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Original Article

Comparative Analysis of Anthropometric and Body Composition Changes in Professional Football Players and Recreational Players Following a Four-Month Uniform Exercise Regimen

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Abstract

This study examined the effects of a four-month standardized exercise regimen on anthropometric and body composition changes in professional football players and recreational players. It sought to determine how varying training intensities influence physiological adaptations between these two groups. The research included 36 professional players and 32 recreational players, who underwent pre- and post-intervention assessments of weight, body mass index, circumferences, body fat percentage, muscle mass, and basal metabolic rate, using standardized protocols. The results demonstrated that professional players achieved significantly greater reductions in weight, BMI, and waist circumference, along with notable increases in muscle mass and basal metabolic rate compared to recreational players. These findings are consistent with previous studies, reinforcing the

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relationship between training intensity and physiological improvements.
This study highlights the need for tailored training regimens to optimize body composition and performance, emphasizing that athletes of different skill levels require customized approaches to achieve maximum benefits.

1. Introduction

Monitoring anthropometric characteristics and body composition is essential for evaluating athletes' abilities and developing optimal training programs (Čoh & Žvan, 2019). In team sports such as football, professional players often display greater lean body mass and lower body fat percentages compared to recreational players or the general population of the same age group (Santos et al., 2014). These differences are largely attributed to the intensity and consistency of training experienced by professional athletes over several years (Tomić, 2023). Although there is ongoing debate regarding whether a specific body type can predict success in professional team sports, there is clear evidence of body composition changes across different phases of the training macrocycle (Mathisen et al., 2023; Cullen et al., 2020).

The training process, which encompasses technical, tactical, psychological, physio-logical, and physical preparation, aims to enable athletes to achieve peak performance levels (Oliver, Ramachandran, Singh, Ramirez-Campillo, & Lloyd, 2024). For this to be effective, the training must provide an adequate stimulus for adaptation, which includes monitoring progress, ensuring proper rest, mental support, nutrition, and supplementation (Lindblom & Hägglund, 2024; Poffé et al., 2023). Assessing body composition is a key method for tracking changes in performance during various stages of the training cycle, typically divided into the preparatory, competitive, and transitional periods (Bjelica et al., 2024). Each phase serves a distinct purpose in developing athletic form: the preparatory phase focuses on enhancing physical fitness, the competitive phase aims to optimize performance, and the transitional phase allows for recovery and a reduction in training intensity (Barrera-Díaz et al., 2023).

Research in football indicates significant differences in body composition among players in different positions. For example, forwards and wingers require explosive power and agility to break through opposing defenses, while midfielders need high levels of endurance due to the long distances they cover during matches (Varjan et al., 2024). Defenders focus on strength and spatial awareness to counter attacks, whereas goalkeepers rely on reflexes and explosive movements to make crucial saves (West, 2018). These position-specific demands may contribute to distinct variations in body composition, underscoring the importance of tailored training and nutritional strategies (Bongiovanni et al., 2023). Certainly, it should be emphasized that it is very relevant and important to research anthropometry and body composition in football players, because they are of great importance for success in football, as well as in the process of identifying young talents.

Therefore, this study aims to contribute to the understanding of anthropometric characteristics and body composition changes in both professional

and recreational foot-ball players over a fourth-month uniform training regimen, providing a foundation for further adaptation of training programs and performance enhancement across different competition levels.

2. Material and methods

Participants Sample

A prospective study was conducted involving two groups: the first group consisted of football players from the "Novi Pazar" Football Club, aged (21.5 ± 2.1 years), while the second group comprised recreational football players, aged (23.1 ± 1.3 years) who agreed to participate in the research.

The inclusion criteria required participants to:

a) actively engage in the training process during the study period and

b) provide consent for participation in the study.

Exclusion criteria included:

a) lack of active participation in the training process,

b) age below 18 or above 25 years and

c) sustaining an injury during the study period that restricted their ability to fully participate in the training regimen.

The total number of included professional football players was 36, while there were 32 recreational football players, with total 68 participants.

Training program

The initial assessment was conducted in March 2023, followed by a subsequent evaluation in July 2023, establishing a four-month monitoring period (Table 1).

Throughout the study period, the participants from both groups maintained a structured training schedule, engaging in five training sessions per week, each lasting at least two hours. These sessions were supplemented by participation in competitive sports activities on weekends. This regimen was designed to ensure that the participants received consistent physical stimuli, which is critical for accurately tracking changes in their anthropometric and body composition parameters over the course of the study. A detailed description of the training program is showed in Table 1.

Measuring instruments

The study involved two separate evaluations of anthropometric and body composition parameters.

The anthropometric measurements encompassed a comprehensive range of variables, including body height (cm), body weight (kg), shoulder circumference across the back (cm), chest circumference (cm), waist circumference measured 5 cm above the umbilicus (cm), hip circumference (cm), upper arm circumference (cm), forearm circumference (cm), thigh circumference (cm), and calf circumference (cm).

Based on the collected data for body weight and height, the Body Mass Index (BMI) was calculated using the standard formula: BMI = body weight [kg] / (body height [m])^2.

In addition to these anthropometric measures, a range of body composition indicators were assessed. These included the percentage of body fat, percentage of total body water, muscle mass (kg), total body weight (kg), basal metabolic rate expressed in kilo-calories (KCAL), biological age, and the level of visceral fat.

Data analysis

The statistical analysis was conducted using the SPSS software, version 26.0 (Statistical Package for the Social Sciences). Categorical variables were presented using frequencies (N) and percentages (%), while continuous variables were described by mean values (Mean) and standard deviations (SD). The t-test of dependent samples was used to determine the differences between the initial and final measurements of professional and recreational football players. The t-test of independent samples was used to determine the differences between the groups at the final measurement.

3. Results and Discussions

In a study involving 36 professional football players, measurements taken four months after the initial assessment revealed several significant changes in anthropometric and body composition metrics.

Table 2. *Anthropometric and body composition changes in professional football players*

Variable	Initial measurement (Mean ± SD)	Final measurement (Mean ± SD)	p
Height (cm)	180.1 ± 5.1	180.1 ± 5.1	1
Weight (kg)	72.85 ± 8.95	69.55 ± 6.85	0.041
BMI (kg/m²)	22.98 ± 1.15	21.82 ± 0.88	0.001
Circumferences (cm)			
Shoulder width	112.22 ± 8.10	115.05 ± 8.11	0.045
Chest	89.77 ± 4.11	90.88 ± 4.10	0.482
Waist 5 cm above navel	77.98 ± 3.42	76.24 ± 2.35	0.003
Waist at navel	82.01 ± 4.02	78.72 ± 3.60	0.015
Hip circumference	95.80 ± 3.75	94.65 ± 3.39	0.048
Upper arm	29.70 ± 2.66	30.40 ± 2.95	0.152
Forearm	26.52 ± 1.92	26.61 ± 2.02	0.24
Thigh	54.00 ± 3.44	54.61 ± 3.50	0.063
Calf	36.84 ± 1.79	37.94 ± 1.88	0.034
Body composition measurements			
% fat	9.50 ± 3.35	8.75 ± 3.40	0.003
Muscle mass (kg)	34.95 ± 2.08	36.83 ± 2.00	0.001
Bone mass (kg)	3.30 ± 0.65	3.42 ± 0.67	0.253
BMR (kcal)	1865.0 ± 330.0	2041.0 ± 305.0	0.001

Table 2 showed that players experienced a notable reduction in weight, (3.3 kg; $p = 0.041$), leading to a decrease in BMI of (1.16 kg/m²; $p = 0.001$). Circumference measurements indicated significant reductions in waist size, both 5 cm above the navel (-1.74 cm; $p = 0.003$) and at the navel (-3.29 cm; $p = 0.015$), alongside a decrease in hip circumference (-1.15 cm; $p = 0.048$). Conversely,

shoulder width increased significantly by (2.83 cm; p = 0.045), and calf circumference increase by (1.1 cm; p = 0.034). Body composition analysis showed a significant decline in % fat by (0.75%; p = 0.003) and a significant increase in muscle mass by (1.88 kg; p = 0.001), while, chest, upper arm, forearm and bone mass remained unchanged (p > 0.05). Additionally, BMR increased significantly by (176 kcal; p = 0.001), suggesting improved metabolic efficiency and potential adaptations to training over the four-month period.

Table 3. *Anthropometric and body composition changes in recreational football players*

Variable	Initial measurement (Mean ± SD)	Final measurement (Mean ± SD)	p
Height (cm)	175.5 ± 6.2	175.5 ± 6.2	1
Weight (kg)	79.50 ± 10.3	74.80 ± 9.45	0.001
BMI (kg/m²)	25.40 ± 2.15	24.75 ± 1.85	0.01
Circumferences (cm)			
Shoulder width	109.00 ± 7.10	110.80 ± 6.95	0.058
Chest	90.10 ± 4.80	91.30 ± 5.15	0.412
Waist 5 cm above navel	81.00 ± 4.50	79.40 ± 3.95	0.005
Waist at navel	83.50 ± 5.00	81.20 ± 4.60	0.015
Hip circumference	97.00 ± 4.00	95.70 ± 3.90	0.022
Upper arm	30.00 ± 2.60	30.70 ± 2.80	0.123
Forearm	27.25 ± 1.85	27.35 ± 1.95	0.335
Thigh	55.10 ± 2.90	55.60 ± 3.05	0.076
Calf	37.15 ± 2.05	37.45 ± 2.10	0.424
Body composition measurements			
% fat	12.00 ± 3.25	11.20 ± 3.10	0.003
Muscle mass (kg)	32.50 ± 2.40	33.80 ± 2.30	0.001
Bone mass (kg)	3.05 ± 0.70	3.15 ± 0.65	0.215
BMR (kcal)	1905.0 ± 300.5	1952.0 ± 290.7	0.044

Table 3 presents the changes in anthropometric and body composition measurements of recreational football players over four months. Weight significantly decreased from 79.50 ± 10.3 kg to 74.80 ± 9.45 kg (p = 0.001), resulting in a reduction in BMI from 25.40 ± 2.15 kg/m² to 24.75 ± 1.85 kg (p = 0.01). Shoulder width increased slightly from 109.00 ± 7.10 cm to 110.80 ± 6.95 cm (p = 0.058). Waist measurements decreased, with the waist 5 cm above the navel dropping from 81.00 ± 4.50 cm to 79.40 ± 3.95 cm (p = 0.005), and waist at the navel decreasing from 83.50 ± 5.00 cm to 81.20 ± 4.60 cm (p = 0.015). Hip circumference decreased from 97.00 ± 4.00 cm to 95.70 ± 3.90 cm (p = 0.022), thigh circumference increased from 55.10 ± 2.90 cm to 55.60 ± 3.05 cm (p = 0.076), Body fat percentage decreased from 12.00 ± 3.25% to 11.20 ± 3.10% (p = 0.003), while muscle mass in-ceased from 32.50 ± 2.40 kg to 33.80 ± 2.30 kg (p = 0.001), BMR from 1905.0 ± 300.5 kcal to 1952.0 ± 290.7 kcal (p = 0.044). Chest, upper arm, forearm, calf and bone mass showed no significant change (p > 0.05). Overall, these results indicate that the training program led to significant improvements in body composition and various anthropometric measurements.

Table 4. *Comparison of anthropometric and body composition measures in professional football players and recreational players*

Variable	Mean difference for professional players	Mean difference for recreational players	p
Height (cm)	0	0	1
Weight (kg)	-3.3	-4.7	0.045
BMI (kg/m²)	-1.16	-0.65	0.018
Shoulder width	2.83	1.8	0.032
Chest	1.11	1.2	0.54
Waist 5 cm above navel	-1.74	-1.6	0.050
Waist at navel	-3.29	-2.3	0.021
Hip circumference	-1.15	-1.3	0.042
Upper arm	0.7	0.7	0.998
Forearm	0.09	0.1	0.657
Thigh	0.61	0.5	0.21
Calf	1.1	0.3	0.049
% fat	-0.75	-0.8	0.012
Muscle mass (kg)	1.88	1.3	0.001
Bone mass (kg)	0.12	0.1	0.54
BMR (kcal)	176	47	0.001

Table 4 compares anthropometric and body composition measures between professional and recreational football players. Both groups had no change in height, but professionals experienced a weight reduction of (-3.3 kg), while recreational players lost (-4.7 kg; $p = 0.045$). BMI decreased significantly more in professionals (-1.16 kg/m²) than in recreational players (-0.65 kg/m²; $p = 0.018$). Professional players showed greater increases in shoulder width (2.83 cm; $p = 0.032$) and calf circumference (1.1 cm; $p = 0.049$), while waist measurements decreased significantly for both groups, particularly at the navel (-3.29 cm for professionals vs. -2.3 cm for recreational; $p = 0.021$). Body fat percentage decreased in both groups (-0.75% for professionals vs. -0.8% for recreational; $p = 0.012$), and muscle mass increased significantly more in professionals (1.88 kg vs. 1.3 kg; $p = 0.001$). BMR also significantly more in professionals (176 kcal) compared to recreational players (47 kcal; $p = 0.001$), indicating greater overall improvements in professional players. The results in table 4 show that there are no statistically significant differences ($p > 0.05$) between the groups on the variables: chest, upper arm, forearm and thigh.

Discussions

The primary purpose of the study was to determine the differences in anthropometric characteristics and body composition between professional and recreational football players after four months of training. The results of the study clearly show differences in anthropometric characteristics and body composition at the final measurement, between professional and recreational football players, highlighting the role and importance of the applied training program. The practical and theoretical purpose of this study is reflected in the fact that football coaches,

experts in the field of football and sports in general, will gain new information about the importance of anthropometry and body composition in the selection process of football players. Additionally, this study makes a scientific contribution by providing football researchers with clearer and more recent data on the methods of developing anthropometric characteristics and reducing body composition within the fitness training of football players. The comparative analysis of the two groups, both undergoing a uniform four-month exercise program, underscores the superior effectiveness of structured training for professionals. Notably, professional players exhibited more substantial reductions in weight, BMI, and waist circumference, indicative of enhanced fat loss and improved body composition. These findings corroborate existing literature, which posits that higher training intensity and volume in elite athletes result in more significant physiological adaptations (Khalafi et al., 2024; Aragon et al., 2017).

Reduction of body fat percentage among professional players suggests an improvement in fat oxidation and metabolic efficiency, vital for maintaining competitive performance (Purdom, Kravitz, Dokladny, & Mermier, 2018; Chavez-Guevara, Amaro-Gahete, Ramos-Jimenez, & Brun, 2023). Significant increase in muscle mass by nearly two kilograms reflects the efficacy of resistance training incorporated into their regimen, essential for enhancing strength and power on the field. In contrast, while recreational players also experienced beneficial changes in body fat and muscle mass, their results were less pronounced, likely due to a lower intensity and focus in their training, as supported by previous studies (Wang et al., 2023; Oja et al., 2024).

Additionally, the increases in shoulder and calf circumferences among professionals further demonstrate how targeted strength training can yield specific muscular adaptations, crucial for athletic performance and injury prevention. Both groups showed significant reductions in waist circumference, emphasizing a common physiological response to increased physical activity and potential dietary modifications aimed at improving body composition. The reduction in waist size, particularly at the navel, under-scores the effectiveness of the training programs in targeting abdominal fat, often associated with metabolic health risks.

Crucially, the analysis reveals that professional players achieved more substantial improvements in muscle mass and BMR. An increase in BMR is indicative of enhanced energy expenditure at rest, vital for athletes to maintain optimal body composition during rigorous training (Woods et al., 2018). The greater rise in BMR for professionals suggests that they underwent more comprehensive adaptations, bolstering their overall metabolic profiles (Martins, Roekenes, Rehfeld, Hunter, & Gower, 2023).

These findings advocate for tailored training regimens that optimize performance outcomes in football. The significant differences between the two groups highlight the necessity of structured training programs to foster physiological adaptations that meet the demands of professional sport. Overall, this study reinforces the importance of differentiated training approaches based on the athlete's competitive level and performance goals (Jayanthi et al., 2022; Ilić et al.,

2023), ensuring that both professional and recreational players can effectively enhance their body composition and motor performance (Bjelica et al., 2023). A recommendation to future researchers on this or a similar topic would be to examine the differences in motor skills between professional and recreational football players. Also, it would be interesting to examine and determine the differences in body composition between football players and other team sports (for example basketball, handball, volleyball).

4. Conclusions

This study demonstrates that professional football players experience significantly greater anthropometric and body composition changes than recreational players following a four-month exercise regimen. Professionals exhibited notable reductions in weight, body fat percentage, and waist circumference, along with increases in muscle mass and basal metabolic rate, indicating enhanced performance and metabolic efficiency. In contrast, recreational players showed improvements but to a lesser extent, highlighting the necessity of tailored, high-intensity training for optimal athletic outcomes. These findings emphasize the importance of customized training strategies based on competitive level to achieve better body composition and performance results.

References

1. ARAGON, A.A., SCHOENFELD, B.J., WILDMAN, R., KLEINER, S., VANDUSSELDORP, T., TAYLOR, L., et al. (2017). International society of sports nutrition position stand: diets and body composition. *J Int Soc Sports Nutr., 14*, 1-19.
2. BARRERA-DÍAZ, J., FIGUEIREDO, A.J., FIELD, A., FERREIRA, B., QUERIDO, S.M., SILVA, J.R., et al. (2023). Contemporary practices of physical trainers in professional soccer: A qualitative study. *Front Psychol., 14*, 1101958.
3. BJELICA, B., AKSOVIĆ, N., BUBANJ, S., ZELENOVIĆ, M., STANKOVIĆ, M., PAJOVIĆ, L., et al. (2024). Effects of Physical Activity on Patients With Diabetes Type 2: A Systematic Review. *Balneo and PRM Research Journal, 15*(3), 719-742.
4. BJELICA, B., ZELENOVIĆ, M., ALEXE, C.I., AKSOVIĆ, N., SETIAWAN, E., & PRŽULJ, R. (2023). Effect of hyperbaric chamber on saturation and heart frequency. *Balneo and PRM Research Journal, 14*(4), 601-609.
5. BONGIOVANNI, T., ROSSI, A., GENOVESI, F., MARTERA, G., PULEO, G., ORLANDI, C., et al. (2023). How Do Football Playing Positions Differ in Body Composition? A First Insight into White Italian Serie A and Serie B Players. *J Funct Morphol Kinesiol., 8*(2), 80.
6. CHAVEZ-GUEVARA, I.A., AMARO-GAHETE, F.J., RAMOS-JIMENEZ, A., & BRUN, J.F. (2023). Toward exercise guidelines for optimizing fat

oxidation during exercise in obesity: A systematic review and meta-regression. *Sport Med., 53*(12), 2399-2416.

7. CULLEN, S., FLEMING, J., LOGUE, D.M., O'CONNOR, J., CONNOR, B., CLEARY, J., et al. (2020). Anthropometric profiles of elite athletes. *J Hum Sport Exerc., 17*, 145-155.
8. ČOH, M., & ŽVAN, M. (2019). Identification of young talents in sport. *Physical Education and Sport Through the Centuries, 6*(1), 70-79.
9. ILIĆ, I., DURLEVIĆ, S., BUBANJ, S., BJELICA, B., AKSOVIĆ, N., & DOBRESCU, T. (2023). Impact of Explosive Strength on Shot Speed in Handball. *Gymnasium, 24*(2), 109-119.
10. JAYANTHI, N., SCHLEY, S., CUMMING, S. P., MYER, G. D., SAFFEL, H., HARTWIG, T., et al. (2022). Developmental training model for the sport specialized youth athlete: A dynamic strategy for individualizing load-response during maturation. *Sports Health, 14*(1), 142-153.
11. KHALAFI, M., SYMONDS, M. E., MALEKI, A.H., SAKHAEI, M.H., EHSANIFAR, M., & ROSENKRANZ, S.K. (2024). Combined versus independent effects of exercise training and intermittent fasting on body composition and cardiometabolic health in adults: A systematic review and meta-analysis. *Nutr J., 23*(1), 7.
12. LINDBLOM, H., & HÄGGLUND, M. (2024). Motivation and goal-pursuit for injury prevention training in amateur football coaches: A cross-sectional study using the Health Action Process Approach. *Inj Prev., 30*(1), 20-26.
13. MARTINS, C., ROEKENES, J.A., REHFELD, J.F., HUNTER, G.R., & GOWER, B.A. (2023). Metabolic adaptation is associated with a greater increase in appetite following weight loss: a longitudinal study. *Am J Clin Nutr., 118*(6), 1192-1201.
14. MATHISEN, T.F., ACKLAND, T., BURKE, L.M., CONSTANTINI, N., HAUDUM, J., MACNAUGHTON, L.S., et al. (2023). Best practice recommendations for body composition considerations in sport to reduce health and performance risks: A critical review, original survey and expert opinion by a subgroup of the IOC consensus on Relative Energy Deficiency in Sport (REDs). *Br J Sports Med., 57*(17), 1148-1158.
15. OJA, P., MEMON, A.R., TITZE, S., JURAKIC, D., CHEN, S.T., SHRESTHA, N., et al. (2024). Health Benefits of Different Sports: A Systematic Review and Meta-Analysis of Longitudinal and Intervention Studies Including 2.6 Million Adult Participants. *Sports Med Open., 10*(1), 46.
16. OLIVER, J.L., RAMACHANDRAN, A.K., SINGH, U., RAMIREZ-CAMPILLO, R., & LLOYD, R.S. (2024). The effects of strength, plyometric and combined training on strength, power and speed characteristics in high-level, highly trained male youth soccer players: A systematic review and meta-analysis. *Sport Med., 54*(3), 623-643.
17. POFFÉ, C., KOPPO, K., JASPERS, A., BOEN, F., HELSEN, W. F., & VAN ROIE, E. (2023). Recreational Football Training Increases Leg-Extensor

Velocity Production in 55-To 70-Year Old Adults: A Randomized Controlled Trial. *J Sports Sci Med.*, *22*(2), 345.

18. PURDOM, T., KRAVITZ, L., DOKLADNY, K., & MERMIER, C. (2018). Understanding the factors that effect maximal fat oxidation. *J Int Soc Sports Nutr.*, *15*(1), 3.
19. SANTOS, D.A., DAWSON, J.A., MATIAS, C.N., ROCHA, P.M., MINDERICO, C.S., ALLISON, D.B., et al. (2014). Reference values for body composition and anthropometric measurements in athletes. *PloS One, 9*(5), e97846.
20. TOMIĆ, S.M. (2023). Football, falcon fighting and equestrian sports in Zaječar and Niš through games and entertainment. *Physical Education and Sport Through the Century, 10*(2), 50-62.
21. VARJAN, M., HANK, M., KALATA, M., CHMURA, P., MALA, L., & ZAHALKA, F. (2024). Weekly Training Load Differences between Starting and Non-Starting Soccer Players. *J Hum Kinet., 90*, 125-135.
22. WANG, X., SOH, K. G., SAMSUDIN, S., DENG, N., LIU, X., ZHAO, Y., & AKBAR, S. (2023). Effects of high-intensity functional training on physical fitness and sport-specific performance among the athletes: A systematic review with meta-analysis. *Plos One, 18*(12), e0295531.
23. WEST, J. (2018). A review of the key demands for a football goalkeeper. *International Journal of Sports Science & Coaching, 13*(6), 1215-1222.
24. WOODS, A. L., RICE, A. J., GARVICAN-LEWIS, L. A., WALLETT, A. M., LUNDY, B., ROGERS, M. A., et al. (2018). The effects of intensified training on resting metabolic rate (RMR), body composition and performance in trained cyclists. *PLoS One, 13*(2), e0191644.