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# Investigation of Relative Age Effect on Gymnasts Who Won Medals in Individual and Group Categories for 7 -14 Years

*7 -14 Yaş Bireysel Ve Grup Kategorilerinde Madalya Kazanan Cimnastikçilerde Bağıl Yaş Etkisinin İncelenmesi*

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**Abstract**The relative age effect is a phenomenon that has emerged especially in the educational processes of children. The fact that children born in the same calendar year have more than 11 months between them according to the month they were born brings along great differences in terms of their development. This situation is also seen in sports education. Especially in sports activities that started at a young age, the time difference between the birth quarters of the athletes born in the same year will cause their physical performance to be affected, as their physical development is affected. Relative age effect studies in gymnastics were carried out in individual branches, but no study was conducted on group categories. Most of the studies also mention the relative age effect. Whether there is a relative age effect on athletes competing in group branches of gymnastics has not been investigated before. Therefore, this study was conducted to understand whether there is a relative age effect in the groups categories in Rhythmic Gymnastics and Aerobic Gymnastics branches. As a result of the evaluations, it was seen that there was no relative age effect on the medal winners in individual and group categories in aerobic gymnastics. While there is a relative age effect in some parts of the three seasons examined in rhythmic gymnastics, there is a relative age effect in terms of the athletes who won medals in the individual and group according to the average of the three seasons.

**Keywords:** Reletive age effects, Rhythmic gymnastics, Aerobic gymnastics, medal.

***Özet:*** *Bağıl yaş etkisi özellikle çocukların eğitim süreçlerinde ortaya çıkmış bir olgudur. Aynı takvim yılında doğmuş çocukların doğdukları aya göre aralarında 11 aydan fazla sürenin olması, gelişimleri açısından büyük farklılıkları da beraberinde getirmektedir. Bu durum spor eğitiminde de karşımıza çıkmaktadır. Özellikle küçük yaşta başlayan spor aktivitelerinde aynı yıl doğmuş olan sporcuların doğum çeyreklerine göre aralarındaki süre farkı, fiziksel gelişimlerinin etkilenmesi sebebi ile fiziksel performanslarının da etkilenmesine sebep olacaktır. Cimnastikte bağıl yaş etkisi çalışmaları bireysel branşlarda yapılmış, grup kategorileri ile ilgili çalışma yapılmamıştır. Çalışmaların çoğunda da bağıl yaş etkisinden bahsedilmektedir. Cimnastiğin grup branşlarında yarışan sporcularında bağıl yaş etkisinin olup olmadığı ise daha önce araştırılmamıştır. Bu nedenle bu çalışma Ritmik Cimnasitk ve Aerobik Cimnastik branşlarında gruplar kategorilerinde bağıl yaş etkisi olup olmadığını anlamak için yapılmıştır. Yapılan değerlendirmeler sonucunda Aerobik cimnastikte bireysel ve grup kategorilerde madalya kazananlarda bağıl yaş etkisi olmadığı görülmüştür. Ritmik cimnastikte incelenen üç sezonun bazı bölümlerinde bağıl yaş etkisi görülürken, üç sezon ortalamasına göre bireyselde ve grupta madalya kazanan sporcular açısından bağıl yaş etkisi vardır.*

***Anahtar Kelimeler:*** *Bağıl yaş etkisi, Ritmik cimnastik, Aerobik cimnastik, madalya.*

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## INTRODUCTION

The first studies on the relative age effect were focused on academic achievement (Shearer, 1967). Later, studies started to be carried out in the field of sports as well. A few-month difference between the birth dates of children in sports activities was found to be important in terms of performance (Grondin, Deshaies, & Nault, 1984). The relative age effect in sports defines the relationship between an individual's month of birth and his/her success in sports (Cobley, Baker, Wattie, & McKenna, 2009). Especially in amateur sports branches, the chronological age difference brings an unfair competition environment. As a result of the study conducted in hockey and volleyball branches, it was observed that hockey players were mostly born in the first quarter (Grondin et al., 1984).

Sports federations determine seasons with certain date intervals according to age groups. For example, some start on January 1 and end on December 31. When examining the relative age effect, a year is divided into four parts and the birth months of the children are evaluated in 4 quarter parts. In the study, it was seen that the number of athletes born in the first quarter was higher than those born in the last quarter (Barnsley, Thompson, & Barnsley, 1985). Season start dates vary according to branches and countries. It is implemented as September in England (Cobley et al., 2009).

The relative age effect provides physical advantages (such as height, strength, aerobic power, endurance, speed) and this provides performance in sports (Cobley et al., 2009). In their study, Delorme et al. stated that age-related differences are ignored during talent selection and that the probability of leaving sports for children born in the 3rd and 4th quarters in later ages decreases compared to younger ones (Delorme, Chalabaev, & Raspaud, 2011). It is seen that the relative age effect does not disappear in advancing ages. On the other hand, there is no relative age effect in recreational sportive activities (Larouche, Laurencelle, Grondin, & Trudeau, 2010).

Low achievement status is associated with short life experience, self-esteem (Thompson, Barnsley, & Battle, 2004) and poorer mental health (Patalay et al., 2015). In addition, there is evidence that relatively older students achieve higher grades in physical education (Roberts & Fairclough, 2012).

In a study investigating the relationship between gender and relative age effect, it was seen that the relative age effect was larger than the gender effect. In other words, the oldest girls outperformed the youngest boys (Vincent & Glamser, 2006).

Musch and Grondin stated that the sports in which the relative age effect is seen are team sports such as ice hockey, which involve more physical contact, or individual sports such as tennis and swimming. On the contrary, being smaller can be seen as an advantage when motor skills come to the fore rather than physical characteristics in other sports branches (Musch & Grondin, 2001). Late adolescence was seen as an advantage in gymnastics, and a positive correlation was found between late adolescence and elite gymnastics practices (Baxter-Jones, 1995).

Gymnastics is one of the sports branches that have been competed since the first Olympic Games. There are eight different branches in the International Gymnastics Federation (FIG) (Ballı, 2021). Each branch has different competition categories within itself. Individual and team competitions are held in artistic gymnastics. In team competitions, gymnasts compete individually (Erkut, 2021). Individual, team and group competitions are held in rhythmic gymnastics. While gymnasts compete individually in team competitions, five gymnasts present a joint choreography in group competition (Örs, 2021). Both individual and group competitions are held in aerobic gymnastics. Gymnasts participate in the competition in the categories of single men, single women, doubles (one man - one woman), trios (three men, three women or mixed) and group (five men, five women or mixed) categories (Bagci, 2021).

Studies investigating the effect of relative age in gymnastics were generally considered on an individual basis, and group categories such as in rhythmic and aerobic gymnastics were ignored. For this reason, this study was conducted to examine the rhythmic and aerobic gymnasts participating in the competition in the groups in terms of the relative age effect.

## METHOD

In this study, the data of aerobic gymnasts between the ages of 9-14 and rhythmic gymnasts between the ages of 7-14 who participated in the competitions organized by the Turkish Gymnastics Federation (TGF) for 3 seasons were used. The quarters in which the gymnasts were born were recorded. In this context, it was determined in which quarter they were born according to the month they were born (1st quarter 1 January - 31 March, 2nd quarter 1 April - 30 June, 3rd quarter 1 July - 30 September and 4th quarter 1 October - 31 December). Considering the results of the competition, the birth quarters of the athletes competing in the individual and group categories who took the first three degrees were examined. 951 data in aerobic gymnastics and 1661 data in rhythmic gymnastics were included in the study. Competition results in individual and group categories in rhythmic gymnastics were evaluated. In aerobic gymnastics, the individual categories of men and women were evaluated together. In order to evaluate the group result, the results of the pair, trio and group categories were evaluated together. Excel 2016 program was used to determine the percentage values of the data.

## FINDINGS

Tables containing the analysis of the data of aerobic and rhythmic gymnasts participating in the competitions organized by TGF are presented below.

**Table 1.**Birth quarters of all licensed gymnasts and medal-winning gymnasts in individual and group categories in aerobics branch.

| | | 1st Q | | 2nd Q | | 3rd Q | | 4th Q | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1st Season | All Athletes | 81 | 22.13% | 104 | 28.42% | 98 | 26.78% | 83 | 22.68% | 366 |
| | Individual Medal Winners | 9 | 25.00% | 11 | 30.56% | 11 | 30.56% | 5 | 13.89% | 36 |
| | Group Medal Winners | 14 | 18.92% | 18 | 24.32% | 31 | 41.89% | 11 | 14.86% | 74 |
| 2nd Season | All Athletes | 71 | 23.59% | 84 | 27.91% | 75 | 24.92% | 71 | 23.59% | 301 |
| | Individual Medal Winners | 4 | 11.11% | 13 | 36.11% | 15 | 41.67% | 4 | 11.11% | 36 |
| | Group Medal Winners | 11 | 15.28% | 20 | 27.78% | 26 | 36.11% | 15 | 20.83% | 72 |
| 3rd Season | All Athletes | 76 | 26.76% | 71 | 25.00% | 70 | 24.65% | 67 | 23.59% | 284 |
| | Individual Medal Winners | 9 | 25.00% | 13 | 36.11% | 7 | 19.44% | 7 | 19.44% | 36 |
| | Group Medal Winners | 14 | 19.44% | 24 | 33.33% | 13 | 18.06% | 21 | 29.17% | 72 |

When the table is analyzed in terms of the first quarter, it is seen that the medal winners in the individual category are above the general average in the first season, below in the second season and below in the third season. When the relationship between the quarters in the first season is examined, it is seen that those born in the first quarter do not have a proportional advantage in the first season, but they are at a very low rate in the second season, and they are lower than the second quarter in the third season. When the medal winners in the group categories are analyzed in terms of the first quarter, it is seen that they are below the general average in all three seasons. There is no proportional advantage of those born in the first quarter compared to the other quarters.

When the table is analyzed in terms of the second quarter, it is seen that the medal winners in the individual category are higher than the general average in all three seasons. When the medal winners in the group categories are examined, it will be seen that they are above the general average only in the third season.

When analyzed in terms of the third quarter, it will be seen that the medal winners in the individual categories remained below the general average in the third season and above the general average in the other two seasons. When we look at the medal winning situation in the group categories, it is seen that they were below the general average in the third season and above the general average in the other two seasons.

When the table is analyzed in terms of the fourth quarter, the medal winners in the individual categories remained below the general average in each season. It is seen that the medal winners in the group categories were above the general average in the third season and remained below the general average in the other two seasons.

**Table 2:** Mean values of three seasons in Aerobic Gymnastics.

| | 1st Q | | 2nd Q | | 3rd Q | | 4th Q | | Total |
|---|---|---|---|---|---|---|---|---|---|
| All Athletes | 76.00 | 24.16% | 86.33 | 27.11% | 81.00 | 25.45% | 73.67 | 23.29% | 317.00 |
| Individual Medal Winners | 7.33 | 20.37% | 12.33 | 34.26% | 11.00 | 30.56% | 5.33 | 14.81% | 36.00 |
| Group Medal Winners | 13.00 | 17.88% | 20.67 | 28.48% | 23.33 | 32.02% | 15.67 | 21.62% | 72.67 |

When the average of three seasons in aerobic gymnastics is analyzed, it is seen that 51.27% of the participants were born in the first two quarters, but 54.63% of the medal winners in the individual categories were born in the first two quarters, that is, they were above the general average. This rate is 46.36% for medal winners in group categories. In the group category, the medal winners born in the first two quarters were below the general average. Considering the first quarter rates of medal winners in individual or group categories, this rate remains below the second quarter. In this case, it is not possible to talk about the relative age effect in aerobic gymnastics.

**Table 3.** Birth quarters of all licensed gymnasts and medal-winning gymnasts in individual and group categories in rhythmic branch.

| | | 1st Q | | 2nd Q | | 3rd Q | | 4th Q | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1st Season | All Athletes | 147 | 29.70% | 140 | 28.28% | 108 | 21.82% | 100 | 20.20% | 495 |
| | Individual Medal Winners | 19 | 34.55% | 19 | 34.55% | 13 | 23.64% | 4 | 7.27% | 55 |
| | Group Medal Winners | 26 | 23.42% | 38 | 34.23% | 21 | 18.92% | 26 | 23.42% | 111 |
| 2nd Season | All Athletes | 153 | 29.94% | 143 | 27.98% | 108 | 21.14% | 107 | 20.94% | 511 |
| | Individual Medal Winners | 18 | 46.15% | 13 | 33.33% | 5 | 12.82% | 3 | 7.69% | 39 |
| | Group Medal Winners | 29 | 37.18% | 26 | 33.33% | 10 | 12.82% | 13 | 16.67% | 78 |
| 3rd Season | All Athletes | 173 | 26.41% | 190 | 29.01% | 147 | 22.44% | 145 | 22.14% | 655 |
| | Individual Medal Winners | 11 | 30.56% | 15 | 41.67% | 8 | 22.22% | 2 | 5.56% | 36 |
| | Group Medal Winners | 29 | 32.95% | 22 | 25.00% | 19 | 21.59% | 18 | 20.45% | 88 |

When the table is analyzed in terms of the first quarter, it is seen that the individual medal winners are higher than the general average in all three seasons. The medal winners in the group remained below the general average in the first season. In other seasons they are above the general average. Considering the relationship between the quarters, the rate of those who were born in the first quarter among the individual medal winners remained the same in the first season as in the second quarter, remained high in the second season and low in the third season. This shows that the relative age effect in rhythmic gymnastics is not clear. There is no clear proportional superiority in the first quarter among the athletes who won medals in the group.

When the second quarter is analyzed, it is seen that the individual medal winners are still above the general average. The medal winners in the group were below the general average in the third season and were above the other seasons.

Examining the third quarter, the individual medal winners remained below the general average, except for the first season. The medal winners in the group remained below the general average in all three seasons.

In the fourth quarter, individual medal winners were well below the overall average in all three seasons. The medal winners in the group were above the general average in the first season, and although they were below the general average in the other two seasons, they did not have a low rate as in the individual.

**Table 4.** Mean values of three seasons in Rhythmic Gymnastics.

| | 1st Q | | 2nd Q | | 3rd Q | | 4th Q | | Total |
|---|---|---|---|---|---|---|---|---|---|
| All Athletes | 157.67 | 28.68% | 157.67 | 28.42% | 121.00 | 21.80% | 117.33 | 21.09% | 553.67 |
| Individual Medal Winners | 16.00 | 37.08% | 15.67 | 36.52% | 8.67 | 19.56% | 3.00 | 6.84% | 43.33 |
| Group Medal Winners | 28.00 | 31.19% | 28.67 | 30.86% | 16.67 | 17.78% | 19.00 | 20.18% | 92.33 |

When the average of the three seasons in rhythmic gymnastics is analyzed, it is seen that 57.10% of the participants were born in the first two quarters, while 73.60% of the individual medal winners were born in the first two quarters. 62.04% of the gymnasts who won medals in the group were born in the first two quarters. While only 6.48% of the gymnasts who won individual medals were born in the fourth quarter, this rate is 20.18% for those who won medals in the group. The three-season first quarter birth rates of the gymnasts who won individual and group medals are higher than the second quarter, and according to this information, it can be said that there is a relative age effect in rhythmic gymnastics.

## DISCUSSION AND CONCLUSION

In our study, gymnasts who won medals in aerobic and rhythmic gymnastics individually and in group were examined in terms of relative age. When the results were examined, different results were obtained in terms of two disciplines.

When the rate of being born in the first quarter of the athletes participating in the competition in aerobic gymnastics and the rate of individual medal winners are compared, different results are obtained according to the seasons. The medal winners in the group categories remained below the general average in all three seasons. When analyzed in terms of the second quarter, the rate of individual medal winners is higher than the general average in all three seasons, while the medal winners in the group show different results in seasons. Looking at the average of the three seasons, 51.27% of the participants were born in the first two quarters, while 54.63% of the individual medal winners were born in the first two quarters. It is seen that 46.36% of the medal winners in the group categories were born in the first two quarters. However, the fact that the first quarter rate is less than the second quarter rate is interpreted as there is no relative age effect. In group categories, the fact that the medal winners are lower than the average of the participants is interpreted as there is no relative age effect according to the average of three seasons in the group categories.

When the rate of being born in the first quarter of the athletes participating in the competition in rhythmic gymnastics and the rate of individual medal winners are compared, it is seen that the rate of individual medal winners in all three seasons is high. The rate of those competing in the group remained below the general average in the first season. When the second quarter is analyzed, it is seen that the rate of individual medal winners was higher than the average of the participants in all three seasons, but the rate of medal winners in the group remained below the general average in the third season. When discussing these results in terms of the relative age effect. For the same quarter, the rate of medal-winning gymnasts higher than that of the gymnasts participating in the competition was evaluated as having a relative age effect, while a lower rate was evaluated as no relative age effect. In this case, the high rates for the first two quarters in all three individual seasons in rhythmic gymnastics led to the interpretation that there is a relative age effect on the individual. In group categories, it is seen that being below the general average in some seasons does not have a relative age effect in those seasons, and there is a relative age effect in other seasons. Even if there is a relative age effect in the group category, it is not as clear as in the individual.

Looking at the average of the three seasons in rhythmic gymnastics, it is seen that 57.10% of the participants were born in the first two quarters, while 73.60% of the individual medal winners were born in the first two quarters. The rate of being born in the first two quarters of the medal winners in the group category is 62.04%. According to these results, it can be said that there is a relative age effect on the medal winners individually and in the group. The difference between the rates shows that the relative age effect is higher for the individual than for the group category.

In his study on 10-14 year-old girls, Harun looked at the relationship between athletic performance and the effect of relative age. As a result of the study, significant differences were found in height, body weight, BMI, vertical jump, standing long jump, medicine ball throwing and speed tests, except for shuttle run (Harun, 2020). The mentioned performance shows parallelism with the results of rhythmic gymnastics since it includes parameters that are also important in gymnastics. However, it should be taken into account that gymnastics is not only evaluated according to physical parameters.

In his study, Orkun examined the effect of relative age in football players under the age of 15. As a result of the study, there was no difference between athletic performance and birth quarters. These results are similar to the results of aerobic gymnasts of male gymnasts. However, it should also be taken into account that the study was carried out on beginner football players.

In the study conducted on ice hockey athletes, performance athletes and children who play ice hockey for hobby purposes were compared. As a result of the study, there was no relative age effect in hobby athletes, while a relative age effect was found in performance athletes (Montelpare, Scott, & Pelino, 1997). This result shows us that there may be a relative age effect in team athletes as well. This situation shows parallelism with the results of group athletes in rhythmic gymnastics.

Daniel and Janssen stated that 70% of the top players on the 9-10 year hockey team were born in the first two quarters and only 10% were born in the last quarter. On the contrary, it was observed that there was no relative age effect in professional hockey teams (Vincent & Glamser, 2006). This shows that the relative age effect is only present at younger ages.

In a study, a research was conducted on the distribution of birth dates of gymnasts, swimmers and tennis players between the ages of 8-16. It was observed that approximately 50% of female swimmers and tennis players were born in the first quarter of the year. However, the birth dates of female gymnasts were evenly distributed throughout the year. As the reason for this, the view that late physical development and maturation can be an advantage in women's gymnastics has emerged (Edwards, 1994). In our study, the birth times of the gymnasts participating in the competition did not show an equal distribution on an annual basis. In aerobic gymnastics, the rate of medal winners was higher than the birth rate in the first quarters. However, this situation did not show continuity. In rhythmic gymnastics, the gymnasts born in the first quarters gained more medals and this was realized more than in aerobic gymnastics.

In sports where physical characteristics such as body weight, height and strength represent key factors for success, the relative age effect has traditionally been mentioned among elite male athletes (Delorme et al., 2011). In branches where technical skills are at the forefront, such as gymnastics, the effect of relative age alone is not sufficient only based on physical parameters. It is not possible to generalize that the

stronger, faster or more flexible person will be more successful in gymnastics.

***Ethics Text***

The data were taken from the website of the Turkish Gymnastics Federation. Regarding the use of the data, permission was obtained from the federation on 17.04.2023.

***Conflict of Interest:*** The authors state no conflict of interest.

***Author Contributions:*** While the contribution rate of the first author in this study is 25%, the total contribution rate of the other authors is 75%.

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## GENİŞLETİLMİŞ ÖZET


**Çalışmanın Amacı:** Quadriceps ve hamstring kaslarının fonksiyonel olarak değerlendirilmesi için pik torka ulaşma süresi ve pik torktaki eklem açısı parametreleri önemli veriler sunmaktadır. Literatürde bu parametreler ile yapılan çalışmalara az rastlandığı bilinmektedir. Kadın futbol oyuncularının hamstring/quadriceps (H/Q) oranı, pik torka ulaşma süresi ve pik torktaki eklem açısı parametreleri arasındaki ilişkinin incelenmesi bu çalışmanın amacını oluşturmaktadır.

**Araştırma Soruları:** Kadın futbol oyuncularının hamstring/quadriceps oranları ve pik torka ulaşma süreleri arasında bir ilişki var mıdır?

Kadın futbol oyuncularının hamstring/quadriceps oranları ve pik torktaki eklem açıları arasında bir ilişki var mıdır?

**Literatur Araştırması:** Futbolun içerdiği aksiyonlar dikkate alındığında, futbolcuların büyük kas gruplarından çoğunun yeterli kuvvete sahip olması gerekmektedir. Kas kuvveti, top kapmak için yapılan müdahaleler ve sprint gibi birçok aktivitenin önemli bir bileşenidir (Sevinç, 2008). Kuvvet ve dayanıklılığın geliştirilmesi, eklemlerin aktif stabilizörlerini etkili kılar. Aynı zamanda performans için kas ve sinir sistemi etkileşimi de geliştirilmelidir (Koz ve ark., 2010). Kas performansını değerlendirmede kullanılan en yaygın ve güvenilir yöntemlerden biri de izokinetik dinamometrelerdir. Laboratuvar ortamında izokinetik dinamometreler ile yapılan izokinetik kuvvet ölçümleri, eksantrik ve konsantrik kasılmalarda belirlenen kasların kuvvet performansını objektif olarak değerlendirebilme olanağı sunan en geçerli ve güvenilir test yöntemleridir (Brown, 2000). Daha önceden squat ve dikey sıçrama testleri kullanılarak tespit edilebilen alt ekstremite kuvveti, yakın geçmişten itibaren izokinetik dinamometreler kullanılarak daha objektif bir şekilde belirlenebilmekte ve dinamometrelerden elde edilen veriler ile baskın (dominant) ve baskın olmayan (non-dominant)

ekstremite kuvvetleri de ayrı ayrı değerlendirilebilmektedir (Taşmektepligil, 2016). Agonist ve antagonist kaslar arasındaki kuvvet dengesi de sporcu performansı ve sakatlığa yatkınlık için önemli bir belirleyici parametre olarak kabul edilmektedir. Futbol, alt ekstremitelerin yüksek açısal hızlardaki kuvvet üretebilme yeteneği ile yapılabilen birçok aksiyonu (şut, sıçrama vb.) barındırmaktadır. Literatürde, ivmelenme süresi ve pik torka ulaşma süresi, maksimal kasılmalar üretmeye nöromusküler olarak hazır olma konusunda değerli bilgiler sağlayan kassal parametreler olarak değerlendirilmektedir (Miller ve ark., 2006; Chen ve ark., 1994; Van Cingel ve ark., 2006). Diğer yandan ise pik torka ulaşma süresi ve pik torktaki eklem açısı parametreleri hala tartışmalı olarak görülmektedir. Pik torka ulaşma açısı, bireyin önceden belirlenmiş olan hareket aralığında pik torka ulaştığı hareket açısı olarak kabul edilmektedir (Bernard ve ark., 2012). Pik torka ulaşma süresi ise ekstremitelerin patlayıcılık özelliğinin bir göstergesi olarak kabul edilmektedir (Kannus, 1994). Pik torka hızlı bir şekilde ulaşabilme yeteneği çoğu atletik beceri için önemlidir ve sporcularda kassal performans değerlendirilirken, fonksiyonellik bakımından daha iyi bir gösterge olabileceği düşünülmektedir (Miller ve ark., 2006). Ayrıca pik torka ulaşma süresinin, enerji döngüsü ve fibril tipleri oranını tahmin etmek için de kullanılabileceği öne sürülmektedir (Hosking ve ark., 1978).

**Yöntem:** Araştırmanın örneklem grubu, ulusal kadınlar liginde (3. Lig) performans sergileyen 20 kadın futbolcudan oluşmaktadır. Futbolcuların diz eklemlerine ait ölçümler, 60°/sn. ve 180°/sn. açısal hızlardaki konsantrik/konsantrik protokol ile gerçekleştirilmiştir. Futbolculardan elde edilen verilerin normal dağılıma uygunluğu Shapiro-Wilk Test ile incelenmiş ve normal dağılım gösterdikleri tespit edilmiştir. Parametreler arasındaki ilişkiler ise Pearson korelasyon katsayısı ile incelenmiştir.

**Sonuç ve Değerlendirme:** Analiz sonuçlarına göre, non-dominant 180°/sn. H/Q oranı ile 180°/sn. açısal hızdaki fleksör kasın pik torka ulaşma süresi arasında ve dominant 180°/sn. H/Q oranı ile 180°/sn. fleksiyon anındaki pik torka ulaşılan açı değeri arasında istatistiksel olarak anlamlı bir ilişki olduğu tespit edilmiştir ($p<0.05$). Diğer parametrelerde ise bir ilişkiye rastlanmamaktadır ($p>0.05$). Sonuç olarak, kadın futbolcuların H/Q oranlarının fonksiyonel kuvvet parametreleri (pik torka ulaşma süresi ve pik torktaki eklem açısı) ile ilişkili olmadığı ve fonksiyonel performansın farklı yaklaşımlarla değerlendirilmesi gerektiği söylenebilir.