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Statistical Analysis for Various Parameters of An International Functional Training Competition in Turkey

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ABSTRACT

Purpose: The number of Crossfit competitions held is increasing day by day. The factors affecting the results in these competitions have become an important research topic. This study aimed to analyze whether the results of an international Crossfit competition held in Turkey differ according to the age, height, bodyweight, training time, number of daily steps, and athlete history parameters of the competitors.

Method: The competition consisted of six stages and includes eight categories created according to the level of the athletes. For the study, a questionnaire containing this information was applied to the competitors (n = 184; 133 men, 51 women) and the data obtained were statistically compared with the scores at the end of the competition.

Results: The findings of this study showed that age, height, body weight, exercise duration, and athlete history parameters affected the results of the functional training competition. In particular, it was observed that the height factor significantly affected the results of the competition, and the tall athletes scored better in most categories ($p < 0.05$). In addition, it was observed that age and body weight parameters created significant differences in some categories and some stages. It has been determined that the competitors with more than 10,000 daily steps were more unsuccessful in the total ranking. The daily exercise time of the athletes who were successful in the competition was 75-90 minutes. It has been noted that they did Crossfit training 5 days a week and that all finalist athletes were also interested in sports branches other than Crossfit.

Conclusion: The findings of this research can provide enlightening information about the parameters that should be taken into account by the organizers of Crossfit competitions during the preparation phase of the competition content and the athletes during the preparation phase for these competitions.

Keywords: Crossfit, Funtional training, Competition, Performance analysis, High intensity interval training

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ÖZET

Türkiye'de Düzenlenen Fonksiyonel Antrenman Yarışmasının Farklı Değişkenler Açısından İncelenmesi

Amaç: Düzenlenen Crossfit yarışmalarının sayısı gün geçtikçe artmaktadır. Bu yarışmalarda sonuçları etkileyen faktörler önemli bir araştırma konusu haline gelmiştir. Bu çalışmanın amacı Türkiye'de düzenlenen bir uluslararası Crossfit yarışmasının sonuçlarının, yarışmacıların yaş, boy uzunluğu, vücut ağırlığı, antrenman süresi, günlük adım sayısı ve sporcu geçmişi parametrelerine göre farklılık gösterip göstermediğinin analiz edilmesidir.
Yöntem: Yarışmalar 6 farklı etaptan oluşmakta ve sporcuların seviyelerine göre oluşturulmuş 8 farklı kategori içermektedir. Çalışma için yarışmacılara (n = 184; 133 erkek, 51 kadın) bu bilgileri içeren anket uygulanmış ve elde edilen veriler yarışma sonucundaki puanlarla istatistiksel olarak karşılaştırılmıştır.
Bulgular: Bu araştırmanın bulguları, incelenen fonksiyonel antrenman yarışmasında yaş, boy uzunluğu, vücut ağırlığı, egzersiz süresi ve sporcu geçmişi parametrelerinin yarışma sonucunu etkilediğini göstermiştir. Özellikle boy uzunluğu faktörünün yarışma sonucunu önemli ölçüde etkilediği ve çoğu kategoride boyu uzun olan sporcuların daha iyi puan aldıkları gözlenmiştir ($p < 0,05$). Ayrıca yaş ve vücut ağırlığı parametrelerinin de bazı kategorilerde ve bazı etaplarda anlamlı farklılıklar oluşturduğu görülmüştür. Günlük adım sayısı 10.000'den fazla olan yarışmacıların total sıralamada daha başarısız oldukları tespit edilmiştir. Yarışmada başarılı olan sporcuların günlük egzersiz süresinin 75-90 dk. arasında olduğu, haftada 5 gün Crossfit antrenmanı yaptıkları ve tüm finalist sporcuların Crossfit dışında başka spor dallarıyla da ilgilendikleri kaydedilmiştir.
Sonuç: Bu araştırmadan elde edilen bulgular, incelenen tüm parametrelerin yarışma sonucunda farklar oluşturduğunu göstermiştir. Bu çalışmanın bulguları, gelecekte düzenlenecek olan fonksiyonel antrenman ve Crossfit yarışmalarının içeriğinde yer alacak egzersizlerin bir gruba ekstra avantajlar sağlamayacak şekilde, dengeli düzenlenmesi için bir rehber oluşturabilir. Ayrıca, bu tür yarışmalara katılacak olan sporcuların yarışma içerisindeki hareketlerin hangi faktörlerden daha fazla etkilendiğini belirleyerek bu egzersizlere yönelik ekstra çalışmalar yapmaları faydalı olabilir.

Anahtar Kelimeler: Crossfit, Fonksiyonel antrenman, Yarışma, Performans analizi, Yüksek yoğunluklu antrenman

INTRODUCTION

The Crossfit training model, which Greg Glassman revealed in 1995, was incorporated in 2001 and organized competitions under the name of Crossfit Games with the sponsorship of Rebook and gained popularity day by day (Moran et al., 2017). One of the biggest reasons Crossfit is so popular and loved is that it has a community structure and a high-intensity, ever-changing training pattern. Thus, training people can keep this excitement alive (Başar et al., 2020). There are thousands of licensed Crossfit gyms and Crossfit certified trainers globally (Lichtenstein and Jensen, 2016).

Crossfit is a constantly changing training model that uses high-intensity, functional movements. This training model focuses on general strength and conditioning and aims to develop ten essential physical characteristics. These features are; the capacity to do work,

speed, flexibility, cardiovascular ability, balance, coordination, power, explosive strength, agility, and endurance (Glassman, 2002). In addition, Crossfit includes gymnastics, weightlifting, and cardiovascular activities (Fisker et al., 2017).

Although Crossfit is a training model beneficial for human health in general, injuries can occur frequently. This is more common in beginners. In training where rest periods are short and require intense effort, athletes may move away from the technique and engage in movements that may be harmful to them to complete the training (Bergeron et al., 2011). Contrary to popular belief, Poston et al. stated that high-intensity training models such as Crossfit have less or the same level of injury risk compared to other physical activities (Poston et al., 2016).

While there are many studies in the literature on the relationship between Crossfit and functional training and athlete injuries (Bergeron et al., 2011; Poston et al., 2016), the number of studies on parameters that affects practical training results in competitions is insufficient. In this study, the relationships between the age, height, bodyweight, training time, number of daily steps, and athlete history parameters of the Crossfit athletes participating in the Battle of Bosphorus Funcional Fitness Championship'21 competition held in Istanbul and the results of the competition were examined. This study aimed to contribute to the literature on the effects of these parameters on the success of competitors in functional training and Crossfit competitions.

METHOD

Battle of Bosphorus Functional Fitness Championship 2021

The competition was held at Bakırköy Municipality Atatürk Sports and Life Complex on 18-19 September 2021. The competition was held with 221 competitors (156 Men, 65 Women) in 8 categories, including Beginner Man, Beginner Woman, Scaled Man, Scaled Woman, Elite Man, Elite Woman, Master 35+ Man, and Master 35+ Woman. There were six stages in total in the competition. These stages consisted of different workouts arranged according to categories. The Works of the Day (WODs) of all categories are presented in Table 1.

Table 1. Competition WOD's and context for each category.

	Beginner Men	Beginner Women	Scaled Men	Scaled Women	Elite Men	Elite Women	Master 35+ Men	Master 35+ Women
	For Time (Time Cap : 8 min)							
WOD 1	1) 30 Knee to Chest - 300 m Run 2) 30 Knee to Chest - 200 m Run 3) 30 Knee to Chest - 100 m Run		1) 30 Toes to Bar - 300 m Run 2) 30 Toes to Bar - 200 m Run 3) 30 Toes to Bar - 100 m Run	1) 30 Knee to Chest - 300 m Run 2) 30 Knee to Chest - 200 m Run 3) 30 Knee to Chest - 100 m Run	1) 30 Toes to Bar - 300 m Run 2) 30 Toes to Bar - 200 m Run 3) 30 Toes to Bar - 100 m Run		1) 30 Toes to Bar - 300 m Run 2) 30 Toes to Bar - 200 m Run 3) 30 Toes to Bar - 100 m Run	
	7 min Amrap							
WOD 2	1) (7 One Arm DB Thrusters - 7 Burpee Lateral Jump Over DB) x 7 2) Remaining Time Max Meter Overhead Walking Lunge with Plate DB = 15 kg (Man), 10 kg (Woman) Plate = 10 kg (Man), 5 kg (Woman)		1) (7 One Arm DB Thrusters - 7 Burpee Lateral Jump Over DB) x 7 2) Remaining Time Max Meter Overhead Walking Lunge with Plate DB = 17.5 kg (Man), 12.5 kg (Woman) Plate = 15 kg (Man), 10 = kg (Woman)		1) (7 One Arm DB Thrusters - 7 Burpee Lateral Jump Over DB) x 7 2) Remaining Time Max Meter Hand Stand Walk DB = 22,5 (Man), 15 kg (Woman)		1) (7 One Arm DB Thrusters - 7 Burpee Lateral Jump Over DB) x 7 2) Remaining Time Max Meter Hand Stand Walk DB = 22,5 kg (Man), 15 kg (Woman)	
	For Time (Time Cap : 7 min)							
WOD 3	1) Deadlift x 8 – Clean x 7 – Snatch x 6 - 21 rep Pull Up 2) Deadlift x 6 – Clean x 5 – Snatch x 4 - 21 rep Pull Up 3) Deadlift x 4 – Clean x 3 – Snatch x 2 - 21 rep Pull Up Barbell Kg : 40 kg	1) Deadlift x 8 – Clean x 7 – Snatch x 6 - 21 rep Jumping Pull Up 2) Deadlift x 6 – Clean x 5 – Snatch x 4 - 21 rep Jumping Pull Up 3) Deadlift x 4 – Clean x 3 – Snatch x 2 - 21 rep Jumping Pull Up Barbell Kg : 20 kg	1) Deadlift x 8 – Clean x 7 – Snatch x 6 - 21 rep Chest to Bar Pull Up 2) Deadlift x 6 – Clean x 5 – Snatch x 4 - 21 rep Chest to Bar Pull Up 3) Deadlift x 4 – Clean x 3 – Snatch x 2 - 21 rep Chest to Bar Pull Up Barbell Kg : 50 kg	1) Deadlift x 8 – Clean x 7 – Snatch x 6 - 21 rep Pull Up 2) Deadlift x 6 – Clean x 5 – Snatch x 4 - 21 rep Pull Up 3) Deadlift x 4 – Clean x 3 – Snatch x 2 - 21 rep Pull Up Barbell Kg : 30 kg	1) Deadlift x 8– Clean x 7 – Snatch x 6 Pull Up x 8 – Chest to Bar x 7 – Muscle Up x 6 2) Deadlift x 6– Clean x 5 – Snatch x 4 Pull Up x 6 – Chest to Bar x 5 – Muscle Up x 4 3)Deadlift x 4– Clean x 3 – Snatch x 2 Pull Up x 4 – Chest to Bar x 3 – Muscle Up x 2 Barbell Kg : 60 kg (Man) , 40 kg (Woman)	1) Deadlift x 8– Clean x 7 – Snatch x 6 Pull Up x 8 – Chest to Bar x 7 – Muscle Up x 6 2) Deadlift x 6– Clean x 5 – Snatch x 4 Pull Up x 6 – Chest to Bar x 5 – Muscle Up x 4 3)Deadlift x 4– Clean x 3 – Snatch x 2 Pull Up x 4 – Chest to Bar x 3 – Muscle Up x 2 Barbell Kg : 50 kg	1) Deadlift x 8 – Clean x 7 – Snatch x 6 - 21 rep Chest to Bar Pull Up 2) Deadlift x 6 – Clean x 5 – Snatch x 4 - 21 rep Chest to Bar Pull Up 3) Deadlift x 4 – Clean x 3 – Snatch x 2 - 21 rep Chest to Bar Pull Up Barbell Kg : 30 kg
WOD	**For Time (Time Cap : 10 min)**							

	Beginner Men	Beginner Women	Scaled Men	Scaled Women	Elite Men	Elite Women	Master 35+ Men	Master 35+ Women
4	1) 40 GHD Sit Up 2) Cal Airdyne Bike (21 cal) - Air Squat with DB (21 reps) 3) Cal Airdyne Bike (15 cal) - Air Squat with DB (15 reps) 4) Cal Airdyne Bike (9 cal) - Air Squat with DB (9 reps) 5) 40 GHD Sit Up DB = 22.5 kg (Man), 15 kg (Woman)		1) 40 GHD Sit Up 2) Cal Airdyne Bike (21 cal) - Pistol (21) 3) Cal Airdyne Bike (15 cal) - Pistol (15) 4) Cal Airdyne Bike (9 cal) - Pistol (9) 5) 40 GHD Sit Up		1) 40 GHD Sit Up 2) Cal Airdyne Bike (21 cal) - Pistol with DB (21) 3) Cal Airdyne Bike (15 cal) - Pistol with DB (15) 4) Cal Airdyne Bike (9 cal) - Pistol with DB (9) 5) 40 GHD Sit Up DB Kilograms: 22.5 kg (Man) , 15 kg (Woman)		1) 40 GHD Sit Up 2) Cal Airdyne Bike (21 cal) - Pistol with DB (21) 3) Cal Airdyne Bike (15 cal) - Pistol with DB (15) 4) Cal Airdyne Bike (9 cal) - Pistol with DB (9) 5) 40 GHD Sit Up DB Kilograms: 22.5 kg (Man) , 15 kg (Woman)	
	10 min Amrap							
WOD 5	10 Cal Ski Erg 25 mt. Swim 10 Cal Bike Erg 25 mt. Swim							
	For Time : 4:30 + 30 sn rest + 4:30 + 30 sn rest + 4:30							
WOD 6	1) Chest to Bar x 5 Overhead Squat x 5 2) Chest to Bar x 4 Overhead Squat x 4 3) Chest to Bar x 3 Overhead Squat x 3 4) Chest to Bar x 2 Overhead Squat x 2 5) Chest to Bar x 1 Overhead Squat x 1 Barbell Kg: 40 kg Time Cap : 4:30 30 sec rest 6) 1000 mt. Row Time Cap : 4:30 30 sec rest 7) Rope Climb x 5 Handstand Push Up x 5 8) Rope Climb x 4 Handstand Push Up x 4 9) Rope Climb x 3 Handstand Push Up x 3 10) Rope	1) Pull Up x 5 Overhead Squat x 5 2) Pull Up x 4 Overhead Squat x 4 3) Pull Up x 3 Overhead Squat x 3 4) Pull Up x 2 Overhead Squat x 2 5) Pull Up x 1 Overhead Squat x 1 Barbell Kg : 20 kg Time Cap : 4:30 30 sec rest 6) 1000 mt. Row 30 sec rest 7) Rope Climb x 5 Paralette Push Up x 5 8) Rope Climb x 4 Paralette Push Up x 4 9) Rope Climb x 3 Paralette Push Up x 3 10) Rope Climb x 2 Paralette	1) Bar Muscle Up x 5 Overhead Squat x 5 2) Bar Muscle Up x 4 Overhead Squat x 4 3) Bar Muscle Up x 3 Overhead Squat x 3 4) Bar Muscle Up x 2 Overhead Squat x 2 5) Bar Muscle Up x 1 Overhead Squat x 1 Barbell Kg: 50 kg Time Cap : 4:30 30 sec rest 6) 1000 mt. Row Time Cap : 4:30 30 sec rest 7) Rope Climb x 5 Deficit HSPU x 5 8) Rope Climb x 4	1) Chest to Bar x 5 Overhead Squat x 5 2) Chest to Bar x 4 Overhead Squat x 4 3) Chest to Bar x 3 Overhead Squat x 3 4) Chest to Bar x 2 Overhead Squat x 2 5) Chest to Bar x 1 Overhead Squat x 1 Barbell Kg: 30 kg Time Cap : 4:30 30 sec rest 6) 1000 mt. Row Time Cap : 4:30 30 sec rest 7) Rope Climb x 5 Handstand Push Up x 5 8) Rope Climb x 4 Handstand Push Up x 4 9) Rope Climb x 3 Handstand Push Up x 3 10) Rope	1) Ring Muscle Up x 5 Overhead Squat x 5 2) Ring Muscle Up x 4 Overhead Squat x 4 3) Ring Muscle Up x 3 Overhead Squat x 3 4) Ring Muscle Up x 2 Overhead Squat x 2 5) Ring Muscle Up x 1 Overhead Squat x 1 Barbell Kg: 70 kg (Man), 50 kg (Woman) Time Cap : 4:30 30 sec rest 6) 1000 mt. Row Time Cap : 4:30 30 sec rest 7) Rope Climb x 5 Paralette HSPU x 5 8) Rope Climb x 4 Paralette HSPU x 4 9) Rope Climb x 3 Paralette HSPU x 3 10) Rope Climb x 2 Paralette HSPU x 2 11) Rope Climb x 1 Paralette HSPU x 1	1) Ring Muscle Up x 5 Overhead Squat x 5 2) Ring Muscle Up x 4 Overhead Squat x 4 3) Ring Muscle Up x 3 Overhead Squat x 3 4) Ring Muscle Up x 2 Overhead Squat x 2 5) Ring Muscle Up x 1 Overhead Squat x 1 Barbell Kg: 60 kg Time Cap : 4:30 30 sec rest 6) 1000 mt. Row Time Cap : 4:30 30 sec rest 7) Rope Climb x 5 Paralette HSPU x 5 8) Rope Climb x 4 Paralette HSPU x 4 9) Rope Climb x 3 Paralette HSPU x 3 10) Rope	1) Ring Muscle Up x 5 Overhead Squat x 5 2) Ring Muscle Up x 4 Overhead Squat x 4 3) Ring Muscle Up x 3 Overhead Squat x 3 4) Ring Muscle Up x 2 Overhead Squat x 2 5) Ring Muscle Up x 1 Overhead Squat x 1 Barbell Kg: 40 kg Time Cap : 4:30 30 sec rest 6) 1000 mt. Row Time Cap : 4:30 30 sec rest 7) Rope Climb x 5 Deficit HSPU x 5 8) Rope Climb x 4 Deficit HSPU x 4 9) Rope Climb x 3 Deficit HSPU x 3 10) Rope Climb x 2 Deficit HSPU x 2 11) Rope Climb x 1 Deficit HSPU x 1

Beginner Men	Beginner Women	Scaled Men	Scaled Women	Elite Men	Elite Women	Master 35+ Men	Master 35+ Women
Climb x 2 Handstand Push Up x 2 11) Rope Climb x 1 Handstand Push Up x 1	Push Up x 2 11) Rope Climb x 1 Paralette Push Up x 1	Deficit HSPU x 4 9) Rope Climb x 3 Deficit HSPU x 3 10) Rope Climb x 2 Deficit HSPU x 2 11) Rope Climb x 1 Deficit HSPU x 1	Climb x 2 Handstand Push Up x 2 11) Rope Climb x 1 Handstand Push Up x 1			Climb x 2 Paralette HSPU x 2 11) Rope Climb x 1 Paralette HSPU x 1	

For the competition's scoring, a scoring system has been established in each stage according to the completion of the stage content in the shortest time or the maximum number of repetitions. In the scoring system, the most successful competitor in each stage got 1 point, and the unsuccessful ones were ranked by increasing. The total score was obtained by summing the scores obtained in all phases.

Study Design

A questionnaire was applied to the participants the day before the competition, which included the questions of physical activity level, number of daily steps, crossfit training history, daily crossfit training duration, how many days of crossfit training they did, and whether they were interested in another sport. A consent form was presented to the contestants, which clearly stated that their personal information would not be shared. The analysis was to be made with the data received, and the contestants who volunteered to participate in the research answered the questionnaire by signing the consent forms. The height and body weights of the contestants who wanted to participate in the study were measured and recorded on registration. The mean calculated separately for each category and the number of participants, age, height, and body weight data for each type are presented in Table 2.

Table 2. The distribution data and percentiles of age, weight, and height of competitors

Category		Percentiles								
		Mean	Sd.	Q1	M	Q3	Skewness		Kurtosis	
							Statistic	Std. Error	Statistic	Std. Error
Beginner										
Men (n = 36)	Age	26,39	6,88	21,25	25,00	31,00	0,80	0,39	0,67	0,77
	Weight	80,86	8,94	75,00	81,00	88,00	-0,21	0,39	-0,80	0,77
	Height	178,33	6,03	175,00	178,50	183,75	-0,27	0,39	-0,59	0,77

Category		Percentiles								
		Mean	Sd.	Q1	M	Q3	Skewness		Kurtosis	
							Statistic	Std. Error	Statistic	Std. Error
Women (n = 23)	Age	29,09	6,42	25,00	27,00	33,00	0,43	0,48	0,13	0,94
	Weight	57,48	4,79	56,00	58,00	60,00	-0,85	0,48	-0,17	0,94
	Height	163,57	6,73	160,00	163,00	165,00	1,15	0,48	1,76	0,94
Scaled										
Men (n = 39)	Age	26,31	3,81	24,00	26,00	29,00	0,27	0,38	-0,20	0,74
	Weight	83,21	11,03	76,00	83,00	87,00	1,48	0,38	4,30	0,74
	Height	178,05	6,55	174,00	178,00	182,00	0,18	0,38	0,18	0,74
Women (n = 16)	Age	28,19	6,06	22,25	28,50	32,50	0,34	0,56	-1,14	1,09
	Weight	61,44	5,73	58,00	60,00	63,75	0,71	0,56	0,14	1,09
	Height	167,13	5,50	162,25	166,50	170,75	0,80	0,56	0,46	1,09
Master 35+										
Men (n = 26)	Age	39,00	3,07	36,75	38,00	41,00	0,93	0,46	0,05	0,89
	Weight	85,38	7,12	82,00	86,00	90,00	0,01	0,46	0,45	0,89
	Height	177,88	5,29	175,75	179,50	181,00	-1,13	0,46	1,72	0,89
Women (n = 6)	Age	37,00	1,79	35,75	36,50	38,50	0,94	0,85	0,59	1,74
	Weight	59,50	8,71	51,25	60,00	65,50	0,43	0,85	-0,31	1,74
	Height	164,00	5,25	159,25	163,50	170,00	0,05	0,85	-1,43	1,74
Elite										
Men (n = 32)	Age	27,16	3,93	24,25	27,50	30,00	-0,18	0,41	-0,68	0,81
	Weight	85,75	6,07	82,00	85,00	89,75	0,30	0,41	-0,45	0,81
	Height	178,59	5,30	174,25	179,50	181,75	0,16	0,41	-0,70	0,81
Women (n = 6)	Age	30,50	5,32	26,25	32,50	34,25	-1,39	0,85	1,52	1,74
	Weight	61,00	4,82	32,50	60,00	163,50	0,52	0,85	-1,54	1,74
	Height	166,50	7,56	34,25	65,75	175,50	0,81	0,85	-1,71	1,74

Sd. = Standard deviation; Q1 = First percentile (25%); M = Median (%50); Q3 = Third percentile (75%)

All competitors participated in the WOD1 and WOD2 stages of the competition, then the unsuccessful competitors were eliminated, and the winners of each category were determined at the end of the six stages. For this research, the WOD1, WOD2, and end-of-competition total scores of all types were recorded, and it was investigated whether the scores obtained by the competitors from these stages were related to age, height, bodyweight, training time, the number of daily steps and athlete history.

Statistical Analysis

Distribution analyzes were made for each category of the groups participating in the research. The differences between the competition results and demographic data were analyzed with the Independent Sample t-test. In addition, the differences between the answers given to the questions and the competition results were analyzed with the independent sample t-test. Correlations between total competition scores and other parameters were tested with Pearson Correlation analysis. The participant group's age, height, and body weight Q1, M, and Q3 values were calculated, and differences between the groups below and above these values were investigated. Significance levels were $*p < 0.05$; $**p < 0.01$ and $***p < 0.001$. IBM SPSS Statistics 26.0 package program was used for all statistical analyses.

RESULTS

Among the 221 competitors, 184 (133 men, 51 women) volunteer competitors who answered the questionnaire were included in the research analysis. Distribution analysis results and percentiles of age, height, and weight of participants are shown in Table 2.

Age

No significant difference was observed in the beginner category in the Pearson correlation and t-test analyses performed to examine the relationship between Q1, M, and Q3 values and scores. In the elite men category, it was determined that the athletes aged 30 (Q3) and above (n = 10; point = 17.7) in the WOD1 stage scored significantly better than the other athletes (n = 22; point = 20.41) (p = 0.012*). In the scaled women category, the total ranking scores of the athletes who were less than the median age (28.5) of the group (n = 8; point = 61.13) were at a better level than the athletes with the larger ones (n = 8; point = 108.25) (p = 0,02*). No significant age-related difference was recorded in the elite women, scaled men, and master 35+ categories.

Size

Table 3. Independent Samples T-test results depended on height percentages.

Category	DP	Height	n	Point	Sd.	*p*
Beginner						
Men (n = 36)	Q1	>= 175,00	28	76,11	22,16	0,191
		< 175,00	8	87,50	12,55	
	M	>= 178,50	18	73,89	24,69	0,025*
		< 178,50	18	83,39	15,32	
	Q3	>= 183,75	9	72,00	29,14	0,032*

Category	DP	Height	n	Point	Sd.	*p*
		< 183,75	27	80,85	17,37	
Women (n = 23)	Q1	>= 160,00	19	132,68	70,85	0,30
		< 160,00	4	145,50	77,08	
	M	>= 163,00	12	115,92	73,77	0,153
		< 163,00	11	155,64	63,10	
	Q3	>= 165,00	6	66,33	44,85	0,003**
		< 165,00	17	159,12	61,49	
Scaled						
Men (n = 39)	Q1	>= 174,00	30	249,27	112,0	0,538
		< 174,00	9	178,44	116,6	
	M	>= 178,00	22	272,50	106,2	0,013*
		< 178,00	17	181,71	109,2	
	Q3	>= 182,00	11	254,00	117,1	0,482
		< 182,00	28	224,64	115,9	
Women (n = 16)	Q1	>= 162,25	12	75,67	39,8	0,378
		< 162,25	4	111,75	35,4	
	M	>= 166,50	8	93,25	37,0	0,421
		< 166,50	8	76,13	45,2	
	Q3	>= 170,75	4	69,50	37,7	0,410
		< 170,75	12	89,75	42,2	
Master 35+						
Men (n = 26)	Q1	>= 175,75	20	148,00	72,47	0,067
		< 175,75	6	155,83	51,69	
	M	>= 179,50	13	117,23	72,34	0,005**
		< 179,50	13	182,38	43,81	
	Q3	>= 181,00	7	126,00	81,07	0,108
		< 181,00	19	158,58	61,71	
Elite						
Men (n = 32)	Q1	>= 174,25	24	232,17	60,85	0,000***
		< 174,25	8	112,13	72,79	
	M	>= 179,50	16	229,94	56,12	0,005**
		< 179,50	16	174,38	95,49	
	Q3	>= 181,75	8	236,75	41,38	0,038*
		< 181,75	24	190,63	89,43	

DP = Dependent Percentile; n = Count; Sd. = Standard deviation; Point = Competition point (lower point is better); Sd.E. = Standard error mean; M = Median; Q3 = Third quartile (75%); *$p < 0,05$; **$p < 0,01$

A significant difference was found between the height of the competitors and the total competition score in all categories except the scaled women category (Table 3). Accordingly, Pearson correlation analysis was performed for all categories between height and total score, and beginner woman (r = -0.455264*; *p* = 0.029042) and elite man (r = 0.522667**; *p* = 0,002148) significant correlations were found in the categories.

In the scaled man category, those shorter than 174 cm (Q1) (n = 9; WOD2 point = 17.44) scored better in the WOD2 stage (p = 0) than those taller (n = 30; WOD2 point = 23.87) (*p* = 0,03). As a result of the t-test analysis performed according to the median (178 cm) value of the group, in the total ranking (Table 3), WOD1 ((n=17)<178 cm, point = 15.59; (n=22)>=178 cm, point = 26.68; *p* = 0.005**) and WOD2 ((n=17)<178 cm, point = 16.18; (n=22)>=178 cm, point = 27.18; *p* = 0.005**). The shortest competitors in all stages received better ranking points. The differences obtained in the analyzes according to Q3 are insignificant. No significant difference was observed depending on height in the scaled women category. In addition, significant correlations were found between height and WOD1 stage scores in scaled men (r = 0.329876; *p* = 0.040281) and elite men (r = 0.449109**; *p* = 0.009924) categories.

Competitors shorter than 174.25 cm (Q1) in the Elite men stage, in the total ranking (Table 3), in the WOD1 stage ((n=8)<174.25 cm, point = 7.88 ± 4.88; (n=24) >=174.25 cm, point = 23.46 ± 8.28; *p* < 0.001***) and at stage E2 ((n=8)<174.25 cm, point = 12.5 ± 9.3; (n=24)>=174.25 cm, point 22.88 ± 8.56; *p* < 0.001***) scored better.

Bodyweight

The t-test analysis results of the total scores of all categories according to the groups with bodyweight below and above Q1, M and Q3 are presented in Table 4.

Table 4. Independent Samples T-test results depended on weight percentages.

Category	DP	Weight	n	Point	Sd.	*p*
Beginner						
Men (n = 36)	Q1	>= 75,00	28	77,71	22,98	0,094
		< 75,00	8	81,88	10,68	
	M	>= 81,00	18	77,28	25,76	0,035*
		< 81,00	18	80,00	14,99	
	Q3	>= 88,00	10	69,80	29,88	0,001**
		< 88,00	26	82,04	15,55	
Women (n = 23)	Q1	>= 56,00	18	135,17	70,94	0,965
		< 56,00	5	134,00	76,12	
	M	>= 58,00	14	129,21	70,42	0,958
		< 58,00	9	143,78	73,41	
	Q3	>= 60,00	10	131,10	75,03	0,587
		< 60,00	13	137,85	69,40	

Category	DP	Weight	n	Point	Sd.	*p*
Scaled						
Men (n = 39)	Q1	>= 76,00	31	233,87	116,93	0,795
		< 76,00	8	229,25	117,48	
	M	>= 83,00	21	250,57	107,02	0,287
		< 83,00	18	212,33	124,55	
	Q3	>= 87,00	13	263,62	103,52	0,3
		< 87,00	26	217,58	119,99	
Women (n = 16)	Q1	>= 58,00	13	85,15	40,55	0,853
		< 58,00	3	82,67	51,59	
	M	>= 60,00	10	88,60	36,56	0,294
		< 60,00	6	78,17	50,27	
	Q3	>= 63,75	4	63,75	26,51	0,069
		< 63,75	12	91,67	43,30	
Master 35+						
Men (n = 26)	Q1	>= 82,00	21	148,62	70,04	0,338
		< 82,00	5	154,80	61,58	
	M	>= 86,00	13	128,85	74,40	0,04*
		< 86,00	13	170,77	54,45	
	Q3	>= 90,00	7	134,57	90,37	0,014*
		< 90,00	19	155,42	58,79	
Elite						
Men (n = 32)	Q1	>= 82,00	25	223,60	71,43	0,003**
		< 82,00	7	125,57	74,96	
	M	>= 85,00	17	218,12	69,71	0,144
		< 85,00	15	184,07	93,24	
	Q3	>= 89,75	8	222,63	79,76	0,836
		< 89,75	24	195,33	83,33	

DP = Dependent Percentile; n = Count; Sd. = Standard deviation; Point = Competition point (lower point is better); Sd.E. = Standard error mean; M = Median; Q3 = Third quartile (75%); *p < 0,05; **p < 0,01

In the beginner men category, the differences between the groups under and over 75 kg (Q1) of body weight were insignificant. In the WOD1 stage, the ranking scores of the competitors under 81 kg (M) were higher ((n=18)>=81 kg, point = 22.61 ± 15.27; (n=18)<81 kg, point = 20.94 ± 10.75; p = 0.024*). In addition, the WOD1 stage scores of the competitors over 88 kg (Q3) were found higher ((n=10)>=88 kg, point = 20.1 ± 16.95; (n=26)<88 kg, point = 22.42 ± 11.54; p = 0.027*). There was no significant difference in body weight in the Beginner women category.

In the scaled men category, a difference in body weight was observed in the WOD1 stage and the competitors with a bodyweight below 87 kg (Q3) were more successful ((n=26)<87 kg, point = 18.85 ± 13.04; (n=13) >=87 kg, point = 27.85; p = 0.034*). Other differences in the scaled men category were meaningless. Although the average score of the competitors with a bodyweight of 63.75 kg (Q3) and above in the Scaled women category is better, the difference was insignificant (Table 4).

Competitors 86 kg (M) and above were more successful in the Master 35+ category. Over 90 kg (Q3) was also more successful than gold, and the significance value found was higher (Table 4).

When the elite men category was examined, the competitors under 82 kg (Q1) total (Table 4), WOD1 stage ((n=7)<82 kg, point = 10.0 ± 7.35; (n=25)>=82 kg, point = 22.24 ± 9.26; p = 0.003**) and WOD2 ((n=7)<82 kg, point = 11.43 ± 9.55; (n=25)>=82 kg, point = 22 .76 ± 8.38; p = 0.005**) scored better in the stage. Other differences were meaningless.

Training Time

According to the results of the survey, the ranking scores of the competitors whose training time were more than 90 minutes in the Beginner man category (n = 11; score: 85.55) were found to be lower than the scores (n = 25; score = 75.6) of those who trained for less time (p = 0.043*). In the Beginner women category, the ranking score of the competitors who trained for 90 minutes or more ((n=3), point = 51.67 ± 14.19) was lower than those who trained for less time ((n=20), point = 147.4 ± 66, 66) was at a good level. In the WOD1 stage, the ranking scores of those who train for 90 minutes or more ((n=3), point = 6.67 ± 2.52) were better than the others ((n=20), point = 15.5 ± 8.00) (p < 0.001***). As a different result in the WOD2 stage in the Scaled women category, the competitors who train for more than 90 minutes a day ((n=6), point = 13.33 ± 6.56) compared to the others ((n=10), point = 6.8 ± 3 .52) were more unsuccessful (p = 0.02*). In the categories of beginner women (n = 8) and scaled men (n = 8) who made it to the finals, it was determined that the daily training times of the competitors were longer than 75 minutes, and those who did not make it to the finals were shorter (Beginner women: p = 0.012*; scaled men: p = 0.02*).

The ranking points obtained from the WOD1 stage of the athletes in the Beginner men category who train more than 6 days a week ((n=11), point = 18.82 ± 8.54) compared to those who train less ((n=25), point = 23.08 ± 14.56) was better (p = 0.013*). The ranking score of the people who train every day of the week in the same group ((n=2), point = 23.0 ± 1.41) was significantly lower than the others ((n=34), point = 21.76) (p = 0.022*)). However, while the finalists in the elite men category trained 5 days a week (n = 7, a finalist competitor was not included in the analysis because he did not mark an answer to this question in the questionnaire), other competitors (n = 25) stated that they trained more (p = 0.014).

In addition, competitors who have been training for more than 2 years in the Beginner man WOD2 stage (n=5, point = 11.2 ± 4.6) compared to those who have been training for less (n=18, 14.28 ± 9.01) was successful (p = 0.049*).

Number of Steps per Day

In the beginner men category, the ranking scores of the competitors with 10,000 steps or more per day (n=16; point = 85.94) were lower than those who took fewer steps (n=20; score = 72.8) (p = 0.013*). In the Beginner women category, the contestants with more than 10,000 daily steps in the survey achieved better ranking points in the WOD1 stage than the others ((n=4)>=10,000 steps, point = 14.0 ± 12.25; (n=18) <10,000 steps, point = 14.44 ± 7.6; p = 0.037*), ranked worse in stage WOD2 ((n=4)>=10,000 steps, point = 15.0 ± 13.44; (n) =18)<10,000 steps, point = 13 ± 7.34; p = 0.009**). In the Beginner man category, in the WOD2 stage, the competitors with less than 10,000 daily steps achieved more successful results ((n=20)>=10,000 steps, point = 26.88 ± 12.2; (n=16)<10,000 steps, point = 17.8; p = 0.027*). The six (75%) of the eight finalists in the Beginner men category stated that they took more than 5,000 steps per day.

Competitors who stated that they took more than 10,000 steps in the Master 35+ category (n=9, point = 188.0 ± 53.08) received unsuccessful results from those who took fewer steps (n=15, 123.13 ± 67.25) (p = 0.047).

Athlete History

It was determined that all-male (n = 8) and female (n = 8) finalists in the Beginner category and all-female competitors (n = 8) who made it to the finals in the Scaled women category were engaged in another sport, while the majority of those who did not make it to the finals were only interested in Crossfit. Competitors who took part in other sports at the professional level in the elite men category were more successful in the WOD2 stage (n=11, point = 14.82 ± 9.96) than the others (n=21, point = 23.14 ± 8.5) (p = 0.019*). All male competitors who made it to the finals in the Master 35+ category were also interested in another sport, and the difference was significant (p = 0.006**). Similarly, the total ranking scores (n=10, point = 68.6 ± 29.92) of the athletes who were also interested in other sports in the Scaled women category were at a better level than the others (n=6, point = 111.5 ± 44.97) (p = 0.037*). At the same time, all women who reached the finals in the Scaled women category stated that they were interested in another sport (p = 0.025*).

DISCUSSION

As a result of the analyzes made according to age, it was seen that age affects the results of the competition and the stage scores in some categories. Competitors over 30 (Q3) in the WOD1 stage of the Elite Men category achieved better results, while the competitors

younger than 28.5 years (M) in the total ranking in the Scaled women category were more successful. Bellar et al. noted that younger Crossfit competitors achieved better times in AMRAP repetitions than older ones (Bellar et al., 2015). In parallel with the Bellar et al., the inclusion of short-distance running in the WOD1 stage of the competition in our research may be among the reasons for the different results found in this stage in the Elite men and Scaled women categories according to age. At the same time, the pieces of training in the Elite men category were more distinctive than other types. It was known that the competitors competing in this category have been interested in Crossfit for a longer time and were more experienced than other Crossfit competitors. The performance of younger people might be better, but it could be said that Elite category athletes were more successful than younger competitors by reflecting their experiences better in the competition. There was less discriminatory action in the Scaled men category compared to the Elite Men category. The success of young athletes in this category could be because the experience was not very important in this category.

It was seen that the most significant factor affecting the results of the Crossfit competition in our research was height. The taller competitors scored better in the Beginner Men, Beginner Women, and Master 35+ categories, while the shortest athletes scored better in the Elite Men category (Table 3). Aslan and Dalkıran (2014) compared the physical performance parameters of the two groups with an average height of 173.8 (n=80) and 184.0 (n=80). They found that the tall ones had a significantly better vertical jump and anaerobic power output (Aslan and Dalkıran, 2014). Short people were more successful in the Elite Man category because the barbell weights were higher, and the gymnastic movements were more intense in the Elite Man category. Likewise, as the barbell weight and gymnastic movements decreased, it was observed that taller athletes in the Beginner Men, Beginner Women, and Master 35+ categories were more successful. Erman et al. found a positive correlation between hand claw strength and height (Erman et al., 1996). Similarly, studies were showing a positive correlation between height, vertical jump, and anaerobic power output (Aslan and Dalkıran, 2014). In the functional training competition in our research, in parallel with the literature, height affected the results of the competition.

When we looked at the WOD1 stage, it was seen that the bodyweight differences were essential in this stage. As an exciting result in the WOD1 stage in the Beginner men category, it was found that the average points of the competitors with a bodyweight below 81 kg and those over 88 kg were better. When looking at the total ranking, the competitors with a height of 81 and 88 kilograms in the Beginner Men category achieved better scores (Table 4). In the

Scaled Men category, the competitors under 87 kg were more successful by a significant margin. In the Master 35+ category, while the competitors over 86 kg were more successful, it was seen that the scores of the competitors over 90 kg were even higher. Competitors under 82 kilograms were significantly more successful in total, WOD1 and WOD2 categories in the Elite Men category. WOD1 stage included running and “Toes to Bar” movements. One of the reasons athletes with lower body weight were more successful in this stage may be that the stage includes a running section. It is known that bodyweight affects running performance (Peter G. Weyand and Davis, 2005; P. G. Weyand et al., 2000; Wright and Weyand, 2001). In addition, the “Toes to bar” movement on the stage also means lifting more weight. The “toes to bar” movement is a movement that heavily loads the lumbar spine and strongly activates the iliopsoas muscle to flex the hip while lifting the double leg. The movement of touching the toes to the bar in the movement includes double leg lifting and strong hyperextension of the lumbar spine (Mullins, 2015). The fact that bodyweight affected the competition results in the stages that included the "Toes to bar" movement and the more significant hyperextension of the lumbar spine during the movement in individuals with higher body weight might have caused a decrease in performance. These situations may answer why athletes with less body weight were more successful in this stage. There are “Thruster, Burpee, Hand Stand Walking” movements in the WOD2 stage. In these movements, it could be predicted that bodyweight may create a disadvantage, and short athletes may gain an advantage. The fact that athletes with lower body weight were more successful in the WOD2 stage in the Elite Man category may indicate this.

Our findings showed that the training duration creates significant differences in functional training competition. Those who train less than 75 minutes and more than 90 minutes in two different categories were more unsuccessful than others may conclude that the training period between 75-90 minutes was the ideal time for functional training competitions. In a detailed review, it was shown that Crossfit competitors enjoy training highly (Dominski et al., 2021). In our study, the reason the competitors do long-term training could be originated that they want the training. It may be necessary to determine the ideal training time with more detailed analyses in functional training. Meyer et al. reported a case of rhabdomyolysis resulting from Crossfit training (Meyer et al., 2021). It has also been noted that the instances of Crossfit-related sports injuries have increased logarithmically in recent years (Stracciolini et al., 2020). These increases were thought to be due to the popularity of Crossfit and the increase in CrossFit gyms. However, Larsen et al. have shown that beginner

CrossFit athletes suffered injuries more frequently than experienced ones (Larsen et al., 2020). Because there are Olympic lifts with high heart rates in Crossfit, the technique can be ignored from time to time. For these reasons, it is clear that the content of Crossfit training and competitions should be carefully prepared. The athletes should give themselves sufficient recovery periods to recover their body systems after such workouts and competitions.

Competitors who made it to the finals in the Elite men category stated that they train 5 days a week. It is known that sports injuries often occur due to the maximum dose of exercise by the competitors in Crossfit competitions (Lichtenstein and Jensen, 2016; Sprey et al., 2016). It may be beneficial to add rest days to weekly training periods to reduce sports injuries and increase success in competitions during the preparation phase for Crossfit competitions. At the same time, functional training has been shown to activate both aerobic and anaerobic energy systems at a high rate (Escobar et al., 2017). This indicates that a recovery program must be applied after functional training days. Also, Weisenthal et al. (2014) showed that male Crossfit athletes have a higher injury rate than females. This is thought to be because male athletes participating in the competitions are more than female athletes, and the competition is more in the male groups with more. Since the competition is high, the risk of hiding is also increasing. (Weisenthal et al., 2014). This situation requires male competitors to pay more attention to recovery times after Crossfit competitions. Barfield and Anderson (2014) showed that Crossfit training done twice a week increased aerobic capacity and muscular endurance (Barfield and Anderson, 2014). As a result of the statistical analysis made in our study, it was seen that individuals who trained 5 days a week (2 days off) have advanced to the finals and that success in competitions can increase if importance was given to recovery in Crossfit training.

Our research determined that individuals who have been doing Crossfit training for more than 2 years were more successful in the beginner men category WOD2 stage. Poderoso et al. showed that 6-month Crossfit training causes some physiological changes at the hormonal level in the human body. These changes were at different levels in men and women (Poderoso et al., 2019). Bellar et al., in line with our findings, has been noted that athletes with more Crossfit experience showed more success in competitions (Bellar et al., 2015).

As an exciting result, the competitors who took more than 10,000 steps a day had lower results in total scores and some categories, maybe due to the anaerobic content of these stages. Interestingly, 75% of the finalists in the beginner men category stated that they took 5,000-7,500 steps per day. It can be thought that the number of daily steps affects functional

training competitions. The fact that Crossfit training increases the squat jump height of the athletes (Yüksel et al., 2019), it may lead to the conclusion that Crossfit training contributes to the explosiveness and thus to the anaerobic capacity. The fact that the competitors with more daily steps got lower scores than those with fewer steps may be related to their aerobic and anaerobic capacities. Martínez-Gómez et al., in a Crossfit competition with five different stages, found a relationship between the results of some steps and the $MaxVO_2$ levels of the competitors. At the same time, there was no relationship with some stages (Martínez-Gómez et al., 2020). As a similar result, Bellar et al. stated that Crossfit competition performance was associated with at least one aerobic or anaerobic capacity (Bellar et al., 2015). Baker et al. suggested that, with Crossfit training, serum CK (Creatine Kinase) levels increased in competitors. However, individual differences decreased at the end of the first week but were still outside the normal range, and this period could be an acclimation period. The study showed that the serum CK level returned to normal at the beginning of the second week (Baker et al., 2017). Maté-Muñoz et al. noted that in three different CrossFit workouts, the blood lactate level of the competitors rose above 10 mmol/L (Maté-Muñoz et al., 2018). Similarly, Carreker and Grosicki found the average blood lactate average of the competitors as 10.01 ± 3.04 mmol/L after Murph training (1-mile run, 100 pullups, 200 pushups, 300 air squats, 1-mile run) (Carreker and Grosicki, 2020). In addition, Kliszczewicz et al. reported that the heart rates of the competitors were in the range of 76 – 96% in the "Cindy" Crossfit training, which included as many repetitions of pull-ups, push-ups, and air squats as possible (Kliszczewicz et al., 2014). These results show that Crossfit training activates the anaerobic system. In our study, the fact that the competitors who took more than 10,000 steps per day were more unsuccessful suggests that the stages in the competition may be related to more anaerobic capacity. Dexheimer et al. similarly showed that anaerobic peak power was more associated with Crossfit performance (Dexheimer et al., 2019). Also, Butcher et al. suggested that Crossfit performance cannot be predicted by aerobic or anaerobic performance and stated that both energy systems of Crossfit competitors should be adequate (Butcher et al., 2015). The fact that our results in different categories containing different stages were not the same, strengthens this idea.

Competitors who reached the finals in almost all categories stated that they were figured out in another sport. It is known that being in different sports is essential in developing elite athletes (Balyi et al., 2013). The fact that the athletes who finished both the stages and the competitions at the top in the round included in our research were more

employed in another sport besides Crossfit proved that it is beneficial to be interested in different sports branches during the development of elite athletes. In addition, Mangine et al. compared the physiological characteristics of advanced and recreational Crossfit athletes and found significant differences (Mangine et al., 2020). This situation may be among the reasons for the different results according to various parameters in different categories in our study.

CONCLUSION

This study investigated the parameters of age, height, body weight, exercise duration, and athlete history effects on a functional training competition. The findings showed that all the parameters examined created differences in the result of the competition. The findings of this study can constitute a guide for the balanced arrangement of exercises that will be included in the content of functional training and Crossfit competitions to be organized in the future, without providing extra advantages to a group. In addition, it may be beneficial for the athletes who will participate in such competitions to determine which factors affect the competition's movements more and do extra studies for these exercises. The fact that the weekly exercise duration, the number of steps per day, and the factors of being involved in other sports besides Crossfit also affect the competition results shows that the athletes should also consider these factors when preparing for the competition.

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