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Yıldız Taekwondo Sporcularının Kuvvet Performansının Araştırılması: Sağırkaya Yöntemi ile Geleneksel Yöntemin Karşılaştırılması

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Özet

Sağırkaya Yöntemi, taekwondo kyorugi yarışmalarında yaygın olarak kullanılan geleneksel ağırlık bazlı sınıflandırma yöntemine alternatif olarak geliştirilmiştir. Bu yöntem, sporcuları vücut ağırlığı yerine boy uzunluğuna göre sınıflandırır. Bu çalışma, Sağırkaya Yöntemi ile Geleneksel Yöntemi, rakipler arasındaki potansiyel kuvvet dengesizlikleri açısından karşılaştırmayı amaçlamıştır. Araştırma, 20 elit yıldız sporcu (boy: 156.19±13.61 cm; vücut ağırlığı: 52.62±6.25 kg; VKİ: 21.68±4.74 kg/m²) gönüllü katılımı ile gerçekleştirilmiştir. Sporcuların boy ve vücut ağırlığı belirlendikten sonra, izokinetik diz ve kalça kuvvet performansları değerlendirilmiştir. İzokinetik kuvvet, 60º/s ve 180º/s açı hızlarında tepe torku ölçülerek değerlendirilmiştir. Bulgular, vücut ağırlığı ile diz ($r=0.498$-0.736; $p<0.05$) ve kalça ($r=0.465$-0.621; $p<0.05$) kuvveti arasında orta ile güçlü düzeyde anlamlı ilişkiler olduğunu göstermektedir. Ancak, boy ile diz ve kalça kuvveti arasındaki ilişkiler incelendiğinde, anlamlı bir korelasyon bulunmamıştır ($p>0.05$). Sonuç olarak, vücut ağırlığının, yıldız taekwondo sporcuları arasında kuvvet üretiminde önemli bir faktör olduğu görülmüştür. Sağırkaya Yöntemi, Geleneksel Yönteme kıyasla rakipler arasındaki vücut ağırlığı farklarını daha net bir şekilde ortaya koyduğundan, bu yöntemle kuvvet asimetrisinin daha büyük olabileceği ve bunun da adil olmayan bir rekabet ortamı oluşturabileceği sonucuna varılmıştır.

Anahtar Kelimeler: İzokinetik, kuvvet dengesizlikleri, sağırkaya yöntemi, taekwondo kyorugi, ağırlık bazlı sınıflandırma

Investigation of Strength Performance of Cadet Taekwondo Players: Comparison of Sağirkaya Method and Traditional Method

Abstract

The Sağırkaya Method was developed as an alternative to the traditional weight-based classification method commonly used in taekwondo kyorugi competitions. This method classifies athletes based on their height rather than body weight. This study aimed to compare the Sağırkaya Method with the Traditional Method in terms of potential strength imbalances between competitors. The research was conducted with the voluntary participation of 20 elite cadet athletes (height: 156.19±13.61 cm; body weight: 52.62±6.25 kg; BMI: 21.68 ±4.74 kg/m²). After determining the athletes' height and body weight, their isokinetic knee and hip strength performance was assessed. The isokinetic strength was evaluated by measuring peak torque at angular velocities of 60º/s and 180º/s. The findings indicated moderate to strong significant correlations between body weight and knee ($r=0.498$-0.736; $p<0.05$) and hip ($r=0.465$-0.621; $p<0.05$) strength. However, when examining the relationships between height and knee and hip strength, no significant correlations were found ($p>0.05$). In conclusion, body weight appears to be an important factor in strength production among cadet taekwondo athletes. Since the Sağırkaya Method reveals differences in body weight between competitors more clearly compared to the Traditional Method, it was concluded that this method could lead to greater strength asymmetry between opponents, potentially creating an unfair competition environment.

Keywords: Isokinetic, Strength ımbalances, sağırkaya method, taekwondo kyorugi, weight-based classification.

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Introduction

As a martial art, taekwondo was first introduced as a demonstration sport at the Seoul (1988) and Barcelona (1992) Olympic Games, and later officially recognized as an Olympic sport at the Sydney Olympic Games (Albuquerque et al., 2012). Since then, in the kyorugi (sparring) discipline, which requires competition against a real opponent, athletes compete within a set of rules, aiming to score the highest points without causing harm to their opponent. To ensure a fair competitive environment, athletes are divided into categories based on gender, age, and body weight. Age categories include cadets, juniors, and seniors, with the cadet category covering the age range of 12-14 years (Ghazzawi et al., 2023).

Taekwondo athletes are required to execute effective technical maneuvers with appropriate tactics during kyorugi competitions, which necessitates a high level of muscular strength, power, and endurance (Hammami, Ouergui, Zinoubi, Zouita Ben Moussa, & Ben Salah, 2014; Ölmez, 2023). Movements such as kicks, punches, blocks, holds, pushes, and foot maneuvers are fundamental elements that directly impact athletes' performance, and research has shown that foot techniques are the most frequently preferred (Gutiérrez-Santiago, Pereira-Rodríguez, & Prieto-Lage, 2020).Therefore, to become a successful taekwondo athlete, not only physical fitness but also the strength and endurance to sustain these movements are of great importance (Santos et al., 2011). For this reason, athletes must be fairly matched in kyorugi competitions. Otherwise, some athletes may gain an overwhelming advantage, which contradicts the Olympic spirit, and weaker athletes may not have the opportunity to showcase their skills due to physical disadvantages (Klein, 2016). Factors such as sports injuries can cause both physical and psychological harm to athletes (Barley & Harms, 2021; Lystad, Alevras, Rudy, Soligard, & Engebretsen, 2021). We also observe similar practices in other combat sports. In sports such as wrestling, boxing, and judo, competitors have been matched based on body weight for many years (Langan-Evans, Close, & Morton, 2011). From this perspective, matching athletes of similar physical capacities appears to be an effective method. When athletes are physically comparable, it allows the most skilled individual to be selected and to succeed while demonstrating their biomotor, technical, tactical, and psychological abilities. Strength and power are key determinants of success in taekwondo (Hammami et al., 2014; Ölmez, 2021, 2023), as athletes must score points with fast and powerful kicks to gain an advantage over their opponents (Gutiérrez-Santiago et al., 2020; Ölmez, 2021).

In 2020, the Turkey International Taekwondo Open Tournament was organized using the Sağırkaya Method for the first time. In this tournament, athletes competing in the cadet category were matched based on their height rather than their body weight, as per the Sağırkaya Method. However, previous studies have shown positive relationships between body weight and the force produced (Ferland et al., 2020; Ten Hoor, Plasqui, Schols, & Kok, 2018). In this context, matching athletes with similar heights but with significant differences in body weight as opponents may lead to a greater disparity in strength between competitors, given the positive correlation between strength and body weight. Consequently, the Sağırkaya Method, which categorizes athletes based on height, may result in greater weight discrepancies among competitors, potentially causing strength asymmetry and leading to unfair kyorugi matches.

The review revealed that previous research on taekwondo (kyorugi) has focused on body weight (Hammami et al., 2013; Kazemi, Casella, & Perri, 2009; Kazemi, Waalen, Morgan, & White, 2006), while studies using the Sağırkaya Method are very limited and the effects of this method have not been sufficiently explained. Sağırkaya (2023) reported that there is no significant difference in the success of taekwondo athletes in tournaments designed according to weight and height categories, and that height categories provide healthier matchups in terms of BMI normalization for both heavy and light weight classes. Additionally, Sağırkaya (2023) suggested that official tournaments could be organized according to height categories. However, it has been identified that the Sağırkaya Method has not yet been examined concerning the balance of forces, which is a dominant motor characteristic in taekwondo. This study is the first to compare the balance of forces between competitors using the Sağırkaya Method and the Traditional Method during kyorugi matches.

This study aims to compare the strength performance of cadet taekwondo athletes under the Traditional Method and the Sağırkaya Method protocols, analyze the effects of both methods, and investigate how the findings can be utilized for performance enhancement.

Methods

Participants

The Sağırkaya Method is utilized for athletes competing in the cadet category, specifically applied to those aged 12-14. Given that the study involved strength testing, and to minimize potential risks of strength exercises for developing athletes, only those in the later stages of the

cadet category were included in the research. Consequently, the study was conducted with the voluntary participation of 20 elite cadet athletes (age: 13.75±0.44 years; height: 156.19±13.61 cm; body weight: 52.62±6.25 kg; BMI: 21.68±4.74 kg/m²). The sample size was determined using G*Power (version 3.1.9.6, Kiel, Germany) analysis ($p = 0.77$; $\alpha = 0.05$; $1 - \beta = 0.95$) (Ölmez et al., 2023). All athletes and their legal guardians were informed about the study, including its risks and benefits. Following verbal information, a written informed consent form, prepared by the Declaration of Helsinki, was provided. The study complied with the ethical principles of the European Convention on Human Rights and the Declaration of Helsinki (World Medical Association, 2013) and was approved by the University Clinical Research Ethics Committee (No: 2024-30).

Procedure

The study was completed in a total of 6 stages, as illustrated in the flowchart detailed in Table 1. Following the registration and information procedures and the determination of physical characteristics, anthropometric and motor measurements were conducted. During the data collection and testing phase, the athletes were given time to recover. They were instructed to avoid any strenuous activities on their recovery days.

Table 1. Research Flowchart

Stage	Process Flow
1.	Registration and Information Procedures
	Anthropometric Measurements
2.	Introduction to tests to be conducted on the isokinetic dynamometer
3.	Knee EXT-FLX Measurement
	Rest
4.	Hip EXT-FLX Measurement
5.	Data Analysis
6.	Interpretation and Report Writing

Since the Sağırkaya Method aims to equalize athletes' heights while the Traditional Method aims to equalize body weights, this study examined the differences between the two methods

in terms of strength production. Therefore, the relationships between height and body weight variables and their isokinetic knee and hip strength were analyzed.

According to the Traditional Method, cadet athletes compete in the following weight categories, with their heights being disregarded.

Male: 33-37-41-45-49-53-57-61-65 +65 kg

Female: 29-33-37-41-44-47-51-55-59 +59 kg

In the Sağırkaya Method, athletes are categorized according to the criteria listed in Table 2. Here, athletes' body weights are adjusted based on the upper and lower limits of the body mass index (16-20 kg/m²) corresponding to their height, with the primary focus being on equalizing their heights within the specified range (Sağırkaya, 2023).

Table 2. Height and body weight values according to the Sağırkaya Method

Males	Height Range	Weight Range	Females	Height Range	Weight Range
1,48 cm	148 cm and below	33 kg -45 kg	1,44 cm	144 cm and below	32 kg- 43 kg
1,52 cm	148 cm - 152 cm	35 kg- 48 kg	1,48 cm	144 cm - 148 cm	33 kg- 45 kg
1,56 cm	152 cm - 156 cm	37 kg- 51 kg	1,52 cm	148 cm - 152 cm	35 kg- 48 kg
1,60 cm	156 cm - 160 cm	39 kg- 53 kg	1,56 cm	152 cm - 156 cm	37 kg- 51 kg
1,64 cm	160 cm - 164 cm	41 kg- 56 kg	1,60 cm	156 cm - 160 cm	39 kg- 53 kg
1,68 cm	164 cm - 168 cm	43 kg- 59 kg	1,64 cm	160 cm - 164 cm	41 kg- 56 kg
1,72 cm	168 cm - 172 cm	45 kg- 61 kg	1,68 cm	164 cm - 168 cm	43 kg- 59 kg
1,76 cm	172 cm - 176 cm	47 kg- 64 kg	1,72 cm	168 cm - 172 cm	45 kg- 61 kg
1,80 cm	176 cm - 180 cm	49 kg- 67 kg	1,76 cm	172 cm - 176 cm	47 kg- 64 kg
1,85 cm	180 cm and above	52 kg- 80 kg	1,80 cm	176 cm and above	50 kg- 75 kg

Anthropometric and Physical Measurements: Athletes' heights were measured with a Holtain (Holtain Ltd, UK) stadiometer with a sensitivity of 0.01 cm. Body weights of the athletes were determined using a Jawon X Scan Plus (Jawon Medical Co., Korea) body analyzer.

Isokinetic Strength Measurements: Athletes' isokinetic strength performance was assessed using a Cybex (Humac Norm) isokinetic dynamometer (CSMI, Stoughton, MA). The weight of the measurement extremity and the lever arm was calculated for each athlete. This allowed the gravitational effects to be accounted for using computer software, and the torque values were determined.

Knee isokinetic strength measurements (Flexion-Extension) were performed within 0-90 degrees, at angular velocities of 60º/s and 180º/s. Hip isokinetic strength measurements (Flexion-Extension) were conducted within 0-120 degrees, at angular velocities of 60º/s and 180º/s. A 60-second rest interval was provided between sets. Before measurements, each athlete performed a trial of 10 repetitions at 60º/s angular velocity to ensure warm-up and readiness for the set. Additionally, before each angular velocity, a pre-test set of 3 repetitions was conducted to allow the athlete to adapt to the load. All measurements were performed using a concentric-concentric (con/con) protocol.

Data Analyses

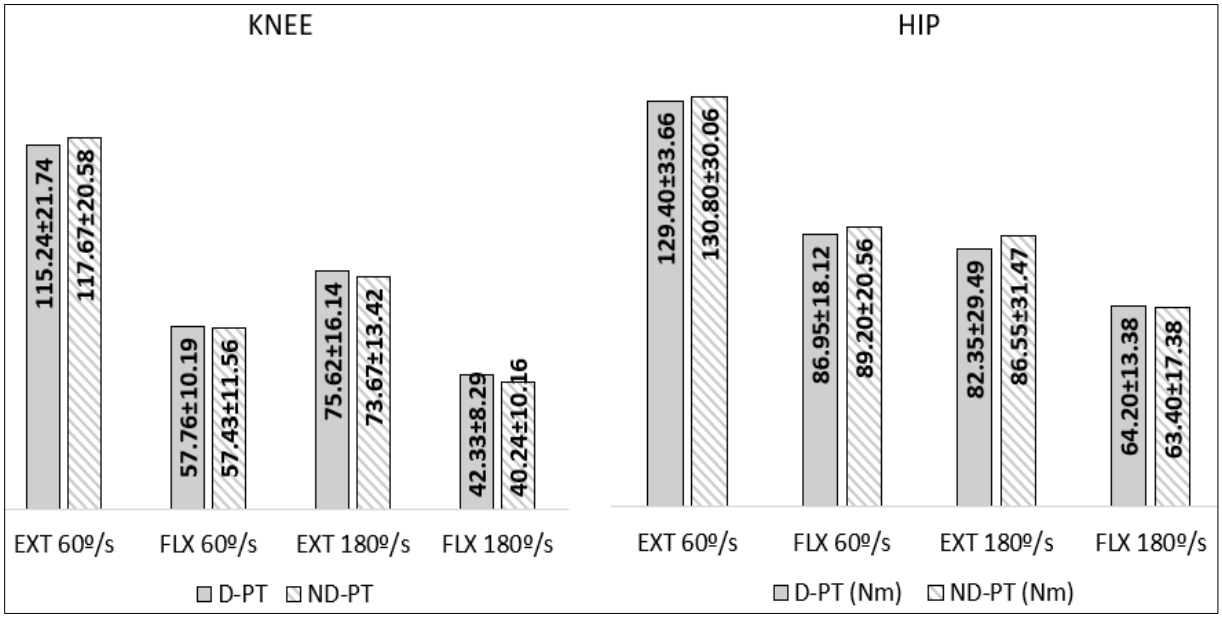
Statistical analyses were conducted using SPSS (version 25.0, Chicago, IL). Results were reported as mean values ± standard deviation (X±SD). Data normality was assessed using the Shapiro-Wilk test and Q-Q plots. Descriptive statistics were used to analyze the mean and standard deviations of all measurements and tests for the athletes, while Pearson correlation analysis was employed to examine relationships between variables. All statistical results were considered significant at a probability level of less than 0.05 ($p<0.05$).

In the first stage of the analysis, the peak torque values for the athletes at angular velocities of 60º/s and 180º/s were calculated as mean ± standard deviation (X±SD).

In the second phase of the analysis, the relationships between the peak torque values at angular velocities of 60º/s and 180º/s and the athletes' body weights and heights were examined. In the correlation analysis, correlations were classified as weak (>0.30), moderate (0.30-0.50), strong (0.60-0.80), and excellent (0.80-1.00) (Akoglu, 2018).

Results

First Stage: Peak Torque Values of Athletes' Knee and Hip



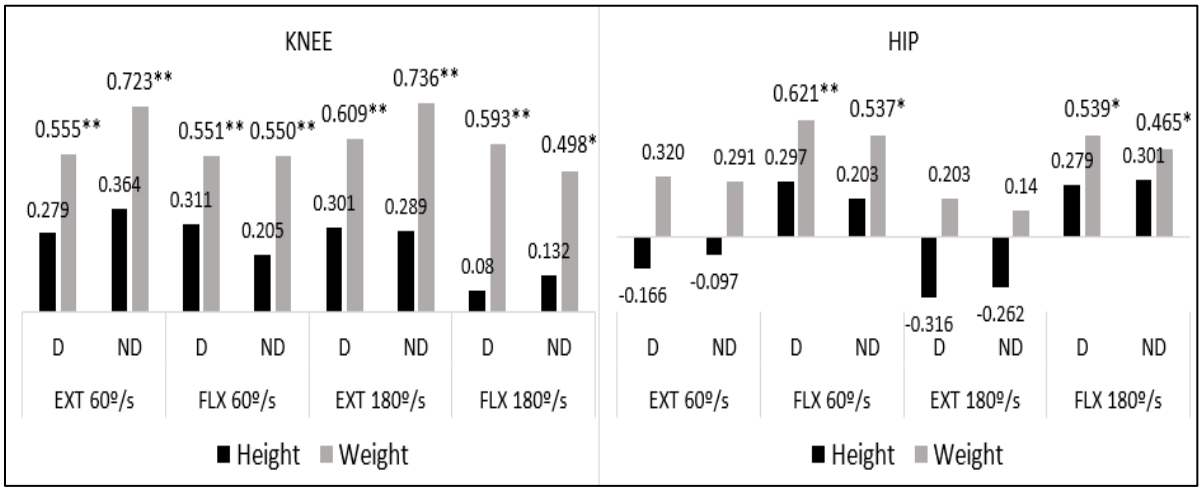
EXT: extansion; FLX: flexion; D-PT: dominant peak torque; ND-PT: non- dominant peak torque

Figure 1. Peak Torque Values of Athletes' Knee and Hip

The differences in peak torque between dominant and non-dominant extremities for knee EXT 60º/s ($p=0.819$; $\eta p^2=0.003$), FLX 60º/s ($p=0.946$; $\eta p^2=0.000$), EXT 180º/s ($p=0.178$; $\eta p^2=0.093$), and FLX 180º/s ($p=0.374$; $\eta p^2=0.042$) angular velocities were found to be non-significant.

Similarly, the differences in peak torque between dominant and non-dominant extremities for hip EXT 60º/s ($p=0.783$; $\eta p^2=0.004$), FLX 60º/s ($p=0.339$; $\eta p^2=0.048$), EXT 180º/s ($p=0.200$; $\eta p^2=0.085$), and FLX 180º/s ($p=0.718$; $\eta p^2=0.007$) angular velocities were also found to be non-significant.

Second Stage: Relationships Between Athletes' Knee and Hip Peak Torque Values and Their Height and Body Weight



*p<0.05; **p<0.01; EXT: extansion; FLX: flexion; D: dominant; ND: non- dominant

Figure 2. Relationships Between Athletes' Knee and Hip Peak Torque Values and Their Height and Body Weight

The relationships between athletes' knee peak torque at 60º/s and 180º/s angular velocities and their body weight were found to be significant at moderate to high levels for both dominant and non-dominant limbs (r=0.498-0.736; p<0.05).

The relationships between athletes' hip peak torque and body weight showed that the relationships between athletes' dominant and non-dominant hip flexion (FLX) peak torque at 60º/s angular velocity and body weight were positive and significant at moderate to high levels (r=0.621; r=0.537; p<0.05). Similarly, the dominant and non-dominant hip FLX peak torque at 180º/s angular velocity also demonstrated moderate positive correlations with body weight (r=0.539; r=0.465; p<0.05).

The relationships between hip extension (EXT) strength and athletes' height and body weight were not significant (p>0.05).

Overall, no significant relationships were found between athletes' isokinetic torque and their height (p>0.05).

Discussion

The most significant finding of this study is the moderate to high positive correlations between athletes' strength and power levels and their body weights, and the lack of significant correlation

with their heights. These results indicate that, unlike height, the strength torque produced by competitive taekwondo athletes can vary in parallel with body weight (Figure 2). To ensure fair competition among athletes, body weight must be taken into account.

Taller athletes often have advantages in certain sports due to longer limbs that can enhance leverage and reach (Patron, Wakely, Hernandez, & Lockie, 2022). However, this advantage may not be universally applicable to all strength-related activities. For example, studies on powerlifters and football players have found moderate to high correlations between body weight and power production (Ferland et al., 2020). For taekwondo, height might be advantageous or disadvantageous in technical and biomechanical aspects, though not necessarily for strength production. Thus, normalizing height among athletes may seem like a fair approach. However, according to taekwondo's scoring system, athletes can only score points by applying sufficient force. Since techniques that do not involve adequate force do not score points, the primary factor determining the winner is the ability to apply maximum force in techniques. Therefore, fair matching between competitors is possible only if strength levels are balanced.

The Sağırkaya Method equalizes athletes' heights while maintaining body weights within a broader range (Table 2). This matching could lead to significant strength asymmetry among athletes. Findings presented in Figure 2 show moderate to high levels of correlation between athletes' body weights and isokinetic peak torque values for the knee and hip. The high correlations with body weight and the lack of relationship between height and strength production indicate that matches between competitors should be based on body weight. The Sağırkaya Method may lead to an unfair competitive environment in terms of strength differences among competitors. Specifically, a lighter athlete may face increased physical disadvantages against a heavier opponent due to strength asymmetry. This disadvantage could lead to physical and motivational harm and potentially result in the athlete withdrawing from the sport.

In terms of training planning and programming, athletes competing under the Sağırkaya Method may need to undergo more strength training. Closing the strength gap among athletes requires increasing strength load during training sessions. The strength asymmetry created by the Sağırkaya Method may lead to strength-focused training plans from the cadet category (ages 12-14). However, according to long-term athlete development protocols, athletes should ideally

begin strength training only after the peak height velocity period, as early strength training could negatively impact development (Balyi & Way, 2005).

Girls typically reach their peak height around age 12, while boys reach it around age 14. However, this can vary significantly according to chronological age. Research shows that girls can reach their peak height between ages 9.3 and 15.0, while boys can reach it between ages 12.0 and 15.8 (Armstrong, 2007; Malina, Bouchard, & Bar-Or, 2004). However, under the Sağırkaya Method, cadet athletes aiming for success may be required to engage in strength training before their growth is fully complete.

Conclusion

In conclusion, body weight is significant in terms of strength production among cadet taekwondo athletes. Since the Sağırkaya Method more clearly reveals the differences in body weight between competitors compared to the Traditional Method, it has been concluded that this method may lead to greater strength asymmetry between opponents. This asymmetry could result in athletes being improperly trained with a focus on strength and create an unfair competition environment.

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Tasarım *Design*	Yöntem ve araştırma desenini tasarlamak *To design the method and research design.*	Şeyma Tuba ACAR, Cengiz ÖLMEZ Author
Literatür Tarama *Literature Review*	Çalışma için gerekli literatürü taramak *Review the literature required for the study*	Şeyma Tuba ACAR Author
Veri Toplama ve İşleme *Data Collecting and Processing*	Verileri toplamak, düzenlemek ve raporlaştırmak *Collecting, organizing and reporting data*	Şeyma Tuba ACAR Author
Tartışma ve Yorum *Discussion and Commentary*	Elde edilen bulguların değerlendirilmesi *Evaluation of the obtained finding*	Şeyma Tuba ACAR, Cengiz ÖLMEZ Author

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