



# Effect of the number of years of experience on physical fitness, sports skills and quality of life in wheelchair basketball players

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## Research Report

**Purpose:** The aim of this study was to identify the effect of the number of years of experience playing wheelchair basketball on physical fitness level and quality of life. **Material and methods:** Thirty two male wheelchair basketball players from three Turkish teams including amateur, national and professional teams participated in this study. The physical characteristics, medical history, the number of years of disability and experience in wheelchair basketball were recorded. The body composition, strength, aerobic and anaerobic capacity, flexibility, skills and quality of life of the players were evaluated. **Results:** There was a significant difference among the groups with regard to their years of experience in playing basketball ( $p<0.05$ ). When the skinfold thickness was compared, a significant difference was found among the groups ( $p<0.05$ ). There were significant differences among the groups ( $p<0.05$ ) in the 6-minute endurance race. There were also noticeable differences among the groups in the lay-up, 20 m sprint, zone-shot, and eight-figure+ball tests ( $p<0.05$ ). The number of years of experience was found to have a positive correlation with the eight-figure+ball test, the 20 m sprint test and the pass for accuracy test ( $p<0.05$ ). There were no significant differences among the groups in the results of the Nottingham Health Profile ( $p>0.05$ ). **Conclusion:** Performance in the sport of wheelchair basketball affects physical fitness, sports skills and quality of life.

**Key words:** Wheelchair basketball, Physical fitness, Quality of life.

## Tekerlekli sandalye basketbol oyuncularında deneyim yılının fiziksel uygunluk, spor becerisi ve yaşam kalitesi üzerine etkisi

**Amaç:** Çalışmamız tekerlekli sandalye basketbol oyuncularının oynama yıllarının fiziksel uygunluk seviyesi ve yaşam kalitesi üzerine etkinliğini göstermek amacıyla planlandı. **Gereç ve yöntem:** Çalışmaya 32 erkek, amatör, ulusal ve profesyonel ligde oynayan üç Türk takımının tekerlekli sandalye basketbol oyuncusu katıldı. Tüm sporcuların fiziksel özellikleri, tıbbi hikâyesi, özür yılı ve tekerlekli sandalye sporundaki tecrübe yılı kaydedildi. Sporcuların vücut kompozisyonu, kuvveti, aerobik ve anaerobik kapasitesi, esnekliği, becerisi ve yaşam kalitesi değerlendirildi. **Sonuçlar:** Grupların basketbol oynama süreleri arasında anlamlı farklılık bulundu ( $p<0.05$ ). Grupların skinfold kalınlıkları karşılaştırıldığında anlamlı fark bulundu ( $p<0.05$ ). Alt dakika dayanıklılık testinde grupların aldığı mesafede fark bulundu ( $p<0.05$ ). Sporcuların yetenek testlerinden lay-up test, 20 m sprint test, zone-shot test ve eight figure+ball testlerinde gruplar arasında anlamlı fark bulundu ( $p<0.05$ ). Sporcuların basketbol oynama yılları ile eight figure+ball, 20 m sprint test ve pass for accuracy testlerinde pozitif ilişki bulundu ( $p<0.05$ ). Grupların Nottingham Sağlık Profili'nde fark bulunmadı ( $p>0.05$ ). **Tartışma:** Sonuç olarak, tekerlekli sandalye basketbol sporu fiziksel uygunluk, spor becerisi ve yaşam kalitesi üzerine etkilidir.

**Anahtar kelimeler:** Tekerlekli sandalye basketbol, Fiziksel uygunluk, Yaşam kalitesi.

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In recent years, wheelchair sports especially wheelchair basketball have an increasing popularity in the Paralympics.<sup>1,2</sup> Thus, the acceptance of this sport and the sportsmen using wheelchairs has increased in the community. In Turkey, the involvement of disabled individuals in professional sports has demonstrated the same progression for the last 10-15 years and in all branches our athletes represent our nation successfully, especially in wheelchair basketball.

Spinal cord injuries and other physical disabilities cause a decrease and distraction in physical performance. In patients who have spinal cord injuries, sports activities may help to decrease depression and the frequency of days in hospital, and to increase social interaction and years of life.<sup>3,4</sup> Systematic endurance activities decrease calcium accumulation in the soft tissue, the frequency of osteoporosis and airway infections in individuals utilizing wheelchair. Increase in leisure activities promotes self-confidence, and is effective in reducing cigarette and alcohol habits.<sup>5</sup>

Wheelchair basketball is especially characterized by intermittent high intensity activities like wheelchair maneuvering and ball handling. Wheelchair maneuvers may include propulsion, starting, stopping and direction changes of the wheelchair. Ball handling may include rebounding, passing and shooting above the head level.<sup>6-8</sup>

The evaluation of wheelchair basketball players should include the measurement of aerobic capacity, anaerobic capacity, and special skills assessment related to wheelchair basketball.<sup>9</sup> Anaerobic work capacity has an important role among a variety of sports disciplines. In the literature, there are few studies on anaerobic work capacity in wheelchair basketball teams.<sup>10</sup> Although there are several studies aiming to assess aerobic capacity, studies utilizing field tests are rare.<sup>9,11</sup>

In the literature, there are studies evaluating the mood status of wheelchair basketball players, however there is no study assessing their quality of life.<sup>12,13</sup> The purpose of this study was to identify the effect of wheelchair basketball sports on the physical fitness level of the players and the

relationship between the number of years of active playing and the quality of life.

## MATERIALS AND METHODS

### Subjects:

The data used in this investigation were collected from 32 male wheelchair basketball players representing three different Turkish teams. The first team consisted of amateur players (N=11), the second team played in the Turkish National Second League, (N=11), and the third team was the Turkish National Team (N=10). They voluntarily took part in the study. All participants provided their informed consent as approved by the Human Subjects Review Board of our institution.

### Test Protocol:

#### 1. History:

Physical characteristics including age, body weight, height and the dominant hand, medical history were recorded. The number of years of disability, experience in playing wheelchair basketball and smoking were also recorded. All players were classified according to the functional classification system (International Wheelchair Basketball Federation (IWBF): 1 and 1.5 point [n=6], 2 and 2.5 point [n=11], 3 and 3.5 point [n=6], and 4 and 4.5 point [n=8].

#### 2. Body Composition:

To determine the body composition of the players, their body fat was assessed and their body mass index (BMI) was calculated.

##### a) Body mass index:

The BMI of the players, except those with amputation, was calculated (weight in kg/square height in meters). The height of the individuals wearing prosthetic devices or braces was measured while wearing these devices. The weight of the individuals wearing prosthetic devices or braces was measured when braces and prosthetic devices were removed. When estimating the weight of a person with a leg amputation, 1/18 of body weight for a below-knee amputation, 1/9 of body weight for an above-knee amputation, and 1/6 of body weight for a hip amputation were added. Once this

was done, the BMI of the amputee players was calculated.<sup>14</sup>

b) **Skinfold measurement:**

To determine body fat, the skinfold measurement was performed on two areas: The triceps skinfold was measured over the triceps muscle at a location midway between the tip of the shoulder and elbow. The biceps skinfold was measured over the biceps muscle at a location midway between the tip of the shoulder and elbow.<sup>14</sup>

**3. Strength:**

To determine the strength of the players, the hand grip strength was assessed using the grip dynamometer (Jamar). The players were positioned in the sitting position, and their elbows were flexed. Three trials were performed on each subject, and the maximum score was recorded. Measurements were done on the dominant and non-dominant hand.<sup>14</sup>

**4. Anaerobic capacity:**

To determine the anaerobic capacity of the subjects, each player had to perform an individual 30-second sprint. All players used wheelchairs during the test. Starting from the baseline, cones were placed at 2-meter intervals along the length of the basketball court, over a total distance of 24 meters. Each player had to drive around the line of cones. The heart rates at the start and finish were evaluated using a polar heart rate monitor and the distance covered within 30 seconds was recorded.<sup>10</sup> The maximal heart rate was calculated using 220-age formula, and the percentage of the maximal heart rate of the subjects was calculated.

**5. Aerobic capacity:**

To determine the aerobic capacity of the subjects, each player had to perform an individual 6-minute endurance race. All players used wheelchairs during the test. The heart rates at the start and finish were evaluated using the polar heart rate monitor and the distance covered within 6 minutes was recorded.<sup>11</sup> The maximal heart rate and the percentage of the maximal heart rate were calculated.

**6. Shoulder flexibility:**

To determine the shoulder flexibility of the subjects, each player was positioned in the sitting

position against the wall. The upper extremities of the players were in full elevation. The distance between the wrist and wall was measured with a tape measure. The shoulder flexibility of the players was evaluated on the same wheelchair in order to prevent differences resulting from wheelchair mechanical properties.<sup>2</sup>

**7. Wheelchair basketball skills:**

To assess the wheelchair basketball skills of the players, a set of six field tests was developed by Vanlandewijck et al evaluating lay-up, wheelchair and ball handling, sprint capacity, shot, wheelchair maneuverability, and pass accuracy were used.<sup>9</sup>

**Test 1: Lay-up test**

Two cones are positioned on the 3-point-line, perpendicular to the intersection of the sidelines of the free throw lane and the baseline. The player has to make as many lay-ups as possible within two minutes. After each attempt, the player takes his own rebound, drives around the opposite cone with the ball, preparing for the next lay-up. The score is the total amount of attempts plus the total number of successful lay-ups.

**Test 2: Figure-eight + ball test**

The player moves his wheelchair around the two cones in a figure of eight during one minute. The cones are positioned 5 m from each other, symmetrically to the centre line of the basketball court. The player has to control the ball while going around the cones. The score is the number of times the player can cover the 5 m distance. If, at the end whistle, the player crosses the centre line of basketball court, this distance is valid.

**Test 3: 20 m sprint test**

The player takes a position behind the baseline. Following the signal of his partner, the player has to cover the 20 m distance as quickly as possible. Each player may have two attempts within the two-minute period. The best result is recorded.

**Test 4: Zone-shot test**

The player starts at foul line. Following the start signal, the player shoots as many baskets as possible from outside the free throw lane in two minutes. After each attempt, the player has to shoot from a different, freely chosen zone. The

score is the total number of successful throws in two minutes.

Test 5: Figure-eight test

Except for the ball handling, this test is identical to test 2.

Test 6: Pass for accuracy test

A 30 cm square is marked on the wall of the sports hall. The centre of the square is at 1.2 m above the ground. Following the start signal of the trainer/coach, the player has to pass the basketball towards the target during two minutes. Any kind of pass is accepted with the restriction that the ball may not bounce before hitting the target. The player has to pass alternatively from behind the 4 and 8 m distance line. Each time the player hits the square from behind the 4 m line, one point is scored, and from behind the 8 m line, two points are scored.

#### **8. Nottingham Health Profile:**

The Nottingham Health Profile is a generic health status measure developed to record the perceived distress of patients in the physical, emotional and social domains. It has been used in a wide range of health problems and in general population studies. It comprises 38 statements (answered 'yes' or 'no') that form six sections of distress; physical mobility (8 items), pain (8 items), sleep (5 items), emotional reaction (9 items), social isolation (5 items), and energy level (3 items).<sup>15</sup>

#### **Statistical analysis:**

The statistical processing was performed using the SPSS version 11.0 for Macintosh. For all measurements, the differences between the groups were analyzed with the Kruskal Wallis test. In addition, the Mann Whitney U test was used for Post Hoc analysis, and the correlation analysis was performed using the Pearson correlation test. The level of significance for all statistical analysis was set at a p value of <0.05.

## **RESULTS**

The physical characteristics of the three groups are given in Table 1. Players in the first group were beginners at wheelchair basketball ( $2.5 \pm 1.5$  years), the second group consisted of players playing in the Turkish Wheelchair

Basketball League ( $4.5 \pm 4.5$  years) and the third group players were in the National Turkish Wheelchair Basketball Team ( $7.5 \pm 3$  years). In the results of the statistical analysis, it was found that there were significant differences in the number of years of experience between the first and second groups ( $p < 0.05$ ), however there were no significant differences between the second and third groups ( $p > 0.05$ ).

The medical examination identified 18 athletes with polio, seven athletes with amputation, four athletes with paraplegia, one athlete with muscular dystrophy, one athlete with syringomyelia and one athlete with spastic paraplegia. There were no significant differences among the groups when age and body mass index were compared ( $p > 0.05$ ). On the other hand, there were significant differences among the groups biceps and triceps skinfold thicknesses ( $p < 0.05$ ). In all the groups, the players of the Turkish Wheelchair Basketball Team had the least skinfold thicknesses on the triceps and biceps. There was no significant difference among the groups when the grip strength was compared ( $p > 0.05$ ). In addition, no significant difference was found among the groups when shoulder flexibility was compared ( $p > 0.05$ ).

There was a significant difference between the distance covered by the first and third groups in anaerobic capacity test. The first group completed longer distances than the third group. There was also a significant difference between the percentage maximal heart rate of the first and second groups. The players in the first group had greater maximal heart rates than the second group.

In the aerobic capacity comparison, no significant differences were found in the heart rate ( $p > 0.05$ ), whereas significant differences were found in the distance covered ( $p < 0.05$ ). The third group completed the longest distance in all the groups. The results of the Physical Fitness test are shown in Table 2.

When quality of life status was compared using the Nottingham Health Profile, no significant differences were found ( $p > 0.05$ ). The Nottingham Health Profile results are given in Figure 1.

In the analysis of the skill tests, the lay-up test, significant differences were found among the groups in 20 m sprint test, zone-shot test, figure-eight test, ( $p < 0.05$ ). However no significant differences were found in the figure-eight +ball test and pass for accuracy test ( $p > 0.05$ ). The first group had the best score in the lay-up test. The third group scored the best in the 20 m sprint test, zone-shot test and figure-eight+ball test. In addition, the third group had a greater score in the pass for accuracy test than the first group ( $p < 0.05$ ). These results are demonstrated in Table 2. The number of years of experience was found to be correlated with the zone shot test, 20 m sprint test and pass for accuracy test ( $p < 0.05$ ), but was not found to be correlated with the lay-up test, figure-eight+ball and figure-eight tests ( $p > 0.05$ ). The classification points of the subjects were not correlated with the skill tests and Nottingham Health Profile ( $p > 0.05$ ) (Table 3). The results of the wheelchair basketball skill tests are shown in Table 4.

## DISCUSSION

The aim of this study is to identify the effect of wheelchair basketball sports on the physical fitness level of the players and the relationship between the number of years of playing wheelchair basketball and the quality of life.

Anaerobic work capacity has an important place in a variety of sports disciplines. The 30-Second Wingate Anaerobic Test is a protocol which has been used for many years in the evaluation of healthy individuals. Vanlandewijck et al compared the 30-second sprint test and the Wingate anaerobic test on a roller ergometer and reported that the high test-retest reliability of the field test and the significant relationship between this field test and the Wingate anaerobic test under laboratory conditions suggest that the 30-second sprint is a reliable and valid tool for anaerobic performance evaluation in wheelchair basketball.<sup>9</sup>

Woude et al divided 67 track athletes into 4 different functional classes. In their study, they determined the class-related mean power output for male and female athletes. They also found that

the mean maximum heart rate in the sprint varied significantly among the track groups. They stated that this outcome was significantly associated with the personal characteristics of gender and hours of training.<sup>10</sup> In our study, anaerobic capacity was evaluated using the 30-second sprint test and the heart rate and distance were measured. The results of the statistical analysis demonstrated that there were no significant differences among the groups. This outcome was explained by the fact that all players had trained at least for one year and their anaerobic capacity had developed, and it could be related to the number of players.

Hutzler compared the aerobic and anaerobic performance of 11 elite wheelchair basketball players from Israel.<sup>11</sup> The ergometric tests included a continuous aerobic maximal peak work capacity test and a 30-second arm-all-out anaerobic test of mean anaerobic capacity and peak anaerobic power. The wheeling tasks included a 428 meter race, slalom and 6-minute endurance race. No relationship was found between variables in the arm ergometric tests and variables in the wheeling tasks. In our study, there were no significant differences among the groups; however there were significant differences in the distance covered in the 6-minute endurance race. After 30 seconds, the heart rate of the sprint test subjects reached 83% of the maximal heart rate. After the 6 minute endurance race test, the heart rate of the subjects reached 86% of the maximal heart rate.

The skinfold test is used to estimate body fat. Midha et al determined the effect of exercise with the wheelchair aerobic fitness trainer on anthropometrics indices.<sup>3</sup> They studied the effects before and after 10 weeks of exercise and found that the upper arm fat area decreased significantly. In our study, according to the results of the statistical analysis, there was no significant difference among the groups when the body mass index (BMI) was compared. On the other hand, there were significant differences among the groups when the skinfold value of the biceps and triceps were compared. The number of years of playing wheelchair basketball has an effect on skinfold thickness. When the number of years of

Table 1. Physical characteristics of the players.

	Group 1	Group 2	Group 3		
	X±SD	X±SD	X±SD	$\chi^2$	p
<b>Age</b> (years)	25±5	26±8	26±2.5	1.821	0.402
<b>Height</b> (cm)	176±8	168±9	155±50	4.376	0.112
<b>Body weight</b> (kg)	72±13	58±9	62±8.4	7.789	0.020*
<b>BMI</b> (kg/m <sup>2</sup> )	23.2±3.9	20.7±3.2	21.4±1.3	4.164	0.125
<b>Experience</b> (years)	2.5±1.5	4.5±4.5	7.5±3	11.301	0.004*

\* p<0.05. BMI: Body mass index.

Table 2. Results of physical fitness tests.

	Group 1	Group 2	Group 3		
	X±SD	X±SD	X±SD	$\chi^2$	p
<b>Skinfold</b> (mm)					
Triceps	10±4	10±8	5±2	7.655	0.022*
Biceps	5±3	6±4	2±0.5	17.075	0.000*
<b>Strength</b> (kg)	47±13	51±21	48±6	0.462	0.794
<b>Flexibility</b> (cm)	13±8	18±7	16±7	2.819	0.244
<b>Anaerobic capacity</b>					
MHR%	87±8	80±6	83±9	4.715	0.095
Distance (m)	101±17	79±33	84±12	5.606	0.052
<b>Aerobic capacity</b>					
MHR%	87±6	84±13	86±7	0.312	0.816
Distance (m)	612±169	951±184	962±150	18.438	0.000*

\* p<0.05. MHR: Maximal heart rate.

Table 3. Correlation of the number of years of experience and classification points with skill tests.

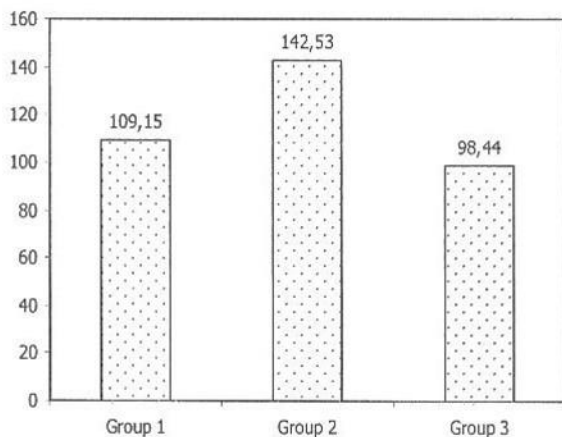
	Number of years of experience	Classification points
	r (p)	r (p)
<b>Lay-up test</b>	-0.051 (0.780)	0.262 (0.147)
<b>Figure eight+ball test</b>	0.010 (0.956)	0.051 (0.781)
<b>20 m sprint test</b>	0.412 (0.019)*	0.246 (0.174)
<b>Zone shot test</b>	0.368 (0.038)*	0.086 (0.638)
<b>Figure eight test</b>	0.125 (0.496)	-0.143 (0.434)
<b>Pass for accuracy test</b>	0.408 (0.020)*	0.205 (0.260)

\*p<0.05.

**Table 4. Results of wheelchair basketball skills test.**

	Group 1	Group 2	Group 3	$\chi^2$	p
	X±SD	X±SD	X±SD		
<b>Skill 1 (m)</b>	292±45	221±60	224±57	10.303	0.006*
<b>Skill 2</b>	3±3	3±3	3±1	1.180	0.554
<b>Skill 3</b>	6±2	5±2	8±1	12.210	0.002*
<b>Skill 4</b>	9±2	7±2	10±1	12.269	0.002*
<b>Skill 5</b>	5±2	5±2	9±5	7.867	0.020*
<b>Skill 6</b>	7±3	8±2	11±4	5.625	0.060

\*p<0.05. Skill 2: Number of the 3 points in 2 minutes. Skill 3: number of the round with ball in one minute. Skill 4: number of the round without ball in one minute. Skill 5: Number of the 1 point in 2 minutes. Skill 6: Number of the shots in 2 minutes.



**Figure 1. Total score of the Nottingham Health Profile (0-600).**

experience increases, the skinfold thickness decreases.

The hand grip dynamometer was used to determine the strength of the players, and no significant difference was found among the groups. This outcome was not only related to the number of years of playing wheelchair basketball but also the BMI. The BMI showed no difference among the groups. In the literature, there are no studies about the hand grip strength of wheelchair basketball players.

In healthy people, the shoulder flexibility test is used. Wang et al assessed the ROM of shoulder joints while the players were in the sitting position

and found the shoulder flexion ROM to be  $154.26 \pm 64.42$ .<sup>3</sup> They used the goniometer to assess the ROM. In the literature, there are no studies about a specialized shoulder flexibility test for wheelchair basketball players. We used a centimetre measuring tape to measure flexibility. We expected the shoulder flexibility of the wheelchair basketball players to increase since wheelchair restricts the mobility of the upper bodies of players. Therefore, shoulder flexibility might increase.

We compared the shoulder flexibility among the groups and found no significant difference.

Vanlandewijck et al developed a basketball skill tests covering 6 different skills for wheelchair basketball players. There were no significant differences among the groups in the figure-eight + ball test and pass for accuracy test.<sup>9</sup> On the other hand, other tests showed significant differences among the groups in our study.

The lay-up test was utilized to determine free throw on the three point line which is a type of throw frequently performed by players during playing basketball. Thus, the number of years of playing wheelchair basketball affects this skill. The number of successful throws is important. For this reason, the test of this skill is more important than the figure-eight + ball test used to determine the agility of the players. In the figure-eight + ball test, agility is more important than the skill.

The 20 meter sprint test was used to determine speed, and significant differences were

found among the groups. It was found that the number of years of playing basketball affected the speed of the players.

The zone- shot test is similar to the lay-up test. This test determines both agility and skills. The score was determined as the total number of successful throws. It was found that the number of successful throws increased with the number of years of playing basketball.

The figure – eight test is similar to the figure-eight + ball test. All players were successful at both of these tests (test 2 and test 5) for wheelchair basketball.

The pass for accuracy test was performed to determine agility and skills. To be successful in this test, the players need to be experienced in wheelchair basketball. Therefore, the players of the national team got higher scores than those of the other groups.

The Nottingham Health Profile is a generic measurement tool developed to identify distress in the physical, emotional and social aspects of the lives of players. In the literature, there are studies evaluating the mood status of wheelchair basketball players; however there is no study assessing the quality of life.

Paulsen et al compared mood states of college able-bodied and wheelchair basketball players. The mood states of 26 college wheelchair basketball players were examined in relation to 11 able-bodied college basketball players. The wheelchair basketball players had significantly better mental health profiles than the two comparison groups.<sup>12</sup> In another study conducted by Paulsen et al, wheelchair athletes and non-athletes were compared on selected mood states. They found that wheelchair athletes had a significantly lower score on depression than the wheelchair non-athletes but all scores were in the normal range.<sup>13</sup> In our study, The Nottingham Health Profile was used to determine the quality of life of wheelchair basketball players. We found no significant difference among the groups and the score of all players to be low. Physical activity, exercise and sports have a positive impact on the physical and psychological health, self concept, body awareness and motor development. Sports also provide an

opportunity for social interaction.

Wheelchair basketball is an effective and suitable sport for enhancing physical performance and inducing positive physiological adaptations. Thus, playing basketball is an important way of increasing the quality of life for disabled people.

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