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Investigation of proprioceptive sense in team and individual athletes

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Abstract

Proprioception is important for both athletic success and the post-injury process. This study aims to examine the proprioceptive senses of team athletes and individual athletes in different branches. A total of 250 volunteer athletes from Ondokuz Mayıs University Faculty of Sports Sciences participated in the study. The athletes were selected from soccer, basketball, volleyball, handball, taekwondo, tennis, athletics and other individual branches (boxing, kickboxing, karate, wushu, muaythai). The mean age of the students was 20.44±1.73. In the study, dominant shoulder, non-dominant shoulder, dominant knee, and non-dominant knee proprioception measurements of the athletes were made. Since the data did not show a normal distribution, Kruskal Wallis test was used in comparisons between groups. Dunn's multiple comparison test was used for subgroup comparisons. Mann Whitney U test was preferred for paired group comparisons. According to results proprioceptive sense is not differ according to gender ($p>0.05$). Dominant and non-dominant knee proprioceptive senses of team athletes were better than individual athletes ($p<0.05$). Participants who did regular weight training had better non-dominant knee proprioception than those who did not ($p<0.05$). Proprioceptive senses of both knees of soccer players were more developed than volleyball players ($p<0.05$). Soccer players had better non-dominant knee proprioception than handball players, and basketball players had better non-dominant knee proprioception than volleyball players ($p<0.05$). Proprioceptive sense of both knees or shoulder joints did not differ according to individual branches ($p>0.05$). Proprioceptive sense varies in athletes according to their branches.

Keywords: Branch, individual, proprioception, sport, team

Takım sporcuları ve bireysel sporcularda proprioseptif duyunun incelenmesi

Öz

Propriosepsiyon hem sportif başarıda hem de yaralanma sonrası süreçte önemlidir. Bu çalışma farklı branşlardaki takım sporcuları ve bireysel sporcuların proprioseptif duyularının incelenmesini amaçlamaktadır. Çalışmaya Ondokuz Mayıs Üniversitesi Spor Bilimleri Fakültesi'nden toplam 250 gönüllü sporcu katılmıştır. Sporcuların futbol, basketbol, voleybol, hentbol, tekvando, tenis, atletizm ve diğer bireysel branşlardan (boks, kickboks, karate, wushu, muaythai) seçilmiştir. Öğrencilerin yaş ortalaması 20,44±1,73'dür. Çalışmada sporcuların dominant omuz, nondominant omuz, dominant diz, nondominant diz propriosepsiyon ölçümleri yapılmıştır. Veriler normal dağılım göstermediği için gruplar arası karşılaştırmada Kruskal Wallis testi kullanılmıştır. Dunn's çoklu karşılaştırma testi alt grup karşılaştırmaları için kullanılmıştır. İkili grup karşılaştırmaları için de Mann Whitney U testi tercih edilmiştir. Elde edilen sonuçlara göre proprioseptif duyu cinsiyete göre farklılık göstermemiştir ($p>0,05$). Takım sporcularının dominant ve nondominant diz proprioseptif duyuları bireysel sporculardan daha iyidir ($p<0,05$). Düzenli ağırlık antrenmanı yapan katılımcılar yapmayanlara göre daha iyi nondominant diz propriosepsiyonuna sahiptir ($p<0,05$). Futbolcuların her iki diz proprioseptif duyuları voleybolculara göre daha gelişmiştir ($p<0,05$). Futbolcular hentbolculardan, basketbolcuların ise voleybolculardan daha iyi nondominant diz propriosepsiyonuna sahiptir ($p<0,05$). Her iki diz ya da omuz eklemlerine ait proprioseptif duyu bireysel branşlara göre farklılık göstermemiştir ($p>0,05$). Proprioseptif duyu sporcularda branşa göre değişiklik göstermektedir.

Anahtar Kelimeler: *Bireysel, branş, propriosepsiyon, spor, takım*

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This study was based on the Doctoral Thesis of the corresponding author.

INTRODUCTION

Proprioception in the most general terms, it can be defined as a special method that covers the movement and position sense of the joint (Lephart et al., 1997; Tuthill & Azim, 2018). Proprioception is the sum of neurological feedback from the systems involved in motor control. Therefore, it has an important place in motor control and general physical health (Ager et al., 2017).

Deep senses such as position and touch perceived by mechanoreceptors located in the joints reach the central nervous system together with visual and vestibular system inputs (Akseki, 2010). After the response in the central nervous system, the relevant functional task can be performed (Shaffer & Harrison, 2007).

The process of proprioception does not only refer to the perception of movement or position. Perceived inputs must be analyzed by the central nervous system, and as a result of this analysis, a response must be created in the periphery by the central nervous system. In summary, there are two basic components in this process. The first of these is that the position and the factors affecting this position are perceived and analyzed by the central nervous system. The second is the response that emerges based on this analysis (Kaynak et al., 2015).

With inadequate proprioception, there is an increase in sports injuries. It has been shown that practices that improve proprioception reduce sports injuries and positively affect the treatment process (Göktepe & Günay, 2016). On the other hand, proprioceptive training programs; It improves balance, agility and the ability to learn new skills. In this way, the athlete's performance and therefore his sporting success increases (Souglis, 2022).

The proprioceptive sense has an important place in both sports performance and sports injuries. It is very important to protect and improve the proprioceptive sense in matters such as performing sports-specific movements in the best way, and to achieve optimal balance, coordination, and agility skills. On the other hand, proprioceptive loss after sports injuries causes decreased sports performance and reduces athletic success. For this reason, proprioceptive training has an important place in both routine training programs and post-injury rehabilitation programs. When the literature is examined, while the relationship between the proprioceptive sense and performance is mostly examined, there is no research comparing the proprioceptive senses of sports branches with each other. Therefore, in this research, an examination is made on a branch basis, the branches are compared with each other and

suggestions are made accordingly. The research was conducted on the most preferred branches in the team and individual groups.

METHOD

Research group (population-sample)

The population of the research consists of athletes studying at Ondokuz Mayıs University Yaşar Doğu Faculty of Sports Sciences. A total of 250 athletes, 125 teams and 125 individuals, were included in the research. The athletes were chosen from among amateur athletes who continue their sports careers. As a result of the literature analysis, when the test power (alpha) was taken as 0.95 and the significance level (beta) as 0.05, the sample group was calculated as 118 people for the experimental and control groups. In order to prevent possible errors and increase the test power, the groups were formed with 125 people. There are 60 female and 65 male athletes in both groups. Team sports include soccer, basketball, volleyball and handball; Individual sports consist of taekwondo, tennis, athletics and other individual branches (boxing, kickboxing, karate, wushu, muaythai). Before the study, an application was made to Ondokuz Mayıs University, Clinical Research Ethics Committee for ethics committee permission. At the Board's meeting dated 14.12.2022, the study was found ethically appropriate with decision number OMÜ KAEK 2022/534.

Data collection tools

Data were collected in the fall semester of the 2023-2024 academic year. In collecting data, demographic information was collected with a demographic information form. A Baseline brand 1º sensitive digital goniometer was used for proprioception measurement.

With the demographic information form, the athletes' age, gender, height, body weight, body mass index (BMI), dominant arm, dominant leg, sports branch, sports age (years), number of weekly training sessions, approximate training duration (hours), regular weight training. their status was questioned.

For the measurement of shoulder proprioception, 60 degrees of shoulder flexion was determined as the target angle. During shoulder proprioception measurement, participants sat in a chair without sides. They were asked to sit in an upright position with their knees at 90 degrees and their feet in full contact with the floor. The measurement started when the goniometer was at 0 degrees. When the person reached the target angle from the starting position, he stood there for 5 seconds and was allowed to learn the movement. Then the athlete brought his shoulder to the target angle and the process was repeated 3 times. The application

was done with eyes closed. The difference between the current angle and the target angle was determined and the absolute value of the difference was taken. The amount of error in 3 transactions was averaged. Separate measurements were made for two shoulders (Kabak et al., 2020).

For the measurement of knee proprioception, 45 degrees of knee flexion was determined as the target angle. First, the participants lay down on a stretcher in a prone position. The participant was taught how to bring his knee to this target angle. Then, he was asked to bring it from the starting position to the target angle. When he reached this angle, he was allowed to learn the movement by waiting there for 5 seconds. Then the athlete brought his knee to the target angle and the process was repeated 3 times. The application was done with eyes closed. The difference between the current angle and the target angle was determined and the absolute value of the difference was taken. The amount of error in 3 transactions was averaged. Separate measurements were made for two knees (Arslan, 2021).

Data analysis

NCSS (Number Cruncher Statistical System) 2007 Statistical Software (Utah, USA) package program was used for statistical analysis. In addition to descriptive methods (mean, standard deviation) in the evaluation of data, Shapiro-Wilk normality test was used to evaluate the distribution of variables. Kruskal Wallis test was used for intergroup comparisons of variables that did not show normal distribution. Dunn's multiple comparison test was used for subgroup comparisons. Paired group comparisons were made with Mann Whitney U test. Results were evaluated at $p<0.05$ significance level.

FINDINGS

Table 1. Average values of demographic information for all athletes

	All Athletes			
	n	**Mean±SD**	**Min.**	**Max.**
Age (years)	250	20.44±1.73	17.00	25.00
Height (cm)	250	172.48±9.40	150.00	198.00
Body weight (kg)	250	66.09±13.30	40.00	120.00
BMI	250	22.07±3.09	15.82	34.72
Sports Age (Years)	250	7.50±3.21	2.00	15.00
Sport Specific Training Frequency (Day)	250	3.95±1.38	2.00	8.00
Weekly Training Time (Hours)	250	7.52±3.46	2.00	21.00

cm: centimeter kg: kilogram BMI: body mass index SD: standard deviation

Table 1 shows the averages of the demographic information of all participants. The average age of the participants is 20.44±1.73; Their average height was 172.48±9.4 cm; average body weight was 66.09±13.3 kg; The average BMI was found to be 22.07±3.09. The average

sports age of the participants is 7.5±3.21; The average training frequency was found to be 3.95±1.38 and weekly training duration was 7.52±3.46.

Table 2. Average proprioception values of all athletes

Proprioception	All Athletes			
	n	Mean ±SD	Min.	Max.
Dominant Shoulder	250	3.70±2,81	0	16.66
Nondominant Shoulder	250	4.04±2,50	0	11.66
Dominant Knee	250	4.59±3,98	0	21.66
Nondominant Knee	250	4.82±3,91	0	24.00

SD: standard deviation

Table 2 shows the average proprioception values of all athletes. The average dominant shoulder proprioception of the athletes was 3.7±2.81; nondominant shoulder proprioception averages 4.04±2.5; dominant knee proprioception averages were 4.59±3.98; Nondominant knee proprioception average was determined as 4.82±3.91.

Table 3. Comparison of proprioception values of male and female athletes

Proprioception	Man n:130	Woman n:120	p
Dominant Shoulder	3.74±2.75	3.65±2.88	0.599
Nondominant Shoulder	3.83±2.38	4.28±2.61	0.192
Dominant Knee	4.79±3.85	4.37±4.11	0.218
Nondominant Knee	4.88±3.71	4.75±4.13	0.575

*p<0,05

In Table 3, proprioception values of male and female athletes are compared. In dominant shoulder, nondominant shoulder, dominant knee and nondominant knee proprioception values; No significant relationship was detected between female athletes and male athletes (p>0.05).

Table 4. Comparison of proprioception values of athletes according to their weight training

Proprioception	Weight Training (-) n:144	Weight Training (+) n:106	p
Dominant Shoulder	3.88±3.01	3.44±2.50	0.371
Nondominant Shoulder	4.01±2.48	4.09±2.55	0.780
Dominant Knee	4.90±4.18	4.17±3.66	0.242
Nondominant Knee	5.21±4.01	4.29±3.73	**0.025***

*p<0,05

Table 4 shows the comparison of proprioception values of athletes according to their weight training. No significant difference was detected in dominant shoulder, nondominant shoulder and dominant knee proprioception values between athletes who did and did not do weight training (p>0.05). There is a significant difference between the groups in non-dominant knee proprioception value (p<0.05).

Table 5. Comparison of proprioception values of team and individual athletes

Proprioception	Team n:125	Individual n:125	p
Dominant Shoulder	4.00±3,02	3.40±2,55	0.120
Nondominant Shoulder	3.97±2,37	4.12±2,63	0.908
Dominant Knee	3.89±3,45	5.29±4,34	**0.006***
Nondominant Knee	4.07±3,23	5.57±4,38	**0.008***

*p<0,05

In Table 5, proprioception values of team and individual athletes are compared. In dominant and non-dominant proprioception values; No significant relationship was detected between team and individual athletes (p>0.05). A significant relationship was detected between team and individual athletes in dominant knee and non-dominant knee proprioception values (p<0.05).

Table 6. Comparison of proprioception values of team athletes

Team	Soccer n:32	Basketball n:31	Volleyball n:31	Handball n:31	p
Dominant Shoulder proprioception	4.06±2,67	3.79±3,31	4.73±3,34	3.40±2,71	0.309
Nondominant Shoulder proprioception	3.89±2,26	3.60±2,27	4.76±2,61	3.61±2,24	0.225
Dominant Knee proprioception	2.72±2,23	3.73±2,88	5.27±4,26	3.89±3,74	**0.048***
Nondominant Knee proprioception	2.69±2,17	3.43±2,54	5.63±3,55	4.56±3,74	**0.001***

*p<0,05

Table 6 shows the comparison of proprioception values of team athletes. There is no significant difference in dominant shoulder proprioception values and non-dominant shoulder proprioception values between soccer, basketball, volleyball and handball branches (p>0.05). It was determined that there was a significant difference in dominant knee and non-dominant knee proprioception values between soccer, basketball, volleyball and handball branches (p<0.05).

Table 7. Multiple comparison of knee proprioception values of team athletes

Dunn's Multiple Comparison test	Dominant Knee	Nondominant Knee
Soccer / Basketball	0.167	0.287
Soccer / Volleyball	**0.004***	**0.0001***
Soccer / Handball	0.196	**0.043***
Basketball / Volleyball	0.205	**0.002***
Basketball / Handball	0.989	0.338
Volleyball / Handball	0.149	0.115

*p<0,05

The branches in which this difference occurs are given in Table 7. It was determined that there was a significant difference in the dominant knee proprioception value of team athletes

between soccer and volleyball branches (p <0.05). No significant difference was detected in dominant knee proprioception value between other branches (p>0.05). It was determined that there was a significant difference in nondominant knee proprioception values between soccer and volleyball athletes, between soccer and handball athletes, and between basketball and volleyball athletes (p <0.05). There was no significant difference in non-dominant knee proprioception value between other branches (p>0.05).

Table 8. Comparison of proprioception values of individual athletes

Individual	Taekwondo n:32	Athletics n:31	Tennis n:31	Other Individual Sports n:31	p
Dominant shoulder proprioception	3.58±2.65	3.07±2.65	3.45±2.75	3.49±2.19	0.633
Nondominant shoulder proprioception	3.75±2.56	4.25±2.70	4.43±2.52	4.07±2.82	0.679
Dominant knee proprioception	5.77±5.00	5.32±4.43	4.12±3.53	5.93±4.25	0.228
Nondominant knee proprioception	5.44±5.16	5.69±3.98	5.35±4.26	5.82±4.21	0.816

*p<0,05

Table 8 shows the comparison of proprioception values of individual athletes. No significant difference was detected in the dominant shoulder, nondominant shoulder, dominant knee and nondominant knee proprioception values of individual athletes between taekwondo, athletics, tennis and other individual sports (p>0.05).

DISCUSSION AND CONCLUSION

The findings of this study show that there is no difference in the proprioceptive sense of the shoulder and knee joints according to gender (Table 3). In a study conducted on volleyball players, no statistically significant difference was found in shoulder proprioception according to gender (Akbuğa et al., 2020). In a study conducted on air pistol shooting athletes; no significant difference was detected between men and women in the shoulder proprioception at 90 degrees of shoulder abduction (Kocahan et al., 2018). In a study conducted on basketball players, no significant difference was found between male and female athletes in the elbow proprioception of basketball players (Küçük & Karakaş, 2023). It seems that the literature findings are parallel to our study.

Our study, it was determined that the nondominant knee proprioception value of those who did regular weight training was better than those who did not do weekly weight training. No significant difference was found between those who did weight training and those who did not in the dominant shoulder, nondominant shoulder and dominant knee proprioception values (Table 4). In a study conducted on elite male table tennis players, shoulder internal and external rotation isokinetic muscle strengths and proprioceptive senses were compared. No significant

relationship was found between the shoulder internal and external rotator muscle strengths and proprioceptive senses on the side where the racket was held and the side where it was not held (Shang et al., 2022). In a study examining the effect of strength training on shoulder proprioception, participants were applied strength training at different intensities. It has been determined that strength training improves shoulder proprioceptive sense, and that proprioceptive sense improves more as training intensity increases (Salles et al., 2015). In this study, it was observed that strength training had a positive effect on proprioceptive sense in the non-dominant knee, and no significant difference was found between those who did and did not do strength training in the shoulder joints and dominant knee. It is thought that the difference may be due to the content of the strength training, the training history of the athletes, individual differences, the difference in the evaluated groups, and whether the participants did proprioceptive training or not.

When the proprioceptive senses of team and individual athletes were examined, it was found that the dominant and non-dominant knee proprioceptive senses of team athletes were significantly better than individual athletes. No significant difference was found between team athletes and individual athletes in terms of dominant and non-dominant shoulder proprioception values (Table 5). There is no study in the literature comparing the proprioceptive senses of team and individual athletes through joint position sense. Due to the close connection between proprioception and balance, studies comparing balance have been included (Şimşek and Ertan, 2011). The first important structures that play a role in the process for the balance mechanism to work correctly are the proprioceptive system and the vestibular system (Baysal et al., 2006). On the other hand, when proprioception measurement methods are examined, it is seen that one of these methods is balance measurement. (Adıgüzel, 2007). Therefore, the comparison of the study results with the literature was made through the balance parameter, and studies in the literature comparing balance in athletes were investigated and compared with the results of this study. In a study conducted on karate, jodo, basketball and handball athletes, it was found that the lower extremity balance of karate and judo athletes was better than soccer and handball players (Türkeri et al., 2019). According to the results of a study investigating the balance performances of soccer, basketball and gymnastics athletes, it was found that the balance performances of gymnasts were significantly higher than those of team athletes. (Erkmen, et al., 2007). When the results of this study are examined, it is seen that the differences in dominant and non-dominant knee proprioceptive sense are significant in favor of team sports. The results in the literature are predominantly in favor of individual athletes. While comparisons are made

based on balance assessment in the studies in the literature, this study evaluates joint position sense. It is thought that balance is better in individual athletes in terms of the characteristics of sports branches.

As a result of the comparison between the proprioceptive senses of team athletes, it was determined that soccer players and basketball players were better at knee proprioception than other branches. No significant difference was detected between branches in shoulder proprioception. (Table 6, Table 7). There is no study in the literature examining the joint position sense and proprioceptive sense of team athletes in different branches. For this reason, studies evaluating balance were examined and a comparison was made. In a study conducted on female athletes, the lower extremity proprioceptive senses of volleyball players were found to be better than those of handball players (Golmoghanı, 2009). In this study, no significant difference was found between volleyball players and handball players. It is thought that the difference may be due to the difference in measurement methods, the athletes' training programs, individual characteristics and the athletes' balance exercises. In a study involving athletes from different branches, it was found that there was no significant difference between soccer players and basketball players in static and dynamic balance values on the dominant and non-dominant sides (Bressel, 2007). Similarly, in this study, no significant difference was found between soccer players and basketball players. In a study conducted on female athletes, it was found that female soccer players were better than female volleyball players in balance parameters and ankle muscle strength measurements (Özcan & Çolak, 2021). In a study conducted on male college athletes, no significant difference was found between the static balance of soccer players and basketball players. In dynamic balance, soccer players were found to have better performance than basketball players (Kachanathu et al., 2013). The results of the relevant studies are in favor of soccer players, similar to our study.

When the proprioceptive senses of individual athletes were examined, no significant difference was found between taekwondo athletes, track and field athletes, tennis players and other individual athletes in dominant shoulder, non-dominant shoulder, dominant knee and non-dominant knee proprioception (Table 8). In a study conducted on taekwondo and tennis athletes, taekwondo athletes were found to have better stability than tennis players (Patti et al., 2018). In a study conducted on judokas, dancers and a control group, it was found that the athlete group showed better balance performance compared to controls when their eyes were open. However, it was found that only judokas showed significantly better performance when their eyes were closed, and it was stated that judo was more effective in the development of the somatosensory

system (Perrin et al., 2002). In a study involving athletes from different branches in the 9-12 age group, balance assessments were made for badminton, swimming, taekwondo and soccer athletes. When we look at the results of individual athletes, it was determined that badminton players had the lowest balance performance while taekwondo players had the highest balance performance (Sevinç & Şıktar, 2016). In particular, taekwondo and judo athletes have better balance performance than other individual athletes. This may be related to the better development of the sensory-motor system due to the characteristics and skills required by these branches. The differences between this study and the literature may be due to differences in age groups, differences in measurement methods, and differences in the training status of the athletes. More studies are needed in this area.

As a result of this research; No gender superiority was observed in dominant knee, non-dominant knee, dominant shoulder and non-dominant shoulder proprioceptive sense. Non-dominant knee proprioceptive sense of athletes who do regular weight training is significantly better than those who do not. No significant difference was detected between athletes who do and do not do weight training in dominant shoulder, non-dominant shoulder and dominant knee proprioceptive sense. Team athletes were found to be significantly better than individual athletes in dominant knee and non-dominant knee proprioception. No significant difference was detected between team and individual athletes in dominant shoulder and non-dominant shoulder proprioceptive sense. soccer players were found to be significantly better than volleyball players in dominant and non-dominant knee proprioception value. Soccer players were found to be significantly better than handball players, and basketball players were found to be significantly better than volleyball players in non-dominant knee proprioception value. Apart from these, no significant difference was detected between soccer, basketball, volleyball and handball branches in knee proprioception. No significant difference was found between soccer, basketball, volleyball and handball branches in dominant shoulder and non-dominant shoulder proprioception. No significant difference was found between taekwondo, athletics, tennis and other individual branches in dominant knee, non-dominant knee, dominant shoulder and non-dominant shoulder proprioception.

Recommendations

It may be recommended that more importance be given to proprioceptive evaluation and proprioceptive exercises in individual athletes. In soccer, it is recommended to focus on the development of the upper extremity proprioceptive sense, and in branches such as volleyball and handball, it is recommended to focus on the development of the lower extremity

proprioceptive sense. The limitation of our study is that the study was conducted in a single center with 250 athletes. New studies with more athletes are needed on this subject.

REFERENCES

Adıgüzel, Ö. (2007). *Genç basketbolcularda proprioseptif eğitimin ayak bileği yaralanmalarından korunmada etkisinin incelenmesi*. [Yüksek lisans tezi, Ankara Üniversitesi].

Ager, A. L., Roy, J., M.Mus, M. R., Belley, A. F., Cools, A., & Hebbert, L. J. (2017). Shoulder proprioception: How is it measured and is it reliable? A systematic review. *Journal of Hand Therapy*, 30(2), 221-231. https://doi.org/10.1016/j.jht.2017.05.003

Akbuğa, E., Bilen, E., & Eliöz, M. (2020). Adölesan voleybolcularda propriyosepsiyon ile servis isabeti arasındaki ilişkinin incelenmesi. *Uluslararası Sosyal Araştırmalar Dergisi*, 13(72), 579-585.

Akseki, D., Erduran, M., Özarslan, S., & Pınar, H. (2010). Patellofemoral ağrı sendromu saptanan hastalarda, dizde vibrasyon duyusu, propriyosepsiyon duyusu ile paralel olarak algılanmaktadır: Pilot çalışma. *Eklem Hastalıkları ve Cerrahisi*, 21(1), 23-30.

Arslan, M. (2021). *Sağlıklı bireylerde spinal stabilizasyon egzersizleri ve kayropraktik spinal manipulasyonun etkinliklerinin karşılaştırılması*. [Doktora Tezi, Sağlık Bilimleri Üniversitesi].

Baysal, E., Gündüz, B., & Bayazıt, Y. A. (2006). Denge sistemi anatomi ve fizyolojisi, kompanzasyon mekanizmaları. *Turkiye Klinikleri Journal of Surgical Medical Sciences*, 2(49), 1-7.

Bressel, E., Yonker, J. C., Kras, J., & Heath, E. M. (2007). Comparison of static and dynamic balance in female collegiate soccer, basketball, and gymnastics athletes. *Journal of Athletic Training*, 4(1), 42-46.

Erkmen, N., Suveren, S., Göktepe, A. S., & Yazıcıoğlu, K. (2007). Farklı branşlardaki sporcuların denge performanslarının karşılaştırılması. *SPORMETRE Beden Eğitimi ve Spor Bilimleri Dergisi*, 5(3), 115-122. https://doi.org/10.1501/Sporm_0000000080

Golmoghanı, N. (2009). *Kadın sporcularda propriosepsiyon ile denge arasındaki ilişki ve motor öğrenmenin propriosepsiyon duyusuna etkisi*. [Yüksek Lisans Tezi, Gazi Üniversitesi].

Göktepe, M., & Günay, M. (2016). Genç futbolcularda dinamik ısınmanın statik denge ve proprioseptif duyuya akut etkisi. *Ankara Üniv Spor Bil Fak*, 14(2), 213-224. https://doi.org/10.1501/Sporm_0000000298

Kabak, B., Kocahan, T., Akınoğlu, B., & Hasanoğlu, A. (2020). Okçularda tutuş ve çekme kollarının omuz eklemi kas kuvveti, esneklik ve propriosepsiyon duyusunun karşılaştırılması. *Hacettepe Journal of Sport Sciences*, 31(1), 20-28. https://doi.org/10.17644/sbd.538393

Kachanathu, S. J., Dhamija, E., & Malhotra, M. (2013). A comparative study on static and dynamic balance in male collegiate soccer and basketball athletes. *Medicina Sportiva: Journal of Romanian Sports Medicine Society*, 9(2), 2087-2093.

Kaynak, H., Altun, M., Özer, M., & Akseki, D. (2015). Sporda propriosepsiyon ve sıcak - soğuk uygulamalarla ilişkisi. *CBÜ Beden Eğitimi ve Spor Bilimleri Dergisi*, 10(1), 10-35.

Kocahan, T., Akınoğlu, B., Ünüvar, E., & Hasanoğlu, A. (2018). Havalı tabanca atıcılık sporcularında tetik kolu ve diğer kolun omuz eklemi izometrik kas kuvveti ve propriyosepsiyon duyusunun karşılaştırılması. *Turkiye Klinikleri Journal of Sports Sciences*, 10(3), 116-122. https://doi.org/10.5336/sportsci.2018-62501

Küçük, H., & Karakaş, F. (2023). The effect of elbow joint proprioception sense on shooting hit in basketball. *Journal of ROL Sports Sciences*, 4(3), 1153-1168. https://doi.org/10.5281/zenodo.8353999

Lephart, S. M., Pincivero, D. M., Giraldo, J. L., & Fu, F. H. (1997). The role of proprioception in the management and rehabilitation of athletic ınjuries. *The American Journal of Sports Medicine*, 25(1), 130-137. https://doi.org/10.1177/036354659702500126

Özcan, K.G., & Çolak, S. (2021). Futbol ve voleybolcuların ayak bileği kas kuvveti ve denge parametrelerinin incelenmesi. *Turkish Studies*, 16(6), 1677-1692. http://dx.doi.org/10.7827/TurkishStudies.52489

Patti, A., Messina, G., Palma, R., Barcelona, M., Brusa, J., Lovane, A., … et al. (2018). Comparison of posturographic parameters between young taekwondo and tennis athletes. *Journal of Physical Therapy Science*, 30(8), 1052-1055. https://doi.org/10.1589/jpts.30.1052

Perrin, P., Deviterne, D., Hugel, F., & Perrot, C. (2002). Judo, better than dance, develops sensorimotor adaptabilities involved in balance control. *Gait & Posture,* 15(2), 187–194. https://doi.org/10.1016/s0966-6362(01)00149-7

Salles, J. I., Velasques, B., Cossich, V., Nicoliche, E., Ribeiro, P., Amaral, M. V., … et al. (2015). Strength training and shoulder proprioception. *Journal of Athletic Training*, 50(3), 277–280. https://doi.org/10.4085/1062-6050-49.3.84

Sevinc, D., & Şıktar, E. (2016). The association of physiological and physical parameters of athletes in different sports with multiple intelligences. *International Journal of Sport Culture and Science*, 4(4), 431-442.

Shaffer, S. W., & Harrison, A. L. (2007). Aging of the somatosensory system: A translational perspective. *Physical Therapy*, 87, 193-207. https://doi.org/10.2522/ptj.20060083

Shang, X-D., Zhang, E-M., Chen, Z-L., Zhang, L., & Qian, J-H. (2022). Correlation analysis of national elite Chinese male table tennis players' shoulder proprioception and muscle strength. World J Clin Cases, 10(24), 8514-8524. https://doi.org/10.12998/wjcc.v10.i24.8514

Souglis, A. G., Travlos, A. K., & Andronikos, G. (2022). The effect of proprioceptive training on technical soccer skills in female soccer. *International Journal of Sports Science,* 18(3), 1-13. https://doi.org/10.1177/17479541221097857

Şimşek, D., & Ertan, H. (2011). Postural kontrol ve spor: spor branşlarına yönelik postural sensör-motor stratejiler ve postural salınım. *SPORMETRE Beden Eğitimi ve Spor Bilimleri Dergisi*, 9(3), 81-90. https://doi.org/10.1501/Sporm_0000000203

Tuthill, J. C., & Azim, E. (2018). Proprioception. *Current Biology*, 28(5), 194-203. https://doi.org/10.1016/j.cub.2018.01.064

Türkeri, C., Öztürk, B., Büyüktaş, B., & Öztürk, D. (2019). Farklı branşlardaki sporcuların statik denge, alt-üst ekstremite dinamik denge ve reaksiyon zamanlarının incelenmesi. *Gaziantep Üniversitesi Spor Bilimleri Dergisi*, 4(4), 480-490. https://doi.org/10.31680/gaunjss.625442

Yıldız, N. (2007). *Diz osteoartritli kadınlarda, fiziksel aktivite düzeyi, kas kuvveti, propriosepsiyon ve ağrı duyusu ilişkisinin incelenmesi*. [Yüksek Lisans Tezi, Ankara Üniversitesi].

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Fikir ve Kavramsal Örgü *Idea or Notion*	Araştırma hipotezini veya fikrini oluşturmak *Form the research hypothesis or idea*	Emine Büşra AYDIN
Tasarım *Design*	Yöntem ve araştırma desenini tasarlamak *To design the method and research design.*	Emine Büşra AYDIN
Literatür Tarama *Literature Review*	Çalışma için gerekli literatürü taramak *Review the literature required for the study*	Emine Büşra AYDIN
Veri Toplama ve İşleme *Data Collecting and Processing*	Verileri toplamak, düzenlemek ve raporlaştırmak *Collecting, organizing and reporting data*	Emine Büşra AYDIN
Tartışma ve Yorum *Discussion and Commentary*	Elde edilen bulguların değerlendirilmesi *Evaluation of the obtained finding*	Emine Büşra AYDIN

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This research was conducted with the decision of Ondokuz Mayıs University Ethics Committee dated 15.12.2022 and numbered OMÜ KAEK 2022/534.