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Comparative study of leg muscle strength and flexibility among cricket, volleyball and badminton players from selected places of Bengaluru

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Abstract
Background and Objectives: A sport has mass participation, drawing individuals either for fun, physical exercise, or work. Sports have been organized at competitive levels in the past, but rivalry in sports has now reached the highest level. Lower leg power serves as an early indicator of diminished function, while elevated leg power may signal the preservation of physical functionality. Flexibility, an integral facet of physical fitness, holds varying degrees of importance across different sports. It becomes even more critical as it enhances athletic efficiency and reduces the risk of injuries. In cricket, muscle strength and flexibility are essential factors that determine an athlete's physical condition, as they are required for batting, bowling, and throwing purposes. Leg strength plays a significant role in the performance of cricket players. Short, explosive movement patterns, quick, agile positioning, jumps, and blocks characterize volleyball. The repeated actions of jumps, abrupt stops, and various movements in volleyball exert significant pressure on joints, elevating the susceptibility to injuries. To mitigate these risks, a protective measure often involves strengthening the musculature surrounding the joints and optimizing joint flexibility.
Methods: This study was done in a sports set-up where 90 subjects were considered equal distribution. The study recruited a population with an age limit of 15 to 24 years who were screened and assessed for handgrip strength, leg muscle strength, shoulder flexibility and trunk flexibility. Demographic data of the subjects was collected and recorded. The data was then subjected to statistical analysis.
Results: The study does not directly correlate lower or higher BMI with decreased flexibility. They all exhibited the same levels of flexibility and reduced amount of strength.
Conclusion: The study concludes that volleyball players had the highest levels of hand grip, leg muscle strength and shoulder flexibility with the least amount of trunk flexibility compared to badminton and cricket. The badminton players had the most minor hand grip strength and shoulder flexibility. In contrast, the cricket players had moderate hand grip strength and shoulder and trunk flexibility compared to volleyball and badminton players.

Keywords: Flexibility, leg muscle strength, badminton, cricket, volleyball, hand grip strength, shoulder flexibility, trunk flexibility

Introduction
A sport has mass participation, as it draws individuals for fun, physical exercise, or work. Sports have been organized at competitive levels in the past, but rivalry in sports has now reached the highest level. Hundreds of young aspirants devote time and energy to these activities to achieve success. Muscle strength is a vital component of an athlete's performance [2]. Morphological and neural factors, including muscle cross-sectional area and architecture, musculotendinous stiffness, motor unit recruitment, rate coding, motor unit synchronization, and neuromuscular inhibition [3] underpin it. Muscle strength may be defined as the maximum force exerted by a muscle [4]. Muscle strength exercise is a central component of athletic training practice. Greater muscular strength is strongly associated with improved force-time characteristics contributing to an athlete's overall performance [6]. Lower leg power is an early indicator of poor function, and higher leg power may indicate preserved physical function [7]. Flexibility stands as a vital component within the realm of physical fitness, assuming varying degrees of significance across diverse sports. Its importance amplifies as it not only enhances athletic efficiency but also serves as a crucial factor in mitigating the risk of injuries. It may be defined as the capacity to move a limb or a body part throughout its range of motion [4].

Some aspects related to lower limb muscle strength deficits and decreased range of motion (ROM) have been associated with a higher likelihood of sustaining a sports injury [9]. Badminton is one of the most widely played sports in the world. The Badminton World Federation (BWF) estimated that about 150 million people play the game worldwide and that more than 2,000 players participate in international competitions. Badminton is a non-contact racquet sport requiring jumps, lunges, quick changes in direction and rapid arm movements from various postural positions [10]. The decision to include badminton in the 1992 Olympics Game increased participation in the game [11].

Cricket is a popular international team sport with multiple game formats ranging from long-duration multiday tests to short-duration Twenty20 gameplay [12]. Cricket is played on a rectangular pitch centred on an oval field with 11 players on a team. Each side comprises batsman bowlers, fielders, and a wicketkeeper [13]. Increased upper body strength is significant in cricket when executing powerful cricket strokes. Well-timed, powerful cricket strokes give batsmen the best chance of hitting boundaries [14]. The physiological demands of cricket are relatively mild, except in fast bowlers during prolonged bowling spells in warm conditions. However, the physiological demands of cricket may be underestimated because of the intermittent nature of the activity and the generally inadequate understanding of the physiological demands of intermittent activity [15]. Leg strength plays a significant role in the highest performance of Cricket players. Back strength is also essential for fast bowlers to perform bowling with maximum speed. Batsmen also require good back strength and bating skills for a longer time [16]. Workload monitoring and analysis have allowed a greater understanding of the risk factors for injury and could lead to more excellent injury prevention in the future [17].

Volleyball has become an extremely popular participation sport worldwide [18]. The Federation Internationale de Volleyball estimates that 500 million people play volleyball worldwide [19]. Short, explosive movement patterns, quick, agile positioning, jumps, and blocks [20] characterize the game. The demanding actions of repeated jumps, stops, and various volleyball movements place considerable stress on joints, elevating the vulnerability to injuries. To mitigate these risks, a common protective strategy involves fortifying the musculature around joints and optimizing joint flexibility. The performance of muscles not only influences the game but also plays a crucial role in achieving favourable outcomes. Various studies have explored the levels of strength and flexibility in badminton, cricket, and volleyball players. This study focuses on comparing the leg muscle strength and flexibility among players engaged in badminton, cricket, and volleyball.

The primary objectives of this study are to evaluate and compare the leg muscle strength, hand grip strength, and flexibility levels among cricket, volleyball, and badminton players in selected areas of Bengaluru. The research aims to provide insights into the physical performance characteristics of athletes engaged in these three sports. By systematically measuring and assessing leg muscle strength, hand grip strength, and flexibility, the study aims to contribute valuable information that can aid in understanding the specific physical demands placed on players in each sport. The comparative analysis will shed light on potential variations in these aspects across the different sporting disciplines, thereby offering a comprehensive perspective on the athletic profiles of cricket, volleyball, and badminton players in the Bengaluru region.

Beyond measurement, this study aims to glean valuable insights for crafting individualized exercise prescriptions to enhance sports performance by assessing flexibility and strength in cricket, volleyball, and badminton players in Bengaluru. This approach allows practitioners and coaches to design targeted training regimens tailored to the unique physical demands of each sport, minimizing injury risks. Conducting prior assessments before engaging in sports activities underscores the importance of a proactive approach to optimize athlete well-being and performance.

Source of data

Amateur sports players of cricket, badminton, volleyball from selected sports training centres of Bengaluru (Centre for sports sciences, MES Grounds)

Method of collection of data

The data for the study was collected based on the following categories:

- **Study setting:** Sports setup in Bengaluru, Karnataka
- **Study subjects:** Male population between the age group 15 to 24 years
- **Study design: A** Comparative study
- **Sampling technique:** Convenient sampling
- **Study recruitment:** Various sports clubs and academy at selected places of Bengaluru.
- **Sample size calculation:** Subjects matching up inclusion and exclusion criteria and each sports normal subject of 30 players were recruited.

Sample size estimated based on prevalence of earlier study N=90.

Inclusion Criteria

- Subjects willing to participate and volunteer in study and ready to sign informed consent form.
- Subjects between the age group of 15 -24 years
- Male subjects will be recruited.
- Amateur players of cricket, badminton and volleyball players.
- Practicing daily in cricket, badminton and volleyball 2-4 hours per week.

Exclusion Criteria

- Subjects with neurological, musculoskeletal deformities.
- Subjects with psychiatric conditions.
- Subjects who had already participated in similar kind of study.
- People with disabilities.
- Ambidextrous subject using both hands with equal ease.
- Subjects suffering from any systemic illness or recent orthopaedic injury.
- Recent surgery.

Materials Required

- Consent form
- Screening form
- Hand grip dynamometer MG4800
- Sit and reach test box.
- Chest-back-leg dynamometer (Baseline^{R})
- Weighing machine
- Inch tape
- Stationaries

The study employed a meticulous methodology, utilizing carefully selected materials and measuring tools to ensure ethical considerations and precise data collection for assessing leg muscle strength, hand grip strength, and flexibility among cricket, badminton, and volleyball players in Bengaluru. Consent and screening forms upheld ethical standards, while specialized tools like the Hand grip dynamometer MG4800 and Back-leg-chest dynamometer (Baseline^{R}) were used for objective measurements. Additional tools, including weighing machines and inch tape, contributed to accuracy, and flexibility was assessed through the Shoulder Rotation Test and the Sit and Reach Test. This comprehensive and standardized approach enhanced the overall robustness of the study's methodology.

Procedure

The study began by securing informed written consent from participants and adhered to predefined inclusion/exclusion criteria during subject recruitment. Demographic information, including age, height, weight, and BMI, was systematically recorded. Shoulder and trunk flexibility, hand grip strength, and leg strength were assessed using specific tests and dynamometers.

The observational data collection method ensured accuracy and consistency. Following ethical guidelines, the collected data underwent thorough statistical analysis to draw comparisons among leg muscle strength, hand grip strength, and flexibility levels in cricket, badminton, and volleyball players in Bengaluru. The study aimed to comprehensively understand the physical attributes under investigation.

Statistical Analysis

Descriptive statistics: All the categorical variables were presented as frequency tables and graphs wherever necessary. The quantitative variables were summarized using Mean ± standard deviation with a 95% confidence interval. The data obtained from the study are analysed statistically, and the results are as follows:

Results Analysis

Table 1: Age Distribution

Age (years)	Frequency	Per cent
15-16	8	8.8
17-18	15	16.6
19-20	12	13.3
21-22	23	25.5
23-24	32	35.5
Total	90	100

Table 2: Hand Dominance Distribution

Hand Dominance	Frequency	Per cent
Right	85	94.4
Left	5	5.5
Total	90	100

Table 3: BMI Distribution

BMI	Frequency	Per cent
Underweight	7	7.7
Normal	66	73.3
Overweight	16	17.7
Obese	1	1.1
Total	90	100

Table 4: Distribution of the sport played.

Sport Played	Frequency	Per cent
Badminton	30	33.3
Volleyball	30	33.3
Cricket	30	33.3
Total	90	100

Table 5: Shoulder flexibility classification

Shoulder Flexibility	Frequency	Per cent
Good	80	88.8
Fair	9	10
Poor	1	1.1
Total	90	100

Table 6: Sit and Reach Test classification.

Sit and Reach Test	Frequency	Per cent
Super	24	26.6
Excellent	37	41.1
Good	26	28.8
Fair	3	3.3
Total	90	100

Table 7: Hand grip strength classification

Hand grip strength	Frequency	Per cent
Excellent	1	1.1
Above average	5	5.5
Average	9	10
Below average	33	36.6
Poor	42	46.6
Total	90	100

Table 8: Leg muscle strength classification

Leg muscle strength	Frequency	Per cent
Below Average	5	5.5
Poor	85	94.4
Total	90	100

Discussion

A comparative study in selected areas of Bengaluru assessed leg muscle strength and flexibility among cricket, volleyball, and badminton players aged 15 to 24. Using tools like Hand grip dynamometer and Chest-back-leg dynamometer, hand grip and leg muscle strength were measured, while shoulder and trunk flexibility were evaluated with inch tape and sit and reach test box.

The study, including 90 participants who signed informed consent forms, revealed that subjects aged 15-17 exhibited lower muscle strength than those aged 18-24. There were no significant differences in flexibility. Obese individuals, regardless of age, have a greater absolute maximum muscle strength compared to non-obese persons, suggesting that increased adiposity acts as a chronic overload stimulus on the antigravity muscles (e.g., quadriceps and calf), thus increasing muscle size and strength. However, when maximum muscular strength is normalized to body mass, obese individuals appear weaker [25]. The result of previous research showed that there was a significant difference in flexibility between cricket and volleyball players. The cricket players' group has much more flexibility than the volleyball players' group [26].There is a positive relationship between leg strength, grip flexibility and the performance of badminton players [27].

Table 9: Show Present study findings

Present study findings	
Hand grip strength	Volleyball > Cricket > Badminton
Leg muscle strength	Volleyball > Badminton > Cricket
Shoulder flexibility	Volleyball > Cricket > Badminton
Trunk flexibility	Badminton > Cricket > Volleyball

Volleyball players demonstrated superior hand grip and leg muscle strength compared to cricket and badminton players. Cricket and volleyball players exhibited greater shoulder flexibility than badminton players, with similar numbers showing good flexibility. Badminton players displayed higher trunk flexibility, surpassing cricket and volleyball players, with 17 players showcasing excellent flexibility.

Conclusion

The study assessed hand grip and leg muscle strength, shoulder, and trunk flexibility in cricket, volleyball, and badminton players, revealing that underweight, overweight, and obese subjects exhibited good flexibility but less strength. Volleyball players showed superior hand grips, leg muscles, and shoulder flexibility, while badminton players excelled in trunk flexibility. The conclusion emphasizes the need for refining and expanding the study, advocating for a larger sample size to comprehensively understand the physical attributes. Future research should explore intervention strategies for optimized sports performance, considering gender and hand dominance, and expanding geographical coverage to enrich our understanding of factors influencing sports performance in Bengaluru.

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