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BIOMOTOR AND TECHNICAL FEATURES OF WHEELCHAIR BASKETBALL PLAYERS BY CLASSIFICATION SCORES: A PILOT STUDY

ORIGINAL ARTICLE

ABSTRACT

Purpose: This study was conducted to examine the biomotor and technical skills of wheelchair basketball players through their classification scores.

Methods: A total of 22 male athletes, 11 with low trunk control (1 to 2.5 points) and 11 with high trunk control (3 to 4.5 points) from Turkish Wheelchair Basketball First League, voluntarily participated in the research. Athletes were grouped according to the International Wheelchair Basketball Federation functional classification system. Biomotor features of the athletes and wheelchair basketball skill test scores were measured. SPSS 24.0 program was used for data analysis. Group differences were determined by Mann-Whitney U analysis.

Results: The study revealed statistically significant differences were in classification points, trunk balance, modified sit-up, modified abdominal endurance, 20 m speed, slalom without the ball, slalom with the ball and 6-min endurance race test parameters ($p < 0.05$).

Conclusion: It can be argued that athletes with low and high trunk control differ in terms of biomotor abilities. However, they have similar features regarding wheelchair basketball technical skills (throwing basketball, layup, shooting, scoring).

Key Words: Individual with Physically Disability, Paralympic, Team Sports, Technical Skill.

TEKERLEKLİ SANDALYE BASKETBOL OYUNCULARINDA KLASİFİKASYON PUANLARINA GÖRE BİYOMOTOR VE TEKNİK ÖZELLİKLER: PİLOT ÇALIŞMA

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Bu çalışma, tekerlekli sandalye basketbolcularında biyomotor ve teknik becerilerinin klasifikasyon puanlarına göre incelenmesi amacıyla gerçekleştirildi.

Yöntem: Araştırmaya Türkiye Tekerlekli Sandalye Basketbol 1. Liginden düşük gövde kontrolüne sahip (1 ile 2,5 puan) 11 erkek sporcu ve yüksek gövde kontrolüne sahip (3 ile 4,5 puan) 11 erkek sporcu olmak üzere 22 sporcu gönüllü olarak katıldı. Sporcular Uluslararası Tekerlekli Sandalye Basketbol Federasyonu fonksiyonel sınıflama sistemine göre gruplandırıldı. Sporcuların biyomotor özellikleri ve tekerlekli sandalye basketboluna özgü beceri test skorları tespit edildi. Verilerin analizinde SPSS 24,0 programı kullanıldı. Gruplar arası farklar Mann-Whitney U analizi ile tespit edildi.

Sonuçlar: Çalışma, gruplar arasında klasifikasyon puanları, gövde denge, modifiye mekik, modifiye şınav, abdominal dayanıklılık, 20 m sürat, top ile slalom, topsuz slalom ve 6 dakika dayanıklılık test parametrelerinde istatistiki olarak anlamlı düzeyde farklılıklar olduğunu gösterdi ($p<0,05$).

Tartışma: Düşük ve yüksek gövde kontrolüne sahip sporcuların biyomotor yetiler yönünden farklılaştığı bununla birlikte tekerlekli sandalye basketboluna özgü teknik beceriler (basketbol topu fırlatma, turnike, şut, isabet) yönünden ise benzer özelliklere sahip olduğu söylenebilir.

Anahtar Kelimeler: Bedensel Engelli, Paralimpik, Takım Sporu, Teknik Beceri.

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INTRODUCTION

Sports for individuals with disabilities has developed rapidly in recent years. This is thanks to the fact that individuals with disabilities come out of social isolation. Since the importance of the positive effects of sports on the physical and psychological features of people is emphasized, the fact that sports activities are also vital for individuals with disabilities (1) has become more common. Sports for people with disabilities are not limited to actively spending their leisure time or improving their physical fitness. Sport is an important part of active rehabilitation that aims to increase the confidence of the individuals with disabilities. Competitive sport is a way to satisfy ambitions, offer superior talent, and even compete with strong people (2, 3). Today, there are several sports branches adapted for people with disabilities. Among the Paralympic sports, wheelchair basketball is one of the most popular.

Wheelchair basketball is an exciting and fast sport with high competition with similar game rules as running basketball (4). It has intermittent activities where both aerobic and anaerobic effort are performed at a high level (5, 6). It is characterized by high intensity movements such as turning the wheel, rebounding, passing, shooting, and sudden forward and backward maneuvering, and short sprints (7, 8). These basic skills are important factors in winning a game. Though many sports with disabilities that are performed individually wheelchair basketball is a team game. It takes place with the participation of individuals with disabilities at different functional levels (4). Functional scoring of individuals with disabilities is performed through the classification system created by the International Wheelchair Basketball Federation (IWBF). Persons with permanent locomotor disabilities are divided into five main classes according to their functional abilities. These are Class I (1-1.5 points; lowest functional level), Class II (2-2.5 points), Class III (3-3.5 points), Class IV (4 points) and Class V (4.5 points; those with minimum disability) (9).

The scholarship includes seminal works on upper extremity functional levels in individuals mobilized by wheelchairs (7, 10), trunk strength (11), upper extremity muscle strength, speed and endurance (8, 12). Moreover, studies on the physical fitness levels of wheelchair basketball players (13-15), technical skills assessment (1, 5, 12, 16, 17), physiological responses of athletes (18, 19) had high impacts in the literature. Molik and Kosmol (20) reported in a pilot study that there was no difference between the performances of athletes with disabilities on the 3 and 4-point level. Another study revealed that there was no functional difference between Class 3 and Class 4 and between Class 1 and Class 2 (21). Therefore, several studies in the literature (1, 7, 8, 12-14), categorize the wheelchair basketball players between functionally low trunk control (1 to 2.5) and high trunk control (3 to 4.5). This study focuses on the compliance of the functional body control levels of the athletes with the literature. Moreover, it offers distinct analyses to determine the performance levels in the Turkish Wheelchair Basketball First League which includes elite athletes. This study was conducted to examine biomotor features and evaluate technical skills of elite athletes with low and high trunk control who compete in Turkish Wheelchair Basketball First League.

METHODS

Subjects and Study Design

The research sample was formed among the volunteer players. 11 male athletes with low trunk control (1 to 2.5 points) and 11 with high trunk control (3 to 4.5 points) from Turkish Wheelchair Basketball First League, participated in the research voluntarily. The study was conducted in line with the Declaration of Helsinki, and the Social and Humanities Scientific Research Ethics Committee of Necmettin Erbakan University approved the protocol numbered 2020/06. All the volunteers participating in the research signed an informed consent (volunteer) form and filled a personal information form. Athletes who regularly attend two or more training sessions a week were included in the study. Disability classification of the players was specified before the tests and measurements. Tests and measurements of wheelchair basketball players were performed at Konya Selçuklu Municipality Sports Hall in October 2020. Measurements took a week and participants were invited to the gym in the afternoon (03:00 pm—05:30 pm) for testing twice

with three days apart. Athletes who did not want to sign the voluntary participation form, did not play at the specified league level and participate in regular training were excluded from the study.

Disability Condition

The disability score distributions of the athletes with low and high trunk control are presented in Table 1.

Table 1 shows that there are four participants with Poliomyelitis/Post-Polio (n = 4), five participants with paraplegia (n = 5), one participant with lower extremity amputation (n = 1), and one participant with Spina Bifida in the low trunk control (A Category) group. Considering mobilization type, it was determined that two participants used crutch (n = 2) and nine participants used wheelchair (n = 9). Three participants have Poliomyelitis/Post-Polio (n = 3), three participants have paraplegia (n = 3), and five participants have lower extremity amputation (n = 5) in the group with high trunk control (B Category). Considering the type of mobilization, it was determined that five participants use crutch (n = 5), two participants use wheelchair (n = 2), and four participants use prosthesis (n = 4).

Procedures

Meetings were held with club officials and coaches, as the necessary permissions were obtained for test and measurements. The players were classified according to the IWBF grading rules. Athletes were grouped in two categories with low trunk control (1 to 2.5, n = 11) and high trunk control (3 to 4.5, n = 11). It was ensured that the athletes did not have any alcoholic and caffeinated beverages before the tests applied on the measurement days. It was also reported that they should avoid intense physical activity in the pre-test period. Tests were performed in two stages. On the first test day, the anthropometric measurements of the athletes and wheelchair basketball field test scores were documented. On the second test day, measurements were conducted to determine the biomotor features. All participants completed technical tests. However, the test scores of ten athletes were determined since one of the athletes with low trunk control hesitated to participate in the tests for the modified sit-up and abdominal endurance test. Moreover, the test scores of nine athletes were assessed because two athletes with low trunk control could not complete the 6-min endurance race test. The measurement and test protocols applied to determine the participants' biomotor and technical features are as follows:

Trunk balance; a modified functional reaching test was used to assess trunk balance. The players were positioned in a posture that keeps hip-knee section in flexion position, upper body is in a vertical 900 position leaned to back support of the chair with 5 cm in between popliteal fossa and the side of the chair. Lower extremities were fastened to each other on the femur shaft distal. The players sat on high chairs to restrain foot support. The players were asked to do 900 shoulder flexion. The length of the arm was marked on the ulnar styloid level and the player was asked to reach out to the front as much as possible. Compensation mechanisms such as shoulder protraction and neck flexion were avoided during this activity. The distance that ulnar styloid moved was marked on the maximal reaching point, as the distance in between the first and the second values were recorded in cm (22).

Modified sit-up test; is performed when the player lies on one's back on a mat, knees bent with soles fully on the mat, hands on each side of the hips and fingers in extension on the mat. The legs were supported to keep the knees bent. The individual was asked to raise until the scapula bottom level and do as many sit-ups as one could in 30 seconds (23).

Modified abdominal endurance; is performed with a player lying on his back on the mat who tries raising until lower angle of scapula and keep this position as much as possible. The timer was stopped and recorded as the participant touched the scapular end or lost the position (24).

Modified push-up; is performed as a participant, whose knees and elbows were flexed on the mat, pushes the trunk backwards by bringing the elbows to extension without deforming the knee flexion. The number of correct moves during 30 seconds was recorded (24).

Shoulder Flexibility; is measured with the Back Scratch Test. The players were seated in a position that their backs were vertical. The players were

asked to tie their hands together at the back while one of their shoulders were respectively in flexion, abduction, external rotation, and elbow flexion as the other shoulder maintains in extension, adduction, and internal rotation and elbow flexion. The distances between the index fingers were recorded in cm in this phase. If the fingers are touching each other the value is 0, otherwise the distance was recorded in minus cm. The measurement was repeated after the positions of the extremities were changed and the results were also recorded in cm (25).

Pass for distance; athletes placed their wheelchairs behind the baseline. The requirement was throwing the ball as far as possible, using chest passes. Six trials were performed and the best grade was recorded in meters (1).

20 m speed test; was conducted to assess the speed of wheelchair use of athletes. After the athletes were positioned with the front bar of the wheelchair at the end of the field, they were asked to drive the chair as fast as possible with the signal. The 20-meter course times were measured and recorded in seconds (16).

Slalom without the ball test; was performed to measure athletes' wheelchair use skills. Five cones were placed on the field starting 1.5 meters off the starting line and with a distance of 1.5 meters each. The athletes were asked to perform slaloms between these cones and to complete the course by returning from the last cone, in the same manner, crossing the starting line. Track completion times were recorded in seconds (21).

Slalom with the ball test; was conducted to assess athletes' chair use and dribbling skills. The athletes were asked to make slalom by dribbling between 5 cones with a distance of 1.5 meters from the starting line within the framework of the rules set by the IWBF. Track completion times were recorded in seconds (21).

Layup test; was performed to assess athletes' layup skills. Two cones were placed on the parallels of the foul shot line on the 3-point line. The athletes were asked to make a layup next to the first cone with a signal, take their own rebounds and then go around the cone on the other side and repeat. The test continued for 2 minutes. The total score was recorded by calculating the accurate shots made by the athletes as 2 points and the missed shots as 1 point (1).

Zone shot test; was performed to assess athletes' shooting skills. When the athletes were on the foul line, they were asked to shoot the basket in the starting position with a signal and then take their own rebounds. They were allowed to shoot back to the basket once from the point where they took the rebounds and then moving to the foul throw line. The test continued for 2 minutes and the total score was recorded by recording the accurate shots made as 2 points and the missed shots as 1 point (16).

Pass for accuracy test; was carried out to assess athletes' ability to pass accurately from different distances. A square was drawn on the wall with a center of 120 cm from the ground and 30 cm on each side. The athletes were required passing to the square (excluding bounce pass) from 8 meters and 4 meters, respectively. The test continued for 2 minutes and the total score was recorded by recording the correct passes from a distance of 8 meters as 2 points, and the ones from 4 meters as 1 point (14).

6 Minutes endurance race test; was performed to determine the endurance of the athletes. The athletes were stood on the starting position with the wheelchair front bar at the edge line. They were asked to take a tour in the basketball court with the first warning and at the end of the 6-minute period, they were made to stand in their position with the second signal. The distance traveled by the athletes was measured and recorded in meters at the end of the period (14).

Statistical Analysis

SPSS 24.0 program was used in the data analysis, and minimum, maximum, arithmetic mean, and standard deviation values were calculated. A non-parametric test was applied because the data did not indicate normal distribution according to Skewness and Kurtosis values. Inter-group differences were determined with Mann-Whitney U analysis. Confidence interval was determined as $p < 0.05$.

Table 1: Disability Distribution of Wheelchair Basketball Players with Low Trunk Control (A Category) and High Trunk Control (B Category).

Parameters	A Category		B Category	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
A. Disability Cause				
Poliomyelitis/Post-Polio	4	36.4	3	27.3
Paraplegia	5	45.4	3	27.3
Lower-extremity amputation	1	9.1	5	45.4
Spina Bifida	1	9.1	-	
B. Mobilization Type				
Crutch	2	18.2	5	45.4
Wheelchair	9	81.8	2	18.2
Prosthesis	-		4	36.4

RESULTS

Table 2 illustrates that there is a significant difference between the average values of wheelchair basketball players with low trunk control and high trunk control such as classification points (U =.000), trunk balance (U = 22.000), modified sit-up (U = 9.000), modified abdominal endurance (U = 25.500), 20 m speed (U = 24.000), slalom without the ball (U = 17.000), slalom with the ball (U = 23.000) and 6 minutes endurance race test (U = 28.500), but there was no statistically significant difference (p> 0.05) in the other parameters.

DISCUSSION

This study was conducted to assess the biomotor and technical features of WB players of Turkish Wheelchair Basketball First League with low (1 to 2.5 points) and high (3 to 4.5 points) trunk control. Several scholars have emphasized the benefits of physical activity for physically handicapped individuals. These studies especially focused on the characteristics of wheelchair basketball and the physical profiles of players. As it is known, wheelchair basketball is played with the participation individuals with disabilities at different functional levels. These score differences are important regarding trunk control and extremities and determining athletes' functional levels. It is aimed that the present study findings will contribute to the literature in this sense.

The classification scores of WB players with low and high trunk control, who participated in the study, differ statistically in a predictable manner. On the other hand, the players had similar results regarding age, training age, height and body weight values. The similarity in these parameters is thought to be significant in examining and comparing the biomotor and technical features of the athletes by their functional levels since the factors such as age and past training level are reflected in test scores as differences between player groups. However, the fact that players with high trunk control have lower body mass index values can be explained through increased independence regarding daily living activities and mobilization.

As statistically significant differences were observed in biomotor abilities between WB players with low and high trunk control, there was no statistically significant difference between the groups in technical features such as pass for accuracy, lay-up, pass for distance, zone shot. These results are similar to several studies found in the literature (1, 7, 12, 13). However, contrary to the contemporary scholarship, Ergun et al. (14) reported that there are significant differences in zone shot test and lay-up test scores. Another study showed that the average pass on target points of Italian young WB players is much lower than this research sample (17). This difference can be explained by the fact that the players in this study are experienced and can use both extremities more harmonically under stress. The fact that some of the athletes in the study group formed by Ergun et al. (14) consisted of amateur athletes may be the reason for the difference with the research results. This finding sup-

Table 2: Average Values of Performance Parameters of Wheelchair Basketball Players with Low Trunk Control (A) and High Trunk Control (B) and Mann Whitney U Test Results.

Group	N	Measurements			Parameters	Mann Whitney U		
		Min	Max	(Mean ± SD)		Mean Rank	U	p
A	11	1.00	2.50	2.09±0.49	**Classification points**	6.00	.000	**0.000***
B	11	3.00	4.50	3.63±0.50		17.00		
A	11	19.00	42.00	32.36±6.83	**Age (year)**	10.59	50.500	0.509
B	11	26.00	48.00	34.72±7.76		12.41		
A	11	2.00	20.00	7.90±5.82	**Training age (year)**	11.23	57.500	0.843
B	11	2.00	21.00	8.63±6.81		11.77		
A	11	137.00	185.00	170.81±14.95	**Height (cm)**	10.77	52.500	0.598
B	11	151.00	186.00	174.90±12.77		12.23		
A	11	47.00	84.00	74.45±10.32	**Weight (kg)**	10.45	49.000	0.447
B	11	60.00	88.00	78.36±9.91		12.55		
A	11	21.86	29.67	26.53±2.83	**BMI (kg/m²)**	12.09	54.000	0.669
B	11	22.16	29.75	25.83±2.59		10.91		
A	11	26.50	39.20	33.23±4.20	**Trunk balance (cm)**	8.00	22.000	**0.011***
B	11	32.00	55.00	41.94±8.10		15.00		
A	10	18.00	36.00	25.27±5.31	**Modified sit-up (number)**	6.82	9.000	**0.001***
B	11	29.00	43.00	34.90±4.88		16.18		
A	10	34.00	184.00	103.36±34.82	**Modified abdominal endurance (s)**	8.32	25.500	**0.022***
B	11	50.00	289.00	179.90±78.69		14.68		
A	11	24.00	38.00	30.45±4.48	**Modified push up (number)**	9.68	40.500	0.188
B	11	26.00	41.00	33.54±5.31		13.32		
A	11	-7.00	22.00	5.96±2.68	**Right shoulder flexibility (cm)**	9.95	43.500	0.264
B	11	-7.00	21.00	9.72±9.13		13.05		
A	11	-4.50	16.00	7.18±8.06	**Left shoulder flexibility (cm)**	10.45	49.000	0.449
B	11	-3.00	21.00	10.18±7.34		12.55		
A	11	6.00	11.30	8.97±1.46	**Pass for distance (m)**	9.27	36.000	0.107
B	11	8.40	12.50	10.15±1.16		13.73		
A	11	5.44	7.62	6.57±0.69	**20 m speed (s)**	14.82	24.000	**0.017***
B	11	5.05	6.71	5.87±0.47		8.18		
A	11	11.22	16.80	14.27±1.72	**Slalom without the ball (s)**	15.45	17.000	**0.004***
B	11	10.90	15.45	12.34±1.18		7.55		
A	11	13.26	25.00	17.66±3.12	**Slalom with the ball (s)**	14.91	23.000	**0.014***
B	11	12.50	17.86	14.74±1.10		8.09		
A	11	14.00	26.00	22.36±3.41	**Lay up (score)**	9.59	39.500	0.159
B	11	21.00	29.00	24.54±2.54		13.41		
A	11	24.00	38.00	29.90±5.00	**Zone shot (score)**	12.55	49.000	0.448
B	11	22.00	36.00	28.54±5.18		10.45		
A	11	3.00	32.00	23.09±8.90	**Pass for accuracy (score)**	12.05	54.500	0.692
B	11	10.00	30.00	23.72±5.42		10.95		
A	9	790.00	1290.00	1025.90±130.39	**6 minutes endurance race (m)**	8.59	28.500	**0.035***
B	11	950.00	1310.00	1153.63±123.47		14.41		

$p<0.05$

ports the findings of Yüksel and Sevindi (26) that revealed fact that wheelchair basketball specific skills are determinant in the league levels at which athletes play. The similarity of the findings in the pass for distance test may indicate the fact that the athletes' upper bodies are not affected, with no weakness and they can throw the basketball ball. Similarly, the lack of statistically significant difference in the modified push up test scores supports this interpretation.

Statistically significant differences were determined in trunk, balance, strength and endurance parameters in favor of players with high trunk control. Goosey-Tolfrey et al. (27) stated that the cardiovascular endurance levels of wheelchair athletes are related to trunk control supporting this

study. Sprigle et al. (28) reported that a good sitting balance and trunk control are necessary to perform upper extremity movements. As Kerr and Eng (22) stated that proximal stabilization and trunk balance are vital to ensure the smoothness of the players' distal movement in wheelchairs sports activities. The significantly higher trunk strength and balance parameters in the player group with low trunk control should stem from the higher number of athletes with paraplegia. Moreover, one athlete had injury at thoracic region and the other athletes had in lumbar region in the player group with high trunk control, while all of the athletes in the group with low trunk control had thoracic region damage. Adegoke et al. (29) found that trunk muscles, especially M. rectus abdominis are innervated at T5-T12 levels and that individuals with spinal cord injuries above this section cannot balance their trunk. Therefore, it can be asserted that this difference between the two athlete groups regarding trunk balance and strength is due to the differences in the injury level.

Statistically significant differences were found in favor of players with high trunk control for 20 m speed and 6-minute endurance, slalom without the ball, slalom with the ball test and trunk balance for the player group with high trunk control. These results are similar to several studies in the literature (7, 12-14, 21, 30). On the other hand, Yanci et al. (8) argued that there was no statistically significant difference between players with low and high trunk control in speed, direction, strength and endurance parameters. Another study showed that the 20 m speed test scores of players with low and high trunk control were similar (1). Although the players were classified as having low and high trunk control in the abovementioned studies, it was not reported whether there was a statistical difference between their classification scores. Therefore, classification score averages for low and high trunk control may be close to each other and may alter the findings.

The main difference between wheelchair basketball and stand-up basketball is the wheelchair itself. Wheelchair basketball players have to control not only the ball but also the wheelchair. Gagnon et al. (10) asserted that the ball control and player skills may be related to lateralization, but wheelchair propulsion is also dependent on trunk strength. It can be argued that trunk strength test scores are reflected in the statistical differences observed between groups in with and without ball slalom tests. As Gil et al. (31) revealed that good performance is also highly dependent on wheelchair use in daily life, but the mobilization type findings in this study contradict this finding. As nine players with low trunk control use wheelchairs in their daily lives, while only two of the players with high trunk control use wheelchairs. Therefore, it is thought that practices that improve wheelchair using skills should be integrated into the training with low trunk control starting from the early period. Thus, inter-classification differences can be avoided.

Although wheelchair basketball players are classified by low and high trunk control, the groups are not homogeneous internally. Even if the disabilities are similar, their functional levels differ. Omitting the separate functional classification scores is one of the limitations. Moreover, it is thought that it will be useful to review similar studies with a power analysis, and higher number of participants, and other performance parameters, for more reliable results. The interest in this sport performed by athletes with disabilities, ongoing development of training methods and materials, advances in technology such as lighter wheelchairs, and efforts to improve functional abilities have gained momentum in recent years. Thus, it is recommended to update the studies focusing on separate assessment of functional classification score differences in further studies.

In conclusion, it can be argued that athletes with low and high trunk control differ in terms of biomotor abilities. However, they have similar features regarding wheelchair basketball technical skills (throwing basketball, layup, shooting, scoring). It can be concluded that practices aim to improve the biomotor skills of athletes with low trunk control are important and necessary regarding the functional levels of the players.

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