

Determining the relationship between the indices of visual reaction and agility in 12-13-year-old soccer players

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Abstract

Background. In the sports field, soccer included, performance is often influenced by a number of factors, such as visual abilities and also agility.

Aims. The paper aims to investigate and determine the relationship between the indices of visual reaction and agility in 12-13-year-old soccer players.

Methods. The subjects of the research were 26 soccer players aged 12-13 years, from the Otopeni Sports Club. The visual reaction at the lower limbs level was determined using the OptoJump Next Platform. Measured indices: TReac. (reaction time) of left and right foot (sec). For agility - Witty SEM system with smart semaphores. Measured indices (sec): Lap L1-10, mean Laps and Time.

Results. Analysis of visual reaction indices revealed a better performance in the right foot compared with the left one. Agility assessment highlights a mean of Laps of 4.82 sec, with significant differences of minimum and maximum values between Laps, indicating diverse levels of agility development in young soccer players. Correlation analysis of the indices of visual reaction and agility shows weak and non-existent connections between them, except for strong correlations at some distinct points. The need for specific training to improve both abilities in 12-13-year-old soccer players is thus demonstrated.

Conclusions. The results of the study show that soccer players aged 12-13 years have differences in their visual performance and feet agility, with a faster visual reaction of the right foot. The various levels of agility development highlight the necessity to organize specific training for both abilities.

Keywords: assessment, indices, young soccer players, correlation analysis, performances.

Introduction

In soccer, performance is not only measured by goals scored or decisive passes. Aspects such as visual reaction and agility play an important role in the success of a player (Vișan & Cojanu, 2020). Especially among young soccer players aged 12 to 13, the development of these skills can be crucial (Bonney, 2020; Cojanu & Vișan, 2019). An assessment of motor skills could be useful in talent development. This assessment estimates the essential perceptual-motor skills of young athletes, deemed necessary for acquiring excellent technical and tactical qualities (Faber et al., 2015). The effective use of Functional Movement Screen tests contributes to

identifying the origin of movement issues. It is well known that movement efficiency can be affected by multiple factors such as strength, endurance, neuromuscular coordination, speed and agility (Łyp et al., 2022). Precise striking abilities, including speed, accuracy, and timing are essential for successful performance in soccer. They ensure a clear advantage for players during matches because they can control the ball in various situations and under pressure (Masmoudi et al., 2021).

This research aims to explore and determine the relationship between visual reaction indices and agility in 12-13-year-old soccer players. The investigation of these factors will lead to a deeper understanding of how these skills influence the athletic performance at this age category.

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Visual reaction and agility are crucial in soccer. They are necessary for quickly observing and reacting to changes in direction and movements of players, as well as for performing rapid and coordinated movements to evade opponents and seize opportunities. Moreover, small-sided games have the ability to test the agility, speed, aerobic conditioning and power of players (Mendes, 2016; Bujalance-Moreno, 2018). Soccer is a sport involving speed and power, requiring athletic training, agility, the ability to tolerate repeated efforts at high intensity (repeated sprint ability) and an adequate level of perceptual and cognitive skills (Ljac et al., 2012, Oliva-Lozano, 2020; Sánchez, 2020; Mitrousis et al., 2023).

Physical fitness and physical coordination are not the only determining factors of success in team sports like soccer. Greater attention is paid to the importance of cognitive abilities, suggesting that executive functions play a fundamental role in soccer success (Vestberg et al., 2017).

This research aims to examine whether there is a correlation between visual reaction and agility among soccer players aged 12 to 13. By employing standardized tests and rigorous methodologies, these abilities will be evaluated and analyzed to find if there is any relationship between them.

Hypothesis

The correlation analysis between visual reaction indices and agility in 12-13-year-old soccer players will highlight their development level and the degree of correlation between reaction time and quality of neurovestibular response.

Material and methods

Research protocol

The balance measurement instrument used belongs to the Human Performance Research Center of the Department of Physical Education and Sports within the National University of Science and Technology Politehnica Bucharest, University Center of Pitești, Romania.

Period and place of the research

The research was conducted in December 2022 during the indoor training period. This scientific approach led to the realization of a descriptive as well as correlational study, carried out within the Otopeni Sports Club, Romania.

Subjects and groups

A group of 26 children, aged 12-13, from the Otopeni Sports Club, football section, participated in this research.

Parental consent was obtained and signed in accordance with the Helsinki Declaration before starting the research. The study received approval from the Ethics Committee of the Doctoral School of Sports Science and Physical Education (ID: 13/26.01.2024), University Center of Pitești, Romania.

Applied tests

The measurement of visual reaction at lower limbs level was performed by means of the OptoJump Next platform. In this regard, the Visual Reaction (VR) Test was used for the left (L) and right (R) foot (3 repetitions), recording the reaction time (T_{Reac.}) in seconds. For segmental agility measurement, the Witty SEM system with smart semaphores was used. To highlight segmental coordination differences, 4 square-shaped semaphores were placed on a 3 x 3 m area, executing 10 impulses with a 3-second pause between impulses (Laps). Ball passing with the foot was performed between impulses. Measured indices: reaction time for each Lap L1-10 (sec), mean time for Laps and total time (sec).

Statistical processing

The statistical analysis was conducted using KyPlot 6.0 software (KyensLab Inc). The standard descriptive indices were calculated: mean, SEM (standard error of mean), Cv% (coefficient of variation), CLM (0.95) – Confidence Level of Mean (0.95), and CLM-L&U - Confidence Limit of Mean (Lower & Upper). The relationship between the measured indices was analyzed using the Pearson correlation coefficient. Statistical significance was set at $p < 0.05$.

Results

The results of determining the visual reaction and agility indices in 12-13-year-old soccer players are presented in Tables I and II.

Comparative analysis of the results regarding visual reaction indices highlights an average of 0.51 seconds for the left foot (L) and 0.48 seconds for the right foot (R). It shows better values at Rep. 1 by 0.03 seconds for the R foot and a smaller Confidence Limit of Mean with Lower & Upper (CLM-L&U) of less than 0.07 seconds for the R foot. As for Rep. 2, there are better values by 0.02 seconds for the R foot and a CLM-L&U value of 0.05 seconds for the L foot; at Rep. 3 - by 0.06 seconds for the R foot and a CLM-L&U of 0.16 for the R foot. These differences with smaller values of reaction time for the R foot indicate better visual reaction in the young soccer players under study (Table I).

Table I
Results of the descriptive statistics for the visual reaction test in 12-13-year-old soccer players, n=26.

| Indices | Foot | Mean ± SEM | CV (%) | Confidence Level of Mean (0.95) | Confidence Limit of Mean | |
|--------------|-------|-------------|--------|---------------------------------|--------------------------|-------|
| | | | | | Lower | Upper |
| Rep. 1 (sec) | Left | 0.51; ±0.03 | 28.9 | 0.06 | 0.45 | 0.56 |
| | Right | 0.48; ±0.02 | 18.2 | 0.03 | 0.45 | 0.52 |
| Rep. 2 (sec) | Left | 0.47; ±0.01 | 15.4 | 0.03 | 0.44 | 0.49 |
| | Right | 0.49; ±0.03 | 30.8 | 0.06 | 0.43 | 0.55 |
| Rep. 3 (sec) | Left | 0.55; ±0.07 | 68.8 | 0.15 | 0.39 | 0.69 |
| | Right | 0.49; ±0.04 | 39.1 | 0.08 | 0.41 | 0.57 |

Statistical calculations of the agility assessment results show an average Lap time of 4.82 seconds and a CLM-L&U value of 0.21 seconds. Regarding the minimum and maximum values between Laps, an interval of 0.25 seconds is observed, ranging from 4.68 seconds to 4.93 seconds. Additionally, the differences in CLM-L&U size are smaller by 0.28 seconds at Lap L7 and larger by 0.56 seconds at Lap L10. These differences in reaction time for each Lap indicate the level of agility development in accordance with the reaction speed and spatial-temporal orientation in young soccer players (Table II).

For determining the relationship between visual reaction and agility indices in 12-13-year-old soccer players, a correlational analysis was done. The results are presented in Figure 1.

The correlation analysis results highlight 72 connections (52.8% positive and 47.2% negative). In the case of the correlations between VR indices at L & R foot and agility, 16.7% very weak connections and 80.5% nonexistent ones are noticed, except for a strong connection at $p < 0.01$ ($R =$

0.525) between Rep. 1 left foot (VR) and Lap L5 (agility). Regarding the correlations between the right foot and agility, 22.2% weak connections and 72.2% nonexistent ones are observed. The exception is represented by the strong correlations at $p < 0.05$ between Rep. 2 (visual reaction) and Lap L8 ($R = 0.425$) and Lap L9 ($R = 0.440$) for agility. All these nearly equal differences between the senses of the connections value (positive and negative) and the low significance level indicate the need for specific training interventions. The specific training will contribute to the development of visual reaction and agility in 12-13-year-old soccer players.

Discussion

This research aimed to investigate and determine the relationship between visual reaction and agility indices in 12-13-year-old soccer players.

Research results based on the comparative analysis of visual reaction indices reveal a lower average by 0.03 seconds for the R foot (Table I). Comparing the

Table II
Results of the descriptive statistics for the agility test in 12-13-year-old soccer players, $n=26$.

| Indices | Mean ± SEM | CV (%) | Confidence Level of Mean (0.95) | Confidence Limit of Mean | |
|-----------------|-------------|--------|---------------------------------|--------------------------|-------|
| | | | | Lower | Upper |
| Lap L1 (sec) | 4.84; 0.09 | 10.1 | 0.19 | 4.64 | 5.04 |
| Lap L2 (sec) | 4.83; 0.08 | 8.15 | 0.16 | 4.67 | 4.99 |
| Lap L3 (sec) | 4.68; 0.07 | 8.05 | 0.15 | 4.53 | 4.84 |
| Lap L4 (sec) | 4.82; 0.10 | 10.88 | 0.21 | 4.61 | 5.03 |
| Lap L5 (sec) | 4.81; 0.10 | 11.07 | 0.21 | 4.59 | 5.02 |
| Lap L6 (sec) | 4.93; 0.09 | 9.27 | 0.18 | 4.74 | 5.11 |
| Lap L7 (sec) | 4.75; 0.07 | 7.29 | 0.14 | 4.60 | 4.88 |
| Lap L8 (sec) | 4.81; 0.09 | 10.1 | 0.19 | 4.61 | 5.01 |
| Lap L9 (sec) | 4.81; 0.10 | 11.02 | 0.21 | 4.59 | 5.03 |
| Lap L10 (sec) | 4.88; 0.13 | 14.09 | 0.28 | 4.60 | 5.16 |
| Mean Laps (sec) | 4.82; 0.05 | 5.44 | 0.11 | 4.71 | 4.92 |
| Time (sec) | 48.16; 0.51 | 5.44 | 1.06 | 47.1 | 49.2 |

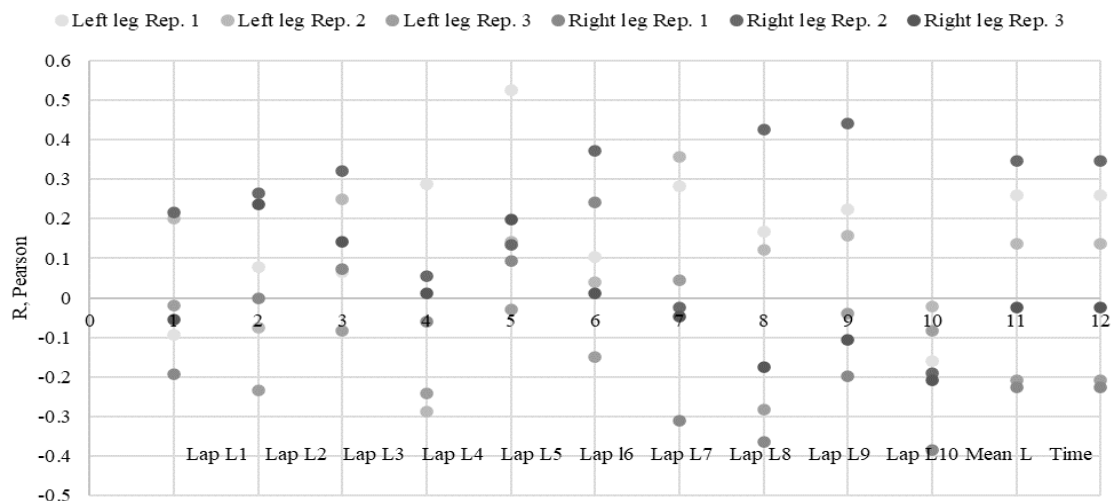


Fig. 1 – Correlation analysis between visual reaction and agility indices in 12-13-year-old soccer players.

executions of both feet indicates significant improvements in the right foot, ranging from 0.02 to 0.06 seconds. These discrepancies, especially with lower reaction times for the R foot, suggest superior visual reaction in the young soccer players participating in the study.

Analyzing the results of agility index assessment highlights an average Lap time of 4.82 seconds. Differences of 0.25 seconds are observed, ranging from 4.68 to 4.93 seconds. Furthermore, discrepancies in the Confidence Limit of Mean (CLM-L&U) are smaller at Lap L7 and larger at Lap L10. These variations in reaction time for each Lap show the level of agility development, in accordance with the speed and precision of spatiotemporal reaction in young soccer players (Table II). Studies have examined the effects of static and dynamic core exercises on motor performance and specific soccer abilities in players aged 10 to 12 (Başkaya, 2023). Other specialists studied the effects of core training on speed and agility abilities of soccer players. There were no significant differences between pre-test values of speed and agility tests (Afyon, 2017). A comparative analysis of psychophysiological functions and physical and technical training indicators in young soccer players aged 12-13 and 15-16 was conducted throughout a 3-month training period. The analysis showed that changes in these indicators could be decisive for the improvement of the players (Kozina et al., 2019). We also investigated how restricted visual feedback affects performance in assessing specific soccer abilities, which includes soccer non-specific perceptual information joined to soccer-specific motor actions (Beavan, 2021). Authors like Davies et al. (2013) demonstrated that reducing the number of players resulted in increased variability found out during training and slight increases in total agility maneuvers.

Soccer training load can affect the antero-posterior curvature of the spine. Higher thoracic kyphosis angles and greater trunk inclination forward were found compared to untrained peers. Significant body posture differences were also noted between children of different ages, both in the soccer players group and the untrained children group (Barczyk-Pawełec, 2022). Soccer is a sport that requires lower limbs flexibility to provide speed, coordination and agility. The research aimed to determine if additional stretching of the soleus muscle in a regular stretching protocol would have greater benefits for ankle flexibility, dynamic balance and functional performance. Thus, added stretches on the soleus muscles may provide additional benefits for speed performance in soccer (Huang, 2022). The examination of intraclass correlation coefficients of six testing elements in table tennis among 6-10-year-old children met the criterion of 0.7, with coefficients of variation from 3 to 8%. The analysis of the main components identified two conceptually significant factors: "ball control" and "gross motor function" (Faber et al., 2015). Other specialists focused on determining if the Functional Movement Screen (FMS) test, performed with young boys - soccer players - can indicate former injuries. The conclusion is that FMS test is an efficient diagnostic tool for identifying previous injuries among young soccer players (Łyp et al., 2022). A study proposes, as primary aim, methodological aspects to ensure a high level of transferability between training and formal play.

Positional play and activities especially designed for this purpose are used. The players will repeat tactical and technical movements and will be exposed to situations similar to those specific to official games, both in attacking and defending actions (Marques, 2020). The investigation of spatial-temporal agility indicators in soccer players aged 12-13 using various research methods and the Witty SEM intelligent semaphore system revealed significant correlations between total time and individual reaction time. The impact of each response on the total testing time and performance was emphasized (Pană et al., 2023). Rhythmic gymnastics too needs a very good hand-eye/body coordination and balance, combined in a dynamic environment, providing gymnasts with the visual advantage they need for elite performance (Potgieter, 2007).

Regarding the results of the correlation analysis, 52.8% show positive connections and 47.2% negative ones (Fig. 1). As for the correlation between VR indices at the left foot and agility, 16.7% connections are very weak and 80.5% are non-existent, except for a strong connection between Rep. 1 at the left foot and Lap L5 at agility ($p < 0.01$). In terms of correlation of VR indices at the right foot and agility, 22.2% are weak connections, and 72.2% are non-existent, except for strong connections between Rep. 2 and agility, Lap L8 and L9 ($p < 0.05$). These findings prove that specific training is necessary for enhancing visual reaction and agility in 12-13-year-old soccer players. Taking into account the almost equal differences between the positive and negative connection values and the low significance level, real improvement is possible.

There are also studies that examined the influence of somatic maturation on anthropometric, physical and game-related variables in youth basketball groups (under 13 and under 15 years old) (Arede et al., 2021). There are authors who monitored elite young soccer players in order to find out whether executive functions are associated with success in this sport. The results of their study, involving a partial correlation analysis, suggest that both basic and higher-level executive functions can predict success in soccer young players (Vestberg, 2017). Physical and anthropometric parameters were also used to anticipate playing status in Australian junior football. The agility tests included stationary vertical jumps and dynamic vertical jumps with dominant and non-dominant leg. Multivariate analysis of variance (MANOVA) was used to test the main effect of "status" on the physical/anthropometric parameters. Logistic regression models helped to foresee the playing status by means of physical/anthropometric parameters (Woods, 2015). There are specialists who studied the anthropometric profiles and certain components of general fitness (speed, agility, hand strength or vertical jump) in young Polish table tennis players (top level). The results indicated the importance of several anthropometric characteristics in performing a fast serve and the correlation between serve speed, body weight and body mass index (Pluta, 2022).

In conclusion, the findings of our research could have significant implications for the training and development of young soccer players. A more thorough understanding of the relationship between visual reaction and agility could lead to more efficient training programs and customized

development strategies. All these could maximize the potential of these young athletes in this fascinating sport.

Conclusions

1. In the case of the young soccer players, the visual reaction time at the right foot level is on average shorter than the one at the left foot. Thus, a potentially faster and more efficient visual reaction is recorded at the right foot. This observation suggests that specific training could be useful for improving visual reaction on both feet, with particular attention paid to the less efficient foot.

2. The analysis of foot agility shows significant variations in the execution time of the laps, with notable differences between different tests. Discrepancies in the confidence interval for various laps reveal that certain aspects of agility are better developed than others among young football players. This finding indicates the need for balanced training aimed at improving all aspects of agility.

3. Correlations between visual reaction indices and agility show that there is an association between these two skills, but in various proportions and with different intensities depending on the analyzed trials. There is also a clear need for specific training interventions, especially meant to improve the weak or nonexistent connections between some aspects of visual reaction and agility. The purpose of this specific training is to optimize the performances of young soccer players in these critical areas of the game.

4. The correlation analysis between visual reaction and agility in 12-13-year-old soccer players makes possible the assessment of the development level of these skills and the degree of correlation between reaction time and neurovestibular performance.

Conflict of interests

The authors declare no conflict of interest.

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