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Professional paper

CHARACTERISTICS OF PHYSICAL FITNESS OF PROFESSIONAL FOOTBALL PLAYERS IN RELATION TO PLAYING POSITION

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Abstract

In this paper, the physical fitness characteristics of professional football players in relation to the playing position have been investigated. The aim of this study was to determine if the speed, speed with change of direction - agility, explosive strength of the lower extremities and isotonic strength of the muscles of the upper extremities in football players varies according to the playing position. The research was conducted on a sample of 24 elite football players (n=24, age 25.82±5.6 years) who play in four different positions, such as goalkeeper (GK), defender (DF), midfielder (MF) and forward (FW). Univariate analysis of variance ANOVA was used to compare the following variables: 10 meter and 20 meters linear sprint, T-test of agility, squat jump, counter movement jump-free hand and 1RM Bench press. The results showed a significant influence of the game positions on the performance of the counter movement jump – free hand ($F=3.800$, $p=0.026$) and the performance of the 10 meters linear sprint ($F=3.243$, $p=0.044$). The LSD post-hoc test analysis revealed significantly better performance in the countermovement jump test (CMJ-free hand) in favor of forwards (FW) (47.24 cm), compared to midfielders (MF) (37.60 cm) and goalkeepers (GK) (38.05 cm), better performance in the squat jump test (SJ) was again shown by forwards (FW) (39.22 cm) compared to goalkeepers (GK) (31.10 cm) and also in speed ability, through in the 10-meter linear sprint test (R10m), significantly better performance was shown by forwards (FW) (1.83 sec.) compared to goalkeepers (GK) (2.03 sec.) and defenders (DF) (1.94 sec.) . The results of this study may provide detailed strategies for coaches and clinical practitioners for developing position-specific fitness programs in professional football players.

Keywords: physical fitness performances, elite football players, speed, agility, explosive strength, ANOVA.

1. Introduction

The laws of human biopsychosocial changes, such as: morphological characteristics and body composition, biomotor skills and physical fitness, aerobic and anaerobic capacity in athletes, conative characteristics, emotional intelligence skills and social aspect, which are located in the human organism and evaluate under the influence of sports activity, studies sports anthropology (Iseni, 2022). Today, although all sports activities present a focus of study for many researchers, the sport of football as the most attractive sport, with high viewership and the most profitable, is an analyzed game in which the participants undergo numerous actions that require general strength. and production of power, speed, agility, balance, flexibility and sufficient level of endurance (Blomfield et al., 2007), (Gorostiaga et al., 2004), thus making the physical fitness performances of players a complex process. Activities related to the development of speed, explosive strength and agility are directly related to the factors of the nervous system and the mechanisms of transmission of nerve impulses and impose great metabolic and coordination requirements, they must be performed when the athlete has a minimum level of fatigue (Bompa & Hoff, 2009). Furthermore, morphological and physiological characteristics, physical fitness, maturity status and the influence of age during player selection have been shown to be good predictors of success in young football players (Le Gall et al., 2010). Since research in general is multi-dimensional in nature, there is a need for a longitudinal approach to help predict and develop new talents in football players (Gil, S. et al., 2007). However, it is clear that the demands of playing are multifactorial and the characteristics of elite players should be investigated using multivariate analyzes (Baker et al., 2003). (Wisloff et al., 2004) concluded that maximal strength determines and is highly correlated with sprint and high jump performances in elite football players. It is essential that the individual positional requirements of the players are taken into account during football practice, in terms of completing tactical tasks. Players require specific skills and superior physical condition in order to effectively execute these tasks. Differences in the assessment of players' physical fitness parameters have been shown to be related to playing positions, as observed in many studies regarding different parameters (Barnes et al., 2014) (Di Salvo et al. 2007) (Maly et al. 2016) (Zahalka et al. 2015). Recent research by the authors (Zalai et al. 2015) (Al Haddad et al. 2015) (Boone et al. 2012) highlighted that age, morphology and physical fitness were the influencing parameters of football performance in elite level football players, but also confirmed that playing position decisively dictated absolute performance loads and the intensity of rapid movements during matches. Investigating how physical fitness parameters change based on different playing positions in elite football players can have a profound impact on their daily training and future performance. Therefore, the aim of this study was to determine if speed, turning speed – agility, explosive strength of the lower extremities and isotonic strength of the muscles of the upper extremities in football players varies according to the playing position.

2. Methods

2.1.The participants

The test sample consists of male football players who compete in the highest level of the competition, the North Macedonian Super League. The total number of tested is 24 male football players (25.82±5.6 years, 184.04±6.08 body height, 76.12±6.50 body mass). The study is descriptive, comparative and transversal in nature and the tests were carried out in the pre-competitive period. All subjects were first informed about the study and the purpose of the research was explained to them. Before testing, each player signed a consent form to participate in the study. For this study, consent was also obtained from the head coach and the president of the club. The research was approved by the Ethics Committee of the Faculty of Physical Education, University of Tetova in accordance with the Declaration of Helsinki (World Medial Assocciation, 2013).

2.2. Test procedures

The measurement instruments in this study included several variables of physical fitness characteristics. The assessment of physical fitness characteristics was carried out in the early hours of the morning. The testing was done after a rest day that the players had, so that the results come out as reliable as possible.

2.3.Assessment of physical fitness characteristics

Speed

Speed indicators were evaluated using motor tests linear sprint running at 10 and 20 meters. 10 and 20 meter linear running performance was measured using sophisticated photocells (Microgate Witty timer, Balzano, Italy). The start of the start run was from the high start position, where every football player had the right to make at least two attempts, while as a result the best time was obtained. These speed tests are used in different age groups (Little, 2003).

Agility

To assess agility, we used the T-test agility (Kainoa, 2000), which included running forward, sideways, and backward. The positioning of the four cones is illustrated in Figure 1. The subject starts from cone A, runs linearly to cone B and touches with the right hand, then runs sideways to the left to cone C, and again touches the cone, then runs sideways up to cone D and touches the cone, then continues sideways to cone B and touches the cone, and at the end the subject runs back to cone A, where he ends the test.

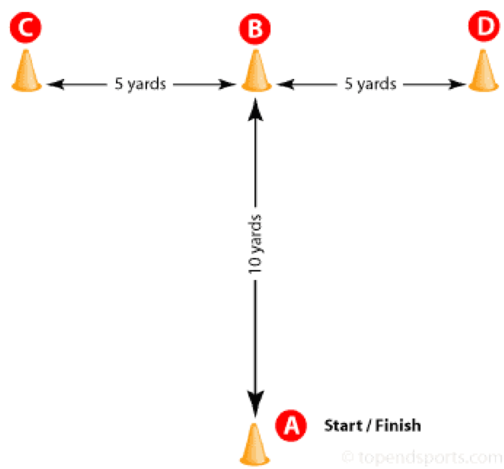


Figure 1. T-test agility

Explosive strength of the lower extremities

The indicators of the explosive strength of the lower extremities were evaluated using the squat jump motor tests (figure 2) and countermovement jump-free hand (figure 3). The SJ and CMJ-free hand tests are reliable and valid tests for evaluating the explosive strength of the lower limbs (Fischetti et al., 2018) (Kryeziu et al., 2023). Both tests are performed between two opto jump poles connected to a digital timer (accuracy ±0.001 sec.) (Microgate, Opto jump, Balzana, Rome, Italy) that records flight time and contact time, together with the height of the jump in centimeters. Each test is performed a minimum of three times, with 1 minute breaks between attempts. The athlete's best result in centimeters is noted.

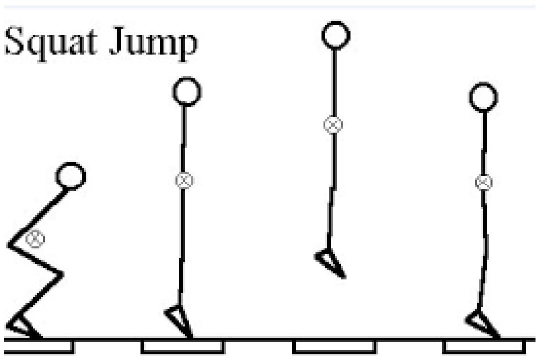


Figure 2. Squat jump

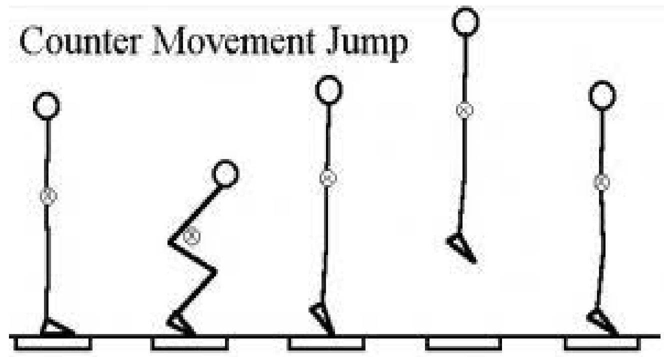


Figure 3. Counter movement jump

Maximum isotonic strength of the upper extremities

To assess maximal isotonic strength of the upper extremities, we used the 1RM Bench press test (Wilk et al., 2020). This is a specific upper body repetition maximum (RM) test using the bench press test. The subject must perform an adequate warm-up. An example would be to warm up with 5-10 reps of a light to moderate weight, then after a minute of rest, continue the warm-up with a heavier weight for 2-5 reps, with a two minute rest. The subject should then rest for two to four minutes, then perform the one-repetition maximum effort with proper technique. If the lift is successful, rest for another two to four minutes and increase the load by 5-10% and try another lift. If the subject is unable to perform the lift with proper technique, rest two to four minutes and try a 2.5-5% lower weight. Continue raising and lowering the weight until the maximum is done. Selection of the starting weight is essential so that the maximum lift is performed within approximately five attempts after the warm-up sets.

2.4.Statistical analysis

Data were processed using the SPSS statistical package, version 26, IBM, U.S.A. In the first step, the basic descriptive parameters and the distribution of the variables were defined. Central and dispersive parameters were calculated for all tests and groups, such as arithmetic mean (mean) and standard deviation (St.Dev.). The normality of the distribution of the variables is derived through the asymmetry of the results (Skewnes) and the homogeneity of the results (Kurtosis). To determine the differences between the groups in the researched variables, we used the univariate analysis of variance ANOVA, while to determine how the groups differ statistically from each other, we used the LSD-Post hoc test. The statistical significance of the differences was determined at the $p<0.05$ level.

3. Results

Table 1. Basic statistical parameters of physical fitness variables (total of 24 football players)

Variables	N	Min.	Max.	Mean	Std. Dev	Skewn.	Kurt.
BH	24	172.00	194.00	184.0417	6.08261	-.055	-.972
BW	24	63.00	86.00	76.1229	6.50862	-.420	-.623
10m	24	1.72	2.11	1.9129	.10352	.058	-.375
20m	24	2.88	3.47	3.1958	.12897	-.556	.894
T-TEST AGILITY	24	9.00	10.76	10.0925	.40707	-1.046	1.453
SQUAT JUMP	24	28.70	45.60	35.9542	4.89063	.573	-.676
CMJ-FREE HAND	24	33.50	59.00	42.1583	6.37556	.938	.831
BENCH PRESS 1RM	24	60.00	93.30	76.5458	9.37054	.182	-.783

In table 1, we have shown the main values of the physical fitness indicators, the basic statistical parameters have been processed, including: the minimum score, the maximum score, the arithmetic mean as the main central indicators, the standard deviation as the main dispersive indicator, as well as the main indicators of the distribution of curve, curve asymmetry or skewness index and curve roundness or kurtosis index. The value of body height is 184.04 cm, which means that this dimension advances compared to other anthropometric indicators, and compared to the growth values of peers from other countries where this dimension has been tracked, in the football players tested in this study we have higher values than the elite football players of Germany (Kadlubovksi et al. 2019). The standard deviation values are low for all variables, which proves that the discriminability is very low and it is about results that are homogeneous. All the curves of the variables have slight asymmetry, except for the T-test agility variable where the asymmetry is more pronounced and negative. The roundness of the curve in all variables is paltikurtic in shape or scores less than 2.75.

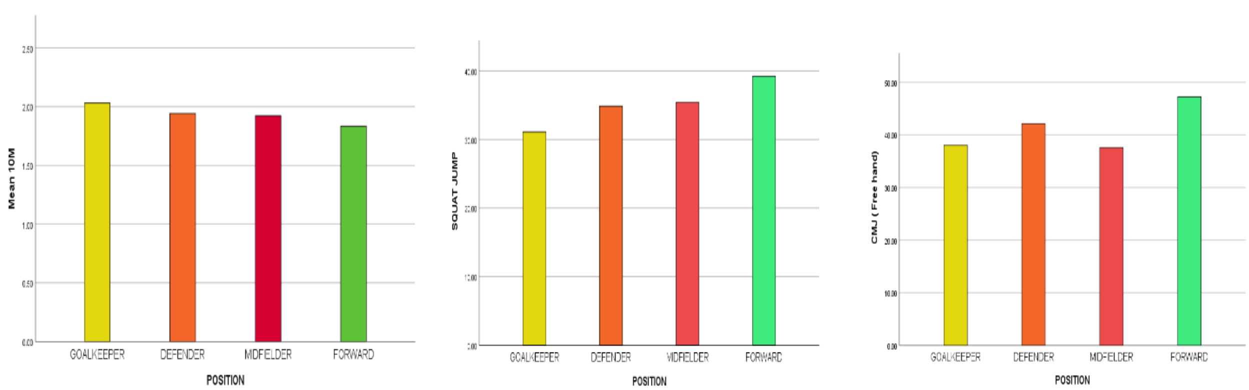
Table 2. Differences in physical fitness parameters according to playing position. Data values are expressed in the following format: Arithmetic mean (standard deviation), Anova, LSD Post hoc test

Variables	GK	DF	MF	FW	ANOVA		Post hoc
	n=2	n=9	n=6	n=7	F	p	
BH	188.00 (1.41)	185.44 (6.67)	180.66 (5.27)	184.00 (6.27)	1.067	.385	-
BW	80.5 (5.23)	76.67 (6.04)	73.68 (8.16)	76.25 (6.39)	.571	.641	-
10m	2.03 (.07)	1.94 (.09)	1.92 (,10)	1.83 (.08)	3.243	.044	GKvsFW DFvsFW

20m	3.28 (.007)	3.20 (.083)	3.20 (.15)	3.14 (.167)	.656	.588	-
ATT	10.53 (.014)	10.10 (.235)	10.03 (.536)	10.00 (.495)	.904	.457	-
SJ	31.10 (3.39)	34.84 (4.17)	35.41 (4.91)	39.22 (4.88)	2.168	.124	GKvsFW
CMJ-FH	38.05 (1.34)	42.15 (4.86)	37.60 (4.35)	47.24 (7.18)	3.800	.026	GKvsFW MFvsFW
B1RM	86.05 (1.90)	75.40 (11.1)	76.66 (9.19)	75.02 (7.73)	.866	.475	-

Legend: GK-goalkeeper, DF-defender, MF-midfielder, FW-forward, BH-body height, BW-body weight, 10m-sprint 10m, 20m-sprint 20m, ATT-agility t-test, SJ-squat jump, CMJFH-countermovement jump free hand, B1RM-bench press 1 rest maximum.

Univariate ANOVA analysis of variance revealed significant differences in the observed parameters related to playing position in football players. It can be noted that we have significant statistical differences in only 2 of the 6 physical fitness variables used in this research, where we have significant differences in the variable that expresses explosive strength - the countermovement jump test (CMJ-free hand), with reliability (p =0.026, F=3.800) and in the speed variable-10 meter sprint test (R10m), with reliability (p=0.044, F=3.243). The LSD post-hoc test analysis revealed significantly better performance in the countermovement jump test (CMJ-free hand) in favor of forwards (FW) (47.24 cm), compared to midfielders (MF) (37.60 cm) and goalkeepers (GK) (38.05 cm). Also better performance in the squat jump test (SJ) was again shown by forward players (FW) (39.22 cm) compared to goalkeepers (GK) (31.10 cm). Also in speed ability, through the 10 meter sprint test (R10m), significantly better performance was shown by forward players (FW) (1.83 sec.) compared to goalkeepers (GK) (2.03 sec.) and defenders (DF)) (1.94 sec.).



a) b) c)

Figure 1. Physical fitness characteristics of the football players, LSD Post hoc tests for: a)10m sprint, b) squat jump, c) countermovement jump.

4. Disccussion

The purpose of this study was to investigate physical fitness characteristics in professional football players in relation to playing position. Our findings of accelerated sprints (S10m and S20m) were consistent with the authors' recent studies (Gil et al., 2018) (Bujnovski et al., 2019). (Lockie et al. 2016) support that linear speed is a crucial factor for football players for positional play and goal scoring. (Pyne et al. 2008) reported a finish time of 3.04 ± 0.08 s for the 20 m sprint from a stationary (prone) start, which is approximately 0.2 s slower than that of our test of 20 meter sprint. A better result in the squat jump test appeared in the author's study (Rebelo et al. 2013) compared to our study, while in the countermovement jump test the results were almost identical. Identical results where forwards had advantages over other positions in the football game in terms of performing physical fitness tests such as vertical jump, countermovement jump and agility tests were also presented to the authors (Dey et al. 2010) (Donegan et al. 2022). By comparing the paired means of different playing positions in football, goalkeepers have shown statistically significant differences with forwards, also midfielders have shown significant differences with forwards, as far as the countermovement jump-free hand test is concerned. The authors (Boraczynski et al. 2020) also identified a large inverse relationship between CMJ and 30m sprint and large positive correlation between CMJ and maximal knee extensor contraction. The results show that elite players with lower body strength show better sprint and CMJ performance, suggesting the inclusion of specific resistance training in football players to develop lower body musculature. The authors (Barrera et al. 2023) observed a moderate correlation between the countermovement jump and squat jump test, as well as the 20 and 30 meter sprint performances. The model combining squat jump, countermovement jump, and the Kecon 180 s-1 isokinetic strength test was also significant for predicting 20- and 30-meter sprint times, where jump performance was significantly related to linear sprint performance. Another article suggested the education and instruction of fundamental movements with progressive exercise formats through a variety of exercise modes and adequate rest in the adolescent developmental stage that help increase athletic performance in football players (Barbalho et al. 2018). The current data of the study is possible to build an effective training tactic based on the stages of physical fitness development and football positions.

5. Conclusion

The results of this study showed significant differences in 10m sprint performance between the tested groups of goalkeepers (GK), defenders (DF), midfielders (MF) and forwards (FW), FW demonstrated significantly better skills than the other groups while statistically significant difference was presented between GK and WG, as well as DF and WF, GK showed significantly slower performance than FW, MF and DF. Furthermore, forwards (FW) performed better than goalkeepers (GK) in the squat jump (SJ) test, while goalkeepers (GK) had significantly lower finishing times than players of other positions. Forwards (FW) also demonstrated better performance in the countermovement jump (CMJ) – free hand test, which may be a result of the tactical play common in the modern football game, where they have to perform many repeated sprints and jumps to pass more at the end or to secure a cross ball into the penalty areas to facilitate the attack. The most significant statistical differences in the CMJ test were presented between goalkeepers (GK) and forwards (FW), as well as between midfielders (MF) and forwards (FW), all in favor of forwards. The present results showed significant differences between playing positions and the physical fitness skill requirements required for each position. For this reason, it is essential to work on the individual needs of players according to their positions during the football training process to help them achieve the necessary fitness levels to perform efficiently on match days. The task of all sports coaches and educators, including strength and conditioning coaches and athletic trainers, is to improve the morpho-functional condition of players and build successful teams. The results of this study may provide detailed strategies for coaches and clinical practitioners for developing position-specific fitness programs in professional football players. Another possibility is to create new and specific tests for individual player positions.

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