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The Effect of Q Angle on Anaerobic Peak Power and Balance in 15-17 Age Group Football Players[i]

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ORIGINAL ARTICLE

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Abstract

Quadriceps angle (QA) is a method that is frequently used in the kinesiological evaluation of the knee joint and lower extremity. In particular, strength has been shown to be important factors for basic football actions such as sprinting or changing direction, passing, jumping, kicking the ball, or stepping fast. In light of these informations, the aim of the study is to examine the effect of QA on anaerobic peak power and balance in youth football players aged 15-17. To measure individuals' QA, a digital manual goniometer was used, half squat vertical jump test with SmartSpeed Contact Mat to measure anaerobic peak power, and Y balance test to measure balance performance were applied. It was determined that the obtained data were normally distributed, and the Pearson correlation test and simple regression tests were applied to the analysis. The analysis showed no statistically significant relationship between the subjects' QA average values and their anaerobic peak power averages. There was a moderate relationship between left QA and left anterior reach distances (R=0,436, R^2 =0,190, p=,048), and a moderately significant relationship between height and right QA and left posterolateral reach distances (R=0,543, R^2 =0,295, p=,043). As a result, the subjects' left anterior reach distance variable explained 19% of the total variance in the left QA, while the right QA and left posteromedial reach distance variables explained approximately 30% of the total variance in height.

Keywords: Q Angle, Football, Anaerobic Peak Power, Balance.

15-17 Yaş Grubu Futbolcularda Q Açısının Anaerobik Zirve Güce ve Dengeye Etkisi

Öz

Kuadriceps açısı (QA), diz eklemi ve alt ekstremitenin kinezyolojik olarak değerlendirilmesinde sıklıkla kullanılan bir yöntemdir. Özellikle kuvvet, sürat koşusu veya hızlı yön değiştirme, pas atma, zıplama, topa tekme atma veya hızlı adım atma gibi temel futbol eylemleri için önemli faktörler olduğunu göstermiştir. Bu bilgiler ışığında çalışmanın amacı 15-17 yaş grubu altyapı futbolcularda QA'nın anaerobik zirve güce ve dengeye etkisini incelemektir. QA'yı ölçmek amacıyla dijital manuel gonyometre, anaerobik zirve gücü ölçmek amacıyla SmartSpeed Kontakt Matı ile yarım squat dikey sıçrama testi, denge performansını ölçmek amacıyla Y denge testi uygulanmıştır. Elde edilen verilerin normal dağıldığı tespit edilmiş, analizinde Pearson korelasyon testi ve basit regresyon testleri uygulanmıştır. Analiz sonuçlarına göre katılımcıların QA ortalamalarıyla anaerobik zirve güçleri ortalamaları arasında herhangi bir istatistiksel anlamlılığa rastlanmamıştır. Sol QA'ları ile sol anterior uzanma mesafeleri arasında orta düzeyde (R=0,436, R^2 =0,190, p=.048), boy ile sağ QA ve sol posteriolateral uzanma mesafeleri arasında orta düzeyde (R=0,543, R^2 =0,295, p=,043) anlamlı ilişkiye rastlanmıştır. Yapılan regresyon analizleri sonuçlarına göre katılımcıların sol anterior uzanma mesafesi değişkeninin sol QA'daki toplam varyansın %19'unu, sağ QA ve sol posteriomedial uzanma mesafesi değişkenlerinin de boydaki toplam varyansın yaklaşık %30'unu açıkladığı tespit edilmiştir.

Anahtar kelimeler: Q Açısı, Futbol, Anaerobik Zirve Güç, Denge.

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Introduction

Quadriceps Angle (QA) is referred to as the angle of the quadriceps femoris muscle. The patellofemoral angle is a method that is frequently used in the kinesiological evaluation of the knee joint and lower extremity (O'Brien, 2001). As a result of most research, it is seen that although the norm values for the QA have been reported and accepted, there is still no fixed idea about the acceptable values. The findings in the literature show that the norm values of men are lower than women (Jaiyesimi and Jegede 2009; Tella et al., 2010). In some studies (Emami et al., 2007) it was stated that the norm values of the QA were 12° for males and 17° for females, while in other studies (Davies, 1978; Horton and Hall, 1989; Woodland and Francis, 1992) it was 15° for males and 15° for females. It is stated that if it is greater than 20°, it can be considered abnormal.

Football is a game in which advanced balance performance is required in addition to strength, endurance, speed, agility, flexibility, and coordination for high-level performance on different surfaces and climates (Bloomfield et al., 2007; Jovanovic et al., 2011). Despite the various health benefits associated with balance, its regular practice increases the possibility of mechanical imbalances that can cause changes in both the muscle and joint systems due to excessive training load and competition (Ribeiro et al., 2003).

Cometti et al. (2001) discussed that anaerobic performance is a key factor of game-winning actions in football, and the emphasis on changing sprints, tactics, low-intensity jumps, and high-intensity jumps (Wallace et al., 2014) has led to the study of high-intensity activities in football for the past two decades (Carling et al., 2012; Hammami ve ark., 2017). These examinations are made with various vertical jump and bicycle sprint tests, two of the most obvious methods to emerge from past research for assessing anaerobic power through a variety of tests. (Vandewalle et al., 1987; Van Praagh, 2007; Driss, 1998). Both test forms' validity and reliability are widely accepted (McMaster et al. 2014; Mendez-Villanueva, 2007; Coso et al., 2006; Markovic et al., 2004). While previous studies of the vertical jump test concentrate on jump height (Vandelle et al., 1987), mechanical power has emerged in recent times as the remarkable parameter for assessing athletes' lower extremity explosive power.

Different lower extremity morphologies may affect postural control techniques due to alterations in proprioceptive feedback, according to studies examining the effects of biomechanical parameter differences on postural control or performance (Cote et al., 2005; Samaei et al., 2012; Maninenti et al., 2014). Injuries generally occur during jumping and one-

leg landing maneuvers (Kristianslund et al., 2014). For these reasons, there are also studies stating that the measurement of balance performance in one leg is an important predictor of musculoskeletal injuries (Trojian and McKeag 2006). Based on the knowledge that changes in QA may affect balance performance in young people, this study aimed to examine the effect of QA on anaerobic peak power and balance performance of youth football players.

Method

In this study, 21 male athletes (Avg_{age}=15,71±,717), who play football actively participated voluntarily. All methods were explained to all individuals who participated. The body mass indexes of the participants were calculated using the formula *BMI = Weight in kg / Height in* m^2.

Quadriceps (Q) Angle

The quadriceps angle (QA) is the angle formed by drawing a straight line from the anterior superior iliac spine (ASIS) to the center point of the patella and another line from the patella's center point to the middle of the tibial tubercle (Insall et al., 1976). In this study, a digital goniometer, which is valid in the literature, was used for QA measurements. In order to avoid minor deviations while taking measurements, a single person from the research team was allowed to measure all the athletes. The goniometer hinge was positioned at the center point of the patella, the goniometer arms were corrected to be placed on the line connecting the ASIS and the tibial tuberosity, and the small angle on the goniometer was noted as QA (Khasawneh et al., 2019).

Vertical Jump Test

The SmartSpeed Contact Mat (Reeve and Tyler, 2013) was used to measure vertical jump parameters. In the test, the athlete was asked to perform the highest jump that he could jump upwards while in a half squat position (knee angle 90°) with his hands on his waist. The best measurement was evaluated by using two replicates (Koca-Kosova and Kosova, 2021; Söğüt et al., 2022). In both groups, the anaerobic peak power of individuals was calculated in Watt(W) by adapting the vertical jump data to the Harman Formula (Harman et.al 1991).

Y Balance Test

The Y balance test evaluates contralateral leg lower extremity access in three directions (anterior, posteromedial, and posterolateral) while maintaining unilateral posture. The anterior,

posteromedial, and posterolateral reach distances were measured bilaterally using the Y Balance Test in this study (Plisky et al., 2009).

During the test, each subject stood by one barefoot in the middle of the center plate, toes behind the designated line. Throughout the test, the subjects kept their hands on their hips while performing all of the reaches. Each athlete had three trials in each direction, and the averages of these measurements were recorded.

Analysis of Data

Since the number of participants was less than 30 (n=21), the Shapiro Wilk test was taken into consideration from the normality tests. As a result of the normality test, it was found that the data showed normal distribution. Since the Scala variables are parametric, parametric tests (the Pearson correlation test and simple regression tests) were applied in the analysis with SPSS 22.0.

Results

Table 1

Demographic Information of the Individuals Who Participated in the Study

	N	$\overline{X}$	**S.s.**
Age (years)	21	15,71	,717
Height (cm)	21	173,95	5,47
Weight (kg)	21	61,43	9,3
BMI (kg/m^2)	21	20,22	2,36
Right QA (°)	21	8,41	2,37
Left QA (°)	21	8,34	1,96
Anaerobic Peak Power (W)	21	4232,07	406,41

Demographic analyzes were performed to determine the averages of age, height, body weight, BMI, right QA, left QA, and anaerobic peak power values of the participants. When Table 1 is examined, it was determined that the mean age of the participants is 15,71±0,717 years, the average height is 173,95±5,472 cm, the average weight is 61,432±9,309 kg, the average BMI is 20,2286±2,36625 kg/m^2, right QA averages were 8,41905°±1,9673768, left QA averages were 8,342857°±1,9673768 and anaerobic peak power averages were 4232,07486±406,417197 Watts.

Table 2

Correlation Analysis Between Age, BMI, Left QA, Right QA, Left Anterior Reach Distance, and Anaerobic Peak Power

		Age	BMI	Left QA	Right QA	Left Anterior Reach Distance	Anaerobic Peak Power
BMI	r	-,166	1				
Left QA	r	,190	,131	1			
Right QA	r	,056	-,101	**,494***	1		
Left Anterior Reach Distance	r	,047	-,188	**,436***	,215	1	
Anaerobic Peak Power	r	-,007	**,539***	-,082	-,376	-,266	1

The Pearson Correlation analysis was performed to determine the relationship between Age, BMI, Left QA, Right QA, Left Anterior Reach Distance, and Anaerobic Peak Power. The results of the analysis between these variables are given in Table 2. When Table 2 is examined, it is seen that there is a moderately positive and significant relationship between the BMI values of individuals and their anaerobic peak power (r=,539, p=0,12). It is seen that there is a moderately positive and significant relationship between the left QA and the right QA of the individuals (r=,494, p=0,023). It is seen that there is a moderately positive and significant relationship between the Left QA and the Left anterior reach distance of the individuals (r=,436, p=0,048).

Table 3

Simple Regression Analysis Results for Prediction of Anaerobic Peak Power

	B	Standard Error $_B$	β	t	p
Constant	4180,004	675,807	-	6,185	,000
BMI	92,555	33,193	0,539	2,788	**,012**

R=0,539, R^2=0,290, F=7,775, p=0,12

The simple regression analysis results regarding the prediction of anaerobic peak power according to the BMI variable are given in Table 3. When the regression analysis results in Table 3 are examined, it is seen that BMI is a significant predictor of the athlete's anaerobic peak power (R=0,539, R^2=0,290, F=7,775, p=0,12). It can be stated that 29% of the total variance in anaerobic peak power is explained by the BMI value of the athlete.

Table 4

Simple Regression Analysis Results for the Prediction of Right QA

	B	Standard Error $_B$	β	t	p
Constant	3,440	2,061	-	1,669	,112
Left QA	,597	,241	,494	2,479	**,023**

R=0,494, R^2=0,244, F=6,144, p=0,23

The results of the simple regression analysis for the prediction of the right QA according to the left QA variable are given in Table 4. When the analysis results are examined, it is seen that the left QA is a significant predictor of the athlete's right QA (R=0,494, R^2=0,244, F=6,144, p=0,23). It can be stated that 24.4% of the total variance in the right QA is explained by the left QA value of the athlete. In other words, it is seen that the right QA is a significant predictor of the left QA (R=0,494, R^2=0,244, F=6,144, p=0,23).

Table 5

Simple Regression Analysis Results for the Prediction of the Left QA

	B	Standard Error $_B$	β	t	p
Constant	2,340	2,867	-	,816	,424
Left Anterior Reach Distance	,105	,049	,436	2,114	**,048**

R=0,436, R^2=0,190, F=4,468, p=0,48

The results of the simple regression analysis for the prediction of the left QA according to the variable of the left anterior reach distance are given in Table 5. When the results of the regression analysis given in Table 5 are examined, it is seen that the left QA is a significant predictor of the left anterior reach distance of the athlete (R=0,436, R^2=0,190, F=4,468, p=0,48). It can be stated that 19% of the total variance in left anterior reach distance is explained by the left QA value of the athlete.

Discussion and Conclusion

When the findings of our study were examined, no relationship could be detected between QA and vertical jump, but it was observed that QA was an important predictor of the left anterior reach distance of athletes, and it was determined that 19% of the total variance in the left anterior reach distance was explained by the left QA value of athletes.

Hewett et al. (1999), and Contarlı and Özmen (2021), in their research, measured the relationship between the QA and vertical jump and found that there was no relationship between the QA and vertical jump. On the other hand, Ferreira et al., in a study they conducted in 2010, associated having a lower QA with better jumping ability.

In parallel with this research, to give an example of some studies in the literature that argue that QA has a relationship with balance, Denizoğlu Kulli et al. (2019) emphasized that individuals with low QA showed lower balance performance in the lateral direction than individuals with high and normal QA. Patole et al. (2021) noted a weak and negative relationship between QA and static balance, as well as a moderate negative relationship between QA and dynamic balance. However, when we look at the literature, many studies do not have a relationship between QA and balance performance (Contarlı and Ozmen, 2021; Hoffman et al., 1998. In their study in 2019, Şenol et al. found significant correlation between neither single-leg balance performance nor QA scores and the somatotypes they assessed.

The QA is also used to define the relationship between sports injuries and structural factors and as a predictor of susceptibility to sports injuries (Shambaugh et al., 1991). Researchers have argued that a QA above normal may cause an increase in lateral patellofemoral compressive strength and cause problems such as anterior knee pain, joint instability, and patellofemoral pain syndrome (Byl et al., 2000; Schulthies et al., 1995; Huberti et al., 1984).

Reilly (1976), Rösch et al. (2000), and Stolen et al. (2005) showed that the quadriceps and hamstring muscles were especially important for basic functions such as strength, sprinting or rapid change of direction, passing, shooting, jumping, or taking a quick step. It has been reported in the literature that there is a relationship between QA, an indicator of lower extremity biomechanical alignment, and knee joint muscle strength, and that quadriceps muscle strength decreases as the QA increases (Mohanty et al., 2019; Messier et al., 1991).

Tiberio (1987) and Izraelski (2012) found that pronation and supination foot stance may have an interactive effect on QA. Samaei et al. showed in their study in 2012 that low QA can affect frontal plane balance control via the base of support or ankle and knee alignment. Ishida et al. (2018) also found that jumping immediately after landing significantly increased the knee abduction angle during the early landing phase in women, but not in men.

Tropp et al. (1984), Watson (1999), and McGuine et al. (2000) identified poor balance as a risk factor for injury in a wide range of sports, whereas others identified good balance as a risk factor or found no relationship between balance and injury risk (Beynnon et al., 2001; Söderman et al., 2001). Although poor balance has been proposed as a risk factor for injury, only several studies have looked into this.

As a result, when we look at the studies in the literature, it has been seen that there is a positive correlation in balance performance by increasing joint instability, but not in anaerobic power, especially in sports branches that require sudden reactive skills such as football.

Authors' contributions

Both authors contributed equally at all stages of the research.

Conflicts of interest

The authors do not have a statement of conflict regarding the research.

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[i] Bu çalışma 6. Uluslararası Akademik Spor Araştırmaları Kongresi'nde özet bildiri olarak sunulmuştur.