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Optimising Physical Training in DanceSport by Using HIIT Training and Smart Devices for Monitoring Physical Activity

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Abstract: *This study investigates the effectiveness of High-Intensity Interval Training (HIIT), specifically for Tabata, combined with smart monitoring devices on adult dancesport practitioners' physical fitness and performance. The primary objective was to assess the impact of these interventions on key physical parameters and overall performance. Forty participants were divided into two groups: an experimental group (n=20) that engaged in Tabata training three times a week while using smart devices to monitor their activity, and a control group (n=20) that continued with their regular training routines. The experimental group showed significant improvements in aerobic and anaerobic capacity, agility, and overall motor performance throughout the study. These enhancements were measured using standardized physical assessments and the Mann-Whitney non-parametric test, confirming statistically significant progress in the experimental group compared to the control group. Integrating smart devices was crucial in maintaining and enhancing participant motivation, providing real-time feedback, facilitating goal-setting, and allowing for progress tracking, contributing to increased responsibility and engagement in physical activity. Participant feedback highlighted the motivational benefits of smart technology, consistent with existing literature. The immediate performance data and synchronization with fitness apps enhanced the training experience, promoting continuous improvement and long-term commitment. The findings indicate that combining Tabata training with smart monitoring devices effectively improves the physical and technical performance of adult dancesport practitioners. This dual approach enhances physical conditioning and also ensures training relevance to the specific demands of dancesport, maintaining both aesthetic and functional performance aspects. In conclusion, using HIIT, specifically Tabata, alongside smart devices, offers a powerful methodology for optimizing dancers' physical preparation. Future research should investigate the long-term impacts of these training programs, integrate different forms of HIIT, and include a broader participant demographic to validate and expand these findings.*

Keywords: *dancesport; physical training; HIIT; Tabata; smart devices*

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1. Introduction

DanceSport is a socio-sporting phenomenon that has acquired significant popularity in recent years, both nationally and globally, which is certified by the increasing number of legitimate athletes, as well as by the intensification of competitive activity.

In this context, specialists in the field make considerable efforts aimed at finding the most appropriate methods, strategies, and means of action to obtain the exceptional results that all those who step into a dancesport hall want (Roșa, 2021).

The practice of dancesport involves a unique combination of artistic and athletic skills, and how a practitioner identifies can vary based on individual preferences and perspectives. In general, sports dancers are often viewed as both artists and athletes, and many of them appreciate and embrace aspects of both sides of this sport discipline.

However, considering the intensification of the competitive activity and, implicitly, the fight for supremacy, especially in the case of adult dancers, it is very clear to us that beyond the technical skills, brought to a high level of perfection, it also requires an effort capacity brought to the level of excellence, as well as an optimal health.

The complexity of sports performance is also reflected in the complexity of training which, in the modern approach to training, must cover all aspects: technical training, tactics, choreography, general and specific physical training, recovery capacity, artistic training, and theoretical training.

The field of dancesport research is constantly expanding, reflecting the increased interest in the performance and the health of dancers.

However, going through the specialised literature (both Romanian and foreign authors) provides us with information mainly about technique, the evolution of figures, and artistic training, but too little about physical training and its methodology in dancesport.

This can be explained by the fact that there was a prejudice among those involved in the dancesport phenomenon (coaches and athletes), according to which physical training, especially strength training, induces morphological changes that will negatively affect the dance technique, as well as the aesthetic side (Koutedakis et al., 2005).

Lately, however, the mentality of dancesports specialists has changed, and adult dancers, especially, tend to give increased importance to physical training, especially to strength training that uses various objects and respects the technical bases of the movement (Girard et al., 2015).

We find very interesting and useful the approach undertaken by (Bota & Arnăutu, 2022) who searched multiple databases (PubMed, Google Scholar, ScienceDirect) to gather the most important research articles on the topic of physical training in dancesports.

According to them, there was a preoccupation of the specialists to complement the traditional training of dancers with other physical training, intended to contribute to the increase of performance capacity. Thus, we learned that additional Pilates training positively influences the posture, strength, and flexibility of dancers (Ahearn et al., 2018). Also, the authors of this review highlighted articles (Mistiaen et al. 2012, McNeely & Sandler, 2007) that promote strength training, resistance, and plyometric exercises to improve some dance-specific motor parameters.

According to (Macovei, 2007), physical training, which has the express purpose of developing motor skills, is present in the training of all categories of athletes, with an appropriate proportion specific to each discipline and sports classification category.

Starting from the premise that physical training constitutes a basic component of the training process of dancers, determining the performance and efficiency of athletes in training and competitions, its major objectives are to obtain an optimal functional capacity of the body, which is reached through a level of superior development and manifestation of the basic and specific motor qualities, through appropriate values of the morpho-functional indices, all based on a perfect state of health.

As in rhythmic gymnastics, in dancesport there is this specific particularity, namely that mainly the coordinative factors are required, and the manifestation of the other capacities is carried out complexly and simultaneously (Macovei, 2007).

The physical component of dancesport, which interests us in this article, aims at both effort capacity and motor qualities, their development being, in fact, the ultimate goal of the training process, achieved through physical training - a set of measures, methods, and means that ensure the development of morphological indices, functional capacity, basic motor qualities and those specific to dancesports.

Most theorists in the field who have undertaken research related to the sports training process place the physical component in an important position for obtaining superior sports performances (Ozolin, 1972; Verhoshansky& Viru, 1991; Nicu, 1993; Manno, 1996; Pradet, 2000).

According to (Nastase, 2011), the effort in dancesport is differentiated according to the tasks required: physical, technical, choreographic, and artistic, both in training and in competitions. Consequently, the purpose of training in dancesports is to improve the effort capacity, the effectiveness of the technical and tactical skills, and the psychic and communication qualities of the dancers, all to maximise the performance capacity.

An older research, carried out in 2009, with the support of the National Sports Research Institute from Bucharest, aimed to establish the characteristics of effort in the 10 dances, based on heart rate indices.

A synthesis of the conclusions of this research highlights the following aspects (Nastase, 2011):

- Latin dances claim a higher energy consumption than standard dances, in both cases girls register higher heart rate values than boys (for example, the most demanding Latin dance is the Jive, with a maximum heart rate for girls of 191 beats/ minute, and from the standard section, the Quickstep);
- In the case of standard dances (Tango and Quickstep), the heart rate undergoes sudden changes right from the beginning of the dance due to the vigorous movements (Tango) and the alert rhythm (Quickstep), after which it stabilises on a slightly ascending platform, almost constant.
- In the case of Latin dances, high heart rate values are noted, both maximum and average, which places the dances in the category of severe efforts.
- Due to the variable duration of the breaks between dances (depending on the phase of the competition, the organisers, etc.), recovery - another important aspect that must be taken into account, is influenced by the volume and intensity of the effort; also, it was highlighted that the optimal recovery time is relatively longer than the real one (in competition), being also influenced by the training period.

Starting from the characteristics of dancesports and specific effort, stated above, we propose in this paper to highlight how HIIT (Tabata) training, but also the use of smart devices for monitoring physical activity, can influence the physical training of dancers, implicitly their performance.

In recent years, interval training (HIIT) has enjoyed great popularity both in gyms and during training in various sports, due to its proven effectiveness in improving cardiovascular capacity in a relatively short time and in its own way flexible training mode.

A particular variant of HIIT programs is the Tabata protocol, whose initiator, Dr. Izumi Tabata, a Japanese researcher, conducted a study (Tabata et al., 1996), that demonstrated the effectiveness of a specific HIIT protocol, which involves short intervals of high-intensity exercises followed by periods of rest or recovery.

In particular, each Tabata round lasts 4 minutes, implicitly 8 intervals of 20 seconds of intense exercises and 10 seconds of rest. There are several studies (Emberts et al., 2013) about the effectiveness of Tabata training, most highlighting the following benefits:

- Stimulation of metabolism;
- Improving aerobic and anaerobic exercise capacity;
- Increasing lean muscle mass;
- Time efficiency.

The versatility of HIIT (Tabata) training, i.e. the possibility of using various exercises, with the body weight, with various objects, as well as the multiple effects common to the specific objectives of physical training in dancesport - improving coordination, balance, agility, strength, developing aerobic and anaerobic resistance (Zabrocka, et al, 2015), encouraged us in our endeavor to complete the technical training of sports dance practitioners with this type of HIIT training (Tabata).

The exercises we used, with figures and technical combinations from dancesport, did not interfere with the aesthetic, artistic, or choreographic aspects and pursued both physical and technical objectives.

HIIT workouts, such as the Tabata protocol, not only improve physical fitness but also contribute to brain adaptations through neuroplasticity (Cotman, C. W., & Berchtold, N. C., 2002). Neuroplasticity—the brain's ability to adapt and change in response to training experiences—plays a critical role in the development of complex motor skills involved in dancesport. Previous studies (Ratey, J. J., & Loehr, J. E., 2011) have shown that intense HIIT exercises increase brain-derived neurotrophic factors (BDNF), a key marker of neuroplasticity, which plays a central role in motor learning processes and the reinforcement of coordination. These neurobiological changes are crucial for motor learning, as they enhance the brain's capacity to adapt to new movement patterns and improve coordination—a critical factor in dancesport, where precise motor skills are essential.

Moreover, attention and decision-making are often under heightened pressure in competitive environments. HIIT has been linked to improved executive function, particularly in managing complex tasks that require sustained attention and quick, strategic decisions (Chang et al., 2012). This is particularly relevant in dancesport, where athletes must respond to dynamic stimuli and adjust their movements in real-time. The intermittent nature of HIIT, with alternating bouts of high-intensity effort and recovery, mirrors the cognitive demands of decision-making in competition. Dancers benefit from the rapid, repetitive exposure to this form of training, which may improve their ability to shift attention and make split-second decisions during performances.

Additionally, mental fatigue is a known factor that can impair both cognitive and physical performance. HIIT's ability to improve aerobic capacity can mitigate mental fatigue by enhancing oxygen delivery to the brain, thus helping athletes maintain high levels of focus and cognitive clarity even under physically demanding conditions (Tomporowski & Ellis, 1986). As a result, HIIT can foster better cognitive resilience, allowing dancers to sustain optimal performance levels during long training sessions or competitive routines.

Moreover, the neuromuscular adaptations driven by HIIT positively influence sensorimotor integration—the process by which the brain integrates sensory inputs to produce smooth and coordinated muscle activity (Mang et al., 2013). This is critical in dancesport, where the integration of visual, vestibular, and proprioceptive feedback is necessary for executing movements accurately in response to environmental cues. By fostering neuroplastic changes in brain regions associated with motor control, such as the motor cortex and cerebellum, HIIT training improves movement accuracy, reduces reaction times, and optimises overall technical performance (Boyke et al., 2008).

Thus, HIIT not only conditions the body but also primes the brain for better motor performance, enhancing both the physical and technical execution required in competitive dancesport. Future studies could further investigate the BDNF-mediated mechanisms underlying these improvements, using techniques like EEG neurofeedback to track real-time neural adaptations during training.

In the context of dancesport, this neural adaptability can optimise the precision and speed of executing technical movements, providing dancers with a competitive advantage.

Another reality of modern times, which we cannot dispute, is the abundance of gadgets, and technologies that come to support an active and healthy lifestyle (Shuang Wu et al., 2023).

Although they can only be worn as cool, fashionable accessories, the number of young people who use them to obtain real-time information about their activity level is increasing, to help them achieve their daily goals.

Equally accessible and "fashionable" are the applications installed on mobile phones which, in Dyachenko's view (2021), cited by Adamenko & al (2022), contribute to increasing students' motivation for regular physical activity.According to these authors, mobile applications increase the interest in independent physical exercises, form the ability to control physical activity, increase motivation to take care of one's health, and form the creative use of digital tools and technologies. (Siepmann & Kowalczuk, 2021) think that self-quantification behavior increases confirmation as smartwatches allow individuals to monitor their health as initially expected.

Regarding the young dancesport practitioners who use such gadgets and applications, we can say that their role is very vast and covers the following aspects (Zahrt et al., 2023):

- ***Measuring and monitoring progress***: Physical activity monitoring devices such as smartwatches, fitness bracelets, or motion sensors allow athletic dancers to measure and track progress in real-time and identify positive developments or areas for improvement. This helps them set realistic goals and adjust their workouts and diet accordingly.
- ***Heart rate and effort level monitoring***: Fitness monitoring devices can monitor the heart rate of athletic dancers during training and performance, providing essential information about their level of effort and recovery. This allows dancers and coaches to optimise the intensity of their training and properly plan their rest periods to avoid overtraining and injuries.
- ***Tracking calories and activity level***: Fitness trackers can calculate roughly how many calories are burned during a workout session or a dance performance. This information is useful for managing nutrition and caloric intake, as well as for assessing the balance between physical activity and food intake.
- ***Analysis of sleep quality and recovery***: A crucial aspect of physical training is ensuring good recovery between training sessions and competitions. Fitness trackers can track the sleep quality and recovery level of the athletic dancers, providing recommendations to improve them and reduce the risk of overwork and chronic fatigue.
- ***Motivation and engagement***: The interface and interactive functionalities of physical activity monitoring devices can increase the motivation and engagement of athletic dancers in physical training. The ability to set goals, track progress, and compete with other users can provide extra incentive to achieve better performance and stay committed to their training regimen.

2. Materials and Methods

2.1. Research hypotheses

In this study, we aim to verify the following research hypotheses:

The use of interval training, more specifically Tabata, in the physical training of dancers, in a proportion corresponding to the characteristics of the training periods, will contribute to improving the indices of motor qualities involved in the practice of sports dance.

In addition to Tabata training, the smart gadgets and mobile applications used by sports dance practitioners provide extra motivation and aid in optimising athletes' functional capacity, while also improving their technical and competitive performance indicators.

2.2. Research objectives

- Initial assessment of physical, functional, and technical parameters for both groups;
- Development and implementation of HIIT – Tabata training programs;
- Identifying the motivation for the use of smart devices for monitoring physical activity in dancesport practitioners, adult category;
- Experimental demonstration of the effectiveness of the application of HIIT programs and the use of smart gadgets in improving the indices of manifestation of dance-specific motor qualities, as well as the functional capacity of dancers.

2.3. Research sample

Our experimental approach took place on a sample of 40 subjects (20 girls and 20 boys), aged between 18 and 23, from various sports classes, registered at the ACS Top Dance 2007 Sports Club and the ”Sportul Studențesc” Club Bucharest, all engaged in the competitive system of the Romanian Dance Sport Federation.

Among them, 20 athletes (10 pairs) who used smartwatches and also benefited from Tabata training, 3 times a week, constituted the experimental group, and the other 10 pairs (20 practitioners), who trained as usual, represented the control group.

The dancers in the experimental group used smartwatches (e.g., Garmin, Apple Watch) and fitness trackers (e.g., Fitbit, Xiaomi Mi Band), along with compatible monitoring apps installed on smartphones, such as Garmin Connect and Fitbit App. These devices tracked several physiological and physical activity parameters, including:

- ***Heart rate***: real-time monitoring of heart rate during training sessions and competitions, with an evaluation of the cardiovascular response to HIIT exercises;
- ***Number of steps and distance covered***: to measure the intensity of physical activity and ensure that daily goals were met (at least 13,000 steps, of which 3,000 were running steps);
- ***Calories burned***: an estimate of energy expenditure during each training and dance session.

The devices used in this study provide real-time monitoring, but the implementation of artificial intelligence (AI) algorithms could significantly improve the training process. Recent advances in artificial intelligence (AI) (Connolly, M., & Moran, K., 2020) offer new possibilities for personalising and optimising training. Smart devices that use machine learning algorithms can analyse physiological and motor data collected during training sessions to provide real-time personalised feedback (Jordan, M. I., & Mitchell, T. M., 2015). For example, AI can analyse the data obtained during training to detect subtle patterns of fatigue or overexertion, allowing for the adjustment of the training program before injuries occur. Additionally, AI could customise training programs according to each dancer's individual needs, optimising technical and motor performance.

AI-based feedback can also optimise technical and motor performance by making real-time adjustments to the intensity of exercises (Marzbani, H., Rezaei, M., & Moini, A., 2016). This continuous adaptation capability is essential for preventing injuries and improving overall performance among dancers. AI integration can support training by automatically assessing motor parameters and adjusting training programs to maximise efficiency.

Furthermore, future research could explore the use of neurofeedback during training (Gruzelier, J. H., 2014). Neurofeedback is a technique that allows individuals to monitor and regulate their brain activity, often leading to improvements in focus, emotional regulation, and stress management. In high-performance environments such as DanceSport, where mental clarity and focus are as critical as physical ability, neurofeedback could serve as a powerful tool for enhancing both cognitive and physical performance (Gruzelier, 2014).

Studies have demonstrated that neurofeedback training can help athletes learn to modulate their brainwaves, particularly in regions associated with attention and stress response (Vernon et al., 2009). By training dancers to self-regulate cognitive states such as focus and arousal, neurofeedback could enable them to maintain optimal concentration during performances, particularly under pressure. For example, during competitive events, dancers often experience heightened anxiety or mental fatigue, which can impair technical execution. Real-time neurofeedback could provide them with the ability to monitor and adjust their brain activity, potentially reducing performance anxiety and enhancing motor control and decision-making.

Moreover, neurofeedback could bridge the gap between neuroscience and physical training by offering dancers insight into their cognitive and emotional responses during high-intensity training. By incorporating neurofeedback into regular training sessions, dancers could fine-tune their mental performance alongside their physical conditioning. This integrated approach could support improved mind-body synchronisation, fostering greater resilience in high-pressure competitive environments. Future research could explore the specific benefits of neurofeedback in dance, particularly in how it influences brain plasticity, motor learning, and attention regulation during complex motor tasks.

Subject eligibility criteria:

To be included in the study, subjects had to meet the following criteria:

- Over 18 years old;
- Their consent to participate in evaluation and training;

Subject exclusion criteria:

- Refusal of evaluating and training;
- Age less than 18 years;
- Medical problems, especially cardio-respiratory.

The research took place between September 2023 and December 2023, with 4-5 training per week and competitions on weekends (competitive period), our study has the following stages (table no. 1):

Table 1. The stages of the research

September 2023	Initial assessment - experimental group and control group
September – December 2023	Application of the training program to the experimental group
December 2023	Final assessment - experimental group and control group Experiment data processing

2.4. Research instruments

In our approach, we used a battery of tests that we developed on the occasion of another scientific initiative (Rosa, 2021), with the help of which we tried to create the motor profile of dancesport practitioners.

We consider that the use of this combination of tests allows for the assessment of the majority of Physical Fitness components and can help plan effective training programs and cultivate sporting talent (Tabacchi et al., 2019).

Thus, starting from the famous Eurofit test battery (1993), respectively the version for adults (1995), for the evaluation of motor parameters we adapted the respective tests to the specificity of dancesport.

- Dynamic balance test

The subject sits on the narrow side of the gymnastic bench, contact with the support surface is made at the level of the tip of the foot, facing a trellis. The test consists of performing for 45 sec. of the technical element "samba walk" in samba. The timer starts at the start of the music, when the subject is in the starting position, without any support, and each imbalance (falling, rebalancing, using the trellis as a support) is counted. If the subject loses balance 10 times in the first 25 seconds of the test, the test is stopped.

The examiner awards points according to the number of mistakes (imbalances): 0 mistakes - 10 points, 1 mistake - 9 points, 2 mistakes - 8 points, 3 mistakes - 7 points, 4 mistakes - 6 points, 5 mistakes - 5 points, 6 mistakes - 4 points, 7 mistakes - 3 points, 8 mistakes - 2 points, 9 mistakes - 1 point, 10 mistakes - 0 points.

- Spinal mobility measurement – ensures the assessment of the flexibility of the vertebral and coxo-femoral joints.

A gymnastic bench and a ruler are used. The subject will sit in front of the gymnastic bench and will try, by bending the trunk forward, to touch it with his fingers or go over its edge. With the help of the ruler, the distance between the fingertips and the bench is measured, recording a positive value in centimeters if the fingers exceed the edge of the bench and a negative value if the subject does not touch the bench.

- Measurement of trunk and shoulder mobility

A vertical line is drawn on the wall. The subject stands directly in front of the line, with his back to the wall, an arm's length away, with his feet shoulder-width apart. The arms are extended in front, parallel to the ground, and from this position the athlete will twist the trunk to the right and touch the wall with the fingertips, keeping the arms extended and parallel to the ground (the legs must not move from the starting position). Mark the place where the fingertips touch the wall and measure the distance from this point to the vertical line. If this point is located up to the vertical line, the score is negative, if it exceeds this line, the score is positive. The whole protocol is repeated on the left side as well.

The score is given by the average of the results obtained on the two sides.

- Vertical jump test – to measure the explosive strength in the lower limbs

The subject stands sideways to the wall, extends the arm closest to the wall, and marks the point where the fingers touch the wall with chalk. Next, the subject steps away from the wall and, using both legs and arms, projects the body vertically, marking where the toes touch the wall at the peak of the jump. Measure the distance between the points on the wall. The best performance in three attempts is recorded.

- Raises of the trunk from lying on the back (Crunches) - ensure the assessment of the strength of the abdominal muscles.

The subject, lying on his back, knees bent, forming an angle of 90 degrees between the thigh and the pelvis, with his hands at the back of his head and with his ankles fixed by a partner, performs as many trunk lifts as possible in 30 sec. The examiner times and records the number of repetitions.

- Maintaining an isometric position: support on the palms and the top of the legs (plank) - palms separated by twice the width of the shoulders, elbows bent, arms parallel to the ground - to measure strength and resistance at the level of the back, shoulders, and abdomen.

From standing on the knees, the subject fixes the position of the palms and arms, then raises the pelvis, and stretches the legs, creating a straight line from head to feet. Once this position is fixed, the timer starts. The test stops when the subject can no longer keep his back straight when he lowers his pelvis, or when his arms give out. The value is recorded in seconds.

- Shuttle: 10x5m chasse – provides an assessment of specific movement speed and agility.

Two parallel lines are drawn on the ground at a distance of 5 m from each other, and the subject is asked to move as quickly as possible between them using the chasse in the quick step, covering a total of 50 m and touching the line each time with his foot towards which the movement was made. The examiner times the execution and records the performance in seconds.

Since the cardio-respiratory demand is extremely important in dance, for the *functional evaluation*, we used The High-Intensity Dance Fitness Test, adapted for DanceSport. Dancers need good stamina to work at their best, delay the onset of fatigue, and help prevent fatigue-induced injuries.

Thus, we composed a simple jive choreography, one of the most demanding of the 10 dances, the actual test consisting of 4 one-minute dance stages, followed by a 1-minute break each, this ratio being characteristic of competitions of dancesport (an average as the duration of requests and breaks, depending on the competition stage).

At the end of each one-minute stage, the athletes' heart rate was measured, so that at the end of the test, 4 values were recorded and averaged.

Description of the 1 minute movement (Figure 1):

LF Flick
RF Flick
Double Flick with LF - forward, to side
LF-RF-LF Drunken sailor step
RF Flick
LF Flick
4 Flicks with RF – forward, to side, backward, to side
RF-LF-RF Drunken sailor step
LF-RF-LF Drunken sailor step
4 Taps with RF – forward, to side, forward, to side
RF Closed Step
LF Tap to side
LF-RF-LF Drunken sailor step
Spot Turn on LF
RF-LF-RF Three Step Turn to R

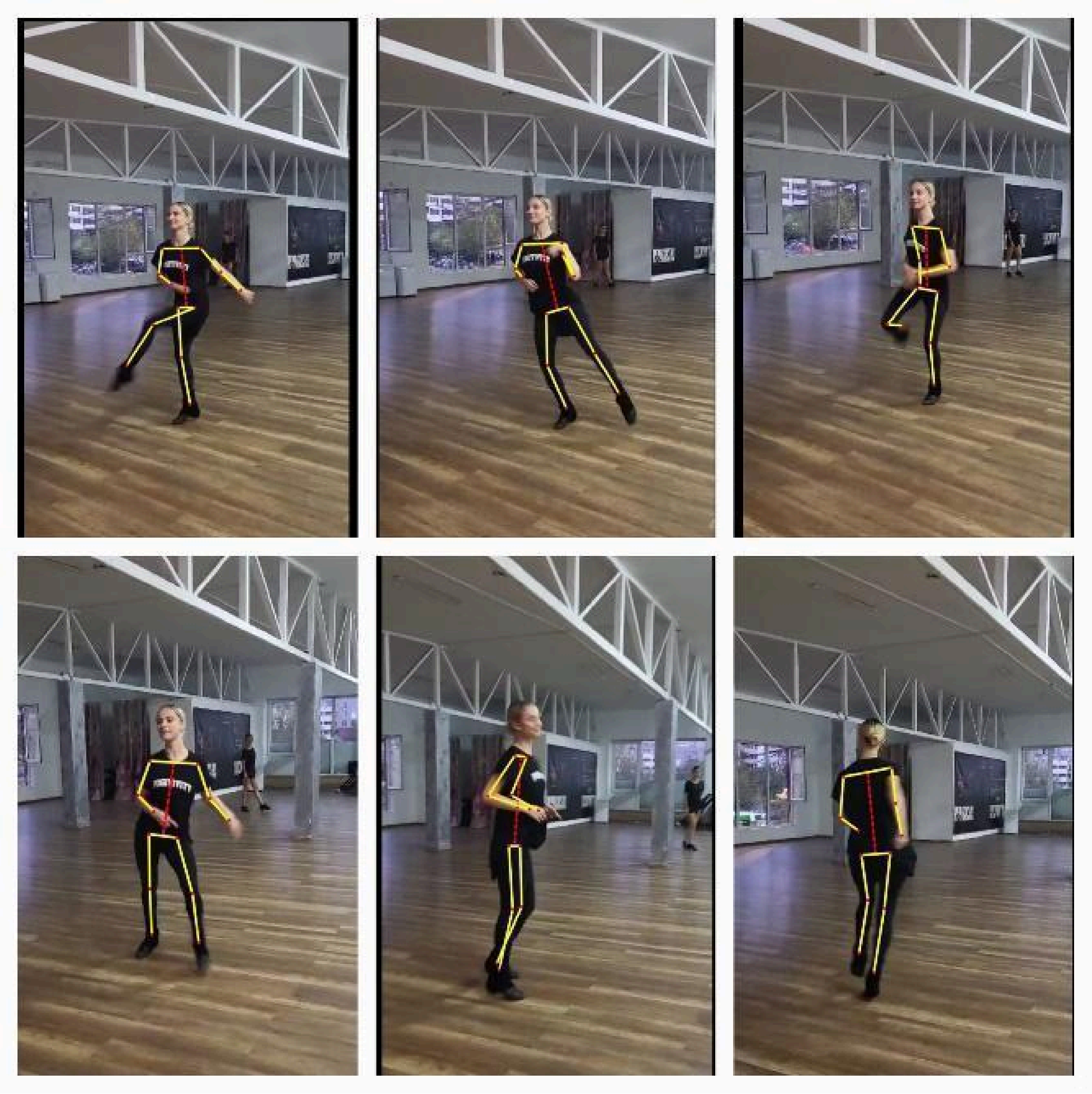

Figure 1. Description of the functional test

For the subjects in the experimental group, the heart rate was measured using the devices (smartwatches) that they wear during training, and in the case of those in the control group, the manual method was used.

We used this kind of functional assessment, based on other studies that demonstrated (Wyon et al, 2004) the degree to which HR and VO2 are related during intense activity such dance, therefore the high intensity dance specific test is a reliable and valid means of assessing and monitoring the cardiovascular fitness of dancers. The test allows dancers to be assessed within an environment that they are used to (the studio) using a mode of exercise that is relevant (dance) and is of an adequate intensity to be representative of performance.

In the case of *the technical evaluation*, to achieve the most objective evaluation of the quality of technical expression against the background of specific physical demands, we used the research evaluation method with characteristics from arbitration, by awarding marks both at the initial testing and at the final testing. The 2 evaluators who were part of the team are coaches at the ACS Top Dance 2007 Sports Club, respectively the ”Sportul Studentesc” Bucharest Club.

We specify that, both at the initial and at the final testing, the athletes were filmed while performing the choreography for evaluation, respecting the same conditions, namely the location, the outfit, and the music. The judges had the opportunity to watch the recordings several times, and with the help of the CoachView **application** (Firecracker Software LLC, 2024) (CoachView is a cutting-edge video player designed specifically for coaches and athletes who want to improve their technique in any sport), it was possible to analyse the performance frame by frame, as well as the simultaneous comparison of the 2 choreographic evolutions (initial and final) to easily identify the differences.

In this way, we consider that each criterion and sub-criteria that are the subject of the evaluation benefited from the maximum objectivity.

Grades were given from 1 to 10 (1 – very poor, 2 – poor, 3- weak, 4 – fair, 5 – average, 6 – above average, 7- good, 8 – very good, 9 – superior, 10 – outstanding), according to the following criteria (Nicoara, 2016): movement to music (timing, rhythm, musical structure, musicality), posture and coordination (lines of the upper limbs, coordination), quality of movement and balance, the relationship between partners and leadership (physical connection, collaboration without connection, leading according to the character of the dance, efficiency, consistency), choreography and presentation (content, space, level of difficulty, atmosphere, creativity, interpretation).

To evaluate the dancers' *motivation* regarding the use of smart monitoring devices, we utilised an *online questionnaire* specifically developed for this study. The questionnaire included questions structured on a 5-point Likert scale (1 - Strongly Disagree, 5 - Strongly Agree) to measure the athletes' perception of responsibility, personal improvement, immediate feedback, planning and adjustment, long-term motivation, ease of use, and the integration of devices into daily activities. The questionnaire was distributed to participants at the end of the experimental period and the data were collected and analysed to identify trends in their responses.

2.5. Procedure of intervention

During the period dedicated to our experiment, the athletes in the experimental group benefited from additional HIIT (Tabata) training (Table 2), 3 times a week. Also, the subjects in the experimental group were required to set a goal of at least 13,000 steps on their smartwatch, of which at least 3,000 steps should be run.

The data collected from the smart devices were correlated with the observed improvements in functional parameters (e.g., lower heart rate during intense activities) and technical parameters (e.g., trunk mobility and coordination). The use of smart devices allowed for detailed and objective monitoring of each dancer's progress, thus contributing to the adjustment and personalisation of training sessions.

The dancers in the control group carried out their training in the usual way, with different proportions of the technical, physical, and artistic components depending on the training period (preparatory, pre-competitive, competitive, etc.).

Table 2. Tabata program models

Workout 1: Jive and Core Focus	**Workout 2: Samba and Lower Body Strength**	**Workout 3: Quickstep and Cardio Blast**	**Workout 4: General Conditioning**	**Workout 5: Jive and Quick Feet**
Jive Basic Movement (20 sec) Plank (20 sec) Jive Chasses (20 sec) Bicycle Crunches (20 sec) Jive Swivels (20 sec) Russian Twists (20 sec) Jive Kicks (20 sec)	Samba Whisks (20 sec) Squats (20 sec) Samba Voltas (20 sec) Lunges (20 sec) Samba Bota Fogos (20 sec) Jumping Jacks (20 sec)	Quickstep Scatter Chasse (20 sec) High Knees (20 sec) Quickstep Continuous Forward Lock Steps (20 sec) Burpees (20 sec) Quickstep Running Steps (20 sec) Mountain Climbers (20 sec)	Jumping Jacks (20 sec) Push-ups (20 sec) High Knees (20 sec) Plank (20 sec) Burpees (20 sec) Russian Twists (20 sec) Mountain Climbers (20 sec)	Jive Flicks (20 sec) Fast Feet Drill (20 sec) Jive Chasse to left and to right(20 sec) Side-to-Side Hops (20 sec) Jive Toe and Heel swivel (20 sec) Lateral Shuffle (20 sec) Jive Rock Basic Movement (20 sec)

Flutter Kicks (20 sec)	Samba Basic Movement (20 sec) Calf Raises (20 sec)	Quickstep Stutter Chasse (20 sec) Jump Rope (20 sec)	Bicycle Crunches (20 sec)	Box Jumps (20 sec)
Workout 6: Samba and Core Stability Samba Carioca Runs (20 sec) Plank with Leg Lifts (20 sec) Samba Side Steps (20 sec) Side Plank (20 sec) Samba Cruzados Walks (20 sec) Superman Hold (20 sec) Samba Travelling Voltas (20 sec) Russian Twists (20 sec)	**Workout 7: Quickstep and Agility** Quickstep Tipsy Chasse (20 sec) Agility Ladder Drills (20 sec) Quickstep Chasses Combination (20 sec) Shuttle Runs (20 sec) Quickstep Step Hops (20 sec) Cone Drills (20 sec) Quickstep Running Steps (20 sec) Side-to-Side Hops (20 sec)	**Workout 8: Jive and Explosiveness** Jive Kicks (20 sec) Squat Jumps (20 sec) Jive Kick Ball Change and chasse (20 sec) Power Lunges (20 sec) Jive Flicks (20 sec) Plyometric Push-ups (20 sec) Jive Chasses to left and to right (20 sec) Box Jumps (20 sec)	**Workout 9: Samba and Endurance** Samba Whisks (20 sec) Jog in Place (20 sec) Samba Bota Fogos (20 sec) Jumping Jacks (20 sec) Samba Travelling Voltas (20 sec) High Knees (20 sec) Samba Cruzados Walks (20 sec) Jump Rope (20 sec)	**Workout 10: Quickstep and Full Body Burn** Quickstep Running Step (20 sec) Burpees (20 sec) Quickstep Scatter Chasses (20 sec) Mountain Climbers (20 sec) Quickstep Continuous Forward Lock Steps (20 sec) Russian Twists (20 sec) Quickstep Step Hops (20 sec) Plank Jacks (20 sec)

3. Results

The statistical analysis was conducted using SPSS software (version X.X). To compare the results between the experimental group and the control group, the Mann-Whitney and Wilcoxon tests were applied for non-parametric data, as the distribution of variables was not normal according to the Shapiro-Wilk test. Means, standard deviations, and coefficients of variability were calculated for each evaluated physical and technical parameter. The significance threshold was set at $p \leq 0.05$ to determine statistically significant differences between the groups.

Given the relatively small sample size (n=40) and the fact that the distribution of variables was not normal according to the Shapiro-Wilk test, we opted for non-parametric statistical methods. The Mann-Whitney and Wilcoxon tests are frequently used in studies with small sample sizes and non-normal distributions because they provide a robust solution for comparing medians between groups without assuming data normality. These methods allow for the identification of significant differences in the physical and technical performances between the experimental and control groups, maintaining statistical rigor under limited sample conditions.

The results of processing the functional, technical, and motor data, for the experimental groups are shown in tables 3, 4, and 5 (girls) and tables 6, 7, and 8 (boys). Each table is structured on four elements:

1. Statistical indicators resulting from the processing of the data collected during the initial testing, for each evaluation performed (mean, standard deviation, and coefficient of variability).
2. Statistical indicators resulting from processing the data recorded at the final test, for each assessment (mean, standard deviation, and coefficient of variability).
3. The average progress made by the athletes at each evaluation, as the difference between the averages obtained in the two tests (Mean ft - Mean it). The progress is highlighted both in terms of value and percentage.
4. The result of the non-parametric Wilcoxon test, applied for each assessment, with the help of which the threshold of statistical significance, p, is determined, which establishes whether or not there are significant differences between the athletes' results in the two tests. In other words, whether the progress is statistically significant or not. If $p <= 0.05$, the athletes' results in the two tests are significantly different (Popa, 2008).

Table 3. Results of the experimental group – Girls (Functional Evaluation)

Evaluations	**EXPERIMENTAL GROUP - GIRLS**						**Non-parametric Wilcoxon Test**	
	Initial Test		Final Test		Average progress			
	Mean ± Stdev	CV	Mean ± Abstd	CV	Value	%	Z	P
FUNCTIONAL EVALUATION								
Heart Rate (beats/ min)								
	189.80 ± 2.10	1.1%	**185.66** ± 2.32	1.2%	-4.14	2.18%	2.803	0.006^{**}

** Progress is significant at the < 0.01 level

Table 4. Results of the experimental group – Girls (Technical Evaluation)

Evaluations	**EXPERIMENTAL GROUP - GIRLS**						**Non-parametric Wilcoxon Test**	
	Initial Test		Final Test		Average progress			
	Mean ± Stdev	CV	Mean ± Abstd	CV	Value	%	Z	P
TECHNICAL EVALUATION								
Marks								
	7.60 ± 0.38	5.0%	**8.82** ± 0.41	4.6%	1.22	16.05%	-2.803	0.006^{**}

** Progress is significant at the < 0.01 level

Table 5. Results of the experimental group – Girls (Motor Evaluation)

Evaluations	**EXPERIMENTAL GROUP - GIRLS**						**Non-parametric Wilcoxon Test**	
	Initial Test		Final Test		Average progress			
	Mean ± Stdev	CV	Mean ± Abstd	CV	Value	%	Z	P
MOTOR EVALUATION								
Dynamic balance (pts.)								
	7.70 ± 1.06	13.8%	**9.20** ± 0.79	8.6%	1.50	19.48%	-2.666	0.007^{**}
Spinal mobility (cm)								
	13.15 ± 5.56	42.3%	**15.10** ± 5.11	33.8%	1.95	14.83%	-2.666	0.008^{**}
Trunk and shoulder mobility (cm)								
	45.50 ± 2.49	5.5%	**48.17** ± 1.98	4.1%	2.67	5.87%	-2.666	0.009^{**}
Vertical jump (cm)								
	29.80 ± 3.16	10.6%	**32.73** ± 3.24	9.9%	2.93	9.83%	-2.803	0.006^{**}
Crunches (reps/30s)								
	22.70 ± 4.00	17.6%	**25.50** ± 1.96	7.7%	2.80	12.33%	-2.521	0.014^{*}
Plank (sec)								
	130.20 ± 2.44	1.9%	**134.50** ± 2.32	1.7%	4.30	3.30%	-2.803	0.005^{**}
Shuttle: 10x5m chasse (sec)								
	21.35 ± 1.27	6.0%	**20.99** ± 1.09	5.2%	-0.36	1.69%	2.666	0.009^{**}

** Progress is significant at the < 0.01 level * Progress is significant at the < 0.05 level

As can be seen from the tables above, during the initial testing, the data are homogeneously dispersed in the case of the majority of evaluations, except for the *spinal mobility* parameter where the dispersion is inhomogeneous, and the *crunches* parameter where the dispersion is relatively homogeneous. At the final test, the data are homogeneously dispersed for all evaluations, except for *spinal mobility*, whose data is inhomogeneously dispersed.

The Wilcoxon test shows for all evaluations the existence of significant progress achieved by the experimental group of girls, the value of the significance threshold $p < 0.05$.

Figures no. 2, 3, and 4 show the differences between the averages in the two tests.

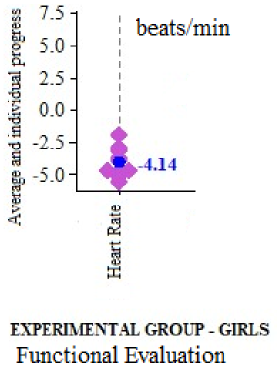

Figure 2. The differences between averages – Final Test – Initial Test
(Girls – Functional evaluation)

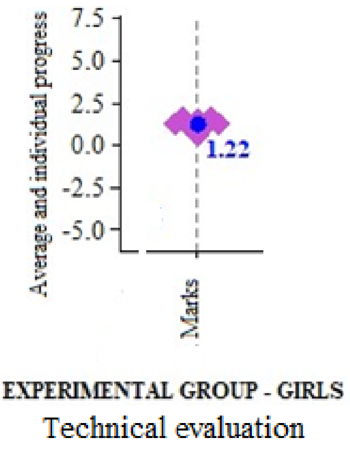

Fig. 3 – The differences between averages – Final Test – Initial Test
(Girls – Technical evaluation)

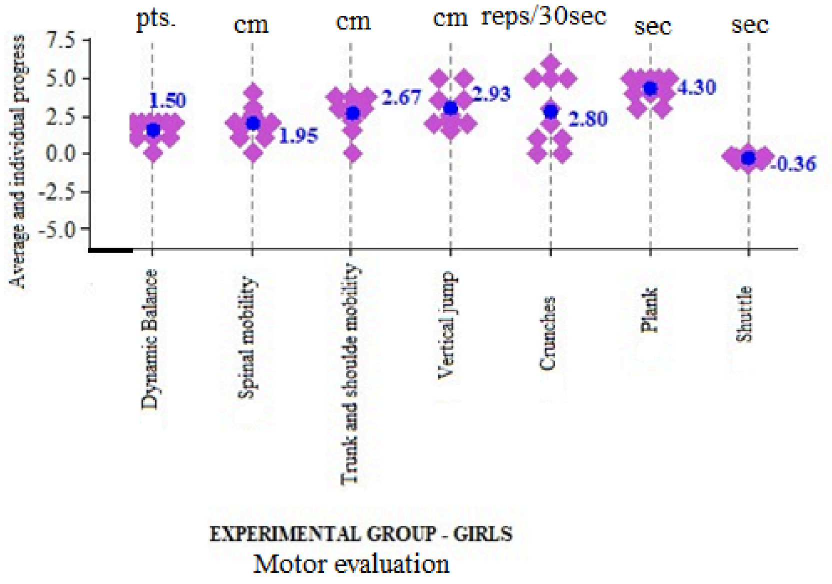

Figure 4. The differences between averages – Final Test – Initial Test
(Girls – Motor evaluation)

The results of the statistical processing of the data specific to the experimental group of boys are presented in Tables no. 6, 7, and 8. At the initial testing, the data are dispersed homogeneously in all evaluations, with the exception of dynamic balance, spinal mobility, and mobility of the trunk and shoulders for which the dispersion is relatively homogeneous. In the final testing, the data is homogeneously dispersed at all assessments.

For this group, the Wilcoxon test shows significant progress for all evaluations, the value of the significance threshold $p < 0.05$.

Table 6. Results of the experimental group – Boys (Functional Evaluation)

Evaluations	**EXPERIMENTAL GROUP - BOYS**						**Non-parametric Wilcoxon Test**	
	Initial Test		Final Test		Average progress			
	Mean ± Stdev	CV	Mean ± Abstd	CV	Value	%	Z	P
FUNCTIONAL EVALUATION								
Heart Rate (beats/ min)								
	186.74 ± 2.96	1.6%	**181.52** ± 2.09	1.1%	-5.22	2.80%	2.803	0.006**

** Progress is significant at the < 0.01 level

Table 7. Results of the experimental group – Boys (Technical Evaluation)

Evaluations	**EXPERIMENTAL GROUP - BOYS**						**Non-parametric Wilcoxon Test**	
	Initial Test		Final Test		Average progress			
	Mean ± Stdev	CV	Mean ± Abstd	CV	Value	%	Z	P
TECHNICAL EVALUATION								
Marks								
	8.21 ± 0.49	6.0%	**8.96** ± 0.49	5.4%	0.75	9.14%	-2.803	0.006**

** Progress is significant at the < 0.01 level

Table 8. Results of the experimental group – Boys (Motor Evaluation)

Evaluations	**EXPERIMENTAL GROUP - BOYS**						**Non-parametric Wilcoxon Test**	
	Initial Test		Final Test		Average progress			
	Mean ± Stdev	CV	Mean ± Abstd	CV	Value	%	Z	P
MOTOR EVALUATION								
Dynamic balance (pts.)								
	7.60 ± 1.43	18.8%	**8.80** ± 0.92	10.4%	1.20	15.79%	-2.366	0.021*
Spinal mobility (cm)								
	7.80 ± 1.32	16.9%	**9.35** ± 1.25	13.4%	1.55	19.87%	-2.803	0.005**
Trunk and shoulder mobility (cm)								
	52.80 ± 9.24	17.5%	**54.05** ± 7.93	14.7%	1.25	2.37%	-2.201	0.035*
Vertical jump (cm)								
	43.00 ± 2.40	5.6%	**44.65** ± 1.86	4.2%	1.65	3.84%	-2.803	0.006**
Crunches (reps/30s)								
	24.30 ± 1.25	5.2%	**25.90** ± 1.29	5.0%	1.60	6.58%	-2.803	0.005**
Plank (sec)								
	130.80 ± 2.20	1.7%	**136.00** ± 2.26	1.7%	5.20	3.98%	-2.803	0.006**
Shuttle: 10x5m chasse (sec)								
	20.50 ± 1.40	6.8%	**20.13** ± 1.25	6.2%	-0.37	1.08%	2.521	0.014*

** Progress is significant at the < 0.01 level * Progress is significant at the < 0.05 level

Figures no. 5, 6, and 7 show the differences between the averages in the two tests.

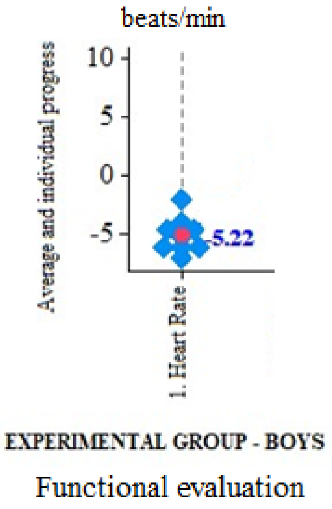

Figure 5. The differences between averages – Final Test – Initial Test (Boys – Functional evaluation)

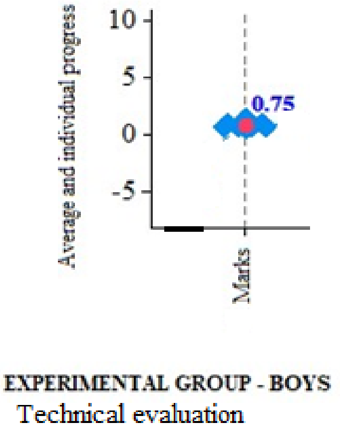

Figure 6. The differences between averages – Final Test – Initial Test (Boys – Technical evaluation)

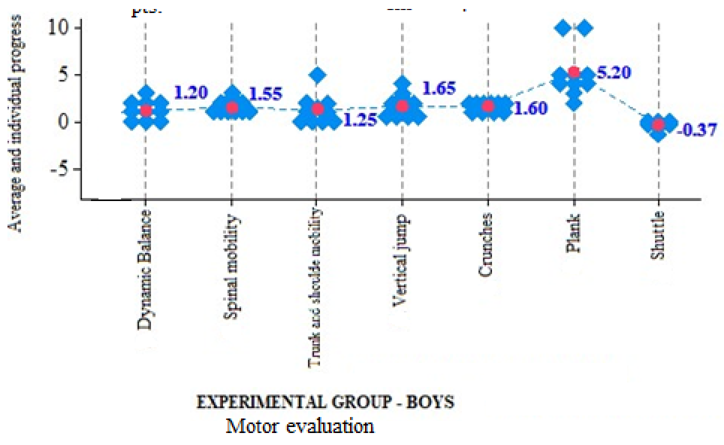

Figure 7. The differences between averages – Final Test – Initial Test (Boys – Motor evaluation)

Tables 9, 10, 11 (girls) and tables 12, 13, and 14 (boys) show the results of processing the functional, technical, and motor data for the experimental and control groups, final tests, also structured on four elements:

1. Statistical indicators resulting from the processing of the data collected at the final test, for the experimental group, with the rendering of the statistical indicators for each evaluation performed (mean, median, and mode ¬ the result with the highest frequency).
2. The same statistical indicators resulted from the final testing of the control groups, girls and boys respectively.
3. The difference in the average results obtained by the athletes of the two groups at the final test for each assessment, (Mean E - Mean C). The difference is highlighted both in terms of value and percentage.
4. The result of the non-parametric Mann-Whitney test, applied to each assessment, to determine the threshold of statistical significance, p, which establishes whether or not there are significant differences between the athletes' results at the final tests of the two groups. The effect size indicator is also shown here, which expresses in value the size of the difference between the final results of the two groups.

Table 9. Girls Final Test – Experimental Group vs. Control Group (Functional Evaluation)

FINAL TEST - GIRLS						**COMPARISON OF FINAL TESTS PER GROUP**				
Control Group			**Experimental Group**			**Means Differences**		**Non-parametric Mann Whitney Test**		**Size effect**
Mean	Median	Mode	**Mean**	Median	Mode	**E - C**				
						Value	%	Z	P	
FUNCTIONAL EVALUATION										
Heart Rate (beats/ min)										
188.56	189.00	189.00	**185.66**	185.70	181.00	-2.90	1.54%	-3.154	0.002^{**}	0.83

** Progress is significant at the < 0.01 level

Table 10. Girls Final Test – Experimental Group vs. Control Group (Technical Evaluation)

FINAL TEST - GIRLS						**COMPARISON OF FINAL TESTS PER GROUP**				
Control Group			**Experimental Group**			**Means Differences**		**Non-parametric Mann Whitney Test**		**Size effect**
Mean	Median	Mode	**Mean**	Median	Mode	**E - C**				
						Value	%	Z	P	
TECHNICAL EVALUATION										
Marks										
7.86	7.80	7.80	**8.82**	8.90	9.00	0.96	12.21%	-3.535	$< .001^{**}$	0.93

** Progress is significant at the < 0.01 level

Table 11. Girls Final Test – Experimental Group vs. Control Group (Motor Evaluation)

FINAL TEST - GIRLS						**COMPARISON OF FINAL TESTS PER GROUP**				
Control Group			**Experimental Group**			**Means Differences**		**Non-parametric Mann Whitney Test**		**Size effect**
Mean	Median	Mode	**Mean**	Median	Mode	**E - C**				
						Value	%	Z	P	
MOTOR EVALUATION										
Dynamic balance (pct.)										
8.40	8.50	9.00	**9.20**	9.00	9.00	0.80	9.52%	-2.100	0.039^{*}	0.52
Spinal Mobility (cm)										
10.80	11.00	10.00	**15.10**	13.00	10.00	4.30	39.81%	-2.022	0.047^{*}	0.52

Trunk and shoulder mobility (cm)										
45.48	45.50	44.50	48.17	48.60	47.80	2.69	5.91%	-2.233	0.028*	0.59
Vertical Jump (cm)										
30.03	30.15	31.00	**32.73**	31.75	31.00	2.70	8.99%	-2.060	0.043*	0.54
Crunches (nr. rep./30s)										
23.20	23.00	23.00	**25.50**	25.00	24.00	2.30	9.91%	-2.140	0.036*	0.56
Plank (sec)										
131.30	130.50	130.00	**134.50**	133.50	133.00	3.20	2.44%	-2.721	0.007*	0.71
Shuttle 10/5 m chasse (sec)										
21.20	20.95	19.60	**20.99**	21.00	21.00	-0.21	0.99%	-0.265	0.820	0.07

* Progress is significant at the < 0.05 level

The non-parametric Mann-Whitney test, the results of which are presented in the tables above, shows that between the experimental and control groups there are statistically significant differences in the final tests, the significance threshold $p < 0.05$, in all evaluations except the evaluation of *Shuttle* 10/5 m, for which the significance threshold $p = 0.820 > 0.05$. The effect size shows a large to very large difference between the results of the two groups (effect size > 0.50)

The differences between the averages of the two groups of girls at the final evaluations are shown in Figures no. 8, 9, 10.

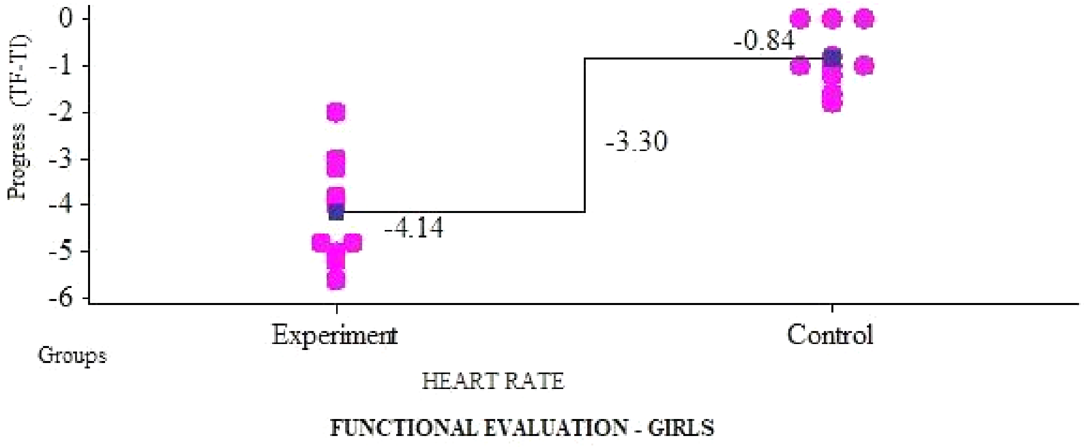

Figure 8. The differences between averages – Functional Evaluation – Girls

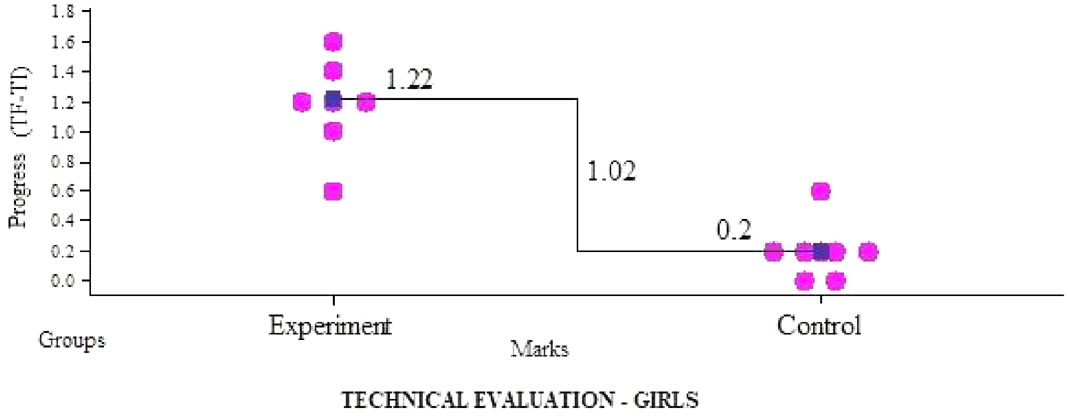

Figure 9. The differences between averages – Technical Evaluation – Girls

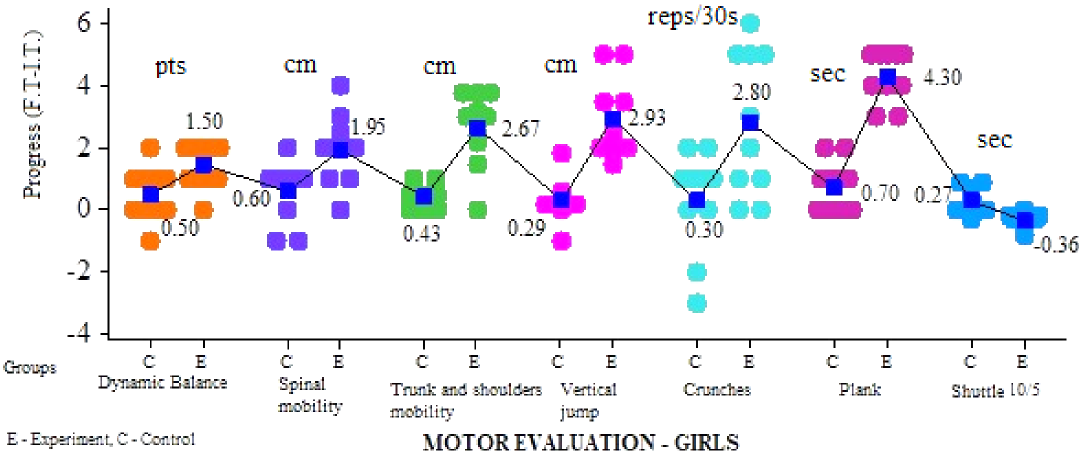

Figure 10. The differences between averages – Motor Evaluation – Girls

Table 12. Boys Final Test – Experimental Group vs. Control Group (Functional Evaluation)

FINAL TEST - BOYS						**COMPARISON OF FINAL TESTS PER GROUP**				
Control Group			**Experimental Group**			**Means Differences**		**Non-parametric Mann Whitney Test**		**Size effect**
Mean	Median	Mode	Mean	Median	Mode	**E - C**				
						Value		Z	P	
FUNCTIONAL EVALUATION										
Heart Rate (beats/ min)										
186.34	186.60	187.20	**181.52**	180.90	180.80	-4.82	2.59%	-3.404	$<.001^{**}$	0.90

** Progress is significant at the < 0.01 level

Table 13. Boys Final Test – Experimental Group vs. Control Group (Technical Evaluation)

FINAL TEST - BOYS						**COMPARISON OF FINAL TESTS PER GROUP**				
Control Group			**Experimental Group**			**Means Differences**		**Non-parametric Mann-Whitney Test**		**Size effect**
Mean	Median	Mode	Mean	Median	Mode	**E - C**				
						Value		Z	P	
TECHNICAL EVALUATION										
Marks										
8.42	8.60	8.60	**8.96**	8.80	8.80	0.54	6.41%	-2.558	0.012^{*}	0.66

* Progress is significant at the < 0.05 level

Table 14. Boys Final Test – Experimental Group vs. Control Group (MotorEvaluation)

FINAL TEST - BOYS						**COMPARISON OF FINAL TESTS PER GROUP**				
Control Group			**Experimental Group**			**Means Differences**		**Non-parametric Mann-Whitney Test**		**Size effect**
Mean	Median	Mode	Mean	Median	Mode	**E - C**				
						Value		Z	P	
MOTOR EVALUATION										
Dynamic balance (pct.)										
7.70	8.00	8.00	**8.80**	8.50	8.00	1.10	14.29%	-2.409	0.018^{*}	0.58
Spinal Mobility (cm)										
7.55	7.00	7.00	**9.35**	9.25	8.00	1.80	23.8%	-2.992	0.003^{**}	0.78
Trunk and shoulder mobility (cm)										

48.20	48.75	49.00	**54.05**	52.50	52.00	5.85	12.14%	-2.052	0.044^{*}	0.54
Vertical Jump (cm)										
42.90	42.45	42.20	**44.65**	44.00	43.50	1.75	4.08%	-1.900	0.063	0.50
Crunches (nr. rep./30s)										
24.30	24.50	25.00	**25.90**	25.50	25.00	1.60	6.58%	-2.251	0.027^{*}	0.58
Plank (sec)										
131.40	131.00	130.00	**136.00**	135.50	135.00	4.60	3.50%	-3.288	0.001^{**}	0.86
Shuttle 10/5 m chasse (sec)										
21.94	22.25	20.00	**20.13**	20.70	21.00	-1.81	8.25%	-2.167	0.033^{*}	0.57

** Progress is significant at the < 0.01 level
* Progress is significant at the < 0.05 level

The results of the Mann-Whitney non-parametric test are presented in the tables above and show that between the experimental and control groups of boys, there are statistically significant differences in the final tests, $p < 0.05$, for all types of assessment, except for the *Vertical Jump* for which the value of the significance threshold $p=0.063 > 0.05$. The effect size indicates a large to very large difference between the results of the two groups of boys (effect size > 0.50)

Figures no. 11, 12, and 13 illustrate the differences between the averages of the two groups of boys at the final evaluations.

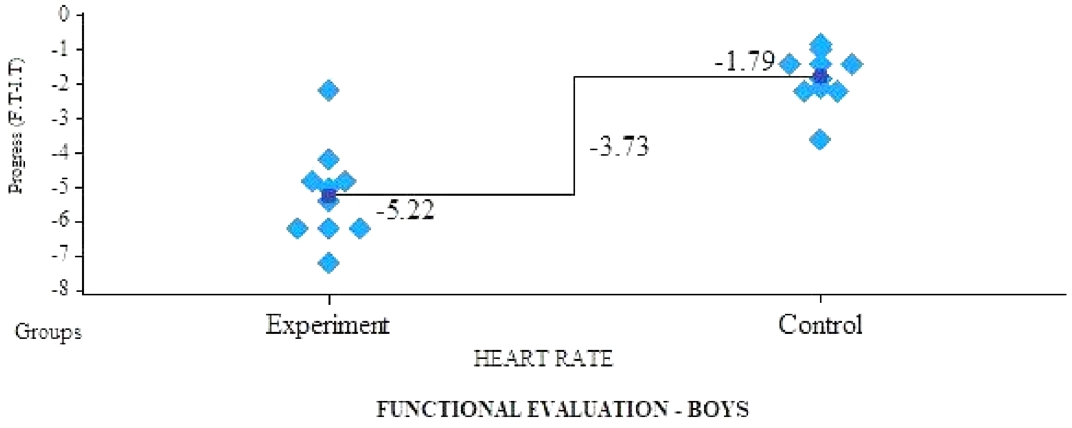

Figure 11. The differences between averages – Functional Evaluation – Boys

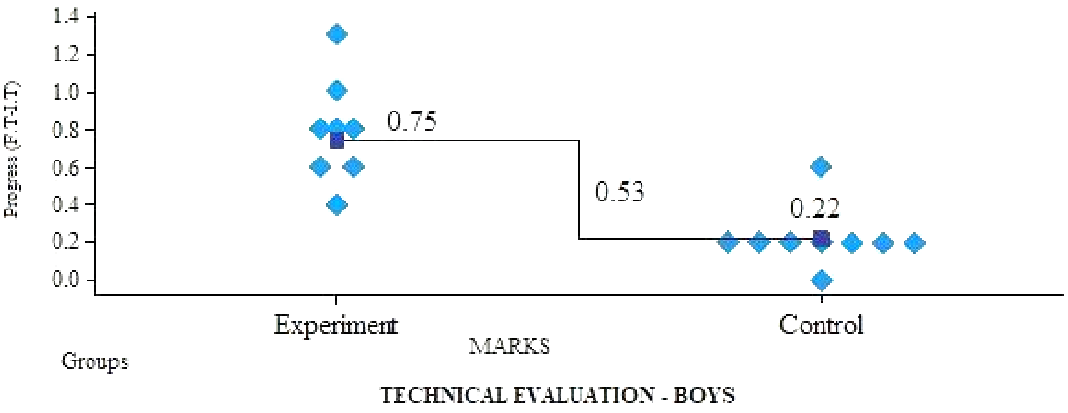

Figure 12. The differences between averages – Technical Evaluation – Boys

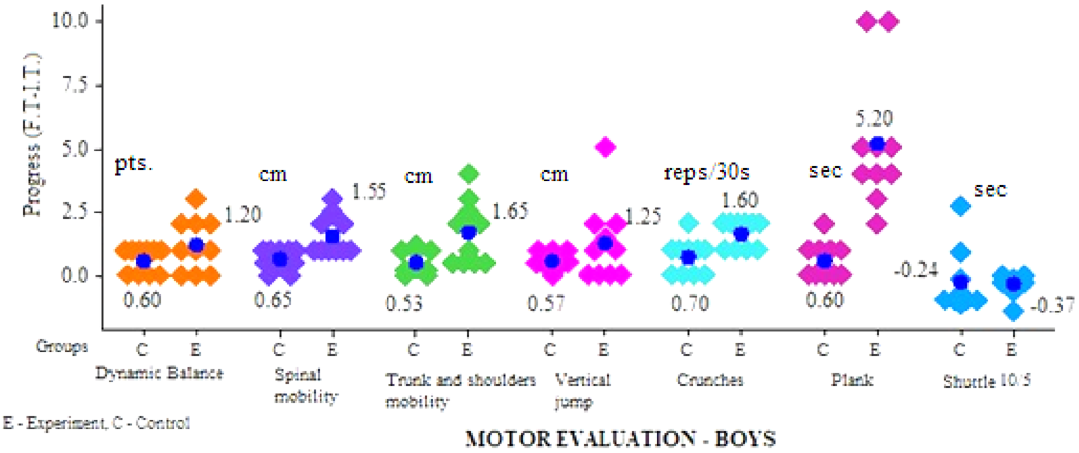

Figure 13. The differences between averages – Motor Evaluation – Boys

The responses from the dancers in the experimental group from the online questionnaire highlighted several clear trends regarding *motivation* related to the use of smart devices. Over 80% of participants stated that setting daily goals through these devices increased their *responsibility and awareness* of their physical activity level. Approximately 75% felt that activity monitoring allowed them *to adjust their training* for continuous improvement and to overcome personal limits. Additionally, 85% of participants appreciated the immediate feedback received through alerts and notifications, noting that it *helped them stay motivated in the long term and reminded them of their daily goals.*

Moreover, 90% of participants found the smart devices *easy to integrate into their daily routines* and considered them useful for personalising training based on recorded progress. Nearly 80% of dancers mentioned that *the synchronisation of these devices with fitness apps* facilitated the management and analysis of their workouts.

4. Discussion and Conclusions

This study aimed to explore the efficacy of High-Intensity Interval Training (HIIT), specifically Tabata, and the use of smart devices in optimising physical training for adult dancers. The findings indicate that incorporating Tabata training and smart gadgets significantly enhances dancers' motor qualities, functional capacity, and technical performance, corroborating previous studies on the efficacy of HIIT in enhancing cardiovascular and neuromuscular performance (Tabata et al., 1996; Emberts et al., 2013).

4.1. Discussion

The results from the initial and final assessments demonstrate a significant improvement in various physical and technical parameters among the experimental group compared to the control group. The use of Tabata training three times a week, coupled with the daily step goals monitored through smart devices, contributed to these improvements.

Physical Improvements: The experimental group showed marked progress in dynamic balance, spinal mobility, trunk and shoulder mobility, vertical jump, and core strength exercises such as crunches and plank holds. These findings align with the work of Zabrocka et al. (2015), who reported that HIIT significantly improves agility, coordination, and overall physical capacity in sports requiring complex motor skills. The integration of HIIT protocols in their training regimen likely facilitated these enhancements by providing short, intense bursts of exercise that improved overall physical fitness and motor skills, underscoring the role of aerobic and anaerobic adaptations fostered by Tabata training (Girard et al., 2015).

Technical Enhancements: The experimental group exhibited marked improvements in technical performance, as measured by expert evaluators using the CoachView application. This improvement in choreography execution, movement coordination, and posture supports the idea that HIIT's contribution to increased muscle strength and flexibility also enables dancers to execute more complex movements with precision (Koutedakis et al., 2005; Ahearn et al., 2018). The observed link between enhanced physical capacity and technical mastery echoes findings in sports science, where physical conditioning underpins athletes' ability to perform specific skills with greater consistency and fluency (Redding et al., 2009).

Functional Capacity: Heart rate monitoring during training sessions provided valuable insights into the dancers' cardiovascular fitness. The experimental group exhibited better heart rate recovery and lower average heart rates during intense activities, indicating improved cardiovascular health.

Role of Smart Devices: The smart devices played a crucial role in monitoring and motivating the dancers. The results obtained after applying the online questionnaire are consistent with the specialised literature, which suggests that smart devices can support extrinsic motivation by providing constant and objective feedback, helping athletes adjust their training and achieve their goals.

In addition to improving physical performance, the use of smart devices in training also has a profound impact on psychological factors, particularly in terms of motivation, mental focus, and adherence to training. According to Self-Determination Theory (SDT), individuals are motivated by three fundamental psychological needs: autonomy, competence, and relatedness (Deci & Ryan, 2000). Smart devices contribute to fulfilling these needs by providing personalised feedback, allowing dancers to feel more autonomous in managing their progress, more competent as they track their performance improvements, and more connected to their training objectives. For example, the real-time feedback and goal-setting features of fitness apps help athletes stay motivated by offering immediate rewards for their efforts, such as reaching daily step goals or achieving a target heart rate zone.

Moreover, the Sport Motivation Scale (SMS) can be applied to further quantify the role of smart devices in enhancing both intrinsic and extrinsic motivation. Intrinsic motivation—the inherent enjoyment and satisfaction derived from participating in physical activity—can be bolstered when athletes see tangible improvements in their performance, such as better endurance or faster recovery times. Meanwhile, extrinsic motivation—driven by external rewards, like data tracking and competition with peers—can be fostered through the smart devices' competitive features, such as leaderboards or progress comparisons (Pelletier et al., 1995). These mechanisms provide athletes with constant reminders of their progress and goals, reinforcing their commitment to training.

In terms of mental focus, smart devices play a critical role by helping dancers maintain cognitive engagement throughout their training sessions. The continuous monitoring of physical parameters such as heart rate or energy expenditure allows athletes to stay attentive to their bodies' needs and limits, preventing overtraining while encouraging optimal effort. Additionally, alerts and notifications can refocus athletes when they become distracted, fostering greater concentration during both practice and competition.

Lastly, adherence to a training program is often a challenge for athletes, particularly during longer training cycles. The integration of smart devices has been shown to improve adherence by increasing accountability. Studies have indicated that athletes who use wearable devices are more likely to stick to their training regimen, as the constant tracking and performance monitoring create a sense of responsibility and a desire to meet daily activity goals (Siepmann & Kowalczuk, 2021).

The psychological reinforcement provided by these devices, combined with the physical benefits, contributes to a more holistic approach to training, ensuring both physical and mental gains.

Also, the findings of this study align with evidence supporting the broader benefits of physical activity for health and well-being. In addition to improving cardiovascular and neuromuscular function, physical activity has been shown to preserve joint integrity and reduce inflammation, as demonstrated in osteoarthritis research (Gherghel et al, 2021). These benefits underscore the multifaceted role of exercise in enhancing performance and preventing physical limitations, which are critical for athletes engaged in high-demand sports like Dancesport.

While this study highlights the physical and technical improvements resulting from HIIT and smart device integration, future research could delve deeper into how physical conditioning influences cognitive performance, particularly in the context of dancesport. The precision of technical execution in dance relies heavily on cognitive processes such as motor learning, attention, and decision-making, all of which are governed by complex neural pathways. Understanding how these processes are affected by intensive training could provide a more holistic perspective on performance optimisation in sports that require high levels of coordination and skill.

Recent advances in neuroimaging techniques, such as functional MRI (fMRI) and electroencephalography (EEG), offer promising avenues for exploring the brain's response to physical training. For instance, fMRI could be used to track changes in brain activation patterns during dance training, particularly in regions associated with motor control, such as the motor cortex and the cerebellum (Lehericy et al., 2006). Similarly, EEG could provide real-time data on cognitive load and attention levels during training sessions, allowing researchers to assess how the brain modulates attention and focus during complex motor tasks (Gruzelier, 2014). This type of research would enable a more explicit linkage between physical conditioning and neurocognitive functions like motor memory, coordination, and reaction time.

Moreover, the relationship between motor learning and neurological plasticity could be further explored by assessing changes in the brain's ability to adapt to new movement patterns over time. By using tools like EEG neurofeedback, future studies could monitor real-time neural adaptations during HIIT or dance-specific training sessions, providing insight into how dancers' brains optimise technical execution through repeated practice (Ring et al., 2015). This line of inquiry would not only enhance our understanding of how physical training supports cognitive function but could also inform more effective training protocols that target both physical and mental performance.

4.2. Conclusions

This study confirms that the integration of HIIT, specifically Tabata training, and the use of smart monitoring devices can significantly enhance the physical and technical performance of adult dancers. The experimental group demonstrated substantial improvements across various metrics compared to the control group, validating the effectiveness of this dual approach.

Heart rate monitoring using the devices showed a significant improvement in the cardiovascular capacity of the dancers in the experimental group, with a 2.5% reduction in their average heart rate during intense exercises. In addition, data on the number of steps and calories burned confirmed an increased level of physical activity, associated with improvements in trunk mobility and muscle strength, suggesting better physical and technical preparation.

The findings suggest that incorporating technology into traditional training programs can offer a comprehensive strategy to optimise athletes' performance. Smart devices, by providing real-time feedback and fostering a sense of accountability, help maintain a high level of motivation and engagement among dancers.

Future research should explore the long-term effects of HIIT and smart device integration in different athletic populations and investigate additional metrics that could further elucidate the benefits of these training tools. This study provides a foundation for developing more efficient and technologically integrated training programs in the field of dancesport and potentially other sports disciplines.

Also, future studies should:

- investigate the integration of AI technologies in training regimes. Wearable devices powered by machine learning could enhance feedback personalisation, providing real-time adjustments to training intensity based on fatigue prediction and performance data (Connolly & Moran, 2020).

- explore neuroscientific parameters such as cognitive function, motor learning, and neural adaptations through techniques like EEG neurofeedback or functional MRI to assess how HIIT impacts brain plasticity and skill retention over time in dancers. This could provide a more comprehensive understanding of how physical training influences both mind and body in high-performance settings (Gruzelier, 2014).
- measure motivation using validated psychometric tools, such as the Sport Motivation Scale (SMS), which could provide additional insight into how these technologies influence not only physical performance but also engagement and the desire to continue physical activity. Investigating motivation could offer a more comprehensive understanding of how technology can support athletes' long-term health and performance.
- broaden the scope of the sample, including dancers from various age groups and experience levels, to generalise findings to a larger dancesport population.

4.3. Limitations

While this study provides valuable insights into the benefits of integrating HIIT and smart devices into the training regimens of adult dancers, several limitations should be acknowledged.

Sample size and short duration:

To evaluate the adequacy of the sample size, we conducted a post-hoc power analysis using the effect size observed in this study. The results of the analysis indicate that, while the sample size was sufficient to detect significant differences in some of the studied variables (such as heart rate and number of steps), the statistical power for more subtle variables may be limited. This suggests that a larger sample size would be necessary to robustly detect smaller effects or more specific technical variables, which we acknowledge as a limitation of the present study.

We acknowledge that the small sample size and the short duration of the intervention represent limitations of this study. Although the non-parametric statistical tests used are appropriate for this type of study with small sample sizes, the generalizability of the results may be limited. Future studies should include larger sample sizes and longer interventions to verify whether the observed improvements are sustainable and applicable in the long term. Nonetheless, despite these limitations, the results obtained provide a solid foundation for investigating the impact of HIIT training and smart devices on performance in dancesport.

Participant Variability: The study participants varied in their baseline physical fitness and dance experience, which could have influenced the outcomes. Future research should aim to control for these variables to ensure a more homogenous sample.

Type of Smart Devices: The study relied on specific models and brands of smart devices, which may not represent the performance and features of other devices available on the market. Future studies should consider including a variety of smart devices to enhance the applicability of the findings.

Self-Reported Data: Some data, such as daily step counts and subjective motivation levels, were self-reported by participants. Self-reported data can be prone to bias, and the accuracy of these reports may vary.

External Factors: The study did not account for external factors such as participants' diet, sleep patterns, and other physical activities outside the training sessions, which could have influenced the results.

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