Revista Brasileira de Prescrição e Fisiologia do Exercício
ISSN 1981-9900 ***versão eletrônica***

Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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ANAEROBIC PERFORMANCE AND ANTHROPOMETRIC CHARACTERISTICS OF AMERICAN FOOTBALL PLAYERS OF A BRAZILIAN TEAM

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ABSTRACT

This study aimed to: a) analyze anaerobic and anthropometric indicators in amateur American football players (AF), and b) to compare the anaerobic and anthropometric indicators between the positions of attack and defense. Forty four (44) amateur players in AF were evaluated. The players were divided into two groups: Attack (AG: n=2) and Defense (DG: n = 23) . Measures of height, weight, body mass index (BMI) and percent body fat (% BF) estimated by bioimpedance were performed. Anaerobic parameters were measured by RAST test (maximum power: Pmax, average power: MP; fatigue index: IF), vertical junp and 20-m running. Significant differences were found between positions for weight, BMI and % BF It was observed that AG is heavier than DG ($p < 0.05$). Absolute differences between the IF and MP DG and AG groups were found. Differences in performance of 20m, with players occupying the Wide Receiver position being faster compared to other players. We may conclude that there are differences in anaerobic and anthropometric parameters between the positions of the AF players.

Key words: Performance. Anaerobic parameter. RAST test. Muscular power. Speed.

RESUMO

O presente estudo teve como objetivos: a) analisar indicadores anaeróbios e antropométricos em jogadores amadores de futebol americano (FA) e, b) comparar os indicadores anaeróbios e antropométricos entre as posições de ataque e defesa. Foram avaliados 44 jogadores amadores de FA. Os jogadores foram divididos em dois grupos: Ataque (GA: n= 21) e Defesa (GD: n= 23). Foram realizadas medidas de estatura, peso, índice de massa corporal (IMC) e percentual de gordura (%G) estimada por bioimpedância. Foram medidos parâmetros anaeróbios pelo teste de RAST (potência máxima: Pmax; potência média: PM; índice de fadiga: IF), salto vertical e corrida de 20m. Foram encontradas diferenças significativas entre as posições para peso, IMC e %G. Observou-se que o GA é mais pesado do que o GD ($p<0,05$). Foram encontradas diferenças para PM absoluta e IF entre os grupos GD e GA. Houve diferença na desempenho de 20m, sendo os jogadores que ocupam a posição wide receiver mais rápidos em relação aos outros jogadores. Conclui-se que existe diferença em parâmetros anaeróbios e antropométricos entre as posições dos jogadores de FA.

Palavras-chave: Desempenho. Indicadores Anaeróbios. Teste de RAST. Potência Muscular. Velocidade.

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Revista Brasileira de Prescrição e Fisiologia do Exercício
ISSN 1981-9900 ***versão eletrônica***

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INTRODUCTION

The American Football (AF) is a very popular sport in the United States and has attracted people from over 100 countries (Holffman, 2008; Vural, Rudarli and Ozkol, 2009). In Brazil, the sport is increasingly becoming popular and now has more than 10 Professional federations (CBFA, 2014).

The CBFA (2014) explains that the game consists of a series of short-term events, involving strategic and tactical actions. With 22 players on the field at the same time (11 per team), each with an assigned task to move. The objective of the game is to score the most points. The main strategy is to enter the area to the bottom opponent's field with possession of the ball (touchdown). According to Holffman (2008) AF primarily consists in repeated actions for maximum intensities, consisting of four quarters lasting 15 minutes, separated by intervals of 20 minutes.

In AF, players have very specialized roles and there is evidence of differences in the physiological and anthropometric characteristics of players according to their occupied positions in the field (Secora and colleagues, 2004; Kraemer and colleagues, 2005; Lockie and colleagues, 2012), so the teams are divided into three separate units: offense, defense, and special players (Vural, Rudarli and Ozkol, 2009).

Characterized as a team sport, the AF demands a high level of strength, power, speed and agility, performance that is typically characterized by a sequence of actions of high intensity, short duration, separated by moments of low intensity (Holffman, 2008; Condello, Schultz and Tessitore, 2013).

In team sports, such as the AF, the activities are composed of explosive movements with frequent changes of direction; runs into different intensities and application situations of force against defensive actions (Kin-Isler and colleagues, 2008), thus characterizing the anaerobic performance as a fundamental aspect of these events.

Considering that the identification of physical qualities that discriminate players of different skill levels can provide information about the factors that are important for reproducing selection to high performance level (Rossignol and colleagues, 2014) and also important criteria selection for sports such as AF include the combination of specific anthropometric and physiological characteristics (Veale and colleagues, 2008.), this study aimed to: a) analyze anaerobic and anthropometric indicators in amateur football players, and b) to compare the anaerobic and anthropometric indicators between the positions of attack and defense.

MATERIALS AND METHODS

A transversal study was conducted with an intentional sampling of amateur football players (n=44) twice champion Brazilian team (2010/2012). The players were divided into two groups: Attack (AG: n = 21), mean age 22.3 ± 4.96 years and Defense (DG: n = 23), mean age 20.7 ± 6.3 years and for most specificity groups were subdivided by their positions on the field, merely considering the positions wherein the largest number of volunteers players were presented. The AG (n = 21) composed of positions: quarterback - QB (n = 4), offensive lineman - OL (n = 5) and wide receiver - WR (n = 12). The DG (n = 23) comprising: cornerback - CB (n = 6), linebacker - LB (n = 9), defensive end - DE, defensive back - DB and defensive line - DL (n = 8).

The individuals were informed about the purpose of the study and signed an Informed Consent Form, approved by Committee for Ethics in Research of University of Cuiaba (CEP / UNIC 2011-220) in accordance with the provisions of Resolution CNS 196 / 96.

Anthropometric variables

Anthropometric data were measured by a bioimpedance (WISO®: W835), according to manufacturer's guidelines, allowing to estimate values of body fat percentage (%BF). The body mass index (BMI) was obtained from the athlete's weight and divided by his height squared.

Anaerobic performance

To the estimation of the anaerobic capacity the run anaerobic speed test (RAST) and 20-m dash test were performed on different days, with at least 24 hours between each test. Before starting both tests, a specific warm-up, involving stretching exercises for

Revista Brasileira de Prescrição e Fisiologia do Exercício
ISSN 1981-9900 ***versão eletrônica***
Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício
w w w . i b p e f e x . c o m . b r / w w w . r b p f e x . c o m . b r

lower limbs and low intensity running was performed.

Running Anaerobic Sprint Test - RAST

To estimate the anaerobic parameters, the RAST (Running Anaerobic Sprint Test) test was applied, according to (Roseguini, Silva and Gobatto, 2008; Adamczyk, 2011).

The test consisted of six runs with maximum speed on the distance of 35 meters, with a minimum 10-second pause among them (just for turning back). The power in each sprint was then calculated by the formula: Power = (Body Mass x Distance2)/Time3. Were recorded as the RAST anaerobic parameters: maximum power (Pmax: high power among six sprints), mean power (MP: average among the powers of the six sprints), minimum power (Pmin: low power among 6 efforts), maximum power per weight (Pmax=W/kg), Total time (TT: The summation of time of 6 efforts), and indicator of power decrease (fatigue index: FI): FI (W.s-1) = (maximum power – minimum power/TT). The results of MP, Pmin and FI relative to total body mass of each athlete were also used as anaerobic parameters for the RAST (Roseguini; Silva; Gobatto, 2008).

20-m dash test

To verify the displacement speed over 20 meters, the 20-m test was applied. For this test two attempts were made at maximal sprint over 20 meters with 5-minutes interval between each sprint, and recorded the best time (s) to the nearest two decimal places.

Muscular power of the lower limbs

To assess muscular power of the lower limbs, the Vertical jump test (Matsushigue, Franchini and Kiss 2003) was used. For the measurement a five meters measuring tape positioned on the wall was used. The athlete was placed next to the wall, feet hip-width apart and fingers painted with ink. Before starting the test was verified the total height with the arms elevated along a 5 meters measuring tape. Next was begun the test, instructing the athlete to jump as high as possible. The jumping was performed three times, with one minute interval between each jump. The vertical displacement was identified by the difference between the total height and achieved height, being considered the best result of the three attempts.

Statistical Analysis

Initially, descriptive statistics (mean ± SD) was applied to each variable. To verify data normality the Shapiro-Wilk test was applied. After verifying normality, Student's t test was applied to compare the values of anthropometric indicators, maximum, average and minimum power, FI absolute and relative between AG and DG. Analysis of variance (ANOVA - one way, post hoc Tukey) was applied to compare values between the subgroups. It was considered $p < 0.05$ to identify statistical significance. The data were analyzed by Bioestat ® 5 software.

RESULTS

The sample was composed by 44 male amateur players with average practice time sport 31.4 ± 27.9 months. Table 1 presents the mean values (± SD) of anthropometric indicators from attack and defense groups the results of comparisons of anthropometric indicators between positions and between AG and DG groups. Significant differences were found between positions for weight, BMI and % BF.

It was observed that AG is heavier than DG group ($p < 0.05$). When comparisons were made between the positions the OL position players were heavier in relation to other players, also repeated for BMI and % BF.

Table 2 shows absolute and relative values from indicators produced by the anaerobic RAST test values.

Differences between absolute MP from DG and AG were found, considered the greatest MP for DG. Differences between Pmax, Pmin were found in the relative parameters, when related from the DG to AG, and significant differences when compared with the FI shown in the two groups.

Table 3 describes the average results (± SD) of the motor variables of the players separate into subgroups related to different positions.

The parameters of the Vertical Leap presented no differences when comparing the positions of the players. Differences in the 20-m performance between the positions CB and DE/DL/DB and OL were identified. Also

Revista Brasileira de Prescrição e Fisiologia do Exercício
ISSN 1981-9900 ***versão eletrônica***
Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício
w w w . i b p e f e x . c o m . b r / w w w . r b p f e x . c o m . b r

regarding performance of 20-m, the players occupying positions DE/DL/DB are slower than the players occupying the WR position and these are faster than the players of the OL position.

Table 1. Anthropometric characteristics (mean ±SD) for position players (attack group: AG; defense group: DG) and general (n = 44).

Positions		Age (years)	Body weight (kg)	Body height (m)	BMI (kg/m²)	%BF
AG	QB	21 ±5,7	87 ±16 [b, c]	1,8 ±0,09	27 ±4,59 [e]	30 ±9,04 [j, k]
	OL	26 ±4	119 ±13 [b, d]	1,8 ±0,07	36 ±4,2 [e, f, g, h, i]	42 ±4,8 [j, l]
	WR	21 ±4,5	69 ±7,8 [c, d]	1,8 ±0,08	22 ±1,5 [f]	22 ±3 [k, l, m]
	General	22 ±5	84,3 ±23,7 [a]	1,8 ±0,1	26 ±6,3	28 ±9,8
DG	LB	23 ±5,8	84 ±8,5	1,8 ±0,1	27 ±3,1 [g]	29 ±7 [n]
	CB	20 ± 2,17	71 ±7,6	1,8 ±0,03	23 ±2,02 [h]	22 ±2,2 [n, o]
	DE/DL/DB	22 ±3,9	89 ±13	1,8 ±0,04	28 ±4,25 [i]	31 ±9,29 [m, o]
	General	22 ±4,4	82 ±27,6 [a]	1,8 ±0,05	26 ±3,8	28 ±7,9

LB – Linebacker, CB – Cornerback; DE – Defensive End; DL – Defensive Line; DB – Defensive Back; QB – Quarterback; OL – Offensive Lineman and WR – Wide Receiver; %BF - Body fat; BMI – Body mass index. Equal letters indicate significant differences between the positions and/or between groups. [a, c, m, n, o] p-value = 0,04; [b, d, e, f, g, h, i, j, k, l] p-value = 0,01.

Table 2. Average values (±SD) absolute and relative anaerobic parameters of the attack group (AG) and defense group (DG) according to the RAST test.

Absolute anaerobic parameters					
Group	P_{max} (w/kg)	MP (w)	P_{min} (w)	FI (w/s)	TT (s)
AG (n=21)	631,30 ±210,24	297,46 ±124,19	296,49 ±92,36	9,17±4,10	34,53 ±9,87
DG (n=23)	642,1±192,1	445,6±137,4*	308,4±103,4	9,3 ±3,6	34,0 ±9,6
Relative anaerobic parameters					
Group	P_{max} (w/kg)	MP (w/kg)	P_{min} (w/kg)	FI (w/kg/s)	
AG (n=21)	11,95 ±4,35	5,36 ±1,80	5, 57±1,74	0,17±0,08 *	
DG (n=23)	8,0 ±2,5 *	5,5 ±1,8	3,9 ±0,92 *	0,12 ±0,0	

P_{max}: maximum power; MP: medium power; P_{min}: minimum power; FI: fatigue index; TT: total time. * p=0,01.

Revista Brasileira de Prescrição e Fisiologia do Exercício
ISSN 1981-9900 ***versão eletrônica***

Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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Table 3. Average values (± SD) of the variables anaerobic motor performance in accordance with the positions of the players.

Positions	Vertical jump power (cm)	20-m (s)
LB	56,9±5,0	4 ±0,24
CB	61,3±10,3	3,3 ±0,13 [a, b]
DE/DL/DB	56,3±7,96	3,6 ±0,47 [a, c]
QB	49±3,74	3,4 ± 0,0
OL	50±6,77	3,9 ±0,30 [b, d]
WR	59±6,84	3,4 ±0,21 [c, d]

LB- Linebacker. CB – Cornerback. DE- Defensive End. DL- Defensive Line. DB - Defensive Back. QB- Quarterback. OL- Offensive Lineman e WR- Wide Receiver. [a] CB<DE/DL/DB (p=0,01); [b] CB< OL (p=0,01); [c] DE/DL/DB> WR (p=0,04); [d] OL> WR (p=0,01).

DISCUSSION

American Football is a popularized and large audience sport for the North American population. In Brazil, it is still a sport that has been increasing, gaining more followers every year and has more than ten federations in the country (CBFA, 2014), thereby have attracted interest by our group to research on some variables related to AF (Comachio and colleagues, 2012; Rietjens and colleagues, 2012.). With the growth of the practice and popularity of the sport in Brazil, is relevant the knowledge of aspects of the physical and functional characteristics of these players.

Studies demonstrate that the best teams and players are those with high levels of muscle strength, power, speed and body size (Burke; Read; Gollan, 1985; Kraemer and colleagues, 2005) and that the physiologic requirements are very specific (Lockie and colleagues, 2012). Hoffman (2008) stated that the ATP-PC energetic system supplies 90% of the energy required during sprint actions, with the glycolytic system contributing 10%. The contribution of the glycolytic pathway while performing repeated sprints was observed in the study by Dal Pupo and colleagues (2010) finding values of lactate concentration of 10.12 ± 1.48 mmol/L.

Lockie and colleagues (2012) reported that, as the actions in the AF games are performed in approximately 5 seconds, with intervals between the moves of at least 30s, the tests focus on line speed runs, vertical leap (which serves as an indirect measure of the vertical power) and agility trials.

It has therefore been observed in this study, through the RAST test, that players operating in DG positions are more tolerant to fatigue, thus presenting a greater ability to perform repeated sprints. Rossignol and colleagues (2014) investigated the relation between the ability to perform repeated sprints in two groups of soccer players (Team A - selected to play the season and B - not selected) and found that the ability to perform repeated sprints in players the team was far superior team B, suggesting that the development of physical quality should be prioritized in the preseason training sessions.

According to the classification established by Bangsbo (1994), which have characterized the results of the RAST test, the relative values of Pmax and MP in the present study still need to be improved to reach higher levels of performance, while the absolute FI presented acceptable. It is known that the smaller the index value of fatigue is higher the tolerance of the athlete to the intense effort

Revista Brasileira de Prescrição e Fisiologia do Exercício
ISSN 1981-9900 ***versão eletrônica***

Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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and consequently to fatigue (Bangsbo, 1994; Krusptrup and Bangsbo, 2001).

In the present study there was no difference in performance at the vertical leap test between the positions of the players. Vural, Rudarli and Ozkol (2009) also found similar results between the evaluated positions in Vertical Leap tests on FA players. In this context, it is suggested that lower limb muscle power along with the ability to generate muscle force is an equally important characteristic for all positions of the game and an essential attribute for players of AF (Secora and colleagues, 2004; Vural, Rudarli and Ozkol, 2009). The players need great muscular strength to confront, lifting, pushing, and other tasks that occur during matches.

The time that athletes take to move can determine a successful outcome in a strategic move, indicating better physical condition to meet the demands the sport requires.

In the present study, we found that players who occupy the CB position are faster than the players of the positions DE/DL/DB and OL. Our results were similar to results found by Iguchi and colleagues (2011), which investigated the performance characteristics of Japanese players. Players who occupy the position named CB, are responsible for preventing passes on race situations, intercepting the ball during a pass to give their team the opportunity to attack, positioned immediately ahead of the WR, which may explain their higher speed displacement of that group, providing a significant advantage for these athletes.

Another relevant finding is that the players who occupy the WR position are faster than those who occupy positions DE/DL/DB and OL, which once again corresponded to the results found by Iguchi and colleagues (2011). Such result can be explained by the function of WR players, who are fast players moving into long and short directions, infiltrating the defense to receive passes and gain yards for their team, through strategic and offensive routes. So as already expected the performance on the speedometer for players of WR and CB positions were similar, suggesting that this ability should be much trained and observed by the coaches.

In this study the average height of the players (178 ± 0.07) presented similar to the height of the Japanese players from Iguchi and colleagues (2011) that analyzed the second team bonded to the first ranking of the university division. However no longer occurring with fat percentage and in the current study the percentage of fat was higher than the Japanese team. On the other hand, the weight (kg) of Japanese players is relatively greater, thus suggesting greater muscle mass to Japanese players.

According to Kraemer and colleagues (2005) and Iguchi and colleagues (2011) studies have given attention to compare body composition and physical performance intra and inter divisions, demonstrating that body composition and muscle performance are essential components to the best teams and players (Iguchi and colleagues, 2011).

Body composition and anthropometry of athletes has been studied by many research (Burke, Read and Gollan, 1985; Kraemer and colleagues, 2005). In the present study, it was observed that anthropometric characteristics such as height, weight and BMI are lower than the characteristics of players from AF amateurs and professionals, but similar to soccer players in studies presented by Burke, Read and Gollan (1985). The same authors evaluated the anthropometric characteristics of players of Australian amateur soccer level and found values of height (178 ± 6 BM), weight (77.1 ± 6.8 kg) and fat percentage (15.4 ± 3.6 %). Regarding the percentage of fat, the values of the present study were higher than the findings of Burke, Read and Gollan (1985) and Kraemer and colleagues (2005). The highest values of percentage of fat may be explained by the amateur category of the players and the training period in this sport, which is still an amateur in Brazil. The sweat rate should be considered in these players and so can increase body weight in evaluations.

By analyzing the study of Kraemer and colleagues (2005) and comparing that with this study, in general terms our players are taller, lighter, with lower BMI than professional players, on the other hand our players have a higher percentage of fat in detriment to muscle mass. However, when compared to players from junior category of the study Lockie and colleagues (2012), these are higher, with similar weights and lower BMI.

Regarding anthropometric comparisons between the positions of the players from the present study, we observed that players who occupy the OL position are

Revista Brasileira de Prescrição e Fisiologia do Exercício
ISSN 1981-9900 ***versão eletrônica***

Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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heavier, with higher BMI and% BF than the other players. The players from OL position represent the players who occupy the offensive line, and usually are bigger, heavier and stronger players. These players are important as they protect the QB and open spaces for the runners.

In athletes, it is expected that the functional and structural characteristics are favorable to the practiced sport, thus separating them from the general population. Such differences may reflect genetic characteristics and changes caused by the effect of high level conditioning (Burke, Read and Gollan, 1985) training. Previous studies on athletes have shown that motor and energy skills can be effective predictors for the success of many sports (Berg, Latin and Baechle, 1990, Black, 1994; Fry and Kraemer, 1991; Garstecki, Latin and Cuppet, 2004).

Although strength, power, speed and anthropometric characteristics are desirable factors for sporting success in sport such as AF, Hoffman and colleagues (1996) presented that the perception of the coach to the specific ability of each athlete is an important component, especially when the group of players is homogenous.

However, success in the AF requires a complex interaction between physical performance as agility, speed, strength, power and endurance, as well as abilities and knowledge about the sport.

CONCLUSION

It may be concluded that AG players are heavier than the players of the DG. It was observed that the anthropometric values of the investigated group AF differ from American, Japanese and Australian teams studied in the literature. Players who occupy positions of WR and CB are the fastest players on the team in relation to different positions. Moreover, the vertical leap performance between the positions of attack and defense are similar. The players who play in the defensive positions are more tolerant to fatigue, therefore showing greater ability to perform repeated sprints.

It is imperative for coaches to know and understand the physical and energetic demands during dynamic matches for training to be optimized effectively. According to the literature, AF coaches should emphasize the increased gain of muscle mass, speed, agility and power.

As in Brazil, the AF is developing and increasing, so it is relevant that other studies investigate more about physiological and biomechanical aspects, improving methodologies for the training and preventive methods, to outline specific training program and thus improving the final performance.

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ISSN 1981-9900 ***versão eletrônica***

Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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Revista Brasileira de Prescrição e Fisiologia do Exercício
ISSN 1981-9900 ***versão eletrônica***

Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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Received for publication 05/13/2014
Accepted 09/03/2014