THE ANALYSIS OF PATELLA FEMORAL (Q) ANGLE'S CORRELATION BETWEEN LEG STRENGTH AND BALANCE IN ATHLETES[1]

Kürşat HAZAR[1]*

Recep GÜRSOY[1]

Ahmet Rahmi GÜNAY[1]

ABSTRACT

The aim of this study is the analyze of patella femoral (q) angle's correlation between leg strength and balance in athletes with different genders.

50 female and 75 male athletes, average of age 20,120±,961, who are receiving education in departments related to Muğla Sıtkı Koçman University Faculty of Sports Science in total 125 regularly practicing and participating in sports competitions athletes voluntarily took part in. Stature, weight, Q angle, medial condyle and medial malleolus space, dynamic balance, leg strength and flexibility values of the participants in the study research study group have been carried out respectively. Comparison of Q angles, balance, strength and flexibility values according to gender has been conducted with t test in SPSS program, Q angle values of the athletes' relationship with age, stature, weight and fitness age, with Pearson Correlation Test, it is analyzed that if there's a relationship between position right-left feet Q angle values in standing& supine position and medial condyle, medial malleolus, balance values, leg strength, flexibility and relative strength values. It is determined that there is a significant difference between left foot Q angles in standing& supine position and right foot Q angles in standing& supine position, and relative strength and medial condyle angles when considered Q angle values of the participants according to gender ($p<0,01$). It is determined that there is a significant negative correlation between female athletes' supine position right and left feet Q angle value and fitness age. There is a significant negative correlation between age, medial malleolus, weight and medial condyle, as well ($p<0,05$). It is determined that while there is a positive correlation between female athletes' both standing & supine positions and both legs Q angles; there is a negative correlation between balance and relative strength values. It is seen that there is a significant negative correlation between balance values and standing left leg Q angle and Q angle in both legs in supine position but in male athletes although it is determined that there is a significant negative correlation between Q angles of both legs in standing & supine positions, in general balance values has a negative correlation with Q angle values. Briefly in this study, it is determined that there is a decrease in leg strength and balance value of the female and male athletes with high Q angle values and it is taught that Q angles affect leg strength and balance performance.

***Key Words*:** Gender, Q Angle, Leg Strength, balance.

SPORCULARDA PATELLA FEMORAL (Q) AÇISININ BACAK KUVVETİ VE DENGE İLE İLİŞKİSİNİN İNCELENMESİ

ÖZ

Bu çalışmanın amacı farklı cinsiyetlerde yer alan sporcularda Q açısı değerlerinin bacak kuvveti ve denge ile ilişkisinin araştırılmasıdır.

Çalışmaya Muğla Sıtkı Koçman Üniversitesi Spor Bilimleri Fakültesine bağlı bölümlerde öğrenim gören yaş ortalamaları 20,120±,961 yıl olup düzenli antrenman yapan, spor müsabakalarına katılan 50 kadın 75 erkek olmak üzere toplam 125 sporcu gönüllü olarak katılmıştır. Çalışmaya katılan araştırma gurubunun sırasıyla boy uzunluğu, vücut ağırlığı, Q açıları, medial kondil ve medial molleol aralıkları, dinamik dengeleri, bacak kuvveti ve esneklik ölçümleri yapılmıştır. cinsiyete göre Q açıları, denge, kuvvet ve esneklik değerlerinin karşılaştırılması SPSS programında t test ile, sporcuların Q açı değerlerinin yaş, boy uzunluğu, ağırlık ve spor yaşı ile ilişkisi, ayakta ve yatar pozisyonda sağ sol bacak Q acı değerleri ile medial kondil, medial molleol, denge değerleri, bacak kuvveti, esneklik ve rölatif kuvvet değerleri arasında ilişki olup olmadığı pearson korelasyon testi ile incelenmiştir. Katılımcıların Q açı değerlerinin cinsiyete göre bakıldığında ayakta ve yatarak sağ bacak Q açıları, ayakta ve yatarak sol bacak Q açıları bacak kuvvetleri, rölatif kuvvetleri ve medial kondil açılarında cinsiyetler arasında anlamlı farklılıklar olduğu ($p<0,01$) tespit edildi. Bayan sporcuların yatarak sağ ve sol bacak Q açı değerleri ile spor yaşı arasında anlamlı negatif yönde ilişki, yaş ile medial molleol ve ağırlık ile medial kondil arasında yine negatif bir ilişkinin olduğu tespit edilmiştir ($p<0,05$). Kadın sporcuların ayakta ve yatar pozisyonda her iki bacak Q açıları arasında pozitif ilişki varken denge ve rölatif kuvvet değerleri ile de negatif yönde bir ilişkinin olduğu tespit edildi. Denge değerleri ile ayakta sağ bacak Q açısı değerleri ve yatar pozisyonda her iki bacaktaki Q açı değerleri arasında güçlü yönde negatif bir ilişki olduğu görülmektedir. Erkek sporcularda ise ayakta ve yatar pozisyonda her iki bacak Q açıları ile medial molleol değerleri arasında pozitif ilişki görülürken Denge değerlerinin genel olarak Q açı değerleri ile negatif bir ilişkinin olduğu tespit edilmiştir. Sonuç olarak bu çalışmada kadın ve erkek sporcularda Q açı değerleri yüksek olanların bacak kuvvetleri ve denge değerlerinde düşüş olduğu tespit edilmiş olup, Q açılarının bacak kuvveti ve denge performanslarını etkilediği düşünülmektedir.

Anahtar kelimeler: Cinsiyet Q açısı, bacak kuvveti, denge

[1] Muğla Sıtkı Koçman University

* Corresponding Author

INTRODUCTION AND AIM

In today's world, it is possible to consider sports as physical and mental facts performed for various aims. It is a known fact that people taking part in sports activities achieve different gains. The main philosophy in doing sports according to athletes is to win. Even wholly practicing the given workout schedule to the athlete and following discipline by gaining personality may not be enough to obtain intended performance. In this sense, performance effective factors' effects over sporty output stands out by analyzing scientifically.

The fact that the recognition of body composition features of the athletes is an effective factor on their performance is a frequently mentioned issue. For this reason, in order to enhance the performance of the athletes, it becomes necessary to determine how much physical and physiological feature affects the other. Patella femoral angel (pfa) is a frequently used method in knee-joint and lower-extremity's evaluation in kinesiology sense, firstly verbalized by Brattström, and nowadays Q angle is m. quadriceps femoris's angle. It is defined as acute angle located in where the middle of the patella and tuberositas tibiae and striae crossing spina iliaca anterior superior and patella intersect[7].

Biomechanically, Q angle is effective on patella femoral translation[25]. But as prior condition to sporty output, it is mentioned that anatomical, conditional coordinate and factors related to personality are necessary[24]. It is possible to attach the features of an individual's posture to anatomical feature. For this reason, it is thought that postural features have effects on athletic output.

In all of the branches of the sports, it is widely accepted by everyone that force has a positive effect on athletic performance. When literature researches have been evaluated, it is observed that many scientists have different force definitions meaning the same. In terms of physiological approach, force expresses the tension during muscle contraction[17]. While the concept of force is defined as the power that changes the position, movement and shape of the objects in physics[18], it is the ability to contraction of the muscles facing a resistance or be good for against the resistance. In other words, it is the characteristic of counteraction against resistance via strain and relaxation[5]. In biomechanics, force is defined as a quantity and capacity to do work[26].

One of the factors affecting performance in sports is balance and generally athletes' having a good balance may contribute to optimize their workout, decrease possibility of injury and practice effective and prolific. Balance is defined as the ability of body's preserving its stance on the balance area[27]. Balance is the basis for top-level performance. The athletes' ability to equilibrate is a determinant factor in the development of other motor systems[3]. The control of the balance is a complex motor ability that includes coalesce of sensory data, planning and practicing of flexible movements[11]. Balance can be analyzed as static and dynamic equilibrium[19]. While static balance is the ability of enabling the body's balance on a specific place or position, dynamic balance is the ability of enabling body's balance in action[28]. Besides many factors affecting the

balance, postural structure is also a factor that affects equilibrium[8]. When Q angles are considered as a postural feature, it is thought that it may affect lower-extremity performance.

In the literature research studies, it is determined that Patella femoral (Q) angle, leg strength and balance issues have been analyzed both between each other and in terms of different parameters[28,23,20]. In this sense, it has an importance to be researched if Q angle differences has a relationship between leg strength and balance values in terms of gender. For this reason, the aim of this study is to analyze if there is a difference in Q angle values of athletes with different genders and the relationship between leg strength and balance relationship.

MATERIAL AND METHOD

Participants: 50 female and 75 male athletes, average of age 20,120±,961, who are receiving education in departments related to Muğla Sıtkı Koçman University Faculty of Sports Science in total 125 regularly practicing and participating in sports competitions athletes voluntarily took part in. After giving detailed information to the participants about measurements before the study, a document has been signed regarding that they are voluntarily participating in the study. Besides, by determining if there is anyone with health problems like knee-injury, both medial condyle and medial malleolus space are 2,5cm and over and genu valgus, these people have been excluded.

Data Collecting Method: Stature, weight, Q angle, medial condyle and medial malleolus space, dynamic balance, leg strength and flexibility values of the participants in the study research study group have been carried out respectively.

Height and Weight Measurements: The height of the study research group participants' have been measured with stadiotmeter (SECA, Germany) which has 0.01 m. degree of accuracy, the weight of the study research group participants' have been measured with electronic bascule which has 0.1 kg (SECA, Germany) degree of accuracy.

Q Angle Measurements: It has been measured by having the participants' bare feet on the ground on standing position while Quadriceps femoris muscle's flabby, and in supine position, while knee-joint is extension and loose hip flexion[4,2]. The mensuration has been carried out with a modified goniometer whose long arm is 60cm and the short is 25cm. While performing the measurement, patella center from spina iliaka anterior superior (SIAS) and tuberositas tibia's midpoint have been carefully marked and goniometer's center has been set towards patella's midpoint; and the midpoint of the long arm's midpoint has been set to SIAS's midpoint has been set towards tuberosiats tibia's midpoint. Besides Q angles, in order to determine Varus and valgus deformity both extremities have been set to adduction in way they touch each other, both medial malleolus and medial condyles spaces have been measured with a modified caliper. In these measurements, if the space between medial femoral condyles is 2,5cm and over it is evaluated as Varus; if the space between both medial malleolus space is

2,5cm and over it is evaluated as valgus deformity.

Balance Measurements: Balance measurements have been conducted barefoot with Lafayette bran &16020 IRF/ E Stabilometer) balance measurement device by providing warmed up participants, during the measurements it has been asked to equally stand in balance by giving 30 seconds and after 30 seconds the obtained maximum value has been recorded in term of second.

Leg Strength Measurements: Leg strength has been determined via 1 maximum repetition method (1MR) with Takei brand dynamometer (T.K.K.5402) by providing warmed up participants. Afterwards relative strength was calculated total strength/body mass (kg).

Flexibility Measurements: Flexibility measurements have been conducted in sit and reach test method with 01285A model Lafayette brand flexibility measurement stands.

Analysis of The Data: The statistical evaluation of the obtained data has been carried out in personal computer with SPSS 21.00 packaged software. The test of normality has been conducted with Kolmagorow-Simirnov test and it is determined that the data spreads normally. For pairwise comparison, t test has been conducted in free from parametric tests. Pearson correlation test has been performed for the correlation evaluation. Significance level has been fictionalized at a level of p<0,05 and 0,01.

FINDINGS

Table 1. Descriptive Statistics of the Participants

Variables		Minimum	Maximum	Mean± Std.
Female N= 50	Age (Years)	19,00	22,00	20,120±,961
	Height (cm)	152,00	183,00	164,576±8,00
	Weight (kg)	46,60	87,00	59,868±10,11
	Training experience (Years)	1,00	14,00	7,060±3,803
Male N=74	Age (Years)	19,00	25,00	20,337±1,327
	Height (cm)	160,00	205,00	175,473±7,300
	Weight (kg)	55,00	94,00	73,066±8,632
	Training experience (Years)	1,00	20,00	8,905±4,181

Table 2. Comparison of Participants Q Angles According to Gender

Variables	Gender	Mean± Std.	t.	p
Standing Right Leg Q Angle	Female	14,320±3,209	4,063	,000**
	Male	12,297±2,333		
Standing Left Leg Q Angle	Female	13,460±2,269	3,363	,001**
	Male	11,824±2,887		
Supine Right Leg Q Angle	Female	14,180±3,134	6,483	,000**
	Male	11,013±2,302		
Supine Left Leg Q Angle	Female	13,220±2,279	6,544	,000**
	Male	10,297±2,541		
Medial Condyle	Female	0,7140±,775	-3,237	,002**
	Male	1,183±,804		
Medial Malleolus	Female	0,690±,683	-,062	,951
	Male	0,698±,733		

*: p<0,05, **: p<0,01.

When Table 2 is analyzed, it is seen that there is a significant difference between genders in Q angles in standing and supine position, left leg Q angles in standing and supine position and medial condyle angles (p<0,01), and there is no significant difference between medial malleolus angles.

Table 3. Comparison of balance, Force and Flexibility Values of The Participants According to Genders

Variables	Gender	Mean± Std.	t.	p
Balance (sn)	Female	10,456±4,979	-0,196	,845
	Male	10,626±4,557		
Leg strength (kg)	Female	70,256±18,198	-13,356	,000**
	Male	126,540±25,755		
Relative strength	Female	1,183±,282	-9,763	,000**
	Male	1,738±,327		
Flexibility (cm)	Female	38,340±9,795	,970	,334
	Male	36,813±7,688		

*: p<0,05, **: p<0,01.

As seen in Table 3, it is seen that there is a significant difference between female and male athletes' leg strength and relative strengths; but there is not a significant difference between balance and flexibility values.

Table 4. The Correlation of Female Athletes' Q Angles with Age, Height, Weight and Fitness Age

Variables(n:50)		Standing Right Leg Q	Standing Left Leg Q	Supine Right Leg Q	Supine Left Leg Q	Medial Condyle	Medial Malleolus
Age (Years)	r	,087	-,101	,135	,183	,077	-,346
	p	,550	,487	,350	,203	,595	,014*
Height (cm)	r	,130	-,199	-,076	-,184	-,137	-,019
	p	,370	,165	,598	,200	,343	,893
Weight (kg)	r	,166	-,039	-,043	-,110	-,323	,125
	p	,249	,787	,768	,449	,022*	,385
Training experience (Years)	r	-,070	-,020	-,301	-,291	,255	,114
	p	,628	,891	,034*	,040*	,074	,431

*: p<0,05, **: p<0,01.

When analyzed Table 4, it is determined that female athletes' standing & supine right & leg Q angles has a significant negative correlation with training experience (Years); and there is a negative correlation between age and medial malleolus and weight and medial condyle as well (p<0, 05).

Table 5. The Correlation of Male Athletes' Q Angle Values with Age, Height, Weight and Fitness Age

Variables (n:74)		Standing Right Leg Q	Standing Left Leg Q	Supine Right Leg Q	Supine Left Leg Q	Medial Condyle	Medial Malleolus
Age (Years)	r	,219	,127	,106	,185	-,010	,099
	p	,060	,283	,368	,114	,932	,402
Height (cm)	r	,078	-,003	-,189	-,091	,084	,175
	p	,506	,983	,106	,440	,475	,136
Weight (kg)	r	,020	,046	-,149	-,072	-,075	,110
	p	,864	,698	,204	,544	,526	,351
Training experience (Years)	r	-,038	-,008	,002	,142	-,087	,095
	p	,749	,945	,989	,228	,459	,420

*: p<0,05, **: p<0,01

When analyzed Table 5, it is determined that Q angles of male athletes has no correlation with age, height, weight and fitness age.

Table 6. Female Athletes' Q Angle Values' Correlation With Other Variables

Variables (n:50)		**Standing Left Leg Q**	**Supine Right Leg Q**	**Supine Left Leg Q**	**Medial Condyle**	**Medial Malleolus**	**Balance Value**	**Leg Force**	**Flexibility**	**Relative Strength**
Standing Right Leg Q	r	,411	,422	,378	-,230	-,274	-,409	-,220	,070	-,331
	p	**,003****	**,002****	**,007****	,108	,054	**,003****	,125	,630	**,019***
Standing Left Leg Q	r	1	,183	,311	-,163	,030	-,197	-,087	,159	-,066
	p		,203	**,028***	,259	,838	,171	,550	,270	,650
Supine Right Leg Q	r	,183	1	,694	-,203	-,297	-,359	-,085	,108	-,092
	p	,203		**,000****	,156	**,036***	**,011***	,556	,457	,526
Supine Left Leg Q	r	,311	,694	1	-,275	-,408	-,475	-,191	,132	-,133
	p	**,028***	**,000****		,053	**,003****	**,000****	,184	,360	,357
Medial Condyle	r	-,163	-,203	-,275	1	,191	,266	-,072	,057	,136
	p	,259	,156	,053		,184	,062	,617	,696	,346
Medial Malleolus	r	,030	-,297	-,408	,191	1	,103	,156	-,026	,052
	p	,838	**,036***	**,003****	,184		,478	,278	,856	,720
Equilibrium Value	r	-,197	-,359	-,475	,266	,103	1	,308	,057	,382
	p	,171	**,011***	**,000****	,062	,478		**,030***	,692	,006
Leg Force	r	-,087	-,085	-,191	-,072	,156	,308	1	,096	,800
	p	,550	,556	,184	,617	,278	**,030***		,506	**,000****
Flexibility	r	,159	,108	,132	,057	-,026	,057	,096	1	,172
	p	,270	,457	,360	,696	,856	,692	,506		,233
Relative Force	r	-,066	-,092	-,133	,136	,052	,382	,800	,172	1
	p	,650	,526	,357	,346	,720	**,006****	**,000****	,233	

*: p<0,05, **: p<0,01

As seen in the Table 6, it is understood that standing right leg Q angle value and standing left leg Q, supine position right leg Q and supine position left leg Q has a positive, yet with balance and relative strength values it has a negative correlation. Standing left leg Q angle value has a positive correlation with supine position left leg Q angle. Although supine position right leg Q angle value has a positive correlation with supine left leg Q angle value and medial malleolus, it has a negative correlation with balance value. On the other hand, supine position left leg Q angle value has a significant positive correlation with standing left leg Q angle and supine position right leg Q angle, but it has a significant negative correlation with medial malleolus and balance values. Medial malleolus values have a negative correlation with supine position Q angle values for both legs.

When looked into balance values, it is seen that standing right leg Q angle values have a significant negative correlation with both legs Q angles in supine position. Leg strength has a positive correlation with balance and relative strength. In addition to this, there is a negative correlation between relative strength and standing right leg Q angle; but balance has a positive correlation with leg strength values.

Table 7. Male Athletes' Q Angle Values' Correlation with Other Variables

Variables (n:74)		**Standing Left Leg Q**	**Supine Right Leg Q**	**Supine Left Leg Q**	**Medial Condyle**	**Medial Malleolus**	**Balance Value**	**Leg Force**	**Flexibility**	**Relative Force**
Standing Right Leg Q	r	,768	,514	,477	-,329	,259	-,325	-,167	-,016	-,185
	p	**,000****	**,000****	**,000****	**,004****	**,026***	**,005****	,155	,893	,114
Standing Left Leg Q	r	1	,530	,595	-,210	,219	-,354	-,107	,063	-,144
	p		**,000****	**,000****	,073	,061	**,002****	,364	,596	,222
Supine Right Leg Q	r	,530	1	,692	-,277	,064	-,130	-,202	,200	-,130
	p	**,000****		**,000****	**,017***	,588	,268	,084	,087	,271
Supine Left Leg Q	r	,595	,692	1	-,316	,068	-,280	-,124	,098	-,087
	p	**,000****	**,000****		**,006****	,566	**,016***	,294	,405	,463
Medial Condyle	r	-,210	-,277	-,316	1	,161	,231	,061	-,108	,126
	p	,073	**,017***	**,006****		,171	**,048***	,605	,361	,286
Medial Malleolus	r	,219	,064	,068	,161	1	-,241	-,078	,042	-,138
	p	,061	,588	,566	,171		**,038***	,506	,720	,241
Equilibrium Value	r	-,354	-,130	-,280	,231	-,241	1	,111	,178	,268
	p	**,002****	,268	**,016***	**,048***	**,038***		,347	,129	,021
Leg strength	r	-,107	-,202	-,124	,061	-,078	,111	1	,157	,830
	p	,364	,084	,294	,605	,506	,347		,182	**,000****
Flexibility	r	,063	,200	,098	-,108	,042	,178	,157	1	,076
	p	,596	,087	,405	,361	,720	,129	,182		,518
Relative Force	r	-,144	-,130	-,087	,126	-,138	,268	,830	,076	1
	p	,222	,271	,463	,286	,241	**,021***	**,000****	,518	

*: p<0,05, **: p<0,01

When analyzed male athletes' correlation of variables, standing right leg Q angle values has a positive correlation with standing left leg, supine position right leg, supine position left leg Q angle and medial malleolus values. On the other hand, standing right leg Q angle values have a negative correlation with medial condyle and balance values. It is seen that standing left leg Q value has a positive correlation with right leg in standing and right leg in supine position, but it has a negative correlation with balance value. Supine position right leg Q angle value has

a positive correlation with supine position left leg, standing right and left leg Q angle values; but has a negative correlation with medial condyle value. When analyzed balance values; angle values have a negative correlation in general and these correlations in standing right and left leg Q angle values are significantly negative ($p<0,01$), have a significant negative correlation with supine position left leg Q angle and medial malleolus values ($p<0,05$); however, balance values have a positive correlation with medial condyle values.

DISCUSSION AND CONCLUSION

Although Q angle is a criterion[6] for diagnosis of the illnesses, determining if the knee is in normal condition after treatment, clarification of knee-joint mechanics and putting the leg. patella in correct position in prosthesis; also when individual's physical and physiological features have been evaluated within the compass of biomechanical and postural features, these features' effects on both sporty output and performance have been considered.

In this study, which we have wanted to study the correlation of both genders'(Female-Male) Q angle values with leg strength and balance in, when analyzed in terms of gender, Q angle values of the participants both standing right- left leg Q angles and supine position right-left leg Q angles have revealed that there is a significant difference and these angles are higher in female participants ($p<0,01$). Besides, in order to determine varus and valgus knee deformity in both genders, medial condyle and medial malleolus angles have been measured as well. It revealed that there is a significant difference in medial condyle angles in terms of genders but there is no difference in malleolus angles. When literature is researched, besides seeing there is no precise value in terms of determining an average value about Q angle, it is reported that commonly accepted reference value is 8-14 degrees (average 10 degrees) in males, and 11-20 degrees (average 15 degrees) in females. While over 15 degrees is considered as abnormal for males, over 20 degrees is considered as abnormal for females. Horton and Hall (1989), have discovered a significant correlation in Q angles in terms of gender [15]. It is seen that in the literature research studies, Q angle in both positions (standing and supine positions) females have higher angles than males [29,1,22].

According to Caylor and his friends (1964) and , the reason for this is females have a wider pelvis space then males [10]. In this aspect, the study shows similarities literature.

Also, it is determined that there is a significant difference between female athletes' leg strength and relative strength ($p<0,01$). Although in some of the studies conducted by researchers in literature male athletes have higher balance values than females, in our study it is determined that there is no significant difference in balance and flexibility values between genders. Femur circumference width shows that muscles forming the femur area (Quadriceps, hamstring etc.) creating force-power is higher depending on muscle mass and muscle fiber[12].

In this sense, it is thought that why male athletes' leg strength values are found to be higher, but there is no significant difference between female and male athletes' balance and flexibility values

are the participants our subject groups are totally athletes from different branches.

When female athletes' Q angle values' correlation with age, height, training experience is analyzed, in the conducted researches, it is seen that females have higher Q angles in both (standing and supine position) positions than males. According to literature, the reason for this is females have a wider pelvis space than males [29,1,22]. In this study, it is found that right and left leg Q angles in supine position and fitness age has a negative correlation in female athletes. Female athletes with high fitness age have been found to have low Q angle values, as Hahn and Foldspang (1997), mentioned high-force performed by quadriceps muscle group decreases Q angle[13]. In this sense, quadriceps muscle's pulling force and speed developing depending on fitness age causes Q angle values to be lower. It is found that there is a negative correlation both between age and medial malleolus and weight and medial condyle ($p<0,05$). In the study Karsan and his friends (1998) conducted to determine knee deformity, they determined that both medial condyle and malleolus are varus and valgus which are 2,5 cm and over[16]. Although this correlation is considered to result from a deformity occurring in knee-joint depending on age weight, it is determined that Q angle values have no correlation with age, height, weight or fitness age for males. In our study, it can be discussed that this situation may result from Q angle references, which take part in literature, are lower in males when compared to females. When female athletes' Q angle values' correlation with other variables, by determining Q angle values of right leg[28], left leg in standing position[8], right leg[28], left leg in supine position[8] as degrees; it is determined that there is a positive correlation among Q angle values in measurements performed in both positions (standing and supine positions). In the young population values coming out of conducted studies related to Q angle vary as indicated by many researchers and authors[1,9]. Although Olcay and his friends (1994), measure Q angles both in standing and supine positions for both genders and find Q angle 14 degrees in supine, 17 degrees in standing position[21]; different population, sample, method and different mensuration means may lead to different consequences.

Besides, while it is understood that there is a correlation like as female athletes' balance values increase relative strength values decrease, in the conducted study while right leg Q angle value in supine position' value has a correlation with left leg Q angle, and medial malleolus; it has a negative correlation with balance. On the other hand, although left leg Q angle value in supine position has a significant positive correlation with leg Q angle in supine position, there is a negative correlation between medial malleolus and balance values. Medial malleolus values have a negative correlation with Q angle values for both legs in supine position.

When analyzed balance values, it is seen that there is a negative correlation between right leg Q angle values in standing position and both legs Q angles in supine position. Leg strength has a positive correlation with balance and relative strength. After all, it is seen that relative strength has a negative correlation with right leg Q angle in standing position; has a positive correlation with balance and leg strength.

When analyzed correlations among male athletes' variables, medial malleolus values have a positive correlation with right leg Q angle value in standing position and left leg position in standing position right leg Q angle value in supine position,

left leg Q angle value in supine position. On the other hand, it is seen that there is negative correlation right leg Q angle value, medial condyle and balance values. While left leg Q angle value has a positive correlation with right and in standing position and right leg in supine position; it has a negative correlation with balance value.

It is seen that right leg's Q angle value in supine position has a positive correlation with left leg in supine position and right and left legs' Q angle value, but it has a negative correlation with medial condyle. When analyzed balance values, it is determined that generally angle values have a negative correlation, it is determined that it has a significant negative correlation with right and left leg Q angle values ($p<0,01$) has a significant negative correlation with left leg Q angle in supine position and malleolus values, it has a significant positive correlation with medial condyle values ($p<0,05$).

In conclusion, any kind of studies about Q angle differences' leg strength and balance in male and female athletes' have not been come across. In this conducted study, it is determined that as Q angle values increase in female and male athletes, the leg strength and balance value decreases. Q angle differences have been considered to be effective on female and male athletes' leg strength and balance performances.

REFERENCES

1. Aglietli, P., Insall , JN., Cerulli , G.: Patellar pain and incongruence. I: Measurements of incongruence. Clin Orthop Relat Res. Jun;(176):217-24. 1983
2. Aglietti P, Giron F, Cuomo P. Disorders of the patellofemoraljoint. In: Scott WN, editor. Surgery of the knee. Philadelphia: Churchill Livingstone. pp. 807, 2006
3. Aksu, S. "Denge Eğitiminin Etkilerinin Postüral Stres Testi İle Değerlendirilmesi", Hacettepe Üniversitesi Sağlık Bilimleri Enstitüsü Bilim Uzmanlığı Tezi, Ankara, 1994 [In Turkish]
4. Anderson MA, Foreman TL. Return to competition Functional rehabilitation. In: Athletic Injuries and Rehabilitation. Zachazewski JE, Magee DJ, Quillen WS,Eds. Philadelphia: WB Saunders. pp. 229-261, 1996
5. Bompa, T. O. Antrenman Kuramı ve Yöntemi, Bağırgan Yapımevi, 2003. [In Turkish]
6. Boucher, J.P., King, MA, Lefebvre, R., Pepin, A. Quadriceps femoris muscle activity in patellofemoral pain syndrome. American Journal of Sports Medicine, 20 (5), 527-532. 1992
7. Brody, D.M. Running Injuries. Clinical Symposia, Volume 32, Number 4, 1980.
8. Cangussu, L.M., Nahas-Neto, J., Nahas, E.A.P., Barral, A.B.C., Buttros, R.D.A., and Uemura, G., Evaluation of postural balance in postmenopausal women and its relationship with bone mineral density- a cross sectional study. BMC Musculoskeletal Disorders, Volume: 13, pp: 2-7, 2012, doi:10.1186/1471-2474-13-2.
9. Carson, WG., James, SL., Larson, RL. , et al. : Patellolemoral di·sorders: Physical and radioographic evalualion. Clin. Orthop.185: 165·177, 1984.
10. Caylor D, Fites R, Worrell T. The relationship between quadriceps angle and anterior knee pain syndrome. JOSPT.;17: 11-5, 1993
11. Ferdjallah, M., Harris, G.F., Smith, P., Wertsch, J.J., "Analysis of Postural Control Synergies During Quiet Standing in Healthy Children and Children With Cerebral Palsy", Clinical Biomechanics, 17, 203-210, 2002.
12. Grant, S, Hynes, V., Whittaker, A., Aitchison, T., Anthropometric, Strength, Endurance and Flexibility Characteristics of Elite and Recreational Climbers, Journal of Sports Sciences, 14: 301-309,
13. Hahn T., Foldspang A., The Q angle and sport. Scand J Med Sci Sports. 1997;7:43-48
14. Hazar F., Taşmektepligil Y., "Puberte Öncesi Dönemde Denge ve Esnekliğin Çeviklik Üzerine Etkilerinin İncelenmesi", Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi, V (1) s. 9- 12, 2008. [In Turkish]
15. Horton MG, Hall TL. Quadriceps femoris muscle angle-normal values and relationships with gender and selected skeletal measures. Phys. Ther.; 69:897-901, 1989
16. Karsan O., Yünceviz R., Aydın Ş, Dane Ş.,Beden eğitimi ve spor bölümü öğrencilerinde quadriceps (Q) açısı değerleri Atatürk Üniversitiesi tıp dergisi icilt-30 sayı-1 .2. (1998) [In Turkish]

17. Muratlı S, Kalyoncu O, Şahin G. Antrenman ve müsabaka. İstanbul: Ladin Matbaası;. S,357.363, 2007 [In Turkish]
18. Muratlı S. Antrenman bilimi yaklaşımıyla çocuk ve spor. Ankara: Nobel yayın dağıtım;.s.11.15, 2007[In Turkish]
19. Muratlı, S. Çocuk ve Spor–Antrenman Bilimi Işığı Altında, Bağırgan Yayımevi, Ankara, s.51.22, 1997 [In Turkish]
20. Okudur. A, Sanioğlu. A, 12 Yaş Tenisçilerde Denge ile Çeviklik İlişkisinin İncelenmesi Selçuk üniversitesi Beden Eğitimi ve Spor Bilim Dergisi,; 14 (2): 165-170, 2012 [In Turkish]
21. Olcay E, Cetinus E, Mert M, Kara AN Genç erkek ve bayanlarda ayakta ve yatar pozisyonlarda quadriceps açısının mukayesesi ve değerlendirilmesiActa Orthop Traumatol Turc 2B, 25-27, 1994 [In Turkish]
22. Outerbridge RE. Further studies on the etiology of chon- dromalacia patellae. J Bone Joint Surg.1964;46-B:179-90.
23. Özkan. A, Sar ol. H, Dağcılarda vücut kompozisyonu, bacak hacmi, bacak kütlesi, aneorobik performans ve bacak kuvveti arasındaki ilişki, Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi, VI (4) 175-181, 2008 [In Turkish]
24. Schnabel G, Harre D, Borde A. Grundkonzept “Sportliche Leistung”. In: Trainingswissenschaft. 10. Ausg. G Shnabel, Hrsg, Berlin, SportVerlag, , 32-79. 1997
25. Schulties SS, Francis RS, Fisher AG, Van der Graaf KM. Does the Q angle reflect the forces on the patella in the frontal plane? Phys Ther; 75(1): 24-30. 1995
26. Sevim, Y., Antrenman bilgisi, Gazi Üniversitesi Beden Eğitimi ve Spor Yüksekokulu Ders Notları, Ankara. ss301, 1997[In Turkish]
27. Spirduso WW., Balance, Posture and Locomotion. in: Physical Dimensions of Aging. Human Kinetics, Champaing, Illionis, Pp 152-185, 1995
28. Toraman F, Yaman H, Taşralı S, Patella Femoral açı farklılığının alt eksremite farklılığına etkisi clınıcal research, Vol. 14, No. 1, (13-17), 2003 [In Turkish]
29. Woodland LH, Francis RS. Parameters and comparisons of the quadriceps angle of college-aged men and women in the supine and standing positions. Am J Sports Med.;20:208-11, 1992