OPEN ACCESS
Turkish Journal of Kinesiology

ORIGINAL RESEARCH

Isokinetic strength and experience: Analyzing key attributes in professional soccer players

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Received: September 01, 2023

Accepted: December 09, 2023

Online Published: March 20, 2024

Keywords: Amateur league, isokinetic, professional league, soccer, strength.

Abstract

Soccer is one of the sports where performance is shaped by the coming together of numerous variables. The importance of strength, a physical variable that determines performance, is thought to be as crucial as the experience levels of athletes, which are also considered important for performance. The present study aimed to compare the isokinetic strength characteristics and soccer experience of professional league (PRL) and amateur league (AML) soccer players. After recording variables such as total playing seasons and weekly training sessions, isokinetic strength measurements were conducted at angular velocities of 60°/sec and 180°/sec. The outcomes revealed that PRL players engaged in significantly more weekly training sessions and had accumulated a higher total number of playing seasons than their AML counterparts ($p<0.05$). Evaluation of the isokinetic strength metrics identified that H/Q ratios in the non-dominant extremities of AML players were notably lower at both angular velocities ($p<0.05$). Notably, among the non-dominant extremities, players exhibited comparable PT during extension at both angular velocities ($p>0.05$); however, PRL exhibited greater flexion strength than AML ($p<0.05$). At an angular velocity of 180°/sec, all players demonstrated similar PT generation during extension ($p>0.05$), yet PRL players excelled in flexion ($p<0.05$). These findings underscore that the PT attributed to the quadriceps doesn't singularly determine player performance. However, PRL consistently achieved higher torque using their quadriceps earlier during extension, emphasizing the significance of swift power generation. In conclusion, the study highlights the significance of soccer experience and training frequency for achieving success in the sport. Furthermore, it underscores the pivotal role of attributes such as rapid power production during extension and overall power, particularly in flexion strength, in distinguishing professional players from their amateur counterparts.

Introduction

Soccer is a high-intensity sport in which many motor movements are performed one after the other. Strength and endurance, which are the main regulators of many movements specific to soccer, are seen as common determinants of physical capacity (Hoff & Helgerud, 2004). Muscle strength performance is the main component of an athlete's physical fitness (Suchomel et al., 2016).

Lack of muscular strength and strength asymmetry between muscles or extremities is considered one of several risk factors for injuries in soccer (Maly et al., 2016; Xaverova et al., 2015). Liporaci et al. (2019) states that the conventional (concentric / concentric) Hamstring / Quadriceps ratio may play a role in non-contact muscle injuries and that the likelihood of any musculoskeletal injury to the lower extremities may increase 16-fold in the case of asymmetry over 10%. Most professional soccer teams regularly implement health screening procedures to prevent injuries, determine athlete profiles and identify athletes at risk (McCall et al., 2016). One of the important parts of these health screenings is strength testing. Isokinetic dynamometers that can measure the torque generated during various movement phases are used to objectively determine the muscle strength performance of athletes (van Dyk et al., 2018).

By its very nature, soccer training can improve the strength and power characteristics of the lower extremities to some extent. This development can be accelerated by training in addition to the normal training program and can cause a significant increase in the strength, sprint and jumping abilities of the athletes (Lehance et al., 2009). Extra training, one of the most important requirements of today's professional soccer,

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To Cite: Ölmez, C., İnce, A., Apaydın, N., & Taşpınar , H. A. (2024). Isokinetic strength and experience: Analyzing key attributes in professional soccer players. *Turk J Kinesiol*, 10(1), 1-9. **DOI:** 10.31459/turkjkin.1353836

increases the physical and technical differences between players playing at different levels of teams or leagues. It is clear that the increased number of training sessions will lead to increased motoric stimulation. Studies show that the motoric development of youth players with more training history progresses faster (Carlson, 1988; Fransen et al., 2012). However, up to what point this development continues is still a controversial issue.

Motor development is rapid in childhood and earlier, but slows down later (Goodway et al., 2021). When it comes to athletic performance, a study of top-level female soccer players reported that motoric performance develops rapidly until the age of 16, after which it slows down, with the best performance occurring between the ages of 18 and 21 (Vescovi et al., 2011). This result shows that athletes experience their peak in athletic performance in the post-adolescent period. It is clear that the success in this period is shaped by ongoing training since childhood. However, after a certain stage, the differences between elite athletes may not be explained solely by differences in motoric performance. Although there are many studies pointing to the importance of motoric performance in elite athletes, a limited number of studies have reported that other characteristics may differentiate elite athletes from each other. Metaxas et al. (2009) stated that there was no significant difference in isokinetic strength performances between players playing in the Greece 1st League and Greece 4th League teams. It is clear that these athletes compete with different characteristics after a certain point of athletic performance development.

Based on the literature review, the effect of strength and power-based characteristics of elite level athletes, especially soccer players, on their success is a controversial issue. Although muscular balance, maximum strength and time to maximum strength seem to be the main indicators of athletic performance, their effects in soccer, where tactical skills and intelligence are constantly used, may be at different levels in elite soccer.

This study was designed to compare the isokinetic strength characteristics and soccer experiences of professional league (PRL) and amateur league (AML) soccer players. It was hypothesized that the most important factor that differentiates professional soccer players from well-trained amateur league players is the length of experience. The factors of muscular balance, maximal strength production and time to maximal strength cannot differentiate professional athletes from amateur athletes in every phase, angular velocity and extremity.

Methods

Participants

The study was performed with the voluntary participation of 35 elite soccer players (18 professional league players, 17 amateur league players). The sample size of the study was determined by G*power (version 3.1.9.6, Germany) analysis (d=0.8; α=0.05; 1-β=0.7). The criteria for inclusion in the study require that the athletes have not experienced a knee ligament injury for at least two years, have no other health problems, and do not have any issues preventing regular participation in training. Athletes who do not meet the criteria for knee ligament injury and those who, for any reason, cannot maintain regular training have been excluded from the study. Just before the isokinetic measurements, physical and demographic characteristics of the athletes such as height, weight, body mass index, age, experience, level of success in sports, and injury reports were recorded on the information form developed by the researchers. The PRL soccer players consist of players from 1st league teams, while the AML soccer players play for teams in the 1st regional amateur league. PRL soccer players conducted 5 training sessions per week in the last season, whereas AML soccer players had 2 training sessions. The duration of each training session was 2 hours, and it was the same for both groups.

The details of the study were verbally explained to all athletes and they were informed about the possible benefits and risks of the study. After verbal declaration, a written informed consent form prepared according to the Declaration of Helsinki was given to all athletes and their consent was obtained. In addition, the study was conducted in accordance with the ethical principles of the European Convention on Human Rights and the Declaration of Helsinki (ethical principles of human experimentation) (World Medical Association, 2013) and was approved by the University Clinical Research Ethics Committee (No: 2023-37/O.U).

Design and Procedures

The isokinetic testing phase was completed in a total of 5 days. In order to prevent the ongoing routine soccer training of the athletes during the test period from affecting the mean isokinetic strength performance of the groups, care was taken to ensure that the groups invited to the laboratory were homogeneous, including

PRL and AML athletes, as equally as possible (n: 8+8+8+8+6+5). Just before each isokinetic testing session, the body weight and height of the athletes to be measured were determined. Isokinetic tests began as previously recommended, around 16:00, approximately 3 hours after a standard meal (Minetto et al., 2006).

Isokinetic Strength

Isokinetic tests were performed at Ordu University Sports Sciences Research Laboratory. Isokinetic strength performances of the athletes were analyzed using Humac NORM isokinetic dynamometer (CSMI, Stoughton, MA) in concentric protocol (con/con). Before the tests, the dynamometer was calibrated according to the manufacturer's procedures.

Knee isokinetic strength of the athletes was tested with dominant (D) and non-dominant (ND) extremities. In isokinetic measurements, athletes performed 5 repetitions at maximum effort. In isokinetic measurements, knee EXT and FLX peak torque (PTNM), relative peak torque (%BW), ipsilateral H/Q ratio, bilateral deficit ratio and time to peak torque (PTtime) were determined at 60°/s and 180°/s angular velocities. Torque calculation was determined by considering the gravity factor. In order to ensure that the natural weight of the extremity does not provide any advantage or disadvantage to the athlete during the measurements, the accuracy of the gravity for each athlete was calculated with the dynamometer software before the isokinetic measurement. All tests were carried out by the same laboratory assistant trained in Humac NORM testing.

Before the measurements, each athlete was aerobically warmed up for about 10 minutes on an ergometric bicycle (COSMED, Italy) at a moderate speed (60 rpm) for general warm-up. Then, stretching, squatting and straightening movements were performed in the H and Q muscles and FLX and EXT movements in the knee joint. After the general warm-up, athletes were allowed to recover for 5 min before proceeding to isokinetic warm-up.

In the isokinetic warm-up phase, a warm-up set consisting of five repetitions for each joint was performed with 50% perceived effort before the test (Borg, 1982). The purpose of the isokinetic warm-up was to introduce the subjects to the sensation of isokinetic testing and to provide a movement-specific exercise for the muscle to be tested (Perry et al., 2004). After the warm-up, the athletes were allowed to rest and recover for 90 seconds. The laboratory assistant verbally encouraged the athletes to exert maximal effort during the measurements.

The isokinetic knee EXT-FLX test was conducted with the athlete seated. Prior to the test, the isokinetic device's seat back angle was adjusted to 85 degrees, and the seat rotation angle was set at 40 degrees. The dynamometer's rotation angle was also set to 40 degrees, while the tilt angle remained at 0 degrees and the height at 8 units. The monorail, back translation, and fore-aft values were fine-tuned to align the athlete's knee cap and the dynamometer shaft precisely. The athlete's stationary leg and torso were securely fastened using the dynamometer straps. The athlete's leg was set to a zero-degree angle at full extension, and a 90-degree flexion angle was designated, resulting in a movement range spanning from 0 to 90 degrees.

Data Analysis

The statistical analyses were performed using SPSS (SPSS 25.0 version, Chicago, IL). The results are reported as mean values ± standard deviation (X±SD), minimum-maximum (Range), and 95% confidence interval (95% CI). Data normality and variance equality were assessed through the Shapiro-Wilk, Q-Q plot and Levene tests, respectively. The differences between the PRL and AML athletes were analyzed by One-Way Analysis of Variance (ANOVA). All statistical results were considered significant at a probability level below 0.05 ($p<0.05$). To investigate the magnitude of difference between the variables, the effect size (Cohen's d) was examined. Threshold values for Cohen’s d statistics were 0.20, 0.60, 1.20, 2.0, and 4.0 for small, moderate, large, very large, and extremely large effects, respectively (Hopkins et al., 2009).

Results

The analysis of the physical characteristics of the athletes revealed that PRL and AML players had similar physical characteristics ($p>0.05$; Table 1). However, the results of the analyses related to sports experience showed that the number of seasons played by PRL players (experience: 13.11 ± 4.44 yrs.; 95% CI: 10.90-15.32 yrs.) was significantly higher than AML (experience: 3.24 ± 2.46 yrs.; 95% CI: 1.97-4.50 yrs.) players ($F_{(1,33)}=65.011$; $p=0.000$; $d=2.750$) (Figure 2). Figure 3 displays the count of seasons participated by each athlete.

When the isokinetic properties of PRL and AML players at 60°/sec angular velocity in EXT and FLX phases were compared, it was found that there was no statistical difference between the athletes in D extremities (p>0.05), but FLXPT ($F_{(1.33)}$=20.949; p=0.000; d=6.750) and FLX%BW ($F_{(1.33)}$=14.762; p=0.001; d=2.750) variables in ND extremities were significant in favour of PRL players. When the isokinetic parameters of the players at 180°/sec angular velocity were compared, it was found that the difference between FLXPT ($F_{(1.33)}$=8.460; p=0.006; d=0.989) and FLX%BW ($F_{(1.33)}$=5.472; p=0.026; d=5.530) variables was significant in favour of the PRL group in D extremities. The outcomes observed in the ND extremities at an angular velocity of 180°/sec mirror those detected in the D extremities. Consequently, the differences between PRL and AML soccer players in terms of the FLXPT ($F_{(1.33)}$=17.767; p=0.000; d=1.424) and FLX%BW ($F_{(1.33)}$=11.699; p=0.002; d=1.564) variables were statistically significant, favoring the PRL players.

In addition, it was determined that the H/Q ratios in the ND extremity of AML group athletes were significantly lower than those of PRL athletes at 60°/sec ($F_{(1.33)}$=20.610; p=0.000; d=1.524) and 180°/sec ($F_{(1.33)}$=8.938; p=0.005; d=1.004) angular velocities. However, it can be asserted that the H/Q ratios of athletes from both groups are within acceptable levels (Calmels et al., 1997; Chena et al., 1991; Kannus, 1988; Orchard et al., 1997; Rosene et al., 2001). Furthermore, no significant differences were observed in the other parameters for athletes between the two groups (p>0.05).

Table 1
The results of the analysis of the physical characteristics of the athletes.

		n	Mean ± SD	95% CI	Range
Age (yr)	PRL	18	24.39 ± 3.97	22.41-26.36	19-32
	AML	17	22.59 ± 4.35	20.35-24.82	17-31
Height (cm)	PRL	18	181.33 ± 5.39	178.65-184.01	169-191
	AML	17	177.12 ± 6.99	173.52-180.71	163-188
Weight (kg)	PRL	18	75.78 ± 5.97	72.81-78.74	66-90
	AML	17	74.24 ± 11.43	68.36-80.11	56-95
BMI (kg/m^2)	PRL	18	23.04 ± 1.36	22.36-23.71	20.83-25.56
	AML	17	23.58 ± 2.64	22.23-24.94	19.32-27.76

PRL: Professional league; AML: Amateur league; SD: Standard deviation; 95% CI: 95% Confidence interval for mean.

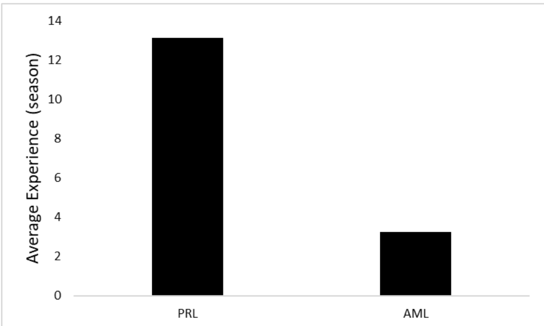

Figure 1. Average length of experience of soccer players.

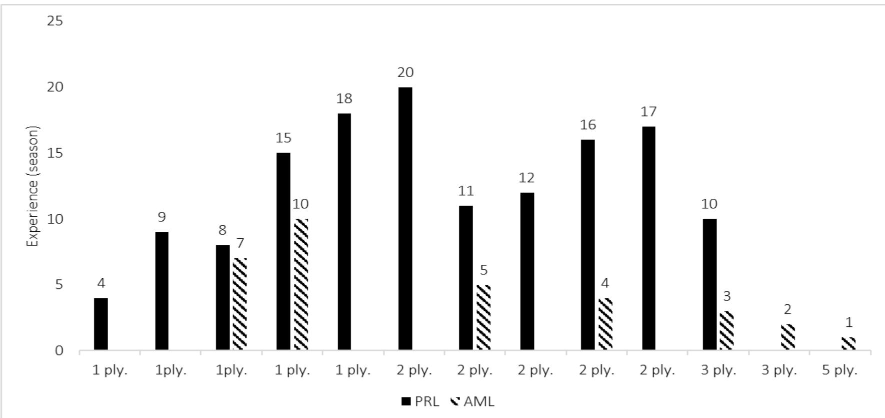

Figure 2. Number of seasons played by athletes.

Table 2

Comparison of EXT and FLX parameters of athletes between D and ND extremities.

		D-60°/sec		ND-60°/sec		D-180°/sec		ND-180°/sec	
		Mean ± SD	95% CI	Mean ± SD	95% CI	Mean ± SD	95% CI	Mean ± SD	95% CI
PT_{EXT}	PRL	238.67 ± 20.75	228.35-248.99	240.11 ± 20.09	230.12-250.1	150 ± 17.58	141.26-158.74	154.78 ± 18.37	145.64-163.91
	AML	220.18 ± 33.19	203.11-237.24	231.06 ± 37.49	211.78-250.33	138.41 ± 25.51	125.29-151.53	142.65 ± 26.52	129.01-156.28
$\%BW_{EXT}$	PRL	315.66 ± 25.3	303.08-328.25	318.07 ± 29.68	303.31-332.83	199.07 ± 27.69	185.3-212.84	204.59 ± 22.41	193.44-215.73
	AML	298.52 ± 36.43	279.79-317.25	313.66 ± 45.5	290.27-337.06	186.47 ± 21.42	175.46-197.49	193.1 ± 30.61	177.36-208.84
PT_{FLX}	PRL	127.11 ± 22	116.17-138.05	136.06 ± 15.34**	128.43-143.68	87.83 ± 16.83**	79.46-96.2	89.22 ± 14.04**	82.24-96.2
	AML	120.18 ± 45.01	97.03-143.32	107 ± 21.83	95.78-118.22	73.47 ± 11.78	67.41-79.53	68.53 ± 15.01	60.81-76.25
$\%BW_{FLX}$	PRL	167.98 ± 28.26	153.93-182.04	180.23 ± 21.36**	169.61-190.85	116.3 ± 22.62*	105.05-127.55	118.33 ± 20.4**	108.19-128.48
	AML	164.65 ± 63.95	131.77-197.53	146 ± 30.77	130.18-161.82	100.34 ± 17.2	91.49-109.18	93.74 ± 22.14	82.36-105.13
H/Q (%)	PRL	53.33 ± 8.17	49.27-57.39	56.78 ± 4.28**	54.65-58.91	58.83 ± 11.31	53.21-64.46	57.78 ± 6.78**	54.41-61.15
	AML	50.47 ± 7.61	46.56-54.38	47.53 ± 7.44	43.7-51.36	53.65 ± 11.68	47.64-59.65	48.65 ± 10.93	43.03-54.26

**p<0.05; **p<0.01; PRL: Professional league; AML: Amateur league; SD: Standard deviation; 95% CI: 95% Confidence interval for mean; PT: Peak torque; BW: Body weight; H: Hamstring; Q: Quadriceps.*

Table 3

Comparison of deficit ratios of athletes in EXT and FLX phases.

		EXT-60°/sec		FLX-60°/sec		EXT-180°/sec		FLX-180°/sec	
		Mean ± SD	95% CI	Mean ± SD	95% CI	Mean ± SD	95% CI	Mean ± SD	95% CI
Deficit (%)	PRL	7.11 ± 6.28	3.99-10.23	11.06 ± 11.06	5.56-16.55	10.78 ± 9.13	6.24-15.32	12.06 ± 11.38	6.4-17.71
	AML	6.47 ± 4.87	3.96-8.98	9.29 ± 5.79	6.32-12.27	6.88 ± 7.08	3.24-10.52	9.06 ± 8.2	4.84-13.27

PRL: Professional league; AML: Amateur league; SD: Standard deviation; 95% CI: 95% Confidence interval for mean.

Table 4
Comparison of the time to reach peak torque in the D and ND extremities of the athletes.

		D-60°/sec PT_{Time}		ND-60°/sec PT_{Time}		D-180°/sec PT_{Time}		ND-180°/sec PT_{Time}	
		Mean ± SD	95% CI	Mean ± SD	95% CI	Mean ± SD	95% CI	Mean ± SD	95% CI
EXT	PRL	0.53 ± 0.11*	0.48-0.59	0.55 ± 0.11	0.5-0.61	0.27 ± 0.03	0.26-0.29	0.27 ± 0.03*	0.26-0.28
	AML	0.61 ± 0.1	0.56-0.67	0.61 ± 0.11	0.55-0.67	0.29 ± 0.04	0.27-0.31	0.29 ± 0.03	0.28-0.31
FLX	PRL	0.56 ± 0.13	0.5-0.63	0.55 ± 0.13	0.49-0.61	0.27 ± 0.04	0.25-0.29	0.28 ± 0.04	0.26-0.3
	AML	0.66 ± 0.23	0.54-0.78	0.58 ± 0.14	0.51-0.65	0.29 ± 0.04	0.26-0.31	0.29 ± 0.04	0.27-0.31

**p<0.05; PRL: Professional league; AML: Amateur league; Mean ± SD: Mean and Standard Deviation; 95% CI: 95% Confidence interval for mean; PT: Peak torque.*

The deficit results at 60°/sec and 180°/sec angular velocity showed that the strength difference between the D and ND extremities of PRL and AML athletes was not statistically significant in EXT and FLX phases, and the athletes had a similar muscle balance between the extremities (p>0.05).

When comparing the peak torque reaching times of PRL and AML athletes at angular velocities of 60°/sec and 180°/sec, a significant difference in peak torque reaching times between the groups was observed only in favor of the PRL group in the EXT phase of the D-60°/sec ($F_{(1.33)}$=5.055; p=0.031; d=0.761) and ND-180°/sec ($F_{(1.33)}$=5.474; p=0.025; d=0.667). No significant differences were found among the other variables (p>0.05).

Discussion

The primary focus of this study is to analyze the isokinetic strength characteristics and soccer experiences of professional league (PRL) and amateur league (AML) soccer players. For this purpose, the total number of seasons played, the number of weekly training sessions in a season, maximum inter-limb torque, relative torque, ipsilateral muscle strength ratio (H/Q), bilateral strength ratio and peak torque reaching times were compared and statistical differences between them were determined.

The most important finding of this study is that the most important feature that distinguishes elite level soccer players from each other may be that the number of training sessions and the total number of seasons played by PRL players are much higher than AML players. This suggests that PRL players have gained much more experience and that this experience may have carried them to the top leagues. To be successful in a sport, experience, game intelligence, and the ability to coordinate and structure the field and teammates are as important as motoric performance characteristics (Den Hartigh et al., 2018). Another important finding of our study may be that PRL players produce more strength with their hamstring muscles in the flexion phase and have a shorter time to reach peak torque with their quadriceps muscles in the extension phase. This can make PRL players more agile and able to change direction more quickly.

The bilateral and ipsilateral strength ratios obtained from isokinetic measurements were similar among PRL and AML players. These ratios are an important indicator of the muscular balance of the athletes. The findings show that the athletes in this study have homogenous and similar muscle balance. A previous bilateral limb comparison showed that athletes with muscle strength imbalance above 15% had an injury frequency 2.6 times higher than those with muscle strength imbalance below 15% (Knapik et al., 1991). Similarly, in other studies in the literature, a strength difference of 15% is mentioned for bilateral muscle balance ratio and ratios above this are accepted as bilateral strength imbalance (Cheung et al., 2012; Kannus, 1994). According to studies on the ipsilateral H/Q ratio, which is another indicator of muscle balance, the ratio should be between 50-80% (Chena et al., 1991; Kannus, 1988; Maly et al., 2018; Orchard et al., 1997; Rosene et al., 2001). The literature generally indicates that the optimum ratio between the maximal torque of the hamstrings and the maximal torque of the quadriceps for the knee joint at an angular velocity of 60°/sec is on average 60% (Fonseca et al., 2007). Previous studies have shown that ipsilateral and bilateral strength ratios of athletes are within acceptable and recommended ranges. This suggests that the rate of injury due to muscular balance is similar in professional and amateur athletes. In a previous study, it was reported that amateurs were more frequently injured during training and professionals were more frequently injured during matches, professional players had a higher rate of minimal injury, while amateurs had a higher rate of serious injury (van Beijsterveldt et al., 2015). The research findings and the results obtained from the literature show that although athletes have a similar physical and physiological structure, the injury situation is much more serious among amateurs. This contrast can only be explained by the differences in the experience level of professionals.

It was determined that the PRL and AML group athletes had similar levels of strength produced by their dominant extremities at an angular velocity of 60°/sec. Papaevangelou (2012), in their study comparing professional soccer players with a mean age of 27.06 ± 6.53 years and U-21 elite soccer players with a mean age of 19.7 ± 0.071 years, reported that although the age difference was significant, the isokinetic H and Q strengths produced by the athletes in the EXT phase at an angular velocity of 60-180°/s and in the FLX phase at angular velocities of 60-180-300°/s were at similar levels. However, in our study, the strength produced by PRL athletes during flexion at an angular velocity of 180°/s was higher in both extremities. Ramos-Campo et al. (2016) reported that the difference between the ipsilateral H/Q ratio, peak torque and relative peak torque performances of soccer players at an angular velocity of 60°/s was not significant in their study comparing the motoric performance of elite and sub-elite female soccer players. Cometti et al. (2001), in a study with elite and sub-elite soccer players, reported that elite soccer players were able to produce higher flexion peak torque at angular velocities below 300°/sec, but there was no significant difference between athletes in extension strength. The angular velocity of 180°/sec is an important indicator of explosive power generation and this characteristic is important for soccer performance. The ability of PRL athletes to produce higher torque at an angular velocity of 180°/sec may be an important motoric trait explaining their playing in a professional league in soccer. Because soccer requires more explosive power characteristics during the match. PRL athletes' ability to reach peak torque in a shorter time is a result that supports their ability to produce more strength at 180°/s angular velocity. It was determined that PRL athletes reached peak torque earlier during EXT at an angular velocity of 60°/s with dominant extremities and 180°/s with non-dominant extremities. This result shows that PRL athletes generally reach maximum power earlier. Being able to generate power in a short time is an important skill to gain superiority over the opponent during the game. These findings suggest that reaching maximum torque in the shortest time and maximum strength produced during FLX are important in high-level soccer.

Although this study focused on athletes' experience status and lower extremity isokinetic strength characteristics, it has some limitations. The biggest limitation of this study regarding the experience dimension is that only the number of seasons played and the number of training sessions during the season were evaluated. Factors such as the quality of the teams the athletes play for, the quality of training or the knowledge and skill level of the coaches may affect their experience status. The limitation of the study related to the isokinetic strength and power dimension is that the measurements were performed only with the con/con protocol and at angular velocities of 60°/sec and 180°/sec. Studies with higher angular velocities and different protocols are needed to strengthen the research findings. In addition, more motoric tests are needed to make clearer inferences about the motoric performance characteristics of athletes playing in professional and amateur leagues.

Conclusion

The findings of the study show that the biggest differences between professional league players and amateur league players occur in terms of the total number of seasons they play and the number of training they do during the season. In addition, it was determined that professional soccer players were able to reach maximum torque in a shorter time than amateur soccer players. It is thought that this may be a distinguishing factor in the explosiveness and change of direction performances of athletes. The fact that the flexion strength of professional soccer players was higher supports this finding.

As a result, the number of training sessions or matches played increases the experience of the athletes and thus increases the probability of success. On the other hand, for maximum performance in soccer, maximum strength production of hamstring and quadriceps muscle groups at high angular velocities, the ability to reach maximum strength in the shortest time, and the balance of hamstring and quadriceps muscle groups are important. Coaches and athletes should pay attention to the development of extensor and flexor muscles. Coaches should test the isokinetic parameters of the athletes at regular intervals and constantly update the training programmes according to the results obtained.

Authors' Contribution

Study Design: CO; Data Collection: NA, HAT; Statistical Analysis: Aİ, CO; Manuscript Preparation: HAT, NA, Aİ, CO.

Ethical Approval

The study was approved by the Ordu University of Clinical Research Ethics Committee (2023/37) and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a declaration of Helsinki.

Funding

The authors declare that the study received no funding.

Conflict of Interest

The authors hereby declare that there was no conflict of interest in conducting this study.

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