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Tekerlekli Sandalye Basketbol Sporcularının Relatif Kol Kuvvetlerinin İvmelenme Hızı Üzerine Etkileri

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Özet

Tekerlekli sandalye basketbolu en popüler Paralimpik sporlardan biridir ve engelli bireyler tarafından uygulanan başlıca sporlardan biridir. Tekerlekli sandalye basketbol sporu özellikle tekerleği çevirme, ribaund alma, pas atma, baş üstü seviyede şut atma gibi manevralar ve yüksek yoğunluktaki aktivitelerle karakterize, kural ve sınıflandırmalar çerçevesinde oynanan bir spordur. Tekerlekli sandalye ile mobilize olan bireylerde üst ekstremite kas kuvveti oldukça önemlidir. Tekerlekli sandalye basketbol sporunda sporcuların üst ekstremite kas kuvveti, dayanıklılık, sürat ve el becerisi gibi parametreler; hem basket atma, pas atma, fırlatma ve tekerlekli sandalyenin itilmesi gibi spora özgü aktiviteleri yerine getirmede, hem de tekerlekli sandalyeyi kontrol etmede kritik önem arz eder. Tekerlekli sandalye oyuncularının fiziksel durum değerlendirmesinde, tekerlekli sandalye kullanımını ve itişini doğrudan etkilemesinden dolayı üst ekstremite kuvveti ve gücü önemlidir. Kas dengesi bir kas veya kas grubuyla bunu karşılayan, ters yönde hareket sağlayan kas veya kas grubuyla ilişkilidir. Sporcunun maksimal kuvvetini kullanabilmesi ve en uygun düzeyde performansa dönüştürebilmesi için belirli bir kas dengesine ihtiyaç vardır. Bugün pek çok spor branşında, kuvvet çalınmalarının daha fazla uygulanması suretiyle kuvvetin daha fazla geliştirilmesi istenmektedir. Kas kuvvetinin artışı, iyi planlanmış ve organize edilmiş antrenmanların içeriğine bağlıdır. Newton’ un ikinci aksiyonuna göre ivmelenme kuvvetin büyüklüğüyle pozitif ilişkiye sahiptir. Bu ilişki kuvvet antrenmanları ile sürat özelliğinin geliştirilebileceği konusuna ışık tutmaktadır. İvmelenme evresinde yerde kalış süresince diğer evrelere göre yüksek olan kas aktivasyonu, sinirsel aktivitenin ivmelenme sırasında maksimuma ulaştığını ve nöromüsküler ateşlemenin önemli olduğunu gösterir. Bu çalışma, tekerlekli sandalye basketbol sporcularının relatif kol kuvvetlerinin ivmelenme hızı üzerine etkilerinin incelenmeyi amaçlamaktadır. Araştırmanın örneklemi ise; gönüllü katılım esasına göre çalışmaya katılmayı kabul eden (Tesadüfi örnekleme yöntemi) Tekerlekli Sandalye Basketbol Süper Ligi 2023-2024 sezonunda oynayan Türk Silahlı Kuvvetleri (TSK) Rehabilitasyon Merkezi Engelli Spor Kulübündeki toplam 12 erkek basketbolcudan oluşmaktadır. Sporculardan alınan verilerin istatistiksel analizleri SPSS 29.0 paket programında yapılmıştır. Yaptığımız çalışmada (yaş 35,25±9,38 yıl, boy 176,92±9,27 cm. ve kilo 74,33±14,75 kg.) tekerlekli sandalye basketbol süper liginde oynayan 12 erkek profesyonel elit oyuncularının 5m, 10m ve 15m ivmelenme değerleri sırasıyla; 1,91±0,26 - 3.18±0,33 – 4,43±0,39 olarak tespit edilmiştir. Sonuç olarak, tekerlekli sandalyeli sporcular için üst ekstremite kas gücü oldukça önemlidir ancak tekerlekli sandalye basketbol sporcularının relatif kol kuvvetinin ivmelenme hızı ile arasında herhangi korelasyon ilişkisine rastlanamamıştır. Bunun nedeni olarak, tekerlekli sandalye basketbolunda sporcuların hızlı bir şekilde hareket etmesine engel olan dış faktörlerden en önemlisi tekerlekli sandalyenin zemin ile arasındaki friksiyondan kaynaklandığı düşünülmektedir.

Anahtar kelimeler: Tekerlekli Sandalye Basketbolcuları, Relatif Kol Kuvveti, İvmelenme.

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The Effects of Relative Arm Strength on Acceleration Speed in Wheelchair Basketball Athletes

Abstract

Wheelchair basketball is one of the most popular Paralympic sports and one of the main sports practiced by people with disabilities. Wheelchair basketball is a sport characterized by maneuvers and high-intensity activities such as spinning the wheel, rebounding, passing, overhead shooting, and is played within the framework of rules and classifications. Upper extremity muscle strength is very important in individuals mobilized with wheelchairs. In wheelchair basketball, parameters such as upper extremity muscle strength, endurance, speed and dexterity are critical in performing sport-specific activities such as basket shooting, passing, throwing and pushing the wheelchair, as well as controlling the wheelchair. Upper extremity strength and power are important in the physical condition assessment of wheelchair players because they directly affect wheelchair use and propulsion. Muscle balance is related to a muscle or muscle group and its counterpart, the muscle or muscle group that provides movement in the opposite direction. A certain muscle balance is needed for the athlete to use maximal strength and convert it into optimal performance. Today, in many sports branches, it is desired to develop strength more by practicing strength exercises more. The increase of muscle strength depends on the content of well-planned and organized training. According to Newton's second action, acceleration has a positive relationship with the magnitude of force. This relationship sheds light on the fact that speed can be improved by strength training. The higher muscle activation in the acceleration phase compared to other phases during the ground stay indicates that neural activity reaches its maximum during acceleration and that neuromuscular firing is important. This study aims to investigate the effects of relative arm strength on acceleration speed in wheelchair basketball athletes. The sample of the study consisted of a total of 12 male basketball players from the Turkish Armed Forces (TAF) Rehabilitation Center Disabled Sports Club playing in the Wheelchair Basketball Super League 2023-2024 season who agreed to participate in the study on the basis of voluntary participation (Random sampling method). Statistical analysis of the data obtained from the athletes was performed in SPSS 29.0 package program. In our study (age 35.25±9.38 years, height 176.92±9.27 cm. and weight 74.33±14.75 kg.), the 5m, 10m and 15m acceleration values of 12 male professional elite players playing in the wheelchair basketball super league were respectively; 1.91±0.26 sec. - 3.18±0.33 sec. 4.43±0.39 sec were determined. In conclusion, upper extremity muscle strength is very important for wheelchair athletes, but no correlation was found between relative arm strength and acceleration speed in wheelchair basketball athletes. The reason for this is thought to be the friction between the wheelchair and the floor, which is the most important of the external factors that prevent athletes from moving quickly in wheelchair basketball.

Keywords: Wheelchair Basketball Athletes, Relative Arm Strength, Acceleration.

Introduction

Wheelchair basketball (WB) is one of the most popular Paralympic sports and one of the main sports practiced by people with disabilities (Cavedon et al. 2018, García-Fresneda et al. 2022). Wheelchair basketball is a sport played within the framework of rules and classifications, characterized by maneuvers and high-intensity activities such as turning the wheel, rebounding, passing, shooting at overhead level. Upper extremity muscle strength is very important in individuals mobilized with wheelchairs (Akınoğlu et al. 2016).

In wheelchair basketball, parameters such as upper extremity muscle strength, endurance, speed and dexterity of athletes are critical both in performing sport-specific activities such as basket shooting, passing, throwing and pushing the wheelchair and in controlling the wheelchair (Darilgen and Yıldırım, 2008). Wheelchair maneuvers may involve pushing, starting, stopping and changing direction of the wheelchair, activities that require explosive power and speed (Sheppard et al. 2006).

Quantitative assessment of an athlete's individual wheelchair mobility performance is required to evaluate game performance, improve wheelchair adjustments and optimize training routines (Mason et al. 2010). Besides sport-specific mobility performance outcomes, speed is one of the key performance indicators relevant to all wheelchair sports (Burton et al. 2010, Van der Slikke et al. 2017). As a physically demanding team sport, wheelchair basketball requires a high degree of skill, technical expertise and teamwork. Since wheelchair basketball, which requires a high level of conditioning, is usually played at a fast pace, acceleration, speed and agility are very important and excellent chair and ball skills are the basis of the game (Goosey, 2010). Upper extremity strength and power are important in the physical condition assessment of wheelchair players because they directly affect wheelchair use and propulsion (Tupling et al. 1986, Turbanski and Schmidtbleicher 2010, Wang et al. 2005).

Muscle balance is related to a muscle or muscle group and its counterpart, the muscle or muscle group that provides movement in the opposite direction. A certain muscle balance is needed for the athlete to be able to use his maximal strength and transform it into optimal performance (Baecchle and Earle 2000). Athletes are able to exhibit their absolute strength up to the weakest of their muscle and muscle group strength (Åstrand 2003). Muscle fibril length and muscle mass are characteristics that play an important role in the power produced by the muscle in anaerobic sports (Armstrong et al. 2001). These characteristics also significantly affect the muscle force produced (De Ste Croix et al. 2001, Staron et al. 2000).

The aim of this study was to investigate the effects of relative arm strength on acceleration speed in wheelchair basketball athletes.

Materials and Methods

This research will be conducted according to the random sampling method, one of the quantitative research methods. This type of sampling is when the researcher selects a part of the universe in any way according to the determined sample size (Alpar, 2020).

Population and Sample / Study Group

The population of the study consists of a total of 120 male basketball players in 10 teams playing in the A group in the Wheelchair Basketball Super League 2023-2024 season. The sample of the study consists of a total of 12 male basketball players in the Turkish Armed Forces (TAF) Rehabilitation Center Disabled Sports Club playing in the Wheelchair Basketball Super League 2023-2024 season who accepted to participate in the study on the basis of voluntary participation (Random sampling method). Wheelchair athletes do not have any health problems or disorders. Inclusion criteria of amputee athletes in the study;

- To be a Wheelchair Basketball Super League A group player in the 2023-2024 season
- Being a basketball player of Turkish Armed Forces (TAF) Rehabilitation Centre Disabled Sports Club
- Being a male athlete.

Data Collection Tools

Height Measurements: Baseline brand gulick meter tape measure (± 0.1 mm) was used. Knee length (between knee and heel) was measured with the tape measure and height was determined by using the formula (2.08 x DB) +59.01 for males (Bosi 2003, WHO 1995).

Body Weight Measurements: It was determined by taking the tare of the wheelchair and the wheelchair used by the athletes during training and competition on the TEM brand (Max: 300kg min: 2 kg scale ± 100gr) weighing machine (Marangoz 2019).

Determination of Relative Arm Strength

- In determining the relative arm strength, firstly, upper arm mass, lower arm mass and hand mass were calculated separately and total arm mass was determined. Secondly, hand claw strength was measured.

– Relative arm strength method was determined by dividing the hand claw force by the total arm mass (in kg) (Marangoz 2022).

Calculation of Arm Mass:

- Upper arm length (length from Acromiale to Radiale)
- Upper arm width (where Acromiale-Radiale gives the widest circumference measurement)
- Lower arm width (where it gives the widest circumference measurement between Radiale and Stylion)Wrist circumference
- Wrist width
- Measurements were made as defined by the Hanavan model method (Formula 1, Formula 2 Formula 3) (Hanavan 1964, Miller and Morrison 1975, Norton 2018).

Calculating Upper Arm Mass: Upper arm length (length between Acromiale and Radiale) and upper arm width (where it gives the widest circumference measurement between Acromiale and Radiale) were calculated according to the Hanavan model method (Formula 1).

Total Upper Arm Mass =

0.007*Body Weight+0.092*Upper Arm Circumference+0.050*Upper Arm Length - 3.101

(Formula 1)

Calculating Lower Arm Mass: Lower arm width (where it gives the widest circumference measurement between Radiale and Stylion) was calculated according to the Hanavan model method (Formula 2).

Lower Arm Mass =
0.081*Body Weight+0.052*Lower Arm Circumference- 1.65
(Formula 2)

***Calculating Hand Mass*:** The circumference of the wrist and the width of the wrist circumference were calculated according to the Hanavan model method (Formula 3).

Total Hand Mass =

0.038*Wrist Circumference + 0.080*Wrist Width - 0.660

(Formula 3)

Determination of Hand Claw Strength: Standard grip strength was measured with the Jamar hand dynamometer, which is the gold standard and recommended by the American Association of Hand Therapists (AETD) (Narin et al. 2009). Hand grip strength was measured in the standard position recommended by AETD; sitting position, shoulder in adduction and neutral rotation, elbow in 90º flexion, forearm in midrotation and supported, wrist in neutral (Keçelioğlu and Akçay 2019, Lafayette 2004, Massy-Westropp et al. 2011, Mathiowetz 2002).

Calculation of Relative Arm Strength

Relative Arm Force = Hand Claw Strength (kg) / Arm Mass (kg) (Marangoz, 2022)

Acceleration Measurement: The running distance is 15 meters. Photocells are placed every 5 meters. The athlete takes a stance by waiting with a wheelchair at the starting point of the 15-meter distance (0 meters). No swaying or similar movements are allowed. After waiting in this position for at least 3 seconds, the athlete starts running with the wheelchair at maximum speed. The best time for the 5 meter interval is recorded as an indicator of acceleration and maximum running speed. The measurement results are recorded in seconds. Each athlete is allowed 3 runs. Athletes are given 3 minutes rest between each run. The measurement results are recorded in seconds. The best time obtained in three attempts is recorded (Bloomfield et al. 2007; Marangoz 2019; Pauole et al. 2000).

Statistical Analysis

The data in the study were analyzed with SPSS 29.0 package program. The normality test of the scale variables was examined. Since the number of participants in the study was 12 people ($n \leq 30$), Shapiro Wilk was checked (Alpar 2020, Cevahir 2020). Parametric analyzes were applied since the variables were $p<0.05$. Descriptive statistics for descriptive statistics (Table 1) and Pearson Correlation analysis for relationship analysis (Table 2 and Table 3) were performed.

Results

Table 1. Means and standard deviations of the data of the athletes participating in the study

	N	x±sd
Age	12	35,25±9,38
Boy	12	176,92±9,27
Weight	12	74,33±14,75
Upper Arm Circumference (cm)	12	32,54±2,86
Upper Arm Length (cm)	12	40,50±2,77
Upper Arm Mass (kg)	12	2,44±0,41
Lower Arm Circumference (cm)	12	29,71±1,81
Lower Arm Mass (kg)	12	5,92±1,26
Wrist Circumference (cm)	12	18,71±0,84
Wrist Width (cm)	12	6,96±0,40
Hand Mass (kg)	12	0,61±0,06
Total Arm Mass (kg)	12	8,96±1,66
Hand Claw Strength left(kg)	12	53,67±9,27

Hand Claw Strength right(kg)	12	52,81±13,86
Relative Arm Strength left (kg)	12	6,18±1,49
Relative Arm Strength right (kg)	12	6,08±1,80
Acceleration 5m	12	1,91±0,26
Acceleration 10m	12	3,18±0,33
Acceleration 15m	12	4,43±0,39

Table 2. Relationship between age, height and weight and acceleration

		Age	Height	Weight	Acceleration 5m	Acceleration 10m
Height	r	0,176				
Weight	r	0,367	,848**			
Acceleration 5m	r	0,449	0,138	0,168		
Acceleration 10m	r	0,47	0,239	0,308	,888**	
Acceleration 15m	r	,681*	0,274	0,379	,863**	,954**

***** $p<0.05$ ** $p<0.01$**

r: 0.00-0.25 very weak relationship, 0.26-0.49 weak relationship, 0.50-0.69 medium relationship, 0.70-0.89 high relationship, 0.90-1.00 very high relationship

Table 2 shows the relationship between age, height, weight and acceleration of wheelchair basketball athletes. As a result of the analysis, there was a moderate positive correlation between age and 15m acceleration (r=.681, p<0.05), High positive correlation between height and weight (r=.848, p<0.01).

There was a high positive correlation between 5m acceleration and 10m acceleration (r=.888, p<0.01), There was a high positive correlation between 5m acceleration and 15m acceleration (r=.863, p<0.01), A positive and very highly significant relationship was found between 10 m acceleration and 15 m acceleration (r=.954, p< 0.01).

Table 3. Pearson correlation relationship between upper arm mass, lower arm mass, hand mass and relative arm strength and acceleration of the athletes participating in the study

		Weight	Upper Arm Mass	Lower Arm Mass	Hand Mass	Total Arm Mass	Hand Claw Strenght Left	Hand Claw Strenght Right	Relative Arm Strenght Left	Relative Arm Strength Right	5m.	10m.
Upper Arm Mass	r	,814**										
Lower Arm Mass	r	,998**	,838**									
Hand Mass	r	,552	,773**	,592*								
Total Arm Mass	r	,979**	,912**	,988**	,678*							
Hand Claw St Left	r	-,076	,148	-,057	,445	,010						
Hand Claw St Right	r	-,012	,037	,001	,215	,018	,200					
Relative Arm St. Left	r	-,812**	-,618*	-,805**	-,219	-,771**	,612*	,122				
Relative Arm St. Right	r	-,645*	-,530	-,638*	-,224	-,623*	,155	,756**	,608*			
5m.	r	,168	,158	,170	,156	,174	,239	,508	-,009	,285		
10m.	r	,308	,211	,306	,262	,294	,144	,338	-,141	,099	,888**	
15m.	r	,379	,243	,376	,318	,357	,157	,414	-,197	,096	,863**	,954**

***** $p<0.05$ ** $p<0.01$**

r: 0.00-0.25 very weak relationship, 0.26-0.49 weak relationship, 0.50-0.69 medium relationship, 0.70-0.89 high relationship, 0.90-1.00 very high relationship

Table 3 shows the relationship between upper arm mass, lower arm mass, hand mass and arm mass, relative arm force, hand claw force and acceleration. As a result of the analysis;

High positive correlation between weight and upper arm mass (r=.814, $p<0.01$), very high positive correlation between weight and lower arm mass (r=.998, $p<0.01$), very high positive correlation between weight and total arm mass (r=.979, $p<0.01$), high negative correlation between weight and relative arm strength (left) (r=-.812, $p< 0.01$), a negative and moderately significant relationship was found between weight and relative arm strength (right) (r=-.645, $p< 0.05$).

High positive correlation between upper arm mass and lower arm mass (r=.838, $p<0.01$), high positive correlation between upper arm mass and hand mass (r=.773, $p<0.01$), very high positive correlation between upper arm mass and total arm mass (r=.912, $p<0.01$), there was a highly significant negative relationship between upper arm mass and relative arm strength (left) (r=-.618, $p<0.05$).

There was a moderate positive correlation between lower arm mass and hand mass (r=.592, $p<0.05$), very high positive correlation between lower arm mass and total arm mass (r=.988, $p<0.01$), high negative correlation between lower arm mass and relative arm strength (left) (r=-.805, $p<0.01$), a negative and moderately significant relationship was found between lower arm mass and relative arm strength (right) (r=-.638, $p<0.05$).

A moderately significant positive relationship was found between hand mass and total arm mass (r=.678, $p<0.05$).

High negative correlation between total arm mass and relative arm strength (left) (r=-.771, $p<0.01$), a negative and moderately significant relationship was found between total arm mass and relative arm strength (right) (r=-.623, $p<0.05$).

There was a positive and moderately significant relationship between left hand claw strength and relative arm strength (left) (r=.612, $p<0.05$). There was a highly significant positive relationship between right hand claw strength and relative arm strength (right) (r=.756, $p<0.01$).

There was a moderately significant positive relationship between Relative arm strength (left) and Relative arm strength (right) (r=-.608, $p<0.05$).

There was a high positive correlation between 5m acceleration and 10m acceleration (r=.888, $p<0.01$), There was a high positive correlation between 5m acceleration and 15m acceleration (r=.863, $p<0.01$), A positive and very highly significant relationship was found between 10 m acceleration and 15 m acceleration (r=.954, $p<0.01$).

Discussion

In today's world where winning in sports is at the forefront, physical training is undoubtedly one of the most important ways to achieve success. The basis of physical training is to develop motoric characteristics. Strength, which is one of the motoric characteristics, is the basic feature that increases success in many sports branches in general. Today, in many sports branches, it is desired to develop strength more by practicing strength exercises more. The increase of muscle strength depends on the content of well-planned and organized training. According to Newton's second action, acceleration has a positive relationship with the magnitude of force. This relationship sheds light on the fact that speed can be improved with strength training (Marangoz, 2016).

Muscle activation, which is higher in the acceleration phase compared to other phases during the stay on the ground, indicates that neural activity reaches its maximum during acceleration and neuromuscular firing is important (Mero and Peltola, 1989). Acceleration is the rate of change in speed that allows the player to reach maximum speed in a minimum amount of time. Maximum speed is the maximum speed at which a player can run. For the success of athletes, it is important that they effectively reach maximum running speed and accelerate. Strength and conditioning programs are key elements in training to achieve high speed (Murphy et al. 2003).

The ability to reach maximum running speed in a short time is an important determinant of success in many sports such as athletics, rugby and basketball (Marangoz, 2016). In basketball, acceleration is more important for successful performance. In addition, it is seen that short accelerations, changes of direction and jumps that depend on anaerobic energy come to the fore during the competition in basketball. They accept acceleration, change of direction and jumping characteristics that occur at intervals within the basketball game. They state that there is an average change in the direction of movement every two seconds in professional sports (Okur, 2011). In practical terms, especially among sports scientists and coaches, acceleration performance should be evaluated in shorter distances as 5m and 10m (Murphy et al. 2003. Power and speed capacity play a decisive role in wheelchair maneuvering performance (Loturco et al. 2020, Paulson and Goosey-Tolfrey 2017).

In the literature review, acceleration values of non-disabled basketball athletes;

They found that the 0-5 m sprint time of 14 elite male athletes in the Tunisian National Basketball Team was 0.82 s (Chaouachi et al. 2009). The acceleration values of basketball athletes who received scholarships from the Queensland Sports Academy's high performance basketball program were determined as 1.17±0.06 s for 5 m, 1.95±0.09 s for 10 m and 3.34±0.15 s for 15 m in open skill exercises, and 1.18±0.06 s for 5 m, 1.97±0.10 s for 10 m and 3.36±0.18 s for 15 m in closed skill exercises (Gabbett et al. 2008). The running speed times of 33 professional basketball players aged 27.4 ± 3.3 years, weight 89.8 ± 11.1 kg and height 192 ± 8.2 cm were determined as 1.88 ± 0.21, 3.20 ± 0.33 and 5.39 ± 0.21 seconds for 10, 20 and 40 m, respectively (Shalfawi et al. 2011).. The mean 5 m sprint time of 26 professional rugby players with mean age, weight and height of 23.2±3.3 years, 97.8±11.8 kg, 183.1±5.5 cm was 0.98± 0.05 s (Cronin and Hansen 2005). The post-test acceleration values of 13 male athletes in Konya Selçuk University basketball team were determined as 5 m 1.10 ± 0.05, 10 m 1.88 ± 0.08, 15 m 2.62 ± 0.10 (Okur 2011). Compared to what is available for individuals and team athletes in non-disabled sports, there is limited literature on field-based physiological testing in wheelchair sports such as basketball.

When the acceleration values of wheelchair basketball athletes were examined in the literature review;

In the study conducted on the players of Kardemir Karabükspor wheelchair basketball teams, the 20m pretest value of 5 male wheelchair basketball athletes (Quick strength study group) with an average age of 30.80 ± 5.80 years was 4.74±0.19 and the posttest value was 4.62±0.13, and the pretest value of 5 male wheelchair basketball athletes (control group) with an average age of 31.60 ± 2.30 years was 4.62±0.13 and the posttest value was 4.85±0.24 (Özmen, 2011).

The 5m and 10m acceleration values of the players of the Spanish First League (n=8; age 36.05± 8.25 years) wheelchair basketball teams were 1.73±0.60 and 5.16±0.18, respectively, and the 5m and 10m acceleration values of the players of the Spanish Third League (n=11; age=31.10±6.37 years) wheelchair basketball teams were 1.81±0.15 and 5.61±0.44, respectively. The 5m and 10m acceleration values of the total participating athletes (n=19) were determined as 1.78±0.13 and 5.43±0.41, respectively (Granados et al. 2015).

The wheelchair basketball team of the national wheelchair basketball team (n = 19) determined their 20m acceleration value as 5.18±0.32 (Fulton and Gough 2010).

Nineteen wheelchair basketball players from two clubs in the premier basketball league with different skill levels had a 5m acceleration value of 2.5±0.2 and a 20m test value (with ball) of 7.7±1.0 in the 1st test and a 5m acceleration value of 2.6±0.3 and a 20m test value (with ball) of 7.5±0.8 in the 2nd test (De Groot et al. 2012). In another study of sixty-one elite male wheelchair basketball players (mean age 28.5 ± 6.7 years) representing the national wheelchair basketball teams of Poland (n = 23), Latvia (n = 8), Lithuania (n = 11) and France (n = 19), participants were divided into two functional categories A and B according to the IWBF rules (Class A n = 29 persons 1.0 to 2.5 and (Class B n = 32 persons 3.0 to 4.5). The 5m, 10m and 20m acceleration values of the players in category A were determined as 2.14±0.73 - 3.28±0.27 - 5.57±0.47, and the 5m, 10m and 20m acceleration values of the players in category B were determined as 1.87±0.15 - 3.22±0.32 - 5.40±0.48, respectively (Marszałek et al. 2019).

In our study (age 35.25±9.38 years, height 176.92±9.27 cm. and weight 74.33±14.75 kg.), 5m, 10m and 15m acceleration values of 12 male professional elite players playing in the wheelchair basketball super league were determined as 1.91±0.26- 3.18±0.33- 4.43±0.39, respectively (Table 1).

When the data obtained in our study are compared with the literature, similar results are observed. This supports our study. When we look at the literature, when the acceleration values of running basketball athletes (non-disabled) and wheelchair basketball athletes are compared, it is seen that the values of wheelchair basketball athletes are higher.

In conclusion, upper extremity muscle strength is very important for wheelchair athletes, but no correlation was found between relative arm strength and acceleration speed in wheelchair basketball athletes. The reason for this is the friction between the wheelchair and the floor, which is one of the most important external factors that prevent athletes from moving quickly in wheelchair basketball. In terms of power elicitation ability, the most prominent feature that distinguishes wheelchair basketball from running basketball players (non-disabled) is the athlete's struggle against gravity and friction on the floor with the weight of the wheelchair in addition to his own weight.

Recommendations

The muscle mass that increases with age and the strength value that increases accordingly is not the true strength value of the athlete. Relative measurements are the healthiest way to determine the actual strength increase of the athlete. For this reason

- In monitoring the development of strength parameters of disabled athletes (wheelchair basketball, amputee soccer, amputee swimming, etc.),

- In determining the actual strength increase of disabled athletes

- In the correct determination and evaluation of physical and anthropometric development, especially in combat sports and performance athletes where grip strength is important,

- It is recommended to use the relative arm strength method in determining the actual strength value of athletes, especially on a one-to-one (individual) basis and in monitoring and evaluation.

Ethics Committee Permission Information

For this study, the necessary permissions were obtained from Kırşehir Ahi Evran University, Faculty of Sports Sciences Dean's Office (Number: E-51788177-100-00000607430 Date: 31.01.2024), Turkish Armed Forces (TAF) Rehabilitation Center Disabled Sports Club (Date: 16.02.2024) and Kırşehir Ahi Evran University, Faculty of Medicine, Clinical Research Ethics Committee decision number 2024-06/37 and dated 05.03.2024. In the method of the article, "during the current research, the "Directive on Scientific Research and Publication Ethics of Higher Education Institutions" was followed.

Contribution Rates of Researchers

The entire research has been carried out by the lead author of the study.

Conflict Statement

The author has no conflict statement regarding the research

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