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Maisarah Mohd Saleh
sarahms@uitm.edu.my

Fatin Aqilah Abd Razak
fatinaqilah@uitm.edu.my

Siti Aishah Abd Rahman
sitiaishah85@uitm.edu.my

Rozella Ab Razak
rozella@uitm.edu.my

Nurul Diyana Sanuddin
diyanasanuddin@uitm.edu.my

Nur Atikah Mohamed Kassim
atikahmk@uitm.edu.my

Ahmad Waqi Wiz
waqi@gmail.com

*Faculty of Sports Science & Recreation, Universiti Teknologi MARA Cawangan Pahang,
Jengka Campus 26400 Bandar Tun Abdul Razak, MALAYSIA*

Adam Linoby
*Faculty of Sports Science & Recreation, Universiti Teknologi MARA Cawangan Negeri
Sembilan, Seremban Campus 70300 Seremban, Negeri Sembilan, MALAYSIA*
linoby@uitm.edu.my

Received: 13 March, 2023

Accepted: 16 June, 2023

Published: 15 Sept, 2023

Corresponding Author

Nurul Diyana Sanuddin

Email: diyanasanuddin@uitm.edu.my

Faculty of Sports Science & Recreation,

Universiti Teknologi MARA Cawangan Pahang,

Jengka Campus 26400 Bandar Tun Abdul Razak, MALAYSIA

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Maisarah Mohd Saleh¹, Fatin Aqilah Abd Razak², Siti Aishah Abd Rahman³, Rozella Ab Razak⁴, Nurul Diyana Sanuddin⁵, Adam Linoby⁶, Nur Atikah Mohamed Kassim⁷, & Ahmad Waqi Wiz⁸

^{1,2,3,4,5,7,8}*Faculty of Sports Science & Recreation, Universiti Teknologi MARA Cawangan Pahang, Jengka Campus 26400 Bandar Tun Abdul Razak, MALAYSIA*

⁶*Faculty of Sports Science & Recreation, Universiti Teknologi MARA Cawangan Negeri Sembilan, Seremban Campus 70300 Seremban, Negeri Sembilan, MALAYSIA*

ABSTRACT

Music has been shown to reduce the rating of perceived exertion (RPE), increase motivation and enhance exercise performance. However, the effects of exercise performance and RPE with recommended tempo songs are less conclusive. The purpose of this study was to examine the effects of listening to preferred music on aerobic endurance performance and rate perceived of exertion responses. Thirty physically active males (mean \pm SD: 18.27 \pm 0.45 years, body mass 21.45 \pm 1.40 kg·m⁻²) were recruited for this study. In the experimental study design, participants completed two trials separated by a minimum of 72 hours. In music condition, participants listened to their own preferred music (selection song tempo range was between 121 - 131 bpm). Participants were required to complete a 2.4 km maximal effort run with RPE measured throughout the test. Time to complete 2.4 km aerobic endurance performance and RPE score were significantly lower (PRE: in music condition (11.30 min \pm 1.67; 4.83 \pm 1.15) compared with in no music condition (11.58 min \pm 1.59; 5.43 \pm 0.73). In conclusion, the findings of this study indicated that listening to music preference has a significant effect on running performance during 2.4 km aerobic endurance performance. The results from this study could hold important implications for the application of music and enduring aerobic endurance exercise.

Keywords: *Music, Aerobic, Endurance performance, RPE, Running*

INTRODUCTION

Music-related therapies have been frequently employed in exercise and training as a means to enhance physiological variables (Archana & Mukilan, 2016; Bird et al., 2016), resists mental fatigue (Silva et al., 2021) and may even increase performance (Belkhir et al., 2019). In recent years, music has received a growing interest in enhancing exercise and sports context (Maddigan et al., 2019; Terry et al., 2020). Music has been extensively studied for its ergogenic benefits in a variety of exercise modalities such as running (Hutchinson et al., 2018; Van Dyck & Leman, 2016) cycling (Ballmann et al., 2019), resistance training (Ballmann et al., 2021; Köse, 2018) and dart thrower (Arbinaga et al., 2020; Kuan et al., 2018). Music exerts an ergogenic effect, either through increased work capacity, and influences psychological components, such as motivation, improved mood and elevated psychomotor arousal and creating exercising experience into something more enjoyable (Ballmann et al., 2019; Karageorghis et al., 2021).

Running is a common physical exercise worldwide that requires minimal equipment and effort. Therefore, it is easily accessible for many people. Previous research has reported that music can facilitate running by diverging the attention on discomfort feelings during exercise (Feiss et al., 2020; Yamashita et al., 2006). The discomfort feelings can be defined as physical sensation that an individual experience during performing an exercise. It is commonly used by Borg's ratings of perceived exertion scale (RPE) to measure the hardness of exercise (Feiss et al., 2020). Currently, findings from relevant studies consistently suggest that music decreases the perceived exertion during exercise (Silva et al., 2021; Van Dyck & Leman, 2016; Ballmann, 2021). In a study conducted by Feiss et al (Feiss et al., 2020) listening to music reduced RPE score in a group of subjects exercised with music compared with the non-music counterpart. Moreover, Karageorghis et al (Karageorghis et al., 2021) found that the RPE is higher with high tempo music compared with the no-music condition. This influence of music can be explained by attentional processing. If the training takes place at a low or moderate intensity, external variables like music can be processed in conjunction with physiological indications that attenuate the reaction to the information process (Silva et al., 2021). As a result, RPE was influenced by music condition and song tempo.

Music preference has been demonstrated to play a significant influence in physiological and psychological variables (Ballmann, 2021). Listening to preferred music has been shown to increase cycling distance and RPE when compared to non-preferred music (Nakamura et al., 2010). Karageorghis et al., (Karageorghis et al., 2021), explained that if non-preferred music is chosen, tempo can be a hindrance to pacing for runners since people tend to synchronize stride or movement to a specific tempo (Karageorghis et al., 2009). Edworthy and Waring (Waterhouse et al., 2010) investigated the effect of song tempo on the treadmill and they found that an increase in the tempo, resulted in an increase in running speed. Additionally, listening to music at a tempo greater than 120 beats per minute (bpm) while performing moderate intensity running, increases adherence to exercise substantially (Ballmann, 2019; Ballmann, 2021; Karageorghis et al., 2009). Evidence indicates that high tempo music has elicited positive impacts on performance while slow-tempo music has been demonstrated to have calming effects, suitable for a low intensity activity such as warm down session (Hutchinson et al., 2018). Findings in the literature song tempo, it is quite plausible that song tempo could serve as a means to influence the running pace of individuals. Songs identified as a 'motivational'

commonly have relatively high tempo (>120bpm) and could induce bodily action (Karageorghis et al., 1999). Hence, the ideal song tempo for endurance running exercise could be in between the medium to high beat music to psychologically motivate an individual performing an exercise. Given that Clark et al (Clark et al., 2021) used self-selected music with no recommendation of song tempo during the 1.5mile time-trial. The average tempo for the chosen songs in his study was 118 bpm, which narrowly meets the classification of fast-beat music (120 bpm) as established by Karageorghis et al. (1999). Hence, the current study will implement a recommended range of song tempo from 121 – 131 bpm. Clearly the supplementation of appropriately chosen song tempo could induce an ergogenic effect. Thus, the disparities in previous findings may be due to no recommendation of song tempo, leaving the need for further study.

The aim of this investigation was to determine the effects of listening to music preferences with a recommended range of song tempo on 2.4 km aerobic endurance and RPE. We hypothesized that the self-preferred music condition would decrease the time completion of the 2.4 km aerobic endurance and attenuated the RPE response during the exercise trial.

METHODS

Subjects

Thirty recreational active male participants (mean \pm SD: 18.27 \pm 0.45 years, body mass 21.45 \pm 1.40 kg·m⁻²) were recruited from Universiti Teknologi MARA Pahang to participate in this study. Inclusion criteria were as follows: 1) physically healthy; 2) regularly active (\geq 30 min with \geq 3 times per week); 3) normal BMI (18.5–22.9 kg/m²); 4) free from injury within 6 months prior to study intervention 5) participants have experience using ear bud. All participants were completed with no contraindication to the Physical Activity Readiness Questionnaire (PAR-Q). The study was conducted in accordance with the Declaration of Helsinki.

Music selection

Participants self-selected any song within their preferred genre as long as the tempo for each song tempo was in between 121 – 131 bpm. Music was played through a MP3 music player (Sony, Japan) using “earbud” type headphones and volume was held constant for each participant at a constant volume (~75% of maximum volume on the music player’s scale). The same electronic device and pair of headphones were used to play all music during the experimental period.

Experimental design

All participants visited the stadium track on four occasions for over 3 weeks, separated by 72 hrs between each visit. They were randomly assigned either into music or no music condition (n = 30). During the first visit, each participant was subjected to undergo a screening process, completed a general physical activity and medical background questionnaire, and signed an informed consent. On visit 2, the participant underwent a familiarization session prior to the

experimental visit. During the experimental visit, the participant performed a 10-min warm-up prior to 2.4 km aerobic endurance exercise testing in both conditions. During the first trial, the participant was performed without any form of music player device (MP3). In the second trial, music was played through a MP3 player using “earbud” type headphones throughout the exercise testing in music condition. Time completion of the 2.4 km aerobic endurance was recorded at the end of each trial. The RPE score was measured using the Borg 1 to 10 scale. Participants were instructed to abstain from caffeine, tobacco products, or alcohol prior to each visit.

Experimental protocol

During the experimental visit, each participant did a 10-min warm up that included slow jogging and stretching. Each participant completed the trial individually, in order to control for a competition effect and pace of another runner was not a confounding factor during exercise testing. Music selection was played throughout the 2.4 km aerobic endurance exercise testing in music condition. In the no-music condition, headphones were connected, but the songs were not played throughout the trial. The time to complete the 2.4 km aerobic endurance was recorded as the participants crossed the finishing line. Immediately after completion of the trial, the participants were required to pick a number that indicated their exertion from the RPE (1 - 10) scale.

Statistics

All data was analyzed using SPSS 25 (IBM, Armonk, NY, USA). Paired T-test was conducted to compare performance time 2.4 km aerobic endurance and RPE score between music and no music conditions. The significance level was set at $p \leq 0.05$ a priori.

RESULTS

Table 1. The effects of listening to preferred music vs. no music on 2.4 km aerobic endurance and RPE

	Music	No Music	p- Value
2.4 km aerobic endurance (min)	11.30 ± 1.67	11.58 ± 1.59	0.003*
RPE	4.83 ± 1.15	5.43 ± 0.73	0.010*

*Data were expressed as means ± standard deviations; 2.4 km aerobic endurance, RPE after the test; *Significant difference between music and control conditions ($p < 0.05$).*

The mean time to complete 2.4 km aerobic endurance for the second trial was lower in music condition (11.30 ± 1.67) compared to no music condition (11.58 ± 1.59). There was a significant difference between music and no music condition in the 2.4 km aerobic endurance, $t(29) = 3.20$, $p < 0.05$. Meanwhile, the RPE results showed a mean test score of rates perceived of exertion (RPE) for the second trial was significantly lower 4.83 ± 1.14 compared to the first trial 5.43 ± 0.73 (no music condition). Therefore, the RPE showed a significant difference between music and no music condition, $t(29) = 2.76$, $p < 0.05$.

DISCUSSION

The present study found that music preferences serve a pivotal role in creating ergogenic effects to enhance performance and lower RPE. The current results are generally consistent with previous studies who reported listening to one's favorite music boosts one's ability to dissociate and lowers one's rate of perceived RPE during endurance activity (Ballmann et al., 2019; Silva et al., 2021; Stork et al., 2015). These findings may have substantial implications for employing music to endure repeated high-intensity sprint workout exercise performance. Apart from that, past research has demonstrated that adding music to aerobic exercise such as stationary cycling (Connon & Scott, 2011) and running (Stork et al., 2015) effectively increases exercise duration. Moreover, other research has found that preferred music increased power output and speed (Karow et al., 2020). Twelve physically active individuals conducted a 5-minute rowing warm-up at 50% HRmax with preferred music, or no music. The music came to a halt as subjects finished the 2000-meter rowing time trial. The increment of power output and speed was shown in preferred music groups. Therefore, it implies the benefits of preferred music is conditional, attracting the attention being diverted away from the task and toward the music (Ballmann, 2021). Music assists in diverting the mind away from exhaustion symptoms and focusing on the music, allowing for longer periods of activity. It appears that preferred music can redirect attentional concentration from the unpleasantness of physical activity and external musical inducements.

In this current study, selection of music tempo was used as it also plays a crucial role in enhancing exercise performance. As mentioned by Ballman et al (Ballman, 2021), fast tempo music yielded a greater performance effect compared with slow to moderate music tempo. Listening to fast music tempo will cause participants to become a lot more eager and motivated to extend their effort as they prefer to increase the exercise intensity. Fast tempo and strong rhythms are inherently stimulative (Ballman, et al., 2021), and thus create greater arousal. Arousal and musical tempo possess a positive relationship i.e faster the tempo the greater the intensity of the arousal response (Stork et al., 2015). Other factors such as the music intensity (i.e) volume may influence exercise responses with listening to music during exercise. Preference for loud volume music have been shown to be increased among participants during high intensity exercise on maximal treadmill graded exercise test (Centala et al., 2020).

The current study allowed the participants to select their preferred song with recommended range of song tempo during exercise testing. Individual preference has been discovered to be critical in influencing the best reaction in the individual (Ballmann et al., 2021). It can be posited that simply the ability to choose the song is enough of a psychological advantage to produce a greater performance. According to Waterhouse et al., (Waterhouse et al., 2010), listening to preferred music through exercise can create improvement on the distance pedalled. Listening to music can help them to block out unwanted thoughts and focus on physical activity. Kuan, Morris, Kueh and Terry (Kuan et al., 2018) found out exciting music, relaxation music, and favourite music had a significant effect on improving performance among novice dart throwers. Besides, the effects of music seem to have an acute positive result on endurance exercise performance were found by Chtourou et al., (Chtourou et al., 2021), believed that during warm up sessions before performing competitive games with listening to music may be considered as additional aid for young athletes. Therefore, providing participants

with the opportunity to select their own music may have served as a motivator and potentially account for the improvements in the music condition.

Preferred music genre appears to have a dissociation effect, resulting in lower RPE during exercise (Connon & Scott, 2011). The present results corroborate with previous studies, preferred music lowered RPE in music group compared to no music group. Silva et al., (Silva et al., 2021), noticed a lower RPE after performing strength-endurance tests when participants listened to music, compared to the no-music condition. In addition, The majority of studies demonstrate decreased RPE with preferred compared to non-preferred music during the workout session (Ballmann, 2021). Music preference is an effective approach of diverting attention, and the motivational nature of the music can have an effect on physical performance. Therefore, for exercise participants, motivational and preferred music can be used to extend exercise duration and improve physical performance.

CONCLUSION

The music condition in the present study elicited an enhancement in performance time 2.4 km aerobic endurance and reduced RPE. Even Though, it was a slight change in performance time in 2.4 km aerobic endurance and RPE, it was suggested that listening to the music may have masked any beneficial effect of music condition. It is recommended that future research include both genders as we know that male and female natures are physiologically and psychologically distinct. Additionally, applying this study to a variety of sports settings is likely to result in further refinement, allowing the music to gain more validity and relevance in enhancing athletic performance.

Conflict of Interest

The authors declare that they have no conflict of interest.

Author's Contributions:

All authors contributed equally to this work and approved the final version to be published.

Acknowledgements

We express our sincere gratitude to Universiti Teknologi MARA for providing the research facilities and resources to carry out this project.

Funding Bodies (If Applicable)

This research received no external funding.

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