Testing of Power Abilities in High Level Soccer Players: Quantitive and Qualitive Assessment Methods

Anna Zakharova, Anastasia Berdnikova and Kamiliia Mekhdieva
Institute of Physical Education, Sport and Youth Policy, Ural Federal University named after the first President of Russia B.N. Yeltsin, 19 Mira Street, Yekaterinburg, Russia

Keywords: Power Abilities, Wingate-test, Performance Analysis for Vertical Jumps, High Level Soccer Players.

Abstract: The aim of the study was to evaluate power in high level soccer players by means of Wingate cycling test and performance analysis for vertical jumps. Thirty-two male professional soccer players (mean age 25.29±5.4 years, height 180.22±6.63 cm, weight 73.8±7.07 kg) underwent Wingate test and jump tests with the use of force plate with ongoing analysis of four types of jumps (countermovement jumps, squat jumps, single leg jumps on the right and left legs, CMJs with arms swing). We found: (i) high-level soccer players' norms are PP>13 W/kg, AP_{30}/kg>11W/kg; (ii) 34.5% of studied athletes demonstrated high level of power; AP_{30}/kg>11W/kg showed only 13.79%; 10.34% showed significant power decrement by 30th second of Wingate-test (ΔP_{15}/kg–P_{30}/kg>4W/kg); (iii) countermovement jump height was 35.94±4.2 cm, height of the jump with additional arms swing was 44.72±5.04 cm; (iv) motor disbalance of antagonist muscle work of lower extremities; (v) parameter of average power in Wingate test correlated with height (r=.476, P<0.01), flying time (r=.463, P<0.01), maximum force for take-off (r=.393, P<0.05) in countermovement jump with arms swing. Anaerobic Wingate test and performance analysis for vertical jumps allow estimation of athletes' fitness weak aspects and undertaking appropriate timely amendments to trainings.

1 INTRODUCTION

Strength, speed and power are human physical abilities which are extremely important in sport:

- Strength determines the level of success in majority kinds of sport;
- Speed and strength are interdependent abilities that together provide fast movements herewith motor effectiveness depends upon speed-strength intercommunion.
- Power is the ability to apply force in as short time as possible, as in accelerating, throwing, shooting, etc.

Power abilities are more challenging for athlete and more demanding in team sports than strength alone. We mean them challenging because of (1) neural factors limiting the ability of explosive push-offs; (2) great number of movement patterns to demonstrate these abilities and (3) athlete capacity to utilize their strength in tests and what is more important in professional sport activity. This capacity is gained through motor skills learning at early stages of training and called movement culture.

We mean power abilities demanding because of vast of sprints and jumps during the sport game performance.

Strength and power assessment in sport is provided by a number of methods: tests without measuring equipment (Cissik, 2012), direct (by dyna- and tenzometry) and indirect methods (through accelerations) to get main (instantaneous and average force), integral (force impulse) and differential (force gradient) strength parameters (Guba and Presniakov, 2017). Since power abilities have complex manifestation the task of the coach is to assess the values and determine deficiencies in athlete.

The purpose of the research was to evaluate power in high level soccer players by means of two methods: cycling Wingate test and performance analysis for different vertical jumps on tenzoplatform.

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2 ORGANIZATION AND METHODS

Subjects. Thirty-two healthy male high-level soccer players (mean age 25.29±5.4 years, height 180.22±6.63 cm, weight 73.8±7.07 kg) participated in the study. Recruited subjects were members of professional soccer teams "Ural-2" and "Sinara" (Sverdlovsk region, Russia).

"Ural-2" is a reserve of team of FC "Ural" (Yekaterinburg, Russia). The core team "Ural" participates in the National championship and holds 6th place in the Russian Football Premier-League.

Members of "Ural-2" are young soccer players aged 19-23. In the current season 2017/2018 they hold of Russian championship among Professional Football League teams.

Soccer team "Sinara" is a regular participant of Russian Futsal Championship and holds a large number of cups and titles. It was the winner of UEFA Cup (2008), Russian Cup (2007), Eremenko Cup (2015), National championship (2009-2010). In the current season 2017/2018 "Sinara" is on the 3th-5th place of Russian Futsal championship. Players of "Sinara" are frequently invited in the National team for participation in international competitions. In 2018 UEFA Cup two players of "Sinara" won bronze medals as part of the National team.

The participants of the study had more than 10 years of sport experience in soccer. All tested athletes were free of neurological, cardiovascular or any other chronic disease, and were admitted to perform the tests by team doctor. The investigation conforms to the principles of the Declaration of Helsinki of the World Medical Association. Subjects involved in the study had been provided with comprehensive information on the procedures, methods, benefits and possible risks before their written consent was obtained. The study protocol was approved by the Ural Federal University Ethics Committee (#03-2018).

All undertaken tests were conducted in the research laboratory "Sports and health technologies" of the Institute of Physical education, sports and youth policy, Ural Federal University (Yekaterinburg, Russia).

2.1 Anthropometric Measurements

Evaluation of anthropometric parameters, body composition, height, lean muscle mass (absolute and relative values), body fat component and BMI are commonly used in professional sport practice and research. Monitoring of anthropometric parametres during the competition season permits to amend nutrition of soccer player saving optimal fat and muscle ratio. It is well-known that there is a range of specific criteria of anthropometric parameters for each playing position in soccer, as well as in futsal players.

Weight and segment body composition were measured with the use of the MC-980MA Plus Multi Frequency Segmental Body Composition Monitor (TANITA, Japan) based on the advanced Bioelectric Impedance Analysis (BIA) technology. The following parameters were registered: body mass (kg), body mass index (BMI, kg/m^2), muscle mass – absolute and relative values (kg; %), absolute and relative fat mass (kg; %), fat free mass (kg), bone mass (kg), separately lean mass of the trunk, upper and lower extremities (kg). Special attention was paid to weight asymmetry.

2.2 Cycling Wingate Test

Cycling Wingate test was conducted with the use of the ergometer BIKE MED (TechnoGym, Italy) and Cardio Memory software V 1.0 SP3. Power and speed abilities were estimated during leg cycling Wingate anaerobic test by means of the device producer protocol provided.

Before the test athletes were familiarized with the technique of the test and given comprehensive instructions on the procedure. The position of cycle seat was adjusted in accordance with the height and lower limbs length. Foots were fixed in the pedals with straps. Data about the age, gender and weight of the tested player were entered into cycle computer manually. Based on these variables, device automatically calculated power resistance for each athlete. Before the test all subjects had sufficient for power testing warming up. Each test started from the 30 sec pre-test warming-up pedaling with required cadence 50 rpm. After the command "Go" athlete started pedaling as fast as possible keeping the efforts up to the end of the test. The test duration was 30 seconds.

During Wingate test instantaneous force parameters were fixed automatically by Cardio Memory software. For further evaluation of power preparedness of soccer players following parameters were selected: peak power (PP, W), relative PP (PP, W/kg), power at 15 (P_{15}, W) and 30 sec (P_{30}, W), average power (AP_{30}, W), their relative values (P_{15}/kg, W/kg, P_{30}/kg, W/kg, AP_{30}/kg, W/kg), fatigue index (%) and maximum attained cadence (rpm). Post-test analysis also included time of PP attained.

Results of Wingate-test are distributed by the cycle software as digital and graphical data (Fig. 1).

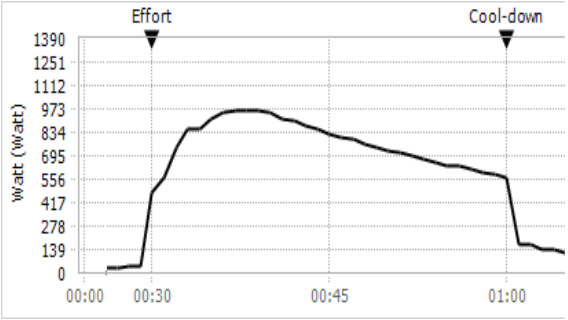

Figure 1: Example of Wingate-test graph.

2.3 Performance Analysis for Vertical Jumps

Performance analysis for vertical jumps is a widely used test in power and sprint sports (Ntai, 2017; Van Hooren, 2017; Zakharova et al., 2017; Lara, 2006; Pyansin and Pyanzina, 2016). Application of this test in soccer could have also good benefits as efficiency of shots and bounces in attempts for headings in most cases is based on power abilities of lower extremities of soccer players.

The main objectives of this part of study were to obtain descriptive data on maximal power output of the lower extremities with the use of a force platform through detailed analysis of four types of jumps.

The athletes were given the task to make triple jumps with short rest time between jumps:

- counter movement jumps (CMJs) bending hands on hips,
- squat jumps (SJs) bending hands on hips,
- single leg jumps on the right and left legs bending hands on hips,
- CMJs with arms swing.

One minute of rest was allowed between the consecutive trials of jumps.

Before the test studied soccer players were familiarized with required jumping technique of each type of jump. To meet technical requirements of the CMJ, athletes were instructed to perform an unconstrained maximal vertical jump from a standing position on the force plate keeping arms on hips. Each jump was performed by a countermovement of acceleration below the center of gravity attained by flexing the knees. No specific instructions were given regarding the depth of the countermovement. The trunk should be kept as vertical as possible.

While carrying-out SJ subjects started from the static semi-squat position with knees flexed at about 90 degrees, hands on hips keeping trunk as vertical as possible. It was required to perform the jump without any countermovement to have just the concentric action of the agonist muscles involved at the movement.

Vertical double and single leg jumps are the essential part of game situations in soccer. Fights for overhead ball, vaults and over-jumps are common elements in football as well as in futsal.

In an attempt to carry out a shooting move a player may be both in supporting position, as well as in the bounce. These skills imply one leg vigorous pushing off and swing of kicking foot. These playing actions are rather complicated from biomechanical point of view. The direction of the movement varies and it may be upwards, forward- aside, backwards-aside, etc. These movements require recruitment of a significant number of muscles and muscle groups. Application of such a simple test as single-leg vertical jump provides with data on symmetry/asymmetry (motor balance or disbalance) of lower extremities muscles and power of thigh extensors.

We decided to include CMJ with the arms swing as in most game situations in soccer the attempts to kick the ball with a head are coupled with jumps with arms swing. Thus this type of jump may be considered as more specific for soccer players' practice.

All studied athletes were instructed to perform the jumps with the maximum effort. For each jump it was important to jump at the highest possible speed and to attain the highest point as possible, as the best attempt of the jump was further analyzed.

Vertical jumps were `performed on a force plate TJ4002 (Marafon-Electro, Russia) which was mounted and calibrated according to manufacturer's specifications. The signal was sampled at a rate of 2000 Hz. Original custom-designed software for ongoing analysis was used for acquisition and processing of the vertical component of the ground reaction force.

Based on the collected data, the following variables were measured and analyzed:

- flying time (t, s);
- jump height (Jh, cm), calculated using TJ4002 software;
- maximum force for take-off (F, N);
- motor asymmetry.

Fig. 2 shows an example of countermovement jump of tested athletes.

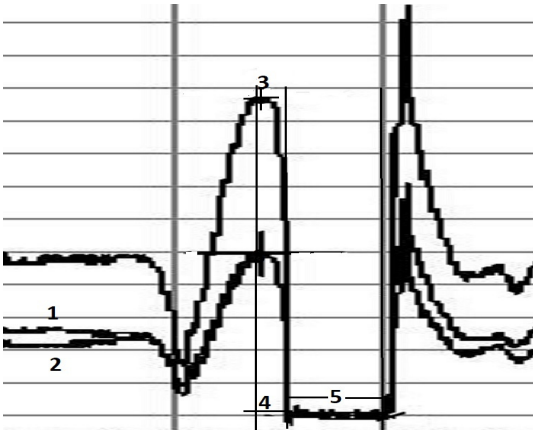

Figure 2: Example of CMJ force curve: 1 – force of right leg, 2 – force of left leg, 3 – F_{max}, 4 – push off time, 2 – flying time.

2.4 Statistical Analysis

Statistical analysis was performed with the use of statistic software package "SPSS Statistics 17.0" (IBM). We used descriptive analysis of the obtained data in order to estimate anthropometric profile and power abilities of athletes. Mean value (M), standard deviation (SD), minimum and maximal values of the measured parameters were calculated. Normality of distribution was assessed by the Shapiro-Wilk test and results showed that all variables had normal distribution.

To reveal the possible interrelations between indices obtained from Wingate cycling and force plate tests Pearson correlations were calculated. The level of significance was set at $P < 0.05$.

3 RESULTS AND DISCUSSIONS

The detailed descriptive data on body composition and anthropometric measurements of soccer players (Table 1) show that generally studied athletes have well-balanced body composition for trained soccer players. They have low absolute and relative fat content and high index of lean mass. High value of lean mass in studied athletes is undoubtedly an advantage and may serve as a proof of appropriate sports selection as well as proper training and nutrition.

Table 1: Anthropometric and body composition data of soccer players.

Parameters	M±SD	(min-max)
Height, cm	180.22±6.63	169-194
Body mass, kg	73.8±7.01	62.4-90
BMI, kg/m^2	22.69±1.43	20.4-26.3
Muscle mass, kg	63.4±5.4	53.6-73.4
Muscle mass, %	86.88±3.4	77.8-91.5
Fat mass, kg	7.45±3.4	2.6-18.2
Fat mass, %	9.17±3.29	2.4-14.9

Wingate test revealed that 34.5 % of athletes (33.3 % of futsal players and 35.3 % of soccer players) demonstrated high level of power (PP/kg ≥13 W/kg). Insufficient level (PP/kg < 11.5 W/kg) was revealed in 25 % of futsal players and 5.88 % of soccer players who had short performance time during the season.

Time of reaching PP (t_{pp}, s) was chosen as an important criterion of power abilities evaluation. Optimal results for soccer players are considered as reaching PP within 3rd-4th second of the test (Zakharova and Berdnikova, 2016). We found that $t_{pp} \leq 4$ s showed 75 % of futsal players and 23.53 % of soccer players. Notably, only 13.79 % of tested athletes with high results of PP (16.67 % of futsal players and 11.76 % of soccer players) showed prompt reaching peak values of power.

The obtained ratio of indices of power abilities may be explained by different duration of competitions in futsal and soccer, as well as peculiarities of training approaches. In terms of differences of pitches sizes and quantity of players the main features of futsal are fast and short dashes and motions, whereas higher variety of ball velocity and speed of players are more typical in soccer.

High level of strength endurance is normally characterized by low values of fatigue (≤ 35 %) with sufficient (high or intermediate) level of power abilities of athletes. Our research revealed that only 13.79 % of studied athletes had high level of strength endurance (25 % of futsal players and 5.88 % of soccer players).

Additionally we were interested in parameter of speed of power decrement by 15th and 30th seconds of the test (P_{15}/kg, P_{30}/kg). Optimal (desirable for high-level soccer players) power decrement by 15th second was registered in 37.93 % of athletes with sufficient values of PP (33.3 % of futsal players and 41.18 % of soccer players). Noteworthy, 10.34 % of athletes showed significant power decrement by 30th second (P_{30}/kg) of Wingate-test (ΔP_{15}/kg – P_{30}/kg > 4W/kg). These serves as a proof of insufficient level of strength endurance in studied subjects.

The fact that high values of average relative strength AP_{30}/kg (> 11W/kg) showed only 13.79 % of studied players, also pointed at insufficient level of strength endurance in subjects.

Table 2: Cycling Wingate-test parameters of high-level soccer players.

Parameters	M±SD (min-max)
PP, W	931.62±89.9 (800-1222)
PP/kg, W/kg	12.63±0.99 (10.8-14.9)
AP_{30}, W	728.52±63.13 (608-839)
AP_{30}/kg, W/kg	9.88±0.78 (7.75-11.19)
Fatigue, %	42.6±8.4 (23-56)
t_{pp}, s	5.24±2.21 (2-9)
P_{15}, W	736.8±79.24 (572-884)
P_{15}/kg, W/kg	10±1.01 97.15-11.62)
P_{30}, W	527.2±60.2 (375-619)
P_{30}/kg, W/kg	7.2±0.8 (4.7-8.8)

PP – peak power; AP – average power; t_{pp}, - time of PP attainment.

Figure 3 illustrates examples of Wingate-test individual results of three players. We ranged them as excellent, permissible and insufficient patterns (Table 3). Athlete #9 showed fast reaching PP (t_{pp} = 4 s) with minor gradual power decrement by 15th and 30th seconds of the test. Player #12 showed insufficient strength endurance with high values of PP (graph demonstrates PP reaching by the third second of the test with significant power decrease by 5.53 W/kg at 15th second and by 8.61 W/kg at 30th second). As one can see, athlete #17 had low level of power abilities: low values of PP/kg = 11.27 W/kg reached only by 9th second of Wingate-test.

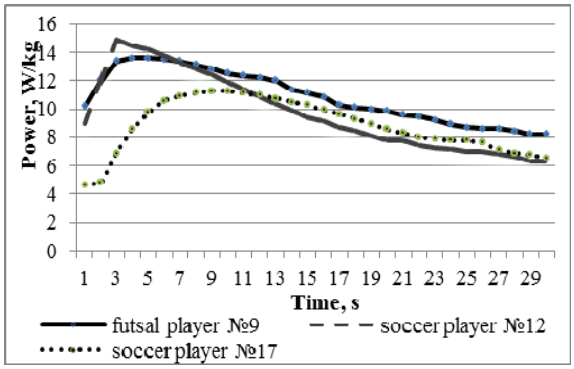

Figure 3: Graphs of individual results of Wingate-test.

Although age of recruited for the research players varied within a wide range (25.29 ± 5.4 years), no interrelations between the level of power abilities and age/sport experience of athletes were found. Young players (aged 19) along with more experienced elder athletes (30-36 years) showed high level of strength and power preparedness.

Table 3: Individual results of Wingate-test of soccer players.

	t_{pp}, s	PP/kg, W/kg	PP_{15}/kg, W/kg	PP_{30}/kg, W/kg	Fatigue, %
High level players norm	≤ 4	> 13	<PP/kg-2	<PP_{15}/kg-4	≤ 35
Player # 9	4	13.6	11.13	8.22	37
Player # 12	3	14.91	9.38	6.3	56
Player # 17	9	11.27	10.28	6.55	39

PP – peak power; t_{pp}, - time of PP attainment.

Data obtained from the performance analysis for vertical jumps provided with important information on parameters of prompt manifestation of power, as they are more typical for competitive soccer activity. To estimate speed and power preparedness of athletes the following indices were chosen: jump height (cm), double leg maximum force for take-off (N), single leg (right and left) maximum force for take-off (N), as well as parameter of relative strength (N/kg) and push off time (s) (Table 4).

Results of CMJ are probably conditioned by a range of factors: hip extensors strength, development of intermuscular coordination – consecutive coordinated agonists and antagonists muscles engaging (Gissis, 2006; Pupo, 2012).

The recorded mean data on CMJ height in studied players (35.94 ± 4.2 cm) are significantly lower than described in previous studies of elite soccer players (37.8 ± 5.9 cm in Slovak elite soccer players (Pivovarniček, 2015); 39.4 ± 0.4 cm in Icelandic elite soccer players (Arnason, 2004); 40.94±4.93 cm in soccer players from Spanish 2nd and 3rd division of championships (Los Arcos, 2017). Values of CMJ height higher than 40 cm were demonstrated only by 23.3 % of studied players (33.3 % of futsal players and 16.67 % of soccer players).

Parameter of relative strength (RS) in jumps characterizes strength abilities of athletes. We registered mean values of RS in studied group as 18±1.68 (15-21.36) N/kg in CMJs and 17.52±2.4 (9.24-21.6) N/kg in SJs.

Table 4: Maximal anaerobic power of the lower extremities of high-level soccer players (M±SD (min-max)).

Parameters	CMJ	SJ	Single leg jump right	Single leg jump left	CMJ with arms swing
Height jump, cm	35.94±4.2 (29-46)	36.65±4.62 (30-45)	20.5±3.4 (15-28)	20.8±3.7 (15-29)	44.72±5.04 (37-58)
Push off time, s	0.16±0.09 (0.09-0.26)	0.12±0.06 (0.07-0.25)	-	-	-
Maximum force for take-off, N	1325±139.8 (1075.2-1650)	1274.9±214.68 (644.4-1696.8)	1097.4±116.4 (932.4-1419.6)	1082.16±115.2 (894-1412.4)	1290.48±119.52 (1065.6-1574.4)
Flying time, s	0.54±0.03 (0.49-0.61)	0.54±0.03 (0.49-0.60)	0.40 ±0.03 (0.34-0.48)	0.41±0.04 (0.35-0.49)	0.60±0.03 (0.55-0.69)
Relative strength, N/kg	18±1.68 (15-21.36)	17.52±2.4 (9.24-21.6)	-	-	-

Squat jump results are mainly obtained due to central nervous impulsation to working muscles during concentric work, which allows development of maximal strength of lower extremities. The obtained mean values of SJ height (36.25±4.62 cm) are comparable with the exciting data of elite athletes (Arnason, 2004; Pivovarniček, 2015; Los Arcos, 2017). High level of maximal force development (SJh > 38 cm) was observed in 40 % of studied athletes (58.33% of futsal players and 27.78% of soccer players).

We were also interested in calculated index of ΔCMJh-SJh,. This parameter characterizes the ability to use muscle extension to generate elastic energy when eccentric phase converts to concentric phase. Normally, the value of ΔCMJh-SJh is about 2-4 cm. We registered, that the SJ height in 63.3 % (66.67 % of futsal players and 61.11 % of soccer players) was higher than in CMJ (mean value ΔCMJh-SJh was -0.71 cm). Although high level of maximum power and high strength abilities of athletes were registered during Wingate test, testing on a force plate revealed motor disbalance of antagonist muscle work. We found a disruption of antagonist muscles work due to disorders of speed-power neuromuscular coordination.

Probably, the described above results refer to breakdown of soccer trainings at earlier stages of soccer career, i.e. disorders of basic motion skills and capabilities built up, as well as insufficiency of speed-power trainings at the level of elite sport (Kraemer, 2004; Mujika, 2009; Loturco, 2015; Silva, 2016).

Balance of muscular strength of lower extremities is the integral requirement in any sport and in team sports especially. The asymmetry of muscles development of increased risk of injuries and negatively affects the level of high-speed and power readiness of athletes (Lawson, 2005; Newton, 2006; Lawson, 2006; Impellizzeri, 2007; McElveen, 2010). 25 % players (20 % futsal – and 28.57 % of soccer players) have muscles development asymmetry of the right and left legs (i.e. difference in jump height on the right and left leg is more than 15 %). The difference of right and left single legs jumps height varied in rather wide range from 0 to 37.5 % among the studied soccer players. Additional polling of football players and the analysis of the obtained data has allowed to reveal that imbalance is connected with shooting or long passing leg role rather than preference for a leg.

The received results of single leg jump height were high (20.5 – 20.8 cm) in comparison with the data obtained in the research by McElveen et al. (2010) in athletes of the 2nd division in soccer and basketball (15.2 – 15.7 cm). Results of SLJ higher than 20 cm were shown by 70.83% of the tested athletes (90% futsal and 57.14% soccer players).

The jump of CMJ with arms swing is more specific to soccer than vertical jumps with hands on hips. The movement of arms during jumps in soccer happens automatically since these motor skills are formatted at the level of steady skill. To find out integrated power abilities of high level soccer players the vertical jump test protocol was modified. Jumping with arms swings athletes have improved results in ASJ jump height in comparison with CMJ by 23.83 ± 11.82 (2.4–50) %. Average ASJ height was 44.72 ± 5.04 (37-58) cm, at the same time ASJ h values higher than 45 cm were shown by 41.38 % of athletes (66.67 % of futsal – and 35.29 % of soccer players).

Data from correlative analysis showed that there were significant interrelations between parameters measured during cycling Wingate-test and variables of performance analysis for vertical jumps (Table 5).

Table 5: Correlations of indices from jump tests with parameters obtained from Wingate-test.

	P_{max}	P_{max}/kg	P_{15}	P_{30}	AP
CMJ h	.210	.195	.212	.253	.301
CMJ t	.226	.345	.104	.115	.196
CMJ MF	.201	-.421*	.322	-.186	.327
CMJ Fr	.193	-.312	.217	-.207	.247
CMJ Fl	.205	-.440*	.395*	-.110	.413*
SJ h	.270	.144	.349	.222	.360
SJ t	.228	.127	.336	.233	.346
SJ MF	.596**	.060	.382*	-.104	.058
SJ Fr	.515**	-.072	.320	-.185	.111
SJ Fl	.565**	.000	.529**	.022	.343
RLJ h	.148	.136	.014	-.018	.240
RLJ t	.144	.139	.035	.013	.286
RLJ MF	.428*	-.141	.289	-.174	.410*
LLJ h	.232	.017	.035	-.121	.072
LLJ t	.246	.050	.029	-.117	.046
LLJ MF	.248	-.298	.481*	.045	.471*
ASJ h	.411*	.102	.463*	.178	.476**
ASJ t	.397*	.100	.453*	.180	.463*
ASJ MF	.085	-.116	.352	.189	.393*
ASJ Fr	.075	-.017	.248	.175	.183
ASJ Fl	.125	-.202	.341	.078	.452*

CMJ – countermovement jump, h – jump height, t – flying time, MF – maximum force for take-off, Fr – right leg force for take-off, Fl – left leg force for take-off, SJ – squat jump, RLJ – single leg jump (right leg), LLJ – single leg jump (left leg), ASJ – countermovement jump with arms swing
* $P < 0.05$; ** $P < 0.01$

We found that parameter of AP significantly correlated with jump height ($r=.476$, $P < 0.01$), flying time ($r=.463$, $P < 0.01$), maximum force for take-off ($r=.393$, $P < 0.05$) in countermovement jump with arms swing. Noteworthy, maximum power correlated with maximum force for take-off ($r= .596$, $P < 0.01$), force for take-off of right leg ($r = .515$, $P < 0.01$) and left leg ($r = .565$, $P < 0.05$) in squat jump.

4 CONCLUSIONS

1. Both methods – anaerobic Wingate test and performance analysis for vertical jumps– are informative power and strength measuring instruments. Wingate test provides the information on power and strength endurance during 30 s while performance analysis for vertical jumps – on power and muscle work in sole movement. The obtained data from both tests complement the results, giving an expanded view of the various components of speed-strength training athletes. Thus, it is possible to detect the weak aspects of the athletes' fitness and to make appropriate adjustments in the training process, which is particularly important in high performance sport.

2. Following Wingate test parameters may be assumed as sufficient for high level soccer players: fast achievement (at 3-4 seconds) of high PP values (more than 13 W/kg) and a gradual slight decrease in power by 15th (up to PP/kg-2) and 30th seconds (up to PP_{15}/kg-4), characterized by a high level of strength endurance with a fatigue rate of less than 35 %.

3. In whole studied high level soccer players demonstrated a high level of power abilities (strength + power). Excellent indicators of the maximum force in squat jumps and maximum power in Wingate test were demonstrated, but only a small part of athletes (13.79 %) were able to transfer good strength into power with maximum speed ($t_{pp} \leq 4$ s at high values of Peak Power). The components requiring priority attention for further training of football players are revealed: inconsistency of antagonist muscles functioning (it was noted in 2/3 tested football players) and insufficient level of strength endurance in ¾ athletes.

According to the results of the research it was revealed that high level players in futsal is characterized by a higher level of speed, power and strength endurance training than soccer players, which is directly related to the requirements for athletes in competitive activities. In futsal there is a predominance of anaerobic mechanisms of energy supply, while for soccer the mixed (aerobic-anaerobic) capacity is inherent. Along with the evaluation of power abilities should be compulsory in both sports.

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