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A Comparison of Reaction and Agility Tests of Female Soccer Players in Different Leagues

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Abstract

This study aims to see whether there is a difference in the reaction and agility running tests of female soccer players in different leagues. The sample group of this study consisted of 30 participants, 15 of whom were licensed female soccer players in the 1st League (Konak Belediyespor) aged 18-25 and the other 15 were female soccer players in the 2nd League (Manisa Gençlerbirliği), who are actively engaged in soccer. Reaction and agility tests such as reactive agility test, grid drill (reaction test), 30m sprint test, and zig-zag change-of-direction running tests were applied with the Smartspeed (Fusion Sport) branded photocell device. Average age, height, body weight, BMI, and athlete ages in the study are 21.26±2.08 years, 165.53±5.65 cm, 56.60±4.62 kg, 20.64±1.16 kg/m², 7.53±3.41 years. In the 2nd League (Manisa Gençlerbirliği), they are 20.66±2.57 years, 165.20±5.91 cm, 57.13±7.01 kg, 20.92±2.19 kg/m², 3.86±1.88 years, respectively. As a result of the tests, there was no statistically significant difference ($p>0,5$) between the two groups regarding the reaction and reactive agility tests, while a positive significance ($p<0.05$) was found in the 30-meter sprint in favor of the 1st League (Konak Belediyespor) and a statistically significant difference ($p<0.05$) was found in the zig-zag test in favor of the 2nd League (Manisa Gençlerbirliği). As a result, we can say that to be more successful in the agility performance, the players should be more effective in making decisions rather than leaning close to the ground at the moment of changing direction.

Keywords: Reaction, Agility, Soccer, Smartspeed.

Introduction

Soccer has several rules and is the art of defeating the opponent and finding a way to succeed by knowing these rules well and following the rules in practice (Durusoy, 2002). At the same time, it is a sports discipline in which aerobic and anaerobic powers are used consecutively and factors such as speed, strength, balance, agility, reaction, muscle, cardio-circulatory, and respiratory system directly affect it. Being quick and fast on the field in a competition will be advantageous. Thinking and applying it faster than the opponent will have a positive effect on the score. During a soccer match, the player is involved in many activities that require rapid strength development, such as sprinting or changing direction (İmamoğlu et al., 2017). However, although its goal, strategy, and tactics are determined, it is a game that its outcome cannot be predicted because it involves the human factor (Durusoy, 2002).

Many studies have been conducted to define the characteristic structures of athletes from different sports branches (Aslan, 2014). The factors determining the performance, which are among the elements that make up these characteristic structures; are elements such as strength, power, flexibility, endurance, speed, and quickness and it is possible to achieve success by combining these elements with compatible training and individual efforts of the athlete (Sezgin, 2011).

Soccer is undoubtedly the most widespread, most popular, and most-watched sport in the world. It has a unique place among other branches with its features such as the number of players, the size of the playing field, and the required competing skills (Marancı, 2001). As in other sports branches, the sportsman responds voluntarily (reaction) or involuntarily (reflex) to external stimuli in soccer. Çakıroğlu et al. (2012) state that the reaction time, which determines the time between performing the first muscular reaction or movement against external stimuli, should be good and this skill should be improved. The athlete must be able to maintain his/her physical characteristics during the match (Ağaoğlu et al., 2017). For these reasons, high reaction-time performance can affect the speed and agility of the athlete as well as increase the shooting performance (Bulgurcuoğlu et al., 2018).

Due to the characteristic feature of soccer sport, together with the flow of the game, the athlete needs the ability to move fast and change place-direction, that is, agility (Sonchan, 2017). Agility is considered as a locomotor skill that enables the body to change its direction as quickly, fluently, easily and in a controlled manner while moving from one point to another (Ağaoğlu et al,, 2017).

Each sports branch has its own training program, criteria, and tests. In order to reach the top rank in a sports match, we should evaluate the current situation of athletes by performing performance measurement tests as well as doing long and very tiring training.

This study is crucial for women's soccer to become widespread. However, it is thought to be beneficial in terms of contributing to the personal development of female soccer players. When the studies in the literature are examined, it is seen that although there are many studies on male soccer players, there are not many studies enough on female soccer players. From this point of view, emphasis should be put on women's soccer, and studies that will improve their performance should be included in the research. With this study, it is aimed to measure the reaction speed of female soccer players who play soccer in different leagues to reaction and agility tests and to see whether there is a significant difference between them.

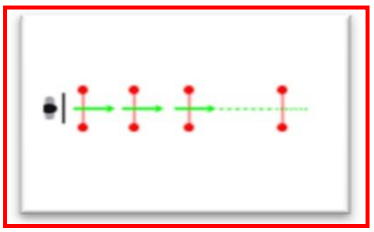
Material and Method

Participants

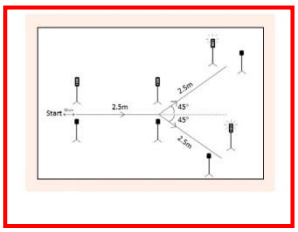
The sample group of this study consisted of 30 participants who are actively engaged in soccer, 15 of whom are licensed female soccer players in the 1st League (Konak Belediyespor) aged 18-25, the other 15 are female soccer players in the 2nd League (Manisa Gençlerbirliği).

Procedure

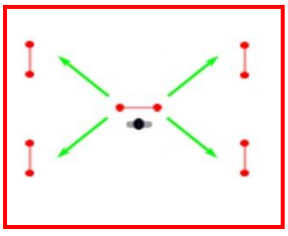
In body composition measurements, body weight (BW) was measured with a digital scale (its sensitivity is 0.1 kg (100g). Following that, reactive agility, grid drill (reaction test), zig-zag running test, and 30m sprint test were applied to all participants using a SmartSpeed (Fusion Sport) branded photocell device after 30 minutes of warm-up on the first day of the study. Measurements were carried out at 19.00 in the evening in the soccer field of Manisa Celal Bayar University, Faculty of Sport Sciences.



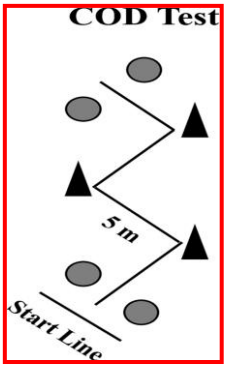
30m Sprint Test



Reactive Agility



Grid Drill Test



Zig-Zag Test

Data Analysis

In order to perform the statistical analysis of the study, the minimum, maximum, average, and standard deviation values of the descriptive, physical, and physiological parameters were calculated with descriptive statistics in the SPSS 16.0 package program running under Windows XP. Mann Whitney U test was used for comparison of the two groups.

Findings

Table 1. Descriptive Parameters of The Participants (M±SD)

Parameters	1st League (n =15)		2nd League (n=15)	
	M±SD	Min. Max	M±SD	Min. Max
Age (years)	21.26±2.08	18-25	20.66±2.57	18-25
Height (cm)	165.53±5.65	155-175	165.20±5.91	156-175
Body Weight (kg)	56.60±4.62	50-66	57.13±7.01	50-76
BMI (kg/m2)	20.64±1.16	18.64-22.89	20.92±2.19	18.97-25.39
Athletic Age (years)	7.53±3.41	4-13	3.86±1.88	2-7

M= mean; SD= standart deviation

When Table 1 is examined, the descriptive parameters of the participants are shown. According to this, the average age of the 1st League Group is 20.66 years, the average height is 165.53 cm, the average BMI is 20.64 ± 1.16 kg/m², the average athletic age is 7.53 years. The average age of the 2nd League Group is 20.26 years, the average height is 165.20 cm, the average BMI is 20.92 ± 2.19 kg/m², the average athletic age is 3.86 years.

Table 2. Mean Scores of Reaction and Agility Tests of Participants (M±SD)

Parameters	1st League Group (n =15)		2nd League Group (n=15)	
	M±SD	Min. Max	M±SD	Min. Max
R.A. Test (1-1-2)(sec)	3.35±0.35	3-4.02	3.60±0.57	2.67-4.46
30m sprint (sec)	4.98±0.21	4.62-5.25	6.36±0.29	6.02-6.79
Zig-zag Test (sec)	6.51±0.37	5.98-7.21	5.17±0.47	4.54-6.13
Reaction Test (Grid Drill) (Tot.sec)	23.91±2.21	16.99-26.60	24.13±1.50	21.38-26.28

M= mean; SD= standard deviation R.A.=Reactive Agility Test

Table 2 shows the average of the reaction and reactive agility tests of the participants. According to this, the average of reactive agility test of the 1st League Group is 3.35±0.35sec, 30m. Sprint test is 4.98±0.21sec, Zig-zag test is 6.51±0.37sec, and the grid drill (reaction

test) is 23.91±2.21sec. The average of reactive agility test of the 2nd League Group is 3.60±0.57sec, 30m. Sprint test is 6.36±0.29sece, the zig-zag test is 5.17±0.47sec, the reaction test is 24.13±1.50sec.

Table 3. The Comparison of Agility and Reaction Parameters of Groups

Parameters	**1st League Group (n =15)**	**2nd League Group (n=15)**	**P**
Reactive Agility Test (1-1-2) (sec)	3.35±0.35	3.60±0.57	.206
30 m. Sprint (sec.)	4.98±0.21	6.36±0.29	.000*
Zig-zag Test (sn.)	6.51±0.37	5.17±0.47	.000*
Reaction Test (Grid Drill) (Total sec)	23.91±2.21	24.13±1.50	.885

*p<0,05

When Table 3 is examined, the comparison of the reactive agility and reaction parameters of the groups is shown.

There was no significant difference (p>0.05) between the reaction and reactive agility tests between the two groups, a statistically significant difference (p<0.05) was found in favor of the 1st League in the 30m sprint test, and a statistically significant difference (p<0,05) was found in favor of the 2nd League in the zigzag test.

Discussion and Conclusion

The main findings of this study were that the reaction and reactive agility ability was not sensitive enough to detect a difference between 1st and 2nd league female soccer players. On the contrary, physical capacities in terms of 30m sprint and zig-zag test results were found to be suitable for detecting significant differences according to the game level.

The sprint distance in the soccer game varies between 5 meters and 40 meters in research (Leger & Lambent 1982). In our study, 30 meters was preferred for the maximal anaerobic sprint test. The reason we decided on this is that it is the maximal sprint distance in soccer.

The ability to slow down quickly, change body orientation, and accelerate are important prerequisites that increase the chances of players to win one-on-one duels or perform effective defensive maneuvers (Trecroci et al., 2018; Reilly 2007; Young et al., 2015). Therefore, both young and adult players with a high level of competitiveness should present a better change of direction speed (COD) profile than their lower-level counterparts. However, the second assumption is the opposite of the current results. One possible explanation might be that,

during a match, the ability of players to change direction depends not only on physical capacity but also on known perceptual and decision-making factors that refer to their reaction skills (Sheppard et al., 2006).

In the study conducted by Haugen et al. (2012), out of 194 Norwegian female soccer players from National Team, 1st League, 2nd League, 3rd League, National Team players were found to be 2% faster (P = .027, d = 0.5) than 1st league players and they were found to be 5% faster than the players of the 2nd division over 0--20 m. Mujika (2009) compared the sprint performances of 34 Spanish Super League and Premier League female players within themselves and 34 Super League and Premier League male soccer players within themselves. Female: the super league player outperformed the premier league player (2.1%, ES (d) = 0.64). In the study conducted by Koç et al. (2011), a 30-meter speed test was applied to male basketball and handball players, and 5.20 ± 0.77sec was reported for basketball players and 4.65 ± 0.48sec was reported for handball players.

In the 30-meter sprint test in our study, the 30m Sprint test of the 1st League Group is 4.98 ± 0.21sec. The 30m Sprint test of the 2nd League Group is 6.36 ± 0.29sec. It was found to be significant in favor of the 1st League (Konak Belediyespor). It can be said that it is a result of Konak Belediyespor being in an upper league.

Sheppard and Young (2006), Farrow et al. (2005) investigated the reactive agility netball players with high and low performances. The test consisted of a full-size screen that showed the opponents pass, the direction of the pass, and then triggered a timing gate to turn on the light that the player should run. Since this particular test is for a netball-specific sport, it goes to a place to deal with the reactive agility element, and it involves the player deciding on a response to a stimulus. The results showed a difference in reaction time between high performer players and low-level players. High-performers showed shorter response times, most likely due to being able to predict the direction of transition by recalling previous technique and body position experience. This also concerns most commonly tennis players, predicting the opponent's serving direction. Green et al. (2010) conducted a study aiming to create a simple COD (Change of Direction) and reactive agility test that can be used to evaluate rugby players. In the test results, the two skill groups, club, and academy, were compared. The authors concluded that players with a higher game standard were superior to those who are less skilled, in reactive agility tests. Gabbett and Benton (2009) conducted a very similar study investigating reactive agility performance in rugby players. Similarly, the results of this study also revealed that reactive agility tests can distinguish between players with different abilities, but also indicate it is worth noting that reactive agility tests can distinguish the specific types of training needed to improve the individual's performance. Oliver and Meyers (2009) investigated the reliability of photoelectric timing gates and an agility test protocol similar to this study. The protocol has been recognized as reliable in distinguishing different abilities.

Although there is a lot of literature to say that elite athletes perform better in reactive agility tests than less skilled performers (Farrow et al. 2005; Sheppard et al. 2006; Gabbett et al., 2009; Oliver et al., 2009; Green et al. 2010), Ward (2011) was unable to report such clear results, unfortunately. Although the non-elite group was higher than elite players in the reactive agility test, statistically no significant difference (P> 0.05) was found.

In our study, the average of the reactive agility test of the 1st League (Konak Belediyespor) was 3.35±0.35 sec, while the average of the reactive agility test of the 2nd League (Manisa Gençlerbirliği) is 3.60±0.57 sec. There was no significant difference between the two groups.

Pereira et al. (2018) took measurements of 20m sprint, unloaded countermovement jump (CMJ), squat jump (SJ), loaded jump squat (JS), Zig-zag test and T-test of 15 men and 23 women from Brazilian National Olympic Team in their study and looked at gender differences. They found that male athletes outperformed female athletes in all tested variables. The difference between performances resulted as expected due to gender differences.

Ward (2011) the average score of elite participants was higher than that of the non-elite in the planned single agility test, however, the difference in performance was not statistically significant (P> 0.05). This result is to be expected as it is far more likely that the elite players are likely to be well trained in the requirements for quick changes. The standard deviation (SD) was also much less in the elite planned single test (SD = ± 0.78) than in the non-elite (SD = ±3.52) when it came to CODS, whereas, members of the non-elite population were very varied in their CODS ability. Given that all participants in a given group had comparable mean scores, an SD of this magnitude indicated that some participants in the non-elite group recorded much slower scores than the elite group, but the average was better. Other participants in the group performed better. Again, this is thought to be because tennis is about effective changes in direction, giving an advantage to the elite group of players.

Farrow et al. (2005) also could not find a significant difference in planned agility scores between elite and non-elite handball players.

The pre-planned zig-zag change of direction running test, which is the agility test we conducted, was found to be significant in favor of the 2nd League (Manisa Gençlerbirliği). As a result of our study, while the zig-zag change of direction running test of the 1st League was 6.51±0.37sec, the 2nd League zig-zag change of direction running test was 5.17±0.47sec. The performances of the 2nd League players have been found to be better. Considering the results of the planned agility test, the 1st League would have been expected to perform faster in the planned agility test results. The reason for this is that they have superior experience regarding technique and the individual movements required to make changes in direction and because they are more experienced than the 2nd League. However, contrary to the findings in the planned single tests, 2nd League players performed better than the 1st League players in the repeated phase of the planned test (P <0.05). After the first testing session, it was conducted by explaining to the participants what the purpose of the study was and why some individuals were tested. This information could have two possible effects on tests due to the participant's different effort levels. Participants who realized that they were in the lower skill group may be motivated to work harder to prove themselves against better players; or on the contrary, high-performance players may have complained about their abilities and took the test rather than maintaining maximum effort as desired. An attempt was made to eliminate this possibility by providing equal incentives and motivation for both groups; however, the amount of effort put into in the end depends on the participant. Contrary to what was expected, it can be said that 2nd League players were better motivated.

Reaction skill is an indispensable skill for performance athletes to take action and use their existing abilities. In a study, soccer players should watch moving balls and other players at different distances and at visual distances, which shows that it is important for soccer players to react and respond to objects of different sizes and shapes (Ando et al., 2001; Vurmaz, 2018).

A new methodological approach was presented to examine the visual reaction responses of goalkeepers during simulated penalty kicks in soccer, as the reaction skill in soccer has a great impact on goalkeepers. Goalkeepers were classified as successful or unsuccessful based on their performance by looking at the expectation test skill, thus allowing for in-group

comparison of visual search behavior between goalkeepers. In the test of expectation, participants were asked to move a joystick in response to the penalty kick situation presented on a large screen. The rate of fines recorded as well as the frequency and time of initiation of joystick corrections were evaluated. Visual search behavior was studied using a portable eye movement recording system. Consequently, when the goalkeepers who continued to do their exercises regularly and exercised in intervals were compared, the goalkeepers who were more successful in predicting the height and direction of the penalty kick were found to be the goalkeepers who continued their exercises regularly. Goalkeepers who exercised in intervals had longer waiting times before reacting and had a lower prediction rate of penalty kicks (Savelsbergh et al., 2005).

Lesiakowsk et al. (2017) included 119 men, 95 of whom were athletes in their study: soccer players (n = 24), volleyball players (n = 22), boxers (n = 26), and rowers (n = 23), and the study included simple reaction time (SRT), choice reaction time (CRT) and visual stimulus discrimination. Analysis of the results showed that volleyball and soccer players had shorter ($p < 0.01$) reaction times compared to non-athletes and representatives of other sports. We found significant differences ($p < 0.01$) between athletes and non-athletes in visual stimulus discrimination. In addition, boxers showed less correct reactions than volleyball players and showed shorter times of stimulus detection than volleyball and soccer players.

In the study conducted by Ölçülü et al. (2010) to evaluate the factors affecting the development of tennis skill in 10-14-year-old children, the conditional and coordinative factors that affect the tennis skill acquisition of young people who do sports and those who do not, have been examined. A comparison was made between the two groups who do sports and those who do not. The first measurements of the individuals were taken prior to any tennis training. Then, the same measurements were repeated in the 3rd week and the 6th week.6-week tennis training was given to the 1st and 2nd groups. During the training, pre-test, mid-test, and final-test were applied to both groups. There was no significant difference between the 2 groups in all measurements in visual reaction time. However, a significant difference was found between the initial and third measurements of the 1st group ($p<0.05$). There was no significant difference in auditory reaction time between both groups and all measurements of both groups ($p>0.05$).

In the study conducted by Dodanlı (2008), response times to visual stimulus (light) in soccer players were detected as 260.58±49.46 ms for goalkeepers, 258.03±44.86 ms for other position players, response times to auditory stimulus (sound) as; 238.88±72.52 ms for goalkeepers, 243.2±54.34 ms for other position players. Response times to visual stimulus (light) in handball players were detected as; 244.86±34.08 ms for goalkeepers, 250.77±34.6 ms for other position players, response times to auditory stimulus (sound) as; 214.5±27.66 ms for goalkeepers and 227.41±36.28 ms for other position players. These values were analyzed according to the 0.05 significance level and no statistically significant difference was found. Nowadays, players of a team in all positions must have all kinds of motor skills. Defensive and forward players should assist each other when necessary (Taş et al., 2013). Kamar (1987) in a similar study of his, compared the reaction times of goalkeepers and other position players in soccer but found no statistically significant difference.

In his study on amateur soccer players, Marancı (2001) determined the reaction times of goalkeepers, defenders, midfielders and forwards to visual stimulus as 470 ms for goalkeepers, 530 ms for defenders, 510 ms for midfielders and 490 ms for forwards, and to auditory stimulus as 397 ms for goalkeepers, 490 ms for defenders, 430 ms for midfielders, and 420 ms for forwards. Nowadays, players of a team in all positions must have all kinds of

motor skills. Defensive and forward players should assist each other when necessary (Akyüz et al., 2010).

In our study, in the reaction test, both groups were 23.91±2.21 and 24.13±1.50, respectively, and no statistically significant difference was found. The fact that the athletes participating in our study consisted of athletes who played soccer in the 1st and 2nd League actively, having better visual reaction levels can be explained by their ability to experience similar game experiences and being good at reflecting that.

As a result, since there are skills specific to soccer in the agility test, it can be said that performance is affected by technical skills. Also, the results of the running technique analysis show that to be more successful in the agility performance, the players should be more effective in making decisions rather than leaning to the ground at the moment of changing direction.

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REFERENCES

Ağaoğlu, S.A. , Ergin, R. (2017). 9-14 Yaş badmintoncularda çeviklik, reaksiyon zamanı ve denge parametrelerinin incelenmesi. Int J Sport. Exer. & Train, 3 (4):109–119.

Akyüz, M., Koç, H., Uzun, A., Özkan, A., Taş, M. (2010) Türkiye güreş milli takımında yer alan genç sporcuların bazı fiziksel uygunluk ve somatotip özelliklerinin incelenmesi, Atatürk Üniversitesi, Beden Eğitimi ve Spor Bilimleri Dergisi, 12(1): 41-47.

Ando, S., Kida, N., Oda, S. (2000). Central and peripheral visual reaction time of soccer players and nonathletes. Perceptual and Motor Skills, 92(3):786-94.

Aslan, A.K., (2014). Genç futbolcularda sekiz haftalık "core" antrenmanın denge ve fonksiyonel performans üzerine etkisi. Selçuk Üniversitesi Sağlık Bilimleri Enstitüsü, Yüksek Lisans Tezi, , Konya.

Bulgurcuoğlu, A.N., Karadenizli, Z.İ. (2018). Hentbolde dayanma adımlı kale atışındaki top hızı ile reaksiyon zamanı, çeviklik ve antropometrik özellikler arasındaki ilişkiler. The Journal of Academic Social Science, 6(82): 302-313.

Çakıroğlu. T., Sökmen, T. (2012). 12 Haftalık judo teknik antrenman ve oyunlarının 8–10 yaş grubu erkek çocuklarda reaksiyon zamanı üzerine etkisi. Selçuk Üniversitesi Beden Eğitimi ve Spor Bilimi Dergisi. 14(1): 71–74.

Dodanlı, O., (2008). Futbol ve hentbol süper liginde mücadele eden takımların kaleci ve diğer mevki oyuncularının görsel ve işitsel reaksiyon zamanı farklarının belirlenmesi. Gazi Üniversitesi Sağlık Bilimleri Enstitüsü Beden Eğitimi Ve Spor Ana Bilim Dalı, Yükse lisans Tezi, Ankara.

Durusoy, İ. (2002). Futbol Teorisi. Boyut Yayıncılık ve Tic. A.Ş., İstanbul; s: 17.

Farrow, D., Young, W., Bruce, L. (2005). The development of a test of reactive agility for netball: a new methodology. Journal of Science and Medicine in Sport; 8: 52-60.

Gabbett, T., Benton, D. (2009). Reactive agility of rugby league players. Journal of Science and Medicine in Sport; 12: 212-214.

Green, BS., Blake, C., Caulfield, B.M. (2010). A valid field test protocol of linear speed and agility in rugby union. Journal of Strength and Conditioning Research; 25: 1-7.

Haugen, T.A., Tønnessen, E., Seiler, S. (2012). Speed and countermovement-jump characteristics of elite female soccer players, 1995–2010. Int J Sports Physiol Perform, 7; 340–349.

İmamoğlu, A., Eliöz, M., Çebi, M. (2017). Kadın futbolcularda 8 haftalık hazırlık çalışmalarının bazı biyo-motor ve fizyolojik özellikler üzerine etkisi. Spor ve Performans Araştırmaları Dergisi Journal of Sports and Performance Researches; 8(3): 222-231.

Kamar, A. (1987). Futbol oyuncularında reaksiyon zamanının muhtelif branş ve parametrelerle ilişkilerinin mukayeseli olarak araştırılması. Marmara Üniversitesi Sosyal Bilimler Enstitüsü, Yüksek Lisans Tezi, İstanbul (Danışman: Doç. Dr. Kut Sarpyener).

Koç, H., Pulur, A., Karabulut, E.O. (2011). erkek basketbol ve hentbol oyuncularının bazı motorik özelliklerinin karşılaştırılması. Niğde Üniversitesi Beden Eğitim ve Spor Bilimleri Dergisi, 5(1); 21-27.

Leger, L.A., Lambent, J.A. (1982). Maxsimal muttistage 20m. shuttle run teststopredict vo2 max. Eur. J.Appl. Physiol. , 1–10.

Lesiakowski, P., Krzepota, J., Zwierko, T. (2017). The differentiation of visual sensorimotor processes in the representatives of various sport disciplines. Central European Journal of Sport Sciences and Medicine | Vol. 19, No. 3/2017: 43–53 | DOI: 10.18276/cej.2017.3-04.

Marancı, B., Müniroğlu, S. (2001). Futbol kalecileri ile diğer mevkilerde bulunan oyuncuların motorik özellikleri, reaksiyon zamanları ve vücut yağ yüzdelerinin karşılaştırılması. Gazi Beden Eğitimi ve Spor Bilimleri Dergisi, 6(3):13-26.

Mujika, I., Santisteban, J., Impellizzeri, F.M., Castagna, C. (2009). Fitness determinants of success in men's and women's football. J Sports Sci., 27;107–114.

Oliver, J., Meyers, R. (2009). Reliability and generality of measures of acceleration, planned agility, and reactive agility. International Journal of Sports Physiology and Performance, 4: 345-354.

Ölçücü, B., Canikli, A., Ağaoğlu, Y.S., Erzurumluoğlu, A. (2010). 10-14 Yaş çocuklarda tenis becerisinin gelişimine etki eden faktörlerin değerlendirilmesi, 12 (2):1-11.

Pereira, L.A., Nimphius, S., Kobal, R., Kitamura, K., Turisco, L.A.L., Orsi, R.C., Cal Abad, C.C., Loturca, 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 Issue: Volume, 32(10); 2987–2994.

Reilly, T. (2007). The science of training - soccer: a scientific approach to developing strength, speed and endurance. NewYork: Routledge.

Savelsbergh, G. J. P., Van der Kamp, J., Williams, A. M., & Ward, P. (2005). Anticipation and visual search behaviour in expert soccer goalkeepers. Ergonomics, 48(11–14), 1686–1697. https://doi.org/10.1080/00140130500101346.

Sezgin, E. (2011). Bayan futbolcuların oyun pozisyonlarına göre aerobik güç performanslarının ve toparlanma sürelerinin karşılaştırılması. Karadeniz Teknik Üniversitesi Eğitim Bilimleri Enstitüsü, Yüksek Lisans Tezi, Trabzon.

Sheppard, J.M., Young, W. (2006). Agility literatüre review: Classifications, training and testing. Journal of Sports Sciences, 24(9); 919 – 932.

Sheppard, J.M., Young, W.B., Doyle, T.L.A., Sheppard, T.A., Newton, R.U. (2006). An evaluation of a new test of reactive agility and its relationship to sprint speed and change of direction speed. Journal of Science and Medicine in Sport, 9; 342-349.

Sonchan, W., Moungmee, P., Sootmongkol, A. (2017). the effects of a circuit training program on muscle strength, agility, anaerobic performance and cardiovascular endurance. International Journal of Medical, Health, Biomedical, Bioengineering and Pharmaceutical Engineering. 11(4): 170-173.

Trecroci1, A., Milanović, Z., Frontini, M., Iaia1, F.M., Alberti, G. (2018). physical performance comparison between under 15 elite and sub-elite soccer players. Journal of Human Kinetics, 61;209-216.

Taş, M., Sevim, O., Özkan, A., Akyüz, M., Akyüz, Ö., Uslu, S. (2013). Yıldız basketbol milli takımında yer alan kız sporcuların anaerobik performans ve kuvvet değerlerinin belirlenmesinde çevresel ölçümlerden elde edilen bazı değerlerin rolü, International Journal of Science, Culture, and Sport, Vol. 1, Issue 3;12-20.

Ward, R. (2011). The ınfluence of tennıs playıng ability on change of directıon speed and reactive agility; University Of Wales Institute, Cardiff.

Vurmaz, M.O. (2018). U-20 futbolcularda ışıklı reaksiyon egzersizlerinin, çeviklik-çabukluk ve reaksiyon sürati üzerine olan etkisinin incelenmesi; Kocaeli Üniversitesi Sağlık Bilimleri Enstitüsü Yükseklisans Tezi, Danışmanı: Doç. Dr. Bergün MERİÇ BİNGÜL.

Young, W.B., Dawson, B., Henry, G.J. (2015). Agility and change-of-direction speed are independent skills: implications for training for agility in invasion sports. Int J Sports Sci Coach, 10(1); 159–169.