 2022) com os seguintes critérios de inclusão: (1) experimentais e não-experimentais; (2) publicados numa revista com revisão por pares; (3) escritos em inglês; (4) que explorassem a autosseleção da intensidade e/ou a autorregulação em contextos de exercício; (5) amostras com indivíduos com idades compreendidas entre os 18 e os 64 anos; e (6) focados em indivíduos aparentemente saudáveis. Vinte e nove estudos (N = 749 participantes) foram incluídos nesta revisão, 25 explorando o exercício aeróbico e quatro atividades de treino de resistência. Em geral, a intensidade de exercício autosselecionada mostrou melhores resultados positivos a nível afetivo, cognitivo e comportamental em comparação com a prescrição de intensidade de exercício imposta, mas a elevada heterogeneidade dos métodos e dos resultados justifica cautela na interpretação dos resultados. A intensidade autosselecionada pode promover melhores respostas afetivas, perceções de autonomia, autoeficácia, intenção de ser fisicamente ativo e mais minutos de participação no exercício. No entanto, a discrepância entre os métodos de autosseleção da intensidade, as diferenças entre os protocolos de exercício e as características das amostras, realçam a necessidade de mais estudos sobre o tema para melhor compreender a possível magnitude deste efeito.

Palavras-chave: exercício físico, prazer, afeto, hedónico, adesão.

INTRODUCTION

In a world full of scientific evidence concerning the health benefits of the regular practice of physical activity (PA), one of the greatest challenges for public health during the last decades is the battle against inactivity (European Commission, 2022; Loyen et al., 2017). Even though many people start a physical activity program, few remain in practice, and the “revolving door” phenomenon (individuals

quitting an exercise program soon after commencing) stands stout, with 40-65% dropout rates within the first 3-6 months (Rodrigues et al., 2021; Radel et al., 2017; Rand et al. 2020; Sperandei et al., 2016). According to research, only about 3.7% of gym members are expected to maintain their gym activities for more than 12 consecutive months. Among gym-goers, younger individuals with high body mass index who are primarily motivated by weight loss are considered the "at-risk" group for long-term adherence to physical activity in a fitness center setting. On the other hand, older individuals with low body mass index, whose main motivations are hypertrophy, aesthetics, and health, fall into the "lower risk" group. They are more likely to continue their fitness practice for extended periods, with approximately a 10% likelihood of staying for more than 12 consecutive months (Sperandei et al., 2016).

Several theories have been suggested to address the exercise adherence problem. One of them is grounded in the dual-mode theory assumptions (Ekkekakis, 2009). According to this theory, exercise intensity is seen as an essential training variable with a direct influence on cortically mediated cognitive processes and ascending interoceptive cues. Changes in exercise intensity are hypothesized to impact affective responses, and consequently, influence individual motivational quality. On this ground, several studies have tested this hypothesis and provided considerable evidence for it (Ekkekakis et al., 2011; Oliveira et al., 2015; Stevens et al., 2020; Teixeira et al., 2022). However, the way intensity is delivered and perceived by the exerciser has been suggested to have other differentiated outcomes. Particularly, some differences in prescribed versus self-selected intensities have been suggested (e.g., Oliveira et al., 2015; Parfitt et al., 2006; Portugal et al., 2015), although with mixed findings, and mainly focused on affective responses. Although relevant, other affective, cognitive, and behavioral aspects may warrant attention in the comprehension of these exercise intensity selection methods. This is what this systematic review aims to address.

Self-selection of exercise intensity: possible mechanisms and outcomes

Self-selected exercise intensity can be expressed by several approaches, such as selecting a walking or running speed (e.g., Lind et al., 2005; Monedero et al., 2017) or exercise load (e.g., Portugal et al., 2015; Teixeira et al., 2023). These can also be used to target specific aims, like the speed the exerciser feels comfortable for a given period (Ekekkakis & Lind, 2006), or even towards pleasurable feelings (e.g., Baldwin et al., 2016; Teixeira et al., 2023). Also, the possibility to self-regulate intensity (during the exercise; in each period) toward these goals is also a commonly used approach (Ekkekakis et al., 2011; Oliveira et al., 2015).

The bulk of the literature on this topic has highlighted that intensity self-selection may boost autonomy perceptions, a key aspect of intrinsic motivation (Ryan & Deci, 2017). For example, Parfitt et al. (2000) showed that the exercisers' perceived choice in a prescribed versus self-selected intensity treadmill exercise, was higher in the self-selection group; Vazou-Ekkekakis & Ekkekakis (2009) have also found that when contrasting these two intensity-selection approaches, the individuals in the prescribed intensity presented a lower sense of autonomy, even when the intensities among the conditions were the same. These results align with several others and have been explained, for example, through the lens of the self-determination theory (SDT; Deci & Ryan, 1985). Mechanistically, is it expected that when an individual experiences flexibility and low pressure in each behavior, particularly if the behavior is self-endorsed, autonomous perceptions would be present and support intrinsic motivation, a well-known predictor of exercise adherence (Oman & McAuley, 1993; Ryan et al., 1997; Teixeira et al., 2012; Turner & Reed, 2022).

When considering that an intrinsically motivated behavior is commonly accepted to be the one that is performed for its inherent satisfaction, leading to experiences of enjoyment, personal accomplishment, and excitement (Rodrigues et al., 2020a; Ryan & Deci, 2017), it would not be surprising that positive affective responses would also emerge. This has been reported in Teixeira et al. (2018) review, where intrinsic motivation and perceived autonomy were associated with positive affect. In specific experimental approaches testing the prescribed versus self-selected exercise intensity methods, the pattern of autonomy perception and positive affect development was verified, as reported in Ekkekakis

et al. (2011) review and posterior studies (e.g., Yang & Petrini, 2018). However, some studies have shown no differences in this approach (Portugal et al., 2015; Waaso et al., 2022), leaving a gap in the understanding of the possible impact of this mode of intensity prescription.

Additionally, less is known in cognitive and behavioral outcomes in self-selected exercise intensity activities, as for other affective variables besides, for example, the affective response. There is evidence that exercise habit, for example, is a predictor of exercise adherence (Feil et al., 2021), which can be supported by self-determined motivation (e.g., as the one promoted by autonomy perceptions; Radel et al., 2017); exercise frequency and intention to be physically active have also been positively associated to autonomous behaviors (Ryan & Deci, 2017; Teixeira et al., 2012; Rodrigues et al., 2020b).

Notwithstanding, autonomy perceptions may not be sufficient to help sustain exercise practice (Rhodes et al., 2020). Recent positions on exercise adherence promotion have suggested that the motivation behind a complex behavior like exercise practice is developed through reflective and automatic processes (i.e., dual-process theories; ACSM, 2021; Williams, 2023). Thus, a hedonic approach (i.e., promotion of enjoyable and pleasant feelings) to exercise, where intensity is a key aspect (Ekkekakis et al., 2011; Stevens et al., 2020), may help understand exercise adherence. However, explorations targeting the possible mechanisms and outcomes resulting from the self-selection of intensity are scarce and warrant current attention.

Current study

A first approach to better understand this topic pertains to a thorough analysis of existing research explorations of self-selected, and particularly, self-selected versus imposed/prescribed exercise intensities, with the objective of identifying relevant outcomes susceptible to being posteriorly explored in future research efforts targeting exercise adherence promotion. Therefore, this study aims to: 1) explore the relationship between self-selected exercise intensity and affective (e.g., positive affect), cognitive (e.g., intention), and behavioral (e.g., exercise frequency) outcomes in physical activity settings; and 2) whenever possible, compare this approach to other forms of exercise intensity prescription (e.g., heart rate percentage).

MATERIALS AND METHODS

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol (Page et al., 2021) recommendations were followed in the development of this review. The present review has been registered in the international prospective register of systematic reviews (PROSPERO) under the registration number: CRD42020214533. We were also guided by the Population, Intervention, Comparison, Outcomes and Study (PICOS) strategy. Both the PRISMA guidelines and the PICOS tool are endorsed by the Cochrane Collaboration (Higgins & Green, 2011; Methley et al., 2014), and PROSPERO registration had been widely endorsed for transparency purposes (Both et al., 2012). The means by which we followed to these varied guidelines is specified below.

Eligibility criteria

The present review applied the following inclusion criteria: (1) experimental and non-experimental studies; (2) published in a peer-reviewed journal until July 31, 2022; (3) written in English; (4) exploring intensity self-selection and/or self-regulation in exercise settings; (5) samples with individuals aged between 18 and 64 years; and (6) focused on apparently healthy individuals. The exclusion criteria were as follows: (1) population with disease; (2) body mass index > 34.9 Kg/m^2; (3) instrument validation studies; and (4) review studies.

Information sources and search strategy

An extensive search of scientific papers was conducted on the PubMed (host: MEDLINE), SportDISCUS (host: EBSCO), and PsycINFO (host: EBSCO) databases from December 31st, 2021, until July 31st, 2022. Utilizing the PICOS strategy, the search was executed with the following entries in each individual database: (((physical AND (activity OR exercise)) AND (self-paced OR self (pace OR paced) OR self-regulation OR self (regulation OR regulated) OR self-selected OR self (selected OR selection OR select) AND intensity) AND (effort OR exertion OR activation OR arousal OR tolerance OR preference OR tolerated OR preferred OR pleasur*) AND (cognitive OR behavioral OR affective OR

emotional)) NOT cancer NOT disease NOT fibromyalgia NOT depression NOT diet NOT hypertensive NOT pain). An example of the PubMed query is included as a supplemental material file (Appendix 1). Bibliographic references from related studies and other sources were examined to potentially include more studies that met inclusion criteria (last search conducted July 31st, 2022).

Selection process

Three researchers (AJA, VB and DST) independently conducted the article selection process. All researchers were trained in the reviewing procedures and disagreements were resolved in group discussion until a consensus was reached. At Level I screening, the titles and abstracts of all the resulting records of the database search were analyzed and checked for potential matching with the eligibility criteria. This was followed by Level II screening, consisting of a meticulous analysis of the full text of each publication not eliminated in the previous screening round. At this stage, each author looked to guarantee that the inclusion criteria were met, and no exclusion criteria were present. Figure 1 illustrates the complete search and screening process.

Data collection process and data items

The data collection process was independently conducted by three reviewers (AJA, VB and DST) utilizing a predefined checklist created for this purpose. All reviewers were previously trained and familiarized with the procedures. For a general description (Table 1), the following information was extracted from the included studies: (1) bibliographic information (authors, year of publication, country of research); (2) study design; (3) sample size; (4) sample features; (5) measures; (6) analysis; (7) general outcomes. A data extraction sheet was made in Excel to summarize all data of interest from the studies. For a summary of the main characteristics of interest (Table 2), the following data were collected: (1) age; (2) gender; (3) sample size; (4) physical activity level; (5) intensity prescription; and (6) location. Furthermore, to better understand how and in which conditions the self-selection and/or self-regulation of exercise intensity was made (Table 3), the following data was summarized: (1) exercise mode; (2) exercise protocol; (3) structure of the exercise session; (4) exercise intensity; (5) script and (6) specific outcomes (affective, behavioral, cognitive).

Study Risk of Bias Assessment

The risk of bias was assessed using the revised Cochrane "Risk of bias" tool for randomized controlled trials (RoB 2.0; Sterne et al., 2019). RoB 2.0 assesses the risk of bias by addressing six specific domains: (1) randomization process; (2) deviations from intended interventions; (3) missing outcome data; (4) measurement of the outcome; (5) selection of the reported result; and (6) overall bias. This instrument was applied to each included study and the supporting information and justifications regarding the assessment of the risk of bias were recorded for each domain (low; some concerns; high). Regarding the quasi-experimental studies, the risk of bias assessment was conducted with the Risk of Bias in Non-randomized Studies – of Interventions (ROBINS-I; Sterne et al., 2016). Scores of "low risk", "moderate risk", "serious risk", "critical risk", or "no information" are used to classify each of the following domains: (1) confounding; (2) selection of participants into the study; (3) classification of interventions; (4) deviations from intended intervention; (5) missing data; (6) measurement of outcomes; and (7) selection of the reported outcomes. Three authors reviewed independently the included studies. When in disagreement, the scores were discussed and resolved through consensus. All reviewers were debriefed and instructed prior to the use of each risk of bias assessment tool.

RESULTADOS

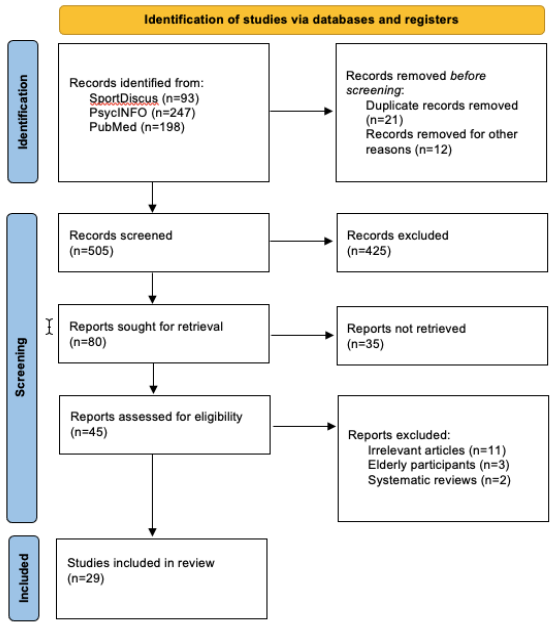
Study selection

A total of 538 articles were identified during the database search for possible inclusion. Of 505 records screened (after the removal of 21 duplicates and 12 records for other reasons), and excluded another 425 articles, 80 articles were considered potentially relevant. After reading their abstracts and realizing that the authors had different motives for their studies than those, we excluded another 35 articles. We then read the full text of the 45 papers. Sixteen articles were excluded for the following reasons: irrelevant articles (n = 11), used elderly participants (n = 3), and they were systematic reviews (n = 2). Analysis of the bibliographical references of the selected studies revealed no additional studies of relevance for this review.

Twenty-nine studies met all inclusion criteria and were included in the present review (Baldwin et al., 2016; DaSilva et al., 2011; Ekkekakis & Lind, 2006; Elsangedy et al., 2016; 2018a; 2018b; Focht, 2009; Focht et al., 2015; Freitas et al., 2015; Glen et al., 2017; Haile et al., 2013; Hamlyn-Williams et al., 2015; Krinski et al., 2017; Kellogg et al., 2018; Lattari et al., 2016; Lind et al., 2005; Monedero et al., 2017; Oliveira et al. 2014; Parfitt et al., 2000; Parfitt et al., 2006; Portugal et al., 2015; Rose & Parfitt, 2007; 2008; 2010; 2012; Vazou-Ekkekakis & Ekkekakis, 2009; Waaso et al., 2022; Williams and Raynor, 2013; Williams et al., 2016). The description of the screening steps is presented in the flow diagram (Figure 1).

Figure 1

Study Chart.



All the included studies were published until July 31 of 2022. A synthesis of the extracted data can be observed in Table 1, Table 2, and Table 3. These tables are organized in alphabetic order according to the first author's surname.

Study characteristics

A summary of the descriptive data of the included studies can be observed in Table 1 and Table 2. All 29 studies had an intervention/experimental design (25 quasi-experimental and four randomized controlled trials), with convenience methods being utilized for recruitment. Eighteen studies had self-selected and imposed exercise intensity, and only 11 had self-selected exercise intensity. The inclusion criteria were met by the studies' participants, allowing for a wide exploration of self-selection dynamics in a variety of PA contexts. In 14 studies the samples were composed only of females, in six studies only of males, and in 13 studies both sexes were represented (n = 258). There was also one study with 20 adults with sex not reported (Lattari et al., 2016). The selected studies had a total of 749 participants, with 25 studies (86%) being conducted with a sample size of 35 or below, and four studies (14%) presenting samples of over 35 participants. The physical activity level can be considered diversified, with 18 studies sampling sedentary individuals (62%), 10 studies including only active individuals (34%), and only one study (4%) reporting a sample with both sedentary and active individuals. The mean age ranged from 21 ± 2 (Vazou-Ekkekakis & Ekkekakis, 2009) to 47.7 ± 11.1 (Williams et al., 2016) years, representing a considerable range of adult-aged samples.

Risk of bias

The risk of bias for all studies is summarized in Table 1. Of the four randomized controlled trials included in this review, three studies were scored as some concerns (Williams et al., 2016, Baldwin et al., 2016, Freitas et al., 2015) due to the possible deviations from intended interventions; and Haile et al. (2013) was scored as high risk of bias due to the possible deviations from intended interventions and selection of the reported result.

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Table 1
Descriptive characteristics of the studies and main outcomes.

Study	Location	Design	Settings	Participants	Measures	Analysis	General Outcomes	Risk of Bias
Baldwin et al. (2016)	USA	Randomized Controlled Trial	Gym	67 (48 women, 28 men, plus one participant that did not report sex) (age=34.6±10.6, BMI=30.04±9.01) Sedentary	7-Day PA Recall, CRF, FS	Linear regression models	At one week, for participants with lower CRF (i.e., poor conditioning), the affect-guided prescription resulted in significantly greater change in PA minutes than the heart rate-guided prescription. For those with higher CRF (i.e., good conditioning), the means were in the opposite direction but not significantly different. At one month, the same pattern emerged but the interaction was not significant.	Some concerns
DaSilva et al. (2011)	Brazil	Quasi-experimental	Outdoor, Laboratory	17 men, 7 women (age= 24.0±3.3, BMI=23.3±2.2; 22.5±2.6, BMI=22.2±1.8) Active	HRR, VO_2, FS, Borg 6–20 RPE	*t*-test, RM-ANOVA	Overground (O) speed was significantly faster than treadmill (T). Exercise intensity and perceived exertion during O were significantly lower compared to T.	Moderate
Ekkekakis & Lind (2006)	USA	Quasi-experimental	Laboratory	25 women (Normal weight (NW)=9, (BMI=22.34±1.82) Overweight (O) =16; (BMI=31.06±4.91) NW age=43.67±4.24; O age=43.00±5.40) Sedentary	HR Polar Electro Oy, VO_2, FS, Borg 6–20 RPE	Mixed Models ANOVA, RM-ANOVAs	The O women showed higher oxygen uptake and perceived exertion than the NW women during both sessions. Although the two groups did not differ in ratings of pleasure–displeasure during the session at self-selected speed, only the O women showed a significant decline when the speed was imposed.	Serious
Elsangedy et al. (2016)	Brazil	Quasi-experimental	Gym	12 men (age=35.8±5.8, BMI=25.5±2.6) Sedentary	OMNI-RES RPE, FS	Coefficient of variation	The percentage of one repetition maximum for all exercises was >51% (14–31% variability), the rating of perceived exertion was 5–6 (7–11% variability), and the affective responses was 0–1 point with large variability.	Serious
Elsangedy et al. (2018a)	Brazil	Quasi-experimental	Gym	16 men (age=39.7±7.5, BMI=27.1±3.6) Sedentary	OMNI-RES RPE, FS	Three-way ANOVA	FS can be used to self-regulate exercise intensity in RT. The lower the FS descriptor, the higher the weight lifted. In addition, the load self-selected for each FS descriptor was reliable across the four sessions.	Moderate

Note. LTEQ = Leisure-Time Exercise Questionnaire; FS = Feeling Scale; FAS = Felt Arousal Scale; EFI = Exercise-Induced Feeling Inventory; PACES = Physical Activity Enjoyment Scale; SIAS = Single-Item Attention Scale; SEES = Subjective Exercise Experiences Scale; IMI = Intrinsic Motivation Inventory, AD ACL = Activation Deactivation Adjective Check List.

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Table 1 (continuation)
Descriptive characteristics of the studies and main outcomes.

Study	Location	Design	Settings	Participants	Measures	Analysis	General Outcomes	Risk of Bias
Elsangedy et al. (2018b)	Brazil	Quasi-experimental	Gym	66 women: obese = 22 (age=33.5±8.5, BMI=34.9±4.1); overweight = 22 (age=34.8±8.6, BMI=24.6±1.3); normal weight = 22 (age=30.8±9.3, BMI=22.0±1.6) Sedentary	HR, VO2, RPE Borg 6-20, FS	One-way ANOVA, two-way ANOVA	Women with obesity experienced the lowest affective rates, despite similar RPE, HR and VO_2 to the other normal weight and overweight groups.	Moderate
Foch (2009)	USA	Quasi-experimental	Outdoor, Laboratory	35 women (age=22.14±1.73; BMI=22.59±2.61) Active	LTEQ, FS, FAS, EFI, PACES, Intention scale, Borg 6–20 RPE	Bivariate correlation, RM-ANOVA, Paired samples *t*-test, bivariate corelation	Both walks resulted in improvements in affective responses, participants reported greater pleasant affective states, enjoyment, and intention for future participation with outdoor walking.	Serious
Foch et al. (2015)	USA	Quasi-experimental	Gym	20 women (age=23.15±2.92) Active BMI = not reported	FS, Intention, Self-efficacy	RM-ANOVA; univariate ANOVA; LSD test; bivariate correlations	Acute bouts of SS and imposed load RE resulted in comparable improvements in affect; recreationally trained women reported the highest self-efficacy and intention to use the load chosen in SS condition in their own resistance training; and affective responses were unrelated to motivational correlates of resistance training.	Moderate
Freitas et al. (2015)	Brazil	Randomized Controlled Trial	Gym	26 women (age=45.9±7, BMI SS=33.4±2.3, IMP=35.6.9±4.2) Sedentary obese	RPE Borg Scale 6-20; FS; FAS; VO_2	t-test; one-way ANOVA	Use of a self-selected exercise intensity can promote smaller negative affective responses during exercise and provide a sufficient stimulus for improvement in cardiorespiratory fitness.	Some concerns
Glen et al. (2017)	Australia	Quasi-experimental	Laboratory	16 women, 4 men (age=22.5±2.5, 30.8±10.8; BMI=25.0±4.3) Sedentary	Watts, HR Polar Electro Oy, Borg 6–20 RPE, FS, SIAS, PACES	ANOVA	Exergaming could be used as a strategy to encourage individuals to exercise, with participants choosing to work harder physiologically, but reporting more positive psychological responses during and following the exercise.	Moderate
Haile et al. (2013)	USA	Randomized Controlled Trial	Gym	32 men (age=22.3±2.2) BMI=not reported Active	FS (modified), VO2 TrueOne 2400, OMNI Cycle RPE	*t*-test, ANOVA	There were no differences between the self-selected (SS) and imposed trials (IMP). For SS and IMP trials, session perceived exertion was greater than acute perceived exertion. Session affective responses (AR) was greater than acute AR for the SS trial, but not the IMP trial.	High
Hamlyn-Williams et al. (2015)	UK	Quasi-experimental	Gym	14 women (age=24.9±5.2, BMI=24.1.9±5.5) Sedentary	FS, Borg 6–20 RPE, Gas analyser Cosmed K4, HR Polar Electro	ANOVA	Sedentary women can use the FS in an ecological setting to regulate their exercise intensity and that regulating intensity to feel 'good' should lead to individuals exercising at an intensity that would result in cardiovascular gains if maintained.	Serious

Table 1 (continuation)

Descriptive characteristics of the studies and main outcomes.

Study	Location	Design	Settings	Participants	Measures	Analysis	General Outcomes	Risk of Bias
Krinski et al. (2017)	Brazil	Quasi-experimental	Outdoor, Laboratory	38 women (age=45.64±8.63; BMI=35.12±3.42) Sedentary	Borg 6–20 RPE, FS, FAS, AS	ANOVA, Pearson's correlation, Linear regression	Women with obesity self-selected an appropriate exercise intensity to improve fitness and health in both environmental settings. Self-paced outdoor walking presented improved psychological responses. The more externally focused attention predicted greater future intentions to participate in walking.	Moderate
Kellogg et al. (2018)	USA	Quasi-experimental	Gym	7 men, 7 women (age=24±3, BMI=23.7±2.7) Active	VO_2, PPO, RPE – Borg CR10, BLa PACES, FS	Two-way analysis of variance with repeated measures.	Results showed higher VO2, BLa, and RPE in HIIESS vs. HIIEIMP, and lower affect, and enjoyment. There was a significantly higher power output in self-selected vs. imposed HIIE. Intensity mediates affective responses rather than the mode of HIIE performed by the participant.	Moderate
Lattari et al. (2016)	Brazil	Quasi-experimental	Laboratory	20 adults (age=26.5±3.8) BMI=not reported Active	HR, Borg 6-20 RPE, FS, FAS, Frontal Asymmetry	RM-ANOVA	The self-selected intensity provided better affective responses compared to prescribed. No frontal alpha asymmetry was seen due to an exercise intervention.	Moderate
Lind et al. (2005)	USA	Quasi-experimental	Laboratory	23 women (age=43.43±4.85; BMI=28.03±6.25) Sedentary	HR, Borg 6–20 RPE, VO2, FS	ANOVAs, *t*-tests	On average, middle-aged, formerly sedentary women selected an intensity that is considered physiologically effective and reported that it did not feel hard or unpleasant.	Serious
Monedero et al. (2017)	Brazil	Quasi-experimental	Laboratory	11 men, 12 women (age=24.8±1; BMI=24.8±1.3) Sedentary	HRR, VO2, IMI, CFSS, Borg 6–20 RPE, SEES	ANOVA	AVG's can elicit physiological responses that meet recommended exercise intensities and are more enjoyable than conventional exercise in young inactive adults.	Moderate
Oliveira et al. (2014)	Brazil	Quasi-experimental	Laboratory	17 men (age=31±7; BMI=24.0.9±1.9) Active	HR, CR100, FAS, FS, PACES	Two-way ANOVA	Self-selected session did not provide better affective responses than the imposed session with same intensity and duration.	Serious

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Table 1 (continuation)
Descriptive characteristics of the studies and main outcomes.

Study	Location	Design	Settings	Participants	Measures	Analysis	General Outcomes	Risk of Bias
Parfitt et al. (2000)	UK	Quasi-experimental	Laboratory	26 women (age=31.22±4.26; BMI=23.2±2.8) Active	SEES, IMI, RPE	ANOVA, ANCOVA, MANOVA	There was no difference in psychological affect or enjoyment between the two exercise sessions, with work rate higher in the preferred condition.	Serious
Parfitt et al. (2006)	UK	Quasi-experimental	Laboratory	12 men (age=36.5±10.5; BMI=28.5±4.7) Sedentary	FS, FAS, and Borg 6-20 RPE	RM-ANOVA; one factor ANOVA	Interindividual variability in responses was greatest below the VT, with similar levels of variability in the self-selected and above-lactate conditions. There was more positive affective valence from pre- to post-exercise.	Moderate
Portugal et al. (2015)	Brazil	Quasi-experimental	Laboratory	16 men (age=25.1±5.5) BMI = not reported Active	FS, FAS and Borg CR-10 RPE	One-way ANOVA; RM-ANOVA; Bonferroni correction	All prescribed intensities showed increased activation and only the session at 80% 1RM showed reduction valence compared to the Control condition. Thus, the affective response to strength training does not seem to be influenced by exercise intensity.	Moderate
Rose & Parfitt (2007)	New Zealand	Quasi-experimental	Laboratory	19 women (age=39.37±10.29; BMI=25.5±3.6) Sedentary	FS, FAS, and Borg 6-20 RPE	ANOVA	Affect is least positive during the above- LT condition and most positive during the SS and below-LT conditions. Qualitative results showed that factors relating to perceptions of ability, interpretation of exercise intensity, exercise outcomes, focus of concentration, and perceptions of control influenced the affective response and contributed to the individual differences shown in the quantitative data.	Serious
Rose & Parfitt (2008)	New Zealand	Quasi-experimental	Laboratory	17 women (age=44.8*±8.9; BMI=27.2±3.9) Sedentary	FS, Borg 6-12 RPE, Self-efficacy	RM-ANOVA	Sedentary women can regulate intensity using the FS to experience a pleasant affective state, and the intensities chosen are physiologically beneficial for health and fitness.	Serious
Rose & Parfitt (2010)	New Zealand	Quasi-experimental	Laboratory	17 women (age=43.9±9.7) Low-active 15 women (age=46.4±10.6) High-active BMI = not reported	FS, FAS	Thematic analysis (qualitative data)	Results highlight the complex interaction of psychological and physiological influences in producing an affective response to exercise and provide insight into how exercise can be structured to elicit positive affective responses.	Serious

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Table 1 (continuation)

Descriptive characteristics of the studies and main outcomes.

Study	Location	Design	Settings	Participants	Measures	Analysis	General Outcomes	Risk of Bias
Rose & Parfitt (2012)	New Zealand	Quasi-experimental	Laboratory	17 women (age=43.9±9.7; BMI=26.5±3.4) Sedentary 15 women (age=46.4±10.6; BMI=24.8±2.7) High-active	FS, FAS, Borg 6-20, Self-efficacy, IMI, PNSE	ANOVA, ANCOVA	Sedentary women felt relatively positive in the self-selected condition but would benefit from familiarization and experience with exercise to enhance their self-efficacy and competence.	Serious
Vazou-Ekkekakis & Ekkekakis (2009)	Greece	Quasi-experimental	Laboratory	19 women (age=21±2; BMI=20.67±0.2) Sedentary	IMI, Perceived Autonomy 12-item, FS, AD ACL, Self-efficacy, RPE	ANOVA, MANOVA	Imposed exercise intensity reduce perception of autonomy and choice, and also attenuated increases in energy and levels of interest/enjoyment.	Moderate
Waaso et al. (2022)	USA	Quasi-experimental	Laboratory	6 men, 10 women (age=32±13.3, BMI=24.7±4) Sedentary	RPE, mood questionnaire, PACES, SEE	ANOVA, *t*-test, pearson correlation analysis	Sedentary individuals reported no significant differences between conditions (interval and continuous) for self-selected workloads, self-efficacy, perceived enjoyment, and heart rate.	Serious
Williams & Raynor (2013)	USA	Quasi-experimental	Laboratory	29 women (age=39.7±12.3; BMI=29.9±6.6) Sedentary	HR, FS, Borg 6-20	ANOVAs	Over the intensity and a lower intensity per se contributed to greater preference for self-selected intensity over imposed higher intensity PA among healthy low-active women.	Serious
Williams et al. (2016)	USA	Randomized Controlled Trial	Outdoor	59 adults (age=47.7±11.1; BMI=31.9±4.0) Sedentary	Exercise behavior self-report HP iPAC 111; FS	Regression-based mediation model	Modest preliminary support for a mediational pathway linking self-paced, affective response, and exercise adherence.	Some concerns

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Table 2

Summary of samples' characteristics.

Characteristics	Studies 29 totals	Percentages (%)
Age		
< 25 years	9	31
26-35 years	7	24
> 35 years	13	45
Gender		
Female	14	48
Male	6	20
Mixed	8	28
Not reported	1	4
Sample size		
≤ 35 participants	25	86
> 35 participants	4	14
Physical activity level		
Active	10	34
Sedentary	18	62
Mixed	1	4
Intensity prescription		
Self-Selected and imposed	18	62
Self-Selected	11	38
Location		
Europe	4	14
North America	10	34
South America	10	34
Oceania	5	18

Of the 25 quasi-experimental studies, the overall bias was scored as moderate risk for 12 studies (DaSilva et al., 2011; Elsangedy et al., 2018a; 2018b; Focht et al., 2015; Glen et al., 2017; Krinski et al., 2017; Kellogg et al., 2018; Latarri et al., 2016; Monedero et al., 2017; Parfitt et al., 2006; Portugal et al., 2015; Vazou-Ekkekakis & Ekkekakis, 2009) mainly due to a potential bias in the confounding, and selection of reported results. Thirteen studies were scored as serious risk (Ekkekakis & Lind, 2006; Elsangedy et al., 2016; Focht, 2009; Hamlyn-Williams et al., 2015; Lind et al.,2005; Oliveira et al., 2014; Parfitt et al., 2000; Rose & Parfitt, 2007; Rose & Parfitt, 2008; Rose & Parfitt, 2010; Rose & Parfitt, 2012; Waaso et al., 2022, Williams & Raynor, 2013) due to feasible bias in the measurement of outcomes.

Results of individual studies

Exercise mode

Out of the 29 studies that met the inclusion criteria, 25 studied aerobic exercise and four studied resistance training exercise. Concerning aerobic exercise, 13 studies (Ekkekakis & Lind, 2006; Elsangedy et al., 2018b; Freitas et al., 2015; Lind et al., 2005; Parfitt et al., 2000; 2006; Rose & Parfitt, 2007; 2008; 2010; 2012; Vazou-Ekkekakis & Ekkekakis, 2009; Waaso et al., 2022, Williams & Raynor, 2013) were conducted on a treadmill; four studies (Haile et al., 2013; Kellogg et al., 2018; Lattari et al., 2016; Oliveira et al., 2014) were conducted on a cycle ergometer; three studies (DaSilva et al., 2011; Focht, 2009; Krinski et al., 2017) took place in both outdoor and indoor (treadmill) environments; two studies (Baldwin et al., 2016; Williams et al., 2016) consisted in physical activity (walking) in outdoor settings; two studies (Glen et al., 2017; Monedero et al., 2017) were conducted with mixed modes (e.g., entertainment-theme video game); and finally, in one study (Hamlyn-Williams et al., 2015), the participants were given the choice of using either the treadmill or cycle ergometer. Regarding the four resistance training studies, three took place in a gym or health club (Elsangedy et al., 2016; 2018a; Focht et al., 2015), and one was conducted in a laboratory (Portugal et al., 2015).

Aerobic exercise – Protocol volume and intensity

A wide array of different exercise volumes was identified in the included studies. Exercise duration ranged from eight-min (Kellogg et al., 2018), to 10-min (Focht, 2009), 15-min (Glen et al., 2017), 20-min (DaSilva et al., 2011; Ekkekakis & Lind, 2006; Elsangedy et al., 2018b; Freitas et al. 2015; Haile et al., 2013; Hamlyn-Williams et al., 2015; Lattari et al., 2016; Lind et al., 2005; Parfitt et al., 2000; 2006; Rose & Parfitt, 2007), 30-min (Krinski et al., 2017;

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Monedero et al., 2017; Rose & Parfitt, 2008; 2010; 2012; Vazou-Ekkekakis & Ekkekakis, 2009, Waaso et al., 2022), and 38.9 min (Oliveira et al., 2014). Additionally, one intervention (Williams & Raynor, 2013) reported a 1/3-mile distance. Two studies were longitudinal interventions, one with six months of walking exercise promotion programs, where the participants were instructed to fulfill 30 to 60-min walking sessions at least 5 days per week (Williams et al., 2016), and the other an eight-month self-report PA program (Baldwin et al., 2016).

Of the sixteen studies that compared self-selected and imposed intensity, nine met the moderate intensity range recommended by the ACSM (2021) in the self-selection condition (Baldwin et al., 2016; Oliveira et al., 2014; Freitas et al., 2015; Parfitt et al. 2006; Rose & Parfitt, 2007; 2010; 2012; Vazou-Ekkekakis & Ekkekakis, 2009; Williams et al., 2016), two studies were below the moderate intensity range recommended (Lattari et al., 2016; Williams et al., 2013), and three studies exceeded the moderate intensity range (Ekkekakis & Lind, 2006; Kellogg et al., 2018; Parfitt et al., 2000). Haile et al. (2013) had a wide range of exercise intensities from light to vigorous during self-selected conditions, and in the Monedero et al. (2017) study all trials met the ACSM criteria for moderate or vigorous physical activity.

Eight of the nine studies using only self-selected intensity met the intensity range recommended by the ACSM (2021) for the development and maintenance of cardiorespiratory fitness (Elsangedy et. al., 2018b; Focht, 2009; Glen et al., 2017; Hamlyn-Williams et al., 2015; Krinski et al., 2017; Lind et al., 2005; Rose & Parfitt, 2008, Waaso et al., 2022), and only one was below the recommended intensity range (DaSilva et al., 2011).

Self-selected and imposed intensity associations with affective, cognitive, and behavioral outcomes in aerobic activities

Affective outcomes were present in all 25 aerobic studies. Among the several approaches to measure these, affective valence and/or enjoyment were used as variables for that purpose. Of these studies, 16 compared self-selected exercise intensity with imposed intensity. In six of those studies, affective valence was collected as a measure of the exercise session's affective response, with no statistical differences when using the same intensity between conditions being identified (Baldwin et al., 2016; Haile et al., 2013; Oliveira et al., 2014; Rose & Parfitt, 2012; Vazou-Ekkekakis & Ekkekakis, 2009; Williams et al., 2016). Conversely, five studies found that the affective response was more positive during self-selected exercise compared to the imposed one (Ekkekakis & Lind, 2006; Freitas et al., 2015; Lattari et al., 2016; Parfitt et al., 2006; Rose & Parfitt, 2007), with only one study (Kellogg et al., 2018) reporting that the affective response was lower in self-selected high-intensity interval exercise condition versus prescribed. As for the studies that had an approach to study the variable enjoyment, two studies did not find any differences between conditions (Oliveira et al., 2014; Parfitt et al., 2000), two studies showed that the imposed condition presented better enjoyment (Kellogg et al., 2018; Monedero et al., 2017), and one study showed improved enjoyment in the self-selection group (Vazou-Ekkekakis & Ekkekakis, 2009). Studies that only used self-selected exercise intensity protocols (n = 9), always reported positive affective responses throughout their protocols (DaSilva et al., 2011; Elsangedy et. al., 2018b; Focht, 2009; Glen et al., 2017; Hamlyn-Williams et al., 2015; Krinski et al., 2017; Lind et al., 2005; Rose & Parfitt, 2008; Waaso et al., 2022). Only two studies with only self-selected conditions explored enjoyment as an outcome, with one consisting of three self-selection cycling modes that presented enjoyment score above mid-point (Glen et al., 2017), and the other amounting to two acute bouts of self-selected moderate-intensity treadmill training (interval vs. continuous), with high values reported but with no perceive differences between conditions.

Cognitive outcomes were present in 12 of the 25 aerobic protocol studies. In eight studies with self-selected and imposed protocols, social physique anxiety, psychological well-being, competence/self-efficacy, perception of ability, focus of attention, achievement, and autonomy, were studied as cognitive variables of interest (Ekkekakis & Lind, 2006; Monedero et al., 2017; Parfitt et al., 2000; 2006; Rose & Parfitt, 2007; 2010; 2012; Vazou-Ekkekakis & Ekkekakis, 2009). Of these, three studies reported higher autonomy, higher self-efficacy, and competence in the self-selected condition (Parfitt et al., 2000; Rose & Parfitt, 2012; Vazou-Ekkekakis & Ekkekakis, 2009).

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Table 3
Descriptive characteristics of the studies and main outcomes.

Study	Exercise Mode	Exercise Protocol	Sessions	Exercise Intensity Manipulation Rational	Script	Outcomes		
						Affective	Cognitive	Behavioral
Baldwin et al. (2016)	Aerobic SS vs. IMP	Outdoor PA program (affect-guided prescription n =37; HR-guided prescription n=30)	Baseline session (1) n=37 exercise during the next week at a self-selected intensity using affective response as a guide (2) n=30 exercise during the next week at a prescribed intensity	Affect guided group would be associated with better affective responses compared to HR-guided	(1) always exercise at an intensity that felt pleasant (i.e., at or above a "0" on the scale) (2) exercise within the moderate intensity range (HR between 64–76% of their HRmax)	The two conditions did not differ in affective response	None	Significant and meaningful differences in PA minutes in 1st week in the affect-guided prescription (M=203.04) compared to HR-guided prescription (M=184.51)
Da Silva et al. (2011)	Aerobic	20-min self-paced overground walking (OW) vs. treadmill (T)	1st orientation session for self-selecting an exercise intensity. 2nd Maximal graded treadmill test 3rd 20 min of continuous walking at a self-selected pace	Less positive affective valence would occur during the T session	1st 'Select an exercise intensity that you prefer and can be sustained for 20 min and that you would feel happy to do regularly". Note: Warm-up – trial began at a speed of 4 km/h without grade for 2 min. The speedometer was covered throughout the trial so that subjects were blinded to the actual treadmill speed. Subjects were allowed to adjust the treadmill speed only every 5 min of the 20 min trial.	Less positive affective valence reported in T compared to OW	None	None
Ekkekakis & Lind (2006)	Aerobic SS vs. IMP	20-min treadmill self-selected (SS) vs. treadmill-imposed speed (IS) = 10% higher than SS	1st Incremental treadmill test to volitional exhaustion 2nd A 20-min bout of treadmill exercise at a self-selected speed 3rd A 20-min bout of treadmill exercise during which the speed was imposed (10% higher than 2nd session)	Overweight women (OW) would rate less pleasure and higher levels of perceived exertion than normal weight (NW) specially when the intensity is imposed rather SS	The women were told that they were to engage in a 20-min bout of treadmill exercise, during which they would be able to select the speed that they preferred. Note: Warm-up – 5 min at 4.0 km and 0% grade; grade always fixed at 0%, was allowed to adjust every 5 min of the 20-min	Both groups without different ratings of pleasure-displeasure during the session at SS intensity. OW showed a significant decline when the speed was imposed. Less pleasure during IS conditioning in OW.	OW tendency for negative cognitive self-appraisals: higher levels of social physique anxiety (SPA)	None

Note. SS = Self-selected exercise intensity; IMP = Imposed exercise intensity

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Table 3 (continuation)

Descriptive characteristics of the studies and main outcomes.

Study	Exercise Mode	Exercise Protocol	Sessions	Exercise Intensity Manipulation Rational	Script	Outcomes		
						Affective	Cognitive	Behavioral
Elsangedy et al. (2016)	Resistance	3 sets of 10 reps on machines and free weights: chest press, leg press, seated rows, knee extension, overhead press, biceps curl, and triceps pushdown	1st familiarization with the experimental procedures 2nd and 3rd 1RM testing for test and re-test interclass correlation assessment at a 48-h interval. 4th 3x10 SS load	Self-selected (SS) exercise intensity promotes better affective responses	Participants were asked to self-select the load to complete three sets of 10 repetitions. The individuals were permitted to choose the load lifted for each set during the self-selected bout.	Positive affective responses during resistance training (RT) from neutral (FS0) to fairly good (FS+1).	None	None
Elsangedy et al. (2018a)	Resistance	3 sets of 10 reps on machines: leg press, chest press, seated knee extension, and seated biceps curl	1st familiarization process conducted over three non-consecutive days 2nd all participants performed four affect-regulated sessions for each of the four FS descriptors (16 sessions) 3x10m	Feeling Scale (FS) could be used to regulate the exercise intensity during resistance training (RT)	"Today, you are going to perform four different exercises. Please, select a load associated with a [*verbal descriptor of the FS randomly selected for that day*] feeling, corresponding to [*numeral descriptor of the FS randomly selected for that day*] on this scale for performing three sets of 10 repetitions on the [*name of the exercise*]. If needed, at the end of each set, during the 2-min recovery period, you can adjust the load to maintain the correct feeling associated with the descriptor prescribed during the remainder of the sets."	FS conditions decrease from FS+5 to FS-1 in an increased self-selected exercise intensity.	None	None
Elsangedy et al. (2018b)	Aerobic	20-min graded exercise test and 20-min self-paced walking session on a treadmill (three groups normal, overweight, and obese)	1st Familiarization session 2nd Maximal graded exercise test 3rd Experimental session – continuous 20-min treadmill walking	Normal and overweight women would promote better affective response that in obese women.	"Now, you are going to perform treadmill walking for 20-min. Throughout the session, you will be able to adjust the speed as you wish. You can make these adjustments at every 5 minutes. (e.g., either decrease, increase, or maintain)." Notes: grade fixed at 1% and the speedometer was concealed during the exercise session so that participants were unaware of the actual treadmill speed.	Women with obesity experienced the lowest affective rates even at self-paced intensity compared to normal and overweight.	None	None

Table 3 (continuation)

Descriptive characteristics of the studies and main outcomes.

Study	Exercise Mode	Exercise Protocol	Sessions	Exercise Intensity Manipulation Rational	Script	Outcomes		
						Affective	Cognitive	Behavioral
Foch (2009)	Aerobic	10-min walk at self-selected (SS) intensity in outdoor vs. on a treadmill in a laboratory environment	1st 10-min walk on a treadmill (laboratory) self-selected 2nd 10-min walk (outdoor)	Walks were completed at a SS intensity. Outdoor walking (OW) would result in more favourable affective responses and higher ratings of enjoyment and intention when compared to the laboratory environment.	'Choose a walking pace that is comfortable but would still provide you with good exercise. You can select your speed, pace, incline, and effort level throughout the walk and may change them at any time during the walk.'	Brief walks elicited improvements in affective responses in both environments. Pleasure was significantly higher with OW. Higher rating of enjoyment in OW.	Revitalization higher in OW. Physical exhaustion decreased. Positive engagement increased significantly from baseline to during walking.	Higher rating of intention for future participation in OW.
Foch et al. (2015)	Resistance SS vs. IMP	3 sets of 10 reps on machines: leg extension, chest press, leg curl and lat pulldown Imposed Loads (IL) = 40% 1RM, 70% 1RM vs. Self-selected (SS)	1st 1RM testing session 2nd 3 acute randomly assigned RE sessions: a 40% 1RM; a 70% 1RM and a SS session	SS exercise intensity promotes higher ratings of pleasure than imposed in resistance exercise (RE).	Participants were instructed to select a load that would be comfortable, yet still provide a good challenging workout. Participants were allowed to choose the load lifted and to adjust that load at any time during the SS session.	Significant declines in pleasure during 70% 1RM session. Increases in pleasure emerged during 40% 1RM and SS sessions. Similar postexercise improvements in affect after each RE condition.	None	Higher intention for future RE using SS load compared with both 70% 1RM and 40% 1RM session. Greater intention to participate in the 70% 1RM compared to 40% 1RM.
Freitas et al. (2015)	Aerobic SS vs. IMP	20-min SS and IMP (10% above VT) walking treadmill on three non-consecutive days, for 12 weeks	Intervention program of 12 weeks, with three exercise sessions a week. Imposed vs self-selected	Self-selected intensity will be associated with positive ratings of affective valence compared to imposed intensity	"You are supposed to choose a walking intensity of your preference. The session is supposed to last 20 minutes. The intensity must be high enough that you have a good workout but not so high that when exercising every day or every other day it stops you from continuing to exercise. The intensity must be appropriate for you"	The affective responses post exercise was more negative in the imposed intensity group	None	None
Glen et al. (2017)	Aerobic	15-min self-selected (SS) cycle ergometer (control mode - blank screen) vs. exergaming with track mode (following a woodland trail) and a game mode (chasing dragons to accrue points)	1st Familiarisation and submaximal exercise test 2nd 45-min session of self-selected exercise 15-min "control" (standard ergometer), "track", and "game mode".	Exergaming modes besides physiologically hard work, would promote a positive affective response	Participants were told that they would be exercising for three sets of 15 minutes and instructed that they could choose to exercise at whatever intensity they preferred and change the intensity whenever they wanted. There was no physiological or work data visible.	Affect remained positive in all three modes (FS+2) with affect more positive in game mode than track mode, and track mode more positive that control mode. Enjoyment significant higher in game than track mode, which was higher than control mode.	Dissociation higher in game than track mode, which was higher than control mode	None

The Nostrum to Exercise: How Self-Selected and Imposed Exercise Intensity Relates to Affective, Cognitive, and Behavioral Outcomes - A Systematic Review

Table 3 (continuation)

Descriptive characteristics of the studies and main outcomes.

Study	Exercise Mode	Exercise Protocol	Sessions	Exercise Intensity Manipulation Rational	Script	Outcomes		
						Affective	Cognitive	Behavioral
Haile et al. (2013)	Aerobic SS vs. IMP	20-min cycle self-selected (SS) vs. imposed (IMP); EXP subjects were unaware that workload was the same between trials vs. CON subjects were aware that both trials were of the same workload	1st session – familiar session 2nd session - SS exercise intensity 20-min of submaximal exercise on a cycle ergometer 3rd session - IMP exercise intensity 20min of submaximal exercise	Self-selected (SS) trial will promote better acute affective response (A-AR) and session affective responses (S-AR).	"Today I will ask you to select an intensity that you prefer to perform on the cycle. This should be an intensity that you would choose for a 20-min workout if you were participating in a fitness program. The intensity should be high enough that you would get a good workout, but not so high that you would not prefer to exercise at that intensity daily or at least every other day. It should be an intensity that is appropriate for you''. Note: must maintain a 50-RPM cadence, resistance adjustments at the 5, 10 and 15 time points if needed.	A-AR and S-AR values ranged from FS-1 to FS+5 with A-AR greater (FS+1 to FS+3) in SS intensity trial. No differences between groups.	None	None
Hamlyn-Williams et al. (2015)	Aerobic	20-min treadmill or cycle ergometer in self-selected intensity	1st Familiarisation with the scales, and a submaximal exercise test (cycling or treadmill) 2nd 20-min exercise sessions in fitness gym (cycling or treadmill)	Self-regulation of exercise intensity using the feeling scale (FS) to experience positive affective responses.	Participants were instructed to aim to work at an intensity which reflected FS+3 "good". Note: during the test participants were able to adjust the exercise intensity (gradient or speed, or resistance) at any stage. The display and values themselves were kept blind.	FS allows individuals to exercise at an intensity to feel 'good'(FS+3)	None	None
Krinski et al. (2017)	Aerobic	30-min self-pace treadmill walking vs. outdoors	1st Initial screening and body composition assessment; 2nd instruction session; 3rd graded exercise test on a treadmill; 4th two 30-min self-paced walking trials (treadmill and outdoor)	Self-paced outdoor walking (OW) presents better affective responses than treadmill.	"Please select an exercise intensity to walk for 30 min." The volunteers were allowed to make pace adjustments (increase, decrease, or maintain) every 5-min in both trials. Note: treadmill grade was fixed at 1%, and the speedometer was covered so that participants could not see the speed.	Affective responses with no effect of the environmental setting. Affect was more positive at 15-min postexercise only in the outdoor trial. Greater enjoyment in OW condition	None	OW increased external focus attention, and attentional focus during the OW predicted future intentions to walk
Kellogg et al. (2018)	Aerobic SS vs. IMP	cycle ergometer 8 x 60" - 80% peak power output (PPO): 60" rest 10% PPO Imposed (IMP) vs. 8 x 60": 60" rest self-selected (SS) hight intensity interval exercise (HIIE)	1st session – assessment of VO_{2max} and peak power output, familiarisation session. 2nd – 8 x 60s bouts at 80%PPO separated by 60s of light pedaling at 10%PPO 3rd – 8 x 60s bouts at self-selected intensity	SS HIIE compared to IMP HIIE, promotes more positive affect.	They were encouraged to do as much work as they could during each bout and to pace themselves based on indices of breathing, leg pain, and overall fatigue Were given verbal cues to confirm that they modified the work rate properly and every 15 seconds were reminded of elapsed time of each bout.	Lower affect in $HIIE_{SS}$ vs. $HIIE_{IMP}$ with variability from FS0 to FS-5 and FS+4 to FS-4, respectively. 15% of participants reported lower enjoyment by >12 units in $HIIE_{SS}$ vs. $HIIE_{IMP}$.	None	None

Table 3 (continuation)
Descriptive characteristics of the studies and main outcomes.

Study	Exercise Mode	Exercise Protocol	Sessions	Exercise Intensity Manipulation Rational	Script	Outcomes		
						Affective	Cognitive	Behavioral
Lattari et al. (2016)	Aerobic SS vs. IMP	CON (without exercise); cycle ergometer 20-min prescribe exercise (PE) (50% PVO2max, 60rpm) and self-selected (SS) intensity session	1st session – anthropometric measures 2nd session – cycle ergometer self-selected or imposed	Better affective responses would be achieved after the SS exercise	SS subjects were free to choose load and rpm at any time	SS was more effective to induce positive changes in the affective state compared to CON and PE however with no significant affective difference between the PE and the CON condition.	None	None
Lind et al. (2005)	Aerobic	20-min treadmill exercise self-selected (SS) speed	1st Incremental treadmill test to volitional exhaustion 2nd A 20-min bout of treadmill exercise at a self-selected pace	SS speed would be associated with positive affect	The women were told that they were to engage in a 20-min bout of activity on the treadmill, during which they would be able to select the speed that they preferred. Note: Warm-up – 5 min at 4.0 km/h and 0% grade; they were allowed to adjust (faster or slower, but with the grade always fixed at 0%) every 5 min of the 20 min bout	Positive affect during the whole bout of SS intensity, from "neutral" to between "good" and "very good".	None	None
Monedero et al. (2017)	Aerobic SS vs. IMP	30-min treadmill running self-selected (SS), running at moderate intensity (MOD), entertainment-themed video game (ET-VG), and fitness-themed video game (FT-VG)	1st and 2nd visit – familiarization session. 3rd, 4th, 5th, and 6th – 4 trials: 30-min of running at a self-selected exercise intensity, running at a 55% VO_2 reserve moderate intensity, playing an entertainment-themed video game and playing a fitness themed video game	AVGs will results in more positive affect that conventional moderate exercise intensity	Select the speed of the treadmill for the first minute of every 5 min block while the gradient was kept constant at 1%. Select an intensity that they would be able to maintain for 30-min and were made aware that they could alter the speed every 5 min.	The AVG trials resulted in greatest affect states of all conditions. Entertainment-themed VG as the most enjoyable and experienced a higher state of flow. SS trial had significantly lower enjoyment than both AVG trials.	SS had lower psychological well-being than the ET-VG.	None
Oliveira et al. (2014)	Aerobic SS vs. IMP	Cycle ergometer "Game model" self-selected (SS) intensity vs. imposed (IMP) intensity (equivalent intensities and duration, mean 38.9 min)	Three exercise sessions on a cycle ergometer (incremental exercise test, self-selected and imposed)	SS exercise would elicit improved affective responses	"You should perform exercise of a continuous nature. The intensity and duration of the exercise will be defined by you and none of the training variables will be imposed on you in this exercise session." Note: participants were allowed to change the rear and/or front gears and the pedal cadence.	Feeling Scale (FS) showed no statistically significant interaction of effect for either condition. Exercise condition had no effect on affective responses. PACES scores between SS and IMP exercise were not statistically significant.	None	None

Table 3 (continuation)

Descriptive characteristics of the studies and main outcomes.

Study	Exercise Mode	Exercise Protocol	Sessions	Exercise Intensity Manipulation Rational	Script	Outcomes		
						Affective	Cognitive	Behavioral
Parfitt et al. (2000)	Aerobic SS vs. IMP	20-min treadmill SS and IMP (65% VO_2max)	1st session: pre-test SEES questionnaire and submaximal VO2 exercise test 2nd session: 7 days later participants were randomly assigned to preferred or the prescribed intensity exercise condition.	Positive well-being will be higher while psychological distress and fatigue will be lower in the preferred, compared to the prescribed, intensity exercise condition. Levels of interest-enjoyment and choice will be higher following the preferred exercise session than the prescribed condition.	Participants were given instructions to: 'select an intensity that you prefer that can be sustained for 20 minutes and that you would feel happy to do regularly'. The participants could change the intensity after 5,10 and 15 minutes if they wished so.	No difference in psychological affect or enjoyment between the two exercise sessions.	Greater choice was experienced in the preferred condition. Feelings of self-determination were reported following the preferred exercise session.	
Parfitt et al. (2006)	Aerobic SS vs. IMP	20-min treadmill walking above-lactate threshold, below-lactate threshold and self-selected (SS) intensity	1st familiarization session 2nd Incremental blood lactate test 3rd session acute bouts of aerobic exercise at: below-lactate, above-lactate, and self-selected intensity	SS condition would respond with more positive affective valence	'Select an intensity that you prefer that can be sustained for 20 minutes and that you would feel happy to do regularly' Note: Short warm-up, main part 20-min (they could change the intensity after 5, 10, and 15 minutes)	Valence was more positive during exercise in the below-lactate condition than the above-lactate condition and increased pre- to post-exercise. In the SS condition the majority reported an increase in affective valence.	SS condition promote competence/self-efficacy in the decisions made.	
Portugal et al. (2015)	Resistance SS vs. IMP	3 sets of 8 reps on machines: pull down, leg extension, chest press and leg curl at 40%, 60%, 80% 1RM, Self-selected (SS) and Control	6 visits to the laboratory 1st control session 2nd multiple 1RM test 3rd to 6th sessions strength exercises at three prescribed intensities (40,60 and 80% 1RM) and one self-selected intensity	The SS exercise intensity will evoke more positive affective responses than all prescribed exercise intensities	"You are free to choose the workload that you prefer to perform eight repetitions. After each set, you may change the workload."	SS intensity did not generate the most positive affective responses. SS, 40% 1RM, 60% 1RM and 80% 1RM generates similar affective responses. Only 80% 1RM generated negative affect.	None	None

Table 3 (continuation)
Descriptive characteristics of the studies and main outcomes.

Study	Exercise Mode	Exercise Protocol	Sessions	Exercise Intensity Manipulation Rational	Script	Outcomes		
						Affective	Cognitive	Behavioral
Rose & Parfitt (2007)	Aerobic SS vs. IMP	20-min treadmill below-LT, at-LT, above-LT, and self-selected (SS)	1st Familiarization session. Incremental blood lactate test, balke treadmill graded. 2nd Exercise session at each of the four intensities (below.LT, at-LT, above-LT, self-selected)	SS condition would result in the most positive affective responses	'Select an intensity that you prefer, that can be sustained for twenty minutes and that you would feel happy to do regularly". Note: could change intensity after 5,10 and 15 min if they so wished.	FS responses were more positive in the SS condition that in the above-LT and at-LT conditions, however the SS and at-LT intensities were not significantly different.	SS condition promotes positive perception of ability. Feeling in control and interpretation of the exercise intensity.	None
Rose & Parfitt (2008)	Aerobic	8 x 30 min treadmill, intensity: 4 sessions perceived to an FS value of 1 and 4 sessions to an FS value of 3	1st Familiarization session for FS and RPE scales and a maximal graded treadmill test. 2nd Eight 30-min sessions of treadmill (four at an FS+3 and four at an FS+1 intensity)	FS could be used to guide the self-regulation of exercise intensity	'You will be exercising on the treadmill for 30 min; we would like you to select a speed and gradient on the treadmill that will result in you feeling "good" (of "fairly good" depending on condition) so reporting an FS score of "3" (or "1") through the 30 min. You will have the opportunity to change the speed and the gradient every 5 min if you wish.'	Using FS facilitates the experience of a positive affective response from exercise. To achieve an affective state (AS) of good (FS3), individuals exercise at a lower intensity than to achieve an AS of fairly good (FS1).	Higher levels of perceived ability for exercise (30-min at an intensity that lay in the fairly good to good range on the FS).	None
Rose & Parfitt (2010)	Aerobic SS vs. IMP	30-min treadmill self-selected (SS) and imposed (IMP) intensity at VT	1st Maximal graded treadmill test 2nd Two 30 min bouts of treadmill exercise at VT, and self-selected intensity	Explore cognitive factors that influence affective responses to exercise (why affective responses to exercise of the same intensity differ between individuals)	'You will be exercising on the treadmill for 30 min, I would like you to select an intensity that you prefer and that you would consider doing regularly. You will have the opportunity to change the speed and the gradient every 5 min if you wish.'	Outcomes from doing exercise: feeling more awake, more relaxed, more invigorated, happier, energized (generally feeling better). During SS condition, affective responses were less positive when the women struggled to find an appropriate intensity. High-active and low-active experiencing enjoyment from doing exercise.	Perception of Ability – both groups described having an ability to cope. Focus of attention – both groups reported thinking about nothing. Achievement – sense of achievement in both groups.	None
Rose & Parfitt (2012)	Aerobic SS vs. IMP	30-min bouts of treadmill two conditions: imposed (IMP) vs. self-selected (SS) intensity	1st Maximal graded treadmill test 2nd Two 30 min bouts of treadmill exercise at VT, and self-selected intensity.	Affect would be more positive in the active group (without condition effect IMP vs. SS). Affect would be less variable in SS condition.	You will be exercising on the treadmill for 30-min, I would like you to select an intensity that you prefer and that you would consider doing regularly. You will have the opportunity to change the speed and the gradient every 5-min if you wish.	No differences in affective responses to the IMP and SS conditions. Active and sedentary women reported the same affective responses. Active women experienced more positive affect during exercise when SS condition was completed first.	Autonomy was higher in the SS compared with the IMP and self-efficacy and competence were higher for the active compared with the sedentary.	None

Table 3 (continuation)

Descriptive characteristics of the studies and main outcomes.

Study	Exercise Mode	Exercise Protocol	Sessions	Exercise Intensity Manipulation Rational	Script	Outcomes		
						Affective	Cognitive	Behavioral
Vazou-Ekkekakis & Ekkekakis (2009)	Aerobic SS vs. IMP	30-min bouts of treadmill two conditions: SS vs. IMP (Same intensity)	1st session – 30-min bout of treadmill SS 2nd session – 30-min bout of treadmill imposed	SS condition would report higher levels of self-determined motivation and more positive affect in comparison to the controlled condition.	Set the initial speed and to modify the speed to their liking (increase it or decrease it) every 5 min (the grade was kept at 0%)	Significant differences between the SS and IMP conditions for interest/enjoyment (higher in SS). Positive affect in both conditions.	Participants perceived the second condition (IMP) as more controlled (less autonomous). No differences in perceive competence and value/usefulness factors.	None
Waaso et al. (2022)	Aerobic	Two 30-min bouts of moderate-intensity treadmill (one interval and one continuous)	1st session – 30-min bout MIIT (moderate-intensity interval training) seven intervals 1-min of 15 RPE, and 2-min active recovery of 11 RPE 2nd session – 30-min bout MICT (moderate-intensity continuous training) RPE of 13 for 20-min	Self-selected moderate-intensity treadmill training (interval vs. continuous) promotes better enjoyment and self-efficacy	The target intensity for the 30 min trials was an RPE value of 13 ("somewhat hard"). Participants self-selected their treadmill speed and grade (i.e., workload) to match the targeted RPE value. However, they were blinded to the treadmill values (could not see speed and grade).	No significant differences between conditions for perceived enjoyment.	No significant differences between conditions for self-efficacy.	None
Williams & Raynor (2013)	Aerobic SS vs. IMP	One-third mile treadmill walking at imposed (IMP) 20% higher than SS, Yoked self-selected (YSS) same as SS but imposed by researchers and SS intensity	1st session pilot - familiarisation 2nd session – three one-third-mile treadmill walks (self-selected, yoked-self-selected, and imposed)	Affective valence would range from more to less pleasant across SS, Yoked and IMP intensity.	"While you are walking today, imagine that it is the first beautiful spring day, and you decide to take a walk outside. You are not walking for fitness, just for leisure, so you can go as fast or as slow as is comfortable for you." Participants were able to see the distance display but were not able to see displays for speed.	No differences in core affective valence in response to the three PA condition. No significant relationships between differences in affective response to and differences in preference for the different intensities.	None	None
Williams et al. (2016)	Aerobic SS vs. IMP	6-month exercise promotion programs Self-paced (but not exceed 76% maximum heart rate) and prescribed moderate intensity exercise (64-76% HRmax)	6-month print-based expert system exercise promotion program (self-paced	Self-paced exercise, relative to a prescribed moderate intensity exercise prescription, would result in more positive affective responses over the course of the 6-month program	We want you to select your own pace when walking for exercise. For safety and study purposes, we ask that you not exceed a heart rate of _____ (76% of age-predicted maximal HR).	Small effects of self-paced versus prescribed moderate intensity exercise on affective response during exercise. Effects of condition on pattern of affective response immediately postexercise were also small and15-min postexercise almost null.	None	Participants scoring one unit higher on the FS in response to exercise performed approximately 13-min of additional exercise at the next exercise session, with self-paced.

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Ekkekakis & Lind (2006) showed that an imposed intensity (10% higher than the self-selected) when compared to self-selected, in overweight women, reported higher levels of social physique anxiety. Also, when both protocols were used, the self-selected condition promoted competence and self-efficacy in the decisions made, positive perception of ability (confidence, ability to cope, and perceptions of competence), an improved interpretation of exercise intensity (negative/positive interpretation, challenge, and preference for exercise intensity), and better perceptions of control (regulation of exercise intensity, lack of control, being in control) (Parfitt et al., 2006; Rose & Parfitt, 2007; 2010), when compared to imposed modes of intensity delivery. Lower psychological well-being was found in one study where running was used as an exercise mode and contrasted with an entertainment-themed video game (Monedero et al., 2017).

Of the four studies with only self-selected exercise intensity, distinct cognitive variables were studied. Focht et al. (2009) reported that revitalization was higher, physical exhaustion lower, and positive engagement increased when comparing baseline versus during the activity (outdoor walking). In the Glen et al. (2017) work, dissociation during exercise was assessed and presented higher scores when performing cycle ergometer with exergaming. In the Rose & Parfitt (2008) study, higher levels of perceived ability for exercise were reported across trials when self-selecting exercise intensity was to be experienced between fairly good to good. Finally, in the Waaso et al. (2022) study, individuals reported no difference in self-efficacy during both self-selected intervals and continuous exercise.

Behavioral outcomes were studied in four of the 25 aerobic protocol studies. Of these, two studies developed self-selected and imposed conditions (Baldwin et al., 2016; Williams et al., 2016), and two others developed only self-selected prescriptions (Focht, 2009; Krinski et al., 2017). In all of these, exercise (in minutes) was studied as an outcome in two studies with self-selected versus imposed conditions. One study reported significant differences in physical activity minutes (in the first week), favoring the self-selected prescription (M = 203.04 min) when compared to imposed (heart rate) guided prescription (M = 184.51 min) (Baldwin et al., 2016). In the other study, participants in self-selected mode performed approximately 13 minutes of additional exercise, compared to the imposed condition, in a six-month exercise program (Williams et al., 2016).

As for the self-selected exercise intensity studies, two explorations were made regarding the future intention to be physically active. In both studies, participants reported above midpoint scores of future intentions to perform exercise (Focht, 2009; Krinski et al., 2017).

Resistance training – Protocol volume and intensity

In resistance training a varied range of %RM intensity were used (40% to 80%, and self-selected); from eight to ten repetitions; recovery time from one to two minutes between each set, and from two to three minutes between each exercise; all studies with three exercise sets (Focht et al., 2015; Portugal et al., 2015; Elsangedy et al., 2016; 2018a). Three studies used four machine exercises in their interventions (Focht et al., 2015; Portugal et al., 2015; Elsangedy et al., 2018a; 2016) used both machine and free weight exercises (four machines and three free weights).

Two studies compared self-selected with imposed intensity (Focht et al., 2015; Portugal et al., 2015), and two studies used self-selected intensity prescription (Elsangedy et al., 2016; 2018a). In the self-selected versus imposed intensity, the load ranged between 40% to 70%RM. In the self-selected intensity conditions, the load ranged between 37.4% RM and 83.2% RM (Elsangedy et al., 2018a) and 51.2% RM and 58.5% RM (Elsangedy et al., 2016).

Self-selected and imposed intensity associations with affective, cognitive, and behavioral outcomes in resistance exercise

Affective outcomes were present in all four studies, focused on the affective valence. Two studies developed self-selected versus imposed exercise intensities. Focht et al. (2015), compared self-selected and imposed exercise intensities in the same participants, and reported a more positive affective response for 40% 1RM and for the self-selected intensity conditions when compared with 70% 1RM. The other study, by Portugal et al. (2015), reported that similar affective responses were found between 40%, 60%, and 80% 1RM, and self-selected sessions.

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Nevertheless, the self-selection of intensity had the more positive affective valence scores, while the 80%RM session reached a negative score in the Leg Curl exercise. With self-selected intensity protocols, two studies demonstrated that self-selecting the load allowed the participants to experience a positive affective response (Elsangedy et al., 2016; 2018a).

Of the four resistance training studies selected, none explored associations with cognitive outcomes. Behavioural outcomes were presented in only one study (Focht et al., 2015) with self-selected intensity reporting higher intention for future resistance training practice when compared with imposed intensities.

DISCUSION

The present systematic review aimed to explore the relationship between self-selected exercise intensity and affective, cognitive, and behavioral outcomes in physical activity settings. Additionally, comparisons were made whenever study protocols used other forms of intensity prescription besides self-selection. A total of 29 studies met the inclusion criteria (aerobic n = 25; resistance training n = 4). Disparities in the number of study outcomes (i.e., variables) and high heterogeneity in study protocols precluded the possibility of other analytic explorations. Studies have focused mainly on affective outcomes (affective valence; enjoyment). Some explorations with behavioral (e.g., minutes of exercise) and cognitive (e.g., autonomy, ability, self-efficacy) were found, albeit in fewer studies. In general, the qualitative analysis results suggest that self-selection of exercise intensity may be a relevant approach in exercise prescription aiming to promote several positive outcomes, but more research is needed to assert further conclusions.

Affective, cognitive, and behavioral outcomes

In the affective outcomes, affective valence and enjoyment were the two main variables explored in research. The affective response results in aerobic training were ambiguous, as approximately half of the studies did not find any differences between conditions, and the other half found them favoring an improved affective response in the self-selection approach. This was clearer in resistance training, where all studies, albeit with a considerably lower number (n = 4), found self-selection to be related to a better affective response. This assessment was made with the FS, an instrument usually used for this purpose. However, previous reviews have highlighted several potential issues with the methodological approach for assessing affective valence (e.g., selecting the timing of assessment) (Bastos et al., in review; Evmenenko & Teixeira, 2020; Henriques & Teixeira, 2023), which can lead to substantially different affective results. Additionally, the affective response is highly dependent of exercise intensity, in which higher intensities may promote an affective rebound after the termination of the exercises (Ekkekakis et al., 2011), but that is not necessarily present in lower intensities (Henriques et al., in review), which once again highlights that the timing of assessment (e.g., during the activity, experiencing the exercise intensity vs. after the activity) may justify differences in the results obtained. As for the resistance training, Andrade et al. (2022) showed that within the 60% to 90% of 1RM the rebound effect could be smaller or even inexistent, thus possibly justifying why the four studies included in this review clearly favor the self-selection approach for an improved affective response. All in all, there seems to be some suggestions that self-selected intensity could have a potential use to improve the exercise affective response. As for enjoyment, studied only in aerobic activities, mixed results could be observed. Two studies found improved enjoyment on the imposed condition, two studies did not found differences between conditions, and one study found differences favoring self-selection. One factor that may justify these differences was the way the construct was evaluated. This variable was assessed mainly with two instruments, the PACES, and the interest/enjoyment subscale of the IMI, which are grounded in different theoretical underpinnings. For example, PACES is organized to be answered on a bipolar Likert scale, whereas the IMI uses a unipolar Likert scale. This would indicate that when responding to the PACES, an exerciser could, for example, dislike the activity, something that the IMI subscale does not allow. Second, the interest/enjoyment subscale is proposed to be a direct indicator of intrinsic motivation (in IMI; McAuley et al., 1989) which conceptually is part, but not the whole, of what is intrinsic motivation (doing an activity for its inherent satisfaction and independently

of other separable outcomes; Ryan & Deci, 2017). These are some reasons that may account for some of the disparities in the results. However, and probably the most relevant factor, enjoyment was assessed in very distinct situations (e.g., exergames vs. regular cycle-ergometer exercise), in which comparisons would be heavily biased towards, for example, novelty, effort/exercise dissociation, and ludic components. These, although relevant for future understanding of how to promote enjoyable sessions, do not allow a proper understanding if it was the self-selection or imposed approach that elicited a better enjoyment perception in the participants. Also noticeable is the absence of other affective or emotional variables, as they have been suggested in the literature to have an interest in the understanding of exercise behavior (e.g., anticipated affective response; affective recall), which could be dependent of exercise intensity (Stevens et al., 2020).

Fewer studies have focused on cognitive outcomes, and they were all the aerobic type (n = 12). Distinct approaches were used, focused on several outcomes, but mainly on autonomy, competence/self-efficacy, competence/control, ability, and focus of attention. Intensity self-selection approaches, when contrasted with an imposed intensity, seemed to elicit improved results in all these variables; studies with only self-selection showed higher scores in pre- to during or post-exercise measures in revitalization, engagement, dissociation, and perceived ability. Generally, and albeit with a lower number of studies and more disparities in the studied variables, some support for the relevance of self-selecting exercise intensity was found. It is known that most of these outcomes have been linked in previous studies with, for example, exercise adherence (e.g., Rhodes et al., 2017; Rhodes & Sui, 2021; Vlachopoulos & Neikou, 2007; Whaley & Schrider, 2005), and thus exercise intensity self-selection may contribute for this endeavor.

Finally, behavioral variables/outcomes were studied only in five studies. The aerobic studies (n=2) focused on the exercise minutes performed. In the self-selected versus imposed conditions, the first condition presented higher total minutes of exercise practice in post-exercise assessments (e.g., one week; six months); also, when using the self-selection method, intentions to be physically active in the future (a proxy for exercise behavior engagement) depicted above midpoint scores. This was also seen in the only resistance training study that compared using self-selected exercise intensity and imposed ones. The authors verified that intention to perform resistance training was higher in the self-selecting versus lower and higher %RM groups.

The small number of explorations on behavioral outcomes tend to suggest that self-selecting exercise intensity may contribute to the exercise behavior, but results must be interpreted with caution due to the limited exploration of these variables (e.g., frequency, attendance, maintenance, dropout), the limited number of studies, the nature of the intention variable (cognitive in nature, although a proxy of exercise behavior) (Sniehotta et al., 2009; Rhodes & Rebar, 2017), and the gap existing between intention and actually performing the behavior (i.e., the intention-behavior gap) (Englert et al., 2023; Rhodes et al., 2021).

Intensity self-selection method disparities

The studies included in this review showed that self-selecting exercise intensity could be made in a wide variety of ways, and thus must be analyzed with caution for adequate interpretations and applications. For example, some studies asked the participants to "select the speed that you prefer" (Ekkekakis & Lind, 2006; Lind et al., 2005), while others asked to "select an intensity that you prefer that can be sustained for 20-min and that you would feel happy to do regularly" (DaSilva et al. 2011; Parfitt et al., 2006; Rose & Parfitt, 2007). Others used the FS to self-regulate intensity, "select a speed that will result in you feeling "good" (or "fairly good" depending on condition) so reporting an FS score of "3" (or "1")" (Rose & Parfitt, 2008) or "participants were instructed to aim to work at an intensity which reflected FS+3 (good)" (Hamlyn-Williamns et al., 2015) and "exercise at an intensity that felt pleasant at or above 0 on the FS" (Baldwin et al., 2016). This variability of the self-selection method is expected to have consequences on how the different outcomes may be experienced.

Physiologically, and as seen in Parfitt et al. (2006) and Lind et al. (2008), when exercisers self-select the aerobic exercise intensity, they tend to choose an intensity near to the one proposed by the ACSM (2021) to elicit development and maintenance of

cardiovascular fitness. In resistance training, self-selecting exercise intensity in sedentary individuals presents a % RM close to the recommended by this entity (Elsangedy et al., 2016); as for active or recreationally trained individuals, their %RM selection may be beneath the general recommendations (Focht et al., 2015; Portugal et al., 2015), although the ACSM (2021) indicate that a wide range of % RM can be used in combination with other training control variables for that purpose. Additionally, intention for future exercise was always high when using self-selection methods. These results tend to suggest that promoting self-selection of exercise intensity may be useful to promote health gains without compromising physiological adaptations, mainly in the most prone-to-dropout participants – the novice exercisers.

Psychologically, the panorama may be substantially different. Allowing to self-select intensity in a given intensity range (e.g., select the speed within the moderate intensity range; allowing to self-pace a walking bout (but excluding the possibility of someone, if wanted, to run)) is different from just allowing to freely self-select, and differences may occur in the sense of choice, control and, consequently, autonomy, given that the participants may perceive to be able to only partially self-regulate the activity. This may be also reflected when given the possibility to self-select the intensity at some time point, but not to continuously self-regulate it, a difference that is expected to favor several outcomes in the latter method (Da Silva et al. 2011; Elsangedy et al., 2018b). On another example, allowing to self-select an intensity or asking to self-select an intensity that is pleasurable is another possible approach. As stated by Zenko et al. (2017) and Teixeira et al. (2023), targeting pleasure-oriented self-regulation is different from just self-regulate intensity. As expected, and seen in the results, distinct affective (valence) results were obtained when intensity selection was focused on pleasurable responses. This may be seen in future efforts to further enhance and use the positive influence of hedonic approaches to exercise adherence. All in all, the extent of these nuances in the methods used is not yet fully clear but holds promise for future efforts on exercise adherence study.

Study limitations and future directions

During the analysis of the studies, some limitations that might influence the interpretation of the results should be acknowledged. Overall, the included literature is tarnished by several small sample studies (25 studies had a sample size < 35 participants), which may not be powered to detect small or medium-sized relationships among intensity definition methods and key outcomes. Moreover, 21 studies did not report effect sizes, or only reported these in relation to statistically significant findings, an approach that does not align with recommendations for research practices in experimental approaches (Lakens, 2013).

On more specific issues, the categorization of some variables may not be clear-cut. One example is the variable intention, which literature has defined sometimes as being of cognitive nature, and others as a behavior outcome (Rhodes & Rebar, 2017). Although we posited that intention is a close related variable for exercise behavior, other interpretations could exist. Nonetheless, the categorization in this review would not change the direction of the results, and thus can be interpreted safely given this assumption.

Finally, it must be noticed that no study involving stretching exercises or flexibility development was found. Considering that it is one of the most prescribed modes of exercise and is based on several activities and classes (e.g., Yoga), future efforts are in need to assert if the same trend of results identified in aerobic and resistance exercise is present.

CONCLUSIONS

In conclusion, using intensity self-selection methods may present benefits in distinct affective, cognitive, and behavioral outcomes. Our results suggest that intensity self-selection may promote improved affective responses, autonomy perceptions, self-efficacy, intention to be physically active, and more minutes of exercise participation. However, methodological disparities in the way self-selection were promoted, as for heterogeneity in exercise protocols and participant characteristics, warrant caution on these interpretations. Future research efforts are needed to better explore the multitude of methods of self-selecting/regulating exercise intensity and respective outcomes.

APLICACIONES PRÁCTICAS

When aiming to improve exercise adherence, targeting individual needs and personal characteristics are paramount, and exercise intensity can be a key aspect for that endeavor. Providing the ability to self-select intensity, framed by the exerciser needs, goals and possibilities of action, can increase the perception of control, autonomy, and self-efficacy, relevant to the support of behavior in an autonomous way. Thus, exercise professionals targeting exercise adherence can adjust their interventions in a simple and cost-free solution that may help bolster exercise behavior.

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Appendix 1

Sample MEDLINE search strategy

Description	Search terms
Physical:	"physical examination"[MeSH Terms] OR ("physical"[All Fields] AND "examination"[All Fields]) OR "physical examination"[All Fields] OR "physical"[All Fields] OR "physically"[All Fields] OR "physicals"[All Fields]
Exercise:	"exercise"[MeSH Terms] OR "exercise"[All Fields] OR "exercises"[All Fields] OR "exercise therapy"[MeSH Terms] OR ("exercise"[All Fields] AND "therapy"[All Fields]) OR "exercise therapy"[All Fields] OR "exercise's"[All Fields] OR "exercised"[All Fields] OR "exerciser"[All Fields] OR "exercisers"[All Fields] OR "exercising"[All Fields]
Activity:	"activable"[All Fields] OR "activate"[All Fields] OR "activated"[All Fields] OR "activates"[All Fields] OR "activating"[All Fields] OR "activation"[All Fields] OR "activations"[All Fields] OR "activator"[All Fields] OR "activator's"[All Fields] OR "activators"[All Fields] OR "active"[All Fields] OR "actived"[All Fields] OR "actively"[All Fields] OR "actives"[All Fields] OR "activities"[All Fields] OR "activity's"[All Fields] OR "activitys"[All Fields] OR "motor activity"[MeSH Terms] OR ("motor"[All Fields] AND "activity"[All Fields]) OR "motor activity"[All Fields] OR "activity"[All Fields]
Self:	"ego"[MeSH Terms] OR "ego"[All Fields] OR "self"[All Fields]
Pace:	"Pacing Clin Electrophysiol"[Journal: __jid7803944] OR "pace"[All Fields]
Paced:	"paced"[All Fields] OR "paces"[All Fields] OR "pacing"[All Fields] OR "pacings"[All Fields]
Self-regulation:	"self-control"[MeSH Terms] OR "self-control"[All Fields] OR ("self"[All Fields] AND "regulation"[All Fields]) OR "self-regulation"[All Fields]
Regulation:	"legislation and jurisprudence"[Subheading] OR ("legislation"[All Fields] AND "jurisprudence"[All Fields]) OR "legislation and jurisprudence"[All Fields] OR "regulations"[All Fields] OR "social control, formal"[MeSH Terms] OR ("social"[All Fields] AND "control"[All Fields] AND "formal"[All Fields]) OR "formal social control"[All Fields] OR "regulate"[All Fields] OR "regulates"[All Fields] OR "regulating"[All Fields] OR "regulation's"[All Fields] OR "regulative"[All Fields] OR "regulator"[All Fields] OR "regulator's"[All Fields] OR "regulators"[All Fields] OR "regulated"[All Fields] OR "regulation"[All Fields]
Regulated:	"legislation and jurisprudence"[Subheading] OR ("legislation"[All Fields] AND "jurisprudence"[All Fields]) OR "legislation and jurisprudence"[All Fields] OR "regulations"[All Fields] OR "social control, formal"[MeSH Terms] OR ("social"[All Fields] AND "control"[All Fields] AND "formal"[All Fields]) OR "formal social control"[All Fields] OR "regulate"[All Fields] OR "regulates"[All Fields] OR "regulating"[All Fields] OR "regulation's"[All Fields] OR "regulative"[All Fields] OR "regulator"[All Fields] OR "regulator's"[All Fields] OR "regulators"[All Fields] OR "regulated"[All Fields] OR "regulation"[All Fields]
Selected	"select"[All Fields] OR "selectability"[All Fields] OR "selectable"[All Fields] OR "selected"[All Fields] OR "selecting"[All Fields] OR "selection's"[All Fields] OR "selection, genetic"[MeSH Terms] OR ("selection"[All Fields] AND "genetic"[All Fields]) OR "genetic selection"[All Fields] OR "selection"[All Fields] OR "selectional"[All Fields] OR "selections"[All Fields] OR "selective"[All Fields] OR "selectively"[All Fields] OR "selectives"[All Fields] OR "selectivities"[All Fields] OR "selectivity"[All Fields] OR "selects"[All Fields]
Selection	"select"[All Fields] OR "selectability"[All Fields] OR "selectable"[All Fields] OR "selected"[All Fields] OR "selecting"[All Fields] OR "selection's"[All Fields] OR "selection, genetic"[MeSH Terms] OR ("selection"[All Fields] AND "genetic"[All Fields]) OR "genetic selection"[All Fields] OR "selection"[All Fields] OR "selectional"[All Fields] OR "selections"[All Fields] OR "selective"[All Fields] OR "selectively"[All Fields] OR "selectives"[All Fields] OR "selectivities"[All Fields] OR "selectivity"[All Fields] OR "selects"[All Fields]
Select	"select"[All Fields] OR "selectability"[All Fields] OR "selectable"[All Fields] OR

	"selected"[All Fields] OR "selecting"[All Fields] OR "selection's"[All Fields] OR "selection, genetic"[MeSH Terms] OR ("selection"[All Fields] AND "genetic"[All Fields]) OR "genetic selection"[All Fields] OR "selection"[All Fields] OR "selectional"[All Fields] OR "selections"[All Fields] OR "selective"[All Fields] OR "selectively"[All Fields] OR "selectives"[All Fields] OR "selectivities"[All Fields] OR "selectivity"[All Fields] OR "selects"[All Fields]
Intensity	"intense"[All Fields] OR "intensely"[All Fields] OR "intensities"[All Fields] OR "intensity"[All Fields] OR "intensively"[All Fields]
Effort	"effort"[All Fields] OR "efforts"[All Fields]
Exertion	"exertion"[All Fields] OR "exertional"[All Fields] OR "exertions"[All Fields]
Activation	"activable"[All Fields] OR "activate"[All Fields] OR "activated"[All Fields] OR "activates"[All Fields] OR "activating"[All Fields] OR "activation"[All Fields] OR "activations"[All Fields] OR "activator"[All Fields] OR "activator's"[All Fields] OR "activators"[All Fields] OR "active"[All Fields] OR "actived"[All Fields] OR "actively"[All Fields] OR "actives"[All Fields] OR "activities"[All Fields] OR "activity's"[All Fields] OR "activitys"[All Fields] OR "motor activity"[MeSH Terms] OR ("motor"[All Fields] AND "activity"[All Fields]) OR "motor activity"[All Fields] OR "activity"[All Fields]
Arousal	"arousability"[All Fields] OR "arousable"[All Fields] OR "arousal"[MeSH Terms] OR "arousal"[All Fields] OR "arousals"[All Fields] OR "arousal's"[All Fields] OR "arouse"[All Fields] OR "arouses"[All Fields] OR "wakefulness"[MeSH Terms] OR "wakefulness"[All Fields] OR "aroused"[All Fields] OR "arousing"[All Fields]
Tolerance	"immune tolerance"[MeSH Terms] OR ("immune"[All Fields] AND "tolerance"[All Fields]) OR "immune tolerance"[All Fields] OR "tolerance"[All Fields] OR "drug tolerance"[MeSH Terms] OR ("drug"[All Fields] AND "tolerance"[All Fields]) OR "drug tolerance"[All Fields] OR "tolerabilities"[All Fields] OR "tolerability"[All Fields] OR "tolerable"[All Fields] OR "tolerableness"[All Fields] OR "tolerably"[All Fields] OR "tolerances"[All Fields] OR "tolerant"[All Fields] OR "tolerants"[All Fields] OR "tolerate"[All Fields] OR "tolerated"[All Fields] OR "tolerates"[All Fields] OR "tolerating"[All Fields] OR "toleration"[All Fields] OR "tolerator"[All Fields] OR "tolerators"[All Fields] OR "tolerence"[All Fields]
Preference	"prefer"[All Fields] OR "preferable"[All Fields] OR "preferably"[All Fields] OR "prefered"[All Fields] OR "preference"[All Fields] OR "preferences"[All Fields] OR "preferred"[All Fields] OR "preferring"[All Fields] OR "prefers"[All Fields]
Tolerated	"immune tolerance"[MeSH Terms] OR ("immune"[All Fields] AND "tolerance"[All Fields]) OR "immune tolerance"[All Fields] OR "tolerance"[All Fields] OR "drug tolerance"[MeSH Terms] OR ("drug"[All Fields] AND "tolerance"[All Fields]) OR "drug tolerance"[All Fields] OR "tolerabilities"[All Fields] OR "tolerability"[All Fields] OR "tolerable"[All Fields] OR "tolerableness"[All Fields] OR "tolerably"[All Fields] OR "tolerances"[All Fields] OR "tolerant"[All Fields] OR "tolerants"[All Fields] OR "tolerate"[All Fields] OR "tolerated"[All Fields] OR "tolerates"[All Fields] OR "tolerating"[All Fields] OR "toleration"[All Fields] OR "tolerator"[All Fields] OR "tolerators"[All Fields] OR "tolerence"[All Fields]
Preferred	"prefer"[All Fields] OR "preferable"[All Fields] OR "preferably"[All Fields] OR "prefered"[All Fields] OR "preference"[All Fields] OR "preferences"[All Fields] OR "preferred"[All Fields] OR "preferring"[All Fields] OR "prefers"[All Fields]
Cognitive	"cognition"[MeSH Terms] OR "cognition"[All Fields] OR "cognitions"[All Fields] OR "cognitive"[All Fields] OR "cognitively"[All Fields] OR "cognitives"[All Fields]
Behavioral	"behavior"[MeSH Terms] OR "behavior"[All Fields] OR "behavioral"[All Fields] OR "behavioural"[All Fields] OR "behavior's"[All Fields] OR "behaviorally"[All Fields] OR "behaviour"[All Fields] OR "behaviourally"[All Fields] OR "behaviours"[All Fields] OR "behaviors"[All Fields] OR "pattern"[All Fields] OR "pattern's"[All Fields] OR "patternability"[All Fields] OR "patternable"[All Fields] OR "patterned"[All Fields] OR "patterning"[All Fields] OR "patternings"[All Fields] OR "patterns"[All Fields]
Affective	"affect's"[All Fields] OR "affectional"[All Fields] OR "affective"[All Fields] OR "affectively"[All Fields] OR "affectives"[All Fields] OR "affectivity"[All Fields]
Emotional	"emoting"[All Fields] OR "emotion's"[All Fields] OR "emotions"[MeSH Terms] OR "emotions"[All Fields] OR "emotion"[All Fields] OR "emotional"[All Fields] OR "emotive"[All Fields]
Cancer	"cancer's"[All Fields] OR "cancerated"[All Fields] OR "canceration"[All Fields] OR "cancerization"[All Fields] OR "cancerized"[All Fields] OR "cancerous"[All Fields] OR "neoplasms"[MeSH Terms] OR "neoplasms"[All Fields] OR "cancer"[All Fields] OR "cancers"[All Fields]
Disease	"disease"[MeSH Terms] OR "disease"[All Fields] OR "diseases"[All Fields] OR "disease's"[All Fields] OR "diseased"[All Fields]
Fibromyalgia	"fibromyalgia"[MeSH Terms] OR "fibromyalgia"[All Fields] OR "fibromyalgias"[All Fields]

Depression	"depressed"[All Fields] OR "depression"[MeSH Terms] OR "depression"[All Fields] OR "depressions"[All Fields] OR "depression's"[All Fields] OR "depressive disorder"[MeSH Terms] OR ("depressive"[All Fields] AND "disorder"[All Fields]) OR "depressive disorder"[All Fields] OR "depressivity"[All Fields] OR "depressive"[All Fields] OR "depressively"[All Fields] OR "depressiveness"[All Fields] OR "depressives"[All Fields]
Diet	"diet"[MeSH Terms] OR "diet"[All Fields]
Hypertensive	"hypertense"[All Fields] OR "hypertension"[MeSH Terms] OR "hypertension"[All Fields] OR "hypertension's"[All Fields] OR "hypertensions"[All Fields] OR "hypertensive"[All Fields] OR "hypertensive's"[All Fields] OR "hypertensives"[All Fields]
Pain	"pain"[MeSH Terms] OR "pain"[All Fields]

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