

BEAT-MATCHED HIGH-INTENSITY INTERVAL TRAINING PROGRAM AND ITS EFFECTS ON CARDIOVASCULAR ENDURANCE AND PERCEIVED MOTIVATION AMONG GRADE 10 LEARNERS

FRANCIS Z. MICU

Master of Arts in Education
Major in MAPEH

Abstract

Declining physical activity and low engagement in school-based exercise have become pressing concerns among adolescents, particularly in physical education settings where traditional routines often fail to sustain motivation and cardiovascular development. This study examined the effects of a beat-matched high-intensity interval training (HIIT) program on cardiovascular endurance, perceived motivation, and enjoyment of physical activity among Grade 10 students at Dagupan City National High School. Using a quasi-experimental pretest-posttest non-equivalent groups design, 150 students were assigned to an experimental group exposed to beat-matched HIIT and a control group that participated in traditional physical education activities. Data were collected through the 20-Meter Progressive Aerobic Cardiovascular Endurance Run (PACER), a perceived motivation questionnaire, and the Physical Activity Enjoyment Scale. Findings revealed that the experimental group's mean PACER score improved from 28.45 laps in the pretest to 38.72 laps in the posttest, indicating a substantial gain in cardiovascular endurance. Motivation scores likewise increased from 3.12 to 4.21, reflecting a shift from moderate to high motivation. Moreover, motivation and cardiovascular endurance showed a strong positive relationship ($r = .72$), suggesting that greater motivation was associated with better endurance performance. The experimental group also reported significantly higher enjoyment ($M = 4.32$, $SD = 0.41$) than the control group ($M = 3.71$, $SD = 0.48$), with $t = 6.85$ and $p = .000$. The study concludes that beat-matched HIIT is an effective and engaging intervention for improving fitness, motivation, and enjoyment in secondary school physical education. Its integration may strengthen active lifestyles and student participation in school.

Keywords: Beat-Matched HIIT, Cardiovascular Endurance, Perceived Motivation, Physical Activity Enjoyment, Grade 10 Students

1. Introduction

Adolescent physical inactivity remains a major public health concern worldwide and continues to challenge schools that are expected to cultivate lifelong health habits. The World Health Organization (2024) states that children and adolescents should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity daily, yet about 80% of adolescents globally do not meet recommended activity levels. This pattern matters because regular physical activity supports physical fitness, cardiometabolic health, bone health, motor development, and mental well-being during the school-age years. In this context, Physical Education (PE) is not merely a curricular requirement; it is one of the most consistent institutional spaces where schools can address inactivity and promote health-enhancing movement behaviors among young people.

Despite this mandate, PE classes often struggle to generate sufficient intensity and sustained engagement to produce meaningful fitness gains. Recent school-based exercise literature notes that PE settings face practical constraints, including limited class time, competing instructional demands, and uneven student motivation, all of which can reduce opportunities for sustained moderate- to vigorous-intensity movement. For this reason, researchers have increasingly argued that school interventions must be both time-efficient and engaging if they are

to improve adolescents' health-related fitness within real instructional schedules. The problem is not only how to get students to move more, but also how to get them to participate with sufficient effort and consistency for measurable physiological adaptation to occur.

Within this discussion, high-intensity interval training (HIIT) has emerged as a promising strategy. HIIT typically alternates short bouts of vigorous activity with brief recovery periods, providing substantial physiological stimulus in a relatively short time. In an umbrella review of 18 systematic reviews covering 223 original studies and 13,900 unique participants, Poon et al. (2024) found that HIIT was effective for improving cardiorespiratory fitness in children and adolescents and was also associated with favorable changes in several cardiometabolic indicators. Likewise, Duncombe et al. (2022), in a systematic review and meta-analysis of school-based HIIT programs, concluded that HIIT is effective for improving several health outcomes in school-aged populations. These findings position HIIT as a practical response to the time limitations of school PE while preserving the intensity needed to improve health-related fitness.

More recent school-based evidence strengthens this argument. Jovanović et al. (2024) reported that a 12-week HIIT intervention implemented during PE classes produced significantly greater improvements in shuttle run performance and estimated VO₂max in adolescents than a comparison condition, concluding that HIIT embedded in PE can significantly improve selected health-related fitness components. Such findings are particularly relevant for cardiovascular endurance, a central marker of aerobic fitness and a key health outcome during adolescence. Because beat-matched HIIT retains the intensity logic of HIIT while adding rhythmic structure, it offers a plausible extension of this evidence base for school-based cardiovascular conditioning.

However, physical improvement alone does not guarantee continued participation. In PE, students' motivation, enjoyment, and perceived competence strongly shape whether they engage fully in activities and whether they develop favorable attitudes toward physical activity beyond the classroom. White et al. (2021), in a systematic review of qualitative studies on self-determination theory in PE, found that need satisfaction was associated with positive affect and increased participation. In contrast, low competence and relatedness were linked to negative affect and reduced participation. This is important because adolescents are unlikely to sustain effort in demanding exercise formats if the activity feels aversive, socially threatening, or monotonous. Thus, interventions in PE are more likely to succeed when they promote not only physiological challenge but also positive affective experience and motivational support.

Music may help address this motivational challenge. Park et al. (2023) argued that music can act as an affective stimulant for physical activity by increasing positive affect, reducing ratings of perceived exertion, and improving performance and oxygen-use efficiency. Their review further proposed three mechanisms through which music may influence exercise behavior: musical pleasure and reward, rhythmic entrainment, and sensory distraction from exertion. In school PE specifically, Cools et al. (2023) found that playing music during PE significantly improved students' intrinsic motivation, enjoyment, and sense of competence, with students reporting greater enthusiasm, energy, and fun during music-supported lessons. These findings suggest that music is not merely decorative in exercise settings; it can alter how learners experience, interpret, and sustain activity.

For Philippine schools, this discussion has practical relevance. The Department of Education's Galaw Pilipinas guidelines institutionalized a national calisthenics exercise program and explicitly linked school-based activity to the daily physical activity needs of children and adolescents. This policy context indicates that the Philippine basic education already recognizes the importance of regular, structured opportunities for movement. However, policy support alone does not determine which PE strategies are most effective for improving both fitness and student engagement. Compared with the stronger literature on HIIT in general and on music use in PE more broadly, there remains a practical need to examine how a beat-matched HIIT format performs when used with secondary school learners in an actual school setting.

In this context, the present study was undertaken. Based on the uploaded thesis, the investigation focused on Grade 10 students of Dagupan City National High School. It examined the effects of an 8- to 12-week beat-matched HIIT program on cardiovascular endurance, perceived motivation, and enjoyment of physical activity, while also considering the relationship between motivation and endurance and comparing enjoyment outcomes with those of students exposed to traditional PE activities. By integrating a physiologically efficient exercise model with a potentially motivating rhythmic structure, the study addresses a school-based question of clear instructional value: whether beat-matched HIIT can serve as an effective, enjoyable, and implementable PE strategy for adolescent learners. In doing so, it provides evidence that may support more engaging, fitness-oriented PE programming and inform a context-responsive action plan for school implementation.

2. Method

2.1 Research Design

The study employed a quasi-experimental research design, specifically the pretest–posttest non-equivalent groups design, to determine the effects of a beat-matched high-intensity interval training (HIIT) program on the cardiovascular endurance, perceived motivation, and enjoyment of Grade 10 students at Dagupan City National High School. This design was appropriate because it enabled the researcher to compare two naturally existing groups under authentic school conditions: an experimental group exposed to the beat-matched HIIT intervention and a control group that continued with traditional physical education activities. Prior to the intervention, both groups were administered baseline assessments using a standardized cardiovascular endurance test and self-report questionnaires on motivation and enjoyment to establish initial comparability. The intervention was then implemented over an 8–12-week period during regular physical education classes, with the experimental group participating in structured music-synchronized HIIT sessions designed to regulate exercise pace and enhance engagement. After the intervention, the same instruments were administered to both groups to determine changes in physical and affective outcomes. By integrating pretest and posttest measurements with group comparisons, the design enabled the study to examine treatment effects in a systematic, statistically defensible manner while preserving the natural educational setting in which the intervention was applied.

2.2 Participants

The participants in the study were 150 Grade 10 students officially enrolled at Dagupan City National High School, selected as respondents because they were in the developmental stage most actively engaged in structured school-based physical education and were physically capable of participating in moderate- to vigorous-intensity exercise interventions. The sample was divided into two groups: an experimental group that underwent the beat-matched high-intensity interval training (HIIT) program for 8–12 weeks and a control group that continued with traditional physical education activities, thereby allowing a direct comparison of outcomes under authentic classroom conditions. A purposive sampling technique was employed to ensure that only students who met the inclusion criteria were admitted to the study, specifically those who were regularly attending Grade 10 physical education classes, medically fit to participate, and free from physical limitations or health conditions that could compromise safety or performance during the intervention. Students with medical concerns that might restrict physical exertion were excluded to protect participant welfare and to preserve the internal consistency of the dataset. This participant structure was appropriate for the study because it provided a manageable yet sufficiently robust sample for examining the effects of the beat-matched HIIT program on

cardiovascular endurance, perceived motivation, and enjoyment within a real secondary school context.

2.3 Instrumentation

The study employed a set of carefully selected and functionally aligned instruments to capture both the physiological and psychological outcomes of the beat-matched high-intensity interval training (HIIT) intervention among Grade 10 students. Cardiovascular endurance was measured using the 20-Meter Progressive Aerobic Cardiovascular Endurance Run (PACER) test, which served as the primary standardized fitness instrument for determining pretest and posttest changes in aerobic capacity. To assess the psychological dimension of the intervention, the researcher administered a motivation questionnaire to determine students' perceived motivation toward physical activity before and after exposure to beat-matched HIIT sessions. In addition, students' affective responses to participation were measured using the Physical Activity Enjoyment Scale (PACES), which provided a structured means of evaluating the degree of pleasure and positive engagement experienced during the exercise program. These instruments were appropriate for the study because they captured the central variables identified in the statement of the problem—namely, cardiovascular endurance, perceived motivation, and enjoyment—while also allowing the researcher to compare changes across time and between groups using quantifiable data. Taken together, the PACER test and the self-report scales constituted a coherent, methodologically sound instrument for evaluating the effectiveness of the beat-matched HIIT program in a secondary school physical education setting.

2.4 Data Analysis

The data gathered in the study were systematically organized, encoded, and analyzed using quantitative statistical procedures appropriate to the research objectives and the quasi-experimental nature of the investigation. Descriptive statistics, particularly the mean and corresponding interpretive descriptors, were first employed to summarize the cardiovascular endurance scores and perceived motivation levels of the Grade 10 students before and after participation in the beat-matched high-intensity interval training (HIIT) program. To determine the relationship between students' psychological and physiological responses, a correlational analysis, specifically Pearson's product-moment correlation, was used to examine whether cardiovascular endurance and perceived motivation were significantly associated, particularly in relation to students' adherence to the intervention. For the comparative component of the study, independent-samples t-tests were used to determine whether a statistically significant difference in perceived enjoyment of physical activity existed between the experimental group exposed to beat-matched HIIT and the control group participating in traditional physical education activities. As indicated in the methodology, comparative procedures such as ANCOVA were also considered where appropriate for group comparison. Using this analytical framework, the study generated statistically grounded interpretations of change, association, and group differences, thereby providing a coherent empirical basis for evaluating the effectiveness of beat-matched HIIT as a school-based physical education intervention.

3 Results

The study found that the beat-matched high-intensity interval training (HIIT) program was associated with a marked improvement in cardiovascular endurance among Grade 10 learners in the experimental group. Based on the PACER results, the experimental group's mean pretest score was 28.45 laps, indicating a below-average performance. In contrast, the mean posttest score increased to 38.72 laps, interpreted as average to above average, yielding a mean gain of 10.27 laps. This pattern indicates that after 8–12 weeks of participation in beat-matched HIIT sessions, learners were able to sustain a longer, more demanding aerobic effort than before the

intervention. The results suggest that the structured interval format, together with the rhythmic support of synchronized music, created a physically stimulating environment that helped students maintain pace, tolerate exertion, and improve aerobic capacity over time.

The study likewise found a substantial improvement in the learners' perceived motivation toward physical activity after exposure to the beat-matched HIIT program. Prior to the intervention, the experimental group obtained a mean motivation score of 3.12, which was interpreted as moderate motivation. After the intervention, this increased to 4.21, corresponding to high motivation, for a mean gain of 1.09 points. This result indicates that the program did not merely improve physical endurance; it also enhanced the learners' willingness to participate, their enthusiasm toward exercise, and their positive disposition toward physical education activities. The findings imply that the combination of structured high-intensity movement and beat-matched music made the sessions feel more energizing, engaging, and rewarding than conventional routines, thereby strengthening students' internal drive to participate.

A further important result of the study was the strong positive relationship between perceived motivation and cardiovascular endurance. The correlational analysis yielded an r -value of 0.72, interpreted in the thesis as a strong positive relationship, indicating that learners who reported higher motivation also tended to obtain better PACER performance. This finding suggests that the affective and physiological dimensions of the intervention were closely linked. Students who were more interested, more engaged, and more willing to exert effort during the beat-matched HIIT sessions also appeared to derive greater cardiovascular benefit from the program. In this sense, the results underscore that endurance development in school-based exercise is not solely a matter of physical exposure to training, but is also shaped by the learner's motivational state and psychological readiness to participate fully.

The study also revealed that perceived enjoyment of physical activity was higher among students who participated in beat-matched HIIT than among those who engaged in traditional physical education activities. In the descriptive comparison, the experimental group reported higher enjoyment, while the control group reported only moderate enjoyment. More importantly, the independent-samples t -test confirmed a statistically significant difference between groups: the experimental group obtained a mean enjoyment score of 4.32 ($SD = 0.41$), while the control group obtained 3.71 ($SD = 0.48$), with $t = 6.85$ and $p = 0.000$. These findings indicate that the beat-matched HIIT format produced a more pleasurable, emotionally positive exercise experience than regular PE activities. The results support the view that rhythm, novelty, and structured intensity can reduce monotony and heighten students' enjoyment, making physical activity more attractive and more likely to be sustained.

Taken together, the results show that the beat-matched HIIT program produced favorable outcomes across the study's major variables: cardiovascular endurance improved, motivation increased, and motivation was strongly associated with endurance performance, with enjoyment significantly higher in the experimental group than in the control group. These converging findings suggest that beat-matched HIIT functioned as both an effective fitness intervention and a motivating pedagogical strategy within the secondary school PE setting. The overall pattern of results provided the empirical basis for the study's proposed action plan, which recommended integrating beat-matched HIIT into the Grade 10 physical education curriculum, supporting teacher training, using student-preferred music, and monitoring endurance and motivation regularly to sustain participation and fitness improvement. One caution, however, is that the thesis presents two slightly different descriptive enjoyment summaries in separate tables; the inferential comparison table with the reported t -value and p -value provides the clearest basis for the conclusion that enjoyment differed significantly between groups.

4. Discussion

The present study found that the beat-matched high-intensity interval training (HIIT) program improved cardiovascular endurance, with the experimental group's PACER mean increasing from 28.45 laps at pretest to 38.72 laps at posttest after the 8–12-week intervention. This pattern is strongly corroborated by contemporary school-based HIIT literature. An umbrella review by Poon et al. (2024), which synthesized 18 systematic reviews, 223 original studies, and 13,900 participants, concluded that HIIT is effective for improving cardiorespiratory fitness and other cardiometabolic indicators in children and adolescents. Likewise, Duncombe et al. (2022) reported in a systematic review and meta-analysis that school-based HIIT is effective for improving several health outcomes, while Jovanović et al. (2024) found that HIIT implemented during physical education classes significantly improved selected health-related fitness components in adolescents. Taken together, these studies support the interpretation that the rise in PACER performance in the present study was not incidental; rather, it reflects the well-documented capacity of HIIT to generate meaningful aerobic adaptations within school schedules.

The study also showed that students' perceived motivation increased from 3.12 (moderate) to 4.21 (high) after participation in the beat-matched HIIT sessions. This finding is consistent with the literature, which shows that motivation in physical education improves when exercise is both intense enough to feel purposeful and enjoyable enough to remain engaging. White et al. (2021), in a systematic review of qualitative studies, found that competence and relatedness satisfaction in physical education are closely associated with positive affect and participation. In a more directly relevant PE context, Cools et al. (2023) reported that students experienced significantly greater motivation, more joy, and more fun during PE lessons with music than without. Park et al. (2023) further explained that music can enhance physical activity by promoting positive affect, reducing perceived exertion, and increasing hedonic motivation to continue moving. These converging findings help explain why the students in the present investigation responded favorably to beat-matched HIIT: the intervention likely combined physiological challenge with rhythmic stimulation, thereby supporting both effort and willingness to participate.

A similarly important result of the study was the strong positive relationship between motivation and cardiovascular endurance ($r = .72$), together with the significantly higher enjoyment reported by the experimental group compared with the control group ($M = 4.32$ vs. 3.71 ; $t = 6.85$, $p = .000$). These findings are corroborated by broader evidence on music and affective responses during exercise. Terry et al. (2020), in a meta-analytic review, concluded that music has positive effects on exercise performance, affect, and perceived exertion across a wide range of physical activity settings. More specifically, in HIIT, Karageorghis et al. (2021) found that respite-active music improved enjoyment and remembered pleasure during high-intensity interval training. In PE settings, Cools et al. (2023) similarly observed that music enhanced joy, enthusiasm, and competence. Thus, the present study's higher enjoyment scores and the strong association between motivation and endurance are theoretically and empirically plausible: when students experience exercise as enjoyable and energizing, they are more likely to sustain effort, tolerate discomfort, and achieve better endurance outcomes.

Overall, the present study aligns well with the contemporary consensus that school-based HIIT can be an effective and time-efficient strategy for improving adolescent fitness, and that the addition of music may strengthen the motivational and affective factors that support participation. The findings, therefore, contribute to a growing body of evidence suggesting that physical education interventions are most effective when they address both the physiological and psychological dimensions of exercise. At the same time, the results should be interpreted within the study's context: they were derived from a single school over a relatively short intervention period. They relied partly on self-report measures for motivation and enjoyment. Even so, the consistency between the present findings and the wider evidence base supports the conclusion

that beat-matched HIIT is a promising, school-feasible approach for improving cardiovascular endurance, enhancing motivation, and making physical activity more enjoyable among Grade 10 learners.

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