



Research article

Effects of sports training on morphological traits in senior football players

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ABSTRACT

In the realm of senior football, training programs meticulously crafted to enhance these traits can wield a profound influence on players' performance. This study engaged 30 senior soccer players in a comprehensive physical fitness assessment, encompassing pre-test measurements taken on October 6, 2022, and post-test measurements on January 10, 2023. This comprehensive study explores the profound impact of sports training on morphological traits among senior football players. The investigation delves into the significant differences observed in weight and BMI, despite the consistency in age and height, shedding light on potential shifts in body composition influenced by the training program's effect on muscle mass and fat distribution. These remarkable findings underscore the program's capacity to meticulously shape the physical attributes of senior players, thereby warranting further in-depth exploration of its overall influence on both performance and health. The comparative analysis of morphological traits between the pre-test and post-test for senior football players yielded compelling results. Notably, leg muscle size exhibited a highly significant increase (p-value=0.000), transitioning from 33.57±2.49 cm in the pre-test to 36.07±2.42 cm in the post-test. This marked change reflects substantial lower-body muscle development attributable to the training program's efficacy. Similarly, hip circumference displayed a significant rise (p-value=0.001), progressing from 90.07±4.29 cm to 95.73±7.72 cm, suggesting intriguing alterations in the hip area, possibly associated with shifts in muscularity or adipose tissue distribution. Waist circumference also underwent a significant increase (p-value=0.020), ascending from 77.23±6.23 cm in the pre-test to 81.23±6.67 cm in the Post-test, implying transformations in abdominal muscularity or fat distribution. Furthermore, shoulder width showed a highly significant increase (p-value=0.0001), expanding from 103.87±3.29 cm to 111.77±5.61 cm, indicating noteworthy developments or changes in the upper body induced by the training program. While the shoulder-to-waist ratio (SWR) remained consistent with a non-significant p-value of 0.220, suggesting no substantial change in the ratio of shoulder width to waist circumference, the waist-to-height ratio (WHtR) displayed a significant increase (p-value=0.024) from 0.47±0.04 in the Pre-test to 0.49±0.04 in the Post-test. This transformation hints at alterations in body composition relative to height. Conversely, the waist-to-hip ratio (WHR) exhibited no significant difference between the pre-test and post-test measurements, with a non-significant p-value of 0.537, implying minimal changes in fat distribution around the waist and hip areas. These findings illuminate the potent effects of sports training on the morphological traits of senior football players, providing a foundation for tailored training strategies and enhanced player performance and health.

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INTRODUCTION

The contemporary demands of soccer require players to possess a multifaceted skill set that encompasses technical finesse, tactical intelligence, and robust physical capabilities. This study delves into the dynamic interaction between sports training and the development of endurance, strength, speed, and morphological traits among adult soccer players, highlighting the essential nature of training in optimizing player performance (Melekoğlu et al., 2019). Sports training plays a pivotal role in shaping the physical capabilities and morphological traits of athletes across various disciplines. This holds particularly true for senior

football players, who rely on a combination of endurance, strength, and speed to maintain peak performance on the field (Imperlini et al., 2020). The interplay between these physical fitness traits and morphological characteristics forms a crucial aspect of athletes' overall development. This study delves into the profound impact of sports training on the selected physical fitness traits—endurance, strength, and speed—while also exploring changes in specific morphological traits among senior football players (Baptista et al., 2018).

By examining these aspects, we can gain a deeper understanding of how training regimens influence the holistic athletic profile of senior football players. Soccer

stands as the most widely embraced sport globally, demanding heightened physical prowess. In contemporary football, players must exhibit enhanced adaptability and versatility concerning the essential performance attributes and field dynamics (Jiménez et al., 2021). Hence, aspiring to achieve professional excellence in football mandates athletes to undergo rigorous and strenuous training, aiming to enhance pivotal physical characteristics. Such an intensive training regimen leads to a cascade of physical and physiological adjustments among football players. These adaptations are contingent upon the rigorous training routine and significantly impact athletes' health indicators (Baptista et al., 2018).

FACTORS INFLUENCING PLAYERS' FITNESS

The attainment of success in men's football is significantly influenced by various fitness determinants. These factors play a pivotal role in shaping the performance and achievements of football players. To excel in the competitive realm of players' football, athletes must hone and optimize these fitness determinants (Mujika et al., 2009). This article delves into the key elements that underpin success in player's football by examining the intricate interplay between fitness components and on-field accomplishments.

Physical endurance and stamina

A cornerstone of success in men's football lies in the players' physical endurance and stamina. The ability to sustain high levels of energy and performance throughout the duration of a match is crucial. This demands rigorous aerobic conditioning and cardiovascular fitness (Parpa and Michaelides, 2021). Longitudinal studies have shown a positive correlation between players with superior endurance levels and their ability to contribute consistently across the entire game duration (Svensson and Drust, 2007).

Speed and explosiveness

In the fast-paced nature of modern football, speed and explosive power are indispensable attributes. A player's ability to swiftly cover distances, execute rapid changes in direction, and engage in explosive sprints significantly impacts their effectiveness on the field or playground. Training regimens focused on enhancing sprinting mechanics, agility, and overall speed contribute to a player's ability to create and capitalize on scoring opportunities (Rüser et al., 2017).

Strength and power

The physical confrontations and challenges intrinsic to football necessitate formidable strength and power. Players must possess the strength to maintain possession, hold off opponents, and excel in aerial duels. Additionally, explosive power aids in quick accelerations and precise ball control (Sánchez-Ureña et al., 2016). Comprehensive strength training programs, encompassing both maximal and functional strength, are integral to enabling players to dominate physical battles (Bush et al., 2015).

Agility and coordination

Agility and coordination are critical in evading opponents, swiftly changing directions, and maintaining precise control over the ball (Kada et al., 2023). Players with superior agility and coordination exhibit enhanced ball-handling skills and defensive prowess. Integrated training routines that emphasize balance, proprioception, and dynamic movement patterns contribute to refining these attributes (Mujika et al., 2009).

Flexibility and injury prevention

An often underestimated yet vital determinant is flexibility. Maintaining adequate joint mobility and muscular flexibility aids in preventing injuries and enables players to execute a diverse range of movements on the field (Kafedžić et al., 2018). Incorporating stretching, yoga, and mobility exercises into training routines supports players' long-term health and sustainability (Drust et al., 2007).

Mental resilience and focus

Beyond physical attributes, mental resilience and focus are indispensable. The ability to withstand pressure, maintain concentration, and make swift decisions during high-stakes moments significantly impacts performance (Suarez-Arrones et al., 2019). Sports psychology techniques, mindfulness practices, and mental training are instrumental in nurturing the mental fortitude required for success in men's football (Sebastiá-Rico et al., 2023).

The success in players' football is the result of a dynamic interplay between various fitness determinants (Abreu et al., 2021). The harmonious development of physical endurance, speed, strength, agility, flexibility, and mental resilience forms the bedrock upon which players elevate their performance to achieve remarkable accomplishments on the field (Teixeira et al., 2023). As the game continues to evolve, the understanding and cultivation of these fitness factors remain central to unlocking the full potential of athletes in player's football (Wallace and Norton, 2014).

Impact on morphological features

Muscle mass and definition

Sports training contribute to the development of lean muscle mass. The research by (Suarez-Arrones et al., 2019) explored the effects of combined strength and endurance training on muscle hypertrophy in soccer players (Jimenez-Reyes et al., 2022). The findings indicated a significant increase in muscle cross-sectional area, highlighting the efficacy of integrated training.

Body composition

A research study by Bento et al. (2023) investigated the impact of concurrent training on the body composition among soccer players. The study demonstrated reductions in body fat percentage and simultaneous increases in lean

body mass, illustrating the potential of training to enhance overall body composition.

Flexibility and range of motion

Incorporating flexibility training enhances players' range of motion. A research study by Fukaya et al. (2020) investigated the effects of a flexibility intervention on soccer players' joint mobility (Teixeira et al., 2023). The results indicated substantial improvements in flexibility, underscoring the importance of flexibility training within comprehensive training programs.

MATERIALS AND METHODS

Participants

The researcher proposed two training tests (pre-post) to the sample of 30 players senior soccer players (CRBT) team activity in the amateur first division from the Algerian championship south for a season 2022/2023, who underwent a comprehensive physical fitness evaluation, including pre-test measurements on 6 October 2022, and post-test measurements on 10 January 2023.

Design

Pre- and post-test design was used to assess changes in physical and morphological traits.

Morphological features assessments

The following assessments were made.

1. Leg muscle (cm)
2. Hip circumference (cm)
3. Waist circumference (cm)
4. Shoulder width (cm)
5. SWR (Shoulder to waist ratio)

6. WHtR (Waist to height ratio)

7. WHR (Waist to hip ratio)

Training program

The training program consisted of (a brief description of the training regimen, including exercises and duration).

Statistical analysis

Statistical analysis was conducted using SPSS 25.0 software. The mean ± standard deviation was used to report continuous variables, while categorical variables were presented as frequencies and percentages. Student's t-tests were used to compare group characteristics. Paired-sample t-tests were used to compare pre-test and post-test results for each fitness trait.

RESULTS AND DISCUSSION

Comparison of demographic data between the pre-test and post-test for senior football players

Table 1 presents a comparison of demographic data between the Pre-test and Post-test for Senior Football Players. The p-values indicate the level of statistical significance for each parameter, and the corresponding values for both the Pre-test and Post-test groups are provided.

The results of Table 1 reveal that while age and height remained consistent before and after the training period, weight and BMI demonstrated significant differences. The increase in weight and BMI signifies potential changes in body composition, likely attributed to the training program's effects on muscle mass and fat distribution. These findings underscore the program's impact on the physical attributes of senior football players, emphasizing the importance of further exploring the training regimen's influence on overall performance and health.

Table 1. Comparison of demographic data between the pre-test and post-test for senior football players

| Parameters | Pre-test N=(30) | Post-test N=(30) | p-value | Decision |
|--------------------------|--------------------|---------------------|---------|-----------------|
| Age (years) | 24.53±3.13 | 24.53±3.13 | 1.000 | Non-Significant |
| Height (cm) | 163.50±6.26 | 163.50±6.26 | 1.000 | Non-Significant |
| Weight (kg) | 61.97±5.54 | 58.33±4.63 | 0.008 | Significant |
| BMI (kg/m ²) | 23.17±1.36 | 21.82±1.24 | 0.0001 | Significant |

Age

The p-value = 1.000 suggests a non-significant difference in age between the Pre-test and Post-test groups. Both groups have nearly identical mean ages of 24.53 years with a standard deviation of 3.13 years. Therefore, the age of the participants does not appear to have changed significantly as a result of a training program.

Height

Similar to age, the p-value = 1.000 indicates that there is no significant difference in height between the

Pre-test and Post-test groups. The mean height remains constant at 163.50±6.26 cm for both groups.

Weight

The p-value = 0.008 suggests a statistically significant difference in weight between the two groups. The mean weight increased from 58.33 kg in the Pre-test to 61.97 kg in the Post-test. This change in weight is likely due to the training program, as indicated by the significant p-value.

BMI

The p-value = 0.0001 indicates a highly significant difference in body mass index (BMI) between the Pre-test

and Post-test groups. The mean BMI increased from 21.82 kg/m² in the Pre-test to 23.17 kg/m² in the Post-test. This significant change suggests a notable alteration in body composition resulting from the training program.

The findings presented in this study shed light on the effects of a sports training program on the physical attributes of senior football players. Notably, the study indicates that despite consistent age and height measurements before and after the training period, there were significant differences observed in weight and BMI (Wallace and Norton, 2014). This discrepancy suggests the potential for notable changes in body composition, potentially influenced by the training regimen's impact on muscle mass and fat distribution. These results are particularly significant as they underscore the tangible effects of the training program on the senior football players' physiological makeup (Cai et al., 2022). The increase in weight and BMI suggests a potential shift towards a more robust body composition, likely due to the development of muscle mass and adjustments in fat distribution resulting from the training efforts. These alterations emphasize the program's potential to reshape and optimize the players' physical attributes (Imperlini et al., 2020). Furthermore, the observed changes in weight and BMI underscore the relevance of delving deeper into the training regimen's broader impact on the overall performance and health of senior football players, this is consistent with the study of Fernández-García et al. (2020). The study highlights the importance of further exploration into how the training program influences various aspects of performance, physiological responses, and health outcomes (Gaesser and Angadi, 2021). This suggests that the program's effects extend beyond the

immediate changes in weight and BMI, prompting a more comprehensive investigation into its influence on the athletes' well-being and athletic capabilities. In essence, the results presented provide an insightful starting point for understanding the multifaceted effects of the training program on senior football players. this corresponds to the study of Willis et al. (2012).

Comparison of some morphological traits between the pre-test and post-test for senior football players

Table 2 presents a comparison of various morphological traits between the Pre-test and Post-test for Senior Football Players. The p-values indicate the level of statistical significance for each parameter, and the corresponding values for both the Pre-test and Post-test groups are provided. The traits being analyzed include leg muscle size, hip circumference, waist circumference, shoulder width, shoulder-to-waist ratio (SWR), waist-to-height ratio (WHtR), and waist-to-hip ratio (WHR).

The analysis of Table 2 reveals significant changes in several morphological traits, including leg muscle size, hip circumference, waist circumference, and shoulder width. These changes suggest potential muscle development and alterations in body composition due to the training program. While some ratios (SWR and WHR) did not show significant differences, others (WHtR) demonstrated changes that may be related to body composition. These findings emphasize the impact of the training program on the participants' morphological characteristics and highlight the importance of considering various morphological indicators for assessing physical changes.

Table 2. Comparison of some morphological traits between the pre-test and post-test for senior football players

| Parameters | Pre-test N=(30) | Post-test N=(30) | p-value | Decision |
|--------------------------|--------------------|---------------------|---------|-----------------|
| Leg muscle (cm) | 36.07±2.42 | 33.57±2.49 | 0.000 | Significant |
| Hip circumference (cm) | 95.73±7.72 | 90.07±4.29 | 0.001 | Significant |
| Waist circumference (cm) | 81.23±6.67 | 77.23±6.23 | 0.020 | Significant |
| Shoulder width (cm) | 111.77±5.61 | 103.87±3.29 | 0.0001 | Significant |
| Shoulder-to-waist ratio | 1.38±0.08 | 1.35±0.09 | 0.220 | Non-Significant |
| Waist-to-height ratio | 0.49±0.04 | 0.47±0.04 | 0.024 | Significant |
| Waist-to-hip ratio | 0.85±0.04 | 0.85±0.06 | 0.537 | Non-Significant |

Leg muscle

The p-value=0.000, suggests a highly significant difference in leg muscle measurements between the two groups. The mean leg muscle size increased from 33.57 cm in the Pre-test to 36.07 cm in the Post-test. This significant change suggests notable muscle development in the lower body due to the training program.

Hip circumference

The p-value=0.001 indicates a significant difference in hip circumference between the two groups. The mean hip circumference increased from 90.07 cm in the Pre-test to 95.73 cm in the Post-test. This suggests changes in the hip area, possibly indicating muscular or adipose tissue alterations.

Waist circumference

The p-value=0.020 suggests a significant difference in waist circumference between the two groups. The mean waist circumference increased from 77.23 cm in the Pre-test to 81.23 cm in the Post-test. This change could reflect changes in abdominal muscularity or fat distribution.

Shoulder width

The p-value=0.0001 indicates a highly significant difference in shoulder width between the two groups. The mean shoulder width increased from 103.87 cm in the Pre-test to 111.77 cm in the Post-test. This suggests notable development or changes in the upper body due to the training program.

Shoulder-to-waist ratio

The non-significant p -value=0.220 indicates that there is a non-significant difference in the shoulder-waist ratio (SWR) between the two groups. The mean SWR values remained consistent, suggesting that shoulder width to waist circumference ratio did not change significantly.

Waist-to-height ratio

The p -value=0.024, suggests a significant difference in the waist-to-height ratio (WHtR) between the two groups. The mean WHtR increased from 0.47 in the Pre-test to 0.49 in the Post-test, potentially indicating alterations in body composition in relation to height.

Waist-to-hip ratio

The non-significant p -value=0.537 indicates that there is no significant difference in the waist-to-hip ratio (WHR) between the two groups. The mean WHR values remained consistent, suggesting minimal changes in fat distribution around the waist and hip areas.

The insightful findings presented in the analysis of Table 2 provide valuable insights into the impact of the sports training program on the morphological traits of senior football players. The results reveal a noteworthy pattern of significant changes across several key morphological indicators, such as leg muscle size, hip circumference, waist circumference, and shoulder width (Gaur et al., 2022). These changes collectively suggest the potential for meaningful muscle development and alterations in body composition arising from the training program. The observed alterations in leg muscle size, hip circumference, waist circumference, and shoulder width strongly imply that the training regimen has contributed to physical changes that go beyond superficial measures (Lawrenson et al., 2019). The potential muscle development suggests that the program has had a positive influence on the participants' muscular structure, likely leading to increased strength and overall physical robustness, this corresponds to Furnham et al. (2005). Moreover, the changes in waist and hip circumferences might suggest alterations in fat distribution, which could further indicate improvements in body composition resulting from the training. Interestingly, while certain ratios like the shoulder-to-waist ratio (SWR) and waist-to-hip ratio (WHR) did not show significant differences, the changes seen in waist-to-height ratio (WHtR) are of particular significance. These changes may be directly related to variations in body composition, underlining the importance of considering a range of morphological indicators to comprehensively assess physical changes, this agreement to (Barlow et al., 2012; Serda, 2013). The differential impact of the training program on these ratios reflects the multifaceted nature of body composition changes and their complex interplay. The implications of these findings extend beyond the physical realm, highlighting the importance of considering morphological changes as an integral part of assessing the training program's effectiveness. The observed alterations emphasize the tangible impact of the training regimen on the participants' morphological characteristics, underlining the program's ability to shape and enhance various aspects of their physical attributes.

CONCLUSION

The notable disparities in weight and BMI, while maintaining consistent age and height parameters, imply shifts in body composition that are likely influenced by the training program's effects on muscle mass and fat distribution. These findings highlight the program's effectiveness in molding the physical attributes of senior players, emphasizing the need for further investigation into its broader impact on performance and health. These results underscore the importance of tailoring training programs to optimize the overall physical fitness and performance of senior football players. Additionally, significant alterations in morphological traits, encompassing leg muscle size, hip circumference, waist circumference, and shoulder width, point to potential muscle development and changes in body composition resulting from the training program.

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AUTHOR STATEMENT

The author contributed to the design and conceptualization of the study, as well as the execution and planning of the statistical analysis and provided the data for the study. The author takes full responsibility for the research, including addressing the accuracy or integrity of the study and conducting appropriate investigations.

CONFLICTS OF INTEREST

The author(s) declare(s) no conflicts of interest.

DECLARATION

The contents of this paper are published after receiving a signed copyright agreement from the corresponding author declaring that the contents of this paper are original. In case of any dispute related to the originality of the contents, editors, reviewers and the publisher will remain neutral.

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