Research Article

The British Journal of Sports Medicine (ISSN 3064-8130)

# Influence Of Tennis Court Surface On Outcomes Of Circuit Training Among Recreational Tennis Players.

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**Received Date** : December 10, 2024
**Accepted Date** : December 10, 2024
**Published Date** : January 11, 2025



## ABSTRACT

The characteristics of tennis game require contrasting velocity, acceleration, deceleration, turns, changeovers, strokes, sprints, sliding and upper arm involvement, making players perform short bursts of high-intensity exercise interspersed with periods of rest or low-intensity activities over a prolonged period. Circuit training was designed to increase muscle strength, endurance and flexibility and significantly reduce workout time. The mechanical properties of clay and acrylic courts vary, which alters the movement patterns and style of play. When low friction and high-friction surfaces are analyzed , high-friction surfaces leads to kinematic changes such as lower attack angles (measured horizontally ), in addition to faster running speeds and movements. To determine the influence of the tennis court surface on the outcomes of circuit training among recreational tennis players. This was an experimental study in which 20 participants were recruited according to the inclusion and exclusion criteria. The pre test results were analyzed via a T test for agility, a 50 yard dash test for speed, a vertical jump test for lower limb strength, wiebe tennis performance strength tests for the forehand and back hand after 8 weeks of the circuit training protocol post test was analyzed . Comparison between pretest and posttest results within groups and between group A and Group B were not statistically significant. This study revealed that there was no significant improvement in either group.

**Keywords:** *Tennis Recreational Players, Circuit Training, Clay Court, Acrylic Court.*

## INTRODUCTION

In recent decades, the evolution of sports has transformed from leisure activity to a major industry Sports sector. It is an art of expressing human emotions and involves various aggressive movements, such as running, hitting, jumping, diving, skating.

In dispersion through distinct sports , Tennis is being categorized under ball-over net games. The word tennis commences from the French word 'TENEZ", which means take it and play. It is being primitively termed Lawn tennis by a British Man – Major Walter Winfield – who coined to Britain in 1873. After a decade, the game was introduced in INDIA by British army and civilian officers. The tennis game is performed on a distinct surface, and some of the relevant tournaments are

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Wimbledon in a grassland court, French open in a clay court, Indoor Madrid open and other ATP tournaments in an acrylic court.

The characteristics of the tennis game include contrasting velocity, sprinting, sliding, and twisting movements, which allow the players to perform high intensity exercise with a period of rest[1].The participants must have high aerobic fitness, muscle strength and agility to achieve the maximum performance level. In depicting the physiological components during an athletes performance, there is an increase in vo2 max and heart rate with progress, which decreases during the rest period,vo2 max values range between 44 and 69ml/kg/min, which parallels the heart rates found to be between 144.6 b/min.

Previous evidence illustrates that the physiology of tennis requires both aerobic and anaerobic capacity because of its long duration, moderate mean heart rate values and rapid change in direction. The physiological peculiarity of player performance relies on 2-8 secs of burst activity followed by rest period of 20-25 secs. The nature of this type of workload may lead to different physiological reactions.[2]

The underlying requirements of a player during performance are speed, strength and agility. Speed is determined as the deracination of the player per unit time regardless of direction; running speed plays a crucial role in accelerating and deaccelerating the player[3]. In parallel, agility is characterized as a player's change in direction precisely and rapidly approaching stimulus, such as movement of a ball or the movement of an opposing player. During performance, the player continually moves, as for every shot, the velocity and spin of the ball varies drastically, which significantly pushes the player in lateral and multidirectional movements. Strength is the ability of a muscle to provoke force with a single maximal effort[5]; to be more clear, strength is required in both muscle and joints to significantly reduce the number of injuries and enhance the performance of the player more specifically. The upper body strengthening plays a decisive role in sustaining a solid contact in holding the racket while hitting back the ball into the opposition court with the same force of velocity and spin. During performance, the upper body plays a more dominant role than the lower body, does however, regardless of whether lower limb injuries, prevail, the lower limb muscles should also be strengthened bilaterally.[10]

Circuit training was designed to increase muscle strength, endurance and flexibility and significantly reduce workout time, and muscles become fatigued after a series of repetitions. An ample period of rest time is necessary to recover the muscle and continue the next set of exercises For contraception, circuit training is a series of exercises that involves a distinct variety of exerices for different regions in one set, with a minimal period of rest. Alcaraz Ramon et-al reported that circuit training effectively decreases the training time[6]. Lozano et al. reported that circuit training permits greater motor engagement time[7]. Circuit training is incorporated in sports to increase both the strength and cardio vascular endurance of the player in parallel, which enhances performance during a game.

Tennis can be exercised and performed on distinct Surfaces , such as grass clay, carpet and acrylic courts . The mechanical properties of each surface are unique, in which the velocity of the ball, bouncing of the ball, game style and length of the game vary accordingly. The grass court and hard court are termed the fastest surface with short bouncing balls, in parallel, the clay court is designed as the lowest surface with high bouncing balls.The mechanical properties of clay and acrylic courts vary, which alters the movement patterns and style of play. Analyzing low and highfriction surfaces leads to kinematic changes [8,9].

Most commonly, tennis is a unique game that can be performed on a distinct surface. There are studies that defines peculiarly when the mechanical properties of the surface change in addition to the physical and physiological parameters, which also changes accordingly. Currently, educators and players tend to adopt a solitary exercise protocol for various surfaces. However evidence on a definite training protocol that is idiosyncratic to a surface is still lacking . The novelty of this study is that it facilitates the perspective of educators and players in exercising specific training protocols in relation to the surface, which increases the strength of the muscle, cardiovascular endurance, speed and agility, which significantly enhances the performance of players.

## OBJECTIVE

Tennis is a sport in which skill is the primary prerequisite for successful performance, with complex interactions among several physical components. In addition, tennis is the game that is being played on different court surfaces. Studies have shown that circuit training has positive effects on increasing strength, agility and speed among tennis players. Many studies have analyzed the properties and biomechanical response of tennis players in relation to different tenni ssurfaces. However, research on the physiological response of a tennis player in relation to the tennis court surface is still lacking. The goal of this study was to analyze the physiological response of a tennis player in relation to the tennis court surface on the basis of the outcome of circuit training. This study will also encourage educators to incorporate appropriate training protocols relative to the court surface. This study is linked with the third sustainable development goal (SDG) to transform the world, i.e., the goal of health and wellness.

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## METHODOLOGY

The study was conducted between 2022 and 2023 in the Vellore district of Tamil Nadu Participants aged 15–25 years, of both genders with a minimum of 2 years of experience, those who adopted to play in a clay court or acrylic court were recruited those with any injury for 6 months, those who underwent surgery for 6 months, and those with any other strengthening program were excluded from the study. Informed consent was obtained from the recruited players. Then, the players were split into two groups, Group A (clay court) and Group B (acrylic court), in accordance with the court they played. The pretest results were analyzed via a t test for agility, 50-yard dash test for speed and a Wiebe tennis performance test. The players were subsequently subjected to circuit training for 8 weeks after which the post test results were analyzed. The collected data were statistically analyzed via SPSS software.

## RESULTS

**Table 1.** Frequency Of Participants Age In Group A And Group B.

| Group A(Clay court) & Group B(Acrylic court) | | Frequency | Percentage | Mean ± SD | Min – Max |
|---|---|---|---|---|---|
| Age | 15 | 2 | 20 | 18 ± 2.449 | 15 – 23 |
| | 17 | 1 | 10 | | |
| | 18 | 4 | 40 | | |
| | 20 | 2 | 20 | | |
| | 23 | 1 | 10 | | |
| | Total | 10 | 100 | | |

**Bar Diagram 1.** Frequency Of Participants Age In Group A And Group B

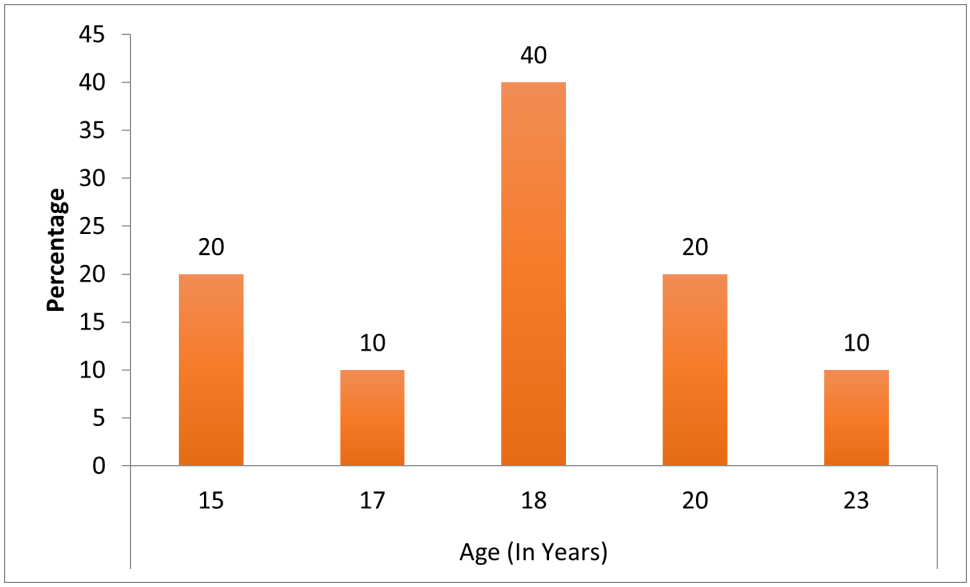

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**Table 2.** Frequency Of Participants Gender In Group A And GroupB.

| Group A(Clay court) & Group B(Acrylic court) | | Group | | | |
|---|---|---|---|---|---|
| | | Clay Court | | Acrylic Court | |
| | | n | % | N | % |
| Mean ± SD | | 17.70 ± 3.268 | | 17.90 ± 2.726 | |
| Gender | Female | 5 | 50.0% | 5 | 50.0% |
| | Male | 5 | 50.0% | 5 | 50.0% |

**Bar Diagram 2.** Frequency Of Participants Gender In Group A And Group B.

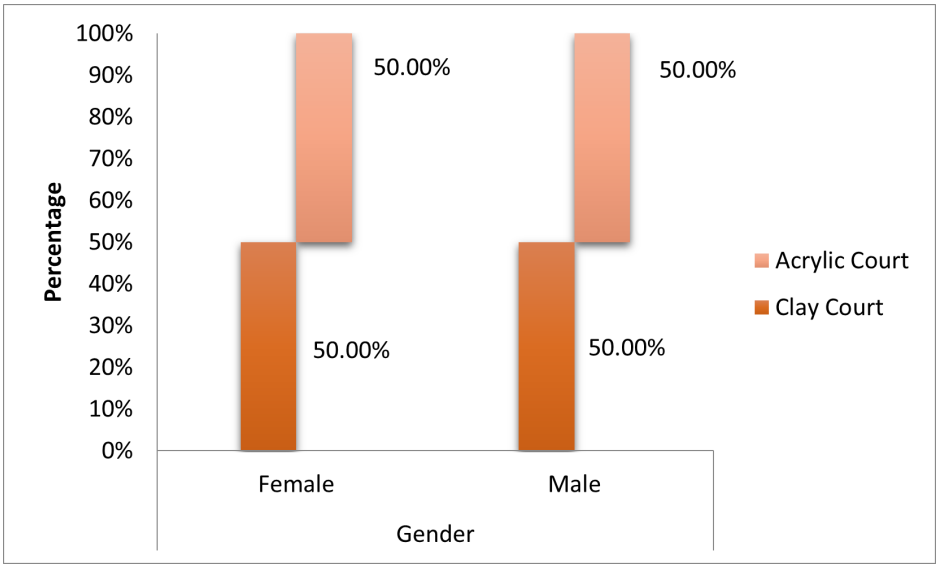


**Table 3.** Table Illsutrates The Pre And Post-Test Of Circuit Training In Clay Court.

| Clay Court | | Mean | N | Std. Deviation | t - Value | P - Value |
|---|---|---|---|---|---|---|
| T Test In Sec | Pre | 11.0820 | 10 | 1.73577 | 2.277 | 0.049 S |
| | Post | 10.4770 | 10 | 2.05731 | | |
| 50 Yard Dash Test In Sec | Pre | 12.5140 | 10 | 1.55865 | 2.306 | 0.047 S |
| | Post | 11.5130 | 10 | .73177 | | |
| Vertical Jump | Pre | 40.50 | 10 | 9.925 | -1.993 | 0.077 NS |
| | Post | 43.30 | 10 | 10.563 | | |
| Fore Hand | Pre | 5.10 | 10 | 1.729 | -1.481 | 0.173 NS |
| | Post | 5.80 | 10 | 1.932 | | |
| Back Hand | Pre | 4.20 | 10 | 1.687 | -1.253 | 0.242 NS |
| | Post | 4.90 | 10 | 2.685 | | |

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**Bar Diagram 3.** Illsutrates The Pre & Post Test Of Circuit Training In Clay Court.

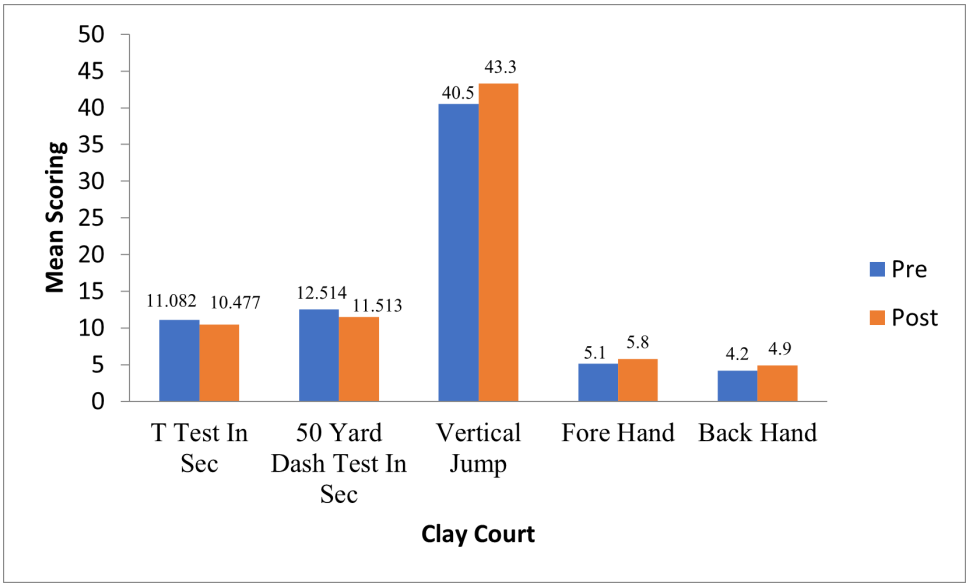


**Table 4.**Table Illsutrates The Pre & Post Test Of Circuit Training In Acrylic Court.

| Acrylic Court | | Mean | N | Std. Deviation | t – Value | P - Value |
|---|---|---|---|---|---|---|
| T Test In Sec | Pre | 12.1690 | 10 | 3.11612 | 0.231 | 0.823 NS |
| | Post | 11.8080 | 10 | 3.06961 | | |
| 50 Yard Dash Test In Sec | Pre | 13.7410 | 10 | 3.52524 | -0.190 | 0.853 NS |
| | Post | 14.1050 | 10 | 4.12414 | | |
| Vertical Jump | Pre | 42.60 | 10 | 7.531 | -0.123 | 0.905 NS |
| | Post | 43.10 | 10 | 11.150 | | |
| Fore Hand | Pre | 4.90 | 10 | 1.853 | -0.635 | 0.541 NS |
| | Post | 5.20 | 10 | 1.229 | | |
| Back Hand | Pre | 5.80 | 10 | 1.989 | -0.739 | 0.479 NS |
| | Post | 6.20 | 10 | 1.476 | | |

**Bar Diagram 4.** Illsutrates The Pre & Post Test Of Circuit Training In Acrylic Court.

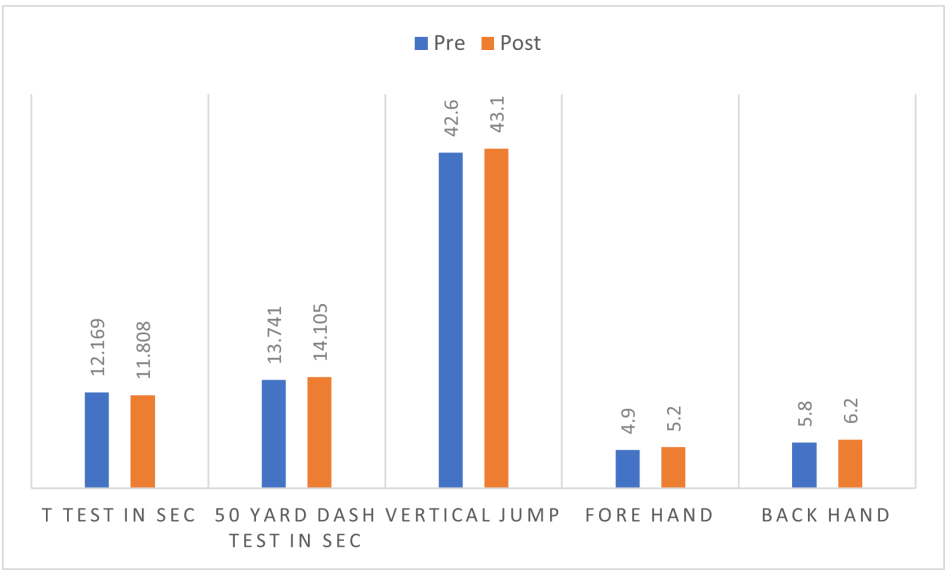

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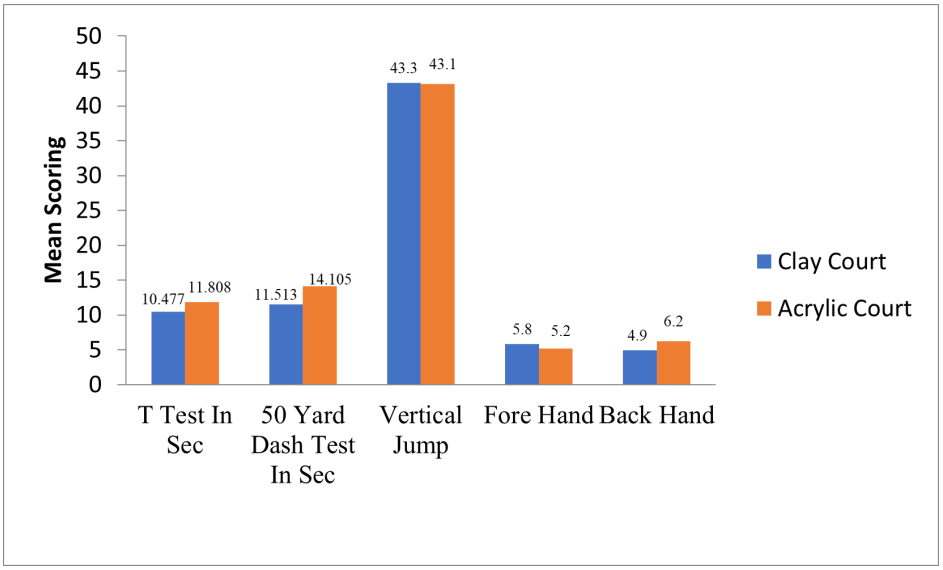
**Table 5.** Table Illsutrates The Post-Test Of Circuit Training In Clay Court And Acrylic Court

| Post Test | Group | N | Mean | Std. Deviation | t - Value | P - Value |
|---|---|---|---|---|---|---|
| T Test In Sec | Clay Court | 10 | 10.4770 | 2.05731 | -1.139 | 0.270 NS |
| | Acrylic Court | 10 | 11.8080 | 3.06961 | | |
| 50 Yard Dash Test In Sec | Clay Court | 10 | 11.5130 | .73177 | -1.957 | 0.066 NS |
| | Acrylic Court | 10 | 14.1050 | 4.12414 | | |
| Vertical Jump | Clay Court | 10 | 43.30 | 10.563 | 0.041 | 0.968 NS |
| | Acrylic Court | 10 | 43.10 | 11.150 | | |
| Fore Hand | Clay Court | 10 | 5.80 | 1.932 | 0.829 | 0.418 NS |
| | Acrylic Court | 10 | 5.20 | 1.229 | | |
| Back Hand | Clay Court | 10 | 4.90 | 2.685 | -1.342 | 0.196 NS |
| | Acrylic Court | 10 | 6.20 | 1.476 | | |

**Bar Diagram 5.** Illsutrates The Post-Test Of Circuit Training In Clay Court And Acrylic Court.




## DISCUSSION

Tennis is being played on different ground surfaces, such as clay courts, lawn tennis courts and acrylic courts, and the texture of each court differs in accordance with the surface. The clay court has physical properties of low friction force, whereas the acrylic court has high hardness.

Research has shown that the prevalence rate of injuries is relatively low on the clay court compared with the acrylic court. The logical reasoning is that low friction combines the dragging force, which facilitates easy movement for the player to move from one place to another in accordance with the ball, In parallel, the hard friction force restricts movement. When the players exhibit supplementary force against the court's force, adjustments to the high friction forces occur, which subsists to long braking phases and increased knee flexion, which significantly causes patellofemoral pain, a commonly reported injury in tennis. The literature review reveals that the physical properties of the court surface have a direct relationship with the performance of the player, which may cause variation in the physical movements of the player, such as speed agility and accuracy.

There are studies that illustrate the biomechanical changes in relation to the court surface, but the focus on changes in the physical properties of the player and appropriate training protocols in accordance with the court surface still lags behind. In this study, 20 players aged 15--25 years of both genders, with at least one year of experience in their respective courts were recruited from the champion tennis academy, Bagayam Vellore District, Tamil Nadu, India. The players were divided into two groups. In Group A, 10 participants who used to play in a clay court were included, and in Group B, 10 participants who used to practice in an acrylic court, were included. The results of the pretest were analyzed via a t test for agility, 50-yard

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dash test for speed, and a tennis performance test for upper extremity strength. Both groups were subjected to circuit training for 8 weeks, and posttest results were analyzed. The preeminent hypothesis of the study was to check whether the physical properties of the player change in accordance with the frictional force of the court and to state that prevailing protocol for all the surfaces is counterproductive, a typical training protocol in accordance with the surface they play must be introduced and practiced.

In Group A, the mean value of the clay court test is 11.0820, and The posttest value is 10.4770, which is significant.In the 50 yard dash test, the pretest mean value is 12.5140, and the posttest mean value is 11.5130, which is significantIn the vertical jump test, the pretest mean value is 40.50, and the posttest mean value is 43.30, which is not significant. In the tennis performance test, the pretest mean value is 5.10, and the posttest mean value is 5.80 In parallel the back hand stroke the pretest mean value is 4.20, and the posttest mean value is 4.90, which is not significant.

In Group B, the mean value of the acrylic court pre-T test is 12.1690, and the posttest value is 11.8080, which is not significantIn the 50-yard dash test, the pretest mean value is 13.7410, and posttest mean value is 14.1050, which is not significant In the vertical jump test, the pretest mean value is 42.60, and the posttest mean value is 43.10, which is not significant. In the tennis performance test, the pretest mean value is 4.90, and the posttest mean value is 5.20 in back hand the pretest mean value is 5.80, and the posttest mean value is 5.20, which is not significant.

Compared with the two court surfaces, the mean value of the players shows that in the clay court, which has a low friction force and a low gravity pull of 15% force reduction, the surface allows the player to have more dragging force from one end to another without any restrictions of movement, whereas parallel to the acrylic court, the players have the opposite concept, with a peak force reduction of less than a 10% reaction, which restricts the players' movement, and the players exhibit supplementary force to achieve the required movement. During performance, sliding is beneficial because it allows immediate braking force during a stroke movement and instantly makes the player move further for another stroke. As a result of sliding on clay, it was apparent that an altered turning technique (e.g., differences in initial knee flexion, attack angle, pressure distribution) occurred compared with the acrylic court, where no sliding was observed. In contrast to the comparison of the pretest performance, such as speed agility and wiebe tennis performance, between the clay court and acrylic court, although it is not significant, the mean value clarifies that the time taken by the player to complete the pretest is less in the clay court than in the acrylic court. This indirectly represents the friction force acting on the players' performance.

The biomechanical aspect states that greater pressure is required for the player to take an upright turn against the sliding force. The greater pressures in the hallux area observed on the clay court than on the acrylic court suggest that an increased grip is needed to turn on the lower friction surface, which is similar to the findings of Fong et al. (2008), who suggested that greater toe grip and lower heel pressures provide balance and grip during walking on slippery surfaces because low friction force pressures are sustained over the hallux area to achieve grip over the court. Circuit training does notimprove speed or agility over recreational tennis players, which is in accordance with the findings of the studies of Ishfaq Rashid Naik and Dr. Ramneek Jain et al. (2020), who reported that circuit training does not affect speed, agility or endurance among physical education students. The racist geographical location and gender might have influenced the negative correlation of the study.

## CONCLUSION

This study concludes that circuit training does not improve speed, agility or strength among recreational tennis players. This study also concludes that there is no influence on the tennis court surface in either group.

**Conflict Of Interest :** Nil
**Source Of Funding :** Self Funding

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