Original Article

Comparison of Physiological Profiles among Collegiate Volleyball Players- With and Without Musculoskeletal Pain: A Case Controlled Study

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Abstract

Background: The success of athletes is greatly influenced by their morphological and anthropometric traits. Numerous studies have examined how often volleyball players experience musculoskeletal pain, which is typically located in the upper and lower back. The present study was to compare the physiological profiles with or without musculoskeletal pain in volleyball players.

Purpose: To compare the difference in the physiological profiles of volleyball players with or without musculoskeletal pain.

Materials and methods: The subjects were collegiate volleyball players selected based on inclusion criteria. They explained about the study. Volleyball players were allocated into two groups of total 83 containing group A (n=23) with musculoskeletal pain and group B without musculoskeletal pain. The pro agility shuttle, vertical jump, standing broad jump, 40-yard test, three cone drill were assessed and the body composition was assessed using skinfold caliper. The entire process was performed from February 2023 to June 2023.

Result: From the statistical analysis made with quantitative data revealed no statistical difference between group A and group B

Conclusion: The present study shows there was no significant difference in the physiological profiles of volleyball players with or without musculoskeletal pain.

Key words: volleyball players, physiological profiles, anthropometric measurement.

Introduction

Athletes' success is influenced by their physical traits. In volleyball, height matters for better ball handling, but taller players may struggle to jump due to higher body weight. Skinfold thickness helps assess body composition and dietary condition brought on by exercise.1 High-impact sports like volleyball, basketball, and football increase the risk of musculoskeletal issues due to agility, repetitive training, and aggressive play. Athletes' body posture is a focal point of research as exercise can impact spine curvature.[2] Volleyball players commonly experience upper and lower back pain. Higher thoracic

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kyphosis and lumbar lordosis angles correlate with increased lower back pain frequency, while a deeper angle of thoracic kyphosis is associated with more frequent neck pain.[3] Volleyball is a popular sport played by 200 million people worldwide. However, it comes with a risk of common injuries such as ankle, knee, and shoulder injuries. Volleyball's dynamic tasks (jumping, blocking, smashing) strain the musculoskeletal system, leading to ankle, knee, and shoulder injuries. Ankle injuries are typically acute, while knee and shoulder injuries can be acute or overuse related.[4] Italian senior volleyball players: centers are more ectomorph, less endomorph; setters are opposite. Hitters/opposites lie between setters and centers.[5] Tall stature's usefulness is well agreed to. Volleyball players have "kinanthropometric" profiles, involving jumping skills, height, body composition, velocity, and coordination, vital for technical prowess, strength, and coordination in the sport.[13] Volleyball players had lower body fat percentages and higher lean body mass and water percentages compared to controls, likely due to consistent physical activity and training.[6,1] Except for low values (often 5 mm or fewer), skinfold thickness was estimated to be the nearest 0.5 mm. These measurements were taken at the arms, triceps, subscapular, and supra-iliac regions of all participants.[10]

Aim

The aim is to study the comparison of physiological profiles between with and without musculoskeletal pain among collegiate volleyball players.

Material and Methods

Subjects: Recruited from Saveetha college physical education

Sampling technique: Convenient sampling.

Sample size:83 samples.

Study period: February 2023 to June 2023

Inclusion criteria:

- Collegiate volleyball players
- Age level (18-24)
- With and without musculoskeletal pain

Exclusion criteria:

- Players with recent surgery.
- Players with fractures.

Procedure

This was a case-controlled study. A total of (N=83) Subjects were assessed based on the inclusion and exclusion criteria. Collegiate Volleyball players, Age Level (18-24), With and without Musculoskeletal pain, Male players were included. Players who recently underwent surgery or had fractures were excluded from the study. Participants provided written authorization after being informed about the study's details. The participants were divided into two groups: Group A (N=23) and Group B (N=60). The following outcome measurements were assessed: height, body weight, skinfold caliper measurements, 40-yard sprint, vertical jump, standing broad jump, pro-agility shuttle, and three cone drill, all conducted on the ground. The vertical jump was measured in centimeters, the 40-yard test required measuring tape and cone markers, and the pro-agility test needed a stopwatch and six cones.

Subjects wore trousers for the ground-based tests. Before data collection, their age, height, and mass were recorded. Height was measured barefoot using a stadiometer, and body mass was measured with a weighing machine to calculate BMI. The next step was a structured warm-up consisting of ten minutes of running and flexible mobilization for the lower body. This was followed by linear and lateral runs over 20-40 yards, progressively increasing in difficulty. The tests were then conducted in the specified order.

Outcome measures:

Skinfold caliper: Skinfold caliper was used to check the body composition of an individual at the sites of Triceps, chest, subscapular, midaxillary, abdominal, iliac crest, thigh, calf.

40-yard sprint: A timing light system recorded sprint episodes at 10 yards, 20 yards, and 40 yards, using gates at specific intervals. Subjects started the sprint 30 cm behind the starting line from a three-point stance, and the best trial of two attempts was rated based on timing accuracy down to 0.001 second.

Vertical jump: To maximize vane movement, the individual stood face-on to the Vertec on their dominant side with feet on the ground, using the last vane movement as the zero reference. The height was measured from the highest vane moved during the jump without moving forward. Knee angle during the jump wasn't restricted. Vertical jump height was calculated by subtracting reach height from leap height. Each subject had three trials, with the best one analyzed.

The pro-agility shuttle: Subjects practiced for the test in advance, starting with a three-point stance between timing gates, crossing the centerline. The test involved a hand tap on the line, followed by a 5-yard (4.57m) sprint to one side. They touched marked lines at both ends of the shuttle for turning. After a 10-yard (9.14 m) run to the opposite side, timing ended upon entering the gate. Three trials were conducted for left and right movements.

Standing broad jump: For the standing wide jump, the athlete placed both toes on the back of the starting line and leaped forward while swinging their arms and crouching, aiming for a two-footed landing. To be valid, the landing had to be stable ("stick" the landing). If not, the trial was redone. Body angles during the jump's warm-up stage were not restricted. The length was measured from the line of sight to the back of the heel at the landing using a tape measure. Each subject performed three tests, and the best trial was analyzed.

Three cone drill: Subjects practiced before the test, starting in a three-point position at Marker 1, 30 cm from the starting line. At the start, they sprinted to Marker 2, touched the floor with their right hand, and returned to Marker 1, repeating the action. Next, they circled Marker 2, ran through Marker 3, around Marker 2, and finished at Marker 1. A subject guided them to ensure correct completion. Timing started when the participant opened the entryway and ended when they closed it after the test. Two trials were completed, with right turns between Markers 2 and 3 in the first trial and left turns in the second. The study used the shortest duration between the three trials for the pro-agility shuttle.

Data Analysis:

Statistical analysis was done to evaluate the physiological profiles with and without musculoskeletal pain among collegiate volleyball players. The selected variables were assessed using Mann-Whitney U test. Mean and standard deviations were calculated and the comparison of the data to normative values.

Table 1: BMI characteristics

BMI (N)	Mean	SD
83	22.85	4.03

Table 2: Agility test

With musculoskeletal pain (n=23)	Without musculoskeletal pain (n=60)			Mann Whitney U test		
Variables	Mean	SD	Mean	SD	Z value	P value
40 yards	5.86	0.37	5.77	0.42	-0.973	0.331
Vertical	2.46	0.18	2.65	1.005	-1.208	0.227
Pro agility	4.37	0.23	4.24	0.26	-1.986	0.047
Standing	2.46	0.12	2.50	0.21	-0.316	0.752
Three cones	10.27	5.66	8.74	0.40	-3.359	0.001

Table - 3: Body Composition

Without musculoskeletal pain (n=23)			With musculoskeletal pain (n=60)		Mann Whitney U test	
Variables	**Mean**	**SD**	**Mean**	**SD**	**Z value**	**P value**
Triceps	9.73	2.299	9.30	1.579	-0.489	0.625
Midaxillary	8.8833	1.58480	9.0435	0.92826	-1.084	0.279
Chest	8.9167	1.66001	8.6522	1.66812	-0.510	0.610
Subscapular	9.9667	2.25469	9.7391	2.00493	-0.382	0.703
Abdomen	11.6000	2.63741	11.2174	2.64500	-0.628	0.530
Iliac crest	10.2167	2.02603	10.2174	2.13108	-0.067	0.947
Thigh	10.1000	2.23758	9.5652	1.61881	-0.851	0.395
Calf	8.7500	1.49150	8.7826	1.12640	-1.347	0.728

Results

The participants were selected based on the specific age group (18-24) of collegiate volleyball players. Body mass index was assessed before the trails. A total of 83 participants were included in the study, selected according to specification for inclusion and exclusion criteria. Among the participants, 23 individuals experienced musculoskeletal pain, including pain in the shoulder, wrist, knee, and ankle, while the remaining 60 participants were without musculoskeletal pain. The BMI of both group A with and group B without musculoskeletal pain participants of 83 collegiate volleyball players with mean of 22.85 ± SD of 4.03. The between the group results using Mann Whitney U test, the variables of group A with and group B without musculoskeletal pain were not significant (p>0.05). The participants' 40 yards sprint measurements were recorded with mean score of 5.86 ± SD of 0.37 (A), 5.77 ± 0.42 (B) and P value is 0. 331.Vertical jump test with mean of 2.46 ± SD of 0.18(A), 2.65 ± 1.00 (B) and P value is 0.227. Pro agility test with mean of 4.37 ± SD of 0.23 (A), 4.24 ± 0.26 (B) and P value is **0.047**. Standing broad jump with mean of 2.46 ± SD of 0.12 (A), 2.50 ± 0.21(B) and P value is 0.752.Three cone drill with mean of 10.27 ± SD of 5.66 (A), 8.74 ± 0.40 (B) and P value is **0.001**. Therefore, three cone drill and pro agility shuttle values are significant. The Normal significant value is less than 0.05. The variables of group A with and group B without musculoskeletal pain were not significant (p>0.05) for skin fold calliper variables at eight sites. The participants triceps with mean of 9.73 ± SD of 2.29 (A), 9.30 ± 1.57 (B) and P value 0.625. Midaxillary with mean of 8.88 ± SD of 1.58 (A), 9.04 ± 0.92 and P value is 0.279. Chest with mean of 8.91 ± SD of 1.66 (A), 8.65 ±1.66 (B) and P value is 0.610. Subscapular with mean of 9.96 ± SD of 2.25 (A). 9.73 ± 2.00 (B) and P value is 0.703. Abdomen with mean of 11.60 ± SD of 2.63 (A), 11.21 ± 2.64 (B) and P value is 0.530. Iliac crest with mean of 10.21 ± SD of 2.02 (A), 10.21 ± 2.13 (B) and P value is 0.947. Thigh with mean of 10.10 ± SD of 2.33 (A), 9.56 ± 1.61 (B) and P value is 0.395 and Calf with mean of 8.75 ± SD of 1.49 (A), 8.78 ± 1.12 and P value is 0.728. The present study found no significant difference in physiological profiles between collegiate volleyball players with and without musculoskeletal pain. However, the three-cone drill and pro agility shuttle tests showed a significant difference in performance outcomes between the two groups. The analysis demonstrated that the three-cone drill exhibited a higher level of variability compared to the pro agility shuttle. This suggests that musculoskeletal pain has an impact on the performance of both the three-cone drill and pro agility shuttle test. This pie chart demonstrates how players with musculoskeletal pain have significant psychological perseverance and were unaffected by their performance level. The three-cone drill and pro agility tests, which evaluate a player's ability to change direction while accelerating, had an impact on the performance of two players.

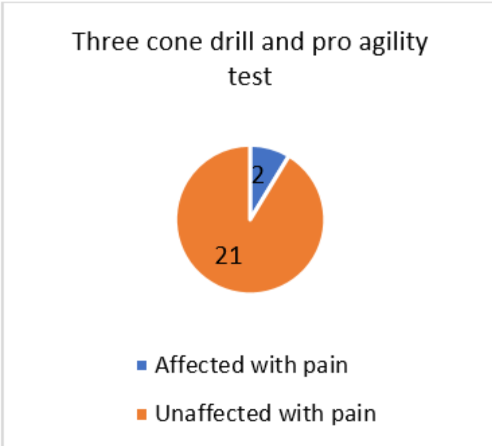

Fig. 1 Participants Involved in Pro Agility

Therefore, performance requires a higher pain tolerance.

Discussion

This study compared physiological profiles of collegiate volleyball players with and without musculoskeletal pain. In order to help those participating in both the immediate and future planning stages of yearly conditioning programs, an effort was made to incorporate information on the physical characteristics (skinfold caliper for measuring the body composition) and physiological characteristics which includes various variables like 40-yard sprint, vertical jump test, pro agility test, standing broad jump and three cone drill. The study finding showed musculoskeletal pain has no effect on participants body composition using skinfold caliper. Despite the fact that the pro agility shuttle 5-10-5 and three cone drills were affected in participants with pain when compared with no pain participants. The three-cone drill demonstrated a considerably greater impact compared to the pro agility shuttle. However, 40-yard sprint, vertical jump test and standing broad jump were not affected in participants with pain. The pro agility test and three cone drill assess how quickly a player can change direction while accelerating, requiring a higher pain tolerance for performance. As a result, players suffering from musculoskeletal pain did not have the same level of tolerance to perform. The study which was done by Julia S Malmborg in 2018 concluded that participants with persistent pain had poor medical conditions but performed at the same level as those with infrequent pain. This is compatible with the current study findings that players' performances were unaffected by musculoskeletal pain as they had high psychological perseverance.[18]

The study conducted by MJ Duncan in 2006, which examined the anthropometric and biological characteristics of elite volleyball players, highlights the value of analyzing physiological profiles for informing position-specific training plans and addressing potential weaknesses in the sport. These findings align with my study, where the identification of weaknesses in players was based on anthropometric and physiological profiling. By incorporating these findings into training programs, athletes can target and improve their specific weaknesses, thereby optimizing their performance and skill development in their respective sport.[13]

The findings from Koley et al.'s 2010 study on Indian inter-university volleyball players, which demonstrated superior hand grasping power compared to controls and indicated mechanical stability benefits in the sport, are consistent with recent research showing that volleyball training significantly improves skill levels without notable changes in skinfold thickness or Vo2max, suggesting that agility performance in volleyball may be influenced more by skill execution and other factors rather than alterations in skinfold thickness.[14]

Kirsch's 2019 analysis links GIRD to shoulder pain in tossing athletes.[17] To minimize musculoskeletal pain and enhance performance during tossing, adopt these strategies: 1) Implement reactive adjustments for increased arm external rotation, and 2) Follow H. Hebestreit's 2008 recommendations to describe, identify risk factors, and implement safeguards against sports injuries.[15]

Conclusion

The findings of the present study indicate that there were no notable differences in the physiological profiles of volleyball players with and without musculoskeletal pain. It was observed that common physical attributes such as the 40-yard sprint, vertical jump, and standing broad jump were not significantly affected by musculoskeletal pain. However, the three-cone drill, which demands a high pain tolerance, displayed a significant impact compared to the pro agility shuttle. These insights shed light on the specific areas of performance that may be influenced by musculoskeletal pain in volleyball players, emphasizing the importance of pain management strategies and targeted interventions to optimize overall performance.

Ethical clearance: The ISRB committee of a private hospital and institution in Chennai has provided its clearance for the conduct of human research that complies with all applicable national laws and institutional regulations. (Application Number 03/016/2022/ISRB/SR/SCPT).

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Conflict of interest: The authors state that there is no conflict of interest.

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