The aim of this study was to examine the relationship between proprioceptive sensory functions and body mass index parameters of football and volleyball players. 16 male football players and 16 male volleyball players, whose average age was 21.4 years, voluntarily participated in this research. In this study, body mass indexes (BMI) were figured out by measuring height and body weight (BW) and proprioceptive sense functions were measured by using TechnoBody PK-252 isokinetic balance system measurement device. Balance parameters were recorded as stability index (SI), average force variance (AFV) and average track error (ATE). In the study findings, it was observed that there was no meaningful correlation between the parameters for football players, though there was a negative meaningful correlation between BW and BMI values and ATE and SI values for volleyball players (p<0.05). Although there was not a difference between research groups’ proprioceptive sense functions and BMI values, there was a meaningful difference between groups’ body height and BW values in the course of comparing the groups. According to these results, it could be said that there was a correlation between some anthropometric data (BW, BMI) and proprioceptive sense functions. However, it is considered that the number of similar studies should be increased in order to reach a final judgement.

Key words: BMI, Football Players, Proprioceptive, Volleyball Players

INTRODUCTION

The basic component of human life is body movement. Most of the daily activities are related to physical movement and a coordinated body is critical for sporting success (Goble, 2010). In recent years the concept of proprioception has attracted attention due to its effects on performance and coordination in sports.

Proprioception is the general name of the process of creating responses in which the central nervous system of the joints, limbs, ligaments, organelles is detected and kept in the safest state (Kaynak et al., 2015). This automatic sensitivity mechanism that sends messages through the central nervous system in the body allows the body to process information from various stimuli and special sensory receptors in the muscles, joints and connective tissues and turn this information into action. Balance or the body’s ability to correct itself requires robust proprioceptive feedback (Duzgun et al., 2011). Proprioceptive function is an important component of postural control (Wang et al., 2008).

Body composition and body mass index (BMI) is one of the subjects that are emphasized in terms of sport competition and performance. The body composition, which is known to have significant effects on athletic performance in sport, also provides information on different physical
properties (Andreoli et al., 2003). BMI, which is an important part of body composition, is generally calculated by dividing body weight (BW) by the square of the body height in meters (Stensland & Margolis, 1990).

The aim of this study was to investigate the relationship between proprioceptive sensory abilities and BMI values that are known to have significant effects in sports.

METHODS
Study Group

16 male football players and 16 male volleyball players between the ages 18-28, who have been playing in a certified team for the last five years and have not been exposed to a sporting injury requiring surgery in the last year and whose average age was 21.4 years, participated in the study voluntarily.

Height and body weight measurements

Height (H) measurements of the subjects were measured with wall-mounted holtain stadiometer and body weight (BW) measurements were measured with tanita MC-580 body analyzer. Body mass index (BMI) was calculated by dividing the kg of body weight by the square of the height measurement (kg / m²).

Data Collection

CSMI TecnoBody PK-252 isokinetic balance system measuring instrument was used to determine proprioceptive sensory values. Measurements were performed in 30 seconds with difficulty level 10 by multiaxial proprioceptive assessment module as both feet. Balance parameters were recorded as stability indicator (SI), average force variance (AFV) and average tracking error (ATE) (Goktepe & Gunay, 2016).

Data Analysis

The data were evaluated by using SPSS software, first with normality test, then with pearson correlation and independent sample t tests, and the results were analyzed statistically.

RESULTS

Descriptive statistics of the football players and volleyball players participating in the research were given in Table 1.

| PARAMETERS | FOOTBALL | VOLLEYBALL |
|------------|----------|------------|
|            | n  | X  | SD | n  | X  | SD |
| ATE        | 16 | 68.31 | 31.26 | 16 | 66.94 | 14.96 |
| AFV        | 16 | 2.97 | 4.89 | 16 | 1.73 | 1.34 |
| SI         | 16 | 1.77 | 1.01 | 16 | 2.00 | 0.75 |
| H          | 16 | 177.88 | 5.03 | 16 | 188.00 | 7.99 |
| BW         | 16 | 72.88 | 6.60 | 16 | 82.81 | 11.08 |
| BMI        | 16 | 23.04 | 1.93 | 16 | 23.41 | 2.68 |

When the descriptive statistics of the research groups are examined in Table 1, the average values of proprioceptive function values were found to be ATE 68.31, AFV 2.97, SI 1.77 in football players and ATE 66.94, AFV 1.73, SI 2.00 in volleyball players and for average body anthropometric values they were found to be H 177.88, BW 72.88, BMI 177.88 in football players and H 188.00, BW 82.81, BMI 23.41 in volleyball players.
Table 2. Correlation analysis of the relationship between height, weight, bmi values and proprioceptive sensory values

| PARAMETERS | FOOTBALL | VOLLEYBALL |
|------------|----------|------------|
|            | ATE      | AFV        | SI         | ATE      | AFV        | SI         |
| HEIGHT     |          |            |            |          |            |            |
| r          | -0.29    | 0.16       | -0.08      | -0.24    | 0.21       | -0.13      |
| p          | 0.29     | 0.55       | 0.76       | 0.36     | 0.44       | 0.63       |
| BW         |          |            |            |          |            |            |
| r          | -0.22    | 0.34       | 0.14       | **-0.69**| 0.13       | **-0.63**  |
| p          | 0.42     | 0.19       | 0.61       | 0.00     | 0.62       | 0.01       |
| BMI        |          |            |            |          |            |            |
| r          | -0.05    | 0.26       | 0.19       | **-0.64**| 0.01       | **-0.64**  |
| p          | 0.87     | 0.34       | 0.48       | **0.01** | 0.97       | **0.01**   |

(**p<0.05).

When Table 2 was examined, no significant relationship was found between the parameters in football players. In volleyball players, it was seen that there was a significant negative correlation between BW, BMI values and ATE, SI values.

Table 3. Analysis results of differences between test parameters of football and volleyball players

|            | FOOTBALL | VOLLEYBALL |
|------------|----------|------------|
|            | ATE      | AFV        | SI         | HEIGHT   | BW        | BMI        |
| t          |          |            |            |          |          |            |
|            | 0.09     | 0.02       | 0.34       | **0.08** | **0.11** | 0.41       |
| p          | 0.88     | 0.33       | 0.48       | **0.00** | **0.00** | 0.66       |

(**p<0.05).

When Table 3 was viewed, it was seen that proprioceptive sensory and BMI values did not differ between the study groups, but there was a significant difference between the height and BW values between the groups.

**DISCUSSION AND CONCLUSION**

According to the findings of the study, the average values of the proprioceptive function values of the research groups were found as ATE 68.31, AFV 2.97, SI 1.77 in football players and ATE 66.94, AFV 1.73, SI 2.00 in volleyball players. The average values of body anthropometric measurements were found to be as height 177.88, BW 72.88, BMI 23.04 for footballers and height 188.00, BW 82.81, BMI 23.41 for volleyball players. Karakas et al. (2011) in a study of the average BMI values of football players found the average as 23.26. Goral et al. (2012) in the study of the average values of football players stated the values as height 176.5, BW 73.4, BMI 23.55. Aslan et al. in the study of volleyball players BMI values found the average as 24.35. In their study, Con et al. (2012) found that the average BMI value of volleyball players was 23.4. Ergin and Yucel (2011) found the average values of volleyball players in their studies as 189.5, BW 77.2 and BMI 21.5. In this study and related studies, anthropometric values were found to be normal and similar.

In the correlation analysis between the anthropometric values and proprioceptive sensory values in the study groups, no significant relationship was found between the parameters in football players, and there was a significant negative correlation between BW and BMI values and ATE and SI values in volleyball players (**p<0.05). In analysis results of the differences between the groups in all parameters, proprioceptive sensory and BMI values were not different between the study groups, while there was a significant difference between the groups in height and BW values (**p<0.05).

When similar studies were examined, Tabrizi and Sabrestani (2013) stated that anthropometric properties affected dynamic balance in a study conducted by athletes from different branches. Greve et al. (2007) and Ku et al. (2012) reported a significant relationship between BMI and postural balance. Arabaci et al. (2009) reported that there was a negative correlation between BMI and agility in taekwondo athletes.
and also that the ratio of BMI, height and weight of athletes affected the skill properties. Wang et al. (2008) and Morano et al. (2011) stated that obesity decreases postural capacity and has negative effects on motor performance. Blaszczzyk et al. (2009) stated that BW and BMI had a significant relationship with dynamic stability. Hogstrom et al. (2012) found that body composition showed a significant relationship with physical performance in adolescents. Gribble et al. (2015) reported that there was a significant relationship between BMI and forward deviation in a study with football players.

Kejonen et al. (2003) found that ankle function showed a significant relationship with BMI. Nikolaidis (2013) found that BMI was related to physical fitness in female volleyball players, and Dane et al. (2002) found that it was associated with sports injuries. Medeiros et al. (2016) emphasized that reduction of fat mass percentage in paralympic athletes was important in improving swimming performance. Mermier et al. (1997) stated that to be superior in sport climbing, a climber must have special anthropometric properties. Erdem et al. (2015) reported that there was a significant relationship between BMI and ball agility in a study on football players. Lopez et al. (2012) emphasized that motor skills showed a negative correlation with BMI in childhood and adolescence.

Similar studies in terms of postural control, physical fitness and performance are in parallel with this study.

It has been proven in many studies that dynamic and static postural stability capabilities are important factors for sporting performance and success. According to the results of this study which examined the relationship between proprioceptive sensory abilities and some anthropometric data which is an important component of postural control, it can be said that BW and BMI are associated with proprioceptive sensory functions in athletes. However, it can be concluded that the number of similar studies should be increased in order to reach a final judgment and that the lack of consideration of muscle mass size compared to sedentary individuals may cause errors when interpreting BMI values in athletes.

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