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Investigation of sitting position of paralympic wheelchair basketball players

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Purpose: The aim of this study was to examine the sitting position (posture) of wheelchair basketball (WB) players who cannot walk and can walk in daily life and to compare them with the able-bodied sedentary individuals. *Methods*: A total of 22 male individuals, including six WB players who could not walk in daily life, eight WB players who walked in daily life, and eight able-bodied sedentary individuals (control group) were included in the study. Posture analysis of individuals was evaluated using rastersterographic system DIERS formetric 4D device. Kruskal–Wallis test was used to compare the data obtained during posture analysis. The Mann–Whitney *U*-test was used to determine which group caused the difference in the data determined to be different. Statistical significance level was taken as $P < 0.05$. *Results*: Trunk-length, sacrum-width, sagittal and coronal imbalance, trunk-torsion, pelvic-obliqueness, pelvic-torsion, pelvic-inclination and fleche-cervicale were found to be values similar in the three groups ($P > 0.05$). It was determined that the lumbar lordosis and thoracic kyphosis angles were different between the groups, and the lumbar lordosis and thoracic kyphosis angles of the WB players who could not walk in daily life were higher than those of the WB players who walked in daily life and the control group ($P < 0.05$). *Conclusions*: Based on the results of our study, we suggest evaluating the sitting postures of WB players and rehabilitating WB players, especially those who cannot walk in daily life, with posture corrective exercises aimed at reducing and normalizing thoracic kyphosis.

Key words: *disability, impairment, posture, sitting, sports*

1. Introduction

Paralympic games provide a platform for people to showcase their talents [2]. WB is one of the most popular team sports among the Paralympic games [12], [31]. WB is played by people with physical impairments with certain diseases such as spinal cord injury, lower extremity amputations, and neuromuscular diseases and they play on a special – sport wheelchairs that are adapted to players' needs and level of functionality [8], [23]. In Paralympic sports, there is a system of classification of players to increase participation in sports among the people with impairments and to reduce the effect of the impairment on sports success, and there is a scoring system according to this classification [7], [30]. The classification of WB players is based on their capacity to complete necessary skills such as pushing, turning, shooting, rebounding, dribbling, passing, and catching [11]. While trunk, lower extremity and upper extremity functions determine the class of the player, trunk movement and sitting stability of the player form the basis of the classification [11], [27]. Each player is awarded a point value between 0.5 (severe impairment) and 4.5 (minimum impairment) depending on their functional skills. The total score of each team during the game must not exceed 14 points [11].

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Wheelchair basketball players attempt to fix their sitting postures in the WB to maximize their support surface. A stable base allows for maximum controlled movement of the trunk so that players move optimally over a large support surface [11]. Sitting stability is impaired in WB players whose trunk, pelvis and hip muscles are affected [30]. To compensate for this loss of stability, players often bring their knees towards their chest, increasing the hip flexion angle and activating different muscle groups with a deep, or increase the sitting stability by connecting the pelvis and trunk with apparatus such as belts and often use a specific elastic bands/belts around their chest/hips and thigh to stabilize themselves stronger and more effectively on a wheelchair [4], [16], [30]. Normally, the adoption of different sitting postures leads to differences in the activity of the musculoskeletal system [3], [21], [22], [34] and prolonged sitting posture creates a static load on the musculoskeletal system [5], [32], [34]. In a study conducted with able-bodied individuals, it was reported that the loads on the lumbar spine increased in the sitting posture compared to the standing position [34]. However, in another study examining the effect of different sitting postures on trunk muscle activity, it was reported that the activity of the multifidus, internal oblique abdominal and thoracic erector spine muscles was lower during kyphotic sitting compared to sitting upright [22].

Sitting position is frequently evaluated and these evaluations are used to determine wheelchair characteristics in people with physical impairments [3], [6], [10]. Although there are studies showing that different muscles are active in different postures and sitting position [22], [34], no study comparing sitting position in individuals with different activity levels has been found. In addition, no study that examines the sitting position of WB players and compares this according to the differences in activity levels has been found in the literature. In this study, it was planned to examine the sitting position (posture) of WB players using 4D technology and to compare the sitting postures of WB players who cannot walk (use wheelchair) and can walk in daily life. Therefore, the aim of this study is to examine the sitting position analyzes of WB players who cannot walk and can walk in daily life and to compare them with the sitting position of sedentary individuals without any impairments. In this study, reference information about sitting position of WB players was to be obtained. In addition, the results of the study may provide us information about the effect of walking and ambulation level on sitting position position in daily life.

2. Materials and methods

2.1. Material

Paralympic WB players and able-bodied sedentary individuals were included in the study. For the study to be conducted, approval was obtained from the University Ethics Committee (2021/105-35). Before starting the study, all individuals who agreed to participate in the study were informed about the purpose of the study, the evaluations included in the study and the benefits of the study. A total of 22 male individuals, including 14 WB players (Paralympic) and 8 able-bodied sedentary individuals (control group), were included in the study. Being a Paralympic na-

Table 1. Comparison of Demographic Characteristics of WC Basketball Players and Control Group

	WC basketball players who can’t walk in daily life median (IQR25-75)	WC basketball players walking in daily life median (IQR 25-75)	Control group median (IQR25-75)	*P*
Age [years]	32.50 (25.00–39.00)	28.50 (26.00–33.00)	32.50 (28.50–37.00)	0.650
Body length [m]	1.79 (1.72–1.86)	1.88 (1.86–1.91)	1.77 (1.72–1.83)	0.089
Body Weight [kg]	64.50 (52.50–71.00)[a, b]	80.00 (74.00–89.00)[a]	80.50 (74.50–88.50)[b]	**0.005**
Body Mass Index [kg/m^2]	20.52 (17.75–22.14)[b]	23.12 (19.46–26.59)	25.50 (24.18–27.00)[b]	**0.007**

[a] Significant difference between WC basketball players walking in daily life and WC basketball players who cannot walk in daily life.

[b] Significant difference between WC basketball players who cannot walk in daily life and the control group.

tional team player and maintaining an independent sitting position were determined as inclusion criteria for WB players. Not having a history of lumbar disc herniation and not doing regular sports were determined as inclusion criteria for sedentary individuals. Individuals not willing to participate in the study and not meeting the inclusion criteria were excluded. It was determined that 6 WB players included in the study use a wheelchair in daily life (WB group that cannot walk in daily life), and 8 WB players walk in daily life (WB group that walks in daily life). The demographic information of 22 male individuals included in the study, including 6 WB players who cannot walk in daily life, 8 WB players who walk in daily life, and 8 able-bodied sedentary individuals, are given in Table 1.

The birth dates of individuals who met the study criteria were collected verbally, stroke lengths were evaluated with tape measure and body weight was evaluated with special digital scale compatible with wheelchair. After these evaluations, posture analysis was performed. Posture analysis of the players was performed using the rastersterographic system DIERS formetric 4D (DIERS International GmbH, Schlangenbad, Germany) device. Rastersterographic system is a valid and reliable optical measurement system that objectively evaluates the 3D analysis of the spine and pelvis and does not expose it to radiation. The system consists of a projector light, a video camera and a computer to process the data. The device reflects a series of parallel light strips (scanning images) emitted by the projector onto the individual's back. This image is transformed into a 3D superficial topography of the body with the principle of mathematical triangulation with high precision.

2.2. Posture analysis

Posture analysis of individuals was carried out in the sitting position. Posture analysis in the sitting position was carried out with a stool considering the criteria specified in the study conducted by Picelli and his colleagues [24]. During sitting position posture analysis, individuals were made to have the upper part of the body naked so that spina ilaca posterior superior (SIPS) appeared. During the measurement, the individuals were seated with their backs facing the light source and camera. In the sitting position posture, individuals were asked to sit comfortably with their feet in contact with the ground and hands dangling in front of the trunk [24]. Posture analysis took six seconds, data from measurements and descriptions were shown in Table 2.

Table 2. Posture analysis data and explanation

Variable/data name	Explanation of the variable/data	Information provided
1	**2**	**3**
Trunk Length VP-DM [mm]	the distance between vertebral prominens and the midpoint of the distance between the two SIPS	It provides information about body length.
Trunk Length VP-SP [mm]	the distance between the vertebral prominens and the sacral point.	
Dimple Distance DL-DR [mm]	the midpoint of the distance between the two SIPS.	It gives information about the width of the sacrum.
Sagittal imbalance VP-DM (trunk inclination) [°]	the angle between the plane and the vertical axis that connects the midpoint of the distance between the Vertebral prominens and the two SIPS.	It shows the stance of the individual to the front or the back. Negative values (–) indicate backside, positive values (+) indicate front stop.
Sagittal imbalance VP-DM (trunk inclination) [mm]	the distance between the plane and the vertical axis, which connects the midpoint of the distance between the Vertebral prominens and the two SIPS.	
Coronal imbalance VP-DM (trunk imbalance) [°]	the lateral deviation of the vertebral prominens in angles of the line that passes through the middle point of the distance between the two SIPS.	It shows the stance of the individual to the right or left side. Negative values (–) indicate stance to the left, Positive values (+) indicate stance to the right.
Coronal imbalance VP-DM (trunk imbalance) [mm]	the lateral deviation of the vertebral prominens in length of the line that passes through the middle point of the distance between the two SIPS.	

Table 2 continued

1	2	3
Trunk Torsion [°]	the maximum deviation of the middle line of the spine from the plane connecting the midpoint between the vertebral prominens and the two SIPS.	It indicates the deviation of the individual's spinal line. Negative values (–) indicate the deviation of the spinal midline from the plane connecting the midpoint between the vertebral prominence and the two SIPS to the left. Positive values (+) indicate the deviation of the spinal midline from the plane connecting the midpoint between the vertebral prominence and the two SIPS to the right.
Pelvic obliquity [°]	the difference in degrees of height between the right SIPS and the left SIPS in the horizontal plane.	It indicates the asymmetry in the pelvis of the individual. Negative values (–) indicate left side up. Positive values (+) indicate right side up.
Pelvic obliquity [mm]	the difference in height between right SIPS and left SIPS in the horizontal plane.	
Pelvic torsion DL-DR [°]	the mutual torsion of both SIPS.	It shows the torsion of the individual's pelvis. Negative values (–) indicate left side up. Positive values (+) indicate right side up.
Pelvic inclination (dimples) [°]	the angle that the line that combines SIAS and SIPS does with the horizontal plane. It is a pelvic slope based on both SIPS.	It shows the anterior or posterior deviation of the individual's pelvis. Negative values (–) indicate backward deviation. Positive values (+) indicate forward deviation.
Pelvic inclination (symm. line) [°]	pelvic slope based on symmetry line	
Pelvic rotation [°]	On the frontal plane, that is the rotation angle of the right SIPS relative to the left SIPS.	It gives information about the rotation of the pelvis of the individual. Negative values (–) indicate the left side being in front, positive values (+) indicate the right side being in front.
Fleche cervicale [mm]:	the horizontal distance between the cervical apex of the vertical axis passing through the kyphotic apex.	It gives information about the cervical lordosis slope of the individual.
Fleche cervicale (VP) [mm]	the horizontal distance between the vertebral prominence of the vertical axis passing through the kyphotic apex.	It gives information about the cervical lordosis slope of the individual.
Lordotic Angle ITL-ILS max [°]	the angle at the intersection of planes passing through the thoracolumbar junction and the lumbosacral junction	It gives information about the individual's lordosis.
Lordotic Angle ITL-DM [°]	the angle at the intersection of planes passing through the midpoint of the distance between the thoracolumbar transition point and the two SIPS	It gives information about the individual's lordosis.
Fleche lombaire [mm]	the horizontal distance between lumbar apex of the vertical axis passing through the kyphotic apex	It gives information about the lumbar lordosis slope of the individual.
Kyphotic Angle ICT-ITL max [°]	the angle at the intersection of the planes passing through the cervicothoracic point and the thoracolumbar transition point	It gives information about the individual's kyphosis.
Kyphotic Angle VP-ITL [°]	the angle at the intersection of the planes passing through the vertebral prominence and the thoracolumbar junction.	It gives information about the individual's kyphosis.

VP – Vertebral prominence, DL – Left SIPS, DR – Right SIPS, DM – Midpoint of the distance between two SIPS, SP – Sacral point, ICT – Cervicothoracic transition point, ITL – Thoracolumbar transition point, ILS – Lumbosacral transition point'.

2.3. Statistical analysis

The data of the study were analyzed with the use of SPSS 20 Package program (Statistical Package for Social Sciences, Inc., Chicago, IL, USA). The normality of the data was analyzed with Shapiro–Wilk test, and it was determined that all the data was not normally distributed. Data from all three groups were compared using the Kruskal–Wallis test among the groups. In the parameters determined to be different, Mann–Whitney *U*-test was performed to determine the presence of the difference between the three groups. In statistical evaluation, the statistical significance level was taken as $P < 0.05$. Median and first and third quarter (IQR25-75) values were used in the identifying statistics.

3. Results

It was determined that the age and stroke length of WB players who cannot walk in daily life, WB players who can walk in daily life and control group were similar to each other ($P > 0.05$). It was determined that the body weight of WB players who cannot walk in daily life was less than sedentary individuals and WB players who can walk in daily life, and their body mass index was lower than the control group ($P < 0.05$) (Table 1).

When the results of sitting position posture analysis were examined among WB players who cannot walk in daily life, WB players who can walk in daily life, and the control group, it was determined that trunk length and sacrum width were similar in three groups ($P > 0.05$); sagittal and coronal imbalances were similar in three groups ($P > 0.05$); trunk torsion, pelvic obliqueness, pelvic torsion and pelvic inclination were similar in the three groups ($P > 0.05$); and fleche cervicale was similar in the three groups ($P > 0.05$). It was determined that lumbar lordosis and thoracic kyphosis angles were different between the groups, and this difference was significant between WB players who cannot walk in daily life, WB players who can walk in daily life and the control group ($P < 0.05$). It was determined that the lumbar lordosis and thoracic kyphosis angles of WB players who cannot walk in daily life were higher than WB players who can walk in daily life and the control group ($P < 0.05$) (Table 3, Figs. 1, 2).

Table 3. Comparison of Posture Analysis of WC Basketball Players and Control Group

	WC basketball players who can't walk in daily life median (IQR25-75)	WC basketball players walking in daily life median (IQR 25-75)	Control group median (IQR25-75)	*P*
1	**2**	**3**	**4**	**5**
Trunk Length VP-DM [mm]	521.65 (423.80–551.00)	541.30 (533.60–567.90)	530.30 (507.70–545.40)	0.309
Trunk Length VP-SP [mm]	573.25 (470.00–612.00)	592.70 (578.80–615.00)	562.35 (560.70–579.35)	0.229
Dimple Distance (DL-DR) [mm]	84.20 (71.60–90.35)	77.45 (76.40–79.90)	82.00 (65.30–87.35)	0.747
Sagittal imbalance VP-DM (trunk inclination) [°]	4.20 (1.30–10.35)	3.95 (3.40–5.40)	9.30 (5.80–10.75)	0.159
Sagittal imbalance VP-DM (trunk inclination) [mm]	35.50 (9.90–81.45)	38.80 (33.00–52.50)	86.95 (49.85–102.60)	0.140
Coronal imbalance VP-DM (trunk imbalance) [°]	0.10 (–1.55–1.40)	0.40 (–0.50–1.50)	–0.95 (–1.60–0.50)	0.121
Coronal imbalance VP-DM (trunk imbalance) [mm]	0.55 (–12.30–11.50)	4.55 (–6.20–14.50)	–9.35 (–15.00–4.75)	0.143
Trunk Torsion [°]	1.15 (–2.60–8.15)	–4.30 (–5.80–1.00)	1.55 (–7.80–4.30)	0.356
Pelvic Obliquity [°]	1.55 (1.00–4.65)	0.65 (–0.50–3.20)	1.25 (–0.75–2.95)	0.800
Pelvic Obliquity [mm]	2.35 (1.45–5.65)	1.25 (–0.70–4.50)	1.50 (–0.70–4.40)	0.788
Pelvic torsion DL-DR [°]	2.00 (–0.85–3.55)	–1.35 (–3.00–3.10)	0.30 (–1.00–1.00)	0.367
Pelvic inclination (dimples) [°]	11.70 (3.95–19.20)	4.80 (2.60–7.20)	11.00 (6.30–20.50)	0.261
Pelvic İnclination (symm.line) [°]	4.35 (–6.15–8.15)	3.45 (–1.20–11.30)	1.30 (–9.00–3.60)	0.503
Pelvic rotation [°]	1.40 (–3.65–3.40)	–1.10 (–2.70–0.90)	–1.15 (–1.95–0.80)	0.587

Table 3 continued

1	2	3	4	5
Fleche cervicale [mm]	93.80 (77.80–123.00)	80.05 (67.20–99.80)	121.35 (82.30–158.60)	0.329
Fleche cervicale (VP) [mm]	69.65 (56.05–103.45)	56.25 (46.00–75.30)	89.40 (61.55–129.95)	0.236
Lordotic Angle ITL-ILS max [°]	25.80 (8.25–46.05)	15.45 (9.40–21.20)	6.55 (1.00–13.15)	0.079
Lordotic Angle ITL-DM [°]	17.15 (7.60–40.60)	14.45 (8.90–20.00)	5.95 (2.75–12.15)	0.195
Fleche lombaire [mm]	41.15 (30.55–50.45)[a, b]	20.45 (15.40–28.90)[a]	19.00 (7.60–33.35)[b]	0.048
Kyphotic Angle ICT-ITL max [°]	62.40 (51.05–74.65)[a, b]	43.95 (36.60–45.40)[a]	48.50 (40.65–54.65)[b]	0.041
Kyphotic Angle VP-ITL [°]	58.80 (48.65–70.00)[a, b]	40.85 (31.50–44.60)[a]	45.85 (38.60-53.25)[b]	0.049

[a] Significant difference between WC basketball players walking in daily life and WC basketball players who cannot walk in daily life.
[b] Significant difference between WC basketball players who cannot walk in daily life and the control group.

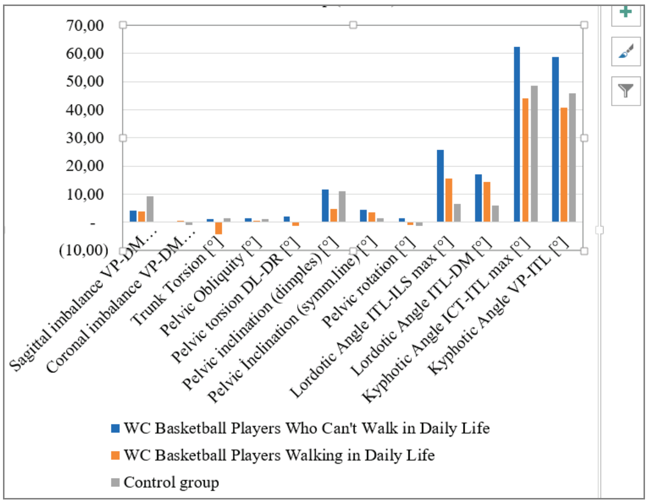

Fig. 1. Comparison of posture analysis of WC basketball players and control group (° values)

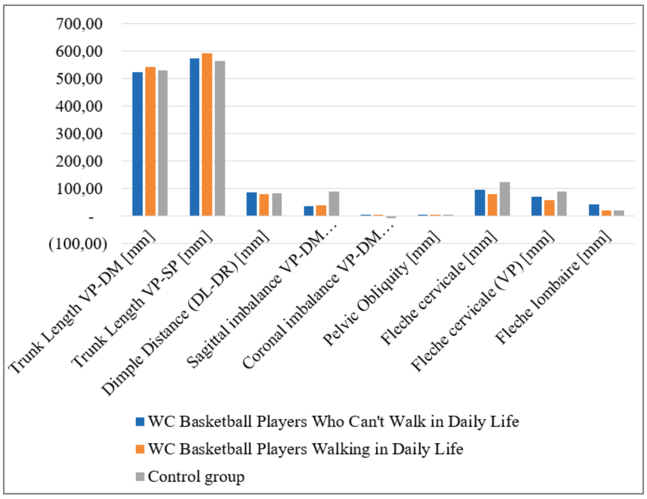

Fig. 2. Comparison of posture analysis of WC basketball players and control group (mm values)

4. Discussion

The aim of our study was to examine the sitting position of WB players, to compare the sitting position of WB players who cannot walk in daily life (use wheelchair) and who walk in daily life with the sitting position of able-bodied sedentary individuals who do not have any. As a result of our study, it was determined that the thoracic kyphosis and lumbar lordosis angles of WB players who cannot walk in daily life are higher than that of WB players walking in daily life and sedentary individuals.

Our study found that WB players and able-bodied sedentary individuals had similar stroke length, and body length and sacrum width were similar in all three groups. We believe this situation is due to the fact that we included individuals of similar ages and same sex in our study. It was determined that the body weight of WB players who cannot walk in daily life was less than that of WB players and sedentary individuals walking in daily life, and that their body mass index was less than that of able-bodied sedentary individuals. In the literature, it is stated that changes in body composition occur in people with impairments [1], [17]. Studies have shown that people with impairments have a high fat mass percentage and a low fat-free mass percentage [17], [20]. This situation has been associated with loss of muscle activity due to vascular hypotrophy and metabolic tissue disorder [20]. In the light of this information in the literature, it is an expected result that the body weight of WB players who cannot walk in daily life is lower.

In our study, it was determined that WB players and able-bodied sedentary individuals were similar in trunk torsion, pelvic obliqueness, pelvic torsion, pelvic inclination angle and fleche cervicale in three groups. In the literature, we have not found any studies that examined these data during sitting or analyzed this information in WB players. However, we suppose that this data obtained as a result of our study may contribute to the literature about both the sitting posture of sedentary individuals and the sitting posture of WB players.

In WB players Proximal stabilization is important for the functionality of the upper extremity, while sitting balance is of great importance for trunk control and selective movement [26], [33]. Trunk control and sitting balance are mostly provided by synchronized contraction of the core muscles [28]. In a study conducted with WB players, it was determined that core endurance was associated with sitting balance. The core muscles, which include the body and pelvic muscles, maintain the stability of the spine and pelvis, and provide energy transfer from the body to the extremities during many sports activities [28]. As a result of our study, it was determined that the sagittal and coronal balances during sitting were similar between WB players who cannot walk in daily life, WB players who can walk in daily life, and able-bodied sedentary individuals. Some WB players may not have independent sitting balance. However, having independent sitting balance is one of the criteria for inclusion in this study. So, we think that this result of our study is due to the fact that WB players have independent sitting balance. However, the fact that the core endurance of our players and able-bodied sedentary individuals was not examined and its relationship with sitting balance was not investigated can be seen as a limitation of our study.

Sitting balance is important in WB players because it affects upper extremity functionality. The lack of dynamic lumbopelvic control causes a decrease in trunk control and thus a decrease in sitting balance [9], [30], [33]. Wheelchair basketball players tend to sit deeply by tilting their pelvis more posteriorly to improve sitting balance [9], [30], [33]. This deep sitting position causes increased thoracic kyphosis, but also causes forward displacement of the shoulder girdle [19]. In parallel with this information in the literature, in our study, it was determined that the thoracic kyphosis angles of WB players who cannot walk in daily life were higher than those of WB players who can walk in daily life. Another finding in our study is that the lumbar lordosis angles of WB players who cannot walk in daily life are higher than both WB players who walk in daily life and able-bodied sedentary individuals. In a study, it was determined that WB players compensate for postural muscle function loss with postural adaptation [25]. Physiologically, the vertebral column consists of two lordotic and two kyphotic curvatures. However, it has been reported in the literature that the curvatures in the vertebral column compensate each other [13]–[15]. As a result of our study, the high lumbar lordosis angle of WB players who cannot walk in daily life may have developed as an adaptation and compensation mechanism due to their high thoracic kyphosis. At the same time, we think that this situation may be due to the deterioration of the structural feature and biomechanical alignment of the musculoskeletal system that supports the posture, since WB players who cannot walk in daily life have a pathology that will prevent walking in daily life.

When we examined the thoracal kyphosis and lumbar lordosis angles of the players and sedentary individuals we evaluated in our study, it was determined that the lumbar lordosis angles of WB players who cannot walk in daily life were within the normal 40–45-degree limits, and that the lumbar lordosis angles of WB players and sedentary individuals who can walk in daily life were between 19 and 22 degrees and less than normal. However, it was determined that the thoracal kyphosis angles of WB players and sedentary individuals who can walk in daily life were within the normal limits of 40–45 degrees, while the thoracal kyphosis angles of WB players who cannot walk in daily life were between 48–75 degrees and more than normal. In this context, the fact that normative data of thoracal kyphosis and lumbar lordosis angles in the sitting position in the literature were not examined and that sedentary wheelchair individuals who did not play sports were not included in our study makes it difficult to interpret the results of our study. However, according to the results obtained by the information available in the literature, it can be said that the lumbar lordosis angles of WB players who cannot walk in daily life are within the normal limits of 40–45 degrees, and their thoracal kyphosis angles are high. In [18], reference values of active trunk movements were established in wheelchair basketball players according to their classification. We think that our study may be a pilot in establishing reference values for spinal alignment in wheelchair basketball players in the static sitting position.

In our study, WB athletes were compared only with the able-bodied sedentary control group, and the fact that individuals using wheelchair who did not do any sports were not included in the study is a limitation of the study. At the same time, another limitation of the study is that only sitting position was examined in the study and that it was not investigated whether there is a relationship between position and parameters such as muscle strength, core endurance and the characteristics of wheelchair used, which may affect the sitting position. There is a need for studies that would investigate the factors that may affect the sitting position and compare it with individuals who do not do any sports and use wheelchair.

As a result of our study, it was determined that the thoracic kyphosis and lumbar lordosis angles of WB players who cannot walk in daily life were higher than both WB players who can walk in daily life and sedentary individuals, but only thoracic kyphosis angles were higher than the values considered normal in the literature. Based on the results of our study, we recommend evaluating the sitting position of WB players and rehabilitation of WB players, especially those who cannot walk in daily life, with posture-correcting exercises aimed at reducing and normalizing their thoracic kyphosis. Excessive thoracic kyphosis causes back pain, negative effects on respiratory capacity and decrease in sports performance in these athletes. For this reason, while rehabilitating these athletes, it is recommended to plan stretching exercises for the thoracic anterior group muscles, which are expected to be shortened in the case of thoracic kyphosis and strengthening exercises for the thoracic back muscles and core muscles, which are expected to be weak. In addition, these athletes should be informed about standing upright and paying attention to symmetrical sitting postures in daily life. In addition, we think that athletes with physical impairments but who can walk should be supported to walk more in daily life. A periodic assessment of the sitting position of WB athletes may allow assessing the effect of the given posture-correcting exercises and, if necessary, might provide guidance on the modification of these exercises. In this way, it may contribute to both improving sports performance and facilitating daily life activities. At the same time, it may prevent both existing obstacles and postural disorders that may develop due to the use of wheelchair, as well as sports injuries that may be caused by these disorders. However, further studies on this issue and based on which WB players can achieve some benefits are needed.

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