Journal of Physical Education and Sport ® (JPES), Vol. 23 (issue 10), Art 313, pp. 2737 - 2743, October 2023
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Examining the interplay between reactive and planned agility with motor and anthropometric parameters in female volleyball players

Ľ. PAŠKA[1], P. HORIČKA[2], J. ŠIMONEK[3] , N. CZAKOVA[4], L. POLÁČKOVÁ[5]
[1,2,3,4,5,]Department of Physical Education and Sport, Faculty of Education, Constantine the Philosopher University, Nitra[1], SLOVAKIA

Published online: October 31, 2023
(Accepted for publication : October 15, 2023)
DOI:10.7752/jpes.2023.10313

Abstract
The goal of our research study was to determine the relationship between indicators of planned and reactive agility and selected parameters among female volleyball players in Nitra. Our research cohort comprised high school female players (n=13, aged 16.2 ± 1.5 years, height 177.2 ± 5.1 cm) specializing in volleyball. The comprehensive set of parameters under evaluation included reactive agility (Y-Agility test), planned agility (T-Agility test), speed abilities, acceleration (measured through 5m and 10m dash), explosive power of lower limbs and anthropometric indicators. To ensure measurement accuracy, we utilized Mircrogate photocells, a Witty Sem Microgate signalling light device and Tendo power analyzer. Our research yielded noteworthy findings, revealing statistically significant relationships at 1%, 5% and even the 10% level of significance within the realm of sports games as determined through correlation analysis (Pearson correlation). In the domain of planned agility, we identified a statistically significant correlation with the indicator of speed abilities, specifically the 5m dash (r = .633; p = .020) at the 5% level of significance. Furthermore, a similar correlation was noted with the 10m dash (r = .626; p = .022), emphasizing the intricate link between planned agility and speed abilities. Conversely, in the domain of reactive agility, our observations identified a statistically significant relationship solely with anthropometric indicators, notably thigh length (r = .530; p = .062) and body height (r = –.480; p = .097), both at 10% level of significance. Other monitored indicators, though diligently examined, did not exceed the threshold of our predetermined level of significance. We believe that the insights garnered from such research endeavors will contribute significantly to the enhancement of both reactive and planned agility, which are an essential part of the training process in team sports.
Key words: volleyball, agility, sports training, correlation analysis.

Introduction

Šimonek (2013) states that agility as a movement ability, by its nature belongs to mixed movement abilities. On the one hand, it is determined by the type of muscle fibre, and at the same time it is determined by the quality of control and regulation of the CNS and analysers.

Šimonek and Horička (2020) differentiate two forms of agility performance - reactive and running agility. Reactive agility is the ability to move quickly and change the direction of movement in response to a previously unknown stimulus. A good level of both types of agility (running and reactive) according to Sheppard and Young (2006) requires a combination of speed skills, dynamic balance, dynamic strength and coordination abilities. Šimonek (2012) also agrees with this statement of the authors, who also say that agility can be constantly improved not only by developing movement skills, but also by practicing and improving movement skills. Good level of agility performance can make the difference between a good athlete and an average one and provide an advantage in avoiding injury. This definition of agility respects the cognitive components, visual scanning, and decision-making that contribute to agility performance in a sport (Junpalee et al, 2023). Therefore, agility is considered a factor necessary for success in team sports (Komsis et al, 2023). In their more recent research also showed that successful performances in a team sport, such as soccer, requires the ability to change direction, as well as decision-making skills.

According to Little and Williams (2005), running agility is defined by changing the direction of movement, using turns, accelerations or stops. According to them, running agility is influenced by biomechanical factors, motor, but also coordination skills such as dynamic strength or running speed. It is a somewhat less demanding form of agility, where, according to the authors, no demands are placed on the athlete's decision-making, as we can see with reactive agility.

Sheppard & Young (2006) present the reactive part of agility as the ability to change direction and move quickly to an unknown stimulus from the external environment. Reactive agility requires a combination of several skills such as dynamic balance and strength, coordination skills and speed skills (Fig. 1). They also talk about a significant factor in reaction agility, which is time. At the same time, we can consider an external stimulus as a sound signal, but also a light signal, either in the game itself or in tests. It is also necessary that

Corresponding Author: ĽUBOMÍR PAŠKA, E-mail: lpaska@ukf.sk

players have a high level of cognitive-perceptual component in decision-making skills (Spasic et al., 2015, Jones et al., 2009). The study of (Young, 2015) help us to understand two main parts of reactive agility like cognitive and physical one. There have been done many researches connected with reactive agility and different motor abilities or anthropometric parameters in last few years (Horníkova et al., 2021; Sattler et al, 2015.; Popowczak et al, 2021; Pereira et al, 2018).

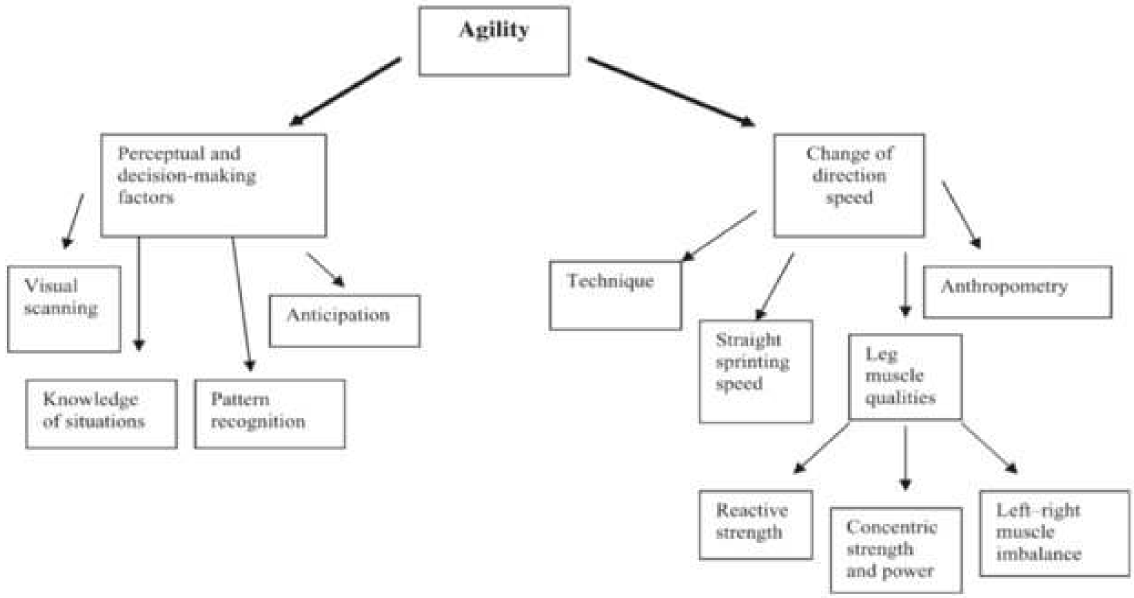

Figure 1. Model of universal agility components (Sheppard &Young, 2006)

According to Přidal & Zapletalová (2003), in volleyball as a whole, in addition to strength skills, speed skills are also important, the diagnosis of which is carried out using tests of movement skills. Among the most well known tests of speed skills are the 50m dash, the 4x10m shuttle run, the Illinois agility test, the agility T-test and the Y-test.

Author Abdelkrim et al. (2010) also carried out research in the field of team sports, planned and reactive agility, who monitored the level and relationships between selected variables in individual age categories. He evaluated the level of planned agility using the T-test in basketball players of the national team of Tunisia U18, U20 and the women's team.

Paška et al. (2019, 2022) realized the research on the issue of reactive and planned agility, where they monitored the impact of sports training in a selected competition period in female volleyball and floorball players. Šišková et al. (2021) observed similar results in their study on male soccer players.

Volleyball players differ from the average population in slightly increased limb circumferences, a narrow torso and strong-arm bones. Middle blockers who are the tallest should have a high jump and especially high reach, which is important for repeated jumps and maneuvering at the net. Spikers or out-side hitters can be smaller and lighter on average.

Their main role is emphatic smashes and high jumps, so they are equipped with more power. The opposite players should be a combination - the reach of a blocker and the explosive power of a spiker. Setters and libero players are mostly of smaller characters. Setters have tasks of a more technical-tactical type, and when it comes to libero players, body height itself is not important, rather speed and selected coordination skills (Grasguber & Cacek, 2008).

The most important conditional factors in volleyball are speed and strength motor abilities, as it present several authors Přidal & Zapletalová (2003), Vavák (2011). They also emphasises that volleyball is characterized as a speed-strength sport. They notice that volleyball is depending on somatic parameters (body height and body weight, muscle mass and fat mass of the player) and anthropometric parameters (length of individual limbs of the player). We distinguish between active and passive body mass in body composition. It is about muscle and fat. In female volleyball players, the average amount of body fat is around 16% (Malousaris et al., 2008).

The aim of this research study was to determine the relationship between indicators of planned and reactive agility and selected parameters among female volleyball players.

Material & methods

A girls' volleyball team that worked in Nitra represented our research group. At the beginning of the work, we handed out informed consents to the players, which they had their parents sign at home to express their consent to the girls' testing. The tested group consisted of a total of n=13 girls from the volleyball team aged 16.2 ± 1.5 years with an average height of 177.2 ± 5.1 cm and a weight of 67.4 ± 8 kg and a BMI of 21.5 ± 2.2. The players played actively and regularly in the youth and junior women competition.

Indicators of selected motor abilities and anthropometric parameters: reactive agility test (RAT) was chosen Y-agility test (Fiorili, Giovanni, 2017) using Witty Sem (Microgate Bolzano, Italy), planned agility test (PAT) was chosen T-test (Paoule, 2000), 5 and 10m Run (www.topendsports.com/testing/tests/sprint.htm), Squat with – calf rise (Laczo, Buzgó, Kováč, 2012), Spike and block reach (Satter, 2012).

Anthropometric parameters (arm length, thigh length, foreleg length, body height when sitting), body height and body weight.

The testing was carried out once during the competition period, when the members of the team completed a weekly microcycle of 5-8 training units lasting 90-120 minutes. The conditions in which the testing took place were standard, and before the actual testing, we carried out a thorough warm-up of 15 minutes.

The evaluation of the obtained data took place as follows: we performed the normality of the sample distribution using the Shapiro-Wilk test. Subsequently, we continued with the correlation analysis (Pearson). We performed the correlation analysis from the available data, which were prepared in MS Excel sheets. Subsequently, we evaluated the correlation matrix and marked the stronger correlation coefficients, and we were interested in the 1, 5 and 10% level of statistical significance (Hopkins et al., 2009).

We used an alternative significance level of 10% based on research in team sports, where higher significance levels than 1% and 5% (Peráček & Hrnčiarik, 2012; Paška et al., 2019). We statistically evaluated the measured values using the SPSS program, and we used tables and graphs processed in the Microsoft Excel program to record the obtained data in our research.

Results

In the indicators of anthropometric parameters of female players, such as body height, we found the following data in the monitored group of girls (tab. 1). The tallest girl measured 184 cm and the smallest 168 cm. The total height average of the team was (x = 177.2 cm).

The weight of the girls in the team ranged from 57.3kg to 90.9kg. The total weight average was (x = 67.4 kg). We recorded the sitting height indicator (x = 95 cm, ± 7), in the next indicator we recorded the length of the foreleg (x = 40.9 cm, ± 7.9), in the next indicator the length of the thigh (x = 53.2 cm, ± 3.2) and in the last indicator we recorded arm length (x = 71.4 cm, ± 6.4).

Table 1 Anthropometric indicators

N=13	Body height (cm)	Fat (%)	Muscle (%)	Standing reach height (cm)	Sitting height (cm)	Length of foreleg (cm)	Length of thigh (cm)	Arm length (cm)
X	177,2	19,1	52,3	229,9	95	40,9	53,2	71,4
Std.	5,1	4,1	5,8	6,9	3,8	1,9	2,1	3,2
Min.	168	13,8	43,2	216	88	37	50	65
Max.	184	27,3	63,7	241	102	43	56	76

We found the following values in the field of motor indicators (tab. 2). The first we describe are speed abilities, in the monitored group we recorded the average time of the girls who performed the 5m Run (x=1.1s). The fastest player ran with a time of (1.07s) and the slowest female player with a time of (1.21s). In the 10m run indicator, the average time of the girls was (x =2.0s), of which the fastest, the same player as in the 5m test, with a time of (1.86s), and the slowest, also the same player as in the 5m test, with a time of (2.14s). In the area of planned and reactive agility, we determined the level in the T-test and Y-test.

In the T-test indicator, the average time of the tested girls was (x = 10.9s), the fastest player managed it with a time of 10.5s, the slowest player achieved a time of 11.44s. In the Y-test indicator we recorded (x= 2.66s), where the fastest player was with a time of 2.19s, the slowest recorded a time of 2.96s. In the indicators of the explosive power of the lower limbs, we recorded the average value of the tested girls (x = 431.5 W) in the squat calf rise (W) indicator.

The best player managed it with a data of (528W), and on the contrary, a player of (298W) recorded the weakest data. In the indicators of special motor performance such as spike and block reach; we recorded the following data in the monitored group of girls. In the spike reach we recorded (x = 281.3cm, ± 16.3) and in the block reach we recorded (x = 268.5cm, ± 18.5). In the standing reach indicator, we recorded (x = 229.9 cm, ± 13.9).

Table 2 Motor indicators

N=13	5m dash (s)	10m dash (S)	T - test (s)	Y agility test (s)	Spike reach test (cm)	Block reach test (cm)	Squat – calf rise (W)
X	1.1	2.0	10.9	2.66	281.3	268.5	431.5
Std.	0.0	0.1	0.3	0.2	8	8.2	73.5
Min.	1.07	1.86	10.5	2.19	265	250	298
Max.	1.21	2.4	11.44	2.96	291	279	535

Subsequently, we calculated the normality of the sample. We found that most indicators meet the condition of normality (p>0.05). Next, we continued using correlation analysis and looked for mutual relationships between the selected variables, which are determined more closely by Perarson's correlation coefficient.

Table 3 Relationship of planned and reactive agility to selected motor indicators

		T – test (PA)	**Y test (RA)**
Anthropometric indicators	Body height	r=0.265; p=0.382	r= -0.480; p=0.097*
	Fat	r=0.185; p=0.546	r=0.089; p=0.771
	Fibre	r=0.186; p=0.543	r=0.095; p=0.759
	Standing reach height	r=0.487; p=0.091*	r=0.379; p=0.201
	Sitting height	r=0.269; p=0.374	r=0.191; p=0.532
	Length foreleg	r=0.141; p=0.646	r=0.127; p=0.660
	Length of thigh	r=0.210; p=0.481	r=0.530; p=0.062*
	Arm length	r=0.178; p=0.560	r=0.322; p=0.284
Speed indicators	5m run	r=0.633; p=0.020**	r=0.134; p=0.663
	10m run	r=0.626; p=0.022**	r=0.053; p=0.863
Explosive strength of lower limbs	Spike reach	r=0.040; p=0.897	r=0.172; p=0.573
	Block reach	r=0.294; p=0.330	r=0.035; p=0.909
	Squat with calf rise	r=0.191; p=0.532	r=0.185; p=0.545

p<0,01*** - level of significance
p<0,05** - level of significance
p<0,1* - level of significance

Individual selected indicators of motor abilities and anthropometric parameters were subjected to statistical processing with the statistical program SPSS. We were interested in the mutual relationship of reactive and planned agility to the selected indicators.

In the field of planned agility, we recorded statistically significant relationships at the selected levels of significance in 3 of the selected indicators. At the 5% significance level, it was an indicator of speed abilities (fig. 2), 5m run (r = .633; p = .020) and the other speed indicator for 10m run (r = .626; p = .022), see (fig. 3.). In both cases, the correlation coefficient reached a strong dependence of the monitored variables. At the 10% level of significance, we noted a statistically significant relationship between planned agility and standing reach (r = .520; p = .069). The correlation coefficient reached a strong level of dependence between the monitored variables. We did not observe a statistically significant relationship at the 1% level.

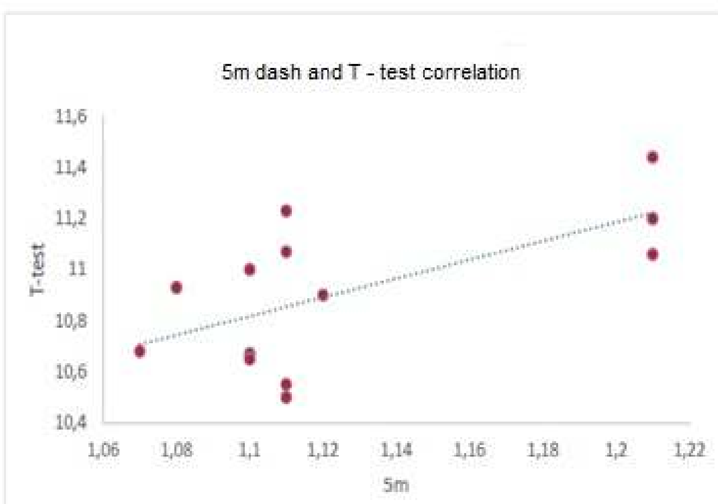

Figure 2. Graphical expressing of the relationship between variables

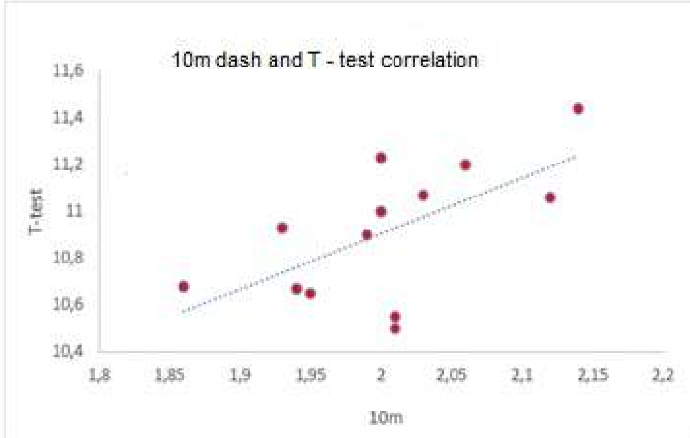

Figure 3. Graphical expressing of the relationship between variables

In the field of reaction agility, we found statistically significant relationships only at the 10% significance level. We recorded mutual relationships with the observed variables with the following indicators: body height (r = .480; p = .097)) and thigh length (r = .530; p = .062). The correlation coefficient in the case of body height reached a negative polarity with a moderately strong dependence between the variables; on the contrary, with thigh length we recorded a moderately strong dependence between the variables with a positive polarity.

Discussion

When comparing the level in the indicator of planned agility (T test), we found in researches the following situations and results. There was found the level in PA (x = 10.90s). In the group of female floorball players Paška et al (2022), reached (x = 11.36s), which is 0.46s weaker than the performance of our monitored group of volleyball players. The second group is the team of female floorball players (Suchánková, 2021), which conducted research (n = 70) on female players (x = 12.02). However, the best performance was achieved by the Tunisian U18 basketball team (x = 10.53) in the research conducted by Abdelkrim (2010). At the same time, we also confirmed a statistically significant relationship between planned agility and speed indicators in 5m dash (r = .633; p = .020) and 10m dash (r = .626; p = .022) in our monitored group of 5% volleyball players level of statistical significance. We did not notice any statistically significant relationship between anthropometric indicators and planned agility, which was confirmed by the research by (Garcia - Gil et al., 2018).

In the field of reactive agility, we also recorded several research observations in team sports. In the research of Paška et al (2019), which followed a research sample of female volleyball players (n=10) in the highest women's competition in Slovakia, they implemented a reaction agility test (Y test). At the initial measurement, they recorded a level of (x=2.30s) for volleyball players and (x=2.36) for floorball players (Paška et al, 2022). Both teams played in the highest women's competition in Slovakia. Our team recorded a level of (x = 2.66s), which is a weaker performance than the top women's teams in volleyball and floorball. It is extremely important to understand not only the age limit of the monitored groups, where our team was the youngest, but also a certain experience in making decisions in critical, time-stressed situations. We believe that in this regard, older players definitely have more calmness and balance in critical situations. At the same time, we were also interested in the mutual relationship between the individual monitored indicators, where we noted statistically significant relationships only at the 10% level of significance. Between the indicator of reactive agility and anthropometric indicators (body height r = .480; p = .097) and subsequently between (thigh length r = .530; p = .062). The authors also dealt with similar indicators in their research (Popowczak et al., 2022) and the mutual relationship between individual anthropometric and reactive agility indicators in handball and basketball female players were partially confirmed.

Conclusion

Based on our research findings, we have come to the conclusion that agility is an essential part of team sports. It is important to constantly monitor the level of planned and reactive agility, not only in elite sportsmen, but also in youth. We confirm that movement speed ability was one of the determinants involved in the level of planned agility in our players. We also noted statistically significant relationships at the 5% significance level. In the part of reactive agility, apart from anthropometric indicators, we did not observe any statistically significant relationship in our monitored group. We believe that our research results will contribute to the enhancement of knowledge on the determinants of planned and reactive agility in different team sports.

We recommend the coaches use not only non – specific training means which are really very important but also work implement constantly balls in their exercises. There are many possibilities how to develop the level of reactive agility, which seems to be the crucial part of improving player's performance. We understand the important role of technique in training sessions but also we have to focus on speed exercises combined with the change of direction ones. When using these exercises 3 times a week for 8 – 10 microcycles we can reach higher level in planned and also in reactive agility. It is necessary that players are fully concentrated on every exercise. We have to prepare the situations, which are very close to the real level of player's performance in the match. Then there is a chance how to develop the level of reactive agility, which is crucial in micro – situations on the net or in the position of passing and digging.

In the youth categories (till the age of 15) coaches should devote enough time to practising separately both types of agility.

Conflict of interest: The authors have no conflict of interest relevant to this article.
Funding: The mentioned research was created with the support of the VEGA grant, Ministry of Education, Science, Research and Sport of the Slovak Republic, no. 1/0313/22 – Identification of reactive agility factors in team sports

References

Agdogan, E., & Guven, B. (2021). Relationship between Body Composition, Agility and Vertical Jump Performance in Young Female Volleyball Players. *Turkiye Klinikleri Journal of Sports Sciences* , 13 (3), 352-357

Ben Abdelkrim, N., Chaouachi, A., Chamari, K., Chtara, M, & Castagna, C. (2010). Positional role and competitive-level differences in elite-level men's basketball players. *J. Strength Cond* Res, 24: 1346–1355

García-Gil, M., Torres-Unda, J., Esain, I., Duñabeitia, I., Gil, S. M., Gil, J., & Irazusta, J. (2018). Anthropometric parameters, age, and agility as performance predictors in elite female basketball players. *Journal of Strength and Conditioning Research*, 32 (6), 1723–1730. https://doi.org/10.1519/jsc.0000000000002043

Grasgruber, P., & Cacek, J. (2008). Sports genes. Brno: Computer Press, 480 s. ISBN 978-80-251-1873-3.

Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hanin, J. (2009). Progressive statistics for studies in sports medicine and exercise science. *Medicine and Science in Sports and Exercise*, *41*(1), 3–12. https://doi.org/10.1249/mss.0b013e31818cb278

Horníková, H., Jeleń, M., & Zemková, E. (2021). Determinants of Reactive Agility in Tests with Different Demands on Sensory and Motor Components in Handball Players. *Applied Sciences*, *11*(14), 6531. https://doi.org/10.3390/app11146531

Jones, P. A., Bampouras, T. M., & Marrin, K. (2009). An investigation into the physical determinants of change of direction speed. *PubMed*, *49*(1), 97–104. https://pubmed.ncbi.nlm.nih.gov/19188902

Junpalee, P., Singchainara, J., & Butcharoen, S. (2023). Effects of the intelligence innovative smart ladder drill training program on developing agility of female youth volleyball players at Sriracha School. *Journal of Physical Education and Sport,* 23(4), 1025 - 1035, ISSN 2247 - 806X

Komsis, T., Komsis, S., Komsis, G., Papadopoulou, Z., Metaxas, T., Gissis, I., & Vrabas, S. I. (2023). The effect of a four-week mesocycle with small side games on the agility and sprinting ability of professional soccer players during in-season. *Journal of Physical Education and Sport*, *23(6)*, 1449 - 1455, ISSN 2247 - 806X

Little, T. D. C., & Williams, A. G. (2005). Specificity of acceleration, maximum speed, and agility in professional soccer players. *Journal of Strength and Conditioning Research*, 19 (1), 76. https://doi.org/10.1519/14253.1

Malousaris, G. G., Bergeles, N., Barzouka, K., Bayios, I., Nassis, G. P., & Koskolou, M. (2008). Somatotype, size and body composition of competitive female volleyball players. *Journal of Science and Medicine in Sport*, 11(3), 337–344. https://doi.org/10.1016/j.jsams.2006.11.008

Paška, Ľ., Horička, P., Šimonek, J., & Gavronová, A. (2019). The influence of the content of sports training on the development of agility in the top volleyball team. *In Studia Kinanthropologica*. 20 (2), 183-188. ISSN 1213-2101.

Paška Ľ., Horička P., Šimonek J., & Liptáková G. (2022). The influence of specific training load on the level of reactive and planned agility in floorball. In *Studia Kinanthropologica*. 23 (3), 167-175. ISSN 1213-2101.

Peráček, P. & Hrnčiarik, P. (2012). The influence of specific training stimuli on the individual game performance of junior goalkeepers in soccer. In *Studia Sportiva*, 6(2), 19-37.

Pereira, L. A., Nimphius, S., Kobal, R., Kitamura, K., Turisco, L. a. L., Orsi, R. C., Abad, C. C. C., & Loturco, I. (2018). Relationship between change of direction, speed, and power in male and female National Olympic Team handball athletes. *Journal of Strength and Conditioning Research*, *32*(10), 2987–2994. https://doi.org/10.1519/jsc.0000000000002494

Popowczak, M., Horička, P., Šimonek, J., & Domaradzki, J. (2022). The Functional Form of the Relationship between Body Height, Body Mass Index and Change of Direction Speed, Agility in Elite Female Basketball and Handball Players. *International Journal of Environmental Research and Public Health*, *19*(22), 15038. https://doi.org/10.3390/ijerph192215038

Sattler, T., Sekulić, D., Spasić, M., Perić, M., Krolo, A., Uljević, O., & Kondrić, M. (2015). Analysis of the association between motor and anthropometric variables with change of direction speed and reactive agility performance. *Journal of Human Kinetic,* 47, 137–145.

Sheppard, J. M., & Young, W. (2006). Agility literature review: Classifications, training and testing. *Journal of Sports Sciences*, *24*(9), 919–932. https://doi.org/10.1080/02640410500457109

Spasić, M., Krolo, A., Zenić, N., Delextrat, A., & Sekulić, D. (2015). Reactive agility performance in handball; Development and evaluation of a Sport-Specific Measurement Protocol. *PubMed*, *14*(3), 501–506. https://pubmed.ncbi.nlm.nih.gov/26336335

Suchánková, B. (2021). Testing the fitness abilities of women's extra league floorball players in the FBS Olomouc team. from https://theses.cz/id/o1fzhu/

Šimonek J. & Mikovičová, D. (2012). Development of agility in school physical and sports education programs. *Nitra: UKF.*

Šimonek J. (2012). Tests of motor skills. *Nitra: UKF,* 194 p. ISBN 978-80-970857-6-6.

Šimonek, J. & P. Horička. (2020). Agility in sports. *Nitra: UKF.* 160 p. ISBN 978-80-558-1566-4

Šišková, N., Kaplánová, A., Longová, K., Kohút, R., & Vanderka, M. (2021). Effects of plyometric–agility and agility training on agility and running acceleration of 10-year-old soccer players. *Journal of Physical Education and Sport*, *21(2)*, 875 - 881, ISSN: 2247 - 806X

Vencurik, T., Bokuvka, D., Nykodym, J. & Struhár.J. (2021). Association between reactive agility and speed and power characteristics in womens basketball. In *Faculty of Sports Studies, Masaryk University, Czech Republic.*