



## 2022 Manchester Taekwondo Grand Prix'sinin zaman-hareket analizi

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Araştırma Makalesi/Research Article

DOI: 10.5281/zenodo.7739712

Gönderi Tarihi/ Received:

Kabul Tarihi/ Accepted:

Online Yayın Tarihi/ Published:

14.12.2022

16.03.2023

20.03.2023

### Özet

Bu çalışmada, Manchester 2022 Taekwondo Grand Prix'sine erkek ve kadın sporcuların fizyolojik taleplerini zaman-hareket analizi yöntemiyle incelemeyi amaçlanmıştır. 92 kadın ve 103 erkek olmak üzere toplam 195 müsabaka analiz edilmiştir. Turnuvaya katılan tüm olimpik ağırlıklar (kadın: 49kg, 57kg, 67kg ve +67kg; erkek: 58kg, 68kg, 80kg ve +80kg) analiz edildi. Zaman-hareket analizi için Kinovea video analiz programı kullanılmıştır. Sonuç: Dövüş Süresi (FT), Dövüş Olmayan Süre (NFT) ve Duraklatma Süresi (PT) arasında Cinsiyet ve ağırlık kategorileri arasında anlamlı farklar bulunmuştur. Ek olarak, kadınlarda turlar arasında FT'de önemli farklılıklar saptanmıştır. Sonuçlar, cinsiyete ve ağırlığa göre FT'de anlamlı farklılıklar olduğunu göstermektedir ( $p<0,05$ ). Genel olarak, kadınların erkeklerden daha fazla FT'ye sahiptir. Ayrıca her iki cinsiyette de hafif sıklıtlar, ağır sıklıtlara göre daha yüksek FT'ye sahiptir ( $p<0,05$ ). Bu bulgular, her iki cinsiyetin fizyolojik taleplerinin kilolara göre değiştiğini göstermektedir. Antrenörler, sporcuları müsabakalara hazırlarken ağırlıklar kategorilerinin farklı fizyolojik taleplerinin olduğunu bilmeli ve bu talepleri karşılayacak şekilde programlarını tasarlamalıdır.

**Anahtar Kelimeler:** Taekwondo, Atletik Performans, Video Analiz

### *Time-motion analysis of the 2022 Manchester Taekwondo Grand Prix*

#### **Abstract**

*The aims of this study were to examine the physiological demands of male and female athletes in the Manchester 2022 Taekwondo Grand Prix by time-motion analysis method. A total of 195 competitions, 92 women and 103 men, were analyzed. All Olympic weights participating in the tournament (women: 49kg, 57kg, 67kg and +67kg; men: 58kg, 68kg, 80kg and +80kg) were analyzed. Kinovea video analysis program was used for time-motion analysis. Conclusion: Significant differences were found between the Fighting Time (FT), Non-Fighting Time (NFT), and Pause Time (PT) Gender and weight categories. In addition, significant differences in FT were found between rounds in females. The results show that there are significant differences in FT according to gender and weight ( $p<0.05$ ). In general, women have more FT than men. In addition, both genders of light weights have higher FT than heavyweights ( $p<0.05$ ). These findings show that the physiological demands of both sexes vary according to weight. Trainers should know that weight categories have different physiological demands while preparing athletes for competitions and should design their programs to meet these demands.*

**Keywords:** Taekwondo, Athletic Performance, Video Analysis

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Genişletilmiş Türkçe Özet, makalenin sonunda yer almaktadır.

## INTRODUCTION

In Taekwondo (TKD), which is an individual combat sport, athletes struggle to win over their opponents in a limited time, in a limited scoring area, by producing strong kick and punch variations. Competitions require a high level of general physical and psychological fitness. In TKD competitions, two rival athletes fight each other within the framework of certain rules, using technical-tactical strategies, with kicks, punches, and blocks (Tornello et al., 2013; Akman & Orhan, 2020). By following the performance of the athletes in the competitions, analyzing the situation with objective measurements makes it possible to plan the most appropriate strategy for the next competitions. Performance analyzes help coaches and researchers to reflect the demands of competition, while also supporting the physical, physiological, and psychological preparation of athletes. Analyzing movement patterns in sports is very effective in increasing the performance of athletes. These analyzes also help improve the training preparation process (Hughes, 2004; Lames & McGarry, 2007; Menescardi et al., 2020).

To make the training preparation more specific, it is essential to determine the loading: rest ratio for the metabolic needs of the athlete (Smits et al., 2014). It is very difficult to make physiological measurements to determine the physiological demands of the athletes during a competition (Slimani et al., 2017), and since electronic safeguards are used in tournaments for which World Taekwondo Federation (WTF) is responsible, the use of any measuring device (heart rate) is prohibited (Aydemir & Sevinc-Yilmaz, 2022). Therefore, researchers resorted to video analysis methods to better understand the physiological demands and loading: rest ratios of Taekwondo competitions (Santos et al. 2020).

One of the methods used to measure physiological demands is to use time-motion analysis, which provides data directly applicable to physical preparation and performance tests (Deutsch et al., 2007; Hodgson et al., 2014). The competitive characteristic of TKD consists of short-term attacks and defenses with high effort. Understanding the physiological demands of the carried-out efforts depends on the duration and intensity of the movements (Matsushigue et al., 2009). In martial arts such as TKD, time-motion analysis research is a very effective method for describing the movements of athletes and predicting how competition actions can affect performance (Ambroży et al., 2021; Vargas-Barrientos et al., 2021). Determining the physiological loading demands during the competition helps to determine the loading (effort) and rest (all pauses) ratio and improve training preparation when planning the training of the athletes. The researchers calculated the effort: pause (E:P) ratios using the Fighting Time (FT)

and non-Fighting Time (NFT) performed during the match. In TKD, these ratios are the aerobic and anaerobic metabolism of the athletes; characterized by heart rate and lactate tolerance (Bridge et al., 2011; Bridge et al., 2013; Campos et al., 2021).

There are several studies investigating TKD competitions according to loading: rest ratios (Ouergui et al., 2014; Santos et al., 2022). In most of the studies, video analysis method was used. In these studies, the efforts were marked in 1/10th of a second and thus the physiological demands of the athletes were evaluated based on the time-motion analysis of the TKD competition. These studies, using time-motion analysis, were examined as FT and NFT and pause-time (PT). Previous research has reported ratios ranging from 1:1 to 1:7 when athletes compared FT and NFT. In addition, researchers reported that each gender and weight category may have different physiological demands and proportions. However, it should be noted that these studies differ in terms of fighting styles, experience, age, and tournament level. Moreover, similar studies are needed to compare results (Ouergui et al., 2014; Santos et al., 2022).

WTF is responsible for organizing international TKD competitions and determining the competition rules (Güder & Günay, 2019). Since the above-mentioned study results, the WTF has undergone a series of fundamental rule changes (WTF, 2023). Researchers think that these changes may affect TKD competition characteristics. Therefore, the purpose of this research is to examine the 2022 Manchester GP tournament by time-motion analysis method. GP tournaments consist of 8 different weight categories (male:58, 68, 80, +80, female:49, 57, 67, +67) determined by the IOC for TKD and The GP tournaments are a very tough tournament where the 31 best athletes from the WTF world rankings compete. Researchers have chosen this tournament to examine how the current rules affect the competition characteristics of TKD, as it is one of the tournaments where the most elite athletes compete. In general, lightweight categories (58 and 68) are expected to have more FT. In this context, the aim of this research is to analyze the 2022 Manchester Grand-Prix competition, which is considered one of the most challenging tournaments in taekwondo, using the time-motion analysis method. Based on previous studies, we expect light weight athletes to have more FT.

## **MATERIAL AND METHOD**

### **Subjects**

The research group consists of the athletes who are in the top 31 in their own weights in the WTF athlete rankings. Only competitions won by score are included in the statistical analysis of the competitions. During the current research, it was acted within the framework of "Higher Education Institutions Scientific Research and Publication Ethics Directive".

### **Data collection tools**

Video analysis was conducted by two researchers with TKD 3rd Dan and 2nd Dan generation certificate (WTF approved Coaching certificate) and 10 and 7 years of competitive experience. The analyzed video recordings were accessed from the public website of WTF. Time motion analysis was performed using direct video recordings (Antonietto et al., 2022) or using a video analysis program (Francesco et al., 2013). Kinovea video analysis software was used in this study. Kinovea is software used to analyze sports competitions. It has also been used for time-motion analysis of taekwondo competitions in previous studies (Falcao et al., 2012). In this research, for time-motion analyzes in each competition examined, loading (FT: Fighting time), rest (non-Fighting time: No attack time) and pause (PT: Total pause time in the competition) variables were determined as seconds (sec) and 10 of a 1(ms). During the examined competitions, the time period from the beginning of the leg raising, kicking or punching movement towards the opponent until the athlete stops the attacking movement or cannot continue to attack (due to a fall or the referee's stopping) was accepted as the FT. The time period in which the athletes do not attempt any attack during the competition, NFT, pauses determined by the referees and objection, time-out, etc. The time elapsed in the time slots was accepted as the PT.

### **Statistical analysis**

The data obtained in the research were analyzed using SPSS (Statistical Package for Social Sciences) for Windows version 26.0. Data are presented as mean  $\pm$  SD, and statistical significance was set at  $p < 0.05$ . While evaluating the data, descriptive statistical methods (number, percentage, min-max values, mean, median, standard deviation, etc.) were used. Non-parametric analyzes are recommended for data whose volume of the analyzed research group is less than 30 (see: Armutlulu, 2008; Kul, 2014; Sümbüloğlu & Sümbüloğlu, 2007). Non-parametric tests were used for data that did not show normal distribution. The Kruskal Wallis H test was used to detect significant differences between the groups, and the multiple comparison test was used to determine which group favored significant differences. In addition, Bonferroni Correction was considered for the significance value.

## RESULTS

**Table 1. Descriptive statistics for the sex and weight category variables of the competitions**

	N	%
<b>Female Athlete Category</b>	103	52,8
<b>49kg</b>	26	13,3
<b>57kg</b>	29	14,9
<b>67kg</b>	21	10,8
<b>+67kg</b>	27	13,8
<b>Male Athlete Category</b>	92	47,2
<b>58kg</b>	18	9,2
<b>68kg</b>	23	11,8
<b>80kg</b>	27	13,8
<b>+80kg</b>	24	12,3
<b>Total</b>	195	100,0

Kg: Kilogram, N: Number of competitions analyzed, %: Percent

Table 1 contains information on the numbers and percentages of the analyzed competitions in the category of men and women competing in the Manchester 2022 Grand-Prix Tournament. A total of 195 competitions, 103 for women and 92 for men, were analyzed.

**Table 2. Descriptive statistics of female competitions on the round variable**

	Women's Competitions						
	N		Average time (sec)	Median (sec)	Standard deviation	Minimum (sec)	Maximum (sec)
Number of Competitions	Number of missed rounds						
<b>1st Round Fighting</b>	103	0	20.2	20	4.594	11	33
<b>1st Round Non-Fighting</b>	103	0	99.8	100	4.594	87	109
<b>2st Round Fighting</b>	103	0	21.24	21	5.546	9	39
<b>2st Round Non-Fighting</b>	103	0	98.66	99	5.558	81	111
<b>3st Round Fighting</b>	37	66	22.08	23	6.08	12	34
<b>3st Round Non-Fighting</b>	37	66	97.92	97	6.08	86	108
<b>Stopping Phase</b>	103	0	107.81	103	75.766	10	359

N: Number of competitions; sec: second; Fighting: Attack time; Non-Fighting: No attack time; Stopping Phase: Total pause time in the competition

In table 2, the 1st Round of the competitions of female athletes, FT: 20.2sec, NFT 99.8sec; in Round 2, FT: 21.24sec, NFT: 98.66sec; in the 3rd rounds, FT: 22.08sec, NFT: 97.92sec. were

determined. In addition, while the Stopping Phase was seen as 107.81 seconds, it was determined that 66 out of 103 matches did not have the 3rd round due to round dominance rule.

**Table 3. Descriptive statistics of male competitions on the round variable**

	Men's Competitions						
	N		Average time (sec)	Median (sec)	Standard deviation	Minimum (sec)	Maximum (sec) Number of Competitions
Number of Competitions	Number of missed rounds						
<b>1st Round Fighting</b>	92	0	18.89	18	4.738	8	33
<b>1st Round Non-Fighting</b>	92	0	101.11	102	4.738	87	112
<b>2st Round Fighting</b>	92	0	19.23	18	6.152	6	44
<b>2st Round Non-Fighting</b>	92	0	100.77	102	6.152	76	114
<b>3st Round Fighting</b>	36	56	18.22	18	5.713	6	37
<b>3st Round Non-Fighting</b>	36	56	101.78	102	5.713	83	114
<b>Stopping Phase</b>	92	0	114.38	90	80.775	15	386

N: Number of competitions; sec: second; Fighting: Attack time; Non-Fighting: No attack time; Stopping Phase: Total pause time in the competition

In table 3, the 1st Round of the competitions of male athletes, FT: 18.89sec, NFT:101.11sec; in Round 2, FT: 19.23sec, NFT:100.77sec; in the 3rd rounds, FT: 18.22sec, NFT:101.78sec. were determined. In addition, while the Stopping Phase was seen as 114.38 seconds, it was determined that 56 out of 92 matches did not have the 3rd round due to round dominance rule.

**Table 4. Kruskal-Wallis test analysis results according to the round variables of the weight category of female competitions**

Female	Kruskal-Wallis H	df	p	Sig. Diff.
<b>1st Round Fighting</b>	9.926	3	<b>0.019*</b>	49kg>+67kg
<b>1st Round Non-Fighting</b>	9.926	3	<b>0.019*</b>	+67kg>49kg
<b>2st Round Fighting</b>	14.36	3	<b>0.002*</b>	49kg>67+kg
<b>2st Round Non-Fighting</b>	17.026	3	<b>0.001*</b>	49kg>+67kg; 49kg>57kg
<b>3st Round Fighting</b>	10.971	3	<b>0.012*</b>	49kg>+67kg
<b>3st Round Non-Fighting</b>	10.971	3	<b>0.012*</b>	+67kg>49kg
<b>Stopping Phase</b>	2.691	3	0.442	---

\*=p<0.05, Fighting: Attack time; Non-Fighting: No attack time; Stopping Phase: Total pause time in the competition

Table 4 showed that there was a statistically significant difference between 49kg and +67kg in fight scores in all rounds (1,2,3) in female athletes according to weight categories (p<0.05). Again, it was determined that there was a statistically significant difference in the NFT score of +67kg, 49kg ve 49kg, 57kg; in all rounds (1,2,3) in female athletes according to the weight categories (p<0.05). According to the Bonferroni test result, which shows which group the significant difference originates from, it has been observed that the 49kg weight category is more than the +67kg and 57kg weight category in the context of Fighting. There was no significant difference between the weight categories in the PT (p<0.05).

**Table 5. Kruskal-Wallis test analysis results of male competitions according to weight category and round variables**

Male	Kruskal-Wallis H	df	p	Sig. Diff.
<b>1st Round Fighting</b>	21.428	3	<b>0.000*</b>	68kg>+80kg; 58kg>+80kg; 58kg>80kg
<b>1st Round Non-Fighting</b>	21.428	3	<b>0.000*</b>	68kg<+80kg; 58kg<+80kg; 58kg<80kg
<b>2st Round Fighting</b>	14.354	3	<b>0.002*</b>	68kg>+80kg; 58kg>+80kg
<b>2st Round Non-Fighting</b>	14.354	3	<b>0.002*</b>	68kg<+80kg; 58kg<+80kg
<b>3st Round Fighting</b>	9.637	3	<b>0.022*</b>	58kg>+80kg
<b>3st Round Non-Fighting</b>	9.637	3	<b>0.022*</b>	58kg<+80kg
<b>Stopping Phase</b>	1.58	3	0.664	---

\*p<0.05, Fighting: Attack time; Non-Fighting: No attack time; Stopping Phase: Total pause time in the competition

In table 5, it was determined that there was a statistically significant difference in the FT of 68 kg and +80 kg; 58kg and +80kg; 58kg and 80kg in all rounds (1,2,3) in male athletes according to the weight categories (p<0.05). Again, it was determined that there was a statistically significant difference in the NFT of 68 kg and +80 kg; 58kg and +80kg; 58kg and 80kg in all rounds (1,2,3) in male athletes according to the weight categories (p<0.05). According to the Bonferroni test result, from +80kg of 68kg in the 1st round; 58kg from +80kg; 58kg from 80kg, 68kg from +80kg in Round 2; 58kg from +80kg; in Round 3, 58kg from +80kg

was seen to be more than in the context of Fighting. There was no significant difference between the weight categories in the Stopping Phase ( $p < 0.05$ ).

**Table 6. Kruskal-Wallis test analysis results of male and female competitions according to weight category and total rounds variables**

Gender	W	n	Mean Rank	Kruskal-Wallis H	df	p	Sig. Diff.	
Female	49kg	14	48.46	12.004	3	<b>0.007*</b>	49kg>67kg; 49kg>67+kg	
	Total Fighting for 2 rounds	57kg	21					32.88
		67kg	14					26.32
		67+kg	17					27.85
	Total	66						
Female	49kg	12	25.88	14.043	3	<b>0.003*</b>	49kg>67+kg	
	Total Fighting for 3 rounds	57kg	8					14.81
		67kg	7					24.29
		67+kg	10					10.40
	Total	37						
Male	58kg	14	35.11	11.121	3	<b>0.011*</b>	58kg>80+kg; 68kg>80+kg	
	Total Fighting for 2 rounds	68kg	12					34.25
		80kg	17					28.35
		80+kg	13					16.27
	Total	56						
Male	58kg	4	33.75	14.655	3	<b>0.002*</b>	58kg>80kg; 58kg>80+kg	
	Total Fighting for 3 rounds	68kg	11					22.36
		80kg	10					14.50
		80+kg	11					12.73
	Total	36						

\*= $p < 0.050$

Table 6 shows that the total fighting time of the female 49kg category in 2 rounds is more than 67kg and +67kg. Similarly, the 3 rounds total fight time of the female 49kg category is more than +67kg. In male 58kg and 68kg category, 2 rounds of total fighting time are more than +80 kg. In addition, 58kg category in 3 rounds total fight time more than 80kg and +80kg.

## DISCUSSION AND CONCLUSION

The aim of this research is to analyze the 2022 Manchester GP TKD tournament with the time-motion analysis method. In the competitions, 38% of the female and 33% of the male fighting 1 more round (3rd round) due to the tide (Tables 2 and 3). Significant differences were found in the main findings of the study (Tables 4 & 5). As we expected, for both genders the lightweights had more fight time than the heavyweights, and the research results supported our hypothesis ( $p < 0.05$ ). In 49 kg, female athletes, had more FT in 1st, 2nd and 3rd rounds compared to the +67kg category ( $p < 0.05$ ). Accordingly, the 49kg weight has less time in NFT ( $p < 0.05$ ). Similar results were seen in male athletes. Competing in male 58kg and 68kg weights have significantly longer FT than the heavier +80kg athletes ( $p < 0.05$ ). Men's 58kg and 68kg weight groups had significantly more FT than +80kg in the 1st and 2nd rounds, significantly



( $p < 0.05$ ). In addition, there was a significant difference between 58kg and 80kg in the 1st and 2nd rounds (Table 5). In the 3rd round, a significant difference was observed between 58kg and +80kg ( $p < 0.05$ ).

According to Markovic et al. (2008), the average FT of elite female athletes in rounds was determined as  $16.7 \pm 6.2$  seconds,  $18.1 \pm 4.3$ ,  $23.5 \pm 3.8$ , respectively. Like our research (Table 2), the average FT increased as the rounds progressed in the competition. The difference in FT may be due to competition rules and athletes with different competition characteristics.

In our study, unlike most other studies, we focused on the total active fight time between two opponents for each round in a competition. However, the results were similar when considering of FT and NFT. As a matter of fact, studies have reported that athletes competing in the light weights have more FT than the athletes competing in the heavyweight category (Bridge et al., 2011; Santos et al., 2011; Heller et al., 1998). According to the data of our research, it is seen that the EP ratios increase as the average weight increases in male athletes (tables 4 & 5). When the literature is examined, it has been reported that EP ratios vary between 1:1 and 1:8 (Bridge et al., 2011; Campos et al., 2012; Heller et al., 1998; Hausen et al., 2017; Samadi et al., 2014; Santos et al., 2011). However, as previously reported (Ouergui et al., 2014), there is no consensus in the results of these studies. Although the methods of these studies are similar, there are serious differences in the age, experience and fighting styles of the subject. In addition, it is thought that the difficulty level of the tournaments and the changes in the competition rules may be effective. Previous research has reported that fight times for athletes in general are short compared to non-fight times. Only one study reported no difference in EP ratio (Matsushigue et al., 2009). However, it was reported that the E:P ratio included all activities and this ratio increased to 1:6 when high-intensity actions were considered. Hausen et al. (2017) reported the EP ratio as 1:2 in their research. However, in this research, an attempt was made to simulate real conditions and an experimental study was conducted in a smaller competition area to increase the fighting intensity.

In general, studies examining EP ratios in TKD competitions have used weight or gender variables. When the results are analyzed in terms of male-female comparison, interestingly, female athletes fought more than male athletes for each round (1.round:1.31s, 2.round: 2.01s and 3.round: 3.86s). Based on this, they have less rest periods than men. Additionally, the average pause time in female competitions was less than in men. Contrary to our study, Tornello et al. (2013) reported that fighting rates were independent of gender and weight variables.

However, in this research, the TKD youth Olympic games were analyzed; the competition rules are old and the characteristics of the athletes (age, experience and fighting style) are different. WTF made a radical change in the competition rules in 2016 and made serious changes in the scoring system and competition area, it has been reported that this may affect the competition characteristics of TKD (Ferhat, 2022). Thus, our research examined athletes competing under current competition rules and is fundamentally different from most other studies. Considering that competition rules affect fighting characteristics in TKD, it is not surprising that the results are different.

Our results shows that female athletes fight time increased with each round, while men did not find a similar result (Tables 2 and 3). However, our research shows that for both genders, lightweights have more FT than heavyweights. These results support the hypothesis that heavier athletes expend more energy when performing kicks and punches because they have more body weight, thus causing them to fight slower and less often. (Santos et al., 2011). The fact that women have more FT each round may be due to the fighting characteristics, but more research is needed to interpret the results more accurately. To our knowledge, only one study has examined whether there is a difference in the intensity of fights in male and female athletes. Tornello et al. (2013) did not report a difference in combat intensity between men and women. However, as stated above, this study has serious differences with our research. Unfortunately, the study in time-motion analysis of Olympic female TKD athletes in competitions is sterile and there is no data to compare our research results.

### **Suggestions**

In conclusion, the findings of this study show that elite athletes have different physiological demands according to gender and weight variables. Our results support the idea that lightweight athletes have more FT and less NFT than heavyweight athletes. In addition, it is seen that the competitions in the tournament extended to the 3rd round by approximately 33-38%. Coaches should consider the different physiological demands of weight categories when preparing their athletes for competitions. Coaches can adjust the load-rest ratio applied in training according to the fight time of different weight categories. In addition, differences in resting times according to weight categories of athletes play a critical role in physiological energy regeneration, and coaches should consider these differences.

## GENİŞLETİLMİŞ ÖZET

### GİRİŞ

Sporcuların müsabakalardaki performanslarının takip edilerek objektif ölçümlerle durumun analiz edilmesi bir sonraki müsabakalar için en uygun stratejinin planlanmasını mümkün kılar. Performans analizleri, sporcuların fiziksel, fizyolojik ve psikolojik hazırlıklarını desteklerken antrenörlerin ve araştırmacıların rekabetin taleplerini yansıtmasına yardımcı olur. Sporda hareket kalıplarının analiz edilmesi, sporcuların performanslarının artmasında oldukça etkilidir. Bu analizler aynı zamanda antrenman hazırlık sürecini iyileştirmeye yardımcı olur (Hughes, 2004; Lames & McGarry, 2007; Menescardi ve ark., 2020).

Taekwondo (TKD) yarışmalarını yüklenme: dinlenme oranlarına göre araştıran birkaç çalışma vardır (Ouergui ve ark., 2014; Santos ve ark., 2022). Çalışmaların çoğunda video analiz yöntemi kullanılmıştır. Bu çalışmalarda çabalar saniyenin 1/10'unda işaretlenmiş ve böylece sporcuların fizyolojik talepleri TKD müsabakasının zaman-hareket analizine dayalı olarak değerlendirilmiştir. Zaman-hareket analizi kullanılarak yapılan bu çalışmalar dövüş zamanı (FT) ve dövüş olmayan zaman (NFT) ve duraklama zamanı (PT) olarak incelenmiştir. Önceki araştırmalar, sporcular FT ve NFT'yi karşılaştırdıklarında 1:1 ile 1:7 arasında değişen oranlar bildirmişti. Ayrıca araştırmacılar, her cinsiyet ve ağırlık kategorisinin farklı fizyolojik taleplere ve oranlara sahip olabileceğini bildirdi. Ancak bu çalışmaların dövüş stilleri, deneyim, yaş ve turnuva seviyesi açısından farklılık gösterdiğini belirtmek gerekir. Ayrıca sonuçları karşılaştırmak için benzer çalışmalara ihtiyaç vardır (Ouergui ve ark., 2014; Santos ve ark., 2022). Bu bağlamda, bu araştırmanın amacı, zaman-hareket analizi yöntemini kullanarak, taekwondoda en zorlu turnuvalardan biri olarak kabul edilen Grand-Prix (2022 Manchester) turnuvasının analiz edilmesidir. Önceki çalışmalara dayanarak, hafif siklet sporcuların daha fazla FT'ye sahip olduğunu bekliyoruz.

Uluslararası TKD yarışmalarının düzenlenmesinden ve yarışma kurallarının belirlenmesinden Dünya Taekwondo Federasyonu (WTF) sorumludur (Güder & Günay, 2019). Yukarıda belirtilen çalışma sonuçlarından bu yana, WTF bir dizi temel kural değişikliğine uğramıştır (WTF, 2023). Araştırmacılar, bu değişikliklerin TKD rekabet özelliklerini etkileyebileceğini düşünüyor. Bu nedenle bu araştırmanın amacı, 2022 Manchester GP turnuvasını zaman-hareket analizi yöntemiyle incelemektir. GP turnuvaları, Uluslararası Olimpiyat Komitesi (IOC) tarafından TKD için belirlenen 8 farklı ağırlık kategorisinden (Erkek:58, 68, 80, +80, Kadın:49, 57, 67, +67) oluşur ve GP turnuvaları en iyi 31 kişinin yer aldığı çok zorlu bir turnuvadır. WTF dünya sıralamasındaki sporcular yarışıyor. Araştırmacılar, en seçkin sporcuların yarıştığı turnuvalardan biri olduğu için mevcut kuralların TKD'nin rekabet özelliklerini nasıl etkilediğini incelemek için bu turnuvayı seçtiler. Genel olarak hafif siklet kategorilerinin (58 ve 68) daha fazla FT'ye sahip olması beklenir.

## YÖNTEM

Video analizi, TKD 3. dan ve 2. dan nesil sertifikasına (WTF onaylı Antrenörlük sertifikası) ve 10 ve 7 yıllık rekabet deneyimine sahip iki araştırmacı tarafından yapılmıştır. Analiz edilen video kayıtlarına WTF'nin halka açık web sitesinden erişildi. Yarışma videolarının analizinde Kinovea video analiz yazılımı kullanılmıştır (Falcao vd., 2012). İncelenen her müsabakada zaman-hareket analizleri için yükleme (FT: Dövüş süresi), dinlenme (Dövüşme dışı süre: Atak yapılmayan süre) ve duraklama (PT: Müsabakadaki toplam duraklama süresi) değişkenleri saniye (sn) olarak belirlenmiş ve 10/1(ms). Araştırmada elde edilen veriler SPSS (Statistical Package for Social Sciences) for Windows 26.0 versiyonu kullanılarak analiz edilmiştir.

## TARTIŞMA

Bu araştırmanın amacı, 2022 Manchester GP TKD turnuvasının zaman-hareket analizi yöntemi ile incelenmesidir. Zaman-hareket analizinde sporcuların hareketleri FT NFT ve PT'ye bölündü. Sonuçlarımız, kadın sporcuların dövüş sürelerinin her turda arttığını gösterirken, erkekler benzer bir sonuç bulamadı. Bildiğimiz kadarıyla, sadece bir çalışma, erkek ve kadın sporcularda dövüşlerin yoğunluğunda bir fark olup olmadığını inceledi. Tornello ve arkadaşları (2013), erkekler ve kadınlar arasında savaş yoğunluğunda bir fark bildirmedi. Ancak yukarıda da belirtildiği gibi bu çalışmanın bizim araştırmamızla ciddi farklılıkları bulunmaktadır. Sonuç olarak, bu çalışmanın bulguları elit sporcuların cinsiyet ve ağırlık değişkenlerine göre farklı fizyolojik taleplere sahip olduğunu göstermektedir. Sonuçlarımız, hafif sıklet sporcuların ağır sıklet sporculara göre daha fazla FT ve daha az NFT'ye sahip olduğu fikrini desteklemektedir. Ayrıca turnavadaki müsabakaların yaklaşık %33-38 oranında 3. tura kadar uzadığı görülmektedir. Antrenörler sporcularını müsabakalara hazırlarken, ağırlık kategorilerinin farklı fizyolojik taleplerini göz önünde bulundurmalıdır.

## SONUÇ

Araştırmada Manchester 2022 Grand-Prix Turnuvasında toplam 195 müsabaka analiz edildi. Araştırmanın ana bulguları, kadınlarda ve erkeklerde hafif sıkletlerin ağır sıkletlere oranla daha fazla dövüş zamanına sahip olmasıdır. Bu sonuçlar, hafif sıkletlerde yarışan sporcuların, ağır sıkletlere oranla daha fazla mücadele gerçekleştirdiği ve dolayısıyla daha yüksek bir fizyolojik talep içerdiği hipotezini doğrulamaktadır.

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<b>Destek ve Teşekkür Beyanı/ Statement of Support and Acknowledgment</b>		
Bu çalışmanın yazım sürecinde katkı ve/veya destek alınmamıştır. <i>No contribution and/or support was received during the writing process of this study.</i>		
<b>Çatışma Beyanı/ Statement of Conflict</b>		
Araştırmacıların araştırma ile ilgili diğer kişi ve kurumlarla herhangi bir kişisel ve finansal çıkar çatışması yoktur. <i>Researchers do not have any personal or financial conflicts of interest with other people and institutions related to the research.</i>		
<b>Etik Kurul Beyanı/ Statement of Ethics Committee</b>		
Bu araştırma, Bayburt Üniversitesi Etik Kurulunun E-15604681-100-116690 sayılı kararı ile yürütülmüştür. <i>This research was conducted with the decision of Bayburt University Ethics Committee numbered E-15604681-100-116690.</i>		



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