

Evaluation of posture in sports performance

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Abstract

The *aim* of this paper was to study a number of 34 athletes practicing different kinds of sports activities, in order to determine whether they have developed a certain spine deficiency and if there is any association between the type of sports they practice and the postural changes they develop. *Methods:* In this study we have enrolled 12 members of the men's volleyball team of the "West University of Timisoara", 9 members of the men's football team ASU Politehnica Timișoara, and 13 members of the men's basketball team BC SCM Timișoara. Postural analysis was carried out with the Zebris CMS-10 from the mechatronics department of the Politehnica University Timisoara, a device that determines the spatial coordinates of the spinous processes. From the obtained data we have established the angle of the spinal deviation both sagittal and frontal, in a similar manner as with the Cobb method. *Results:* We have observed a reduction in the spinal curvature in volleyball players; 8 out of 12 had values under the normal range that can in time lead to a rigid spine. 7 players from the basketball team presented values out of the normal range for kyphosis and 8 of them for lordosis, while all except two of the team players present with a front plane deviation of the spine. From the evaluation of the football players from ASU Politehnica Timișoara we cannot generalize a deviation in the sagittal plane, but all of them present deviations in the frontal plane. *Conclusion:* Professional athletes can also present postural changes determined by the positions they most frequently adopt depending on the type of sports they practice.

Keywords: posture, evaluation, athletes, Zebris

Rezumat

Scopul lucrării este de a studia un număr 34 de sportivi care practică diferite ramuri sportive, de a determina dacă aceștia au dezvoltat o anumită deficiență la nivelul coloanei vertebrale și dacă există o asociere între sportul practicat și eventualele modificări posturale apărute. *Metode:* În acest studiu au participat 12 sportivi din cadrul echipei de volei masculin "Universitatea de Vest Timișoara", 9 sportivi din cadrul echipei de fotbal masculin ASU Politehnica Timișoara și 13 sportivi din cadrul echipei de baschet masculin BC SCM Timișoara. Analiza posturală a fost realizată cu aparatul Zebris CMS-10 din cadrul departamentului de mecatronică a Universității Politehnica Timișoara, care determina coordonatele spațiale ale proceselor spinose vertebrale, iar din datele obținute se stabilește valoarea unghiului deviațiilor coloanei vertebrale atât în plan sagital cât și frontal, similar metodei Cobb. *Rezultate:* La jucătorii de volei am observat o reducere a curbării coloanei lombare, 8 sportivi din cei 12 au avut valori sub normal, ceea ce în timp poate duce la un spate plan. La jucătorii echipei de baschet masculin 7 sportivi au prezentat valori peste normal în evaluarea cifoziei și 8 sportivi prezintă valori sub normal în evaluarea lordozei, iar în plan frontal, cu excepția a doi sportivi, toți ceilalți au o deviație a coloanei vertebrale. Din rezultatele evaluărilor efectuate jucătorilor din cadrul clubului de fotbal masculin ASU Politehnica Timișoara nu se poate generaliza existența unei deformări accentuate în plan sagital, în schimb toți sportivii prezintă deviație în plan frontal. *Concluzie:* La sportivii de performanță pot exista modificări posturale determinate de pozițiile specifice adoptate de jucători în funcție de sportul practicat.

Cuvinte cheie: postură, evaluare, sportivi, Zebris

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Introduction

Movement is usually perceived as being fluent and dynamic, while posture is seen as static and characterized by the lack of movement. It is fundamentally wrong to see posture as an independent factor from the general functioning of the locomotor system. The word posture refers to a position in which either the entire body or a certain part of it is held for a period of time. A dynamic organism such as the human body cannot be defined as having only one position or posture; it adopts different position and it rarely stays in one of them for a long period of time.

The basic and most important function of the skeletal and muscular systems is movement. Any static state that the body has at one point in time is only an integrative part of this basic activity as the posture "follows" the movement just like a shadow. By extending this idea, the posture can be defined as a temporary position attributed by the organism in the preparation for the next position. Therefore, the static state is not a real position because we rarely actually are in that certain position. The most frequent postural deficiencies in the case of athletes are lordosis and scoliosis, deficiencies that are evident either in the frontal or in the sagittal plane. If present, they can determine a series of clinical manifestations that can negatively influence their performance in various manners [1].

The **aim** of the study is to analyze the posture of athletes registered with the West University Sports Club Timisoara – men's volleyball team, BC SCM Timisoara – men's basketball team, and ASU Politehnica Timisoara – men's football team in order to establish if there is any kind of connection between the type of sport these athletes practice and the postural changes they develop.

Materials and methods

Postural analysis has been carried out using the Zebris CMS-10 from the Mechatronics Department of the Politehnica University Timisoara between the 5th and 25th December 2018. The subjects enrolled in the study were as follows: 12 athletes from the men's volleyball team (with a mean age of $24,83 \pm 5,09$, mean weight of $89 \pm 9,98$ kg, mean height $1,91 \pm 0,04$ m), 9 athletes from the men's football team ASU Politehnica Timisoara (mean age of $26,66 \pm 4,41$), and 13 athletes from the BC SCM

Timisoara men's basketball team (mean age of $26,53 \pm 5,99$ and mean height $1,96 \pm 0,11$ m). The Zebris examination system used for the spine determined the spatial coordinates of the spinous processes and by using these data we have established the angle of the spinal deviation both sagittal and frontal, in a similar manner as with the Cobb method.

Results

Following data analysis from the Win Spine System and the Zebris CMS-10 we have observed the following:

- Normal range for kyphosis are between 33° - 43° and only two volleyball players presented normal measurements ($40,6^\circ$ and $39,4^\circ$), 5 athletes have values over the normal range (out of these the highest values were $60,3^\circ$ and $63,4^\circ$), and other 5 athletes present values that were lower than the normal range ($23,1^\circ$ and $29,9^\circ$) with a clear tendency towards the reduction of the physiological curvature of the spine that in time will lead to a plane and rigid back (Figure 1).

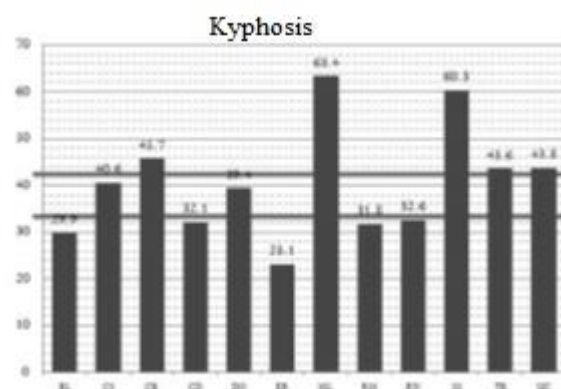


Figure 1. Kyphosis deviation angle values for men's team volleyball players

- Normal values for lordosis are between 22° - 28° and only 2 players presented values within this normal range ($24,7^\circ$ and $26,3^\circ$), 2 present values above normal ($28,8^\circ$ and $31,6^\circ$), and the other 8 players present with values below the normal limit. Out of these last 8 mentioned players, in 5 of them we have observed the tendency towards the reduction of the physiological curvature of the spine that could in time lead to a plane back. (Figure 2)

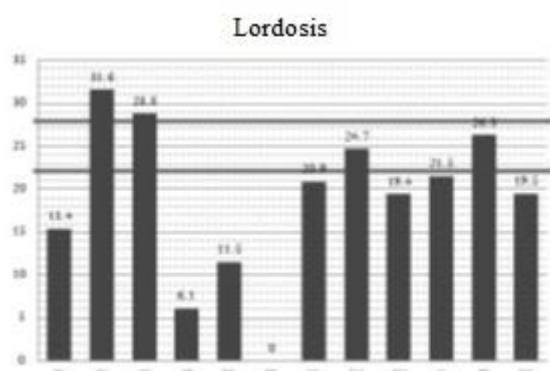


Figure 2. Lordosis deviation angle values for men's team volleyball players

In case of scoliosis the normal value is 0° , a value that could be observed in case of 6 out of the 12 analysed athletes. For 2 of the subjects we observed a left-side deviation of the spine of $10,1^\circ$ and $14,5^\circ$ respectively, which indicate the presence of a left convex scoliosis, while 4 of the athletes presented a right side deviation of the spine ($11,8^\circ$; $12,8^\circ$; $6,7^\circ$ și $8,1^\circ$) indicating a right sided scoliosis due to the fact that they have a right hand dominance and due to the positions they have in the team.

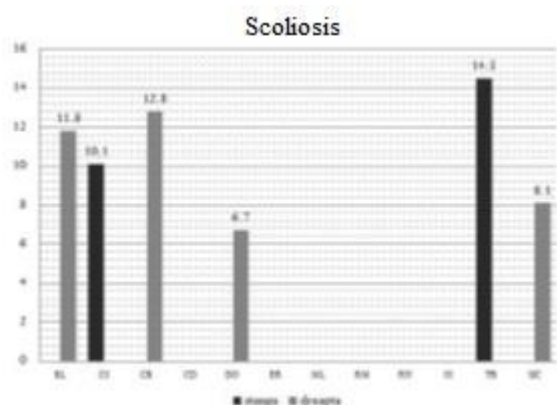


Figure 3. Scoliosis deviation angle values for men's team volleyball players

In the case of the BC SCM Timisoara basketball team we observed that 4 players present normal values in case of kyphosis measurements, 7 have values above the normal range (the highest being $63,1^\circ$ and 70°), and the other 2 players present with values below the normal limit ($24,6^\circ$ and $30,2^\circ$).

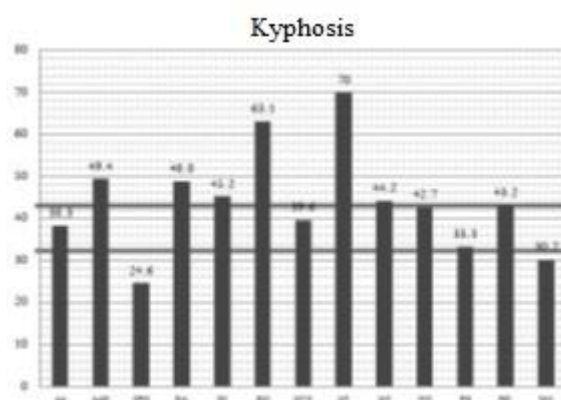


Figure 4. Kyphosis deviation angle values for men's team basketball players

Normal values for lordosis are between 22° - 28° and only 3 of the basketball players presented values within this normal range ($27,6^\circ$; $24,2^\circ$ and $25,9^\circ$), 2 present values above normal ($32,8^\circ$ and $32,2^\circ$) which indicated hyperlordosis leading to frequent back pain episodes; the other 8 players present with values below the normal limit. Out of these last 8 mentioned players, 2 of them presented values that indicate a drastic reduction of the physiological curvature of the spine and present loss of mobility of the lower spine associated with lower back pain for which they had been given specific treatment under the direct supervision of the kinetotherapist.

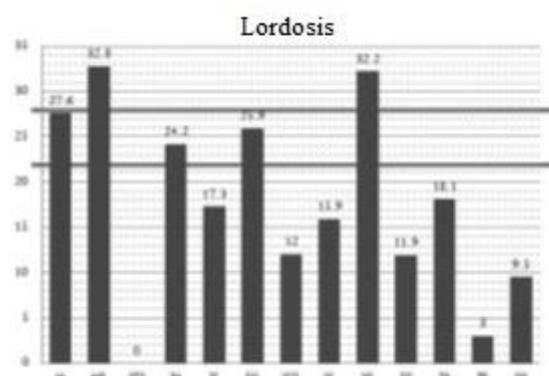


Figure 5. Lordosis deviation angle values for men's team basketball players

In scoliosis the normal value is 0° , a value that could be observed in the case of 3 players from the basketball team. 10 of the subjects presented values outside the normal range; 5 of them showed a left-

sided deviation of the spine ($15,2^{\circ}$; $2,7^{\circ}$; $7,8^{\circ}$; $14,5^{\circ}$ and $11,6^{\circ}$), while the other 5 presented a right-sided deviation of the spine ($8,2^{\circ}$; $13,2^{\circ}$; $14,6^{\circ}$; $5,5^{\circ}$ and $11,8^{\circ}$) indicating that the presence of scoliosis is tightly related to the dominant hand of the player and to the technique they use when shooting baskets.

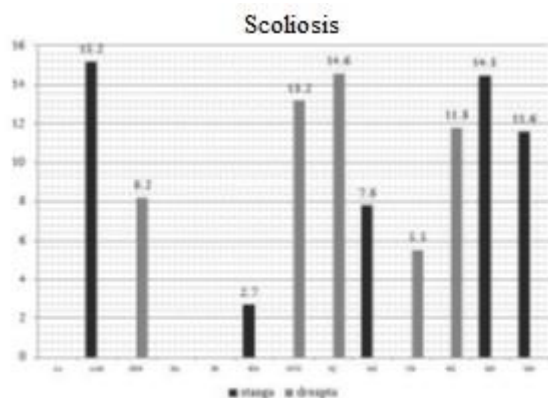


Figure 6. Scoliosis deviation angle values for men's team basketball players

The postural analysis of the football players from ASU Politehnica Timisoara shows that in the case of the kyphosis deviation only 2 players had measurements within the normal range, 4 had values above the normal range (the highest being $52,1^{\circ}$ and $51,5^{\circ}$), and the other 3 players present with values below the normal limit ($18,5^{\circ}$; $26,7^{\circ}$ and $25,3^{\circ}$) which indicates a reduction in the curvature of the spine. (Figure 7)

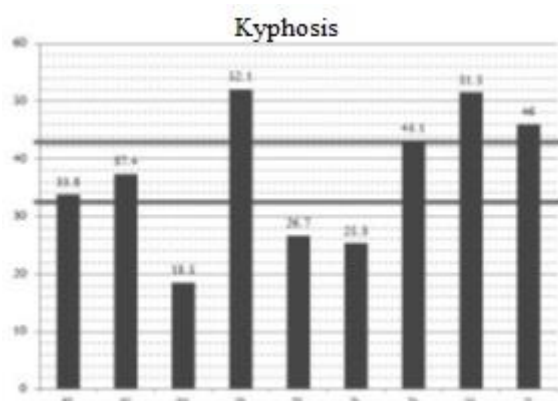


Figure 7. Kyphosis deviation angle values for players in the ASU Politehnica Timisoara team

Normal values for lordosis are between 22° - 28° and only 3 of the basketball players presented values

within this normal range ($27,6^{\circ}$; $24,2^{\circ}$ and $25,9^{\circ}$), 2 present values above normal ($30,1^{\circ}$ and $29,9^{\circ}$) which indicated hyperlordosis leading to frequent back pain episodes; the other 4 players present with values below the normal limit. Out of these last 4 mentioned players, one of them presented values that indicate a drastic reduction of the physiological curvature of the spine ($4,1^{\circ}$), frequently accusing lower back pain and following a strict and individualized kinetic program under the direct supervision of the kinetotherapist. (Figure 8)

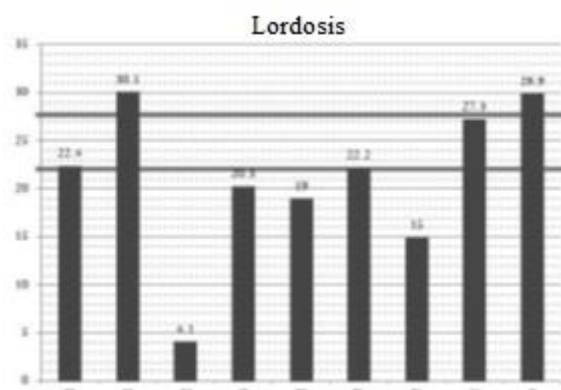


Figure 8. Lordosis deviation angle values for men's football team ASU Politehnica Timisoara

Following the measurements for frontal plane angles we came to the conclusion that neither of the athletes from ASU Politehnica Timisoara were in the normal range. All 9 athletes presented values above normal, out of which 5 presented a left-sided deviation ($14,1^{\circ}$; $10,3^{\circ}$; $0,3^{\circ}$; 13° and $5,9^{\circ}$) and 4 of them a right-sided deviation ($10,4^{\circ}$; $9,5^{\circ}$; $11,4^{\circ}$ and $7,8^{\circ}$).

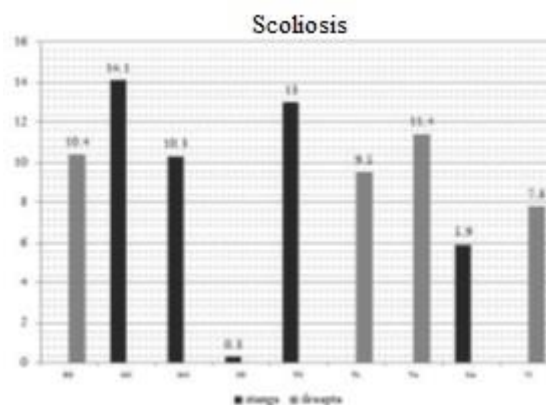


Figure 9. Scoliosis deviation angle values for men's football team ASU Politehnica Timisoara

Discussions

In a similar manner with our present study Małgorzata Grabara in "Analysis of body posture between young football players and their untrained peers" has also analyzed postural differences between two groups of subjects - a group of 73 football players and a group of 78 men that practice no sports, all with an age between 11 and 14. The measurements have been carried out using the MORIE technique, an objective and non-invasive method that records data about the spine as a whole in three different dimensions, in a very short period of time (approximately 5 seconds). Following this analysis they have observed that in the case of football players there is a tendency towards asymmetry in the shoulder alignment, whereas the pelvis was symmetrically aligned in a frontal plane. It was also proven that people who practice football are predisposed towards a reduction of the lumbar curvature. [3]

Another study, "Comparison of posture among adolescent male volleyball players and non-athletes", also carried out by Małgorzata Grabara has analyzed postural differences between volleyball players and people who practice no sports. The study group included 104 volleyball players, while the control group included 114 persons that do not practice sports; all subjects were between 14 and 16 years old. The body position was evaluated through the Moire method. Posture analysis in regard with the symmetry between the frontal and transversal planes had not shown significant differences between the two groups. The volleyball players though presented with a reduction of the lumbar curvature and an accentuation of the thoracic kyphosis in comparison to non-athletes [4].

In "Evaluation of Postural Asymmetry and Gross Joint Mobility in Elite Female Volleyball Athletes", carried out by Renata Vařeková et al, the authors evaluated the postural asymmetry and the joint mobility of female athletes in volleyball. 62 elite volleyball players from the Czech Republic and Slovakia were included in this study. The authors concluded that there is a posture specific for the elite volleyball players, as they have the acromion, scapula and iliac crest more elevated on the left side than on the right side, a fact observed in 50 of the study subjects (80.6%). Apart from two players, all

had functional scoliosis as stated by the Adams test, without any serious asymmetries. A high prevalence for hypermobility was also observed, which was no surprise as elite athletes in female volleyball perform constant stretching exercises. [7]

Joana Glista et al. have carried out a study, "Change in Anthropometric Parameters of the Posture of Students of Physiotherapy after Three Years of Professional Training" in which they followed possible postural changes of physiotherapy students after 3 years of professional training. The study group included 30 students selected randomly. Each subject was examined twice, at the age of 20 and at the age of 23. Both examinations were carried out by the same researcher and by using the same ultrasound ZEBRIS system. The study has shown that the physical activities that the subjects carry out with their patients during university years leads to a worse posture and deterioration of the parameters included in the study: body inclination angle, sacral angle, obliquity between pelvis and shoulder, distance between the scapulae, different in height for the two shoulders. [1]

In the study "Measuring procedures to determine the Cobb angle in idiopathic scoliosis: a systematic review" carried out by S. Langensiepen, et al., they investigate different new techniques used to determine the Cobb angle in idiopathic scoliosis and evaluate these new procedures to see if they are viable options in comparison to manual measuring of the Cobb angle. All these procedures have shown high fidelity degrees. The measurements carried out through digital procedures tend to be more accurate than the manual ones. Therefore, we cannot state that a certain technique is the best at this point in time but we have to underline the fact that formation of observers is very important. The authors also state that one should also take into account the cost-benefit ratio of the measuring procedure. [5]

Mária Takács, et al. in their study "The new processing of the results of examinations made with Zebris win-spine spine-measuring method and its validation", wanted to research and clarify if the Cobb angle values determined through X-ray results of the spine from young people suffering from scoliosis is different from the values obtained while calculating the special coordinated of the spinous

processes with the Zebris examination system. In the case of 25 children with scoliosis, they have carried out vertical x-rays of the spine. Based on the pictures they have calculated the values for thoracic kyphosis, lumbar lordosis and scoliosis using the Cobb method. The same children were then examined with the WINSPINE software, especially developed for the Zebris CMS-HS system, also in a vertical position. After comparing the results from the two measuring methods, the correlation was very strong for the values for dorsal kyphosis and lumbar lordosis (kyphosis = 0.80, lordosis = 0.94); the correlation between the values for dorsal scoliosis and lumbar scoliosis was moderate (dorsal scoliosis = 0.67; lumbar scoliosis = 0.73). The results from the two methods were almost identical in the sagittal plane because the correlation was very strong. The results also showed that scoliosis leads to deformities of the spine in all three planes, but the curvature degree was almost the same with both measuring methods. [6]

Conclusions

In our study we observed that the volleyball players presented with not specific predisposition for a deficiency in the dorsal region or in the frontal plane. On the other hand, most of the athletes presented a reduction in the lumbar spine curvature, 8 out of 12 athletes having measurement values under the normal range, which in time can lead to a plane back.

In the case of the basketball players from BC SCM Timisoara we could observe an accentuation of the dorsal spine curvature and a reduction of the physiological curvature in the lumbar area, 7 athletes presenting with values out of the normal range for kyphosis and 8 for lordosis. Regarding front plane deviations, except from two athletes, all the other ones presented a deficiency, but we could not specify which side is predominant. After analysing the results obtained for the football players at ASU Politehnica Timisoara, we cannot generally state that there is a deformity in the sagittal plane, but we observed that there is a clear deviation in the frontal plane.

We can conclude that professional players can also present postural changes determined in the case of volleyball, basketball, and football by the specific

positions the player take both during practice and during official games.

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