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"EVALUATING AUDITORY STIMULATION FOR IMPROVED EXERCISE OUTCOMES: A RANDOMISED CONTROLLED TRIAL WITH SEDENTARY ADULTS ON THE 12-MINUTE COOPER TEST"

Sports Science

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ABSTRACT

In today's digital age, sedentary lifestyles contribute to obesity, cardiovascular issues, and mental health concerns. The Central Governor Model explains that the brain controls physical performance by regulating exercise intensity, with fatigue being more about perception than physical limitation. Music, as a motivational tool, can elevate mood, lower perceived exertion, and enhance endurance during exercise. **Aim:** To assess the impact of music on physiological and performance metrics during the 12-minute Cooper Run test in sedentary males. **Methodology:** A randomized controlled trial involved 40 male participants, split into two groups. The music group (n = 20, mean age 24 years, BMI 25.7) completed the test with self-selected music, while the control group (n = 20, mean age 24.2 years, BMI 25.7) performed with no stimuli. Metrics included distance covered, average heart rate (HR), Rating of Perceived Exertion (RPE), and VO2 max. **Results:** The music group showed significant improvements, with lower HR (M = 129.3 vs. 142.15, $p < 0.001$), greater distance covered (M = 1.78 km vs. 1.61 km, $p = 0.026$), higher VO2 max (M = 28.44 vs. 24.52, $p = 0.024$), and reduced RPE (M = 6 vs. 8, $p < 0.0001$). **Conclusion:** Music improves exercise performance during the 12-minute Cooper test by enhancing cardiovascular efficiency, increasing aerobic capacity, and lowering perceived exertion. These findings highlight music's potential as a practical tool for optimizing exercise outcomes.

KEYWORDS

Music, Central governor theory, physiology , Vo2 max, RPE, Cooper test

INTRODUCTION

Sedentary lifestyles have become a pressing health concern in today's digital age, with the widespread adoption of technology encouraging prolonged periods of inactivity. This shift has contributed to serious health issues, including obesity, cardiovascular disease, musculoskeletal problems, and mental health challenges such as anxiety and depression. Music plays a crucial role in promoting exercise motivation and combating the negative effects of prolonged inactivity.

The Central Governor Theory, proposed by Noakes et al. (2005, 2012), suggests that the brain acts as a central regulator of physical performance, controlling exercise intensity to prevent physiological harm. Music interacts with this regulatory mechanism by altering perceptions of effort and fatigue, acting as a distraction, shifting focus away from discomfort and allowing individuals to push through mental and physical barriers. This effect is particularly valuable for individuals with low intrinsic motivation or limited exercise experience, as it helps them overcome the psychological challenges associated with physical activity.

Music's influence extends beyond psychological effects, as it has a notable impact on physiological markers such as heart rate, blood pressure, and autonomic nervous system (ANS) activity. Studies, including those by Kulinski 2021 et al., have demonstrated that music can regulate cardiovascular responses during exercise. Listening to music with a tempo synchronized to physical activity can create a rhythmic pattern that improves exercise efficiency, resulting in better cardiovascular performance.Incorporating music into exercise routines addresses both psychological and physiological obstacles, making exercise more accessible and building a positive feedback loop. As individuals experience the benefits of music-enhanced exercise, such as improved mood, better performance, and reduced fatigue, they are more likely to continue exercising regularly, creating a sustainable pathway for adopting a healthier, more active lifestyle.Finding innovative ways to encourage physical activity is essential in today's digital age. Music stands out as a powerful intervention capable of transforming the exercise experience and integrating music into exercise routines, researchers, educators, and health professionals can help individuals overcome the barriers to physical activity and foster healthier, more active communities.

Aim

To evaluate the effect of music on distance covered, Average Heart Rate , Vo2 Max estimates, and Perceived exertion (RPE) during the 12-minute Cooper test.

Methodology

Randomized Controlled Trial (RCT)
Participants

Inclusion Criteria

1. Age 18–25 years.
2. Classified as sedentary based on GPAQ (low physical activity determined by METs).
3. No contraindications to hearing music.
4. No contraindications to performing moderate physical activity.

Exclusion Criteria

1. Conditions impairing hearing.
2. Diagnosed cardiovascular or respiratory conditions.
3. Other comorbid conditions :
   - Metabolic
   - Renal
   - Bleeding disorders.
4. Current muscular injury that would hinder physical activity.

The study involved "40 sedentary students", aged 18–25 years , who

were screened for eligibility based on the Global Physical Activity Questionnaire (GPAQ). Participants meeting the inclusion criteria were enrolled after obtaining informed consent.

Randomisation

Participants were randomly assigned to one of two groups using system-generated randomisation:

Music Group: Listened to self-selected music through wireless headphones during the test.

Control Group: Performed the test without any auditory stimuli.

Procedure

Pre-Test Phase

Participants rested for "10–15 minutes" to record baseline heart rates.

Warm-Up Routine:

- All participants performed a standardized warm-up routine to ensure uniform preparation.
- Stimulants such as caffeine were avoided prior to the test.

Test Execution

Participants ran or walked a 400-meter track to perform the "12-minute Cooper test." It was ensured that each participant completed the test independently to prevent competition from affecting the findings.

Post-Test Phase

- Measurements Recorded:
- Distance covered (in kms).
- Heart rate (via a wearable device connected to an ambulatory monitor).
- Rate of Perceived Exertion (RPE): Measured using the Borg Scale (1–10).
- **VO_2 Max:** Calculated using the formula:
- **VO_2max** = (22.351 x {Distance in km}) - 11.288]

Equipment Used

- Wireless headphones (for the Music Group).
- Wearable device for continuous monitoring of heart rate and distance covered .

Statistical Analysis

Tab 1. Descriptive analysis

GROUP	MEAN AGE (years)	Mean weight (kgs)	Mean height (cms)	Mean BMI	Mean HR (bpm)
Control group (n=20)	24	78.9	175.4	25.5	77
Music group (n=20)	24.2	79.2	175.8	25.6	76

The demographic and baseline characteristics of both groups were comparable, ensuring that the groups were well-matched for the randomized controlled trial.

Heart Rate

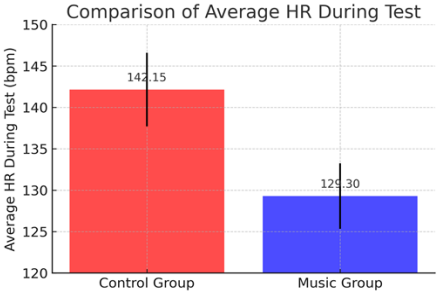

Figure 1. Mean Avg Heart Rate Between Control Group & Music Group

The analysis showed that the **control group** had a significantly higher average HR (M = 142.15 bpm, SD = 4.44) during the test compared to the **music group** (M = 129.3 bpm, SD = 3.97). A t-test revealed a statistically significant difference between the groups (t(38) = -9.64, p < 0.001). The difference in average HR is substantial, with a **95% confidence interval of 10.24 to 15.46 bpm**, indicating that the presence of music helped in reducing heart rate during the test.

Distance Covered

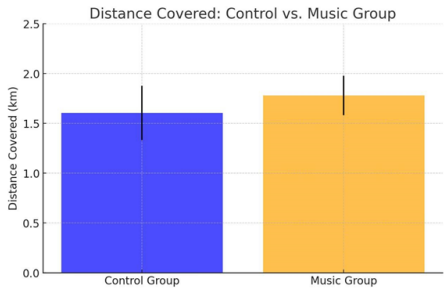

Figure 2. Mean Distance Covered Between Control Group & Music Group

The study compared the distance covered (in kms) between a control group and a music group. The mean distance covered by the control group was **1.605 km** with a standard deviation of 0.272 km, whereas the music group covered a mean distance of **1.78 km** with a standard deviation of 0.199 km.

An independent t-test revealed a statistically significant difference between the two groups (t = -2.32, p = 0.026), indicating that participants in the music group covered significantly more distance compared to the control group.

This suggests listening to music may positively influence performance during the activity.

Vo2 Max

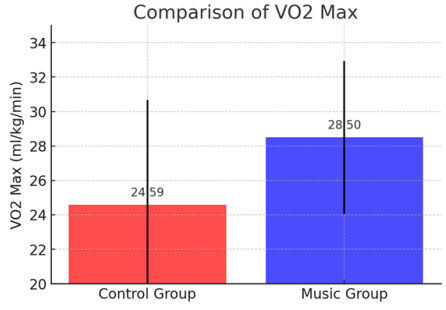

Figure 3. Mean Vo2 Max Comparison Between Control & Music Group

The mean VO2 Max for the control group was **24.59 ml/kg/min**, while the music group had a higher mean value of **28.50 ml/kg/min**.The standard deviation was 6.09 ml/kg/min for the control group and 4.45 ml/kg/min for the music group, indicating less variability in the music group.**A t-test yielded a t-statistic of 2.32 and a p-value of 0.026, which is statistically significant (p < 0.05)**.The 95% confidence interval for the difference in means was [0.61, 7.22], confirming a reliable difference favoring the music group. These results indicate that listening to music during physical activity significantly enhances VO2 Max performance compared to performing without auditory stimuli.

Rate Of Perceived Exertion

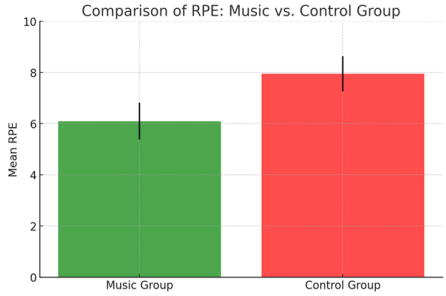

Figure 4. Mean Rpe Difference Between Control & Music Group

The mean **RPE for the control group was 8**, while the **music group**

had a significantly lower mean of 6, indicating that participants in the music group reported less perceived exertion during physical activity compared to the control group, Std Dev was 0.69 for the control group and 0.72 for the music group, suggesting similar variability in the reported RPE values for both groups. A t-test revealed a t-statistic of -8.33, with a p-value of 0.000 (statistically significant at $p < 0.05$). **This indicates a significant difference in RPE between the two groups**.The 95% confidence interval for the difference in means was [-2.29, -1.41], confirming that the music group experienced lower perceived exertion than the control group.

Summary

Tab 2. Comparison Of All Variables Between Both Groups

GROUP	Average Heart Rate during test	Vo2 Max	Distance covered during the test	Rate of Perceived Exertion
CONTROL group (n=20)	142	24.52	1.61kms	6
MUSIC group (n=20)	129	28.44	1.78kms	8

The results of the study demonstrated significant improvements in the music group across all metrics. The **average heart rate (HR)** during the test was notably lower in the music group **(M = 129.3 bpm)** compared to the control group **(M = 142.15 bpm),** with a statistically significant difference ($p < 0.001$), suggesting enhanced cardiovascular efficiency in the music group. Additionally, the music group covered a greater distance during the 12-minute Cooper Run test, with a mean distance of **1.78 km**, compared to the control group's **1.61 km** ($p = 0.026$), indicating better endurance. The music group also exhibited a **higher VO2 max (M = 28.44)** than the control group ($M = 24.52$, $p = 0.024$), suggesting improved aerobic capacity and overall cardiovascular fitness. Moreover, the music group reported significantly lower perceived exertion, with a mean **RPE of 6, compared to 8** in the control group ($p < 0.0001$).

DISCUSSION

This study demonstrates that auditory stimuli, such as **music**, can significantly enhance exercise performance and reduce perceived exertion, particularly in **sedentary individuals**. The results showed that the **music group** had lower average **heart rates**, greater **distances covered**, higher **VO2 max**, and reduced **RPE** compared to the **control group**. These findings suggest that music not only motivates individuals to engage in physical activity but also improves **physiological performance** during exercise. The **Central Governor Theory** offers a framework for understanding these effects, where the brain regulates exercise intensity to prevent harm, and **music** serves as a tool to influence this regulation by altering perceptions of fatigue.

Music activates the brain's **reward centers**, particularly the **hypothalamus**, leading to the release of **dopamine**. This release creates positive feelings and reduces the perception of discomfort and fatigue. Consequently, participants in the **music group** were able to perform at higher levels without feeling as tired, as evidenced by their improved performance in **distance covered** and reduced **RPE**. The rhythmic elements of **music** also engage the **motor cortex** and **cerebellum**, regions involved in **movement coordination**. This synchronization between music and movement can make physical activity feel smoother and more efficient, contributing to the increased **endurance** observed in the **music group**.

Furthermore, **music** can serve as a distraction to the brain's **central governor**, which regulates physical exertion to prevent overexertion. By reducing perceived fatigue, **music** allows individuals to extend their endurance without experiencing additional physiological strain. This effect was reflected in the results, where participants in the **music group** covered more distance with lower **RPE** and showed enhanced **cardiovascular efficiency**, as indicated by their higher **VO2 max** and reduced **heart rate** compared to the **control group**.

The significant improvements observed in **cardiovascular performance** and **endurance** in the **music group** underscore the potential of **music** as an effective intervention for **sedentary individuals**. The study's findings align with previous research suggesting that **music** enhances both the **psychological** and **physiological** aspects of exercise, reducing mental and physical barriers to activity and improving overall performance.

CONCLUSION

In conclusion, this study confirms that music has a positive impact on exercise performance, particularly for sedentary individuals. By reducing perceived exertion, enhancing cardiovascular efficiency, and improving endurance, music serves as a valuable tool to motivate and support individuals in engaging with physical activity. The practical implications of these findings suggest that incorporating music into exercise routines can be an effective strategy to improve adherence to physical activity, enhance cardiovascular health, and support overall well-being. As a cost-effective and easily accessible intervention, music can play a crucial role in promoting regular physical activity, especially among sedentary populations.

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