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Investigation of the Effect of Restricted Environmental Stimulation Technique (Floatation-REST) in Floatation Tank on Physical, Physiological, and Psychological Recovery Parameters of Football Players

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Abstract **Background:** It is known that heavy training and football matches affect the performance of athletes negatively. Therefore, in our study, we aimed to investigate the effect of Floatation-REST on the physical, physiological, and psychological recovery parameters of football players after plyometric training. **Methods:** 24 football players between the ages of 20-26 who play in the amateur league in the province of Bitlis in Turkey participated in the study. Two groups were formed as control (n=12) and float (n=12) groups. After the groups had plyometric training, the control group was shown the documentary video, while Floatation-REST was applied to the float group. The effect of the method on recovery was assessed using heart rate measurement, lactate, cortisol, myoglobin, creatine kinase, leukocytes, IL-6, TNF-alpha serum analyses, performance tests, and a psychological perception questionnaire. **Result:** It was determined that Floatation-REST had statistically significant positive effects on heart rate, lactate, creatine kinase, myoglobin, cortisol and IL-6 levels, rectus femoris, tibialis anterior, gastrocnemius and achilles tendon pain levels, speed (30 m), agility and thrust force performances and accelerated recovery. In the psychological perception questionnaire, the athletes who were applied Floatation-REST stated that they generally felt a decrease in their pain and their performance increased. **Conclusion:** Our results show that Floatation-REST can be used by football clubs as a new recovery method.

Key Words football, fatigue, recovery, plyometric training, floatation-rest

1. Introduction

Football is considered one of the most popular sports branches in the world. Football training includes sports activities that aim to maximize performance, aim at continuity, and have a high percentage of impact [1]. It has been observed that these heavy training and football matches for preparation cause physiological and psychological stress on the athletes and affect their performance negatively [2].

It is stated that consecutive training in football causes muscle damage and limits the reflection of individual skills on performance [3]. Lactate, creatine kinase, and myoglobin levels, the levels of which increase in sports such as football with long training and match seasons, are seen as important parameters in determining muscle damage [4], [5]. It is also reported that muscle damage after training or a match triggers inflammation and muscle pain. [6]. In various studies, it is stated that the levels of some inflammation markers such as leukocytes, TNF-α, and IL-6 increase in case of muscle damage caused by exercise [7], [8]. In some studies, it has been shown that changes in the Testosterone/Cortisol ratio resulting from heavy training are associated with performance improvement [9], [10]. It is seen that these effects, which occur after training or matches, last for hours or even days, seriously reducing the performance of athletes [2].

Recovery is defined as the return of the physiological and psychological values of the athlete to their pre-training values

Group	Age	Height (m)	Weight (kg)
Control (n=12)	22,3±1,87	1,75±1,04	73,41±3,70
Float (n=12)	21,58±0,99	1,78±1,04	72,53±5,53
p	p>0,05	p>0,05	p>0,05

Table 1: Demographic characteristics of the participants

after training or a match [11]. Success in football requires high condition, endurance, speed, and strength. To achieve these high-performance criteria, athletes who can recover physiologically and psychologically early after training and matches are needed [12]. For this reason, recovery studies aimed at providing high-level performance in football players are becoming more important day by day [13]. It is known that the right training and the right recovery strategies accelerate the recovery time. Acute interventions such as massage, cryotherapy, cold-hot water therapies, and nutritional supplements applied in short time intervals after continuous training and matches are among the various methods used to minimize pain and accelerate physiological and psychological recovery [14]. However, there is currently no consensus on recovery strategies. Further studies are needed for effective and individually designed recovery strategies.

In various sportive studies conducted in recent years, a new model that increases the recovery potential is the Floatation-Restricted Environmental Stimulation Technique (Floatation-REST) in the floatation tank. Floatation-REST was designed by John Lilly in 1977 and it has been found that it is good for psychological disorders such as anxiety and stress, which are known to affect sportive performance [2]. Due to this effect, it has recently started to gain popularity in professional sports teams, individual sports branches, and the military. However, there is no study examining the effect of the Floatation-REST application on the recovery parameters of football players. Within the scope of our study, it was aimed to assess the effect of Floatation-REST, which was administered acutely to amateur football players after plyometric training, on recovery using metabolic stress (lactate), neuroendocrine (cortisol, testosterone), structural damage (myoglobin, creatine kinase), inflammation (IL-6, TNF-alpha), physical performance (bounce, jump, agility, speed, shot), and psychological perception (pain, mood, energy, etc.) parameters.

2. Materials and Methods

A. Study Design

24 healthy male football players between the ages of 20-26, who play in the amateur league and regularly train in the province of Bitlis in Turkey, participated in the research. Two groups, the Control (n=12) and Float group (n=12) were formed for the study (Table 1). The study was started after obtaining the approval of the Fırat University Non-Interventional Ethics Committee (No: 423528). Before starting the research, the participants were asked to fill out a "Voluntary Consent Form".

The study was completed under 10 main work packages. Measurements of the parameters to be examined were made in 5 different periods. These periods are Pre-training (T1), immediately after training (T2), Floatation-REST/immediately after rest (T3), 2 hours after Rest/Floatation-REST (T4), and 24 hours after Rest/Floatation-REST (T5) (Figure 1).

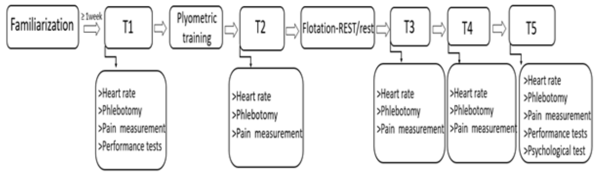

Figure 1: Design of study. T1: Before training, T2: Immediately after training, T3: Immediately after Flotation-REST/rest, T4: 2 hours after Flotation-REST/rest, T5: 24 hours after Flotation-REST/rest. Min: minute

B. Plyometric Training

The plyometric training model used by Cicioğlu et al. was used in the study [15]. The exercises were held in the indoor gym at 23-24°C. In the study, warm-up and stretching exercises were performed for 5-10 minutes just before the training, and then a performance test was applied to the participants. The exercises within the plyometric training were performed in 2 sets, 10 repetitions, and 1-2 minutes of rest were allowed between sets [15].

C. Heart Rate Measurement

Heart Rate (HR) values of the athletes in the control and float groups at T1, T2, T3, T4, and T5 periods were recorded with an electronic blood pressure device (Omron BF 510; Omron Corp. Kyoto, Japan).

D. Performance Tests

To assess the effect of Floatation-REST on performance, after a light warm-up, vertical jump test at T1 and T5 periods, speed test (10, 30 meters), pro-Agility test (5 -10 -5), push force measurement, standing long jump test and various performance tests such as the one-touch pass test were given to the athletes in the control group and float group.

E. Floatation-REST (Floatation Restricted Environmental Stimulation Technique)

Athletes in the float group were included in the training one by one and the same procedure was applied to everyone. Floatation-REST was applied to the athletes in the float group for 45 minutes immediately after the training. Athletes were washed in warm water for a short time with sulfate-free shampoo before and after entering the tank. The galvanized floatation tank was specially built with the dimensions of 260 × 150 × 95 cm. The tank was filled approximately 25-30 cm with water containing Epsom salt (Magnesium sulfate) (1.81 kg:3.79 L). Unlike the sodium chloride solution, Epsom salt is very poorly absorbed by the skin and does not irritate or dry the skin. The temperature of the water in the tank was kept constant at 34.2 °C with aquarium heaters. The floatation medium was isolated from light, sound, and airflow. UV light was used for 15 minutes to ensure the cleanliness of the water in the tank [16], [17].

F. Control Room

The athletes in the control group were allowed to rest for 45 minutes in a waiting room with normal auditory, visual, and temperature sensations. The control room was illuminated with a 65-watt bulb and the room temperature was maintained at 23-24°C. A documentary (BBC Planet Earth) was shown for the visual and auditory activation of athletes [18].

G. Sample collection and Biochemical Analysis

For the measurement of blood parameters, blood samples were taken from the athletes 5 times, at T1, T2, T3, T4, and T5 periods. Then, serum and plasma were obtained by spinning the tubes at 2000xg in a cooled centrifuge for 10-15 minutes. The obtained serum and plasma samples were stored at -80°C until biochemical measurements were made.

Blood lactate values were measured from the finger using an electronic lactate meter (GolDEal Lactate Meter, Aurum Biomedical Technology, Inc., Hsinchu, Taiwan). Cortisol, testosterone, myoglobin, creatine kinase, and lymphocyte levels were analyzed in an autoanalyzer with commercially available kits. IL-6 and TNF-α parameters were analyzed using the Enzyme-linked Immunosorbent Assay Elisa method. Analyzes were performed following the manuals of the human-specific IL-6 (Catalogue No: 201-12-0091, Sunred Biotechnology Company, Shanghai, China) and TNF-α (Catalogue No: 201-11-0765, Sunred Biotechnology Company, Shanghai, China) Elisa kits.

H. Pain Measurement

The trigger point pressure pain algometer with high validity and reliability was used to determine the changes in the pain levels in the muscles of the football players in the Control and Float groups (Baseline 60-pound Dolorimeter/Algometer Pain Threshold Meter, Pro-Health Care, USA). Pain measurements were made from the rectus femoris, vastus lateralis, and vastus medialis muscles in the upper leg, and from the tibialis anterior, gastrocnemius muscles, and Achilles tendon in the lower leg in the T1, T2, T3, T4, and T5 periods. Measurements were performed with 3 repetitions with a 30-second rest period in between.

I. Psychological Perception Assessments

To assess how the Floatation-REST application affects football players psychologically, the questionnaire in Table 2 was applied to the athletes in the float group on the last day of the test [19]. Since Float-REST was not applied to the control group, the effect of this technique on psychological perception was assessed only in the float group.

Floatation-REST application relaxed my body		
	Frequency	Percentage (%)
Neutral	1	8,3
Agree	6	50,0
Strongly agree	5	41,7
Total	12	100
I felt good emotionally after the Floatation-REST application		
	Frequency	Percentage (%)
Neutral	2	16,7
Agree	8	66,7
Strongly agree	2	16,7
Total	12	100
I felt more energetic after Floatation-REST		
	Frequency	Percentage (%)
Neutral	2	16,7
Agree	4	33,3
Strongly agree	6	50
Total	12	100
I enjoyed spending time in the Floatation-REST tank		
	Frequency	Percentage (%)
Neutral	1	8,3
Agree	8	66,7
Strongly agree	3	25,0
Total	12	100
I slept more comfortably after Floatation-REST		
	Frequency	Percentage (%)
Disagree	3	25,0
Neutral	4	33,3
Agree	4	33,3
Total	12	100
Floatation-REST reduced/relieved my muscle soreness		
	Frequency	Percentage (%)
Disagree	2	16,7
Neutral	2	16,7
Agree	6	50,0
Total	12	100
Floatation-REST implementation improved my performance		
	Frequency	Percentage (%)
Neutral	2	16,7
Agree	6	50,0
Strongly agree	4	33,3
Total	12	100
The floatation-REST application increased my concentration		
	Frequency	Percentage (%)
Strongly disagree	1	8,3
Disagree	3	25,0
Neutral	6	50,0
Agree	2	16,7
Total	12	100
I would like to try Floatation-REST again		
	Frequency	Percentage (%)
Neutral	1	8,3
Agree	8	66,7
Strongly agree	3	25,0
Total	12	100

Table 2: Assessment of psychological perception survey data

J. Statistical Analysis

Statistical evaluations of this study were made using IBM SPSS 22.0 package program, licensed by Fırat University (193.255.124.131). Obtained data were expressed as mean ± standard deviation (SD). Statistical differences were calculated in groups using "repeated measures ANOVA", "one-way ANOVA" and "independent student-t" tests. The $p < 0.05$ value was deemed statistically significant in the interpretation of the results obtained.

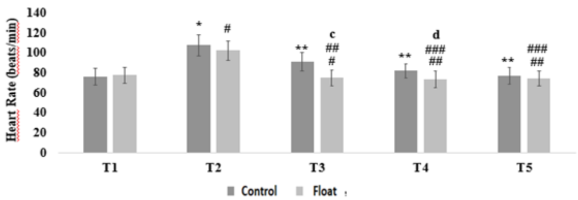

Figure 2: Analysis of heart rate. Data presented as mean ± standard deviation. * : Statistically significant difference compared to the control T1 group. ** : Statistically significant difference compared to the control T2 group. #: Statistically significant difference compared to float T1 group. ##: Statistically significant difference compared to float T2 group. ###: Statistically significant difference compared to float T3 group. d: Statistically significant difference compared to the control T4 group. T1: Before training, T2: Immediately after training, T3: Immediately after Flotation-REST/rest, T4: 2 hours after Flotation-REST/rest, T5: 24 hours after Flotation-REST/rest. Min: minute

3. Results

A. Analysis of Heart Rate Data

In the control group, it was determined that HR increased in T2 compared to T1 (p<0.001) and decreased in T3, T4, and T5 compared to T2 (for all; p<0.001). It was observed that HR in the float group increased in T2 and T3 compared to T1, decreased in T3, T4, and T5 compared to T2, and decreased in T4 and T5 compared to T3 (p<0.001). It was determined that HR was decreased in T3 and T4 of the float group compared to the control (respectively; p<0.001, p=0.019) (Figure 2).

B. Analysis of Blood Parameters

1) Analysis of Lactate Data

It was determined that lactate levels in the control group decreased in T2 compared to T1 and in T3 compared to T2 (p<0.001 and p=0.005, respectively). It was observed that lactate level decreased in T2 and T5 compared to T1 (respectively; p=0.001, p=0.006), in T4 and T5 compared to T2 (respectively; p=0,004, p<0,001), and in T4 compared to T3 (p=0,018) in the float group. It was determined that the lactate level was lower in the float group in T4 and T5 compared to the control group (respectively; p=0.010, p=0.001) (Figure 3).

2) Analysis of Creatine Kinase and Myoglobin Data

In the control group, creatine kinase was found to be increased in T2, T3, T4, and T5 compared to T1 (respectively; p=0.037, p=0.009, p=0.014, p<0.001). It was determined that creatine kinase increased in T2, T3, and T4 compared to T1 in the float group (respectively; p=0.029, p=0.016, p=0.003). Creatine kinase was found to be decreased at T5 in the float group compared to the control (p=0.020) (Figure 3).

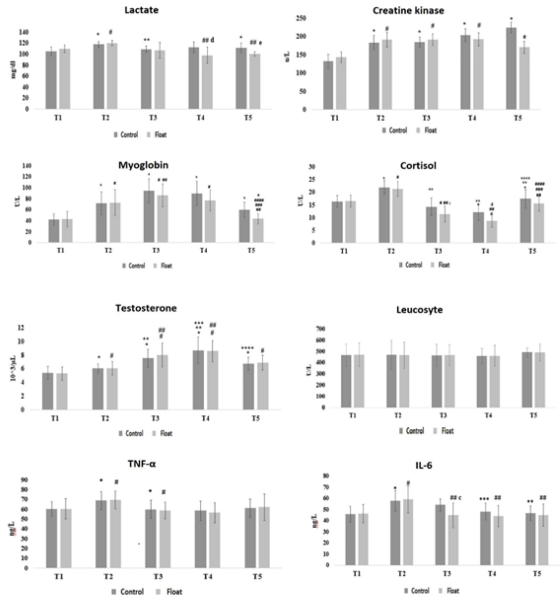

Figure 3: Analysis of blood parameters of Control and Float groups. Data presented as mean ± standard deviation. * : Statistically significant difference compared to the control T1 group. ** : Statistically significant difference compared to the control T2 group. *** : Statistically significant difference compared to the control T3 group. **** : Statistically significant difference compared to the control T4 group.#: Statistically significant difference compared to float T1 group. ##: Statistically significant difference compared to float T2 group. ###: Statistically significant difference compared to float T3 group. ####: Statistically significant difference compared to float T3 group. d: Statistically significant difference compared to the control T4 group. e: Statistically significant difference compared to the control T5 group. T1: Before training, T2: Immediately after training, T3: Immediately after Flotation-REST/rest, T4: 2 hours after Flotation-REST/rest, T5: 24 hours after Flotation-REST/rest.

In the control group, an increase in myoglobin T2, T3, T4 and T5 compared to T1 (respectively; p=0,001, p=0,006, p=0,028, p=0,024), an increase in T2, T3, T4 compared to T1 in the Float group (respectively; p=0,007, p<0,001, p<0,001), and a decrease in T5 compared to T2, T3 and T4 were detected (respectively; p=0,032, p=0,001). It was observed that myoglobulin decreased in T5 in the float group compared to the control (p=0.003) (Figure 3).

3) Analysis of Cortisol and Testosterone Data

In the control group, it was determined that cortisol increased in T2 compared to T1, decreased in T4 (respectively; p<0,001, p=0,044), decreased in T3, T4, and T5 compared to T2 (respectively; p<0,001, p<0,001, p=0,039), and increased in T5 compared to T4 (p=0,008). In the float group, it was determined that cortisol increased in T2 compared to T1 (p=0.024), decreased in T3 and T4 (respectively; p=0,011, p<0,001), decreased in T3, T4, and T5 compared to T2 (respectively; p<0,001, p<0,001, p=0,005), and increased in T5 compared to T4 (p=0,001). It was determined that the cortisol level was lower in the float group than in the control group in T3 and T4 (respectively; p=0.038, p=0.008) (Figure 3). When the testosterone levels were examined, no significant difference was found between the control group, float group, and control and float groups (respectively; F=0.007, p=0.934; F=1.373, p=0.259; F=1.561, p=0.192) (Figure 3).

4) Analysis of Leukocyte, TNF-α, IL-6 Data

In the control group, it was observed that the number of leukocytes increased in T2, T3, T4, and T5 compared to T1 (respectively; p=0,043, p=0,002, p=0,001, p=0,011), in T3, T4 compared to T2 (respectively; p=0,003, p=0,001), in T4 compared to T3 (p=0,002), and decreased in T5 compared to T4 (p=0,009). In the float group, it was determined that it increased in T2, T3, T4, and T5 compared to T1 (respectively; p<0,001, p=0,001, p<0,001, p=0,001), and in T3 and T4 compared to T2 (respectively; p=0,024, p=0,001). There was no significant difference between the control and float groups in terms of leukocyte levels (F=0.469, p=0.758) (Figure 3). In the control group, it was found that TNF-α increased in T2 compared to T1 (p=0.054) and decreased in T3 compared to T2 (p=0.026). In the float group, TNF-α was found to be increased compared to T1 (p=0.002) and T3 decreased compared to T2 (p=0.022). No significant difference was found between the control and float groups (F=0.25, p=0.925) (Figure 3).

In the control group, it was found that IL-6 levels increased in T2 compared to T1 (p=0.003), decreased in T5 compared to T2 (p=0.020), and decreased in T4 compared to T3 (p=0.046). In the float group, IL-6 was found to be increased in T2 compared to T1 (p=0.005) and decreased in T3, T4, and T5 compared to T2 (for all; p<0.001). IL-6 level was found to be lower in T3 than in the control group (F=4.03, p<0.001) (Figure 3).

C. Analysis of Muscle Pain Data

In the control group, it was determined that the rectus femoris pain level increased in T2 compared to T1 (p=0.005), decreased in T3, T4, and T5 compared to T2 (respectively; p=0,018, p=0,021, p=0,001), and decreased in T4 compared to T3 (p=0.013). In the float group, it was determined that it increased in T2 compared to T1 (p=0.012), and decreased in T3, T4, and T5 compared to T2 (p<0.001, p=0.002, p=0.006, respectively). The rectus femoris pain level was found to be lower in the float group than in the control group in T3 (F=2.935, p=0.046).

In the control group, it was determined that vastus lateralis pain level increased in T2 compared to T1 (p=0.004) and decreased in T3, T4, and T5 compared to T2 (respectively; p=0.001, p<0.001, p<0.001). In the float group, an increase in T2 compared to T1 (p=0.050) and a decrease in T3, T4, and T5 compared to T2 were determined (p=0.030, p=0.002, p=0.005, respectively). There was no significant difference between the control and float groups in terms of vastus lateralis pain changes (F=0.127, p=0.972).

There was no significant difference between control, float, or control and float groups in terms of vastus medialis pain changes (respectively; F=1.317, p=0.278; F=1.713, p=0.190; F=0.075, p=0.075).

In the control group, tibialis anterior pain level was found to be increased in T2 compared to T1 (p=0.034). In the float group, it was determined that the tibialis anterior pain level increased in T2 compared to T1 (p<0.001) and decreased in T3, T4, and T5 compared to T2 (p<0.001, p=0.005, p<0.001, respectively). The tibialis anterior pain level was found to be lower in T3, T4, and T5 in the Float group compared to the control group (p=0.003, p=0.026, p=0.006, respectively).

In the control group, gastrocnemius pain level was found to be increased in T2 compared to T1 (p=0.048). In the float group, gastrocnemius pain level increased in T2 compared to T1 (p<0.001) and decreased in T4 and T5 compared to T2 (p=0.002, p<0.001, respectively). Gastrocnemius pain level was found to be lower in T4 and T5 of the Float group compared to the control (respectively; p=0.013, p=0.003).

In the control group, the pain level of the Achilles tendon increased in T2 compared to T1 (p=0.001) and decreased in T5 compared to T2 and T3 (respectively; p=0.029, p=0.031). In the float group, it was determined that the pain level of the Achilles tendon increased in T2 compared to T1 (p<0.001), decreased in T4 and T5 compared to T2 (respectively; p<0,001, p<0,001), and decreased in T4 and T5 compared to T3 (respectively; p=0,003, p=0,001). The pain level of the Achilles tendon was found to be lower in T4 and T5 in the Float group compared to the control (respectively; p<0.001, p=0.018) (Figure 4).

D. Analysis of Performance Test Data

It was observed that there was no significant difference between the performance values of the control and float groups before the training (T1) (p>0.05). It was found that there was no significant difference in the vertical jump, speed (10 m), long jump, and one-touch pass performances in T5 in the Floatation-Rest group (p>0,05) compared to the control group, and the duration (sec.) of speed (30 m), agility and thrust force were significantly reduced (p=0.020, p=0.033, p=0.044) (Figure 5).

E. Analysis of Psychological Perception Questionnaire Data

The frequency and percentage values of the responses to the psychological perception questionnaire are shown in Table 2.

4. Discussion

It is known that the heavy training and frequent matches of football team players who participated in many organizations throughout the year affect psychological, physiological, and physical performance negatively. Recovery strategies are very important so that the performance of football players can reach the best level quickly and the risk of injury can

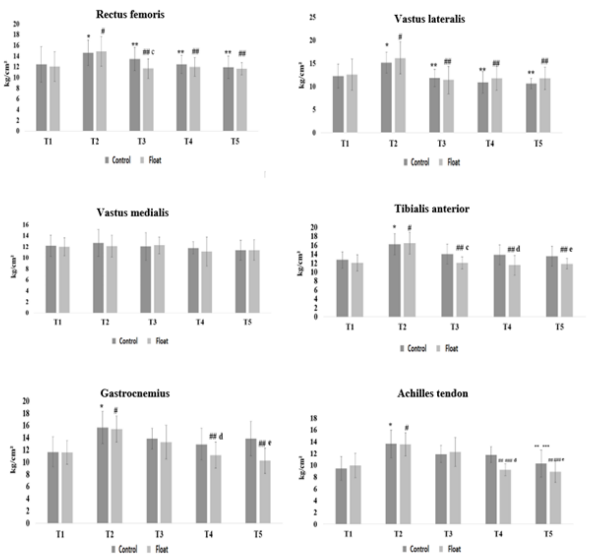

Figure 4: Analysis of pain level of control and float groups. Data presented as mean ± standard deviation. * : Statistically significant difference compared to the control T1 group. ** : Statistically significant difference compared to the control T2 group. *** : Statistically significant difference compared to the control T3 group. #: Statistically significant difference compared to float T1 group. ##: Statistically significant difference compared to float T2 group. ###: Statistically significant difference compared to float T3 group. d: Statistically significant difference compared to the control T4 group. e: Statistically significant difference compared to the control T5 group. T1: Before training, T2: Immediately after training, T3: Immediately after Flotation-REST/rest, T4: 2 hours after Flotation-REST/rest, T5: 24 hours after Flotation-REST/rest

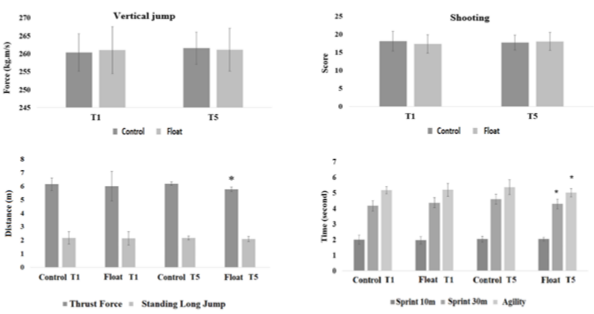

Figure 5: Analysis of Performance Tests. Data presented as mean ± standard deviation. * : Statistically significant difference compared to the control T1 or float T1 group. T1: Before training, T5: 24 hours after Flotation-REST/rest

be reduced [20]. For this reason, recovery research for high-level performance in football players are becoming more important day by day.

Heart rate is the primary indicator of autonomic nervous system stimulation, and studies have reported that HR change can be used to analyze the metabolic stress experienced by the body during exercise and to obtain information about physiological recovery after exercise [21]. In the current study, it was observed that the HR values that increased after the training decreased more rapidly with the Floatation-REST application, thus providing a faster recovery. Similar to our study in the literature, it was determined that there were significant decreases in HR in various Floatation-REST studies [22]–[25]. It is known that recovery begins with a decrease in the level of lactic acid in the body [26]. According to the findings of our study, although the lactate level of the athletes who were applied Floatation-REST started to decrease later than the control, it was seen that the application of Floatation-REST accelerated the normalization of the values, especially when looking at the values after 24 hours. In the study of Morgan et al., it was determined that the Floatation-REST application after eccentric exercise reduced the lactate level more than the control [24]. In another study, acute Floatation-REST was applied to individuals who underwent resistance exercise and no significant change was found compared to the control group [27].

Damage to muscle tissue as a result of heavy training causes pain, deterioration of joint range of motion, and edema, leading to a decrease in the performance of athletes [28]. Creatine kinase and myoglobin levels, the levels of which increase in sports such as football where the training and match seasons are long, are seen as important parameters in determining muscle damage, therefore they are evaluated within the recovery criteria [4], [5]. Our findings show that Floatation-REST has a significant effect on normalizing myoglobin and creatine kinase levels after 24 hours. In a similar study, it is stated that creatine kinase and myoglobin levels increase after training and after Floatation-REST and decrease after 24-48 hours [19].

Muscle damage, which occurs in sports activities such as plyometric training, which requires excessive force and where different muscle contractions (concentric and eccentric) are applied simultaneously, also triggers inflammation and muscle pain [6]. In various studies, it has been reported that muscle damage caused by exercise increases the levels of leukocytes, TNF-α, and IL-6, which are markers of inflammation [7], [8]. It is known that long-term exercises and strength exercises cause remarkable changes in leukocyte composition and concentration. In our current study, it was determined that the leukocyte level in the control and float groups increased more and more in T2, T3, and T4 compared to the previous period. It is known that in leukocytosis seen after short-term exercise, there is an increase in mononuclear cells and an increase in the number of neutrophils, and a small number of lymphocytes as the exercise is prolonged. Since the elevation of leukocytes during and immediately after exercise mainly causes an increase in both neutrophils and lymphocytes, it has been reported that the delayed rise of several hours after exercise, as in our study, is mainly due to circulating neutrophils [29]. IL-6, which is another inflammation marker and is known to increase in amount first in muscle damage, was also found to increase in T2 in our study, and it was determined that the Floatation-REST application provided faster recovery of these levels compared to the control. Similar to our findings, Caldwell's study showed that the TNF-α and IL-6 levels of the athletes who underwent intense resistance exercise increased, the TNF-α level decreased after 24 hours, but the IL-6 level started to decrease immediately after the application of Floatation-REST [19].

Heavy workouts are known to trigger muscle damage by causing the breakdown of some proteins. It is known that endogenous anabolic hormones stimulate the synthesis of these proteins, which are broken down by increasing levels [30], [31]. It has been reported that the concentrations of testosterone, an anabolic hormone, and cortisol, a catabolic hormone, increase in response to the physical stress caused by training [12], [19], [32]. While the immunosuppressive effect of cortisol increases the tendency to infections, its catabolic effects on muscle cells may cause injuries to occur more easily as well as reduce performance [33]. For this reason, testosterone and cortisol are frequently used in recovery studies to monitor tissue repair [20]. In the current study, it was determined that there was no significant change in the testosterone levels of the control and float groups. Similarly, in various studies, the testosterone level did not show a significant change after the match [32]. It has been reported that testosterone changes typically do not occur during or immediately after the competition, but increase up to 5 days after contact sports [32]. When the cortisol levels of our study were examined, it was observed that the cortisol levels, which increased significantly in T2 in both groups, decreased more with the Floatation-REST application compared to the control group. Similarly, in a study by Turner and his team, it was observed that Floatation-REST reduced cortisol levels [34]. Our findings show that the application of Floatation-REST significantly reduces the stress level and accelerates the recovery of the athletes.

Athletes feel muscle pain after training or match due to micro-tears that occur in weak myofibrils in muscle fiber due to the high stretching that occurs during high-intensity exercises. These ruptures cause circulatory disorders and edema in the muscle tissue, and as a result, ion problems that trigger pain in the muscle are observed [35]. Various studies have reported that Floatation-REST is good for pain relief [34]. In a study conducted with elite athletes, it was reported that the Floatation-REST application was good for athletes muscle pain and it was suggested that this technique could be used as a new recovery method [36]. In our current study, muscle pain was measured in various muscles of athletes and analyzed comprehensively. According to our findings, Floatation-REST application especially improves the pain levels of rectus femoris, tibialis anterior, gastrocnemius, and Achilles tendon and accelerates recovery.

In addition to the physical strain of football matches, athletes may also feel mental fatigue due to stress factors such as physiological changes, intense match schedules, opponent pressure, match result, travel, and sleep disorders. This mental fatigue is often reflected in performance [20]. Therefore, in our current study, the psychological effect of Floatation-REST on athletes was also assessed. Athletes in the float group who were applied Floatation-REST stated that the application relaxed their bodies, felt good emotionally, increased their energy, enjoyed the application, felt a decrease in muscle pain, increased their performance, and wanted to try the application again. The findings show that Floatation-REST has a positive effect on recovery parameters, especially by reducing the stress level. In a meta-analysis study, 25 publications on Floatation-REST were examined and it was shown that this technique as a stress management tool has positive effects on physiology, health, and performance [37]. However, the number of studies on the psychological recovery of athletes with Floatation-REST is quite insufficient. In a study conducted with elite athletes, it was stated that the Floatation-REST application affected the athletes positively [36].

The effect of all these parameters investigated in our current study on performance was assessed with various performance tests. According to our findings, it was observed that the Floatation-REST application positively affected the speed (30 m), agility, and thrust performances of the float group compared to the control group. There was no significant difference in the vertical jump, one-touch pass, speed (10m), and long jump performances. In a study by Mcalaney and his team on tennis players, it was determined that Floatation-REST increased the first serve win [38]. In various studies, it has been determined that Floatation-REST increases the athletic performance of basketball players [39]. In a study conducted with young gymnasts, it was observed that the application of Floatation-REST increased the performance of gymnasts compared to the control [40]. In a study conducted with dart players, it was shown that Floatation-REST increased the motor coordination of dart players and performed higher accuracy shots [39].

5. Conclusion

In terms of continuity and continuity of quality during the football match, recovery time after high-intensity workouts is important. Although various recovery strategies aiming to relieve fatigue are applied in professional football clubs, these strategies are not effective enough. For this reason, there is a need for new methods that will enable football players to recover faster and more effectively in all aspects. The Floatation-REST application, which we used in our study, has been revealed by analyzing in a very comprehensive way that the athletes recover from all aspects physically, physiologically, and psychologically. Based on our findings, we think that the Floatation-REST application can be used as a new recovery method by football clubs. Our study is important in terms of shedding light on more comprehensive and comparative studies for recovery strategies and studies on improving the method and using it effectively and individually by athletes.

Contributions

Conceived and designed the experiments: KK, CB, BKİ. Performed the experiments: KK, BKİ, AAE. Analyzed the data: KK, BKİ, EO. Wrote the paper: BKİ, EO

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Conflict of interest

The authors declare no conflict of interests. All authors read and approved final version of the paper.

Authors Contribution

All authors contributed equally in this paper.

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