



Examination of the Relationship Between the Reaction Time, Competition Result With the Competition Hour in the World Indoor Championships (2006-2022): 60 Meters

Nuray SATILMIŞ^{1A}, Bülent TAŞDEMİR^{2B}, Işık BAYRAKTAR^{3C},

Akan BAYRAKDAR^{4D}

¹Faculty of Sports Science, Alanya Alaaddin Keykubat University, Antalya, Turkey.

²Alanya Alaaddin Keykubat University, Graduate Education Institute, Department of Coaching Education, Antalya, Turkey.

³Faculty of Sports Science, Alanya Alaaddin Keykubat University, Antalya, Turkey.

⁴Faculty of Sports Science, Alanya Alaaddin Keykubat University, Antalya, Turkey.

Address Correspondence to A. BAYRAKDAR: e-mail: jsareditor@gmail.com

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A: Orcid ID: 0000-0002-2086-1436 B: Orcid ID: 0000-0001-8515-716X

C: Orcid ID: 0000-0003-1001-5348 D: Orcid ID: 0000-0002-3217-0253

Abstract

The relationship between the reaction time and the total running time of male (n=407) and female (n=345) athletes competing in the 60-meter wind sprint branch at the world indoor championships between 2006 and 2022 and the competition hour was examined in this study. Statistically significant and negative relationships were found between competition hour and athletes' reaction times, competition hour and athletes' competition result ratings in both genders ($\rho < 0.040$; $p < 0.05$). When the subject is examined in terms of the stages of the competitions, no relationship was found for both genders in the final stage while the same relationships were preserved in the semi-final stage. At the qualification stage, a positive relationship was observed between the competition hour and the reaction time in both men ($\rho = 0.25$) and women ($\rho = 0.22$). In particular, it will be important that the competition time zones in the qualification stage are in similar circadian zones so as not to create a disadvantage among the athletes, and that the competition programs should be prepared by taking the performance-limiting and performance-supporting time zones into account.

Keywords: Athletics, Sprint, Circadian, Reaction Time

Özet

Dünya Salon Şampiyonasında (2006-2022): 60 Metrede Reaksiyon Süresi, Müsabaka Sonucu ve Müsabaka Saati Arasındaki İlişkinin İncelenmesi

Dünya salon şampiyonalarında 2006 ve 2022 yılları arasında 60 metre sürat koşu branşında yarışan erkek (n=407) ve kadın (n=345) sporcuların reaksiyon süresi ve toplam koşu süresinin yarışmanın yapıldığı saat ile ilişkileri bu

çalışmada incelenmiştir. Her iki cinsiyette de yarışma saatleri ile sporcuların reaksiyon süreleri, yarışma saatleri ve sporcuların yarışma sonuç dereceleri arasında istatistiksel olarak anlamlı ve negatif yönde ilişkiler bulunmuştur ($\rho < 0,040$; $p < 0,05$). Yarışmaların etapları yönüyle konu incelendiğinde ise her iki cinsiyette de yarı final etabında aynı ilişkiler korunmuşken, final etabında ise herhangi bir herhangi bir ilişki tespit edilememiştir. Seçme etabında ise yarışma saatiyle reaksiyon süresi arasında hem erkeklerde ($\rho = 0,25$) hem de kadınlarda ($\rho = 0,22$) pozitif bir ilişki görülmüştür. Özellikle seçme etabındaki yarışma saat dilimlerinin sporcular arasında dezavantaj oluşturmayacak şekilde benzer sirkadyen dilimlerde olması ve müsabaka programlarının performansı sınırlayıcı ve performansı destekleyici saat dilimlerinin göz önüne alınarak hazırlanması önemli olacaktır.

Anahtar Kelimeler: Atletizm, Sprint, Sirkadiyen, Reaksiyon Süresi

INTRODUCTION

Citius, altius, fortius (faster, higher, stronger), the motto of the Olympic games, can be considered as a philosophy that wonders about the limits of human performance. When it comes to the limits of performance in sports, sports scientists have conducted numerous scientific studies to this day in order to be able to understand this multidimensional, multifactorial complex process and share the information they have obtained (1). It seems that scientific studies based on this curiosity will continue as long as humankind exists.

Although there is no single formula that determines performance in sports, it is necessary to study and understand the components in harmony. In the target sports branch, the limits of human performance are examined by including sub-disciplines such as exercise physiology, biomechanics, performance analysis, cognitive motor neuroscience, history, philosophy, exercise/sport psychology, and pedagogy (2). The performance of wind sprint branches also depends on many factors. It is categorized according to tags such as biomechanical, physiological, environmental, mechanical, equipment, and psychological (3). "Citius", that is, successful performance in the sprint branches chasing the title of the fastest, consists of the components of a fast reaction (reflex speed), acceleration (power), the highest achievable running speed (maximal speed), speed protection (maximal speed endurance) and the ability to minimize fatigue-related speed loss (submaximal speed endurance). In other words, acceleration, maximal velocity, and deceleration, which are the phases of sprint kinematics, are considered to be the determinants of speed (4).

In order for the athletes to reach their potential, sports staff aims to improve and develop all performance components. It has been demonstrated that athletic performance and the time zones of the day in which this performance is realized, in other words, circadian rhythm are related (5-14). In studies conducted in different groups, it was found that the power changes between 3% and 21.2% in different time zones of the day (6, 9, 14). The fact that the power change can be observed at this level makes the time when the performance takes place in the branches with a priority on speed performance even more important.

Within the scope of this study, the relationships between the total duration of sprint performance of elite athletes in the 60-meter wind sprint branch and the athlete's reaction time with the time of day at which the competitions were held were investigated.

METHODOLOGY

The research group of this study in the descriptive survey model consists of athletes (male=407, female=345) who competed in the qualification, semi-final and final stages of the World Indoor Championships held between 2006-2022. Athletes who made a false start or failed to achieve a competition result rating by violating different rules were excluded from the scope of the research. Information about the participants' age, competition hour, reaction time, and competition result variables were taken from the official competition results on the World Athletics official website (15).

Excel (Analysis Toolpak) and the SPSS 26.0 program have been used for statistical analyses and the p-value was accepted as < 0.05 . Kurtosis, skewness values and Kolmogorov-Smirnov (KS) normality test were applied to test the suitability of the data for normal distribution. Kurtosis and skewness values have been accepted as ± 1.5 (16).

Since the kurtosis and skewness values of the variables belonging to the athletes are other than ± 1.5 standard deviation values and the Kolmogorov smirnov (KS) value is $p < 0.05$, it was determined that the data do not show a normal distribution. For this reason, Spearman correlation analysis has been used to determine the relationships between the competition hour and reaction time and the competition result. In evaluating correlation coefficients: the classification form of 0-0.40 is weak, 0.41-0.60 is moderate, 0.61-0.80 is significant (high), and 0.81-1.00 is almost perfect was accepted (17).

Ethical considerations

This study was conducted as an observational study with publicly available data. The study data have been taken from the publicly accessible World Athletics official website (15). The study data are not of ethical concern because they can be accessed online in an unprocessed format and the data are not collected through experiments, as stated by Morley and Thomas (18).

FINDINGS

The descriptive findings of the age, competition result, reaction time, and competition hour variables of the sprinters who competed in the World Indoor Championships between 2006 and 2022 are given in the tables below. The relationships between the competition result and reaction time and the competition hour were also calculated separately.

Table 1. Descriptive statistics of male and female athletes in the 60 m sprint

Gender		Age (year)	Result (second)	Reaction (second)	Competition Hour (time)
Male (n=651)	Mean	25.2	6.78	0.177	15:55
	SD	3.9	0.27	0.056	3:06
	Median	24.9	6.70	0.158	16:33
	25%	22.5	6.62	0.142	13:11
	75%	27.7	6.85	0.192	18:36
Female (n=587)	Mean	25.4	7.39	0.179	14:14
	SD	4.3	0.35	0.050	3:27
	Median	25.2	7.30	0.165	12:21
	25%	22.6	7.19	0.146	10:59
	75%	27.9	7.43	0.198	17:49

In this table, each race that the athletes ran in the qualification, semi-final, and final stages was evaluated as separate data and considered as the total number of races run for men and women. It was found that the average of the competitions run in the championships examined within the scope of the research was 6.78 seconds for men and 7.39 seconds for women. In terms of reaction time, the average reaction time of women was calculated as 0.179 seconds, while it was 0.177 seconds for men. The earliest competition hour for women was 10:15 and the latest competition time was 21:17 (average 14:14). For men, this condition is 10:13 and 21:42 hours (average 15:55).

Table 2. The relationship between the competition hours and reaction times and competition results of male and female athletes in the 60 m sprint

Gender	Male(n=651)		Female(n=587)		
	Reaction	Result	Reaction	Result	
Competition	rho	-0.10*	-0.38**	-0.09*	-0.36**
Hour	p	0.01	0.000	0.03	0.000

Statistically significant ($p < 0.05$) and weak relationships have been found between both genders, both between the competition hour and reaction time and between the competition hour and the competition result ($\rho < 0.40$). In other words, shorter reaction times and better competition results were achieved in competitions later in the day.

The analyses conducted to determine whether the findings obtained without separating the competition stages showed changes when they were examined by dividing them into qualification, semi-final, and final stages of the championships are given in the following tables.

Table 3. Descriptive statistics of the qualification, semi-final, and final stages of male athletes in the 60 m sprint

Male - 60 m		Age (year)	Result (second)	Reaction (second)	Competition Hour (time)
Qualification (n=407)	Mean	24.8	6.87	0.189	14:21
	SD	4.0	0.28	0.063	02:45
	Median	24.5	6.77	0.168	13:37
	25%	21.9	6.67	0.145	12:44
	75%	27.5	7.02	0.218	15:35
Semi-Final (n=197)	Mean	25.9	6.65	0.159	18:03
	SD	3.8	0.15	0.035	01:07
	Median	25.5	6.64	0.152	17:53
	25%	23.3	6.59	0.138	17:30
	75%	28.0	6.71	0.168	18:47
Final (n=47)	Mean	25.8	6.56	0.146	20:29
	SD	3.1	0.09	0.013	00:52
	Median	25.2	6.57	0.148	20:56
	25%	23.5	6.52	0.135	19:46
	75%	27.4	6.62	0.159	21:12

In Table 3, it is seen that the average reaction times and competition results of male athletes decreased progressively from the qualification to the final stage. In the same way, it is seen that the average competition hours increase from the qualification to the final.

Table 4. The relations between the competition hours, reaction times, and competition results of the qualification, semi-final, and final stages of male athletes in the 60 m sprint

Male - 60 m		Qualification (n=407)		Semi-Final (n=197)		Final (n=47)	
		Reaction	Result	Reaction	Result	Reaction	Result
Competition	rho	0.25*	0.10	-0.25*	-0.38*	-0.25	-0.23
Hour	p	0.000	0.06	0.000	0.000	0.09	0.13

In the qualification stage, a significant relationship in a positive direction has been found between competition hour and only reaction time in the male athletes. However, in the semi-final stage, a significant relationship in a negative direction and at a weak level ($\rho < 0.40$) has been found between competition hour and both reaction time and competition result in the male athletes ($p < 0.05$). The qualification stage was held at 10:15 at the earliest and 19:15 at the latest. In the semifinals, these times are 16:20 and 20:39, and in the finals, they are 18:50 and 21:17. When examining the relationships with the competition hour, it is necessary to evaluate the subject in terms of the time intervals of the stages. It is understood that the reaction times of the competitions run at earlier hours are shorter in the qualification stage, which is seen to be run at an earlier time of the day compared to the semi-final and final stages. In the semi-finals, contrary to the qualification, the reaction times of the competitions run later in the day can be interpreted as shortened and the results of the competition improved.

Table 5. Descriptive statistics of the qualification, semi-final, and final stages of female athletes in the 60 m sprint

Female - 60 m		Age (year)	Result (second)	Reaction (second)	Competition Hour (time)
Qualification (n=345)	Mean	24.8	7.50	0.191	11:59
	SD	4.3	0.40	0.058	2:21
	Median	24.5	7.37	0.172	11:10
	25%	21.8	7.24	0.149	10:43
	75%	27.4	7.64	0.218	12:07
Semi-Final (n=195)	Mean	26.2	7.24	0.164	16:51
	SD	4.2	0.14	0.029	1:26
	Median	25.7	7.23	0.158	17:09
	25%	23.6	7.15	0.144	16:00
	75%	28.5	7.33	0.176	18:05
Final (n=47)	Mean	27.1	7.13	0.159	19:54
	SD	3.6	0.11	0.031	1:28
	Median	26.2	7.11	0.155	20:28
	25%	24.8	7.04	0.142	19:25
	75%	29.3	7.22	0.170	20:51

In Table 5, it is seen that the average reaction times and competition results of female athletes decreased progressively from the qualification to the final stage. In the same way, it is seen that the average competition hours increase from the qualification to the final.

Table 6. The relations between the competition hours, reaction times, and competition results of the qualification, semi-final, and final stages of female athletes in the 60 m sprint

Female - 60 m		Qualification (n=345)		Semi-Final (n=195)		Final (n=47)	
		Reaction	Result	Reaction	Result	Reaction	Result
Competition	rho	0.22*	0.08	-0.28*	-0.29*	-0.12	-0.19
Hour	p	0.000	0.15	0.000	0.000	0.42	0.20

In the qualification stage, a significant relationship in a positive direction has been found between competition hour and only reaction time in female athletes. However, in the semi-final stage, a significant relationship in a negative direction and at a weak level ($\rho < 0.40$) has been found between competition hour and both reaction time and competition result in the male athletes ($p < 0.05$).

The qualification stage was held at 10:13 at the earliest and 19:45 at the latest. In the semifinals, these times are 16:16 and 19:04, and in the finals, they are 17:06 and 21:42. As in the case of men, it can be interpreted that the reaction times of the competitions run in the early hours are shorter at the qualification stage, while in the semifinals, unlike the qualification, the competitions run later in the day have shorter reaction times.

The charts of the athletes' reaction times and competition results in terms of the time of day are given in Chart 1 and Chart 2 according to gender.

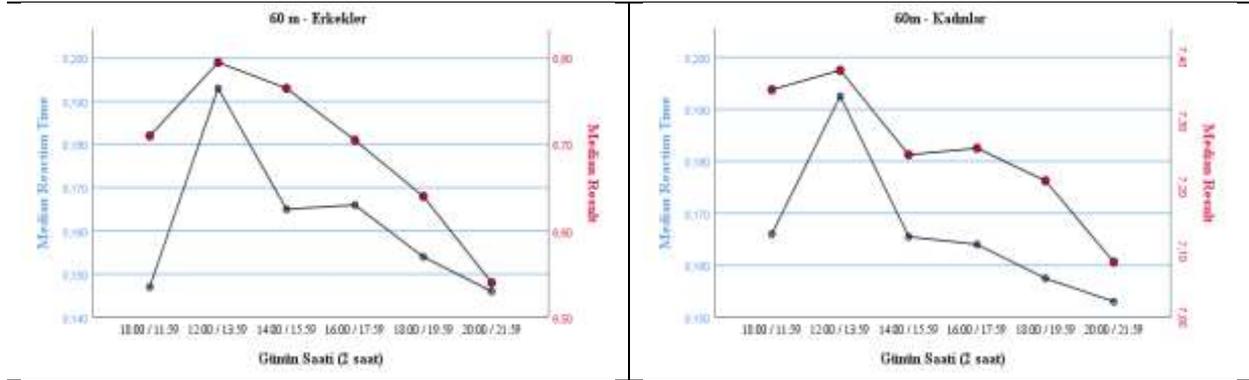


Chart 1. The Chart of the median values of the reaction time and competition results of men according to the time of day with an interval of two hours

Chart 2. The Chart of the median values of the reaction time and competition results of women according to the time of day with an interval of two hours

It is understood from the charts that the performance of the athletes decreased in terms of reaction time and the competition result in the competitions held between 12:00 and 14:00 in both genders.

DISCUSSION and CONCLUSION

In the current study, the relationship between the reaction time and the total running time of male (n=407) and female (n=345) athletes competing in the 60-meter sprint event at the World Indoor Championships held between 2006 and 2022 and the competition hour were examined. Statistically significant ($p<0.05$) and weak relationships have been found between both genders, both between the competition hour and reaction time and between the competition hour and the competition result ($\rho<0.40$). In other words, shorter reaction times and better competition results were achieved in competitions later in the day.

It is known that the components of sports performance change in a sinusoidal way according to the time of day. It has been found in studies conducted that physical fitness tests and long-term submaximal exercise performance show the busiest times in the morning, and the performance capacity test results based on heart rate are at the peak level in the morning. Post-lunch decreases in performance variables such as muscle strength were found to be significant (7). Hill and Smith (1991) obtained higher peak power outputs in their study on anaerobic power and capacity in the evening compared to other times of the day (12).

When the competitions conducted within the scope of the research were examined by dividing the time of day, it has been found that the performance of athletes decreased in terms of reaction time and competition result in competitions held between 12:00 and 14:00 in both genders. The best reaction times have been put between 10:00-12:00 and 20:00-22:00 in men, and in women between 18:00-22:00. In a study examining the changes in sprint performance according to the time of day, it was reported that the performance in the evening hours was higher than in the morning hours, while this situation could not be maintained in repeated sprints (19).

As a result, it has been observed that there are changes in the reaction times and competition performances of athletes in the sprint branch depending on the time of day. In major competitions organized in sports branches such as athletics, reasons such as the high number of athletes and the diversity of branches make it difficult to prepare competition programs. Nevertheless, it is recommended that the competition time zones should be in similar circadian zones so as not to create a disadvantage among athletes, and performance-limiting and performance-supporting time zones should be considered when preparing competition programs.

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