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ORIGINAL ARTICLE

A Study on Female Soccer Players: An Examination of the Effects of Reaction-Based Exercises on Soccer-Specific Skills

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Women's Soccer,
Reaction,
Exercise,
Skill.

ABSTRACT

Background. Training approaches aimed at improving performance in women's soccer are becoming increasingly important, and the effects of reaction-based exercises on balance and soccer-specific skills are among the current research topics. The development of motor skills such as reaction, balance, and coordination can directly affect the effectiveness of basic soccer skills. **Objectives.** The purpose of this study is to examine the effect of reaction-based exercises applied to female soccer players on soccer-specific skills. A pre-test post-test control group quasi-experimental model was used in the study. **Methods.** The research group consisted of a total of 28 female soccer players aged 14-16, 14 in the experimental group and 14 in the control group. For a duration of 10 weeks, the experimental group performed reaction-based exercises 2 days a week in addition to their normal training. The control group continued their normal training. Data collection tools included height measurement, weight measurement, the TOGU balance test, and Mor & Christian general soccer skill tests. **Results.** SPSS 25 software was used for data analysis, with a significance level of $p<0.05$. For normal distribution, skewness and kurtosis values were checked to be between -1.5 and +1.5. While the experimental group showed significant results in passing and dribbling skills ($p<0.05$), no significance was found in the control group ($p>0.05$). A significant difference was found in the balance test in both the experimental and control groups ($p<0.05$). However, no significant difference was found in the shooting test in either group ($p>0.05$). **Conclusion.** In conclusion, it can be stated that 10 weeks of reaction-based exercises improved balance, passing, and dribbling skills in female soccer players.

INTRODUCTION

To be successful in sports competitions, athletes must demonstrate high performance in terms of physical and motor skills. However, many factors influence this performance, and the most important of these is the gender parameter. There is a great deal of research examining performance differences between female and male athletes. These studies have revealed that male athletes perform better than female athletes in jumping (1-5), strength (1, 5-10), speed (1, 3, 5, 7-9, 11, 12), and agility (1, 9, 12-14). Female athletes, on the other hand, perform significantly better than male athletes in flexibility (1) and balance parameters (8, 12, 15, 16). When both genders are examined in soccer, male soccer players have higher performance than female soccer players in the

parameters of jumping (17-20), speed (18, 20-23), endurance (18, 21, 23, 24), and agility (20). At the same time, female soccer players perform better than male soccer players in flexibility and balance parameters (25). Beyond these parameters, it has been found that male soccer players possess superior technical skills specific to the sport (20, 21, 26, 27). Considering the current level of performance in soccer, it is a team and contact sport that demands high-level endurance, strength, flexibility, sprinting, agility, athletic performance, and control (28). One of the parameters that enables athletes to achieve such performance is reaction time (29). Defined as the duration between the start of the stimulus and the start of the reaction, reaction time is one of the determinants of performance in modern soccer and is closely related to the ability of players to make quick decisions under field, time, and opponent pressure (30). Reaction time is said to play an important role in many areas such as sports, daily life tasks, and academic achievement (31).

FITLIGHT training is a modern approach used in athlete training. FITLIGHT involves wireless light units connected to tablets; these colored light units enhance a person's thinking processes and motor skills. This technology is used in many sports (32). When the literature was reviewed, it was observed that the performance and basic skills of athletes increased in the study where fitlight training was performed (33). When comparing reaction time values of athletes in different sports, it was observed that football players and those in other branches (34, 35) showed differences compared to their non-elite peers (36); furthermore, it was found that men had lower reaction times than women (30). This situation may contribute to the quality of play for female soccer players and may increase the overall speed of the game. Reaction time is also an essential element of athletic performance and is an integral part of success in female soccer players (35). Interest in the performance characteristics of soccer players has increased rapidly in recent years because it allows sports scientists to determine the current demands placed on players in competition and apply the data to training and testing protocols (37). Although less progress has been made in women's soccer, more research is needed on quantifying the physical and technical characteristics of elite female players (21). The growing interest in women's soccer in general highlights the need for research in this area (38).

Although there are many studies on the physical and physiological characteristics of soccer players, it can be noted that studies describing the reaction characteristics of female soccer players are quite limited (30). In this respect, the research is of great importance in terms of contributing to the scientific studies needed in women's soccer, and it is crucial to establish the physical preparation process in women's soccer on a scientific foundation. Women's late presence in the field of soccer, where men have been for decades, has been reflected in many areas, including scientific research. Therefore, studies conducted on women's soccer are very valuable and contribute to women's soccer.

MATERIALS AND METHODS

Research Design. This study aimed to examine the effect of reaction-based exercises applied to female soccer players on soccer-specific skills. A pre-test post-test control group quasi-experimental model was used in the study. In this model, individuals are not randomly assigned but are selected from naturally occurring groups (39). Care was taken to ensure that the participants forming the groups had similar characteristics, and it was decided randomly which group would form the experimental group or the control group (40).

Participants. The study included a total of 28 female soccer players, comprising 14 participants in the experimental group and 14 in the control group, all licensed members of a soccer club located in the Sincan district of Ankara province. Twenty-eight female soccer players who met the inclusion criteria were randomly assigned to either the experimental or control group. All subjects completed the study, as shown in Figure 1.

The ages of the athletes participating in the study ranged from 15±0.96 in the experimental group to 14.57±0.64 in the control group. The sample size was estimated using G*Power software (G-Power, version 3.1.9.7), Düsseldorf University, Düsseldorf, Germany (41). The recommended total sample size was determined to be 27 individuals for an effect size of .50, a power of .80, and a p-value of .05 (95% CI). Additionally, since there is only one women's soccer club in the district, the number is limited to 28.

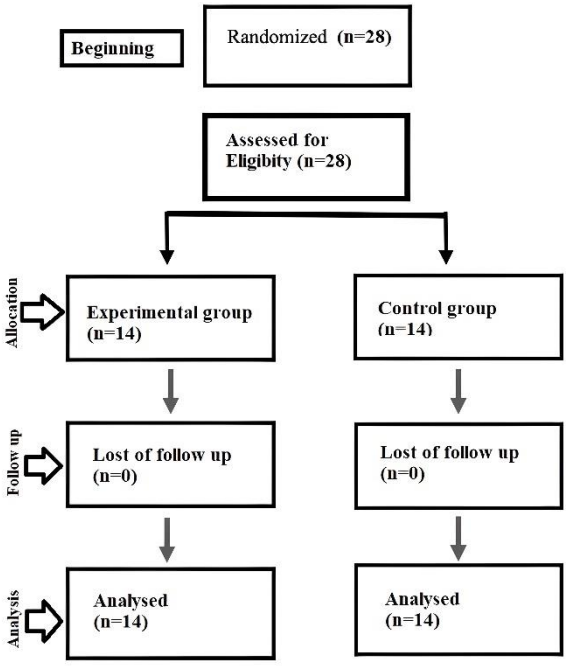

Figure 1. Randomized trial.

Ethical approval for the study was obtained from the Gazi University Ethics Committee 2024 – 1969. Athletes were provided with the necessary information about the study and informed that they could withdraw from the study at any time without giving any reason. The athletes and their guardians signed informed consent forms to ensure their voluntary participation in the study. This study was conducted in accordance with the Helsinki Declaration. The inclusion criteria for the study were: being a volunteer, having no health-related problems, being a female aged 14-16 with a soccer license, actively participating in competitions and training sessions at a soccer club, and having at least 3 years of soccer experience. The exclusion criteria for participants were defined as follows: having a license in a sport other than soccer, having a chronic illness or disability, and not taking medication regularly. Data Collection Tools. In the following, the test for data collection is described in detail:

Height Measurement. Participants' height measurements were taken using a wall-mounted measuring tape with a precision of 0.1mm. Measurements were taken in centimeters with participants standing with their heels together, head upright, and eyes looking straight ahead.

Body Weight Measurement. Participants' weights were measured on an electronic laboratory scale with a sensitivity of 0.01 kg, with their feet bare and wearing shorts. The results were recorded in kilograms.

TOGU Balance Test. A portable dynamic balance device (Togu Challenge Disc 2.0, Prien am Chiemsee, Rosenheim, Germany) was used to determine the athletes' balance. The device is a dynamic balance, body stability, coordination measurement, and training (development and rehabilitation through games) system that features a 44 cm diameter circular upper platform and a base/lower platform of the same shape and size, connected to a mechanism with four 8 cm long rubber cylinders at its exact center. The platform has a structure that can move in any direction (maximum 12°) and thus has an unstable surface. The disc detects the movements made by the person on it to maintain balance using three-dimensional motion sensors and transmits the data wirelessly and in real time via Bluetooth to its own software on a smartphone or tablet through the application. The device has a rating scale of 1-5 (stability index range: 1-very good/2-good/3-average/4-poor/5-very poor), with 1 being the best score and five being the worst. At the start of the test, the researcher displays the application on the

computer at a distance where the athlete can comfortably see the screen in front of the platform, while the athlete stands barefoot on the platform to eliminate the possible effects of different types of shoes on the results. Subsequently, the test is completed with the athlete attempting to maintain balance for 20 seconds with arms free and both feet in the center of the disc, following a 10-second preparation period with a 5-second countdown. Participants are asked to focus on the target throughout the test and keep the point within the circle as centered and steady as possible. The test is repeated after 3 minutes of passive rest, and the best score is recorded (42, 43). The construct validity of the measurement tool used in this study is seen to yield findings consistent with similar studies (44, 45).

Mor-Christian Dribbling Test (Fgure 2). This test was administered to college students and is said to be suitable for younger age groups. The test's validity was reported to be 0.73, and its reliability coefficient was 0.80. Twelve funnels (45 cm high) are placed in a circle at 4.5 m intervals in the 18 m station area of the dribbling test. A 1 m starting line is marked outside the circle and perpendicular to it. The soccer player performing the dribbling test starts the test with the ball at the starting line upon the "start" command, dribbles the ball as fast as possible through the cones, and finishes the test by reaching the starting line. Two types of trials are performed in this test: clockwise and counterclockwise. The fastest duration is recorded in seconds (46).

Mor-Christian Passing Test (Figure 3). A 91 cm wide and 45 cm high goal is placed behind the goal, with a 1.20 m rope serving as the goal line (the distance between the two cones should be 91 cm). Two cones are placed 13.5 m away at a 45-degree angle to the goal line, and a third cone is placed 13.5 m away at a 90-degree angle to the goal line. Passing is done from the location of the three cones to the goal in sets of four shots (a total of 12 passes are expected). The player may use either foot when passing. One point is awarded for each successful pass. Balls that hit the goal cones are counted as successful. The final score is the sum of the 12 passes (46, 47).

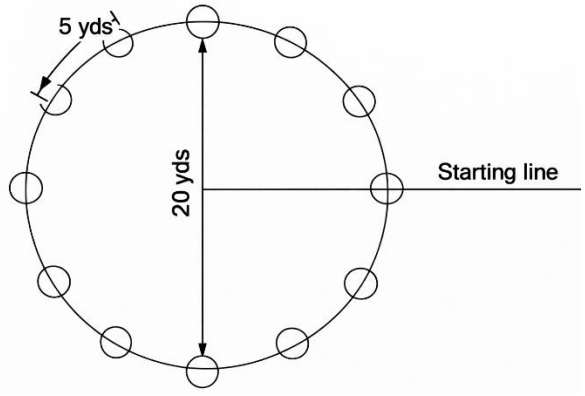

Figure 2. Mor-Christian dribbling test.

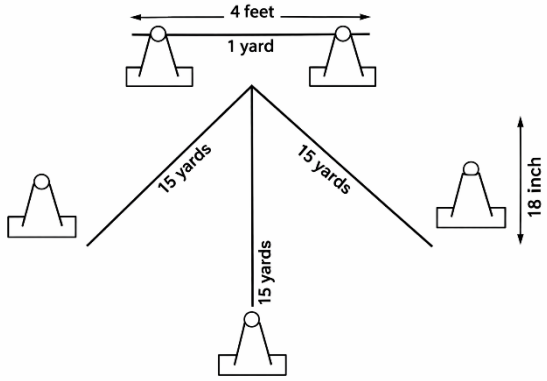

Figure 3. Mor-Christian passing test.

Mor-Christian Shooting Test (Figure 4). The shooting test is conducted with four circles, each 1.21 m in diameter, placed inside the goal. The shooting line is marked 14.5 m away from the goal and parallel to it. The player shoots at the stationary balls toward the target from behind the shooting line. The player may shoot the ball with either foot. The player takes a total of 16 shots, four at each of the four circular targets. Shots that hit the correct target are awarded 10 points, while shots that hit the wrong target are awarded 4 points. For example, a successful shot at the top-left target earns 10 points, while a shot that enters the bottom target earns 4 points. Balls that enter the target directly are considered successful, while balls that roll or bounce on the ground before entering the target are considered unsuccessful. The final score is recorded as the sum of the 16 attempts. The findings obtained from the measurement tool, being consistent with the literature, provide an important indicator of validity (48-51).

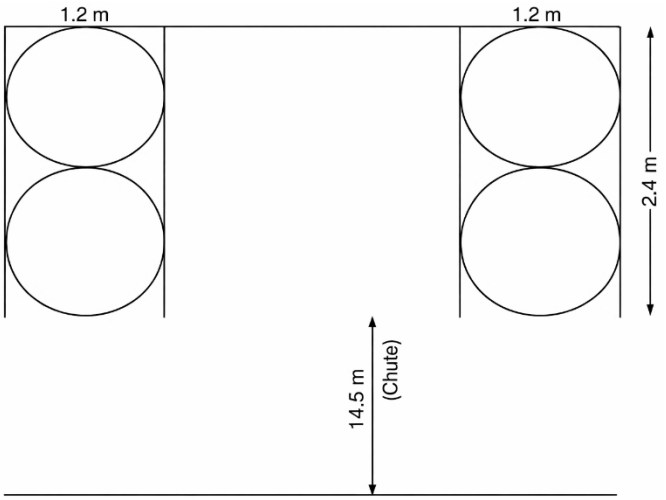

Figure 4. Mor- Christian shooting test.

10-Week Reaction-Based Exercise Applications (Table 1). For a period of 10 weeks, the experimental group performed reaction-based exercises on two additional days in addition to their regular training. The control group continued with their regular training. A size five soccer ball was used in the exercises, and a 2-minute rest interval was provided. In addition, the exercises were varied (duration, color, distance, etc.) to prevent the athletes from memorizing them.

Warm-up. To prevent injury and performance-related risks before training, a standard warm-up procedure was implemented. Sessions began with a 5-minute light-intensity warm-up run; at the end of this period, dynamic stretching was used to increase blood flow to the muscles. After 2 minutes of dynamic stretching, players performed 3 minutes of basic ball-familiarization drills such as inside-foot passing and juggling.

Color Run. Sensors (Fitlight Trainer/CA) placed at different locations on the field flash different colors every 10 seconds, with a specific color assigned to each athlete. Athletes analyze their surroundings and begin running toward the station where their color is flashing, then change direction toward the new station when the color changes. The purpose of this exercise is to develop the athlete's environmental awareness and ball-handling skills.

Green-Target Shot. Light sensors are placed at the four corners of the castle. Seven cones are placed in front of the athlete, who is required to pass through them with a slalom maneuver. When the athlete passes through the last cone, all light sensors placed inside the castle light up in 4 different colors. After passing through the last cone, the athlete is asked to shoot at the corner lit up in green. The purpose of this exercise is to develop the athlete's ability to make split-second decisions and improve their shooting skills.

Catch and Run. Seven cones are placed to the left, right, and front of the athlete. The athlete is asked to dribble the ball with their back to the cones. The coach asks the dribbling athlete to catch a stick with three heads, each of a different color, holding the head of the specified color. The athlete holds the stick in the specified color, stops dribbling the ball, quickly turns around, and slaloms through the cones of the same color as the one they are holding. The purpose of this exercise is to develop the athlete's coordination, decision-making, and ball control skills.

Blue Pass. The athlete is required to pass the ball according to the color lit on the platforms, which are positioned to surround them circularly and are hard and designed to return the passed ball. With each pass, the colors change positions, and the athlete is only required to pass the ball to the blue color. This exercise aims to develop the athlete's spatial awareness and passing skills.

Find the Color. Three sensor lights are placed 2 meters apart in front of the athlete. The sensors change color every 5 seconds. Athletes are asked to dribble the ball horizontally toward the position where the yellow light is located. The purpose of this exercise is to develop environmental awareness and ball control skills.

Focus and Go. A sensor is placed between two athletes. The athletes are asked to dribble the ball

until the yellow light turns on. When the yellow light turns on, the objective is to take the ball, pass through the cones near their own area, and shoot at the goal. The first athlete to successfully shoot the ball is declared the winner. The objective of this exercise is to develop ball control, ball handling, and shooting skills.

Data Analysis. In this study, descriptive statistics (percentages and frequencies) were calculated regarding the demographic characteristics of the participants. Subsequently, assumptions regarding whether the data followed a normal distribution were tested. The SPSS 25 software package was used to test these assumptions. Skewness and kurtosis values between -1.5 and +1.5 indicated that the research data showed a normal distribution (52). Since our research data was between -1.5 and +1.5, parametric tests were used in the analysis of the data. Paired-samples t-tests were used to examine the differences between the experimental and control groups in the pre-test and post-test. The significance level was set at 0.05. Significance was calculated using effect size (Cohen's d). Effect size criteria: small: 0,10 - 0,29, moderate: 0,30 - 0,49, large: 0,50 (53).

Table 1. Reaction-based exercise application protocol

Week	Application	Time
Week 1	Color run Green-target Shot Catch and run Find the color	1st day 60 minutes 2nd day 60 minutes
Week 2	Blue pass Focus and go Color run Catch and run	1st day 60 minutes 2nd day 60 minutes
Week 3	Green-target Shot Blue pass Catch and run Find the color	1st day 60 minutes 2nd day 60 minutes
Week 4	Color run Focus and go Green-target Shot Catch and run	1st day 60 minutes 2nd day 60 minutes
Week 5	Blue pass Find the color Focus and go Catch and run	1st day 60 minutes 2nd day 60 minutes
Week 6	Color run Green-target Shot Catch and run Find the color	1st day 60 minutes 2nd day 60 minutes
Week 7	Blue pass Focus and go Color run Catch and run	1st day 60 minutes 2nd day 60 minutes
Week 8	Green-target Shot Blue pass Catch and run Find the color	1st day 60 minutes 2nd day 60 minutes
Week 9	Color run Focus and go Green-target Shot Catch and run	1st day 60 minutes 2nd day 60 minutes
Week 10	Blue pass Find the color Focus and go Catch and run	1st day 60 minutes 2nd day 60 minutes

RESULTS

The age, height, and weight information of the participants is shown in Table 2. It displays the average ages of the female soccer players participating in the study: the experimental group was 15±.96, and the control group was 14.57±0.64 years. The average height of the experimental group was 163.45±6.05 cm, and that of the control group was 162.05±6.28 cm. The average body weight of the experimental group was 55.82±6.40 kg, and that of the control group was 54.77±5.63 kg.

Table 2. Participants' demographic information

	Demographic Variables	N	x̄± Sd
Experimental group	Age (years)	14	15±,96
	Height (cm)	14	163,45±6,05
	Weight (kg)	14	55,82±6,40
Control group	Age (years)	14	14,57±,64
	Height (cm)	14	162,05±6,28
	Weight (kg)	14	54,77±5,63

Table 3 shows that a statistically significant difference was found in the pre-test and post-test data of the experimental group according to the number of passes variable and the ball dribbling time variable (p<.05); however, no statistically significant difference was found in the pre-test and post-test data of the control group (p>.05). When examining the balance variable, a statistically significant difference was found in both the experimental and control group data (p<.05). This difference is higher in favor of the experimental group. In the target shots variable, no significant difference was found in either the experimental or control group.

Table 3. Pre-test and post-test results for the experimental and control groups

			Pre-test	Post-test					
Variable	Group	n	x̄ ±Sd.	x̄ ±Sd.	%Δ	t	df	p	d
Passing test	Experimental	14	4.50±1.70	7.36±2.41	63.55	-4.82	13	.001	1.37
	Control	14	4.29±2.02	4.36±1.78	1.63	-.20	13	.844	
Ball dribbling test (s)	Experimental	14	18.01±2.13	17.09±2.01	-5.10	2.50	13	.026	0.44
	Control	14	20.14±1.87	19.58±2.24	-2.78	1.30	13	.213	
Shooting test	Experimental	14	37.29±19.03	37.43±15.26	0.37	-.02	13	.982	
	Control	14	21.71±17.50	21.29±14.41	-1.93	.11	13	.909	
Balance test	Experimental	14	2.00±.49	1.86±.46	-7.01	15.11	13	.001	0.29
	Control	14	2.04±.46	1.99±.43	-2.45	2.49	13	.027	0.11

***: Significant at p<0.05.**

Table 4 shows that there was a significant difference between the pre-test scores of the experimental and control groups in the dribbling and passing variables (p<0.05); however, no significant difference was found in the passing and balance variables (p>.05). A significant difference was found between the experimental and control groups in the post-test scores for the passing, dribbling, and passing variables (p<.05); however, no significant difference was found in the balance variable for either group (p>0.05).

DISCUSSION

The primary objective of this study is to examine the effects of a 10-week reaction-based exercise program applied to female soccer players aged 14-16 on soccer-specific skills. The results revealed that athletes in the experimental group showed statistically significant improvement in passing and dribbling skills compared to the control group. While a significant increase in balance performance was observed in both groups, no significant difference was found

between the groups in shooting skills. These findings suggest that reaction-based training may be an effective method for developing certain technical skills in female soccer players, but it may not have the same effect on every skill.

Table 1. Pre-test and post-test results between the experimental and control groups

	Variable	Group	n	Mean ±SD	t	df	p
Pre-test	**Passing test**	Experimental	14	4.50±1.70	.30	26	.763
		Control	14	4.29±2.02			
	Ball dribbling test (s)	Experimental	14	18.01±2.13	-2.81	26	.009
		Control	14	20.14±1.87			
	Shooting test	Experimental	14	37.29±19.03	2.253	25.820	.033
		Control	14	21.71±17.50			
	Balance test	Experimental	14	2.00±.50	-.237	26	.814
		Control	14	2.04±.46			
Post-test	**Passing test**	Experimental	14	7.36±2.41	3.75	26.00	.001
		Control	14	4.36±1.78			
	Ball dribbling test (s)	Experimental	14	17.09±2.01	-3.10	26.00	.005
		Control	14	19.58±2.24			
	Shooting test	Experimental	14	37.43±15.26	2.88	26.00	.008
		Control	14	21.29±14.41			
	Balance test	Experimental	14	1.86±.46	-.77	26.00	.446
		Control	14	1.99±.43			

***: Significant at p<0.05.**

Passing and Dribbling Skills. Our study found that reaction-based exercises significantly improved the passing and dribbling skills of the experimental group, a finding consistent with similar studies in the literature. Reaction time is considered one of the most critical components of performance in modern soccer and is directly related to the ability to make quick and accurate decisions, especially under field, time, and opponent pressure (30). Atan and Akyol (34) state that when comparing the reaction time values of athletes involved in different sports, the fastest reaction values are found in soccer players. This can be explained by the nature of soccer, which requires rapid adaptation to constantly changing game conditions. The reaction exercises applied in our study (e.g., Color Run, Blue Pass, Find the Color) required athletes to respond quickly to visual stimuli changing constantly (colors, positions) and to perform technical actions such as dribbling or passing accordingly. Kaplan et al. (54), in their study examining the acute effect of anaerobic exercise on simple visual and auditory reaction times in team sports, emphasized that reaction time is critically important for athletic performance. This may have contributed to athletes developing not only their motor skills but also their cognitive processes, particularly decision-making and attention mechanisms. As a matter of fact, the execution of technical skills in soccer is not merely a physical action, but also involves a complex perception-decision-action cycle. Bradley et al. (21), in their study comparing match performance characteristics between male and female soccer players, stated that female players have a greater potential for improvement in technical skills compared to their male counterparts. Reaction training may have enhanced the speed and efficiency of this cycle, enabling players to make more accurate and faster passes and to control and dribble the ball more effectively.

Balance Performance. In our study, it is noteworthy that both the experimental and control groups showed significant improvement in the balance test. The improvement observed in the experimental group may be attributed to the reaction-based exercises that included movements challenging dynamic balance (e.g., Catch and Run). The improvement in the control group, on the other hand, indicates that ten weeks of regular soccer training can also enhance balance skills. By its very nature, soccer involves movements that challenge balance, such as standing on one leg, changing direction, and jumping. Therefore, an increase in balance performance among young athletes who train regularly is an expected outcome. Akınoğlu et al.

(25), in their study comparing static and dynamic balance abilities of athletes by gender, found that female athletes performed better than male athletes in balance parameters. Similarly, Sekulic et al. (12), in their study examining the gender-specific effects of balance, speed, and strength parameters on agility performance, reported that female athletes have an advantage in balance skills. Promsri et al. (43), in their research investigating the effect of leg dominance on postural control during challenging balance exercises, demonstrated that balance training improves neuromuscular control. Naumann et al. (42), on the other hand, stated that in balance training programs based on tasks with different postural demands, there is no transfer between conditions; however, specific balance exercises effectively improve the targeted skills. This study confirms that both specific reaction and balance exercises, as well as general soccer training, are effective in enhancing balance abilities among young female soccer players.

Shooting Skill. The lack of a significant effect of reaction-based exercises on shooting ability in our study can be explained by the complexity of this skill. Shooting is a multifaceted ability that requires not only quick reaction time and decision-making speed but also a high level of technical proficiency, strength, coordination, and accuracy. Peek et al. (27), in their study examining differences in heading technique performance between male and female soccer players during the 2022 FIFA World Cup and the 2023 FIFA Women's World Cup, noted that female soccer players exhibit different developmental patterns in technical skills compared to men. Although our "Green-Target Shot" exercise aimed to improve players' decision-making and targeting skills, a 10-week period may not be sufficient to produce meaningful changes in the motor patterns and power involved in shooting technique. Ostojic et al. (28), in their study on the effects of six weeks of training on physical fitness and performance in young and elite adult soccer players, emphasized that longer-term training programs may be required for the development of technical skills.

Gender-Specific Factors and Reaction Time. It is known that female soccer players differ from male players in certain physical and technical parameters. In studies examining gender differences in reaction time during elections, researchers reported that men had shorter reaction times than women, but this could be due to the use of different methods (30). Elena et al. (35), in a recent study analyzing reaction time in female soccer players, found that lower-limb response speed to auditory and visual stimuli varies according to positional roles. Zwierko et al. (14), in their study investigating factors contributing to sensorimotor adaptation capacity in reactive agility performance among young athletes, demonstrated that reaction training enhances sensorimotor adaptation abilities. These findings support that the reaction-based exercises applied in our study further improved the natural balance advantage of female soccer players.

Physical Performance and Gender Differences. The literature indicates that male soccer players are superior to female soccer players in terms of jumping (**17**, **19**), strength (**18**, **55**), speed (**11**, **21**), and agility (**15**, **19**). However, it is also emphasized that female athletes perform better than males in terms of flexibility and balance parameters (**1**, **16**). Mujika et al. (**22**), in their study examining the fitness determinants of success in male and female soccer, stated that female soccer players need different physical and technical development strategies than males. This highlights the importance of gender-specific approaches in the training programs of female soccer players.

Limitations and recommendations. This study has some limitations. The relatively small sample size (n=28) and the participation of athletes from only one soccer club may limit the generalizability of the results. Additionally, the duration of the training program (10 weeks) may be too short to observe changes in certain skills (especially shooting). Future studies examining the effects of training programs of longer duration involving a larger number of athletes from different levels would be beneficial. Furthermore, researching the effects of reaction training on both technical skills and cognitive abilities, such as tactical decision-making and game reading, would significantly contribute to strengthening the scientific foundation of women's soccer. It is important for future research that researchers apply different response training methods (e.g., auditory response, complex response scenarios) for subsequent studies.

CONCLUSION

This study has demonstrated that a 10-week reaction-based exercise program is an effective method for improving fundamental technical skills

such as passing and dribbling in female soccer players aged 14-16. These findings emphasize the importance of coaches to include reaction-based exercises in female soccer players' training programs, as these exercises simultaneously develop both the physical and cognitive abilities of the players. With the growing interest and participation in women's soccer today, such scientific studies play a critical role in maximizing the performance of female athletes and enabling them to reach their full potential.

APPLICABLE REMARKS

- The reaction-focused training can be added to training programs at least twice a week.
- In addition to reaction training, technical and strength-specific training should be planned for shooting development.

AUTHORS' CONTRIBUTIONS

Study concept and design: R. Eşkil; K. G. Eşkil; M. Çağın. Acquisition of data: R. Eşkil; K. G. Eşkil; M. Çağın. Analysis and interpretation of data: R. Eşkil; H. Kocaman Drafting of the manuscript: R. Eşkil; Ö. Orhan Critical revision of the manuscript for important intellectual content: Ö. Orhan; K. G. Eşkil; M. Çağın Statistical analysis: R. Eşkil Administrative, technical, and material support: H. Kocaman; Ö. Orhan Study supervision: R. Eşkil.

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CONFLICT OF INTEREST

The authors state that they have no conflicts of interest that could have influenced the work reported in this paper.

FINANCIAL DISCLOSURE

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FUNDING/SUPPORT

No funding sources reported.

ETHICAL CONSIDERATION

The necessary permissions and approvals were obtained from the Ethics Committee of Gazi University (Code: 2024 – 1969), and the study was conducted in accordance with the Declaration of Helsinki. Participation in the study was voluntary, and the parents of the students signed informed consent, which informed them about all details of the study.

ROLE OF THE SPONSOR

There was no sponsor involved in this study.

ARTIFICIAL INTELLIGENCE (AI) USE

Artificial intelligence was not used in this research.

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