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The Effect of Music Tempo on Aerobic Performance Among Under-12 Swimmers

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I. INTRODUCTION

Music has been widely recognised as a powerful tool in sports and exercise settings, commonly used to boost motivation, mood, and performance [1]. Among its key elements, tempo measured in beats per minute (BPM) plays a crucial role in influencing physiological and psychological responses. Fast tempo music (>120 BPM) is associated with increased arousal and motivation, while slow tempo music (<80 BPM) promotes relaxation and reduced anxiety [1].

Most existing research has focused on adults participating in land-based sports such as running and cycling [2][3]. Swimming differs significantly due to water resistance, breath control demands, and altered sound perception underwater [4]. Children under 12 are at a distinct developmental stage, exhibiting heightened sensitivity to rhythm and greater variability in effort and attention compared with adults [5][6]. Despite this, limited research exists on how music tempo affects aerobic performance in young swimmers. This study addresses that gap using the 10-Meter Multistage Shuttle Swim Test (MSST), an aquatic-specific progressive endurance test guided by auditory cues.

II. METHODS

A quasi-experimental crossover design was employed with 15 Under-12 swimmers (mean age = 10.2 years; minimum 2 years competitive experience). Participants completed three testing sessions in fixed order: (1) no music, (2) slow tempo music (80–90 BPM), and (3) fast tempo music (130–140 BPM), with one full day of rest between each session to minimise fatigue and carryover effects.

Testing was conducted in a standard 25-metre indoor pool with two cone markers placed 10 metres apart. Music was delivered via waterproof bone-conduction headphones at a consistent volume, using lyric-free instrumental tracks [4]. Aerobic performance was measured by maximum MSST level achieved; post-exercise heart rate (HR) was recorded immediately after each condition. Data were analysed using repeated-measures ANOVA with Bonferroni post hoc comparisons in Jamovi.

Normality was confirmed via Shapiro-Wilk test ($p > 0.05$ for all conditions). Statistical significance was set at $p < 0.05$, with effect sizes reported as partial eta squared (η^2).

III. RESULTS AND DISCUSSION

Descriptive results showed that swimmers achieved the highest mean MSST level under fast tempo music ($M = 7.13$, $SD = 0.38$), compared with no music ($M = 6.89$, $SD = 0.39$) and slow tempo music ($M = 6.89$, $SD = 0.36$). Post-exercise HR was also highest following fast tempo music ($M = 168.60$ BPM), compared with no music ($M = 161.07$ BPM) and slow tempo music ($M = 157.87$ BPM), as summarised in Table I.

TABLE I
VERTICAL JUMP PERFORMANCE RESULTS (CM)

Condition	MSST M (SD)	HR M (BPM)	HR SD
No Music	6.89 (0.39)	161.07	5.46
Slow (80–90 BPM)	6.89 (0.36)	157.87	4.94
Fast (130–140 BPM)	7.13 (0.38)	168.60	4.65

Note. M = Mean; SD = Standard Deviation.

Repeated measures ANOVA revealed a statistically significant main effect of music tempo on MSST performance, $F(2, 28) = 16.62$, $p < 0.001$, $\eta^2 = 0.54$ (large effect). Post hoc Bonferroni comparisons confirmed that fast tempo music produced significantly higher MSST performance than no music ($p < 0.001$, mean diff. = 0.24 levels) and slow tempo music ($p = 0.001$, mean diff. = 0.24 levels). No significant difference was observed between no music and slow tempo music ($p = 1.000$).

Heart rate analysis similarly yielded a significant main effect, $F(2, 28) = 26.45$, $p < 0.001$, $\eta^2 = 0.65$. Post hoc analysis showed significantly elevated HR following fast tempo music versus both no music ($p < 0.001$) and slow tempo music ($p < 0.001$), with no significant HR difference between no music and slow tempo ($p = 0.085$). Strong positive correlations between MSST performance and post-exercise HR

were observed across all conditions ($r = 0.65\text{--}0.72$, $p < 0.01$).

These findings align with the psychophysiological framework of Karageorghis and Priest [1], which links fast music to increased arousal, sympathetic activation, and enhanced motor synchronisation. Results are consistent with [2] and [3], extending their findings from adult land-based settings to a younger aquatic population. The absence of benefit from slow tempo music likely reflects its parasympathetic, calming effect being unsuitable for maximal aerobic effort [3]. Notably, 80% of participants performed best under fast tempo music, suggesting a consistent pattern across individual variability.

IV. CONCLUSIONS

Fast tempo music (130–140 BPM) significantly enhances aerobic performance and physiological exertion in Under-12 swimmers, while slow tempo music provides no measurable benefit over no music during maximal aerobic testing. The large effect sizes ($\eta^2 = 0.54\text{--}0.65$) support the practical utility of fast tempo music as a simple, non-invasive, and cost-effective ergogenic aid. Coaches are encouraged to incorporate fast tempo music during interval and endurance training sets, reserving slow tempo music for warm-up, cool-down, or recovery phases. Future research should include larger randomised samples, individual music preference controls, and

longitudinal designs to further validate these findings.

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