**Scope**
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# Assessment of Sagittal Spinal Curvature among Highly Trained Male Volleyball Players

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**Abstract:** The aim of this study was to evaluate the spinal thoracic curvature, lumbar curvature and pelvic tilt inclination in volleyball players .A total of 12male athletes aged 20 -28 years were evaluated in this study. The spinal mouse system(Ideag 360) was used to measure thoracic curvature, lumbar curvature and pelvic tilt in sagittal standing position. Study observed hyper thoracic kyphosis in volleyball players and no changes recorded in lumbar curvature & pelvic tilt inclination. In conclusion, the different type of high intensity sports training impact on angle of spinal curvatures. Repeating specific sports skills or movements for several times may generate specific spinal adaptations in sports persons.

**Key words:** spine, volleyball, thoracic, spinal mouse.

## Introduction:

The spine status is the most essential part of physical condition and the spine is the most significant component of the upper body. Spine has specific structural features to meet the mobility and stability of the body. Arches are the one of the features of the spine to strengthen by absorbing the pressure and also contribute to the muscles efficiency, associated with the spine. (Narasteh et.al. 2019).

The spine has physiological curvatures in the sagittal plane. The curve termed lordosis and kyphosis. The lordosis is the forward curve in the neck (cervical spine) and low back (lumbar spine). The kyphosis is the outward curve in the chest (thoracic spineo and hip region (sacral spine). The degree of spinal curvature depends on many factors such as gender, lifestyle, physical activity etc. the physical activity process of ossification of muscle strength, so it is the one of the important factor affecting posture structure ( Kutzner, 2001; Lichota, 2011)

The reciprocal curvature of the spine in sagittal alignment allows for efficient absorption of the loads applied to the spinal column and increases the efficiency of spinal musculature (Vialle et. al. 2005). Kyphosis and lordosis are common in number of sports athletes. They are usually observed in gym asters, wrestlers and water skier who begin the training process very early. MalgorzataGrabara (2017) says the training loads to a specific

sport may put strain on elements of the spine, leading to the development of postural asymmetries and may affecting on the spinal curvatures.

Specific positions and movements can generate different adaptations in spine postures. In sports training the athlete repeating the same skills or movements several times to gain more perfection in particular skill or movements. The sports performance also depends on the exhibition of perfect skill or movement in competitions. Previous researchers argue that the sports training influence on spine posture of an athlete. Specific positions and movements during sports training and competition may generate different adaptations in spinal curvatures and pelvic postures (Lopez PA et. al)

The specific of movements performed during the training and competition in a particular sports may influence the spinal anterior-posterior curvatures. (Mariumameer, 2017) in sports like volleyball forward flexion and extension are common, which tend to change the sagittal spinal curvature.

Achieving the highest performance in sports require performing heavy physical exercises that are repeated many times in un natural positions which causes muscle imbalances. Intensive physical exercise leads to adaptation of the spinal column. (Dejan, Sasa).Several researchers are confirmed that the sports training or physical exercises affects on the spine posture and spine mobility of the trainees. The current study aimed to assess the spinal curvatures (thoracic and lumbar curvature) and pelvic tilt among highly trained players of different sports events.

Volleyball training includes improving technical skills such as service, receive attacking and blocking. Jump and serve, attack comprise number of asymmetric techniques which may impact on posture. (Grabara M, 2015). Observing this, the study aimed to evaluate thoracic and lumbar spinal curvatures and pelvic tilt among male volleyball players while sagittal standing.

**Methodology**

A total of 12 male volleyball athletes aged 20 -28 years were participated in this study. The criteria under which the athletes were selected on 1). 2 to 4 hours daily training in their respective games, 2). 3 to 4 days of training per week 3). At least 3 to 4 years of training experience and 4). the athletes participated in state and inter university level tournaments.

Some information such as the subject's personal information and the history of injuries or pain were recorded in an information sheet prepared for this study. The subjects excluded if they reported thoracic or lumbar pain lasting for 6 months. Participants were instructed not to undertake and training session or strenuous exercise 24 hours before testing.

Each subject's assessment was carried out by the same examiner. The spinal mouse system (Ideag 360) was used to measure spinal curvature and pelvic tilt inclination of players in sagittal standing position.

Prior to taking measurements the researcher determined C7 (seventh cervical process, the starting point) and the top of the anal crease (the end point). The starting point (C7) and end point (top of the anal crease- S3) determined by palpation method and marked their position on the skin surface with a marker.

The subject assumed a relaxed standing position, with the head facing forward, the arms hanging by the side, the knees normally extended and the feet shoulder width apart. Spinal mouse was placed on defined C7 and moved along the midline of the spine, finishing at top of the anal crease at a constant speed.

In standing position the thoracic spine, lumbar spine and the pelvic inclination were recorded. In thoracic and lumbar curvatures, positive values corresponded to kyphotic curves and negative values corresponded to lordotic curves. With respect to the pelvic inclination, a value of $0^{o}$ represented the vertical position. Thus, an increase in the angle reflected an anterior pelvic tilt while a decrease in the angle (negative) reflected a posterior pelvic tilt. Descriptive statistics including means and standard deviation were calculated.

**Results:**

Demographic characteristics of the subjects are shown in table number 1, and the mean value and standard deviation of subjects spinal curvatures recorded in table number 2.

Table1. Mean value and SD of Demographic characteristics of male volleyball players

| | Mean value | Standard deviation |
|---|---|---|
| Age | 24.36 | 0.66 |
| Height (m) | 1.84 | 0.08 |
| Body mass (kg) | 73.25 | 8.70 |
| Body mass Index ($kg*m^2$) | 21.49 | 1.98 |
| Training years | 5.05 | 0.88 |
| Training hours per day | 5.47 | 0.67 |

The 12 volleyball players with age average of 24.36 ± 0.66 years, average height of 1.84 + 0.08 meters, average body mass of 73.25 + 8.70 kilo grams, average training of 5.05 + 0.88 years and training time of 5.47 + 0.67 hours per day was taken as the subjects for this study to evaluate sagittal spinal curvatures.

Table 2. Mean value and standard deviation of spinal curvatures of volleyball players

| Spinal Curvatures | Mean value | Standard deviation |
|---|---|---|
| Thoracic curvature | 43.684 | 3.934 |
| Lumbar curvature | -17.263 | 14.153 |
| Pelvic tilt | 12.692 | 5.368 |

Participants had an average age of 24.36 ± 0.66 years, a mean value of height 1.84 + 0.08 cms, average body mass 73.25 + 8.70 kg, Body mass index 21.29 + 1.98. The results showed the mean value of thoracic curvature (43.684+3.934), lumbar curvature (-17.263+14.153) and pelvic tilt (12.692 + 5.368). The results indicates male volleyball players who participated in this study having thoracic hyperkyposis.

**Discussion:**

The aim of this study was to assess the spinal curvature and pelvic tilt among male volleyball players. The spine has physiological curvatures in the sagittal plane which are classified as kyphosis and lordosis. The increased kypotic curvature than its normal range is hyper-kyphosis decreased kyphosis curvature is hypo-kyphosis. The increased lordotic curvature than its normal range is hyperlordosis and decreased lordotic curvature is hypolordosis. However the specific movements during sports training and competition generate different adaptations in spinal and pelvic posture (Lopez Minnero et. al. 2017).

In this present study, it is observed that volleyball players showed hyper thoracic spine. No significant changes were observed in lumbar spine angle and pelvic tilt in volleyball players. These results are similar to the previous researchers who assume the sports training might effect on thoracic kyphosis angle.

Volleyball players demonstrated increased thoracic kyphosis angle more frequently than non-training peers (Grabara M. 2015). JianuhuaYing(2020) argues that the movements like overland jump, deep bump set and spike movements causes larger thoracic kyphosis angle in volleyball. Their study noted that long training volleyball players had larger thoracic kyphosis angle than short-training players and no significant difference was found in lumbar lordosis angle and pelvic inclination.

Volleyball is one of the most popular sports. The event volleyball includes offensive and defensive skills. The offensive skills like attack, spike, and jump service needed long training to become master in particular skills. To get perfection in all these skills a player must do the skills repeatedly for long periods with high intensity. High-

level player needs to perform hard and one-sided repeated exercises for a long period in unbalanced positions, which are associated with dynamic loading(Lichota et. al 2011). Volleyball players repeat the maximal effort jumps in training and competition with the overhand movements to spike, block and frequent sudden change of direction sprint movements. (Hedrick. A. 2008).

The previous studies concluded that spinal variations are related to spinal twisting, flexing and spikers or attackers have more characterized by increased kyphotic angle. (Pope.MH et. al. 1986).

The present study indicated hyper-kyphosis in volleyball players. Previous studies noted that long-training volleyball players had larger thoracic kyphosis angles. Serve and attack constitute a series of asymmetric movements, which impose adverse effects on the body posture (MałgorzataGrabara, AndrzejHadzik 2009).Volleyball is a sport with a predominance of forward-bending and extension postures. This type of position has been associated with alterations in the sagittal spinal curvature(Gabara2014). Volleyball activities involve several factors such as symmetrical movements, muscle imbalance and continual overloading that damage body posture(Hitesh Modi, 2008).

The majority of researchers confirmed the influence of sports training on vertebral curvatures. The formation of the curvatures depended on the specificities of sports disciplines. The sprinters, runners, jumpers, and throwers had a deep spinal curvature, whereas swimmers, bodybuilders, sailors, soccer players, rugby players and non-athletes had a shallow curvature (Uetake et. al.).

Wang and Cochrane (2001) stated in their study thatvolleyball involves trunk flexion combined with trunk extension, rotational trunk movements in a standing position, and jumps. Serves and attacks in volleyball are performed with several asymmetric techniques which may result on spine.

Posture evaluation among the participants of different sports events indicated that thoracic kyphosis was greater than lumbar lordosis (kyphotic type of posture) in both volleyball and handball players, whereas sprinters and taekwondo competitors exhibited a balanced posture type. The specificity of movements performed during the training applied in a particular sport may influence the shape of anterior- posterior curvatures of the spine.

Sports training as a specific form of directional physical activity can exert a significant effect on the process of posture development of young men due to high training loads and repeated unilateral exercises.Each sport places the spine of the athletes in specific postures. Theoretically intensive training couldlead to adaptations in the spine and mightbe an important factor associated with changes in the degreeof spinal

curvatures. Years of intense athletic training may influence the spinal posture in certain sports.

Lichotaet. al (2011) mentioned in their study that prolonged involvement in sports training depending on intensity, technical requirements and sports competitions appliesconsiderable load on the spine and causes vertebrae, discs, ligaments and muscles to adjust to the given strain which may increase in the curves of the spinal column.

Volleyball players have to play numerous competitive matches in a year. In competitions a players must do repeated high-intensity explosive activities such as jumps, attaching, blockings and rapid changes in directions. These unexpected and repeated movements may create a load on spine and result in increasing or decreasing spinal curvature of the player.

**Conclusion:**

The study concludes that the different type of high-intensity sports training impact on angle of spinal curvatures. Sports training may generate specific spinal adaptations depending on the sports training.

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