PHYSICAL EDUCATION OF STUDENTS

ORIGINAL ARTICLE

# The effect of combined training on players' body composition and their performance in beach soccer

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**Abstract**

*Background and Study Aim*: Beach soccer is a high-intensity sport requiring a combination of aerobic capacity, strength, agility, and coordination, making training strategies crucial for optimizing performance and physical fitness. Evaluating the impact of specific training regimens can provide insights into effective methods to enhance players' capabilities. The aim of this study was to assess the effects of a six-week combined training program on body composition and performance parameters in beach soccer players.

*Material and Methods*: A total of 26 beach soccer players voluntarily participated in the study. The athletes were divided into two groups: an exercise group and a control group. Training programs were implemented for both groups over a period of six weeks. Body composition and performance tests, including sit and reach, 20-meter sprint, vertical jump, long jump, and Illinois agility, were applied to both groups twice: at the beginning of the study and at the end of the six-week training period. The data obtained were analyzed using paired samples t-test and Wilcoxon Signed Ranks Test with the SPSS software. The significance level was set at $p < .05$.

*Results*: A significant difference was found between the pre-test and post-test results for several variables in the exercise group. These variables included body fat percentage, body fat mass, sit and reach, 20-meter sprint, vertical jump, long jump, and Illinois agility tests ($p < .05$).

*Conclusions*: These findings highlight the effectiveness of sport-specific combined training in enhancing both physical fitness and athletic performance. Incorporating such programs into the training routines of beach soccer athletes can be a valuable strategy for optimizing their competitive capabilities.

**Keywords**: sports, beach soccer, body composition, performance, combined training

## Introduction

Beach soccer is a dynamic and physically demanding sport that requires a unique combination of aerobic capacity, explosive strength, agility, and technical skills. The high-intensity nature of the game, played on an unstable sand surface, places significant physiological demands on players. As a result, optimizing training methods to enhance both physical performance and body composition is crucial for success in this sport. Combined training, which integrates strength, endurance, and agility exercises, has been recognized as an effective approach in various sports. However, its specific impact on beach soccer players requires consideration of the unique characteristics of this sport.

Football is the most popular sport in the world, with approximately 265 million active players [1]. In addition to being played on green fields, it can also be played on the beach. With the fitness benefits of playing on a sand surface and barefoot, beach soccer serves as an important training ground for developing players for traditional football. Although beach soccer is an enjoyable and visually appealing sport, it is also highly challenging. Physical endurance plays a critical role in performance. It is well known that Brazilian players' exceptional soccer-specific techniques and endurance can be attributed to their experience with beach soccer [2].

Beach soccer is a team sport that demands a variety of physical attributes from players due to the unique challenges posed by the sport and the sand surface [3]. Unlike traditional soccer, beach soccer is played on a sandy field, which requires players to exhibit exceptional speed, agility, and technical skills. One of the key characteristics of this sport is its intermittent and high-intensity nature [4]. Although beach soccer offers high visual appeal, it is also an exceptionally demanding sport, with physical endurance playing a critical role in performance [2].

The differences between classical soccer and beach soccer significantly influence the physical, technical, and tactical demands placed on players, requiring a specialized approach to training and gameplay. The unique surface and conditions of beach soccer necessitate adaptations in movement, ball control, and game strategies. These adaptations emphasize aerial play, acrobatic skills, and heightened


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positional awareness, which are critical for success in this challenging and high-intensity sport [5].

Beach soccer's growing popularity in Turkey, supported by favorable geographic and climatic conditions, highlights the need for tailored training approaches. The Turkish Beach Soccer National Team's success, including advancement to the European A League, underscores the importance of developing training methods to enhance player performance and physical fitness [2].

Combined training in beach soccer is a model where athletes are systematically trained in basic motor skills and technical-tactical features during preparation phases, aligned with appropriate loading levels within unit training [6]. This approach is crucial for achieving optimal performance, meeting or exceeding predetermined standards, and reaching competitive goals. Performance relies on the ability to exhibit individual or team behaviors based on various skills, abilities, and physical conditions. It is determined by the ability to adapt specific skills to unexpected environmental factors and the consistent and reliable application of these skills in competitive situations [7].

In football, numerous studies have evaluated physical fitness, analyzed training outcomes [8, 9], and conducted match analyses [10, 11]. However, a review of the literature on beach soccer reveals limited research on performance measurement [12, 13] and a smaller number of match analysis studies similar to those in football [14, 15].

Despite the importance of combined training for enhancing performance in beach soccer, existing research remains insufficient. While studies in football have extensively examined physical fitness, training outcomes, and match analysis, similar investigations in beach soccer are limited. Only a few of the studies identified can be indirectly attributed to those examining the effects of combined training in beach soccer. This highlights the need for targeted studies to develop training strategies tailored to the unique demands of beach soccer.

The aim of this study was to assess the effects of a six-week combined training program on body composition and performance parameters in beach soccer players.

## Materials and Methods

*Participants*

The study included 26 male beach soccer players, aged 18 years and older, who volunteered to participate. Fourteen of these athletes were members of the Turkish National Beach Soccer Team. Twelve were players in the Turkish Beach Soccer League with a minimum of two years of experience in the sport. The group also included university students among the athletes. Both groups consisted of experienced athletes with comparable levels of qualification. This balance provided a solid basis for conducting the experiment. All participants were informed about the study's objectives, the tests involved, and safety protocols. Informed consent was obtained from each player. Ethics committee approval was also obtained for the study.

*Study Design*

The participants were divided into two groups. The exercise group included National Team players. The control group was composed of league players. The exercise group underwent a six-week, beach soccer-specific combined training program. This program was designed to improve physical performance and body composition. The control group continued with their usual training routines. Measurements were taken before and after the training period. Body composition parameters included body weight, body mass index, body fat percentage, and body fat mass. Performance metrics included the 20 m sprint test, sit and reach flexibility test, standing long jump test, Illinois agility test, and vertical jump test. These metrics were used to evaluate the effects of the training program on the athletes.

*Tests*

Body composition was measured using electrical bioimpedance with a Tanita MC-780 multi-frequency segmental body composition analyzer.

*Height:*

Height was measured on a flat surface with participants barefoot. The athletes were instructed to lean against the wall with their heads upright, their backs, and the heels of their feet in contact with the wall. The measurement results were recorded in centimeters [16].

*20m Sprint Test:*

This test required athletes to run from the start line to the finish line over a 20-meter distance. Athletes were given ten minutes to warm up and stretch before the test began. They were then instructed to wait at the starting point. After the first test, a 15-minute rest interval was provided, and the athletes proceeded with the second test. The best performance result was recorded in the study [17].

*Illinois Agility Test:*

The aim of the Illinois agility test is to monitor the development of an athlete's agility and speed. The test course was 10 meters in length and 5 meters in width (distance between the start and finish cones). Four cones were used to mark the start, two turns, and the end points. Additionally, 4 cones were placed at 3.3-meter intervals in the center for the turns. The athlete began by lying face down on the ground at the starting point. Upon the start command, the athlete got up and completed the course correctly until reaching the finish line [18].

*Sit and Reach Test:*

The aim of this test is to measure the development of an athlete's hamstring and lower back flexibility. At the beginning of the test, shoes were removed, and the feet were placed against the table while sitting on the floor with legs straight. The arms were extended as far forward as possible. The distance from the fingertips to the edge of the table was recorded in centimeters. Several warm-up attempts were allowed, and the best result was recorded [18].

*Standing Long Jump Test:*

The athlete was instructed to jump forward with maximum power from a position behind a marked starting line, using both feet simultaneously. The distance between the starting line and the back heel of the athlete's rear foot upon landing was measured with a meter. The measurement was recorded in centimeters [19].

*Vertical Jump Test:*

The athletes were instructed to jump barefoot on a flat surface. They were advised to avoid bending their knees towards their abdomen during the jump and to ensure both feet landed equally on the ground. The best result was recorded after two repetitions [20].

*Training Plan:*

A specially designed combined training program for beach soccer was implemented for the exercise group participating in the study over a six-week period. (Table 1, 2).

**Table 1.** Six-week training plan

| | 1. WEEK | | 2. WEEK | | 3. WEEK | |
|---|---|---|---|---|---|---|
| **Day/Time** | **Morning** | **Evening** | **Morning** | **Evening** | **Morning** | **Evening** |
| **Monday** | Adaptation, Mobility, Core Training, Foam Roller | Rest | Regeneration, Foam Roller (Players with Less Match Time + Strength Training) | Rest | Permission | Permission |
| **Tuesday** | General Aerobic Endurance, Rest, Adaptation with Ball, Stretching | Warm-Up Exercises, Combined Training, Small-Sided Games for Endurance, Stretching | General Aerobic Endurance, Rest, Core Training, Stretching | Warm-Up Exercises, Coordination, Combined Training, Stretching | Permission | Permission |
| **Wednesday** | General Aerobic Endurance, Rest, Technical Work, Stretching | Warm-Up Exercises, Flexibility, Combined Training, Stretching | General Aerobic Endurance, Rest, Technical Work, Stretching | Warm-Up Exercises, Combined Training, Game Without Goal, Stretching | Permission | Permission |
| **Thursday** | Rest | Tactical Study | Rest | Tactical Study | Gathering, Mobility, Core Training, Foam Roller | Tactical Study |
| **Friday** | General Aerobic Endurance, Rest, Core Training | Warm-Up Exercises, Coordination, Combined Training, Game, Stretching | General Aerobic Endurance, Rest, Core Training, Stretching | Warm-Up Exercises, Coordination, Combined Training, Small-Sided Games (4:4:4), Stretching | General Aerobic Endurance, Rest, Core Training | Warm-Up Exercises, Coordination, Combined Training, Full-Court Game, Stretching |
| **Saturday** | Rest | Tactical Study | Rest | Tactical Study | General Aerobic Endurance, Rest, Technical Work, Stretching | Tactical Study |

**Table 1.** (Continued)

| | 1. WEEK | | 2. WEEK | | 3. WEEK | |
|---|---|---|---|---|---|---|
| **Day/Time** | **Morning** | **Evening** | **Morning** | **Evening** | **Morning** | **Evening** |
| **Sunday** | Rest | Match Warm-Up, Training Match, Stretching | Rest | Match Warm-Up, Training Match, Stretching | Rest | Match Warm-Up, Training Match, Stretching |

| | 4. WEEK | | 5. WEEK | | 6. WEEK | |
|---|---|---|---|---|---|---|
| **Day/Time** | **Morning** | **Evening** | **Morning** | **Evening** | **Morning** | **Evening** |
| **Monday** | Rest | Regeneration, Mobility, Foam Roller, Shock Pool (Players with Less Match Time + Strength Training) | Rest | Regeneration, Bicycle, Foam Roller (Players with Less Match Time + Strength Training) | Permission | Permission |
| **Tuesday** | Rest | Warm-Up Exercises, Combined Training, Small-Sided Games for Endurance, Stretching | Rest | Warm-Up Exercises, Combined Training, Small-Sided Games (4:4:4), Stretching | Rest | Warm-Up Exercises, Combined Training, Stretching |
| **Wednesday** | Rest | Warm-Up Exercises, Flexibility, Combined Training, Stretching | Rest | Warm-Up Exercises, Coordination, Combined Training, Anaerobic Threshold Training (2v2, 2 min), Stretching | Rest | Warm-Up Exercises, Coordination, Combined Training, Anaerobic Threshold Training (1v1, 1 min), Stretching |
| **Thursday** | Fitness Strength Training | Tactical Study | Fitness Strength Training | Tactical Study | Fitness Strength Training | Tactical Study |
| **Friday** | Rest | Warm-Up Exercises, Coordination, Combined Training, Game, Stretching | Rest | Warm-Up Exercises, Combined Training, Full-Court Game, Sprint Study, Stretching | Rest | Warm-Up Exercises, Combined Training, Sprint Study, Stretching |
| **Saturday** | Rest | Tactical Study | Rest | Tactical Study | Rest | Tactical Study |
| **Sunday** | Rest | Match Warm-Up, Training Match, Stretching | Rest | Match Warm-Up, Training Match, Stretching | Rest | Match Warm-Up, Training Match, Stretching |

**Table 2.** Daily training program

| Program Components |
|---|
| - Warm-up (20 min. active)<br>- Combined Training (40 min.) (Speed, plyometric, endurance, skill)<br>- Small-sided game 4:4:4 (15 min.)<br>- Stretching 10 min. |
| **WARM-UP:**<br>- 5 min. free running<br>- 5 min. dynamic warm-up<br>- 10 min. quickness, coordination work |
| **PART 1:**<br>- Aerobic endurance training (endurance, speed, agility, plyometric, skill) (40 min.)<br>- 2 sets (7 reps per set), 3 min. rest between sets |
| **PART 2:**<br>- 4:4:4 Small sided play (Pass and support) (15 min.) |
| **FINISH:**<br>- Stretching (10 min.) |

Aerobic endurance training with ball content:

- Transition by skipping stairs.
- Running with the ball at 70% intensity.
- Double-footed jump over an obstacle.
- Jumping through hoops with one foot.
- Shot on goal.
- Slalom with a ball.
- Passage between the ball and the funnels.
- Step frequency.
- Shot on goal.

*Statistical Analysis*

The IBM SPSS (25.0) software package was used for data analysis. Since the number of participants was less than 50, the Shapiro-Wilk test was performed to assess normality. For normally distributed data, the paired samples t-test, a parametric test, was used to determine differences. For non-normally distributed data, the Wilcoxon Signed Ranks Test was applied. The significance level was set at $p < .05$.

## Results

The findings obtained from the statistical analyses conducted at the end of the measurements in the study are presented in Tables 3–9. The descriptive statistics of the study group, including height, body weight (BW), body mass index (BMI), body fat percentage (BF%), and body fat mass (BFM), are presented below (Table 3). These variables provide an overview of the physical characteristics of the participants in both groups.

The data reveal notable trends in the physical characteristics of the study group (Table 3). Participants in both groups demonstrated variability in body composition metrics, reflecting differences in their physical conditioning. These descriptive statistics provide a foundation for interpreting the study's outcomes. Key metrics such as BMI and body fat percentage offer valuable insights into the participants' health and fitness levels.

The body composition values for the exercise group, including body weight (BW) and body fat percentage (BF%), are detailed below (Table 4). The pre- and post-training values are compared to evaluate the impact of the training program.

The results indicate a significant reduction in body fat percentage (BF%) following the training program, with the mean difference reaching statistical significance at the $p < .05$ level (Table 4). However, no change was observed in body weight (BW), suggesting that the combined training program primarily influenced body composition rather than total body mass.

**Table 4.** Body composition values of exercise group

| Variables | Mean | SD | t | p |
|---|---|---|---|---|
| BW (kg) pre | 81.35 | 11.34 | 0.00 | 1.00 |
| BW (kg) post | 81.35 | 11.30 | | |
| BF% pre | 16.36 | 4.75 | 7.29 | 0.00 |
| BF% post | 11.93 | 4.53 | | |

*. Mean difference is significant at .05 level.

The differences in BMI and body fat mass (BFM) measurements for the exercise group are presented below (Table 5). The table summarizes the distribution of negative, positive, and equal ranks for pre- and post-training values.

The findings indicate the following trends:

- For BMI, both increases and decreases 6,35.
- tistical differences in BMI and body fat mass (BFM) tests for the exercise group are summarized below (Table 6). The results are based on the

**Table 3.** Descriptive statistics of the study group

| Variables | Exercise Group | | | | | Control Group | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | Min. | Max. | Mean | SD | N | Min. | Max. | Mean | SD |
| Height (cm) | 14 | 174.00 | 197.00 | 181.85 | 6.41 | 12 | 165.00 | 195.00 | 176.50 | 8.22 |
| BW (kg) | 14 | 67.40 | 104.00 | 81.35 | 11.34 | 12 | 44.60 | 87.90 | 73.00 | 12.37 |
| BMI (kg/m²) | 14 | 22.20 | 29.00 | 24.53 | 2.22 | 12 | 16.40 | 30.40 | 23.38 | 3.61 |
| BF% (%) | 14 | 9.40 | 23.08 | 16.36 | 4.75 | 12 | 9.60 | 23.80 | 16.03 | 4.78 |
| BFM (kg) | 14 | 6.79 | 24.00 | 13.61 | 5.51 | 12 | 4.77 | 19.40 | 12.04 | 4.91 |

**Table 5.** Difference table between BMI and BFM measurements in exercise group

| Variables | Rows | N | Average ranks | Ranks Total |
|---|---|---|---|---|
| BMI2 - BMI1 | Negative rows | 8[a] | 7.00 | 56.00 |
| | Positive rows | 6[b] | 8.17 | 49.00 |
| | Total | 14 | | |
| BFM2 - BFM1 | Negative rows | 14[a] | 7.50 | 105.00 |
| | Positive rows | 0[b] | .00 | .00 |
| | Total | 14 | | |

Note:

a. EBKI2 < EBKI1 a. EBFM2 < EBFM1

b. EBKI2 > EBKI1 b. EBFM2 > EBFM1

c. EBKI2 = EBKI1 c. EBFM2 = EBFM1

Wilcoxon Signed Ranks Test, highlighting the significance of changes observed between pre- and post-training measurements.

The results indicate:

- No statistically significant change in BMI between pre- and post-training values ($p = 0.825$).
- A highly significant reduction in BFM between pre- and post-training values ($p < 0.05$).

The body composition values for the control group, including body weight (BW), body mass index (BMI), body fat percentage (BF%), and body fat mass (BFM), are detailed below (Table 6). Pre- and post-training values are compared to evaluate any changes in these variables.

**Table 6.** Control group body composition values

| Variables | Mean | SD | t | p |
|---|---|---|---|---|
| BW (kg) pre | 72.63 | 12.42 | -1.02 | 0.32 |
| BW (kg) post | 74.10 | 13.99 | | |
| BMI (kg/m²) pre | 23.26 | 3.63 | -0.85 | 0.40 |
| BMI (kg/m²) post | 23.65 | 3.80 | | |
| BF (%) pre | 15.80 | 5.08 | -0.09 | 0.92 |
| BF (%) post | 15.95 | 5.51 | | |
| BFM (kg) pre | 11.84 | 5.13 | -0.49 | 0.63 |
| BFM (kg) post | 12.50 | 5.85 | | |

Note. *. Mean difference is significant at .05 level.

The results (Table 7) indicate no statistically significant changes in body composition values for the control group across all variables ($p > 0.05$). Body weight, BMI, BF%, and BFM showed minor variations between pre- and post-training measurements, but these changes did not reach statistical significance.

The performance test results for the exercise group, including sit-and-reach (SAR), 20-meter sprint time (20ST), vertical jump test (VJT), standing long jump (SLJ), and Illinois agility test (IAT), are summarized below (Table 8). Pre- and post-training comparisons are provided to evaluate the effects of the training program.

The results demonstrate significant improvements across all performance metrics in the exercise group (Table 7). Key findings include:

- Increased flexibility (SAR) with a significant mean difference ($p < 0.05$).
- Faster sprint times (20ST) and agility (IAT) after training ($p < 0.05$).
- Enhanced jump performance (VJT and SLJ) with significant gains ($p < 0.05$).

**Table 7.** Exercise group performance t-test results

| Tests | Mean | SD | t | p |
|---|---|---|---|---|
| SAR pre (cm) | 9.78 | 6.86 | -6.23 | 0.00 |
| SAR post (cm) | 13.00 | 6.93 | | |
| 20ST pre (sec) | 3.51 | 0.13 | 5.26 | 0.00 |
| 20ST post (sec) | 3.35 | 0.12 | | |
| VJT pre (cm) | 35.77 | 4.39 | -6.10 | 0.00 |
| VJT post (cm) | 40.53 | 5.38 | | |
| SLJ pre (cm) | 212.00 | 12.14 | -2.26 | 0.04 |
| SLJ post (cm) | 219.57 | 14.74 | | |
| IAT pre (sec) | 18.59 | 0.50 | 9.56 | 0.00 |
| IAT post (sec) | 17.05 | 0.50 | | |

Note. *. Mean difference is significant at .05 level.

The performance test results for the control group, including sit-and-reach (SAR), 20-meter sprint time (20ST), vertical jump test (VJT), standing long jump (SLJ), and Illinois agility test (IAT), are presented below (Table 8). Pre- and post-training comparisons are provided to evaluate any changes in performance.

The results indicate the following (Table 9):

- A significant improvement was observed in flexibility (SAR) with a mean difference at the $p < 0.05$ level.
- No statistically significant changes were found in other performance metrics, including 20ST, VJT, SLJ, or IAT ($p > 0.05$).

**Table 8.** Control group t-test results

| Tests | Mean | SD | t | p |
|---|---|---|---|---|
| SAR pre (cm) | 5.99 | 4.33 | -3.90 | 0.00 |
| SAR post (cm) | 6.38 | 4.43 | | |
| 20ST pre (sec) | 3.58 | 0.23 | -0.63 | 0.53 |
| 20ST post (sec) | 3.62 | 0.25 | | |
| VJT pre (cm) | 35.43 | 6.67 | 0.58 | 0.57 |
| VJT post (cm) | 35.02 | 5.51 | | |
| SLJ pre (cm) | 193.16 | 16.84 | -0.18 | 0.85 |
| SLJ post (cm) | 193.58 | 15.90 | | |
| IAT pre (sec) | 18.09 | 0.84 | -0.94 | 0.36 |
| IAT post (sec) | 18.28 | 0.83 | | |

Note. *. Mean difference is significant at .05 level.

## Discussion

This study was conducted with individuals aged 18 years and older who played beach soccer to evaluate the effects of combined training on body composition and performance. Due to the limited number of studies on beach soccer available in the literature, findings from similar studies were referenced for comparison and discussion.

*Effects of Combined Training on Body Composition*

In our study, a statistically significant difference was observed in the pre-test and post-test values of body composition parameters, specifically BF% and BFM, among athletes in the exercise group (combined training group) ($p < .05$). However, no statistically significant differences were found in the BMI and BW values of the exercise group. Similarly, the pre-test and post-test values of the body composition parameters (BW, BMI, BF%, and BFM) in the control group did not show any statistically significant differences ($p > .05$).

No statistically significant differences were observed in BW and BMI pre-test and post-test values in various studies involving soccer players and combined training interventions. In our study, this was consistent with findings in young male soccer players undergoing eight weeks of combined training [21], as well as studies on 27 professional and 30 amateur soccer players [22]. Similarly, no significant changes in BW were reported in a study on 12–14-year-old male soccer players following combined training [23] or in a six-week training program with 40 athletes under 15 years of age training three days per week [24]. Additionally, an eight-week combined training program for students aged 12–14 years attending a football course showed no significant differences in experimental group BMI measurements [25]. Further, in a study on 51 soccer players and 50 non-athletes aged 17–21 years with regular training over five years, BW was found to be higher in soccer players compared to non-athletes [26]. Similarly, a 24-week combined endurance and strength training program conducted 2–3 times per week with 34 active, healthy young individuals reported no significant differences in BW and BMI ($p > .05$) [27].

When the literature is examined, several studies report findings on BF% (body fat percentage) changes among soccer players and athletes undergoing various training interventions. A study on 14–17-year-old futsal athletes who underwent combined training showed differences between pre-test and post-test BF% values [28]. Similarly, in an eight-week study involving exercise groups of young male soccer players, BF% values showed significant changes [21]. In a study on 27 professional and 30 amateur soccer players, BF% values were also compared and analyzed [22].

Another study with 24 male soccer players involved an aerobic exercise program conducted three days a week for eight weeks, showing changes in BF% values between pre- and post-tests [29]. For young male soccer players participating in a youth football team, eight weeks of dynamic core exercises led to differences in BF% [30]. A separate study on 239 children aged 9–15 playing in the football substructure found BF% changes after three hours of weekly training [31].

High-intensity interval training applied three days per week for four weeks, in addition to soccer training for 24 male soccer players aged 15–17, also demonstrated differences in BF% values [32]. Similarly, six weeks of pre-season training for professional soccer players resulted in BF% changes between pre- and post-tests [33].

In a study with 10 men and 9 women, a 10-week high-intensity intermittent combined endurance training program led to significant changes in BF% for male participants [34]. Another study comparing 51 soccer players aged 17–21 with 50 non-athletes found that BF% was significantly lower in soccer players [26]. Finally, a study on 111 female and 105 male athletes reported statistically significant differences in BF% according to an analysis of variance ($p < 0.05$) [35].

Significant differences in BFM (body fat mass) values have been reported in several studies. For example, in an eight-week study involving exercise groups of young male soccer players, pre-test and post-test BFM values showed significant changes [21]. Similarly, a study comparing 27 professional and 30 amateur soccer players found differences in BFM values [22]. Six weeks of pre-season training for professional soccer players also resulted in changes in BFM [33]. In a study comparing 51 soccer players aged 17–21 and 50 non-athletes who had been training regularly for five years, soccer players exhibited significantly lower BFM than non-athletes [26]. Additionally, in a study of 111 female and 105 male athletes, highly significant differences in BFM were observed based on the results of an analysis of variance ($p < 0.05$) [35].

When the literature is reviewed, it is evident that the training method, content, intensity, and regularity significantly impact physical and anthropometric characteristics, positively influencing performance [21, 22, 26, 28, 33, 35]. In our study, a significant decrease was observed in the BF% and BFM values of the exercise group ($p < .05$). This reduction is likely attributed to the training program increasing the metabolic rate of the soccer players, promoting fat burning, and reducing overall fat mass. These effects resulted in significant differences in the BF% and BFM ratios of the exercise group participants.

*Effects of Combined Training on Performance*

A statistically significant difference was observed in the speed, vertical jump, standing long jump, agility, and flexibility values of the exercise group athletes between pre- and post-training measurements ($p < .05$). Additionally, the flexibility values of the control group athletes showed significant improvement ($p < .05$). However, no statistically significant differences were found in the speed, vertical jump, standing long jump, or agility values of the control group athletes between pre- and post-training measurements ($p > .05$).

A statistically significant difference was observed in the pre-test and post-test values of the sit-and-reach flexibility test for the exercise group in our study ($p < .05$) (Table 8). When examining the literature, similar findings were reported. For example, a statistically significant difference was found between the pre-test and post-test flexibility test values in combined training applied to futsal athletes aged 14–17 years [28], and in the sit-and-reach test measurements of 55 soccer players aged 12–14 years undergoing combined training [36] ($p < .05$). In our study, the significant increase in flexibility test values can likely be attributed to the mobility and intensive stretching exercises included in the unit training, which were effective in improving flexibility.

A statistically significant difference was observed in the pre-test and post-test values of the 20m sprint test for the exercise group in our study ($p < .05$) (Table 8). When reviewing the literature, similar findings were reported. A statistically significant difference was observed in the 30m sprint test pre-test and post-test measurements in combined training programs for 14-year-old soccer players [37]. Additionally, significant differences were found in the 20m sprint test pre-test and post-test measurements in combined training programs for 12–14-year-old male soccer players [23, 36], as well as in the 20m sprint test measurements at the end of an eight-week soccer training program conducted twice weekly for young male soccer players [21].

Further studies reported significant improvements in the 20m sprint test measurements following six weeks of training conducted three days a week for 40 athletes under 15 years of age [24] and in eight-week combined training programs applied to 12–14-year-old football course students [25]. Similarly, the 30m sprint test of the experimental group improved significantly in a study involving narrow-field training applied three days a week for eight weeks to 15–16-year-old male soccer players [38] ($p < .05$).

It is suggested that speed, quickness, strength, and plyometric exercises included in combined training develop the leg muscles and enhance speed potential [21, 23, 36, 37]. In our study, the speed, quickness, strength, and plyometric exercises applied in the exercise group contributed to significant improvements in speed. Therefore, combined training can be considered an effective alternative method for speed enhancement in soccer players.

A statistically significant difference was observed in the pre-test and post-test values of the vertical jump test for the exercise group in our study ($p < .05$) (Table 8). Similar findings have been reported in the literature. Significant improvements in vertical jump test results were observed in 14-year-old soccer players participating in combined training programs [37] and in nonprofessional U16 male soccer players undergoing coordination and agility training three days a week for 10 weeks [39]. Additionally, significant differences were found in vertical jump test results for 14–17-year-old futsal athletes undergoing combined training [28] and for 12–14-year-old male soccer players participating in combined training programs [23].

Further improvements were reported in studies involving six weeks of training conducted three days a week with 40 athletes under 15 years of age [24], eight weeks of football training applied twice weekly to exercise groups of young male soccer players [21], and combined training programs for 55 soccer players aged 12–14 years [36] ($p < .05$).

We believe that determining training load intensity based on pre- and post-training test results and incorporating squat exercises and plyometric exercises into strength training programs are effective in improving vertical jump performance. Similar studies have also demonstrated the effectiveness of squats and plyometric exercises for athletes [40].

A statistically significant difference ($p < .05$) was observed in the pre-test and post-test values of the standing long jump test for the exercise group in our study (Table 8). Similar findings have been reported in the literature. In a study comparing the performance of male and female beach soccer players on sand and hard ground, significant differences were found between pre-test and post-test standing long jump measurements [41]. Likewise, significant improvements were reported in studies involving combined training applied to

12-year-old soccer players [23], and 12–14-year-old male soccer players [13].

Further studies demonstrated significant differences in the standing long jump test results for young male football players after eight weeks of training conducted twice weekly [21], as well as for 55 soccer players aged 12–14 years participating in combined training programs [36]. Similarly, significant improvements were observed in an eight-week combined training program applied to football course students aged 12–14 years [25] ($p < .05$).

In our study, the long jump test results showed a significant increase. This improvement can likely be attributed to the plyometric exercises incorporated into the combined training program. Plyometric exercises are known to enhance explosive power, which is critical for improving standing long jump performance.

A statistically significant difference ($p < .05$) was observed in the pre-test and post-test values of the Illinois agility test for the exercise group in our study (Table 8). Similar results have been reported in the literature. Significant differences were found in the Illinois agility test results for 14–17-year-old futsal athletes undergoing combined training [28]. Additionally, studies demonstrated significant improvements in agility following eight weeks of football training conducted twice weekly with young male soccer players [21], and after coordination and agility training applied three days a week for 10 weeks to a nonprofessional U16 men›s soccer team [39]. Further improvements were observed in a study involving narrow-field training applied three days a week for eight weeks to 15–16-year-old male soccer players [38] ($p < .05$).

It is believed that the versatility of the combined training method contributes to improved agility by enhancing multiple biomotor characteristics simultaneously. In our study, the training program included components such as plyometric, speed, strength, core, reaction, and interval training. These organized and comprehensive methods make combined training an effective approach for improving agility performance in soccer players.

*Study Limitations*

This study has certain limitations that should be acknowledged. The sample size was relatively small, which may limit the generalizability of the findings to broader athletic populations. Additionally, the study duration was six weeks, and long-term effects of combined training were not assessed. Future research should include larger and more diverse populations and extend the training duration to evaluate the sustainability of performance improvements. Investigating the integration of combined training with sport-specific technical and tactical drills could also provide valuable insights for optimizing training programs in beach soccer.

## Conclusions

The six-week combined training program applied to the Turkish Beach Soccer National Team athletes contributed significantly to their motoric and physical characteristics and positively influenced their body composition. Considering that the combined training model used in our study led to improvements in several parameters examined in the athletes, it can be concluded that this training approach is suitable for use by sports scientists and coaches working in beach soccer.

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