THE INFLUENCE OF REACTIVE POWER AND DYNAMIC BALANCE ON THE CHANGE OF DIRECTION SPEED-PLANNED AGILITY

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SUMMARY
The aim of this work was to determine the influence of the reactive power and dyinamic balance on the manifestation of the planned agility, or the ability to quickly change the direction (COD) of movement in students. For the purpose of this study, male students (N = 36) were selected, second and third year of the Faculty of Physical Education and Sports, University of Tuzla. The results achieved on the dynamic balance assessment variables did not significantly contribute to the explanation of the results achieved on the criterion variable for assessing the planned agility. On the other hand, the elastic power of the lower extremities at a significant level explains a total of 19% of the variability of agility. Consequently, the result shown that the elasticstrenght contributes significantly to the explanation of the results achieved on the variables for assessing the planned agility in the T-Test, while the dynamic balance variables has not been demonstrated as a significant factor in the overall explanation results assessing of the motor component of student agility.
Key words: *balance, agility, reactive power*

INTRODUCTION

The importance of the motor quality of speed and agility for successful performance in numerous sports is often emphasized in scientific and professional literature and sports practice. Therefore, it is not surprising that in the process of sports preparation, special attention is paid to the testing and coaching of speed and agility (Markovic, 2010). Whether it is a defense or an attack, agility is the motor ability responsible for quality movement on the sports field, defined as the ability to quickly change the direction without essentially losing the speed of movement while maintaining the steady balance of the body, (Sango, 2010.). In realistic sport motor situations, the eccentric-concentric type of muscular contraction occurs most often, and is manifested as a jump power of the lower extremities. Jump power (for this type of power is used another term: reactive power (Komi, 2000.).

A specific example is rapid power in eccentric-concentric (short range stifness) conditions that occurs in various cyclic, acyclic and combined motor situations. This quality is of great importance in the rapid reactive maneuvers, which occurs in the manifestation of various agile maneuvers. From the aspect of agility, athletes, in order to change a certain direction of movement as efficient and quality as necessary, are essential to slow down or stop completely. On the other hand, the ability to maintain the equilibrium position, represents an important factor in various agile maneuvers.

METHODOLOGY OF RESEARCH

Sample

For the purposes of this study, the sample was composed of students (N = 36), male, second and third year of the Faculty of Physical Education and Sports, University of Tuzla. Only those respondents who did not report some of the contraindicated conditions for conducting such a study were selected. The morphological characteristics of the subjects are presented in Table 1.

Tabel 1. Morphological characteristics of a selected sample of respondents

	N	Min	Max	Mean	SD
Age	36	19	25	20,67	1,414
Body height	36	166	195	180,11	6,886
Body weight	36	59,9	108,6	77,144	9,9452

Sample of variables

Drop jump - a special form of diagnostics of elastic power in eccentrically-concentric condidtions are drop jumps, which are performed from a height of 25 cm to 60 cm. For the purposes of this research, a bilateral drop jumps with arms on the hips was used, performed from a height of 30 centimeters. Results were recorded with Optogait Microgate, (OptoGait - single unit), IT.

Repeated jumps with straight legs – used to estimate the reactive power of the lower leg and foot muscles (RSI index). The respondent performed a series of 6-7 rebounds, with the hands on the hips. The participants stands in an upright position for a few seconds and performs continuous jumps. When performing, attention is paid to the legs being locked in the knee joint stage during contact phase.

Dynamic Balance Testing - conducted on (BIODEX "Balance System" USA) and (Microgate Optogat IT) system. For the purposes of this test, a single leg test was used to test total postural stability on one leg, as well as anterior-poster and medial-lateral stability. The platform was set to the level 1 (1 - the most unstable, 12 - the most stable), and the each respondents work in 20 seconds with a break of 10 seconds.

Planned agility - the "T test" was used. At a distance of 9.14 meters from the start / finish line, there is a cone. The subject runs right to the cone and then the choice, left or right, by the lateral movement (step-by-step) to the first side line, which is 4.57 meters from the first cone. After the leg exceeds the first side line, by the lateral movement (step-by-step), the respondent moves in the opposite direction towards the other side line at a distance of 9.14 meters. After crossing the other side of the foot, the subject moves in the opposite direction towards the apiece at a distance of 4.57 meters by the lateral movement (step-by-step). Then the subject runs back to the start / finish line. Time is measured by electronic gate (Brower Timing System, Salt Lake City, UT, USA).

DESCRIPTION OF THE RESEARCH

The entire testing protocol included the measurement of a set of predictors as well as a criterion variable for a duration of three test sessions (test day) with a 24-hour break between each test session. The first session of testing - on the first day of the measurements, the mentioned parameters from the morphology area (body height, weight and body composition) were measured. After completing the measurements of the constitutional parameters, the respondents performed sandardized warm up (running + dynamic stretching), and then each participant carried out a test for assessing the planned agility in three bouts, with a break of 2 min between. The second test session - on the second day of the test, variables were measured for the assessment of the reactive power of the lower extremities (bilateral depth jumps, multiple repeated jumps), measured by the Microgate Optogait device. The third test session - the subjects were measured parameters for assessing the dynamic balance on the Biodex device for assessing the dynamic balance.

Statistics

For all variables, the basic descriptive parameters are calculated. For the purposes of this research, correlation and multiple regression analyzes were used to determine the association of a set of predictor variables with manifestations of planned agility.

RESULTS

Table 3 presents the basic descriptive parameters of all variables both from the set of predictors and the basic descriptive parameters of the criterion variable, which include the values of the minimum and maximum results, then the mean value (MV), and the corresponding values of the standard deviation (SD), as well values of the coefficient of variation (CV).

Table 3. Basic descriptive statistics parameters of all motoric variables

Variables	N	MIN	MAX	MV	SD	CV
OI STABILITY (RIGHT)	36	2.8	10.1	6.36	2.17	34%
OI STABILITY (LEFT)	36	2.3	11.8	6.66	2.30	34%
ML STABILITY (RIGHT)	36	1.7	5.8	3.14	1.11	35%
ML STABILITY (LEFT)	36	1.5	6.0	3.56	1.17	32%
AP STABILITY (RIGHT)	36	1.7	9.1	4.87	1.91	39%
AP STABILITY (LEFT)	36	1.8	9.5	4.98	1.99	39%
RSI – DROP JUMP	36	0.89	2.09	1.45	0.29	2%
RSI - CONTINUOUS	36	0.78	1.95	1.34	0.28	2%
T AGILITY	36	10.07	12.50	11.23	0.60	5,3%

LEGEND: OI STABILITY (overall stability index - left and right legs); ML STABILITY - mediolateral stability index; AP STABILITY - Anterio posterio stability index; RSI DJ - index of reactive power of the drop jump; RSI CJ - index of reactive power of vertical continuous jumps; T AGILITY - a test for assessing the planned agility.

Table 5 gives the results of the regression analysis, which examined the contribution of the dynamic stability to the explanation of planned agility. By looking at the results, it can be concluded that the coefficient of multiple correlation (R) of the predictor set with the criterion T AGILITY is 0.56, and explains the total variability of 32% (R Square 0.32) at a significance level of 0.06.

Tabel 5. – Results of the regression analysis of dynamic stability

Variable	Beta coefficient	P value
OI STABILITY (RIGHT LEG)	1.51	0.13
OI STABILITY (LEFT LEG)	4.32	0.15
ML STABILITY (RIGHT LEG)	0.62	0.17
ML STABILITY (LEFT LEG)	1.19	0.23
AP STABILITY (RIGHT LEG)	1.50	0.06
AP STABILITY (LEFT LEG)	3.93	0.09
R	**0.56**	
Rsq	**0.32**	
P	**0.06**	

LEGEND: (Beta – beta ponder, p – level of significance, R – coefficent of mutiple reggresion, Rsq – determination coefficient)

The Influence of reactive power

Observing the obtained results of the regression analysis, it is possible to notice that the coefficient of multiple correlation (R) of the predictor set with the criterion T AGILITY is 0.44, which explains the total variability of 19% (R Square 0.19) on statistically significant level 0.02.

Tabel 6. – Results of the regression analysis of reactive power

VARIABLES	Beta	p
RSI - drop jump	0.39	0.07
RSI - continuous	0.41	0.52
R	**0.44**	
Rsq	**0.19**	
p	**0.02**	

LEGEND: (Beta – beta ponder, p – level of significance, R – coefficent of mutiple reggresion, Rsq – determination coefficient)

DISCUSSION

From the results of this study it is evident that the dynamic stability and parameters of the reactive power of the lower extremities separately (contrary) define the planned agility. From the results of the dynamic stability parameters, the complete system is not significant, that is, the constructed model does not contribute at the significant level at the explanation of the planned agility in the above test (T – agility), which is in contrast to the original setting of this study. Why this is so, it is possible to explain in several different specifics of agility from one side, and dynamic balance on the other side. Namely, the dynamic stability is an extremely complex motoric ability for estimation, and it depends on several complex mechanisms (visual apparatus, vestibular apparatus and kinesthetic), which determine synergistic quality performances in tasks that require such motor quality.

Consequently, it is difficult to determine exactly which of the elements listed, the most can contribute to the establishment of efficient moving patterns during the implementation of various agile maneuvers. On the other hand, a diagnostic device on which the dynamic stability has been assessed does not have clearly defined criteria for precisely defining the conditions of testing (device settings) with regard to the characteristics of the sample (the primary level of physical preparedness), and is therefore difficult define optimal parameters with respect to the current state of the participants from the aspect of dynamic balance. For the purposes of this research, a single-leg test was used, where the initial level setting of the dynamic balance assesment device was selected at the highest unstable factor - level one. In practical terms maintaining the balance in such settings for the selected participants was an extremely challenging one, so respondents probably instead of trying to stabilize the platform (trying to get as close as possible to the center of the balance), often after a short stay in that relatively stable position, suddenly lose their balance, and the platform oscillated to the extreme limits (amplitude), which influenced a certain dispersion of measured data, which was confirmed by relatively high coefficients of variations. Jump power (for this type of power, another term is used: reactive power (Komi, 2000) is a specific example of rapid power in eccentric-concentric (short range stiffness) conditions that occur in different cyclic, acyclic and combined motor situations. It is of great importance in the case of fast reactive movable maneuvers, which occurs in the manifestation of various agile tasks. Such conclusions also support the results of this study, which clearly indicate that there is a statistically significant multiple correlation between the planned agility of the reactive (elastic) power of the lower extremities. Of all the types of power, this study also confirmed the influence of elastic power in explaining the planned agility. The values of the coefficient of determination indicate a 19% total explanation of the common variance of the planned agility and variables for estimating the reactive (elastic) power. Looking at the results of our research, although 19% is not an extremely large degree of explanation for common variance, it should be noted that only two variables for estimating elastic spower were used in this study. Also, elastic power is the only type of power that is used as an planned agility predictor. On the other hand, it is indisputable that in addition to strenght-power quality, other motor qualities can be a potentially significant factors in the manifestation of planned agility performance. From all of the foregoing, as well as the results of this study, it could be expected that the reactive power is associated with the ability to rapidly change the direction of movement, because according to some authors, the change in direction of movement involves a relatively small flexion in the knee joint, with short contact of the foot and the base (contact phase), and a high external load during a fast eccentric-concentric cycle of muscles (Young, 1995).

CONCLUSION

The aim of this experiment was to determine the influence (prediction), parameters of the reactive power and the dynamic balance on the manifestation of the motor component of the agility (planned agility). Given the obtained results of this study, it can be concluded that the results achieved on the variables for the assessment of the dynamic balance did not significantly contribute to the explanation of the overall variance of the results achieved on the criterion variable for estimating the planned agility. In accordance with the results, the first working hypothesis was not confirmed in which a significant influence of the selected group of predictor variables was expected (the dynamic balance variables) for expressing the results in the test for assessing the ability to rapidly change the direction of movement - the planned agility. On the other hand, the elastic (reactive) power of the lower extremities at a significant level, explains a total of 19% of the variance of planned agility, which would make look as a small contribution, but given the complex nature of the agility, it should not be surprising. In accordance with the results thus obtained, another working hypothesis was confirmed in which a significant impact of the selected group of predictor variables was expected (reactive power variables) for a manifestation of a planned agility. For future researches it would be interesting to conduct tests, estimating elastic power on one foot, however, it is questionable how many respondents have the ability to achieve elastic power, given the fast EC cycle, which according to the criteria to be included in this type of power should be below 250 ms. Consequently, it would be more convenient to work with athletes with highly developed levels of elastic capacities, who have the ability to establish a contact phase for the specified time.

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