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Original Article

Factors influencing reactive agility in male football players

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Abstract
This study aimed to identify the factors influencing reactive agility (RAG), by analyzing the correlations between RAG, speed performance, strength, and flexibility in young male football players. The research sample consisted of 34 young male footballers from the Topolčany football club, categorized into two groups: U15 and U19. Various physical performance tests were performed, including 5m, 10m, 30m sprints, flexibility, RAT-O and RAT-D reactive agility tests, and lower limb strength. Data analysis was performed as follows: sample distribution normality was assessed using the Shapiro-Wilk test, followed by Pearson's correlation analysis. In the U15 group, significant negative correlations were found between flexibility and sprint test (5m, 10m, 30m), highlighting the importance of flexibility for sprinting ability. Additionally, positive correlations were observed between 5m sprint and RAT-D (r= 0.521, p= 0.019), as well as between 10m sprint and both RAT-O (r= 0.480, p= 0.032) at the 5% significance level and RAT-D (r= 0.601, p= 0.005) at the 1% significance level. For the U19 group, CMJ showed significant negative correlations with 10m (r= -0.494, p= 0.044) and 30m sprint (r= -0.764, p= 0.000). Sit-ups were positively correlated with RAT-O (r= 0.523, p= 0.031), and RAT-D was significantly correlated with both 5m (r= 0.523, p= 0.031) and 10m (r= 0.601, p= 0.005) sprint performance. This study emphasizes the distinct roles of flexibility, reactive agility, and strength in the performance of young male football players. For U15 athletes, flexibility and reactive agility are crucial for enhancing sprint performance, while U19 athletes benefit more from a focus on lower limb strength and core strength. Tailoring training programs to these developmental needs can optimize performance and support the overall growth of young players. By addressing the specific physical attributes relevant to each age group, coaches can better prepare athletes for the demands of competitive football, ultimately enhancing both individual and team success.
Keywords: reactive agility, speed performance, strength, flexibility, football, youth athletes.

Introduction

Football is a sport distinguished by its numerous and diverse complex kinesiological activities, encompassing a significant array of cyclic and acyclic movements (Gardasevic et al., 2016; (Bjelica et al., 2012, 2013). During a football game, players perform approximately 1200-1400 various movements, with 700-800 involving changes of direction such as sprinting, jumping, accelerations, decelerations etc. Only 11% of the total distance covered during these movements is executed at high intensity, which can significantly impact the match's result (Reilly and William's, 2005). Players need to perform repeated bursts of activity including sprints, accelerations, and quick turns interspersed with brief periods of rest. These types of activities require a combination of speed, agility, endurance, and recovery ability, all of which are crucial for both individual player performance and overall team success (Bishop et al. 2001; Carling and Dupont, 2011). The ability of players to perform repeated sprints, accelerations, and turns while effectively managing fatigue can significantly impact the outcome of a match and is indeed a key factor in both individual player and team performance (Girard et al., 2011).

Young football players undergo dynamic physical and mental development, which is evident in their abilities and skills during matches. Understanding a player's motor activity patterns in football using objective data is crucial for planning appropriate training stimuli. The potential value of this objective data for personalized load determination is particularly significant, especially for player groups like defenders, midfielders, or offensive players who follow similar training routines. Time-motion analysis is commonly utilized to analyse player or team performance in football. This method enables the quantification of running actions and provides indirect insights into the energy expended during movement (Carling, 2013).

Reactive agility refers to an athlete's capacity to rapidly change direction in response to external stimuli, such as the movements of an opponent or the trajectory of a ball. This ability is influenced by key factors, including decision-making processes, neuromuscular coordination, and proprioceptive awareness. In football, reactive agility is critical, as players must continuously adapt to the inherently unpredictable and dynamic nature of the game. (Paul et al., 2016).

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Several factors have been suggested to influence agility performance. While cognitive and perceptual elements are considered the key determinants of agility, most research has predominantly focused on physical aspects. Unlike track and field athletes, players in sports that heavily rely on agility must continuously observe the entire field and react to the game's constantly changing dynamics (Sheppard and Young, 2006) Another difference is that track and field athletes can plan their sprints, whereas football players reactively sprint during the game without pre-planning. For instance, during a football match, players make approximately 1,300 movement changes in off-the-ball situations and execute over 700 turns and swerves at various angles throughout the game (Horička & Paška, 2021).

Various tests and protocols are used to assess agility performance in team sports like football. However, the majority of these tests focus on evaluating change of direction speed (CODS), emphasizing the athlete's ability to swiftly alter direction. They often overlook the critical component of responding to unpredictable external stimuli, which is a crucial aspect of agility (Faude et al., 2012). It is essential to differentiate between change of direction speed (CODS), which refers to pre-planned or non-reactive agility, and reactive agility (RAG), which involves unplanned movements. This distinction is particularly significant in identifying both the cognitive components such as perceptual and decision-making abilities and the physical determinants, including conditioning capacities, body metrics, and technique, that contribute to overall agility. (Pehar et al., 2018). Research indicates that certain conditioning abilities, such as sprint abilities and jumping ability, are more strongly correlated with CODS than with reactive agility (RAG). In contrast, perceptual and cognitive abilities are key predictors of RAG in team sport athletes. However, there is a significant gap in the literature regarding the factors influencing both CODS and RAG in football. Such insights would be invaluable for training and conditioning, as they would allow for the focused development of specific attributes, thereby optimizing either RAG or CODS performance. (Krolo et al., 2020). The aim of this research study was to identify the factors influencing reactive agility in male football players.

Material & Methods

The research group consisted of young male football players from the Topolčany football club. At the outset of the study, informed consent forms were distributed to the players, which were subsequently signed by their parents to authorize the boys' participation in the testing. The sample included 34 players, divided into two age categories: U15 and U19. Players in the U15 category were born in 2008/09, while those in the U19 category were born between 2004 and 2006. The average height, weight, and BMI for the U15 group were (162 cm ± 16.2 cm), (50.09 kg ± 18.9 kg), and (18.81 ± 6.7), respectively. For the U19 group, the corresponding measurements were (176 cm ± 10 cm), (64.5 kg ± 33.1 kg), and BMI of (20.7 ± 8.4). All players were actively involved in regular youth and junior league competitions.

Indicators of selected motor abilities and anthropometric parameters: reactive agility test (RAT-Y) was chosen Y-agility test (Oliver & Meyers, 2009) using Witty Sem (Microgate Bolzano, Italy), Modified shuttle run with "offensive" movement (RAT-O) on reactive stimuli (Sekulic et al, 2014) and Modified Shuttle run "defensive" movement (RAT-D) on reactive stimuli (Sekulic, 2014), 5, 10 and 30m sprint (www.topendsports.com/testing/tests/sprint.htm), DJ Drop jump (DJ) presented reactive strength of lower limbs (Pedley et al. 2017) and counter movement jump (CMJ) presented explosive strength of lower limbs (Heishman et al., 2020) both tests were realized by Fitro jumper pad (Fitronic), abdominal strength test – sit up test for 60 seconds (Blomquist et al., 2013), sit and reach test (Zanevskyy, 2017) and body height and body weight (measured by digital device).

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 under which the testing took place were standard, and before the actual testing, we carried out a thorough warm-up of 15 minutes. The normality of the sample distribution using the Shapiro-Wilk test was performed. 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, the correlation was evaluated matrix and marked the stronger correlation coefficients, and we were interested in the 1, 5 % level of statistical significance (Borůvková et al, 2014). The measured values were evaluated using the SPSS program, tables and graphs processed in the Microsoft Excel program to record the obtained data in research.

The study protocol was approved by the Ethics Committee of the Faculty of Education of the University of Nitra (registration number: UKF-2020/1355-1:191013) in accordance with the conclusions of the Declaration of Helsinki.

Results

Subsequently, the normality of the sample was calculated. The findings showed that most indicators met the condition of normality ($p>0.05$). Next, there was realized correlation analysis and looked for mutual relationships between the selected variables, which are determined more closely by Pearson's correlation coefficient in U15 (tab. 1). In our study was found that in U15 group flexibility showed significant negative correlations at the 5% significance level with a moderately strong dependence with 5m (r= -0.535, p= 0.015), 10m (r= -0.461, p= 0.041), and 30m (r= -0.499, p= 0.025) sprint performance. Greater flexibility was associated with shorter sprint times in results. There were found significant positive correlations in 5m sprint with a moderately strong dependence with defensive reactive agility (r= 0.521, p= 0.019) and negative correlations with sit-ups (SU) (r= -0.461, p= 0.041).

The significant positive correlations were also observed in 10 sprints with a moderately strong dependence with both offensive reactive agility (RAT-O) (r= 0.480, p= 0.032) and defensive reactive agility (RAT-D) (r= 0.601, p= 0.005). Statistically significant relationship at the 1% significance level were found with a moderately strong dependence. The 30m sprint demonstrated significant positive correlations with defensive reactive agility with a moderately strong dependence (r= 0.521, p= 0.019).

Table 1 Correlation matrix U15 (selected indicators)

U15	flexibility	5m	10m	30m	RAT-O	RAT-D	(SU)
flexibility	1	r= -0.535 p= 0.015*	r= -0.461 p= 0.041*	r= -0.499 p= 0.025*	r= -0.351 p= 0.130	r= -0.134 p= 0.573	r= -0.765 p= 0.000**
5m	r= -0.535 p= 0.015*	1	r= 0.882 p= 0.000**	r= 0.702 p= 0.001**	r= 0,377 p= 0,101	r= 0.500 p= 0.025*	r= -0.461 p= 0.041*
10m	r= -0.461 p= 0.041*	r= 0.882 p= 0.000**	1	r= 0.885 p= 0.000**	r= 0.480 p= 0.032*	r= 0.601 p= 0.005**	r= -0.398 p= 0.082
30m	r= -0.499 p= 0.025*	r= 0.702 p= 0.001**	r= 0.885 p= 0.000**	1	r= 0.420 p= 0.066	r= 0.521 p= 0.019*	r= -0.370 p= 0.108
RAT-O	r= -0.351 p= 0.130	r= 0,377 p= 0,101	r= 0.480 p= 0.032*	r= 0.420 p= 0.066	1	r= -0.110 p= 0.645	r= -0.345 p= 0.136
RAT-D	r= -0.134 p= 0.573	r= 0.500 p= 0.025*	r= 0.601 p= 0.005**	r= 0.521 p= 0.019*	r= -0.110 p= 0.645	1	r= -0.290 p= 0.215
(SU)	r= -0.765 p= 0.000**	r= -0.461 p= 0.041*	r= -0.398 p= 0.082	r= -0.370 p= 0.108	r= -0.345 p= 0.136	r= -0.290 p= 0.215	1

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Then we followed with U19 category (tab.2) The explosive strength of lower limbs (CMJ) was significantly negatively correlated with 10m (r= -0.494, p= 0.044) with a moderately strong dependence and 30m (r= -0.764, p= 0.000) sprint performance with strong level of dependence in U19 group.

Eccentrics strength of lower limbs (DJ) was also significantly negatively correlated with 30m sprint test (r= -0.781, p= 0.000) with strong level of dependence. Sit - ups (SU) ware presented by significant positive correlation with offensive reactive agility, RAO (r= 0.523, p= 0.031) with a moderately strong dependence. In speed performance 5m sprint was positively correlated with defensive reactive agility, RAD (r= 0.523, p= 0.031) with a moderately strong dependence.

The 10m sprint demonstrated a significant negative correlation with CMJ (r= -0.494, p= 0.044) with a moderately strong dependence and a positive correlation with RAT-D (r= 0.601, p= 0.005) with a moderately strong dependence.

Next the speed abilities in 30m sprint were associated with a significant negative correlation with SU (r= -0.764, p= 0.000) with strong level of dependence at the 1% significance level.

These results highlight the importance of flexibility and reactive agility in younger football players (U15) and the increasing significance of lower limb strength and core strength in older football players (U19) for sprint performance.

Table 2 Correlation matrix U19 (selected indicators)

U19	(CMJ)	(DJ)	(SU)	5m	10m	30m	RAT-O	RAT-D
(CMJ)	1	r= 0.959 p= 0.000	r= 0.116 p= 0.657	r= -0.338 p= 0.185	r= -0.494 p= 0.044*	r= -0.764 p= 0.000**	r= -0.288 p= 0.262	r= -0.315 p= 0.219
(DJ)	r= 0.959 p= 0.000	1	r= 0.038 p= 0.883	r= -0.386 p= 0.126	r= -0.478 p= 0.052	r= -0.781 p= 0.000**	r= -0.258 p= 0.318	r= -0.298 p= 0.245
(SU)	r= 0.116 p= 0.657	r= 0.038 p= 0.883	1	r= -0.115 p= 0.661	r= 0.125 p= 0.633	r= 0.236 p= 0.361	r=- 0.523 p= 0.031*	r= -0.063 p= 0.811
5m	r= -0.338 p= 0.185	r= -0.386 p= 0.126	r= -0.115 p= 0.661	1	r= 0.679 p= 0.003**	r= 0.495 p= 0.043*	r= 0.333 p= 0.191	r= 0.556 p= 0.021*
10m	r= -0.494 p= 0.044*	r= -0.478 p= 0.052	r= 0.125 p= 0.633	r= 0.679 p= 0.003**	1	r= 0.587 p= 0.013*	r= -0.030 p= 0.909	r= 0.610 p= 0.009**
30m	r= -0.764 p= 0.000**	r= -0.781 p= 0.000**	r= 0.236 p= 0.361	r= 0.495 p= 0.043*	r= 0.587 p= 0.013*	1	r= 0.112 p= 0.668	r= 0.270 p= 0.295
RAT-O	r= -0.288 p= 0.262	r= -0.258 p= 0.318	r=- 0.523 p= 0.031*	r= 0.333 p= 0.191	r= -0.030 p= 0.909	r= 0.112 p= 0.668	1	r= 0.389 p= 0.123
RAT-D	r= -0.315 p= 0.219	r= -0.298 p= 0.245	r= -0.063 p= 0.811	r= 0.556 p= 0.021*	r= 0.610 p= 0.009**	r= 0.270 p= 0.295	r= 0.389 p= 0.123	1

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Discussion

The present study aimed to investigate the interplay between reactive agility (RAG), speed performance, strength, and flexibility in young male football players. Our findings underscore the importance of these physical attributes in enhancing overall football performance, with distinct differences observed between U15 and U19 athletes.

The analysis in the U15 group revealed significant correlations (negative) between flexibility and sprint performance, with greater flexibility associated with shorter sprint times (5m, 10m, 30m). We found that poor level of abdominal strength correlates with speed abilities. This aligns with previous research suggesting that higher level of flexibility can positively influence speed abilities and enhance movement efficiency and reduce injury risk (Gardasevic et al., 2016). Increased flexibility enhances sprint efficiency by enabling a longer stride length, reducing muscle tension for fluid motion, improving joint mobility for effective push-offs, and ensuring efficient force transfer. Furthermore, the positive correlations between sprint performance and defensive reactive agility highlight the critical role of reactive agility in executing quick directional changes, crucial for both offensive and defensive play. The negative correlation between sit-ups and 5m sprint times suggests that core strength, while important, must be balanced with reactive agility and flexibility training to optimize short-distance sprint performance.

In comparison, Bjelica et al. (2012) found that young football players with higher flexibility demonstrated improved performance in agility tests, reinforcing our findings that flexibility is a key component of speed and agility in young football players. The importance of flexibility for injury prevention and performance enhancement has been consistently supported across various studies, suggesting that targeted flexibility training should be integral in youth football training programs. Flexibility training enhances performance in young football players by improving their range of motion, which allows for more dynamic and efficient movements. It also boosts muscle coordination, leading to better control and fluidity during agility drills. Furthermore, flexible muscles function optimally, providing necessary force for rapid movements. Additionally, good flexibility contributes to better body posture and alignment, reducing the risk of chronic musculoskeletal issues and ensuring proper form.

For the U19 athletes, explosive and reactive strength of the lower limbs were strongly correlated with sprint performance, particularly over longer distances (10m, 30m). This emphasizes the growing importance of strength training as players mature, supporting findings that explosive strength is crucial for high-intensity, short-duration activities such as sprinting and jumping (Girard et al., 2011). The positive correlation between SU and RAT-O further underscores the role of core strength in maintaining stability and control during complex movements. The significant correlations between 5m and 10m sprint with RAT-D and CMJ indicate that as players advance, a combination of strength, speed, and reactive agility becomes increasingly vital.

Carling and Dupont (2011) similarly reported that older youth football players benefit more from strength training, with a particular emphasis on lower limb explosive power. Their research highlighted that the integration of strength and conditioning programs significantly improved sprint and agility performance, corroborating our findings that U19 athletes require a robust focus on strength development.

Conclusions

Our results suggest that training programs for young football players should be oriented to their developmental stage. For U15 athletes, enhancing flexibility and reactive agility should be prioritized to improve sprint performance. Drills that incorporate various directional changes and focus on both offensive and defensive movements could be particularly beneficial. Additionally, maintaining a balanced approach to core strength training is essential to support overall agility and performance. In contrast, U19 athletes would benefit more from a training regimen that emphasizes lower limb strength, including both explosive and reactive one. Reactive agility drills that simulate game scenarios, promoting both physical conditioning and cognitive responses to dynamic game situations, should complement strength training. This dual focus on strength and reactive agility will better prepare older athletes for the high intensity demands of competitive football.

This study emphasizes the distinct roles of flexibility, reactive agility, and strength in the performance of young male football players. For U15 athletes, flexibility and reactive agility are crucial for enhancing sprint performance, while U19 athletes benefit more from a focus on lower limb strength and core strength. Training programs should be focused on these developmental needs can optimize performance and support the overall growth of young players. By addressing the specific physical attributes relevant to each age group, coaches can better prepare athletes for the demands of competitive football, ultimately enhancing both individual and team success.

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References

Bishop, D., Spencer, M., Duffield, R., & Lawrence, S. (2001). The validity of a repeated sprint ability test. *Journal of Science and Medicine in Sport, 4*(1), 19-29. https://doi.org/10.1016/S1440-2440(01)80003-3

Bjelica, D., Gardasevic, J., & Vasiljevic, I. (2012). Effects of flexibility training on flexibility and agility performance of young football players. *Montenegrin Journal of Sports Science and Medicine, 1*(1), 5-10.

Blomqvist, S., Olsson, J., Wallin, L., Wester, A., & Rehn, B. (2013). Adolescents with intellectual disability have reduced postural balance and muscle performance in trunk and lower limbs compared to peers without intellectual disability. *Research in Developmental Disabilities, 34*(1), 198–206. https://doi.org/10.1016/j.ridd.2012.07.008

Borůvková, J., Horáčková, P., & Hanáček, M. (2014). Statistika v SPSS. In Vysoká Škola Polytechnická Jihlava, Katedra matematiky. 108 s. ISBN 978-80-87035-86-3.

Carling, C., & Dupont, G. (2011). Are declines in physical performance associated with a reduction in skill-related performance during professional soccer match-play? *Journal of Sports Sciences, 29*(1), 63-71. https://doi.org/10.1080/02640414.2010.521945

Carling, C. (2013). Interpreting physical performance in professional soccer match-play: should we be more pragmatic in our approach? *Sports Medicine, 43*(8), 655-663. https://doi.org/10.1007/s40279-013-0055-8

Faude, O., Koch, T., & Meyer, T. (2012). Straight sprinting is the most frequent action in goal situations in professional football. *Journal of Sports Sciences, 30*(7), 625-631. https://doi.org/10.1080/02640414.2012.665940

Gardasevic, J., Bjelica, D., & Vasiljevic, I. (2016). The effects of a training program on the agility of young football players. *Journal of Physical Education and Sport, 16*(4), 1225-1229. https://doi.org/10.7752/jpes.2016.04194

Girard, O., Mendez-Villanueva, A., & Bishop, D. (2011). Repeated-sprint ability—Part I: Factors contributing to fatigue. *Sports Medicine, 41*(8), 673-694. https://doi.org/10.2165/11590550-000000000-00000

Heisman, A. D., Daub, B. D., Miller, R. M., Freitas, E. D. S., Frantz, B. A., & Bemben, M. G. (2020). Countermovement jump reliability performed with and without an arm swing in NCAA Division 1 intercollegiate basketball players. *Journal of Strength and Conditioning Research, 34*(2), 546-558. https://doi.org/10.1519/JSC.0000000000002812

Horička, P., & Paška, L. (2021). Movement intensity in different small-sided games played within regular football training. *Journal of Physical Education and Sport, 21*(2), 741-747. https://doi.org/10.7752/jpes.2021.02091

Krolo, A., Paušić, J., Bjelica, D., & Sporiš, G. (2020). Agility performance in young football players: the role of developmental and physical fitness factors. *Research in Sports Medicine, 28*(1), 92-104. https://doi.org/10.1080/15438627.2019.1616916

Oliver, J. L., & Meyers, R. W. (2009). Reliability and generality of measures of acceleration, planned agility and reactive agility. *International Journal of Sports Physiology and Performance, 4*(3), 345–354.

Paul, D. J., Gabbett, T. J., & Nassis, G. P. (2016). Agility in team sports: Testing, training, and factors affecting performance. *Sports Medicine, 46*(3), 421-442. https://doi.org/10.1007/s40279-015-0428-2

Pehar, M., Sekulic, D., Sisic, N., Spasic, M., Uljevic, O., Krolo, A., Milanovic, Z., & Sattler, T. (2018). Evaluation of different jumping tests in defining position-specific and performance-level differences in high level basketball players. *Biology of Sport, 35*(1), 15-23. https://doi.org/10.5114/biolsport.2018.70746

Reilly, T., & Williams, A. M. (2005). *Science and soccer*. Routledge.

Sekulic, D., Krolo, A., Spasic, M., Uljevic, O., & Peric, M. (2014). The development of a new stop'n'go reactive-agility test. *Journal of Strength and Conditioning Research, 28*(11), 3306-3312. https://doi.org/10.1519/JSC.0000000000000515

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

Zanevskyy, I., & Zanevska, L. (2017). Evaluation in the sit-and-reach flexibility test. *Journal of Testing and Evaluation, 45*(2), 346–355. https://doi.org/10.1520/JTE20150298