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THE INFLUENCE OF AGE FACTOR AND SPORTS SPECIALIZATION ON THE LEVEL OF AGILITY IN SPORTS GAMES

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ABSTRACT. Objectives: The aim of the study was to determine the influence of age factors and the type of sports specialization on performances in planned and reactive agility. The object of the research was 129 players of football, volleyball, basketball and handball from sports clubs in Nitra and its surroundings in the categories of boys U15 ($\bar{x}$ = 14.95r) and boys U 17 ($\bar{x}$ = 16.88r). **Methodology:** The level of planned agility (PA) was diagnosed by the Illinois test and the level of reactive agility (RA) by the Fitro agility Check test. **Results:** The results showed the importance of both factors (Sport specialization and age) on performance in PA and RA, higher values (p) for the age factor ($p < 0.05$). **Conclusions:** The biological mean (age) has affected performance in RA more strongly than a type of sports game. Post hoc tests between groups (sport specialization) confirmed the statistical significance of differences between sports games to the detriment of basketball ($p < 0.01$).

Keywords: *planned agility, reactive agility, sport games*

Introduction

The competitive environment of team sports requires a high level of motor abilities from players with a sufficient degree of accuracy associated with the implementation of game skills. Activities are associated with the perception of stimuli, rapid response and the implementation of sudden movement actions. The ability to make effective decisions and maneuvers seems to be characteristic of some of the best team sports players. Except of it, players perform a variety of movements, such as jumps, reflections, rebounds, rotations, changes of direction, etc., integrated into technical skills (Paul, Gabbet & Nassis, 2016). Despite the fact

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that success is influenced by a number of factors, it is clear that players should have physical, technical and tactical maturity for their sport (Reilly, Williams & Nevill, 2000). "Athletic preparation" comes to the fore as an important indicator, especially since the demands of team sports seem to be greater than in previous years (Barnes et al., 2014). Agility is therefore perceived as an important factor in the structure of a player's game performance in team sports (Scanlan, Tucker & Dalbo, 2014). Young, Dawson and Henry (2015) stated the independence of planned and reactive agility, citing several physical and cognitive components of agility. Although there may be differences in understanding the concept of agility, it is generally defined as the rapid movement of the whole body with a change in speed or direction in response to a stimulus (Sheppard & Young, 2006). It follows from this definition that agility includes not only the speed of change of direction (CODS) but also the cognitive decision-making process and its outcome. These cognitive aspects include perceptual and decision factors, and physical elements are considered as essential during agility. The phrase "reactive agility" is traditionally used in the literature to define movement in response to a stimulus. However, Young, Dawson and Henry (2015) recently expressed the view that the word "reactive" is redundant by the current definition of agility. As a result, we use the word "agility" exclusively to define the process of perceiving decision-making in response to a stimulus.

Each team sport requires specific types of movements and agility. Players must constantly adapt their movements and actions to different game situations (Bloomfield et al. 2007; Brughelli, 2008; Scanlan, Tucker & Dalbo, 2015). The player is constantly in a 1: 1 game, in invasive games in addition the relatively small size of the playing area creates constant pressure from opponents (Vaeyens et al., 2007). The level of agility thus becomes an important indicator of a player's performance in team sports. Finally, it was found that the agility test is sensitive in distinguishing groups of athletes of different sports specializations (Zemková & Hamar, 2014). Although knowledge about the influence of gender (Sekulić et al., 2013), differences between individual and team sports (Mackala et al., 2020), the relationship between age and agility (Andrasić et al., 2021; Horička & Šimonek, 2021) for performance in agility are known. There is a clear lack of data on the influence of potential predictors on various manifestations of agility.

Objectives

The aim of the study was to determine the influence of age factors and the type of sports specialization on performances in planned and reactive agility

Method

The object of the research was 129 players of sports clubs FC Nitra, BKM SPU Nitra, VKP Bystrina SPU Nitra and MHC Štart Nové Zámky in the categories of boys / U15 ($\bar{x}$ = 14.95 years; SD = 1.93 years) and boys category / U17 ($\bar{x}$ = 16.88r; SD = 1.46r.). The set consisted of 61 players of 4 team sports in the category: footballers (U15f = 25); basketball players (U15b = 14); volleyball players (U15v = 12) and handball players (U15h = 10) and 68 players of higher age category in the same sports (U17f = 32; U17b = 11), 23; U17v = 12; U17h = 13). The different number of players in each category was due to objective facts, the availability of the ensemble and the health status of the players. The condition for including the files in the research was age, comparable volume of preparation and participation in the highest competition in the Slovak Republic of the relevant category.

Search strategy

The Illinois Agility Test (Planned Agility, PA; Getchell, 1979) was used to diagnose Planned Agility and the Fitro Agility Check (Reaction Agility, RA; Zemkova & Hamar, 2014).

All the necessary assumptions were confirmed to determine the level of the differences between the medians of the four independent sample groups and the two continuous variables (PA and RA). There were for example variables in the interval and normal data distribution, a two-step analysis of variance (ANOVA) was used with two factors “sports specialization” (F, B, V, H) and “age” (U15 and U17). Finally, a detailed comparison of post-hoc tests (Tukey’s test for different numbers of participants) was performed. We tested the null hypothesis of agreement of variance at the 95% (0.05) and 99% (0.01) level of significance.

Records, registration of primary data were processed by using MS Office 2010 software (MS Word, MS Excel). We performed statistical processing according to Borůvková, Horáčková and Hanáček (2014) using analytical tools of licensed software IBM SPSS Statistics® (v. 25.0).

Results

We focused on evaluating the level of performance of selected factors of agility differences between them in relation to sports specialization in the categories of boys U15 and U17 in this part. The basic descriptive data are presented in Table 1.

Table 1. Descriptive data, U15 and U17

	U15		U17	
	PA	RA	PA	RA
N	61		68	
Mean	16.9367	1485.923	16.1125	1321.881
Median	16.61	1469.23	16.07	1307.425
SD	1.08984	104.5712	0.64911	107.7364
Variance	1.188	10935.14	0.421	11607.13
Minimum	15.52	1291	14.76	1112
Maximum	20.34	1775.63	17.97	1652.9

In a test evaluating the speed of change of direction in response to a standard stimulus (closed skill) - Illinois test, the best performances were observed in U15 in volleyball players ($\bar{x}$ = 16.16s), football players ($\bar{x}$ = 16.66s), handball players ($\bar{x}$ = 16.73s) and basketball players ($\bar{x}$ = 18.2082s). In the U17 category were dominated volleyball players ($\bar{x}$ = 15.76s), followed by basketball players ($\bar{x}$ = 15.79s), footballers and handball players (Fig. 1,2). We also observe greater homogeneity of performance in selected team sports in the test.

The variability of performances was characteristic in the U15 category by:

a) the dominance of the group of volleyball players and relative lagging behind of the group of basketball players in both diagnosed indicators

(b) the relative balance of the football players, volleyball players and handball players (figure 1);

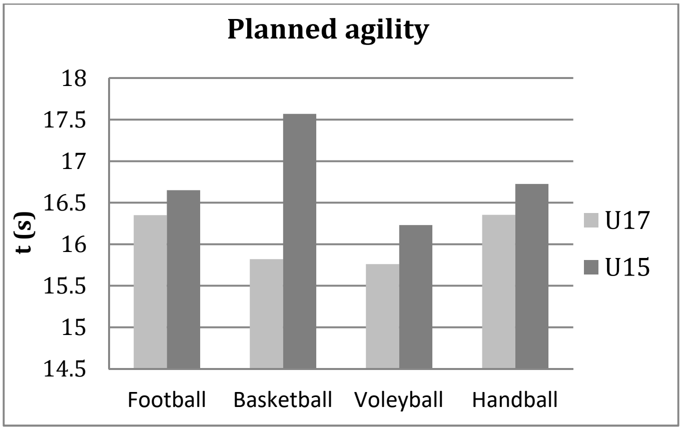

Fig. 1. Comparison of players in U15 and U17 category in Illinois test in team sports

We observed less variability in player performance in the diagnosis of reactive (selection) agility and perception in the test with the selection of adequate motor response (FAC, Fig. 2). Differences in player performance were negligible, with the exception of differences between age categories. The best performances were recorded by footballers ($\bar{x}$ = 1287.40ms), followed by volleyball players ($\bar{x}$ = 1294.7ms), basketball players ($\bar{x}$ = 1334.3ms) and handball players ($\bar{x}$ = 1420.9ms). Less variability was observed between team sports in this test. This is probably due to the fact that coordination ability (reactive speed) and cognition is not limited by the level of fitness factors (speed, strength, special endurance), but by the quality of analysers and the central nervous system and its role in controlling of movement from the age of athletes.

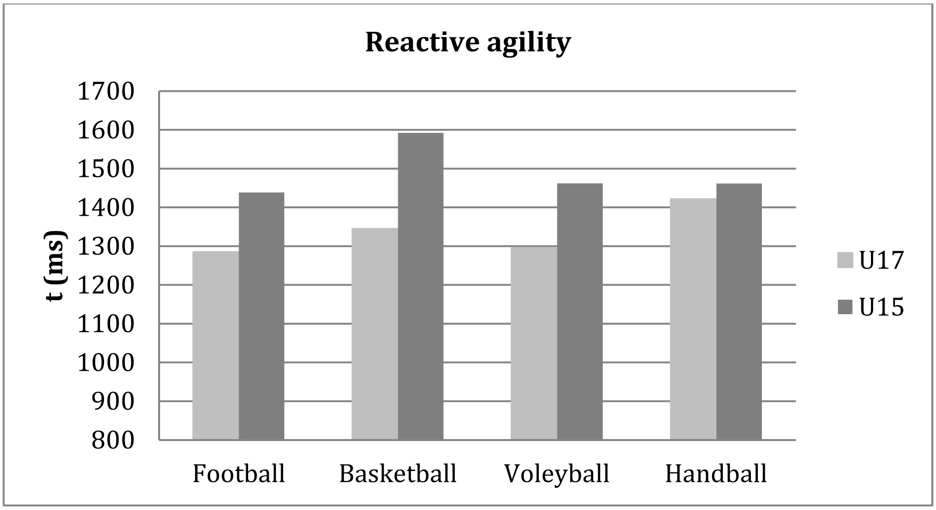

Fig. 2. Comparison of players in U15 and U17 category in reactive agility (FAC) test between team sports

As we expected there were in age differences in the level of performance in favour of U17 category, lower performances are found in basketball. The reason could be the presence of extreme values or other reasons related to the structure of training stimuli, file composition, genetic factors, etc. The best results of the planed agility in terms of the sport specialization were observed in volleyball players in both categories (Figure 3-6). The differences were statistically significant with the exception of football as it was confirmed by detailed post hoc tests (Table 6).

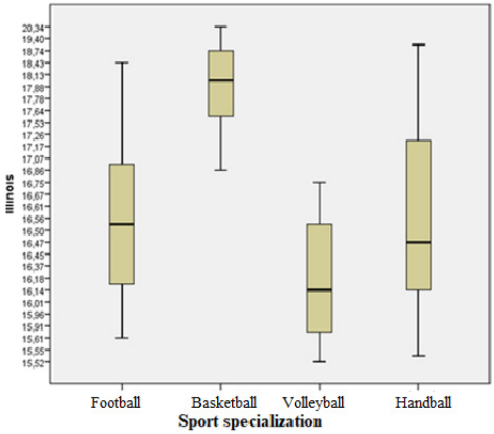

Fig. 3. Variability of performances according according to Sport - U15 (PA)

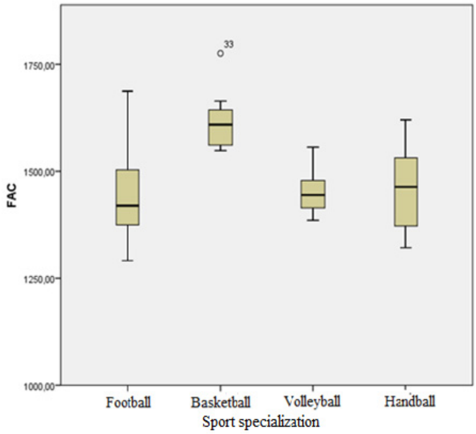

Fig. 4. Variability of performances to Sport - U15 (RA)

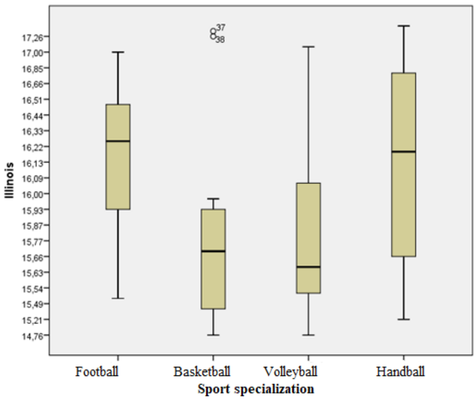

Fig. 5. Variability of performances according according to Sport - U17 (PA)

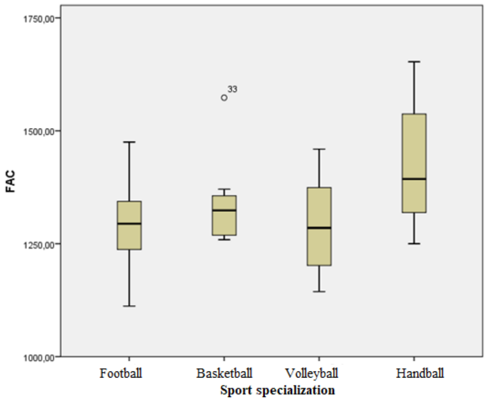

Fig. 6. Variability of performances to Sport - U17 (RA)

The precondition for finding out the differences in performance between sports specializations was the assessment of the normality of the distribution (Table 2). We consider the observed variables to be normally distributed for all variables except of FAC Basketball /U15 sig = 0.036; U17, sig = 0.003) and in both test procedures p <0.05.

Table 2. Test of normality – Sport specialization (football, basketball, volleyball, handball)

Tests of Normality							
Sport specialisation		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
ILL U15	Football	0.178	25	0.039	0.920	25	0.051
	Basketball	0.170	14	0.200	0.969	14	0.868
	Volleyball	0.236	12	0.064	0.873	12	0.071
	Handball	0.199	10	0.200	0.934	10	0.492
FAC U15	Football	0.168	25	0.068	0.944	25	0.187
	Basketball	0.162	14	0.020*	0.865	14	**0.036***
	Volleyball	0.154	12	0.200	0.956	12	0.723
	Handball	0.129	10	0.189	0.980	10	0.967
ILL U17	Football	0.089	32	0.200	0.972	32	0.546
	Basketball	0.238	11	0.083	0.877	11	0.096
	Volleyball	0.170	12	0.212	0.945	12	0.567
	Handball	0.120	13	0.200	0.962	13	0.780
FAC U17	Football	0.092	32	0.200	0.988	32	0.973
	Basketball	0.253	11	0.048	0.767	11	**0.003***
	Volleyball	0.180	12	0.200	0.909	12	0.206
	Handball	0.142	13	0.200	0.944	13	0.507

Note: *. This is a lower bound of the true significance; a. Lilliefors Significance Correction

We wanted to test the hypothesis that sports specialization and age are moderators of the effects on planed agility and reactive agility. Whether this relationship applies regardless of the observed category, a fundamental research question should be resolved: Is the role of sports specialization and age important, or does the type of team sport and the age of the players have a higher effect on planned agility or reactive agility? Both factors (sport specialization and age) were moderators of planned and reactive agility ($p < 0.05$) as shown in Table 3.

Table 3. ANOVA with 2 factors

	PA			RA		
Factor assessed	Mean Square	F	Sig. p-value	Mean Square	F	Sig. p-value
Factor_SS	30.090	7.076	0.04*	87601.51	86.920	0.012*
Factor_age	17.966	41.135	0.000**	683898.85	11.134	0.002**
Factor_SŠ *age	4.518	10.344	0.000**	55288.39	7.027	0.001**

Note: **significance on the level α=0,01, *α=0,01; SS – sport specialization; PA-planned agility; RA – reactive agility

The volume of the effect in ANOVA is measured as a square (MS). Significantly higher MS values for the age factor (p = 0.000 and p=0.002) indicated that this biological trait affected both planned and reactive agility more strongly than sport specialization. The comparisons between the groups were statistically significant, especially in comparison with basketball and volleyball, respectively football. The significance did not found in both types of agility (Table 4). In addition to volleyball, the difference in averages was confirmed in 2 cases also for football players. The difference in averages was confirmed mainly between groups F and B (p = 0.009 and p=0.000), between B and V (p = 0.000). There were no statistically significant interactions observed in all cases, we note only a partial effect of sport specialization. Detailed post hoc tests between the groups of sport specialization confirmed the statistical significance of the differences.

Table 4. Comparison between groups / PA and RA – sport specialization factor

Factor SS	Post-hoc test Tukey between SS					
	F vs B	F vs V	F vs H	B vs V	B vs H	H vs V
PA	0.009*	0.021	0.938	0.000*	0.137*	0.021*
RA	0.000*	0.803	0.001*	0.000*	0.193	0.063

Note: *significance on the level α=0,05.; SS – sport specialization

Taking into account the age factor, the difference in averages was confirmed as expected for both PA and RA (p <0.05). The effect size (Effect size = 1.66) also indicates a higher effect of the age factor on RA compared to PA. Due to the confirmation of statistical and material significance (Effect size), the difference is evident (Table 5) in both cases.

Table 5. Comparison between categories / PA a RA - factor – age
Dependent variable: PA a RA

Factor - age		Mean Difference	Std. Error	Sig.[b]	Effect Size Cohen´s d	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
PA	U15 vs U17	0.805*	0.126	0.000*	0.95	0.557	1.054
RA	U15 vs U17	157.069*	16.847	0.001*	1.66	123.71	190.423

Note: * The difference in averages is significant on the level α= 0,05.

After the subsequent combination of both factors (sport specialization + age), the significance was not confirmed in all pairwise comparisons in the analysis of differences (post hoc) in the averages of all groups (n = 8). Overall, a greater difference was found in PA compared to RA (Table 6).

Differences among the categories in individual sport specialization point to differences especially in sport specialization - basketball, where the difference in both PA and RA (p <0.05) was confirmed in basketball in 9 (out of 13) cases; in football 5x (out of 11); volleyball 5x (out of 10) and handball 5x (out of 8). The importance of the differences observed in the followed specializations is also supported by the size of the coefficient of effect size (ES). In these cases, we evaluate the effect of sport specialization as evident and we accept the hypothesis statistically and materially (confirmed alternative hypothesis HA and strong Effect size).

Table 6. Differences between groups for variables PA and RA
(with unequal sample size)

Post-hoc test Tukey between groups (SS+age) + Effect size														
Variable	F U15 - H U17	F U17 - H U15	B U15 - V U17	V U15 - B U17	F U17 - H U17	F U15 - B U15	H U15 - B U17	V U15 - V U17	H U17 - B U15	F U17 - B U15	F U15 - V U15	H U15 - V U17	H U17 - B U17	B U15 - V U15
PA	0.255	0.179	**0.000****	0.197	0.601	**0.000****	**0.032***	0.098	**0.000****	**0.000****	**0.032***	**0.014***	0.096	**0.000****
ES	0.42	-0.80	1.16	0.55	-0.25	-1.77	1.01	0.71	-2.28	3.43	0.79	1.16	0.77	3.06
RA	0.602	**0.000****	**0.000****	**0.001****	**0.003****	**0.000****	**0.005****	**0.001****	**0.000****	**0.000****	0.643	**0.001****	0.071	**0.000****
ES	0.20	-1.66	3.53	1.63	-1.17	-2.55	1.38	1.82	-1.89	-3.32	-0.21	1.66	0.77	2.64
	F U17 - V U17	F U15 - H U15	V U15 - H U17	B U17 - V U17	B U15 - H U15	F U17 – F U15	V U17 - H U17	V U15 - H U15	B U17 - F U15	B U17 - B U15	H U15 - H U17	V U17 - F U15	V U15 - F U17	F U17 – B U17
PA	**0.005****	**0.032***	0.437	0.923	**0.003****	**0.012***	**0.049***	0.133	**0.003****	**0.000***	0.365	**0.001****	0.550	0.104
ES	1.03	-0.07	-0.35	0.04	1.40	-0.77	-0.92	-0.73	-1.19	-2.90	0.42	-1.34	-1.03	0.85
RA	0.810	0.643	0.413	0.342	**0.000****	**0.000****	**0.013***	0.773	**0.002****	**0.000****	0.402	**0.000****	**0.000****	0.114
ES	-0.07	-0.21	0.32	0.39	1.90	-1.64	-1.05	-0.12	-1.40	-3.58	0.35	-1.72	1.71	-0.46

Notes: *p<0.05; ** p<0.01; PA – planned agility; RA – reactive agility; ES – Effect size; F – football, B – basketball, V – volleyball, H – handaball

Conclusions

We have shown that older players and volleyball and football players were more likely to perform in both planned (PA) and reactive (RA) agility. The character of the load of volleyball players probably creates preconditions for the dynamics of the performance of this ability in comparison with other sports. From the findings, we conclude that RA tends to grow more dynamically with age, compared to PA. In both variables (PA, RA) we found the most significant differences between basketball players between the two age categories. The effect of sport specialization was proved in PA in four cases, in RA in three cases. It suggests that PA is more conditioned by the effect of sport specialization than RA. However, the presence of statistically significant interactions suggests potential additive or synergistic effects between sport specialization and age in terms of performance in both PA and RA.

The relationships between the two factors (age and sport specialization) and their effects on RA were partially different from those for PA, observed and described in the article. This confirms the well-known assumption that both types of agility (PA, RA) are relatively independent qualities and are not determined only by motor factors. At the same time, we claim that the structure of the sports discipline (team sports) determines more of the player's motor qualities, which are reflected in the planned agility. On the other hand, reactive agility does not depend exclusively on the nature of the load in a particular game, but is also conditioned by external psychomotor factors.

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