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Original article

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A randomized controlled trial on the effectiveness of pilates training on physical components in cricketers

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Abstract

Introduction: Cricket is considered as one of the most intense game as it requires several hours of vigorous body movements for which quick reflexes, good strength, speed and power are the main pillars. Pilates is a series of exercises which helps in improvement of core muscle strength that further contribute in controlled movement of extremities, good posture, speed, power and balance. The purpose of the study was to evaluate the effectiveness of Pilates training program on physical components in aspiring state level cricket players.

Material and methods: State level aspiring 39 male cricket players aging between 18–30 years were included in this study which were randomly divided into two groups. Participants in control group (n = 19) performed only conventional exercises while in experimental group (n = 20) participants performed Pilates exercises along with conventional exercises 3 times/week for 6 weeks. The outcome measures for both groups were evaluated at baseline and at the end of 6 weeks which included upper and lower abdominal muscle strength, Speed, Hamstring muscle flexibility, Agility and Power.

Results: Results of the study showed that both groups improved significantly ($p < 0.05$) at the end of the 6th week but experimental group showed more improvement in core muscle strength, hamstring flexibility, agility, speed and power when compared to control group ($p < 0.05$).

Conclusions: The study concluded that Pilates training is an effective method for improvement in physical components such as abdominal muscle strength, hamstring muscle flexibility, agility, speed and power in cricket players. This may further enhance the performance of cricket players.

Keywords: strength, flexibility, balance, speed, agility

Introduction

Cricket is a popular sport played throughout the world. It is played in three common formats, depending upon the duration of game: firstly, a *test match*, the oldest format, is played over 4–5 days, with around 90 overs played per day; secondly, a *one-day match* is shorter, with 50 overs on each side; thirdly, the *T 20 match*, the most recent format with 20 overs played on each side. As each format places different physical demands on the players, they require an extensive combination of tactics, skills and physical fitness in the form

of strength, endurance, speed, power, flexibility and agility [1,2].

The physical fitness requirements vary from one format of the game to the other [3]. Strength is required for batting, chasing the ball, running between the wickets, bowling, fielding and throwing [4–6], while speed is needed for chasing the ball, fielding and running between the wickets, and it is the main asset of fast bowlers [5]. Power is an important factor in cricket, as it is the key to hitting boundaries or throwing a ball for a run-out. Flexibility is also important, as it supports the dynamic multi-directional movements required during wicket keeping, bowling and batting [7]. Finally, agility, i.e. the ability to suddenly change the direction of the body according to requirements in an effective and efficient manner [8], is needed to change direction when running between the wickets, and to catch and return the ball. In addition, the physical fitness status, technical and tactical capabilities of cricket players, and hence their performance, are also influenced by a range of body composition, physique and psychological traits [9].

A good balance between skills, techniques and physical fitness is needed to ensure optimum performance. Most conventional methods of training are aimed at increasing strength, with the targeted muscles generally being sports specific [10]. However, more recently, cricket events have become more competitive and more frequent, and are now randomly spaced throughout the year in a range of formats. The new T-20 format also increases the chance of injury in players; for example, since its introduction, the prevalence of injury among batsmen, spin bowlers and wicketkeepers has been found to increase by approximately 3% [11]. To compensate for this increased risk of injury in the game, high levels of physical fitness and skills are required.

A stable core improves posture and provides control of limb movements by strengthening the lower back muscle groups and abdomen. It also improves the sporting performance and reduces the risk of injury [12,13]. Pilates training consists of a range of multidirectional movements starting with a variety of initial positions in which skeletal muscles are recruited in such a manner that benefits strength, flexibility, neuromuscular coordination and endurance. Training also offers different exercises for the trunk, lower limbs and upper limbs, which help improve body awareness, sensory motor coordination, economical breathing, body alignment, precision and fluency in movement [14]. They also foster greater breath control, strength, posture, balance and coordination, focusing on the entire body, starting from the core. It also supports the physical and mental conditioning of the body [15–17].

However, little literature is available on the effectiveness of Pilates training to improve physical parameters in cricket players. Therefore, the aim of this study was to evaluate the efficacy of Pilates training on selected physical components, *viz.* speed, agility, power, hamstring flexibility, and upper and lower abdominal muscle strength, in cricketers.

Material and methods

Participants

The study was a randomized, controlled and single-blinded (participant-blinded) trial conducted on aspiring state level amateur cricketers at the Sledgehammer Cricket Academy, Faridabad. Ethical approval was obtained from the Institutional Ethical Committee (vide letter no. PTY/2021/42). The study was also registered under Clinical Trial Registry – India (CTRI) with the registration no. CTRI/2021/08/035659. The study included healthy male cricket players aged 18–30 years, who were practicing cricket at least three times a week. To be included, the players needed at least two years' experience in cricket. The exclusion criteria comprised any existing musculoskeletal injury, as well as any history of major hip, knee, ankle or back injury, uncooperative players, unwillingness to participate, any history of psychiatric, neurological, cardiovascular or respiratory disorders, and any previous surgery of the back or hip joint. In addition, any recreational players were excluded.

Procedure

A total of 45 players were screened for inclusion in the study; however, only 39 fulfilled the inclusion criteria and were included in the study (Fig. 1). All participants gave their informed consent prior to intervention. The selected participants were randomly allocated to a control (n = 19) and experimental group (n = 20) using the lottery method. In both groups, the total duration of the intervention was six weeks.

The control group (Group A) followed the conventional cricket training protocol, while the participants in the experimental group (Group B) received a combination of Pilates exercises and conventional cricket training. In both groups, the conventional cricket training included cricket-specific exercises taught to the participants by coaches. These were performed five days each week for a total duration of six weeks. These exercises involved running, push-ups, back extension exercises and stretching of hamstring, quadriceps and calf muscles for a period of about 20 minutes.

Pilates exercises, such as pelvic bridge, pelvic bridge with straight leg raise, planks, side planks, reverse planks and hundreds, were performed by the

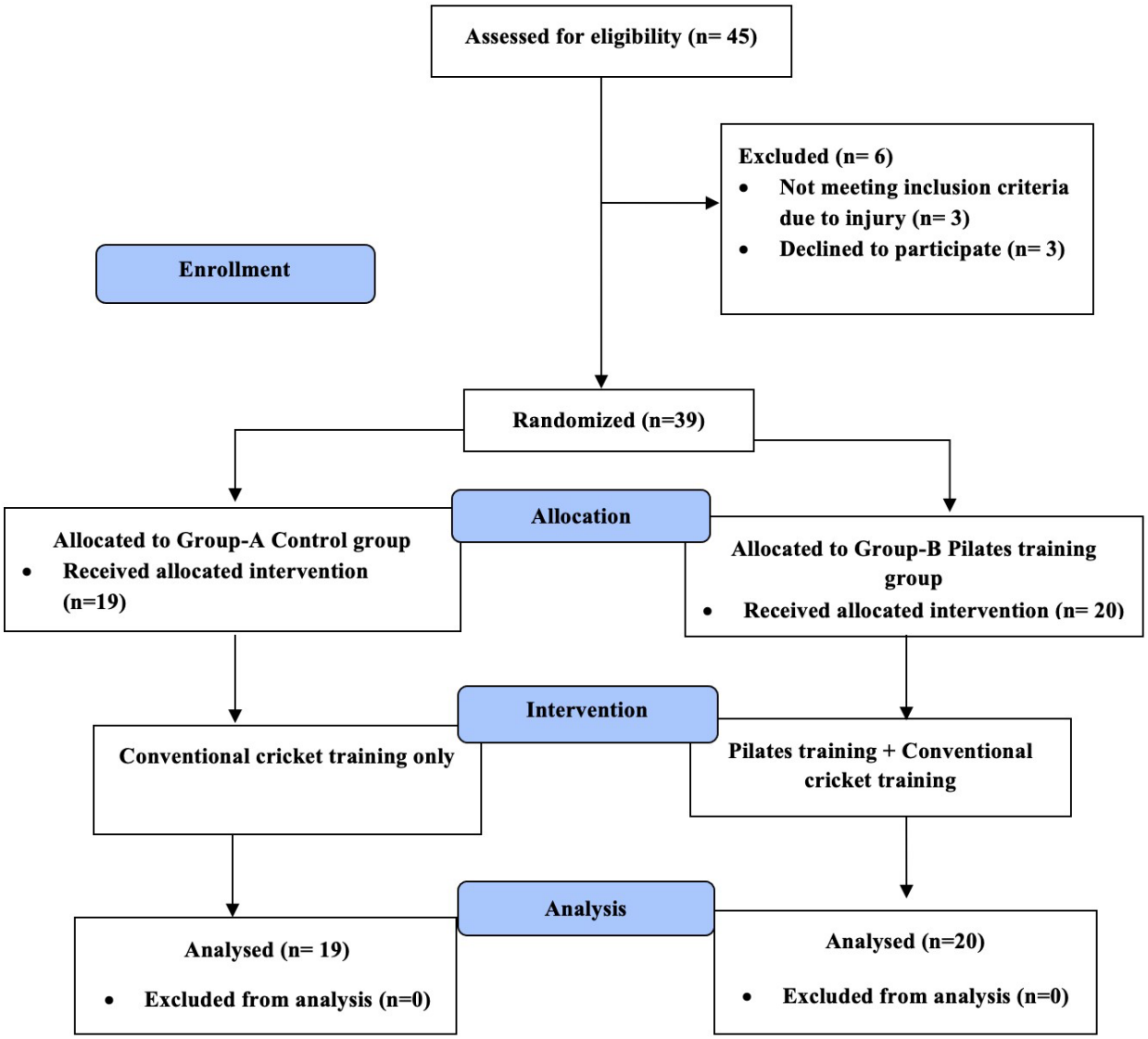

Fig. 1. CONSORT 2010 Flow Diagram

participants for three days in a week for six weeks. The exercises were repeated 10 times during each session, with a rest interval of 10 seconds between the exercises. All the participants in the experimental group performed 10 minutes of warm-up prior to the training sessions, including brisk walking/jogging and mild stretching exercises, as well as 10-minute cool down after the training sessions. The Pilates training protocol was divided into three phases, where each phase lasted for two weeks. The initial duration of the sessions was 30 minutes; however, this time was gradually increased to 55-60 minutes per session by the end of week 6.

Phase I consisted of several exercises including cricket-specific training. Players were advised to do a warm up, cricket specific training, Pilates exercises and cool down. Pilates exercises included pelvic bridge, pelvic bridge with straight leg raise, planks, side planks, reverse planks and hundreds. The Pilates session lasted for 30 minutes, during which, each exercise was repeated 10 times with a hold duration of 15 seconds. All the exercises were performed on a mat. Phase II was started after the end of the second week. In this phase, the same exercises were used as in phase I; however, the length of Pilates training was gradually increased by increasing the holding time from 15 seconds to 30 seconds, while maintaining the same number of repetitions. Following this, in week 5, the training moved to phase III. In this phase, the hold time was slightly increased from 30 seconds to 45 seconds, while using the same exercises as in phase I and phase II.

Outcome measures

The outcome measures in the study comprised speed, agility, hamstring flexibility, power, upper abdominal

strength and lower abdominal strength. The measurements were taken before intervention, i.e. at baseline, and at the end of six weeks. The speed was measured by 30-yard dash test (30YDT) [18], agility was measured by the Illinois agility test (IAT) [18,19], hamstring flexibility was measured by the sit and reach test (SRT) [20], power was assessed by the standing broad test (SBJT) [18,21], upper abdominal strength was assessed by the modified curl-up test (CT) and lower abdominal strength was measured by the double straight leg lowering test (DSLLT) [22,23]. The reliability of 30-yard dash test, Illinois agility test, sit and reach test, standing broad jump test, modified curl up test and double straight leg lowering test has been reported to be good to excellent (ICC = 0.93, 0.96, 0.918, 0.968, 0.65 and 0.98 respectively) [24−29]. During the assessment of the outcome measures, participants were advised to perform mild stretching to warm up their body before each test. Three trials for each test were performed by the players, with the best result out of three being included in the analysis.

Statistical analysis

The statistical analysis for all the outcome measures was performed using SPSS (IBM statistical package for social science) software version 28. The mean and standard deviation were calculated for all the demographic data and outcome measures. The within-group and between-group comparisons were made using the paired t-test and independent t-test, respectively. The level of significance (p-value) was set at ≤ 0.05.

Results

The demographic characteristics, including age (years), height (cm), weight (kilograms) and body mass index (kg/m^2), were recorded at baseline for all the participants (Table 1).

In the control group, training with the conventional exercise program, statistically significant changes in hamstring muscle flexibility, participant speed, abdominal muscle strength, agility and power were observed between baseline and after the six-week intervention ($p < 0.05$), as indicated in Table 2.

In the experimental group, significant improvements were indicated by the within-group comparisons for the Illinois agility test, 30-yard dash test, sit and reach test, standing broad jump test, curl-up test and double straight leg lowering test, as shown in Table 3. The results indicate that all of the outcome measures significantly improved in experimental group, as in the control group. The calculated t-value for all the outcome measures was found to be greater than critical t-value in both groups (Control group = 1.73, Pilates (experimental) group = 1.72).

Tab. 1. Demographic characteristics of participants

Characteristics	Group A (n = 19) Mean ± SD	Group B (n = 20) Mean ± SD
Age (years)	23.31 ± 2.58	21.65 ± 2.92
Height (cm)	172.36 ± 3.56	171.15 ± 4.18
Weight (kg)	67.10 ± 7.88	66.90 ± 8.27
Body Mass Index (kg/m^2)	22.61 ± 2.80	22.82 ± 2.51

Tab. 2. Within group comparison of outcome measures among control group

Outcome Measures	Baseline Mean ± SD	After 6 weeks Mean ± SD	t-value	p-value	Cohen's d
Sit & Reach Test (cm)	2.58 ± 1.15	3.17 ± 1.07	–7.83	< .001*	0.32
Standing Broad Jump Test (m)	2.25 ± 0.18	2.42 ± 0.17	–6.62	< .001*	0.11
30 Yard Dash Test (Sec)	4.89 ± 0.50	4.75 ± 0.53	3.95	< .001*	0.16
Illinois Agility Test (Sec)	13.06 ± 0.93	12.81 ± 0.99	3.04	0.007*	0.36
Modified Curl-up Test (No. of curls)	22.63 ± 5.33	27.36 ± 5.05	–16.07	< .001*	1.28
Double Straight Leg Lowering Test (Degrees)	2.52 ± 0.51	3.15 ± 0.50	–5.55	< .001*	0.49

* Significant at 95% confidence interval ($p < 0.05$).

Tab. 3. Within group comparison of outcome measures in experimental group

Outcome Measures	Baseline Mean ± SD	After 6 weeks Mean ± SD	t-value	p-value	Cohen's d
Sit & Reach Test (cm)	3.53 ± 2.00	5.39 ± 2.01	–8.99	< .001*	0.92
Standing Broad Jump Test (m)	2.29 ± 0.31	2.57 ± 0.17	–6.32	< .001*	0.19
30 Yard Dash Test (Sec)	4.45 ± 0.51	3.95 ± 0.35	6.07	< .001*	0.36
Illinois Agility Test (Sec)	12.42 ± 1.12	11.49 ± 0.97	6.60	< .001*	0.62
Modified Curl-up Test (No. of curls)	23.50 ± 8.74	37.00 ± 7.23	–13.77	< .001*	4.38
Double Straight Leg Lowering Test (Degrees)	2.85 ± 0.48	3.75 ± 0.44	–13.07	< .001*	0.30

* Significant at 95% confidence interval ($p < 0.05$).

Tab. 4. Between group comparison of mean difference among both groups (control & experimental group)

Outcome Measures	Mean Difference – Control Group	Mean Difference – Experimental Group	t-value	p-value
Sit & Reach Test (cm)	–0.58	–1.85	5.65	< 0.001*
Standing Broad Jump Test (m)	–0.16	–0.27	2.08	0.044*
30 Yard Dash Test (Sec)	0.14	0.50	–3.86	< 0.001*
Illinois Agility Test (Sec)	0.25	0.93	–4.09	< 0.001*
Modified Curl-up Test (No. of curls)	–4.73	–13.50	8.37	< 0.001*
Double Straight Leg Lowering Test (Degrees)	–0.63	–0.90	2.04	0.048*

* Significant at 95% confidence interval ($p < 0.05$).

Cohen's d was calculated to determine effect size, based on the difference between the mean values of two groups. If this value is less than 0.2 standard deviations, i.e. a d-value of 0.2, the difference can be regarded as negligible, even if it is statistically significant. Hence, a value of $d = 0.2$ is considered a small effect size, 0.5 a medium effect size and 0.8 a large effect size [30]. Our present findings reveal a higher value of Cohen's d in the experimental group than the control group, which further indicates that the Pilates exercises yielded a greater effect than the control group.

However, the between-group comparison at the end of six weeks, revealed significant differences in all the tested physical parameters, *viz.* hamstring muscle flexibility, upper and lower abdominal muscle strength, speed, power and agility, among the cricket players. This data is given in Table 4. These findings indicate a greater improvement in the experimental (Pilates) group than the control group for all of the stated physical parameters, further suggesting that Pilates training is an effective method for improving the performance of cricketers.

Discussion

The purpose of this study was to determine the effectiveness of a six-week Pilates exercise program on selected physical parameters, *viz.* abdominal muscle strength, power, speed, agility and hamstring muscle flexibility, in cricket players. These physical components are commonly used in sports for evaluating fitness, and were measured using specially-designed tests [18−23].

Pilates comprises a series of stretching and strengthening exercises, and focuses on breathing control, concentration and control of the body, mainly the core. Its pillars are breathing, centering, concentration, flow, precision and co-ordination. It has been found to improve lower limb strength, core muscle group stability, agility, lung capacity, flexibility, muscle tone and coordination in badminton players; it also reduces stress, improves mental focus, and enhances sense of well-being improving physical and mental conditioning, alongside improving posture and balance [15−17].

Our present findings indicate significant improvements in all tested physical parameters, including

abdominal muscle strength, power, speed, agility and hamstring flexibility, in both groups at the end of week 6. However, experimental Group B, which practiced a combination of Pilates exercise training with conventional exercise, showed more improvement than Group A, which only performed their regular training (conventional exercises). Hence, it appears that Pilates exercises brought better results in the tested physical components of the cricketers when combined with conventional exercises.

Improvements were also seen in the players in Group A, who only received conventional cricket training. Such conventional training programs generally comprise warm-up exercises, flexibility exercises, endurance exercises and sports-specific exercises. They enhance the strength of muscles and target specific muscles and muscle groups recruited during sports performance. These exercises are helpful in improving performance by maintaining flexibility, strength and endurance and thus lower the risk of injury [10].

Our findings are supported by those of several studies that have examined various physical components in different populations. Similar results were obtained in one study based on the implementation of four-week Pilates training in badminton players, indicating that Pilates training appeared to be helpful in developing a significant improvement of core strength, agility, neuromuscular co-ordination and dynamic balance [31]. It is reported that strengthening the core muscles by the performance of dynamic, eccentric, isometric stabilization contractions in response to momentum and gravity enhances the neuromuscular system. It also lowers the neural inhibitory reflexes and improves motor unit synchronization. A strong core allows better movement of inter-segments within the body and more sustained contraction of the deep spinal stabilizer muscles.

Similarly, the application of Pilates training has been found to have a significant effect on jump performance, lower limb strength and biological efficiency in volleyball players. The findings indicate that Pilates training can support the development of trunk muscle strength, which improves limb motor co-ordination and can increase the oxygen supply to the lungs by enhancing the passage of oxygen [32].

Our present findings are in line with those of another study performed in badminton players suggesting that five-week Pilates training was found to improve agility, lower limb strength, co-ordination and dynamic balance of the individuals in a Pilates group than a group receiving conventional training [15]. In addition, five-week Pilates training in healthy adults appears to improve core stability and kinesthetic awareness, and reduce faulty movement patterns [33]. Furthermore, a positive correlation was found between a strong core musculature and hand eye co-ordination. A strong core allows smooth movements to be performed of the trunk and upper limbs [34,35].

Similarly, another study concluded that Pilates training program played an effective role in improving the flexibility of indoor soccer players; the players demonstrated improvements in flexibility, which was attributed to gradual changes in muscle, particularly its elastic properties, caused by the combined involvement of neurological, molecular and biomechanical mechanisms [36]. This beneficial effect of Pilates exercise program on hamstring muscle flexibility has also been confirmed in another study [37].

It has been proposed that significant improvements in speed are obtained by influencing kinetic chain activity: when the core is stable, its accessory muscles provide stability for the mobile distal segments. The large muscle groups of the core facilitate lower extremity movements by causing an increase in moment arm, generating and transferring forces to the upper limb from the lower limb and vice-versa [38]. These factors could be the reason for the improvements observed in the speed of athletes after the implementation of Pilates exercise. It has previously been concluded that the implementation of Pilates training appears to have a significant effect on core muscle strength in cricket players, and this was attributed to the increase in activation and recruitment of motor neurons of the abdominal muscles [23]. Therefore, improvement in these physical parameters may produce enhancement in overall performance of cricket players.

Our findings suggest that Pilates training, or other exercises which focus on core muscle strength, may be included in regular cricket training. However, coaches should be informed about the benefits associated with Pilates exercises, and players and coaches should be counselled to make Pilates as part of their regular training.

Conclusion

Together with conventional exercises, Pilates training is helpful in improving various physical components, such as strength of abdominal muscles, power, agility, speed and hamstring muscle flexibility. Such improvements may be caused by strengthening the core; this enhances the ability of neuromuscular system, which in turn improves sports performance, including among cricket players. Therefore, the supplementation of conventional cricket training with Pilates exercises may enhance sports performance by improving physical parameters.

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Conflicts of Interest
The authors have no conflict of interest to declare.

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