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The impact of music listening during exercise on physical performance and perceived exertion – a narrative review

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Abstract

Background. Music is commonly used during exercise, but its effects on performance and perceived exertion vary across tasks, intensities, and music-selection strategies.

Aim. To critically review evidence on the effects of music listened to during exercise on physical performance and ratings of perceived exertion (RPE), in terms of mechanisms and moderators.

Material and methods. A narrative review was constructed using a combination of systematic reviews, meta-analyses, and controlled primary studies addressing in-task music, exercise performance, RPE, physiological responses, preference, tempo, and synchronization. Analysis of the evidence was based on study design, the specific nature of the outcomes, and methodological consistency.

Results. Meta-analytic evidence indicates small-to-moderate improvements in performance and modest reductions in RPE. Effects are more consistent for affective and perceptual responses than for heart rate or other physiological variables. Preferred music, synchronization, exercise modality, and task intensity modify outcomes. High-intensity and highly trained contexts show less uniform effects.

Conclusions. Music is a low-cost ergogenic and psychophysical aid, but its benefits are conditional rather than universal. Personalized, task-compatible music appears most defensible.

Key words: music; exercise; athletic performance; perceived exertion; fatigue; endurance; resistance exercise

Introduction

Music is commonly used during recreational exercise and athletic training. Unlike pharmacological or nutritional ergogenic aids, it acts predominantly through perceptual, affective, attentional, and motor processes, yet these processes can modify externally observable exercise behaviour. The fundamental scientific question is not simply whether music "works," but which outcomes it changes, under which exercise conditions, and to what extent. An exerciser may sustain a workload longer without reporting lower exertion, may experience an unchanged workload as easier, or may voluntarily produce more work while experiencing the same or even greater exertion. These responses represent different forms of benefit and should not be treated as equivalent. The comprehensive quantitative synthesis in this field, involving 139 studies and 3,599 participants, showed

beneficial effects of music on affective valence, physical performance, perceived exertion, and oxygen consumption, but not heart rate [1]. Theoretical explanations for these effects have evolved past a basic distraction model. During exercise, the central nervous system must process interoceptive signals resulting from respiratory strain, muscular discomfort, thermal stress, and other somatic cues while simultaneously processing environmental information. Music can compete for limited attentional resources and redirect attention from unpleasant bodily sensations, especially during low-to-moderate-intensity exercise [2,3]. Music may also influence exercise through rhythm, emotional response, familiarity, and motivational relevance. These factors can alter arousal and attentional focus independently of tempo. Pieces matched for tempo can generate different exercise responses if their personal relevance differs, while the same piece may function differently during running, cycling, or resistance exercise. Rating of perceived exertion (RPE) occupies a particularly important position in this literature because it represents the conscious integration of physiological and psychological information about exercise demand. A reduction in RPE does not necessarily indicate lower physiological strain. If music encourages an exerciser to increase self-selected work, heart rate, oxygen uptake, or total energy expenditure may rise while subjective effort remains unchanged. In contrast, when external workload is experimentally fixed, lower RPE may be a psychophysical benefit without any performance difference. This is a crucial distinction when comparing fixed-intensity laboratory experiments with self-paced time trials, time-to-exhaustion protocols, repeated sprints, or resistance sets performed to failure. The evidence base has expanded since the influential two-part synthesis by Karageorghis and Priest [2,3]. Meta-analyses now allow the estimation of average effects, and recent reviews have focused on aerobic exercise, music preference, and participant choice [4-6]. Substantial heterogeneity remains. Exercise intensity and duration, training status, task type, self-selected music, tempo, beat-movement synchronization, and whether work is externally prescribed or self-paced may all influence the response. Physiological and neurocognitive studies recently reported that endurance improvement can arise through greater tolerance of internal load rather than reduced metabolic demand, whereas cortical experiments indicate that music can modify attentional processing during fatiguing exercise [25-29]. The timing of music exposure may influence its effects. Studies of pre-task music support this possibility, although pre-task listening represents a different intervention from music used during exercise [7]. The aim of this narrative review is to evaluate the effect of listening to music during exercise on physical performance and perceived exertion. Particular attention is given to the magnitude and consistency of performance and RPE effects, circumstances in which these outcomes vary, the moderating roles of preference, tempo, synchronization, intensity and exercise modality, and the plausibility of proposed physiological and neurocognitive mechanisms.

Research Materials and Methods

This narrative review was prepared from targeted literature retrieval performed in September 2026. Searches were directed toward PubMed-indexed records, PubMed Central full texts, and publisher-hosted articles. Search concepts combined terms relating to music with exercise, physical or athletic performance, rating of perceived exertion, fatigue, endurance, cycling, running, resistance exercise, strength, music preference, self-selection, tempo, synchronization, attention, and neurophysiology. Reference lists and citations contained in major reviews and meta-analyses were also used to identify influential controlled primary studies. Priority was assigned to systematic reviews and meta-analyses for assessing overall effect sizes and consistency, and to controlled

primary studies when reporting task-specific or quantitative results. Interpretation considered participant training status, exercise modality and intensity, music-selection procedure, comparator condition, and whether the measured outcome represented performance, perceived exertion, affect, or a physiological correlate. Because the present work is a narrative rather than a prospectively registered systematic review, no PRISMA flow diagram, exhaustive record count, duplicate independent screening procedure, formal risk-of-bias instrument, or de novo quantitative pooling was performed.

Results

Overall magnitude and consistency of music effects

The multilevel meta-analysis by Terry et al. provides the most extensive quantitative overview across exercise and sport [1]. Although this synthesis included pre-task, in-task, and post-task music interventions, it provides the broadest quantitative overview available. Across 598 effect sizes, music was associated with improved physical performance (Hedges' g=0.31, 95% CI 0.25–0.36) and lower perceived exertion (g=0.22, 95% CI 0.14–0.30). The effect was larger for affective valence (g=0.48, 95% CI 0.39–0.56), whereas the effect on oxygen consumption was small (g=0.15, 95% CI 0.02–0.27). There was no significant change in heart rate (g=0.07, 95% CI −0.03 to 0.16). Performance effects were greater in exercise than sport contexts and with fast rather than slow-to-medium music. A 2026 systematic review and meta-analysis restricted to aerobic exercise in physically active adults reached a similar but more cautious conclusion [4]. Fifteen studies involving 339 participants demonstrated better fixed-duration aerobic performance with music (standardized mean difference [SMD]=0.39, 95% CI 0.08–0.70; I^2=30%), although certainty of evidence was rated low. The primary pooled effect for time to exhaustion was considerably larger (SMD=1.89, 95% CI 0.44–3.33) but highly heterogeneous (I^2=95%). After removal of an influential outlier, the estimate decreased to SMD=0.31 (95% CI 0.02–0.60; I^2=8%). RPE was reduced (SMD=−0.36, 95% CI −0.67 to −0.04; I^2=0%) with moderate certainty, whereas heart rate did not change significantly (mean difference −1.16 beats/min, 95% CI −3.57 to 1.26). Reduced perceived exertion was more stable than the estimated endurance or physiological effects.

Perceived exertion, attentional dissociation, and workload

Potteiger et al. studied 27 physically active adults during 20 minutes of cycling at 70% of peak oxygen uptake under fast upbeat, classical, self-selected, and no-music conditions [8]. Heart rate was similar among conditions, while peripheral, central, and overall RPE were lower with each form of music than without music. Nethery reported a similar pattern in 13 untrained men exercising at 50% and 80% of peak oxygen uptake: music reduced RPE at both workloads, while heart rate did not differ among sensory conditions [9]. One possible explanation is that music shifts attention away from exercise-related sensations even when the workload itself does not change. The effect of intensity is more complicated than a strict threshold after which music becomes ineffective. Previous syntheses suggested that the dissociative influence of music diminishes as exercise intensity rises because increasingly strong interoceptive cues dominate attention [2,3]. Chow and Etnier examined healthy men during 20 minutes of cycling at 125% of ventilatory threshold and observed lower perceived exertion and greater

dissociation when music was combined with video, whereas music alone was less effective [17]. Interpretation becomes more difficult when exercise intensity is self-selected. Atkinson et al. reported that 16 participants completed a 10-km cycling time trial faster with music than without it (1030±79 vs 1052±77 seconds), while RPE was approximately 0.8 units higher in the music condition [10]. Differences in speed and heart rate were most evident in the early stages of the trial, suggesting that music changed pacing behavior rather than simply making an identical workload feel easier. The recent study by Danso et al. demonstrates a related but distinct dissociation [25]. Twenty-nine recreationally active adults completed counterbalanced cycling trials to exhaustion at approximately 80% of peak power output with self-selected music of 120–140 beats/min or without music. Time to exhaustion increased from 29.80±11.47 to 35.61±14.01 minutes, corresponding to an approximately 19.5% longer effort. Total cardiovascular and energetic exposure was greater, yet terminal RPE, heart rate, oxygen uptake, and lactate were similar. This pattern suggests that music may have helped participants tolerate the workload for longer rather than reducing its physiological cost.

Endurance performance and auditory-motor synchronization

Endurance exercise provides particularly favourable conditions for music-related effects because continuous rhythmic movement can interact with an auditory beat. Karageorghis et al. compared motivational synchronous music, neutral synchronous music, and no music during treadmill walking to exhaustion at 75% heart-rate reserve [11]. Both music conditions increased endurance, with a larger benefit from motivational music, and affect was more positive. In 11 elite triathletes, Terry et al. subsequently observed approximately 18–20% longer treadmill running time to exhaustion with synchronous motivational or neutral music compared with no music; small improvements in running economy were also reported [12]. Synchronization itself may contribute independently of musical preference. Bacon et al. found lower oxygen consumption during synchronous music than during slower asynchronous music in 10 untrained men performing submaximal cycling, despite similar heart rate and RPE [13]. Bood et al. compared synchronous motivational music, a synchronized metronome, and control during treadmill running to exhaustion [14]. Both acoustic pacing conditions prolonged performance relative to control, without a clear performance advantage of music over the metronome. Regular auditory cues may help organize repetitive movement even without the motivational qualities of music. Endurance findings are not uniformly positive. Hagen et al. observed essentially identical 10-km cycling time-trial performance, average power, peak heart rate, blood lactate, and final RPE with and without music in well-trained cyclists [15]. Bigliassi et al. found that motivational music influenced early pacing during a 5-km run in trained runners, but much of the effect was concentrated in the initial segment [16]. Task familiarity, competitive experience, pacing skill, and the structure of the performance test may attenuate or redistribute music effects.

Resistance exercise, muscular endurance, and power

Evidence from resistance and anaerobic exercise is less homogeneous because tasks are shorter and outcomes range from maximal force to repetitions to failure, power, movement velocity, and isokinetic torque. Biagini et al. studied 20 resistance-trained men and found that self-selected music improved several explosive squat-jump variables but did not increase bench-press repetitions to failure; squat-jump RPE was modestly lower with music

[18]. During repeated Wingate tests, Ballmann et al. found no significant performance advantage of preferred over non-preferred music in 14 men, even though preferred music increased motivation and reduced RPE [19]. Preference may be more consequential for strength-endurance than for pure maximal strength. In resistance-trained men, preferred music increased bench-press repetitions performed at 75% of one-repetition maximum and improved velocity and power during the first repetitions relative to non-preferred music [20]. Silva et al. reported higher handgrip maximal strength and more lat-pulldown repetitions, together with lower RPE, when young men listened to a preferred music genre rather than non-preferred music or no music [21]. Recent evidence extends these observations to a multi-exercise resistance session. Vinovrski et al. studied 19 resistance-trained men and women using a counterbalanced crossover design with three sets to failure of the squat, bench press, deadlift, and bent-over row [24]. Self-selected music increased repetitions in the squat and deadlift compared with non-preferred music and maintained motivation and enjoyment more effectively, while heart rate, muscle oxygenation, muscle activation, and ventilation did not differ. The investigators detected no sex-related effects, but the sample was too small for this absence to establish physiological equivalence between sexes. Other resistance studies temper the apparent advantage. Feiss et al. found that music could prolong a dissociative attentional state during an isometric task but did not consistently modify RPE, heart rate, time to exhaustion, or affect [22]. Svoboda and Kostrna observed improved knee-extension torque with music in resistance-trained young adults but no benefit for knee flexion and no effect of music tempo on the measured psychological outcomes [23]. Current evidence does not justify the broad statement that music increases "strength."

Preference, participant choice, and tempo

The growing literature on preference offers a plausible explanation for conflicting results from studies prescribing identical tracks to all participants. A systematic review and meta-analysis of 41 studies found that preferred music reduced RPE (SMD=−0.36, 95% CI −0.65 to −0.08), increased motivation (SMD=0.85, 95% CI 0.60–1.10), and improved affective response (SMD=1.16, 95% CI 0.13–2.20) relative to non-preferred or no-music comparators [5]. Physical effects favored preferred music for strength-endurance (SMD=0.72), maximal strength (SMD=0.53), and power (SMD=0.47), but no overall advantage was identified for speed or aerobic endurance. Considerable heterogeneity for several outcomes means that these estimates describe average effects, not gains that should be expected in every individual. A 2026 scoping review of 32 studies identified affect, arousal, motivation, and perceived exertion as prominent responses to self-selected or preferred music, while performance effects were more evident for aerobic endurance, anaerobic power, and muscular endurance than for maximal strength [6]. Preference is not merely a methodological nuisance. It incorporates familiarity, reward expectation, emotional association, identity, and perceived task suitability, none of which is reproduced reliably by prescribing tempo alone. Self-selection introduces confounding because preferred tracks may differ simultaneously in tempo, genre, lyrics, loudness, and emotional meaning. Tempo may matter, although its effect is not consistent across exercise types. Terry et al. identified larger performance effects with fast than with slow-to-medium music [1], but resistance-exercise experiments have not demonstrated that faster music universally improves output [22,23]. Tempo is likely to be most relevant when it supports the desired arousal level or movement cadence. When exercisers synchronize movement consciously or spontaneously to the beat, temporal

information may shape cadence and motor timing; in tasks constrained by an apparatus or a brief maximal voluntary effort, there may be less opportunity for this mechanism to influence performance.

Physiological and neurocognitive mechanisms

Physiological findings do not point to one clear mechanism. Meta-analyses generally show no reliable reduction in heart rate despite improvements in performance or RPE [1,4]. Small changes in oxygen consumption and blood lactate have been reported, but interpretation depends on whether external work is matched. If music increases speed, repetitions, or exercise duration, greater total physiological load may be a consequence of ergogenic benefit rather than evidence against it. Lower oxygen consumption during synchronized exercise may represent improved movement economy [12,13]. Neurocognitive experiments provide mechanistic plausibility for the perceptual findings, although most remain small and laboratory based. During a fatiguing isometric ankle-dorsiflexion task, Bigliassi et al. found that music shifted attention externally, improved affect and task performance, and altered cortical oscillatory activity [26]. During light-to-moderate cycle ergometry, music was associated with reduced perceived exertion, greater externally directed attention, and changes in electroencephalographic activity [27]. An fMRI study of isometric handgrip exercise demonstrated increased inferior frontal gyrus activation during music; activity in this region was inversely correlated with limb discomfort and overall exertion [28]. Because these neural associations were observational within the experimental responses, they should not be interpreted as proof that activation of a particular region caused the perceptual effect. More recent functional near-infrared spectroscopy work has examined synchronization during acute cycling. Quan et al. reported that synchronizing movement with music improved affective valence, activation, motivation, external attentional focus, and perceived exertion compared with asynchronous or no-music conditions [29]. The neurophysiological literature is consistent with a model in which music modifies attentional allocation, emotional appraisal, and motor organization rather than simply blocking nociceptive or fatigue-related input.

Discussion

The available evidence supports a modest but reproducible influence of music on exercise, with greater consistency for psychological and psychophysical outcomes than for elementary physiological measures. The broad 2020 meta-analysis identified small average effects on performance and perceived exertion [1], while the 2026 aerobic meta-analysis regarded reduced RPE as its most consistent finding and assigned this outcome moderate certainty [4]. Controlled experiments in which external workload was fixed reinforce this interpretation because lower RPE occurred without corresponding changes in heart rate [8,9]. Music may be useful mainly by changing how exercise is experienced. Current evidence is considerably less consistent regarding reductions in physiological strain. Time-to-exhaustion tests are inherently responsive to motivational and attentional manipulation because the endpoint depends on the participant's willingness or capacity to continue at a fixed workload. This property may partly explain the relatively large improvements reported in individual endurance studies [12,25] and the unstable pooled time-to-exhaustion effect in the recent meta-analysis [4]. Short self-paced time trials and studies involving trained competitors can yield smaller or null effects [15,16]. A large

improvement in a time-to-exhaustion test does not imply a similarly large improvement in race performance. The relationship between RPE and performance is equally conditional. Under fixed workload, a reduction in RPE means that a given external demand is experienced as less effortful. Under self-paced conditions, music may instead alter the amount of work selected. Faster cycling accompanied by slightly higher RPE in the experiment by Atkinson et al. [10], and much longer cycling duration with similar terminal RPE in the study by Danso et al. [25], are both ergogenic responses. These results show that music does not always reduce perceived exertion. In some studies participants report lower effort at the same workload, whereas in others they perform more work without a corresponding increase in RPE. Preference appears to be one of the most practically relevant moderators because it is simple to implement and supported by both aggregate and primary evidence [5,6,20,21,24]. The preferred-music meta-analysis showed especially large effects on motivation and affect, accompanied by a smaller reduction in RPE [5]. Standardized "motivational" playlists may be less reliable than permitting exercisers to select music they regard as energizing and appropriate for the task. A limitation is that many preference studies contrast highly liked with explicitly disliked music; such comparisons may overestimate the difference likely to occur between preferred and emotionally neutral selections. Tempo and synchronization appear to influence exercise differently from music preference. Faster music produced larger performance effects in the broad meta-analysis [1], and rhythmic entrainment can benefit endurance or movement economy in some cyclic activities [11-14]. Yet a synchronized metronome can reproduce part of the endurance effect [14], suggesting that temporal cueing itself has functional significance. Tempo manipulation has generated limited or exercise-specific effects in resistance paradigms [22,23]. "Fast music is better" is an unjustifiably broad recommendation. Higher tempo may assist when it enhances arousal or matches cadence, whereas deliberate synchronization may be more relevant to repetitive cyclic movement. Training status may modify responsiveness, although current evidence does not establish a simple trained-versus-untrained distinction. Experienced athletes have highly developed pacing strategies and may rely strongly on task-relevant internal information, potentially decreasing susceptibility to external stimuli. The absence of benefit in a 10-km cycling trial in well-trained cyclists is compatible with this hypothesis [15]. Conversely, elite triathletes exhibited longer treadmill endurance with synchronous music [12]. The apparent inconsistency probably reflects differences in endpoint, synchronization, music characteristics, and whether the task was self-paced or continued to exhaustion. Physiological outcomes were less consistent. Reliable reductions in heart rate are not supported by pooled evidence [1,4], while changes in oxygen consumption or lactate cannot be interpreted independently of work performed. Danso et al. showed that self-selected music increased exercise duration and total energetic exposure without increasing terminal RPE or terminal physiological indices [25]. This profile is more compatible with increased tolerance than reduced metabolic demand. By contrast, modest improvements in oxygen cost during synchronized running or cycling [12,13] imply that auditory-motor coupling can sometimes improve movement economy. The timing of music exposure is also important. A meta-analysis of 30 controlled studies of pre-task music found beneficial effects on several performance and fatigue-related variables, but these effects arise before the exercise bout and may involve arousal regulation or anticipatory motivation rather than the attentional competition occurring during exercise [7]. Evidence on pre-task and in-task listening should not be pooled conceptually merely because both involve music. Several methodological limitations constrain the strength of inference. Many primary experiments use small crossover samples, leaving effect estimates vulnerable to

individual differences in responsiveness. Participants cannot be blinded to whether music is present, so expectancy effects remain difficult to exclude. Music is also a multidimensional intervention: preference, tempo, loudness, lyrics, familiarity, rhythm, and emotional association frequently vary together. Exercise protocols are heterogeneous, and time to exhaustion, repetitions to failure, completion time, power, RPE, affect, and physiological biomarkers should not be treated as interchangeable manifestations of one endpoint. Publication bias and selective outcome reporting remain plausible concerns where large effects arise from small studies or heterogeneous protocols. The recent aerobic meta-analysis rated certainty as low or very low for several performance and physiological outcomes [4]. These limitations do not eliminate practical value. Music is reasonable when the objective is to make exercise more tolerable or enjoyable and, in suitable contexts, to facilitate performance. The evidence favors an individualized approach: preferred music is generally more defensible than imposed non-preferred selections; an energetic tempo may be useful when congruent with the activity; and beat-movement synchronization is particularly relevant to rhythmic endurance exercise. Music cannot be assumed to override severe physiological fatigue, substitute for training, or generate a substantial performance gain in every athlete. Future research should prioritize adequately powered, preregistered crossover or parallel-group trials capable of separating preference, tempo, synchronization, and loudness. Outcomes should be selected according to the scientific question rather than presented collectively as interchangeable indices of "performance." Within-participant comparisons of self-paced competition-like tasks, fixed-work protocols, and time-to-exhaustion tests could help distinguish effects on pacing, exercise tolerance, and physiological economy. Representation of women, older adults, clinical populations, and highly trained athletes should also improve, because much of the mechanistic and resistance-exercise literature has relied on young healthy samples. Finally, neuroimaging and electrophysiological findings need stronger linkage to ecologically meaningful exercise outcomes before neural correlates are regarded as established causal mechanisms.

Conclusions

Listening to music during exercise has a small average ergogenic effect and a modest but comparatively consistent effect on perceived exertion. Evidence is particularly persuasive for favorable affective and motivational responses and reduced RPE, whereas heart rate and other physiological responses are less consistent. Performance benefits appear more likely when music is preferred, motivationally salient, rhythmically compatible with the activity, or synchronized with repetitive movement, but no single musical characteristic guarantees an effect. Performance and perceived exertion should be interpreted as related but distinct outcomes. Music may lower RPE at a fixed workload, allow greater work at similar RPE, or occasionally increase both work and RPE by changing pacing. Its role is best understood as modifying the psychophysical regulation of exercise rather than uniformly reducing physiological strain. Personalized music represents a reasonable, low-cost adjunct to exercise, provided that claims of benefit remain task-specific and proportional to the quality and heterogeneity of the available evidence.

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