EXAMINATION OF AGILITY FACTORS OF JUNIOR FOOTBALL PLAYERS INBAČKA TOPOLA, SERBIA

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Abstract

The project was designed to collect data about junior football players using complex instrumental measurements. Agility is the ability to move easily and quickly; it infers rapid onset, sudden stops and changes in direction. The execution of these requires complex skillset. In modern football, this factor is considered the most important one in terms of efficiency. Several previous studies have, with no significant results, tried to find a link between individual skills and agility. In the present research we were looking for answers to what factors influence agility among junior football players.

According to the of the movement-structure analysis of these tests, it is possible, that separately they do not cover the whole scale of movement patterns which could be present during a match. Because of this, we promoted two new variables: There are the "Agility without ball" and the "Agility with ball". This tests of movement structure contains all the components which could be expected of the players during a match, such as changes of direction, dribbles, using the dominant and subdominant leg separately and optionally.

In modern football, agility is an extremely complex skill, and the exact structure of its performance components is hard to define. The factors influencing players' agility should be emphasized and methodically developed in youth training in the light of future efficiency.

Key words: agility, junior, football

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Introduction

Success in soccer requires high levels of technical, tactical, psychological and physical skills including aerobic and anaerobic power, muscle strength, flexibility and agility (Chamari et al., 2004). During a soccer game, players perform repeated bouts of low-level activity with high-intensity actions such as sprinting, jumping and directional changes (Rouissi et al., 2016). Referring to the model proposed by (Young et al, 2015) COD speed is influenced by several factors such as straight sprint (SS), leg muscle qualities (i.e. strength, power and reactive strength). In the last decades, the scientific literature has shown controversial findings in that regard. Both tactics and player position on the soccer field are essential for the organization of a soccer match (Ruas et al., 2015). Genetic predispositions influence the potential role selection: anthropometric characteristics indicate that (Perroni et al., 2015; Rebelo et al., 2013; Reilly et al., 2000). Nevertheless, no positional differences in young soccer players have been reported in previous studies, in terms of their anthropometric characteristics, physical capacity or mental confidence (Fiorilli et al., 2013; Coelho et al., 2010). The selection of young players for a specific field position based on their anthropometric, physical and physiological profile may not be appropriate (Deprez et al., 2015; di Cagno et al., 2014). Agility is an essential component in most field and team sports and it is fulfilled by changes of direction every 2–4 seconds, with 1200–1400 changes of direction throughout a game (Sporis et al., 2009). Traditionally, agility was simply defined as speed with directional changes (Draper & Lancaster, 1985). Currently, agility is considered an open skill and was recently defined as a change in velocity or direction in response to a stimulus that cannot be pre-planned (Sheppard et al., 2006). The ability to sprint, accelerate and decelerate alongside change of direction is commonly known as agility. Agility has been, indeed, defined as a rapid whole-body movement with change of velocity or direction in response to a "stimulus" (Sheppard et al., 2006). Adhering to this definition, it is well recognized that agility is composed of perceptual and decision making factors, as well as change of direction (COD) components.

The parameters of agility are: change of direction (Bloomfield et al., 1994), performed at max velocity, quick stoppage and set-off (Gambetta, 1996), explosiveness (Baker & Nance, 1999), a rapid whole-body movement with change of velocity or direction in response to a stimulus (Sheppard & Young, 2006). These movements, the external load components are called together mechanical load (Barnes, 2016). Other researchers study this problem from the aspect of microtraumas, which are caused by inappropriate set-off, stoppage or change in direction (Schuth & Ökrös, 2016). In terms of energy expenditure, they relate on the phosphagen system (Bompa & Buzzicelli, 2015). Agility has repeatedly been tried to be merged to some of the conditional abilities (Buttifant et al., 2002; Condello et al., 2013; Milanović et al., 2014; Young et al., 2010). Nowadays, standardized tests are available to measure agility itself (Sporis et al., 2010). No correlation between leg muscle power and agility has been found yet (Webb & Lander, 1983; Young et al., 2002). Agility performances (performance scores) can vary among different stages of development (Koltai et al., 2016). Some researchers state, that the key to achieve a higher agility can be found in coordination abilities (Katics, 2015). Agility is highly required during the whole match even in defensive (without ball) and in offensive (with ball) situations as well, irrespectively of the player's role (Franks & Hughes, 2016). It is the rarest, in the open movement skill based sports, that a continuous linear motion (running in this case) would happen (Bangsbo & Mohr, 2012). Typically, irregular movements take place on a regular basis, which cannot be foreseen. The angle of the movement change can be below 90 degrees (it is called redirection) and above 90 degrees (which is called change of direction) (Goodman, 2008). During matches, decisions take place before these directional changes of movement (Young & Willey, 2010).

Objectives/Hypothesis

The goal of this study is to determinate the performance-parameters of agility among the subjects. The investigators studied the correlations between the newly made up complex (in terms of movement structure) variables and anthropometric and body composition parameters, and start quickness. The study determines the relations of the merged variables to each other among players from different age groups and their efficiency on different roles.

According to these, the following hypothesis were stated in reference to the studied group:

1. Agility tests do not have any correlation with anthropometric and body composition parameters, neither with the start speed (measured on 5m).
2. The agility with ball, and agility without ball should be referred as two different skills.
3. The merged agility factors develop in different aged teams.
4. Players from different roles show different patterns regarding agility.

Methodology

The Institute of Health Promotion and Sport Sciences in the Faculty of Education and Psychology (PPK) at the EötvösLoránd University (ELTE) accepted the invitation from the University of Novi Sad, Teachers' Training Faculty in Hungarian, Department for Physical Education to collaborate – within the framework of an international program, involving students – in data collection for scientific research.

Experimental approach to the problem

This is a cross-sectional study in which the authors assessed internationally standardized and recommended agility tests IllinoisChange of Direction Speed Test (ICODT) and TDS Dribbling test, performance and ball control techniques of high-level young athletes whoplay in different soccer field positions. The movement structures of these tests perfectly model the solutions applied in the actual game: rapid onset, sudden stops and dynamic changes in direction, both with and without the ball.

Body dimension estimation

For this study, the InBody 720 (Biospace Co. Inc., Seoul, South Korea) Bioelectrical Impedance Analyzer (BIA) was used. This foot-to-foot, hand-to-hand and hand-to-foot contact device uses two stainless-steel foot pad electrodes mounted on a platform scale and two stainless-steel handles to allow for Tetrapolar 8-point tactile electrode system. A multi-frequency (six) current is applied to determine 30 impedance measures (5 paths x 6 frequencies). These measures are integrated into the system to provide output measures of total body water, intracellular water, extracellular water, and segmental lean analysis. The platform scale uses a single load cell to measure body mass (which with a measure of stature) and to calculate body mass index (BMI). Body fat percentage is calculated using a summation of segmental lean analysis to determine total lean body mass, fat mass, and ultimately the proportion of fat to total weight mass fraction. An estimate of muscular percentage is derived by evaluating water content in the segmental regions using proprietor equations.

Starting speed (5m linear running) was measured with OXA Starter gate with photocell system.

Subjects

Sixty-six elite soccer players (age was 14-18 years) belonging TSC FuttballClub BačkaTopolavolunteered for this study.They were classified into four soccer roles: 5 goalkeepers, 17 defenders, 25 midfielders and 19 forwards. Their training regimenconsisted of four training sessions and one game perweek. To be involved in the study, they had to meet thefollowing inclusion criteria: participation in at least 80%of the training sessions of their respective clubs, a minimum of two years of experience in competitive soccer, noinjuries that had occurred in the previous year, and nopresence of relevant diseases. The following exclusioncriteria were applied: presence of injuries, pathologies, orother conditions (temporary or not) that could influencethe correct execution of the tests proposed in this study.The players and their parents were informed about thepurpose of the study, and all of them gave their writteninformed consent to the procedures described in the study.The study was designed and conducted in accordancewith the Declaration of Helsinki.

The data have been processed with the IBM SPSS Statistics22 program. The investigators determined means, minimum and maximum values, standard deviations, and any deviant occurrences compared to the typical Gauss curve in every variable. Correlations between the results of the agility tests and total body height, muscle mass, BMI and 5m start speed were studied with correlation matrixes.

According to the of the movement-structure analysis of these tests, it is possible, that separately they do not cover the whole scale of movement patterns which could be present during a match. Because of this, we promoted two new variables:

The "Agility without ball" title refers to a variable, which comes from adding up the outcome scores of the agility tests (Illinois and TDS Dribbling teams, performed tests without ball) and the values of the T-test, player by player. The result is a complex form of motion, which contains components (without ball) that can be present during a match: quick set-offs, intense redirections, 90 degree changes in direction, 180 and 360 degree turns, slalom movements performed in a small area, drastic decelerations from high velocity running, strafing and quick back and forth motions.

The "Agility with ball" variable was created by adding up the following values in the case of each player: highest scores of optionally altered ball technique test (in case of Illinois players), and tests performed with dominant and subdominant leg (in case of TDS Dribbling players).

This tests of movement structure contains all the components which could be expected of the players during a match, such as changes of direction, dribbles, using the dominant and subdominant leg separately and optionally.

Results

In *(Table 1)* the single variable analysis of anthropometric parameters and the results of the agility tests are shows, minimum, maximum and deviation values of the variables are stated. The data is normally distributed. The correlations between the values of agility test performed without ball and anthropometric parameters was studied with correlation matrixes, and the results are stated in *(Table 2)* We have found a negative significant correlation in the one sample T-test values of the anthropometric parameters (r=-0,502; p<0,001). The players body weight showed significant correlation only with T-test (r=0,521; p<0,001). The muscle mass and the Illinois test (without ball) shows a significant correlation, in terms of the T-test, the correlation is significant and stronger than moderate (r=-0,324 resp. r=-0,615; p<0,001). In the case of BMI values, T-test showed a weaker than moderate correlation (r=-0,420; p<0,001). *(Table 3)* shows the connections of the anthropometric parameters and the values of the tests performed with a ball. Significant correlation can be found between the values of total body height and Illinois (with ball) (r=-0,244; p<0,001), in addition to skeletal muscle mass and Illinois (with ball) (r=-0,324; p<0,001). No other significant correlation has been found. We also studied the relevance of the results of the 5m run tests in the performance of the agility tests; this is showns in *(Table 4)* Among these cases we have only found significant correlation only with the test with Illinois (without ball) (r=0,439; p<0,001) and in T-test (r=0,291; p<0,05). These connections are weaker than moderate.

The linear regression analysis of the test results of agility tests with and without ball can be seen on *(Figure 2)*. The markers on the figure shows the individual scores of each player in the merged agility tests (with and without). Players with markers close to the regression line have shown consistent performance, and players with markers close to the origo are the ones with the best performance.

In *(Table 5)*, the relation of the 5m run test results, anthropometric parameters, and agility test results (with and without) can be seen (r=0,595; p<0,001).

We studied the means a deviations of the merged agility test (with and without) values in different age group teams *(Figure 3)*.The ANOVA tests shows that the mean values of different age group teams are significantly deviant from each other. The variance analysis has the following values: F=24,758; p=0,000 and F=13,017; p=0,000.

The *(Figure 4)* shows the different agility performances of different roles.

The goalkeepers had lower scores both in WB and WOB tests. In case of the WOB tests, the deviation across the roles is lower. The offensive and defensive players are almost identical to each other; however, the scores of the midfielders are slightly behind them. In case of WB tests, the field players' deviation values are similar to the goalkeepers. Low scores of the offensive players can be observed.It must be mentioned however, that the ANOVA analysis has not verified the differences between the means neither in case of WB, nor in case of WOB (F=1,227; p=0,308 and F=2,601; p=0,060).

Discussion

It could be assumed, that the players with shorter body height can have better results in WOB, since they have their center of mass on a lower height, which can be an advantage in directional changes. Likewise can be more efficient a player with higher muscle mass and a proportional build. Even so, we have not found any significant correlation between the important anthropometric parameters and the agility test performances, both in the case of leg strength and in the case of agility (Webb & Lander, 1983; Young et al., 2002). In the case of starting speed and agility tests we have found similar results to previous studies (Buttifant et al., 2002; Condello et al., 2013; Milanović et al., 2014), whereas we have not found any significant correlation either. This proves our **(1)** first hypothesis right. Our **(2)** second hypothesis can be partially proved, which states that the WB agility and WOB agility are two separate and identical skills. The moderate correlation between the two complex variables indicates that they have an effect on each other, however, their relation is not essentially determining.We have found significant correlation between the means of complex agility scores of teams from different age groups (U14, U16, U18). The mean values of WOB agility show spectacular development until the age of 16, then at the age of 18, the performance plateaus. The WB agility shows undiminished development with age, and this largely proves our **(3)** third hypothesis. The deviation values are low in both cases. Our (**4**) fourth hypothesis, which supposed, that the players of different roles will show different results in terms of agility, is not supported by our results. However, it support a previous study, which stated the WB and WOB agility is a mandatory skill to have, independently of the player's role (Franks & Hughes, 2016).

Conclusions

We tried to provide directly useful information and connections to the trainee/practicing trainers through our measurements and studies. In modern football, agility is an extremely complex skill, and the exact structure of its performance components is hard to define. The moderate correlation found in the connection between WBA and WOBA indicates the essential need of developing the WB components during training. The merged agility skills' (WBA, WOBA) weak correlation (or from time to time the lack of correlation) with the most important anthropometric parameters and starting speed measured on 5m, lets us assume that neither the selection of an ideal body build, nor the regular starting speed training have an indirect effect on agility.

The WOBA mean values have a spectacular development until the age of 16, and plateaus at the age of 18, meanwhile in the case of WBA, the development is undiminished, and that verifies the training's efficiency. In terms of different roles, we have not found a statistical difference between the means of agility parameters; therefore our conclusions are exclusive to our sample. The goalkeepers had lower score not only in WOBA, but in WBA tests as well, which is not surprising, but urges the focus on their development/specialized training. Especially if we wanted to mention the goalkeepers as field players, according to the expectations of the modern soccer. In the WOBA tests, field players have lower deviation, this indicates uniform training. Offensive and defensive players have almost identical results, the middle fielders' scores are somewhat behind. In terms of WBA, the offensive players have scores much below the expectations. They should have the best WB performance, because of the frequent occurrence of 1 on 1 situations.

Based upon previous studies, and the investigation on WOBA-WBA, it is getting more and more proven, that the agility is an individual, complex skill.

The factors influencing players' agility should be emphasized and methodically developed in youth training in the light of future efficiency.

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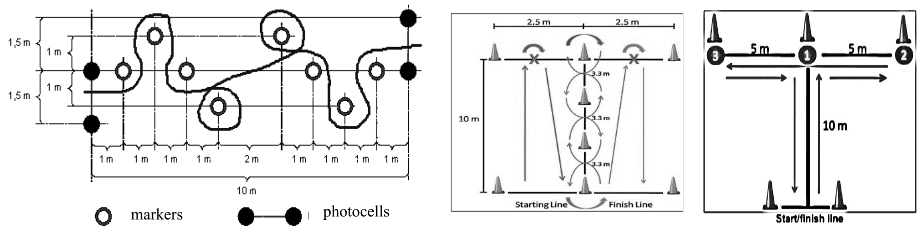

Figure 1Agility tests (TDS Dribbling, Illinois and T-test)
http://www.werthner.at/tds/tds-german/tds-test1.htm download: 7 august, 2017.
http://www.rehab.research.va.gov/jour/2013/507/jrrd-2012-05-0096.html download: 7 august, 2017.

Table 1 The single variable analysis of anthropometric parameters and the results of the agility tests and 5m run test

N=66	Mean	SD	Minimum	Maximum
Bodyweight (kg)	64,55	10,71	36,00	89,00
Skeletal Muscle Mass(kg)	32,40	5,86	18,60	45,20
Height (m/100)	175,09	9,20	151,00	198,00
Illinois without ball	16,65	0,71	15,58	19,98
Dribbling without ball	8,95	0,47	7,94	10,46
T-teszt	11,20	0,91	9,79	14,00
Illinois with ball	22,07	1,60	18,84	26,81
Dribbling with dominant leg	12,79	0,97	10,90	15,24
Dribbling with subdominant leg	14,57	1,46	12,15	18,24
Run 5m (sec)	1,12	0,09	0,87	1,42

Table 2 **The correlations between the values of agility test performed without ball and anthropometric parameters**

	1	2	3	4	5	6	7
1 Height	1						
2 Bodyweight	,847**	1					
3 Skeletal Muscle Mass	,862**	,911**	1				
4 Body Mass Index	,443**	,776**	,711**	1			
5 Illinois without ball	-,219	-,168	-,324**	-,096	1		
6 Dribbling without ball	,051	,000	-,101	-,126	,699**	1	
7 T-teszt	-,502**	-,521**	-,615**	-,420**	,705**	,557**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3 **The correlations between the values of agility test performed with ball and anthropometric parameters**

	1	2	3	4	5	6	7
1 Height	1						
2 Bodyweight	,847**	1					
3 Skeletal Muscle Mass	,862**	,911**	1				
4 Body Mass Index	,443**	,776**	,711**	1			
5 Illinois with ball	-,244*	-,224	-,324**	-,226	1		
6 Dribbling dominant leg	,013	-,040	-,091	-,168	,659**	1	
7 Dribbling subdominantleg	-,132	-,194	-,201	-,215	,507**	,585**	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 The relevance of the results of the 5m run tests in the performance of the agility tests

	1	2	3	4	5	6	7
1 Illinois without ball	1						
2 Dribbling without ball	,699**						
3 T-teszt	,705**	,557**	1				
4 Illinois with ball	,630**	,660**	,547**	1			
5 Dribbling dominantleg	,306*	,473**	,383**	,659**	1		
6 Dribbling subdominantleg	,278*	,412**	,308*	,507**	,585**	1	
7 Run 5m	,439**	,144	,291*	,009	-,096	-,117	1

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.001 level (2-tailed).

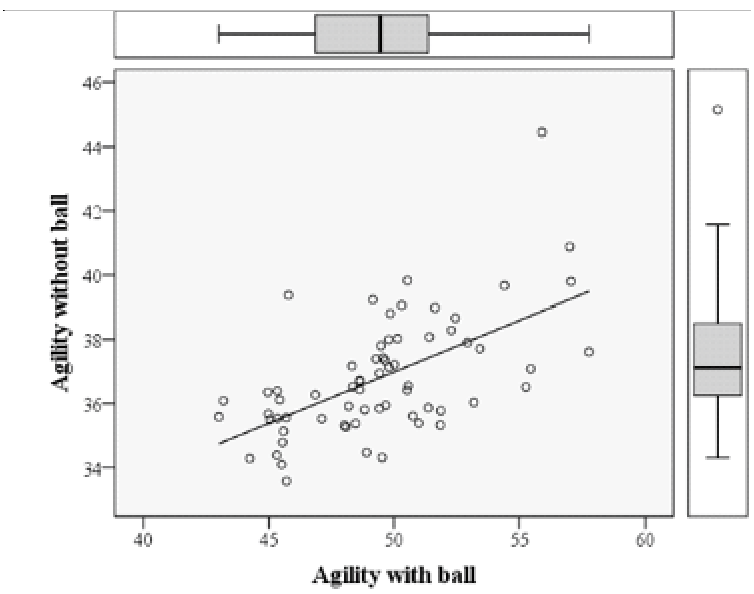

Figure 2.The linear regression analysis of the test results of agility tests with and without ball

Table 5 The relation of the 5m run test results, anthropometric parameters, and agility test results (with and without ball)

	1	2	3	4	5	6	7
1 Heigh	1						
2 Bodyweight	,847**	1					
3 Skeletal Muscle Mass	,862**	,911**	1				
4 Body Mass Index	,443**	,776**	,711**	1			
5 Run 5m	-,001	,171	-,052	,117	1		
6 Agility without ball	-,318**	-,321**	-,453**	-,276*	,349**	1	
7 Agility with ball	-,167	-,198	-,263*	-,245*	-,073	,595**	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

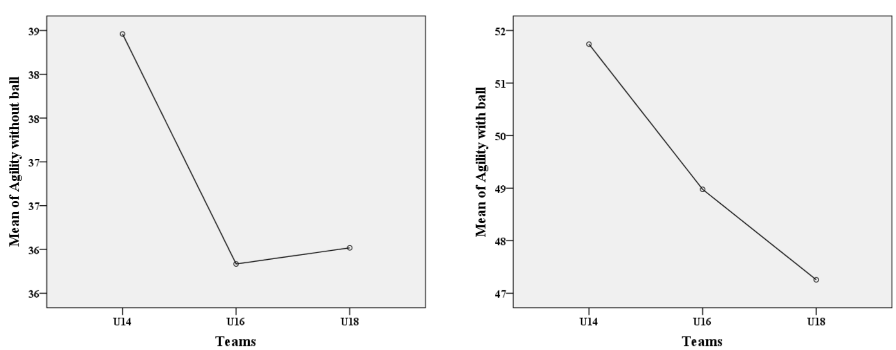

Figure 3 The means and deviations of the merged agility test (with and without ball) values in different age group teams

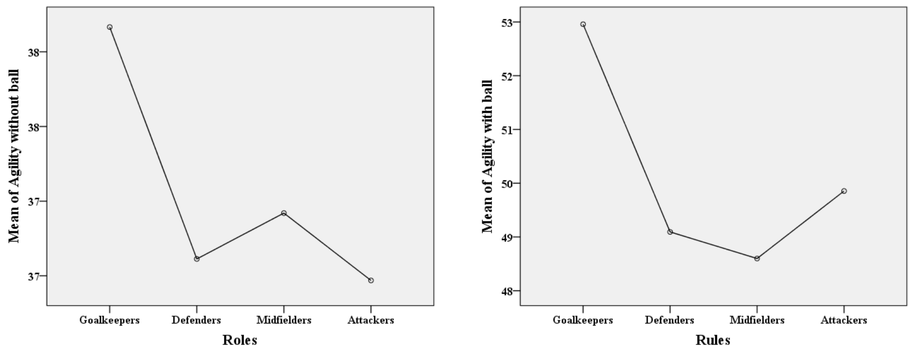

Figure 4 The different agility performances of different roles