# The Impact of Interval Training and Small-sided Game(2V2) on some Physiological Responses of Football players U18

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Abstract

The study was conducted on a cohort of individuals under 18 years of age affiliated with the football section of the sports club ASO Chlef , situated in Chlef, Algeria. The participants were divided into two distinct experimental groups, with each group being exposed to divergent training regimens spanning an 8-week interval. The respective programmes encompassed high-intensity interval training and a spectrum of small-sided games. Each group adhered to its designated training protocol. Based on the results and statistical analyses, no statistically significant differences were found between the two training methods in terms of enhancing and developing maximal airspeed, lactate levels, maximum heart rate, reserve heart rate, and resting heart rate. These findings diverged from the initially posited hypothesis. Moreover, the study observed no noteworthy differences between the suggested specialised approaches, namely, a 10/10 configuration within interval training and a 2v2 arrangement within the realm of small-sided games, with respect to maximum heart rate or lactate concentration.

In summation, training through small-sided games emerges as a specialised form of training that effectively enhances physical capabilities, akin to the benefits associated with interval training. The

selection of an appropriate format in terms of player numbers and playing area is deemed sufficient for achieving the intended goals.

**Keywords:** Interval Training; Small-Sided Game(2V2); Physiological Variables.

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**Introduction and Research Problem:**

In the realm of evolving training methods and diverse preparation concepts, as well as the trend towards specialised exercises, Bangsho (1994) highlighted the importance of incorporating reciprocal training in football. Football is considered a sport that involves alternating periods of effort and rest. This concept of training is specialized and has been discussed by experts such as Fox and Mathews (1977) and Billat et al. (1994, 1999, 2000).

Bangsho's research delved into understanding how reciprocal training affects energy systems and fatigue mechanisms. It also focused on determining the optimal timing for maintaining top speed during this kind of training. Reciprocal training has benefits like covering longer distances, reducing the buildup of lactic acid, and delaying the onset of fatigue (Christemsen, 1960; Billat et al., 1996, p. 28).

In simpler terms, Bangsho's work suggests that incorporating reciprocal training into football can have positive effects on performance by alternating between effort and rest, which can help in covering more ground, reducing fatigue, and improving overall endurance.

The effects of continuous training exercises using reciprocal exercises were discovered among high-level athletes (Gaitanos et al., 1998), leading to an augmentation of VO2 max levels and a discernible attenuation in the onset of fatigue compared to conventional continuous training methods.

It is important to emphasise that this approach leads to a decrease in the accumulation of lactic acid, which is attributed to the utilisation of phosphorous compounds for energy production during exercise. The phosphorylation process and the maintenance of muscle glycogen levels are foundational in furnishing the requisite energy substrates for optimal performance during reciprocal exercise protocols. These endeavours hold significance as heightened aerobic capacities empower players to elevate their on-field performance by augmenting their match engagement capabilities, expanding the scope of distance covered, and improving performance intensity (Helgerud et al., 2001). While these exercise modalities hold significance for football, they are considered incompatible with the activities of football players due to their inherent inability to incorporate technical and tactical complexities.

Within the same context, numerous researchers have endeavoured to establish correlations between these physical metrics and others that are technical and tactical in nature, particularly when compared to specific targeted physical exercises. They conducted investigations into the physical and physiological impacts of exercises involving ball interactions, often referred to as integrated training (Le Gall, 2002, p. 21) ; (Hoff et al., 2002, p. 14). Conversely, some researchers believed that engaging in small-sided games for training purposes contributed to the enhancement of players' aerobic capacities (Rampinini et al.,; Impelizzeri et al., 2005) and the elevation of maximal oxygen consumption levels (Mallo et Navarro, 2008). Additionally, Al-Bassati regards this approach as beneficial in augmenting endurance capacity, delaying fatigue, and ultimately refining skill performance (Al-Bassati, 1989, p. 165).

The training approach has undergone significant evolution and is now widely embraced by numerous coaches across various phases of preparation, taking on diverse variations. It has demonstrated the capability to enhance performance, effectively addressing multifaceted training objectives through the incorporation of small-sided match games as both content and objectives. This innovative approach aims to elevate players' efficiency and augment their competencies in orchestrating small-sided match games (Al-Bassati, 1989, p. 165).

By analysing the activities of football players during matches, a comprehensive understanding of criteria associated with physical fitness, technical aspects, and tactical elements concerning the ball, opponents, and teammates has been attained. Football players cover distances that range from 9995 m to 11230 m (Rampinini et al., 2007). These distances are coupled with intensities spanning between 80% and 90% of FC max (Stolen et al., 2005). Notably, the distance covered in the second half tends to be 1–9% less compared to the first half (Van Gool, 1998). Recent theoretical studies propose that around 4 to 5% of the covered distance entails very high intensity, surpassing 25 km/h, which translates to distances ranging between 250 m and 400 m (Thatcher etBatterham, 2004; Bangsho, 2007). In parallel, players engage in various activities during matches, including 115 to 1300 m of backward running, 50 half turns, 8 aerial duels, and 11 interventions (Witgers et al., 1982; Bangsho, 1994).

The research problem became evident to researchers as they delved into the practicalities of preparations within our clubs and their alignment with the complexities of the game. This highlighted the importance of exploring two distinct football-training methods: one focusing exclusively on physical aspects and the other integrating ball-related components. These approaches aim to enhance the efficiency of functional systems and foster physical fitness among the specific target group under study.

1- Through this theoretical discourse, we formulate the following research questions:

what disparities exist in the effects of employing the high-intensity reciprocal training approach and the integrated small-sided game training method on chosen physiological and physical parameters within the designated study group?

2-What is the effect of both the 10/10 reciprocal training and the 2v2 integrated small-sided game training on the aforementioned indicators under study?

1. Statistically significant differences exist at the 0.05 significance level in the longitudinal assessment, favouring the first group, due to the implementation of the training methods (reciprocal and small-sided games).

2. Statistically significant differences at the 0.05 significance level are evident in the impact of the distinct training modalities, namely 10/10 reciprocal training and 2v2 small-sided game training, on the examined indicators within the subgroup of participants aged below 18 years. These differences are in favour of the 10/10 reciprocal training approach.

**Methodological Approaches:**

**Research Methodology:**

In order to accomplish the study's objectives and arrive at conclusions, an experimental methodology was employed by the researcher, chosen for its appropriateness to the research context. This involved the implementation of two designated training protocols to analyse their impact on the specific physiological and physical variables within the targeted sample.

**Research sample :**

The study involved a sample of soccer players who were under the age of 18. The participants were selected from the under-18 soccer players of the "ASO Chlef" football club during the 2022–2023 sports season of the League one Algeria. A purposive sampling method was utilised, leading to 28 players being included in the study. Initial testing was conducted with a subgroup of eight players, and the main experiment was carried out with 20 players. These participants were divided into two equivalent groups: 10 players for the high-intensity reciprocal training group and 10 players for the small-sided games group. The selection of this specific sample was influenced by several factors:

- The sample's training experience was more than 5 years.
- The optimal age range for maximal airspeed development.
- The availability of suitable conditions to conduct the study.

**Table No. 01 illustrates the percentage distribution of the research sample in the main and exploratory experiments:**

| Sample | Number of Players | Percentage |
|---|---|---|
| Main Experiment | 20 | 71.42% |
| Exploratory Experiment | 08 | 28.42% |

**Research Domains:**

- **Human Domain:** The laboratory sample targeted by the research consisted of football players under the age of 18, distributed into two experimental groups, each comprising 10 players.
- **Spatial Domain:** The field study was conducted at the municipal football artificial turf pitch in Boumezrag Olympic Stadium, Chlef Province. This location serves as the training and official match venue for the team.
- **Temporal Domain:** The exploratory study took place from August 7, 2022, to October 20, 2022. During this period, the testing means were verified through test and retest procedures from August 7, 2022, to August 15, 2022. The main study was carried out between August 20, 2022, and October 20, 2022.

**Exploratory Study:**

An integral aspect of the field study revolved around the isolation of distinct variables that held the potential to impede the achievement of the stipulated objectives and the resolution of the posed research problem. Consequently, the researcher diligently exercised control over these variables to facilitate efficient management. The ensuing measures were undertaken:

- Ensuring the safety and functional integrity of the testing equipment.
- Preparing both participant cohorts to verify their willingness and enthusiasm for participation.
- The formulation of training protocols for both experimental groups was overseen by the research team, comprising a postgraduate student (holding a Master's degree) specialising in physical preparation from the 2016/2017 academic cohort, and a coach specialising in the designated age group, possessing a coaching certificate accredited by CAF.
- In the preliminary matches, all participants were explicitly advised to refrain from participating in aggressive physical contact.

Research Instruments:

In our research, we employed several methods to gather information, which aided in uncovering and delineating various aspects of the study. These tools encompass:

Pedagogical Instruments:

- Synthetic Turf Municipal in Boumezrag Olympic Stadium: This facility served as the central training ground for the study, providing a controlled environment for data collection.
- Laptop computer: Utilised for data entry, storage, and analysis purposes.
- Léger and Boucher Test Sound: Employed to signal the commencement and cessation of the Léger-Boucher test, a crucial element of the study's assessment.
- POLAR Heart Rate Monitor and Chest Strap: Employed to monitor heart rate during physical activities, with a total of 10 sets used for data gathering.

**Lactate Measurement Devices:**

- Lactate Scout Device: Employed to measure blood lactate levels.
- Lactate Pro 2 Device: Utilised as an alternative method for measuring blood lactate levels.
- Excel 2007 Software: Used for statistical analysis of the collected data.
- Soccer Balls (10 balls): used for training exercises and physical activities.
- Set of Pens, Papers, and Recording Notebook: Used for documenting observations, notes, and relevant information.
- Audio Device, Table, Chair, Scale: These items facilitated the organisation of training sessions and measurements.
- Markers and cones are utilised to demarcate training areas and enhance precision during exercises.
- 15-Minute Stopwatch: Employed for accurate timing of training intervals.
- Whistle: Used for signalling during training sessions and exercises.
- 30-Metre Measuring Tape (Decametre): Utilised for precise measurement of distances during various drills and exercises.

**Tests:**

**Maximal Aerobic Speed Test (MAS):**

The researcher employed the maximal aerobic speed test known as the "Léger et Boucher" test (revised in 2008) to assess maximal aerobic speed. This choice was influenced by the test's accessibility to necessary equipment, including an audio tapethat sets the running pace for the players. The rhythm is signalled by a sound at each turning point (going out and coming back). Furthermore, a chart was utilised to correlate different speeds, distances, and corresponding times (refer to the appendices for details).

**Test Execution Procedures:**

Five cones were arranged in a straight line, while another set of five cones was positioned 20 metres away.

- Following the signal, five players immediately commenced running without any prior warm-up (Léger et Coll., 1985, 65).
- The test commenced at a speed of 8 km/h, corresponding to 9 seconds per 20 metres.

- A whistle indicated each passing point (synchronised with the sound from the audio tape loaded into the computer).
- The speed was incremented by 1 km/h after every 7 repetitions, encompassing a distance of 140 metres on each time, and this sequence persisted.
- The test concluded when players could no longer sustain the rhythm, failed to reach the crossing line within the audio signal's duration, or arrived behind schedule.
- The last successfully completed crossing, or two-thirds of it, was taken into consideration.
- The corresponding time was then calculated.
- Utilising the chart, the maximal aerobic speed of each player was determined.

**Test Purpose:**

**This test serves to ascertain:**

- The players' maximal aerobic speed.
- The maximal oxygen consumption, as MAS is associated with VO2 max values via a reference chart.

**Heart Rate Measurement Test:**

We utilised 10 heart rate monitoring devices of the "Cardio Frequency metre" (Polar) type.

Test Execution Protocol:

The wristwatch is worn on the wrist, while the heart rate monitor belt is positioned just below chest level. Player-specific information, including weight and resting heart rate, is entered before commencing **the test.**

**Test Objectives:**

This test is designed to acquire more precise heart rate measurements, particularly during high-intensity activities where manual recording might pose challenges.

**Lactate Measurement Test:**

Two laboratory-available devices were employed for lactate measurement:

- The first device is the Lactate Scout+ (lot: 02–N: 08).

- The second device is the Lactate Pro 2 (lot 02 N17).

**Test Execution Protocol:**

Measurements were taken 3 minutes after the completion of exertion. Firstly, the finger was sanitised with alcohol, and then a specialised needle was employed to puncture the finger and collect a small droplet of blood. This droplet was directly applied to the electronic strip. The readings were obtained in approximately 10 seconds for Lactate Scout+ and 15 seconds for Lactate Pro 2.

**Test Purpose:**

The objective of this test is to assess blood lactate levels post-exertion.

**Proposed Training Programme:**

Developing a training programme holds significant importance in the realm of sports training. Systematic training programmes founded on scientific principles facilitate individual growth and enable individuals to effectively engage in their practise obligations (Qasid Ali, 2005, p. 261).

**Unstructured Training Programmes:**

Unstructured training programmes are developed based on personal judgement or individual preferences. They encompass exercises with similar performance, volume, and intensity characteristics. However, such programmes are susceptible to modifications without undergoing proper assessment or standardisation.

**Team Training in the First Week:**

In the initial week, the team participated in four training sessions before the maximal aerobic speed test. This aspect was thoughtfully taken into account when formulating the two training programmes.

**Development of Training Programmes:**

The researcher developed the training programmes based on scientific principles, taking into account the age-specific characteristics of the study group. The programmes were meticulously structured with distinct goals, content, and scheduling, as outlined below:

- The programme spanned over 8 weeks.

Proposed work included 3 sessions per week, totaling 24 sessions.

- It encompassed 3 sessions per week, summing up to 24 sessions in total.
- The remaining sessions comprised team training conducted during the two practise periods.
- Following the completion of the proposed work for both periods, players converged for the remaining training session.

**Exchange Training Programme:**

**Selection of Exchange Training Periods:**

The choice of periods was based on their involvement in different energy systems:

- 30/30: A neuromuscular, non-aerobic exercise aimed at enhancing non-structural aerobic capacity, facilitating the development of aerobic power.

- 10/10: A neuromuscular, non-aerobic exercise aimed at improving non-structural aerobic capacity and fostering aerobic power.
- 15/15: A neuromuscular exercise involving oxygen consumption for energy over 15 seconds. Oxygen consumption ranges from 29% to 35% for athletes accustomed to non-aerobic activities and 40% for those accustomed to aerobic activities. This system engages glycolytic capacity while concurrently contributing to aerobic power development (Billat et al., 2001, p. 56).
- 5/20: A neuromuscular, non-aerobic exercise aimed at enhancing non-structural aerobic capacity.

**Training Load:**

A gradual intensity progression was maintained throughout each four-week cycle, incorporating a recovery week following a three-week work cycle. This recovery period aimed to mitigate the physiological and psychological impacts of the preceding exchange training. Additionally, it allows young footballers to recuperate.

**Reduced Training Load:**

The reduction in training load does not apply to exercise intensity, which remains approximately at 90%. Instead, it pertains to the volume, reduced to 50% of the previous volume. This strategy aims to preserve the positive conditioning adaptation achieved through training (Majuka, 2003, p. 89).

**Note:** The total work time, number and duration of blocks (e.g., 2x8), type of rest within a block (negative or positive), and rest between blocks (ranging from 6 to 10 minutes) should not exceed 30 minutes in any circumstance (Cometti, 2001, p. 65).

**Building Training Sessions:**

The development of training sessions adhered to Cometti's philosophy of mixed-exchange training.

- **Exchange Strength Training:** Commencing with qualitative muscular work, followed by MCA (Maximal aerobic speed) running to underscore quantitative aerobic effort.
- **Exchange Speed Training:** Vital for enabling explosive performance in the final stages of a football match, even under fatigue.
- **Mixed Exchange Training:** This approach involves alternating between aerobic capacity-building running and economical neuromuscular effort. While demanding in terms of muscular strain, it facilitates the development of both neural aspects and muscular strength.
- **Straight Running Exchange Training:** This type focuses on running pre-determined distances based on the results of the maximal aerobic speed test. It integrates various exchange

exercises. For example, a player with a maximal aerobic speed of 16 km/h would engage in 10–10 exercises at 110% intensity, covering a distance of 50 metres in 10 seconds, repeating this for 7 minutes, amounting to 21 repetitions in a single series. Such an approach enhances both aerobic and non-aerobic capacities.

**Cross-Running Exchange Training:**

The goal of this training approach is to alternate between cross running and straight running. Research has shown that incorporating changes in direction contributes to the development of non-aerobic capacities, including speed endurance and resistance to fatigue (Sureau, 2011). To exemplify, let us revisit the earlier example but divide the distance into 25 metres for one-way and return. The player completes each segment in 10 seconds, with the entire cycle lasting for 7 minutes.

**Small-sided game Programme:**

**Selection of Training Periods for Small-Sided Games:**

Three sessions per week were allocated for small-sided games, considering the principles of gradual training progression and varied intensity within each session. Different game formats were chosen, differing in terms of player count, field dimensions, training duration, and the inclusion of a goalkeeper. These formats aimed to enhance, develop, or improve either aerobic or non-aerobic capacities or both simultaneously.

- Incorporating 2v2 and 4v4 with goalkeepers aims to improve both aerobic and non-aerobic capacities (Monkam, 2011, p. 134).
- Engaging in 4v4 without goalkeepers facilitates an aerobic conditioning session with minimal required intensity (Dellal et al., 2008, p. 126).

**Scientific Foundations of the Tests:**

Following the test validation process, it was essential to assess the reliability, validity, and objectivity of the tests to ensure their appropriateness. This was achieved through calculations of reliability, validity, and objectivity, establishing the scientific basis for the researcher's utilisation of these tests. Table 03 presents the stability and validity of the utilised tests. The tests were conducted and repeated during the time spans of August 7, 2022, and August 15, 2022.

**Table 02: Coefficients of Reliability and Self-Validity of the Employed Tests in the Research,**

| The tests employed: | Stability Coefficient (Calculated | Sample size | The critical value of Pearson's | Statistical Significance | Reliability Coefficient =√(Stability |
|---|---|---|---|---|---|

| | value of Pearson's correlation coefficient) | | correlation coefficient | | Coefficient) |
|---|---|---|---|---|---|
| (MAS) Test | 0,89 | 08 | 0,66 | Statistical Significance | 0,94 |
| (HR max) Test | 0,91 | | | Statistical Significance | 0,95 |
| (RHR) Test | 0,85 | | | Statistical Significance | 0,92 |
| (HRR) Test | 0,96 | | | Statistical Significance | 0,97 |
| Lactate Test | 0,77 | | | Statistical Significance | 0,87 |

**Table 03: Exchange Training Programme.**

| Session / Week | Session 01 | Session 02 | Session 03 |
|---|---|---|---|
| First Week | Running:<br>10-20<br>100% of MAS | Running:<br>15-30<br>100% MAS | Fartlek Running:<br>15-30<br>105% MAS |
| Second Week | Running:<br>30-30<br>100% MAS | Running/Speed:<br>5-25<br>110% MAS | Fartlek Running:<br>10-10<br>105% MAS |
| Third Week | Mixed: Strength/Speed | Mixed: Fartlek/Speed | Mixed: Running/Strength |

| | | | |
|---|---|---|---|
| | 5-25<br>100% MAS | 10-10<br>110% MAS | 15-15<br>105% MAS |
| Fourth Week | Recovery | | |
| Fifth Week | Strength/Endurance: 10-20<br>110% MAS | Running/Two Speeds: 5-25/10-20<br>120% MAS | Endurance/Speed: 10-10<br>115% MAS |
| Sixth Week | Mixed:Strength/Speed 10-20<br>110% MAS | Speed<br>170% MAS | Mixed: Endurance/Strength<br>10-10<br>115% MAS |
| Seventh Week | Mixed: 3 Variations 110% MAS | Mixed: Fartlek/Speed 170% MAS | 4Variations 115% MAS |
| Eighth Week | Recovery | | |

**Table 04 represents the Small-Sided Games Programme.**

| Session / Week | Session 01 | Session 02 | Session 03 |
|---|---|---|---|
| First Week | 8v8 : Ball Possession /Aerobic Capacity Building | 5v5: Focus and Support<br>Basic Endurance | 6v6 Transition Offensive/ Defensive<br>Speed/ Endurance |
| Second Week | 2v2 Dribbling with Fixation<br>Speed | 4v4 Aerobic Endurance | 8v8 Themed Match<br>MAS development |
| Third Week | 6v6 Fixation on One Side and Play on the Other | 1v1 Dribbling: Speed/ Speed | 3v3 Ball Retention Endurance/ Speed |

| | | | |
|---|---|---|---|
| | Speed Endurance | Endurance | |
| Fourth Week | Recovery | | |
| Fifth Week | 2v2 Distribution: Speed/ Explosive Power | 3v3 Disrupting the Opponent's Defensive Balance Endurance/ Speed | 4v4 with Goalkeepers: Game with a Focus on Explosive Power |
| Sixth Week | 5v5 Transition Offence Defence: Speed Endurance | 2v2 Ball Retrieval: Endurance/Speed | 8v8 Possession: MAS |
| Seventh Week | 4v4 Targeted Game: Explosive Strength | 3v3 Pivot and Support: Endurance and Speed | 2v2 Duels in the Operational Zone: Speed and Endurance |
| Eighth Week | Recovery | | |

**Presentation, Analysis, and Discussion of Results:**

**Table 05: Mean (Average), Standard Deviation (S), Coefficient of Variation, and Variance Homogeneity (F) for Variables (Age, Weight, and Height) in the Research Sample at a Significance Level of 0.05 and Degrees of Freedom F (1, 18).**

| Primary Variables | Exchange Training Group (n1=10) | | | Mixed Small-Sided Games Training Group (n2=10) | | | Calculated F Value | Obtained F Value |
|---|---|---|---|---|---|---|---|---|
| | $\overline{X}$ ±S | Median | Pearson's Correlation Coefficient (r) | $\overline{X}$ ±S | Median | Pearson's Correlation Coefficient (r) | | |
| Age | 17,8 ±0,42 | 18 | -1,42 | 17,9 ±0,31 | 18 | 0,94 | 0,36 | 4.41 |
| Weight | 68,3 | 68,5 | -0,29 | 68,6 | 68,5 | 0,16 | 0,11 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (kg) | 5 ±1.5 2 | | | ±1,7 7 | | | | |
| Height (cm) | 169 ±1,8 2 | 169 | 0,00 | 168 ±2,0 0 | 168 | 0,00 | 1,36 | |

According to Table 05, the values of the coefficient of variation for both experimental groups were within the range of the symmetrical distribution [-3, +3], indicating the symmetrical distribution of both research samples in the pre-physical tests.

Furthermore, based on the same Table 07, the calculated proportional values for each variable were smaller than the critical proportional values at the significance level of 0.05 and the degrees of freedom (1, 18). This implies that the differences between the two experimental groups in these variables are not statistically significant. Thus, we can infer that they are homogeneous in the pre-physical tests.

**Table 06 presents the mean, standard deviation (S), coefficient of variation, and homogeneity of variance (F) for the pre-level of the research variables among the individuals of the research sample at a significance level of 0.05 and degrees of freedom (1, 18).**

| Research variables | Exchange Training Group (n1=10) | | | Mixed Small-Sided Games Training Group (n2=10) | | | Calculated F Value | Obtained F Value |
|---|---|---|---|---|---|---|---|---|
| | $\overline{X}$ ±S | Median | Pearson's Correlation Coefficient (r) | $\overline{X}$ ±S | Median | Pearson's Correlation Coefficient (r) | | |
| MAS | 14,55±0,35 | 14,52 | 0,38 - | 14,5±0,27 | 14,75 | 0,55 | 1,29 | 3,27 |
| (HR max) | 180,5± 6,94 | 180,5 | 0,70 - | 180,3±3,03 | 180,2 | 0,59 - | 2,35 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (RHR) | 61,4± 2,71 | 61,3 | 0,18 - | 61,1 ±3,87 | 61 | 0,15 | 0,69 | |
| (HRR) | 119,1± 5,43 | 120 | 0,09 | 120,2± 6,62 | 121 | -0,84 | 0,05 | |
| Lactatemia | 10,48 ±0,08 | 10,5 | 0,20 | 10,42 ±0,09 | 10,45 | -0.28 | 0,19 | |

According to Table 06, the values of the coefficient of variation for the research variables, which include (MAS), (HR max), (RHR), (HRR), and Lactatemia, for both experimental groups were within the range of the symmetrical distribution [-3, +3]. This indicates the symmetrical distribution of both research samples in the pre-physical tests.

Moreover, as per the same Table 08, the calculated proportional values for each variable were smaller than the critical proportional values at the significance level of 0.05 and with degrees of freedom (1, 18). This suggests that the differences between the two experimental groups in these variables are not statistically significant. Consequently, we can deduce that the two groups exhibit homogeneity in the pre-physical tests.

**Table 07 presents the results of the Student's T-test, which assesses the significance of differences between the average scores of the exchange-training group and thesmall-sided games group in the pre-measurements of variables (age, weight, and height). This is done at a significance level of 0.05 and with 18 degrees of freedom.**

| Primary Variables | Exchange Training Group (n1=10) | Small-Sided Games Training Group (n2=10) | Calculated T-value | Tabulated T-value | Statistical Significance Differences |
|---|---|---|---|---|---|
| | $\overline{X}$ ±S | $\overline{X}$ ±S | | | |
| Age | 17,8 ±0,42 | 17,9 ±0,31 | 0,6 | 2,10 | Not statistically significant |
| Weight | 68,35 ±1.52 | 68,6 ±1,77 | 0,33 | | Not |

| | | | | | |
|---|---|---|---|---|---|
| (kg) | | | | | statistically significant |
| Height (cm) | 169 ±1,82 | 168 ±2,00 | 1,16 | | Not statistically significant |

According to Table 07, it is evident that there are no statistically significant differences between the two experimental groups in the variables of age, weight, and height. The calculated t-values were (0.6, 0.33, and 1.16) respectively, which are smaller than the tabulated t-value of 2.10 at a significance level of 0.05 and degrees of freedom of 18. Therefore, the researcher inferred that the two groups are equivalent in terms of basic characteristics.

**Table 08 presents the results of the Student's T-test for the significance of differences between the means of the Exchange Training Group and the Small-sided Games Training Group in the pre-measurement of variables at a significance level of 0.05 and degrees of freedom of 18.**

| Research variables | Exchange Training Group (n1=10) | Small-Sided Games Training Group (n2=10) | Calculated T-value | Tabulated T-value | Statistical Significance Differences |
|---|---|---|---|---|---|
| | $\overline{X}$ ±S | $\overline{X}$ ±S | | | |
| MAS | 14,55±0,35 | 14,5±0,27 | 1 ,09 | | Not statistically significant |
| (HR max) | 180,5±6,94 | 180,3±3,03 | 2,01 | 2,10 | Not statistically significant |
| (RHR) | 61,4±2,71 | 61,1 ±3,87 | 0,36 | | Not statistically significant |

| | | | | | |
|---|---|---|---|---|---|
| (HRR) | 119,1±5,43 | 120,2±6,62 | 1,00 | | Not statistically significant |
| Lactatemia | 10,48 ±0,08 | 10,42±0,09 | 0,43 | | Not statistically significant |

According to Table 08, it becomes apparent that there are no statistically significant differences between the two experimental groups in the pre-physical and physiological tests. The calculated t-values for the physical and physiological tests (MAS), (HR max), (RHR), (HRR), Lactatemia) were respectively (1,09, 2.01, 0.36, 1.00, 0.43), which are smaller than the tabulated t-value of 2.10 at a significance level of 0.05 and degrees of freedom of 18. Therefore, the researcher deduced that the two groups are comparable in the studied variables

Within the context of the first hypothesis, where we posited the existence of statistically significant differences at a significance level of 0.05 in the impact of the two training methods (exchange training and small-sided games) on the post-dimensional measurement, favouring the first group, we undertook the following statistical approaches for validation:

- Calculation of the mean.
- Determination of the standard deviation.
- Utilisation of the Student's t-test for comparing two equivalent groups.
- Examination of the percentage.

The results obtained were as follows:

**Table 09: Illustrates the findings of the t-test conducted to evaluate the significance of disparities between the exchange-training group and the small-sided games group concerning the post-dimensional measurement of the MAS variable, with a significance level of 0.05 and degrees of freedom (18).**

| Statistical study / Sample | Mean | Standard Deviation | Degrees of Freedom (n-2) | Significance Level | Calculated t Value | Critical t Value | Statistical Significance |
|---|---|---|---|---|---|---|---|
| Exchange Training | 15,64 | 0,16 | | | | | Not statistically |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Group | | | 18 | 0,05 | 0,39 | 1,73 | significant |
| Small-sided Games Group | 15,55 | 0,35 | | | | | |

Through Table 09, which illustrates the results of the post-dimensional tests in the maximal aerobic speed assessment for the two experimental groups, the following becomes evident: The calculated "t" value was 0.39, which is lower than the tabulated "t" value of 1.73. Consequently, there are no statistically significant differences between the two groups in the maximal aerobic speed variable (MAS).

**Table 10: Presents the outcomes of the t-test for assessing the significance of differences between the exchange-training group and the small-sided games group in the post-dimensional measurement of the maximum heart rate variable (HR max) at a significance level of 0.05 and degrees of freedom (18).**

| Statistical study / Sample | Mean | Standard Deviation | Degrees of Freedom (n-2) | Significance Level | Calculated t Value | Critical t Value | Statistical Significance |
|---|---|---|---|---|---|---|---|
| Exchange Training Group | 179,8 | 0,84 | 18 | 0,05 | 0,17 | 1,73 | Not statistically significant |
| Small-sided Games Group | 179,7 | 2,45 | | | | | |

Through Table 10, which presents the results of the post-dimensional tests in the maximum heart rate assessment for the two experimental groups, the following becomes evident: The

calculated "t" value was 0.17, which is lower than the tabulated "t" value of 1.73. Therefore, there are no statistically significant differences between the two groups in the variable of maximum heart rate (HR max).

**Table 11: Displays the outcomes of the t-test for assessing the significance of differences between the exchange-training group and the small-sided games group in the post-dimensional measurement of the resting heart rate variable (RHR) at a significance level of 0.05 and degrees of freedom (18).**

| Statistical study / Sample | Mean | Standard Deviation | Degrees of Freedom (n-2) | Significance Level | Calculated t Value | Critical t Value | Statistical Significance |
|---|---|---|---|---|---|---|---|
| Exchange Training Group | 61,6 | 1,82 | 18 | 0,05 | 1,48 | 1,73 | Not statistically significant |
| Small-sided Games Group | 60,8 | 1,06 | | | | | |

Through Table 11, which illustrates the results of the post-dimensional tests in the resting heart rate assessment for the two experimental groups, the following becomes evident: The calculated "t" value was 1.48, which is lower than the tabulated "t" value of 1.73. Hence, there are no statistically significant differences between the two groups in the variable resting heart rate (RHR).

**Table 12: Presents the outcomes of the t-test for assessing the significance of differences between the exchange-training group and the small-sided games group in the post-dimensional measurement of the reserve heart rate variable (HRR) at a significance level of 0.05 and degrees of freedom (18).**

| Statistical | Mean | Standard Deviation | Degrees of | Significance Level | Calculated t Value | Critical t Value | Statistical Significance |
|---|---|---|---|---|---|---|---|

| study / Sample | | | Freedom (n-2) | | | | |
|---|---|---|---|---|---|---|---|
| Exchange Training Group | 119,7 | 3,51 | 18 | 0,05 | 0,09 | 1,73 | Not statistically significant |
| Small-sided Games Group | 119,8 | 6,9 | | | | | |

Through Table 12, which presents the results of the post-dimensional tests assessing the reserve heart rate for the two experimental groups, it becomes evident that the calculated "t" value was 0.09, lower than the tabulated "t" value of (1.73). Therefore, there are no statistically significant differences between the two groups in the variable of reserve heart rate (HRR).

**Table 13: This table displays the outcomes of the t-test aimed at evaluating the significance of differences between the exchange-training group and the small-sided games group in the post-dimensional measurement of the lactate variable (Lactatemia). The analysis was conducted at a significance level of 0.05, with degrees of freedom of (18).**

| Statistical study / Sample | Mean | Standard Deviation | Degrees of Freedom (n-2) | Significance Level | Calculated t Value | Critical t Value | Statistical Significance |
|---|---|---|---|---|---|---|---|
| Exchange Training Group | 9,21 | 0,01 | 18 | 0,05 | 1,16 | 1,73 | Not statistically significant |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Small-sided Games Group | 9,32 | 0,02 | | | | | |

According to Table 13, which illustrates the results of the post-dimensional tests conducted for the lactate assessment within the two experimental groups, the following observation emerges: The calculated "t" value was 0.05, demonstrating a lower value compared to the tabulated "t" value of (1.73). Consequently, there are no statistically significant differences between the two groups in the lactate variable.

Through the second hypothesis, which posits that “there are statistically significant differences at a significance level of 0.05 in the impact of the 10/10 and 2 v 2 training types on the studied indicators among individuals under the age of 18, in favour of the 10/10 exchange-training”, we utilised the following statistical methods for verification:

1. Mean.

2. Standard deviation.

3. Student's t-test for two equal groups.

**4. Percentage.**

The results were as follows:

Table 14: Presents the outcomes of the t-test for assessing the significance of differences between the 10/10 and 2 v 2 training in the post-dimensional measurement of the (HR max) variable at a significance level of 0.05 and degrees of freedom (18).

| Statistical study / Sample | Mean | Standard Deviation | Degrees of Freedom (n-2) | Significance Level | Calculated t Value | Critical t Value | Statistical Significance |
|---|---|---|---|---|---|---|---|
| Exchange Training Group | 180,8 | 4,62 | 18 | 0,05 | 1,59 | 1,73 | Not statistically |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | significant |
| Small-sided Games Group | 179,3 | 4,23 | | | | | |

Through Table 14, which elucidates the distinction between two distinct training modalities, the 10/10 exchange-training and the 2v2 small-sided games training, the calculated "t" value in the assessment of maximum heart rate (HR max) was found to be (1.59), lower than the tabulated "t" value of (1.73). Consequently, there is no statistically significant difference for either of the training methods in the (HR max) variable.

**Table 15: Illustrates the outcomes of the t-test for evaluating the significance of differences between the 10/10 and 2 v 2 training modalities in the post-dimensional measurement of the lactate variable (Lactatemia) at a significance level of 0.05 and degrees of freedom (18).**

| Statistical study / The Training Methods | Mean | Standard Deviation | Degrees of Freedom (n-2) | Significance Level | Calculated t Value | Critical t Value | Statistical Significance |
|---|---|---|---|---|---|---|---|
| Exchange Training Group10/10 | 9.31 | 0.08 | 18 | 0,05 | 0.65 | 1,73 | Not statistically significant |
| Small-sided Games Group 2v2 | 9.24 | 0.03 | | | | | |

Through Table 15, which illustrates the differences between two distinct training methodologies, specifically the 10/10 cross-running training and the 2v2 small-sided game training, the calculated "t" value in the lactate measurement test (0.65) is found to be lower than the critical "t" value (1.73). As a result, there are no statistically significant differences observed in the (Lactatemia) variable for either of the training methods.

**Conclusions:**

In light of the research objectives and the field results obtained, the following conclusions can be drawn:

Variability in the post-dimensional results compared to the pre-dimensional ones for the study variables in the exchange-training group is evident. Statistically significant differences were identified in the maximal aerobic speed test and lactate measurement test, while no statistically significant differences were observed in the maximal heart rate, reserve heart rate, or resting heart rate tests.

Similarly, there is variability in the post-dimensional results compared to the pre-dimensional ones for the study variables in the small-sided games training group. Statistically significant differences were found in the maximal aerobic speed test and lactate measurement test, while no statistically significant differences were, found in the maximal and reserve heart rates or resting heart rates.

The exchange-training programme led to an enhancement in the maximal aerobic speed index and the non-aerobic capacity index, as represented by lactate levels.

Conversely, the exchange-training programme did not yield improvements in heart rate indexes of all types.

On the other hand, the small-sided game training programme resulted in improvements in both the maximal aerobic speed index and the anaerobic capacity index, as indicated by lactate levels.

Conversely, the small-sided game training programme did not lead to improvements in heart rate indexes of all types.

Controlling the training load through the results of the maximal aerobic speed test empowers the coach with greater control over the training process and its direction.

The small-sided game training method effectively challenges players to train at maximum exertion levels.

The outcomes of the exchange training were superior to those of the small-sided game training across all indicators, as demonstrated by percentage figures.

Notably, no statistically significant differences were observed between the high-intensity 10/10 exchange training and the 2v2 format in small-sided game training with regard to lactate levels and heart rate.

The 2v2 training format aligns with high-intensity 10/10 exchange training in optimising maximal training capacities.

Importantly, exchange training led to enhancements in maximal aerobic speed test results in post-tests when compared to pre-tests.

Discussion of Research Hypotheses:

Building on the conclusions obtained from the analysis and discussion of the findings, along with insights from relevant theoretical underpinnings and previous studies, we can summarise the hypotheses of our research as follows:

**Discussion of the first Hypothesis:**

Concerning the initial hypothesis, which postulated "the presence of statistically significant differences at a significance level of 0.05 in the impact of the two training approaches (exchange training and small-sided games) on the post-measurement outcomes in favour of the first group," an examination was conducted to validate this assumption. This was achieved through an analysis of Tables (09, 10, 11, 12, 13), which display the statistical significance of mean differences, complemented by statistical treatment employing the t-test.

The outcomes revealed the absence of statistically significant distinctions between exchange training and small-sided games training in the post-assessment evaluations encompassing all variables under study: maximal aerobic speed, lactate levels, maximal and reserve heart rate, and resting heart rate. This observation aligns with the perspective held by various researchers, suggesting that diverse forms of small-sided game training enhance both aerobic and anaerobic capacities to an extent comparable to exchange training. (Duel et al., 2012; Mansouri, 2013; Al-Bakri, 2008; Afifi, 2001; Rampinini et al., 2007; Little et al., 2006; Billat, 2001; Balsom, 1999; Babault et al., 2017; Barthelemy et al., 2011; Dellal et al., 2008, 2009, 2010, 2011, 2012). Therefore, it can be concluded from the aforementioned evidence that the hypothesis lacked support.

**Discussion of the second Hypothesis:**

In this hypothesis, the assumption was made that "there exist statistically significant differences at a significance level of 0.05 in the effect of the two training methods, 10/10 and 2v2, on the under-study indicators among individuals under the age of 18, in favour of the 10/10 exchange training."

To substantiate the validity of this hypothesis, an examination was conducted through Tables (15, 14) that illustrate the statistical significance of differences between means, alongside statistical analysis using the t-test.

The analysis indicates that there are no statistically significant differences between high-intensity 10/10 exchange training and 2v2 small-sided game training in terms of lactate levels and heart rate. Consequently, it can be asserted that the 2v2 training format challenges the limits of the body's endurance capacities, pushing players to reach their utmost exertion levels. This observation is consistent with the findings of researchers such as JulienRobineu (2017), JulienLoger (2016, 2011, 2008), Dellal et al. (2011), Barthelemy (2011), and MonkamTchokonte (2011). Therefore, it can be inferred from the aforementioned that the hypothesis was not supported.

**Conclusion:**

Football has emerged as a global phenomenon, captivating numerous individuals and fostering its own distinctive realm. In the context of Algeria, nurturing the sport's development necessitates a keen focus on youth categories, accompanied by strategies to cultivate and enhance their athletic abilities. The amalgamation of physical fitness with technical and tactical competence remains pivotal in sustaining performance dynamics throughout a football match.

The primary objective of this study was to juxtapose the impacts of two distinct training modalities in football, namely exchange training and small-sided game training, concerning the augmentation of targeted physical and physiological parameters. Specifically, these parameters encompassed maximal aerobic speed, lactate levels, maximal and reserve heart rates, and resting heart rate, among participants under 18 years old.

Conducted within the youth team of ASO Chlef Sports Club, this investigation entailed the partitioning of participants into two experimental cohorts. Each cohort underwent a distinct training regimen over an 8-week period, encompassing high-intensity 10/10 exchange training and diverse formats of small-sided game training.

Based on the outcomes gleaned from the conducted study and subsequent statistical analyses, it is concluded that there are no statistically significant differences between the two distinct training methodologies with regard to the enhancement of the selected variables. Furthermore, comparable outcomes manifested between the specific training formats of high-intensity 10/10 exchange training and 2v2 small-sided game training, concerning lactate levels and heart rate.

In summation, both exchange training and small-sided game training exhibit efficacy in bolstering physical capacities, with the ultimate choice contingent upon the specific objectives and requisites of the training regimen.

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