CORRELATION OF TESTS FOR EVALUATING EXPLOSIVE STRENGTH AND AGILITY OF FOOTBALL PLAYERS

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Abstract
The primary purpose of this research is to determine correlation of variables for evaluating explosive strength and agility, as well as variables for evaluating situational effectiveness of football players. For the needs of this research, two tests for evaluating agility were designed. In each test there are six changes of movement direction, three changes to the left and three to the right side, with the difference between the two designed tests in the distance covered between two changes of direction. The research was conducted on the sample of 52 (fifty-two) examinees, which included freshman (first-year) and sophomore (second-year) students of Faculty for physical education and sport, University of Tuzla. All examinees are active football players in lower levels of competition, therefore they can be classified to the group of amateur football players. The age of examinees chosen for this research was in the range of 19±3, the average height was in the range of 187±17 cm, while the average weight was 77±18 kg. Cronbach's alpha was calculated for the tests which were designed for the needs of this research to determine reliability of tests. Cross-correlation analysis was used to determine correlation between the used variables. Results of the research show that variables for evaluating explosive strength were more dominant for changes of direction where the distance covered between two changes is smaller. Also, it can be seen that variables 20M and DJ have higher correlation coefficients with change of direction tests (SRED3-90, SRED7-90), which means that due to lengthening and shortening cycle, reactive strength is important for implementation of all above mentioned tests. Variables for evaluating explosive strength did not achieve any statistically significant correlations with variables for evaluating situational effectiveness of football players, and one of the reasons for this is insufficient tactical preparation.

KEY WORDS: *situational efficiency, movement direction, soccer*

INTRODUCTION

The primary purpose of this work is to determine correlation between explosive strength and agility i.e. change-of-direction speed and variables of situational effectiveness of football players. The idea here is also to design two tests for change-of-direction speed, which include six changes, three changes to the right and three to the left side, with the difference between the tests in the distance covered between two changes. This also helped us to determine which variables for evaluating explosive strength are more dominant in tests for evaluating agility.

Football is a game which requires very fast body movement which is determined by situations within the match such as: opposing team's player with and without the ball, ball movement and teammate movement. Because of these reasons, modern football game is characterized by fast movements, which become prominent in short and long sprints, explosive reactions (jump) and quick changes of direction. Authors who dealt with this problem (Cometti et al., 2001) share the opinion that these are some of the characteristics which distinguish winning from losing sides, on high-quality levels of competition.

Many authors searched for the connection between the mentioned abilities and tests of agility in short and long distances, on different samples of examinees. Some of these authors did not find any statistically significant correlations between the power and strength of leg muscles using change-of-direction speed tests (Young et al., 1996, Webb and Lander, 1983). On the other hand, strange correlations of squat (1RM) and vertical leap were found, with running speed at 5, 10 and 30 m distance (Cronin and Hanesen, 2005, Armason et al., 2004).

We can also say that correlation between speed and explosive strength is not the same in relation to the age categories of football players. (Dragoljub et al., 2010). The most important for us in this research is connection between explosive strength of the type of jump, explosive strength of the type of sprint and change-of-direction speed with and without the ball, on the sample of examinees which included amateur football players. Results of some researches (Sukureski, 2010) support the idea that explosive strength is one of the most important abilities for all types of direction changes. In this work we concerned ourselves with establishing a relationship between certain motor abilities, focusing on the abilities with the same name – SAQ (speed, agility, quickness).

These abilities become prominent in sport disciplines i.e. in sports where change of direction occurs frequently, regardless of examinee's age. Age on the other hand influences everything that is required from an athlete. Besides numerous (Buttifant et al., 1999 Young et al., 1996) researches which analyzed the same issue, one cannot positively determine the level of correlation between parameters analyzed in this research.

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METHODS

Participants

Sample of examinees for this research included 52 (fifty-two) freshman (first-year) and sophomore (second-year) students form Faculty of physical education and sport, University of Tuzla. Criterion for being chosen was to actively play in lower levels of competition i.e. first and second Canton League. All examinees went through routine medical examination which helped us to determine whether they are healthy and without any aberrations which can significantly influence their tests results. The age of examinees who where chosen for this research was in the range of 19±3, the average height was in the range of 187±17 cm, while the average weight was 77±18 kg.

Instruments

Tests of the used variables were performed in the morning hours in a gym, while some of the tests were performed on the local stadium which belongs to football club NK "Tuzla". Before the test all examinees had the same warm-up protocol which prepared them for the test. Assistant lecturer on the subject football led examinees through the warm-up session which lasted 10 (ten) minutes. Within the program of this research, eleven variables were used. Three variables were used for evaluating explosive power of lower limbs (vertical jump performance) with high reliability coefficients (Marković et. al., 2004).

SJ – squat jump – In this test, examinee had the task to jump up as high as he could from semi-squat position with his hands on his hips. Upper part of his body remained in vertical position.

CMJ-counter movement jmp – In this test examinee took parallel stance with feet shoulder width apart and with his hands on his hips. He had to jump up as high as he could including a pre-stage (preparation stage) i.e. he first had to take squat position and then to jump up.

DJ-drop jump – Here, examinee first had to jump off the bench which was 40 cm off the ground and then immediately jump up. After jumping off the bench, and before another take off examinee was not allowed to have his feet on the ground longer than 300 milliseconds which can be measured by OptoJump device. If he spends more then 300 milliseconds with his feet on the ground, he must repeat the test.

The jumps were assessed using portable device called the OptoJump System (Microgate, Bolzano, Itali) that is an optical measurement system consisting of a transmitting and receiving bar (one meter long each bar). Each of these contains photocells, positioned 2 millimeters from the ground. The photocells from the transmitting bar communicate continuously with those on the receiving bar. The system detects any interruptions in communication between the bars and calculates their duration. This makes it possible to measure flight time and jump height during the jump performance.

Two variables were used for evaluating explosive strength of the type of sprint:
20 M –20 meter sprint with the standing start – Test is performed outdoors on firm and flat ground with minimum dimensions of 30 X 2 m. The finish line is set 20 meters from the start line. Test was performed on the court, and the test time was measured by automatic timer (Speedtrap II;, Brower Timing, Systems, Draper, UT, USA).

For evaluating abilities of maximum speed the following test was used:
30 m –30 meter sprint with the flying start – Test of this variable was conducted on the stadium of local football team NK "Tuzla", because of necessary space for the test. The finish line was set 30 meters from the start line. Examinee starts ten (10) meters before the finish line, and his time is measured from the start to the finish line. Test time is measured by automatic timer (Speedtrap II, Brower Timing Systems, Draper, UT, USA).

For evaluating situational effectiveness of football players three tests with high reliability were used (Jerkovic and Barisic 1993):

SBRVPO – fast dribble within semicircle – This test is performed in the space of minimum dimensions 25x15 meters. Examinee dribbles the ball outside the semicircle which has diameter of 9,15m, and neither his feet nor the ball can touch the line of the semicircle. When he steps over the extended line of 2 meters, which is positioned at the end of the semicircle, he goes back dribbling the ball again within the semicircle until he dribbles the ball over the finish line bordered with two flags with the width of 2 meters. The task is accomplished at the moment when both player and the ball go over the finish line. Automatic timers are set on starting point which is both the start and the finish line.

SSBRV20 – fast dribbling on the distance of 20 meters with the standing start – This test is performed in the space of minimum dimensions 20x5 meters. Examinee has the task to dribble the ball as fast as possible, so that he kicks the ball once within the zone of 3 meters from the start line, and in the next 17 meters touches the ball at least 3 more times and together with the ball go over the finish line.

SBRVPU – fast dribbling with change of direction at the right angle – task is performed in the space of minimum dimensions 20x10 meters. Examinee dribbles the ball as fast as he can, goes around the flags changing direction at the right angle and

crosses the finish line. During the test, examinee makes two changes of direction to the right and two to the left side.

For evaluating abilities of changes-of-direction speed the following tests were used (tests are constructed for the needs of this research):

SRED3-90 – sprint with change of direction 3 meters – Examinee has the task to go over certain course as fast as possible. During the test examinee makes three changes to the left and three to the right side. After the start he makes change of direction in front of every Indian-club set for these purposes. Space between the Indian clubs is three (3) meters. Task is accomplished when examinee crosses the finish line (Figure 1.)

SRED7-90 – sprint with change of direction 7 meters – This test is the same as the previous one. During this test examinee again makes three changes of direction to the left and three to the right side. Here, space between Indian clubs, where changes of directions are made, is 7 meters (Figure 1.).

Cross-correlation analysis is used for determining correlation between variables, and for determining reliability of tests designed for the needs of this research, Cronbach's alpha is calculated.
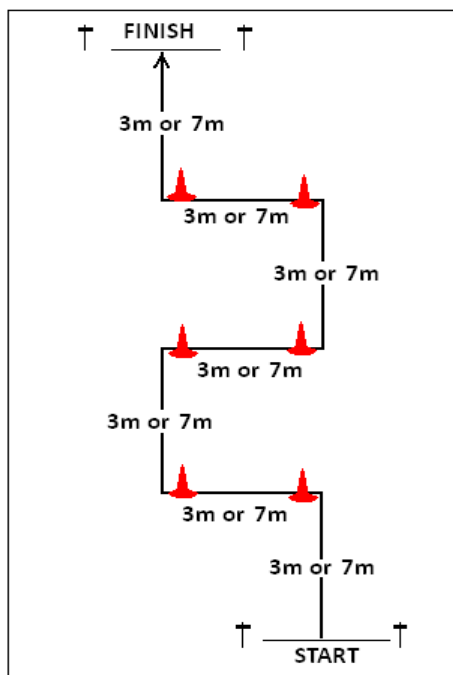

Figure 1.

RESULTS

Reliability of tests

For the needs of this research two tests were designed for evaluating agility (change-of-direction speed). Examinees repeated each of the two tests four times using "test-reset" method. After that, Cronbach's alpha of generalization was calculated

for each of the used tests. To achieve desired reliability, measurement of reliability has to have high values which points to a reliable measuring instrument (Malacko and Popovic, 2001).

The descriptive statistics were calculated for all tested variables. The Table 1 shows the mean value, standard deviation and range are shown in Table 1. Results in table 2 show values of all trails, standard deviation, range, coefficient of variation (CV%), Interclass Correlation Coefficient (ICC) and Cronbach's alpha (α), for test SRED3-90 – sprint with change of direction 3 meters and for test SRED7-90 – sprint with change of direction 7 meters. Therefore, we can say that the used tests have desired reliability.

Table 1. Descriptive statistics

Test (trials)	Mean	SD	Range
SBRVPO	15.57	30.62	8.6
SBRV20	3.75	0.49	1.6
SBRVPU	8.30	0.80	3.0
30M	3.68	0.23	1.3
20 M	3.19	0.16	1.0
SJ	31.53	4.76	19.6
CMJ	35.42	5.34	24.6
DJ	30.62	4.47	21.2

Table 2. Reliability and variability of the new designed agility tests

Test (trials)	Mean	SD	Range	CV (%)	ICC	α
SRED3-90	7.14	0.41	2.38	5.76	*.90*	.90
SRED3-90 – I	7.08	0.38	1.81	5.39		
SRED3-90 – II	6.89	0.37	2.12	5.40		
SRED3-90 – III	6.82	0.35	1.53	5.13		
SRED3-90 - IV	6.78	0.35	1.79	5.17		
SRED7-90	8.43	0.43	2.08	5.13	.94	.94
SRED7 - I	8.24	0.32	1.56	3.93		
SRED7 – II	8.11	0.30	1.44	3.80		
SRED7 – III	8.14	0.32	1.59	3.93		
SRED7 - IV	8.15	0.32	1.88	4.04		

Correlation analysis of the used variables

By analyzing cross-correlation matrices (Table 3) we can see that 30 m sprint test with the flying start did not achieve a significant correlation with the tests evaluating situational effectiveness of football players as well as with the tests evaluating agility or change-of-direction speed without the ball. We can also see that other tests (20M, SJ, CMJ, DJ) did not achieve any statistically significant correlations with the test evaluating situational effectiveness of

amateur football players. However, the same variables together with variables SRED3-90 and SRED7-90 achieved correlation coefficients that show a significant correlation.

Achieved correlation coefficient between variables 20M and SRED3-90 is r =.55, while correlation coefficient with variable SRED7-90 is r=.57. Achieved correlation coefficients have a positive sign which indicates that improved result in one variable leads to a better result in the other.

Achieved correlation coefficient between variables SJ and SRED3-90 is r = -.42, while correlation

coefficient of variable SRED7-90 which indicates easy correlation is r = -.38.
Variable CMJ together with SRED3-90 achieved correlation coefficient r = -.44, while correlation coefficient r = -.42 was achieved with variable SRED7-90.

Achieved correlation coefficients between variables DJ and SRED3-90 is -.49, while coefficient with variable SRED7-90 is -.44. Achieved correlation coefficients have negative sign, which tells us that examinees will be faster in agility variables, if the results in explosive strength variables of the type of jump are better.

Table 3. Cross-correlation matrix

	SBRVPO	SBRV20	SBRVPU	SRED3-90	SRED7-90
30M	-0.05 p=.750	0.14 p=.421	-0.06 p=.728	0.09 p=.598	0.29 p=.076
20 M	0.03 p=.846	0.01 p=.954	0.01 p=.934	0.55 p=.000	0.57 p=.000
SJ	0.16 p=.359	0.15 p=.390	0.04 p=.820	-0.42 p=.009	-0.38 p=.020
CMJ	0.19 p=.262	0.14 p=.412	0.00 p=.981	-0.44 p=.007	-0.42 p=.009
DJ	0.27 p=.110	0.13 p=.460	-0.08 p=.618	-0.49 p=.002	-0.44 p=.007

P value are set at p < .05; n=52

DISCUSSION

By concentrating on the results of this research, we can notice that ability to maintain maximum speed, which is in this research evaluated by 30M test, has achieved low correlation coefficients that are not statistically significant. Obtained results indicate specific quality of straight-line speed i.e. that straight-line speed on longer distances is clearly different ability from change-of-direction speed. Low correlations between straight-line speed, which show specific quality of straight line speed, were also determined by other authors. (Draper and Lancaster, 1985, Draper and Pyke, 1988. Young et.al., 2001). Acceleration ability, which is evaluated by 20 M test is related to tests for evaluating change-of-direction speed (SRED3-90; SRED7-90). We can see that short distance sprints are closely related to change-of-direction speed as compared to tests for maintaining maximum speed 30 M, and the reason for that probably lies in the fact that all three tests (20M, SRED3-90, SRED7-90) include higher acceleration, as well as deceleration in the tests including change of direction, so that can be one of the reasons for their correlation.

Variables for evaluating explosive strength of the type of jumping are good predictors of change-of-direction speed. However, the interesting fact

which is based on the results of this research is that variables SJ, CMJ and DJ achieved somewhat higher correlation coefficients with variables SRED3-90 where the distance covered is smaller in relation to the change-of-direction test where there is larger distance covered SRED7-90. In the change-of-direction test with smaller distance covered due to the fact that there is smaller distance between two changes (3m), explosive strength of the type of jump is manifested during the change. In the other change-of-direction test with larger distance covered, because the distance between the two changes is larger (7m), examinees achieve higher speed between two changes. This theory is also proved by correlation coefficients between 20M test and change-of-direction tests, where change-of-direction test with larger distance covered (SRED7-90) achieved higher coefficient and where explosive strength of the type of sprint becomes more prominent as compared to correlation with change-of-direction tests with smaller distance covered (SRED3-90), where explosive strength of the type of jump becomes more prominent. Results of this research also confirm assumptions by some authors that indicators of explosive strength are better predictors in tests with smaller distance covered than in tests with larger distance covered.

(Negrete and Brophy 2000, Shepard and Young, 2006).

Research results indicate that variables 20M, SJ, CMJ and DJ are weak predictors of situational effectiveness in this research. Some researches indicate that correlation between explosive strength (jumping ability, sprint) and all form of agility (frontal, lateral, change of direction with the ball etc.) (Sukureski, 2010), which is not the case in our research. The reason why variables evaluating explosive strength of the type of jump and acceleration abilities achieved low correlation coefficients with variables of situational effectiveness can probably be in the tactical preparation level of amateur football players who were chosen for the sample of examinees.

CONCLUSION

By concentrating on the results of this research and based on the level of correlation, we can assume that 20 M and DJ tests achieved higher correlation coefficients with change-of-direction tests (SRED3-90, SRED7-90). That means that due to lengthening shortening cycles, reactive strength is important for the implementation of all above mentioned tests. Similar results were obtained in some previous researches. (Djekalikan, 1993, Young et al., 2002).

Based on the results of this research it can be seen that explosive strength is more important for change-of-direction speed on smaller distances i.e.

when the distance between two changes is smaller, than when the distance between two changes is larger. This is also indicated by higher correlation coefficients with SRED3-90 test than with SRED7-90 test.

Results of this research indicate that the level of tactical preparation should be better, which would enable motor potential of players to become completely prominent. Football teams from Bosnia and Herzegovina that compete in all levels of competition, regardless of the division they play in, have insufficient tactical preparation if we compare them to other teams (Mejremic, 2010) which probably is one of the reasons why there are no significant correlations between variables of explosive strength and situational effectiveness of football players. We think that practice aimed at the improvement of explosive strength (jumping ability and sprint) will not have a positive transfer on tests of situational effectiveness, because tests for evaluating situational effectiveness include complex activity specific for a particular sport, especially in tests SBRVPU with changes of direction with the ball where it is necessary that examinees can dribble the ball well with both strong and weak foot.

Therefore, additional researches are necessary but they need to be conducted on different samples of examinees so that correlation of these parameters could be much clearer.

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KOORELACIJA TESTOVA ZA PROCJENU EKSPLOZIVNE SNAGE I AGILNOSTI FUDBALERA

Originalni naučni rad

SAŽETAK

Osnovni cilj ovog istraživanja jeste utvrditi povezanost varijabli za procjenu eksplozivne snage i varijabli za procjenu agilnosti, kao i varijabli za procjenu situacione efikasnosti nogometaša. Za potrebe ovog istraživanja konstruisana su dva testa za procjenu agilnosti. U svakom testu ima šest promjena smjera kretanja i to tri u desnu a tri u lijevu stranu, a rezlika između konstruisanih testova jeste u pređenoj distanci između dvije promjene smjera kretanja. Istraživanje je sprovedeno na uzorku od 52 ispitanika, studenta prve i druge godine studija Faklulteta za tjelesni odgoj i sport Univerziteta u Tuzli. Svi ispitanici se aktivno bave nogometom i nižim rangovima takmičenja, tako da se mogu svrstati pod nogometaše amatere. Starosna dob ispitanika koji su uzeti u obzir za ovo istraživanje kretala se u granici 19±3 godine, prosječna visina ispitanika bila je 183±17 cm, a prosječna masa ispitanika bila je 77±18 kg. Za testove koji su konstruisani za potrebe ovog istraživanja izračunat je Cronbachov koeficijent radi utvrđivanja pouzdanosti testova. Za utvrđivanje povezanosti između primjenjenih varijabli, primjenjena je kroskorelaciona analiza. Rezultati istraživanja ukazuju da su varijable za procjnu eksplozivne snage dominantnije kod promjene smjera kretanja gdje je distanca između dvije promjene manja. Također, može se vidjeti da varijable 20M i DJ imaju ostvarene veće koeficijente korelacije sa testovima promjene smjera (SRED3-90, SRED7-90), što znači da je reaktivna jačina, zbog ciklusa izduženo-skraćeno, važna za realizaciju svih prethodno navedenih testova. Varijable za procjenu eksplozivne snage nisu ostvarile statistički značajne korelacije sa varijablama za procjenu situacione efikasnosti nogometaša, a jedan od razloga za to jeste i nedovoljna tehnička pripremljenost nogometaša.

Ključne riječi: *situaciona efikasnost, promjena smjera kretanja, nogomet*

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