Original Article

Comparative Quasi-Experimental Study of Pilates and Calisthenic Exercises in Snooker Players

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Abstract

Background: Snooker is a kind of cue sport in which skill plays an important role. To reach a professional level, snooker players must acquire many physical and mental skills.

Objective: To compare the effects of Pilates and Callisthenic exercises on skills and static balance among snooker players.

Methodology: A Quasi-Experimental study was approved by the ethical review board of Riphah International university. Sample size was 34 calculated by Epi tool and a convenience sampling technique was used. Pilates and calisthenic training sessions were allocated through simple random sampling (sealed opaque envelopes). Group A received Pilates 3 times per week for 8 weeks while group B received callisthenic training 3 times per week for 8 weeks. Outcomes measured through stork balance test, line-up test and foul count test at baseline and after 8 weeks.

Results: The participants had a mean age of 27.07 ± 0.70 years and a mean BMI of 22 ± 1.25 kg/m². Both Pilates and calisthenics groups showed significant improvements across all outcomes following training ($p < 0.05$). Within-group analyses demonstrated greater gains in the Pilates group for the Line-up Test, Foul Number Test, and Stork Balance Test. Between-group comparisons further confirmed that post-treatment performance was significantly better in the Pilates group, with larger mean differences in skill-based measures and static balance. Overall, Pilates training produced superior improvements compared to calisthenic training.

Conclusion: The study concluded that both Pilates and callisthenic exercises improved skills and static balance among snooker players. However, Pilates was more effective than callisthenic training.

Key words: Balance, Postural Control, Pilates Training ,Snooker , Skill

Introduction

Billiards, or cue sports, are a group of activities that may be divided into three primary categories: snooker, pocket billiards, and carom billiards. A pool table with six pockets is used to play snooker. In 1927, the global snooker championship made its debut.[1] Professional athletes possess some mental attributes including confidence, drive, dedication, and focus. However, coaches, environmental variables, psychological issues, and neuromuscular factors may all impact an athlete's performance in any given sport.[2] Snooker is a precision sport requiring high levels of concentration, fine motor skills, and excellent balance.[3] Pilates and callisthenic exercises are popular forms of exercise that improve these skill areas as these exercises concentrate on distinct

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physical concepts. Cue sports like snooker need a great level of accuracy, steadiness, and control.[4] Moreover, snooker players need excellent static equilibrium to make consistent and accurate shots. To stay steady and maintain a controlled stance during play, they must have good static balance, that is, the ability to keep their body's center of gravity within their base of support.[5] Static balance is the snooker player's ability to keep a solid stance without moving, and it has a direct influence on their overall gameplay and shot accuracy.[6,7] The players must maintain their balance both during and after each of these moves in order to go on to the next, avoid any injuries, and ensure that the following move is executed well.[8] Neuromuscular responses to continual visual, vestibular, and somatosensory feedback result in the balance and capacity to maintain the body center of gravity on the support.[9] Athletes can employ balance to improve their sporting performance as well as to avoid injury.[10] Snooker players can enhance their skill, avoid injuries, and maintain physical condition by including a regular Pilate's exercise as it helps improve core strength, flexibility, posture, focus, muscle endurance, and coordination. All of these advantages work together to improve performance and lower the chance of injury.[11] Recent evidence suggests that calisthenic training, using body weight movements, is also highly effective for improving strength, coordination, and balance.[12] While both Pilates and calisthenics exercise modality targets the motor abilities differently, there is limited research comparing their relative effectiveness in cue sports. Therefore, this study aims to compare the effects of Pilates and calisthenic exercises on skills and static balance among snooker players.

Methodology

A Quasi experimental study was designed and approved through Research & ethical committee. A sample size of 34, including a 10% allowance for attrition, was calculated from the mean and standard deviation of the balance variable using the Epi Info tool.[13] Convenience sampling technique was used and participants were selected as per the inclusion and exclusion criteria listed below. The data for this study was collected from Johar town and Central park Sports complex in Lahore. Pilates and calisthenic training sessions were allocated through simple random sampling through sealed opaque enveloped (Figure I). Group A received Pilates 3 times per week for 8 weeks. Sessions were conducted 3 times per weekas: Warm-Up: 10 minutes, Main Workout: 40 minutes Cool-Down: 10 minutes[14] while group B received callisthenic training 3 times per week for 8 weeks with sessions conducted 3 times per week Warm Up Duration: 10 minutes Workout Duration : 40 minutes Cool Down period: 10 minutes[15] Outcomes measured through stork balance test, line-up test and foul count test at baseline and after 8 weeks.

Ethical consideration: This study was approved by REC committee of Riphah University under the Ethical consideration number REC/RCR&AHS/24/0433, Dated: April 24, 2024. Written informed consent was obtained from all participants. Confidentiality of data was ensured, and participants were free to withdraw at any stage without penalty. It was single blinded study in which assessor was blind.

Inclusion Criteria:

The participants were male snooker players' age range between 18 - 40 years. Intermediate as well as advanced snooker players with a break score > 30 and who participated regularly in snooker training (minimum 3 times per week) were included in this study.

Exclusion Criteria

Athletes with current acute injuries, particularly in the lower body, History of any surgery in the past six months, especially related to musculoskeletal issues, Chronic health conditions like severe arthritis or chronic back pain, Regular use of pain medication or anti-inflammatory drugs, were excluded. Active participation in other high-impact sports (could affect the study results) and cognitive or communication barriers (that hinder understanding or adherence to study protocols) were excluded.

Statistical Analysis:

The data was analyzed using SPSS for window software version 25. Statistical significance was set at $p < 0.05$. Normality of data was assessed through Shapiro Wilks Test. Descriptive Statics like Mean, Standard deviation, minimum and maximum age and BMI of both Interventional groups were analyzed. Difference between pre-treatment and post-treatment readings was calculated by using paired sample t test for parametric data. To estimate the difference between the groups, Independent sample t test was used.

Results

Demographic information of the participants is shown in Table I. The mean age of the participants was 27.07 ± 0.70 years and mean BMI was 22 ± 1.25 kg/m^2.

Table 2 shows significant within-group improvements in both intervention groups. The Pilates Exercises group demonstrated greater gains in the Line-up Test (mean

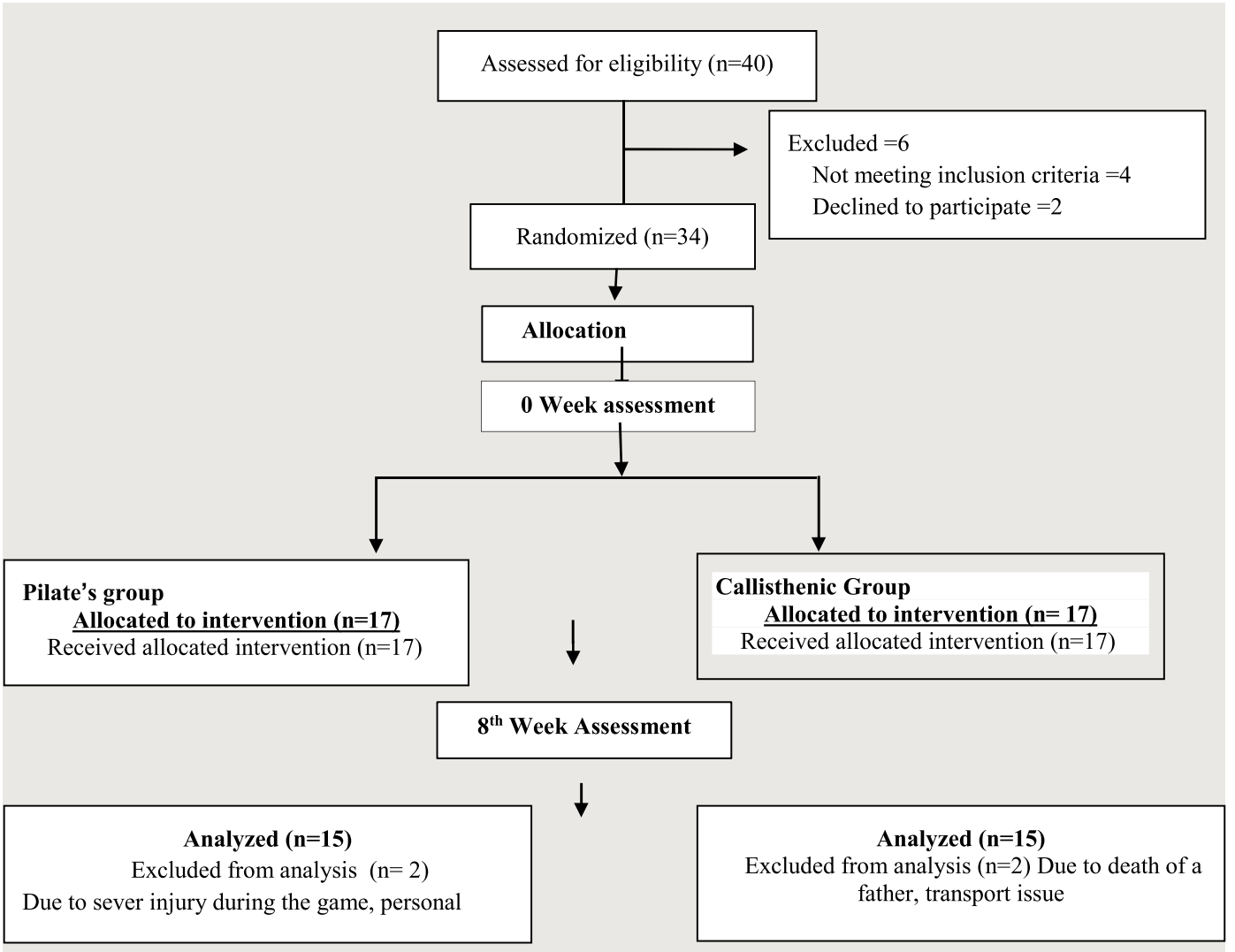

Figure I: *CONSORT Diagram*

difference = 19, p value = 0.01), Foul Number Test (mean difference = 2, p value = 0.01), and Stork Balance Test (mean difference = 14.5, p value = 0.01). value Overall, the magnitude of change was consistently greater in the Pilates Exercises group.

Comparisons across the two groups are shown in Table III. The results show that both interventions improved performance, with greater post-treatment gains in the Pilates Exercises group. The Line-up Test demonstrated a significant between-group difference at post-treatment (mean difference = 5, p valu e= 0.01), indicating superior improvement with Pilates Exercises. Similarly, the Foul Number Test showed a significant post-treatment difference (mean difference = 0.75, p value = 0.01), again favoring the Pilates group. In the Stork Balance Test, a significant post-treatment difference was also observed (mean difference = 9.5, p value = 0.01), confirming greater enhancement in balance following Pilates Exercises compared to Calisthenics Exercises.

Table I: *Demographics of the study participants*

Variable	N	Mean	St.Deviation
Age (years)	30	27.07	0.7
BMI	30	22	1.2
Years of experience		Frequency	
1-3 years		8	
4-6 years		18	
7-9 years		4	
Total		30	

Discussion

In this quasi-experimental study, eight weeks Pilates-

Table II: *Within-Group Comparison of Outcomes Following Pilates and Calisthenics Exercises*

Outcomes	Study Groups	Before Treatment	After Treatment	Mean difference	p value
		Mean ± SD	Mean ± SD		
Line-up Test	Pilate's Exercises.	35 ± 3.80	54 ± 4.30	19	0.01
	Calisthenics Exercises	34 ± 4.06	49 ± 3.99	15	0.02
Foul Number test	Pilate's Exercises.	3.75 ± 2.25	1.75 ± 1.25	02	0.01
	Calisthenics Exercises	3.50 ± 2.50	2.50 ± 1.50	01	0.03
Stork balance test	Pilate's Exercises.	27.25sec ± 4.75	41.75sec ±3.50	14.5	0.01
	Calisthenics Exercises	25.75sec ± 3.50	32.25 sec ± 5.50	6.5	0.03

Mean ± SD: Mean ± Standard Deviation, p value calculated by Paired sample T test, p value < 0.05 considered significant

Table III: *Between-Group Comparison of Post-Intervention Outcomes*

Outcomes	Variables	Pilate's Exercises.	Calisthenics Exercises	Mean difference	p value
		Mean± SD	Mean± SD		
Line-up Test	Pre-treatment	35± 3.80	34 ± 4.06	1	0.76
	Post Treatment	54 ± 4.30	49± 3.99	5	0.01
Foul Number Test	Pre-treatment	3.75 ± 2.25	3.50 ± 2.50	0.25	0.67
	Post Treatment	1.75 ± 1.25	2.50 ± 1.50	0.75	0.01
Stork Balance test	Pre-treatment	27.25sec ± 4.75	25.75sec ± 3.50	1.5	0.87
	Post Treatment	41.75sec ±3.50	32.25 sec ± 5.50	9.5	0.01

Mean ± SD: Mean ± Standard Deviation, p value calculated by Independent sample T test, p value < 0.05 considered significant

based core training and calisthenics exercises was compared in male snooker players. Both groups showed significant within-group improvements in line-up score, foul number and Stork balance time, but the Pilates group had consistently larger changes. This pattern suggests that adding structured core-focused Pilates on top of routine snooker practice may offer a more specific benefit for precision and postural control than more general calisthenics work. The findings are broadly consistent with the trial by Soflaei et al., who also studied male snooker players using the same line-up test, foul number test and Stork balance test. They reported substantial gains in improvement in the Line-up Test score and static balance after six weeks of mat Pilates, but no significant between-group difference in foul numbers compared with a control group doing routine snooker only.[13] In contrast, our Pilates group not only improved improvement in the Line-up Test score and balance but also showed a statistically significant reduction in fouls relative to the calisthenics group. This discrepancy may be due to several factors: differences in the exact exercise content and progression of the Pilates program, slightly different baseline skill levels, or simply random variation in a relatively small sample. The superiority of Pilates over calisthenics in this cohort is in line with broader evidence that core training can enhance sport-specific skill performance, particularly in accuracy and racket-type sports. A systematic review by Luo et al. reported that core training improved technical skills such as serving accuracy in volleyball, throwing velocity in handball and smash performance in badminton across several controlled trials.[15] Similarly, a more recent review on Pilates-based programs in athletes found positive effects on balance, postural control and sport-specific performance measures, especially in sports that require fine control of trunk and upper limb segments.[16] These data support the idea that targeted core stabilization, rather than general conditioning alone, contributes meaningfully to precision tasks such as cue delivery in snooker.

The calisthenics group in the present study also improved, although to a smaller extent. A study by Panihar and Rani showed that adding calisthenics to routine soccer training improved speed, agility, flexibility, balance and ball-control skills more than standard training alone.[17] Calisthenics combines multi-joint movements, body-weight resistance and some dynamic balance, so it is reasonable that snooker players also benefited from this type of training. However, snooker is a highly static and fine-motor sport; thus, training that emphasizes postural alignment, deep trunk control and controlled breathing, as in Pilates, may translate more directly to shot stability and error reduction than more global calisthenics drills. The improvements

observed in line-up and foul tests may also be linked to the way snooker skill is organized. Chung et al. developed a systematic skills test for snooker and highlighted the importance of cue power control, spin control and cue-ball positioning for advanced performance.[9] Biomechanical work on upper-limb coordination in snooker by Zhou and colleagues showed that professional players rely more on elbow-phase and wrist-phase coordination with relatively stable shoulders, whereas amateurs use more shoulder-dominant patterns.[18] Pilates-based core and scapular control may help players stabilize the trunk and shoulder girdle so that the cue action is driven more efficiently from the elbow and wrist, which is a pattern associated with higher skill. Balance findings in the present study are also consistent with what is known about static balance tests. The Stork test has been used as a simple clinical tool to assess single-leg static balance and shows acceptable association with other balance measures in healthy adults.[19] At the same time, its reliability depends on standardizing test procedures, including stance and instructions, as highlighted by Curnow et al., who reported variable outcomes when the starting stance was altered.[20] In present study, the Stork test was administered in a uniform way to all players pre- and post-intervention, so the large within-group and between-group differences are unlikely to be explained only by measurement error. Since snooker performance depends strongly on stance stability and minimal sway during cue delivery, these gains in static balance are likely to be functionally relevant, even though match outcomes were not directly measured. From a more cognitive–perceptual angle, earlier work by Koning et al. found that expert snooker players differ from novices mainly in sport-specific perceptual and cognitive skills rather than basic visual acuity or depth perception.[21] More recent case-study data from an elite snooker player also emphasise high stance stability and minimal centre-of-pressure movement during cueing, even across different shot types.[22] Taken together with the present results, this suggests that physical preparation for snooker should not only focus on general conditioning but also on fine postural control and trunk–upper-limb coordination that support these high-level perceptual–cognitive processes. Overall, therefore, the findings add to a growing body of evidence that core-oriented programs such as Pilates can produce meaningful improvements in skill-related outcomes and static balance in precision sports, and they suggest that Pilates may be more beneficial than calisthenics when the target outcome is accuracy of cue actions and reduction of fouls rather than only general fitness.

Conclusion

In this quasi-experimental study of male snooker players, both Pilates and calisthenics exercises produced significant improvements in snooker-specific skills and static balance over eight weeks, but Pilates training led to larger gains in line-up scores, greater reductions in foul numbers and greater increases in Stork balance times. Taken together with existing evidence from snooker-specific research and broader core-training literature, these findings suggest that Pilates-based core programs may be particularly well suited as an adjunct to routine snooker practice when the goal is to enhance stance stability and precision of cue actions.

Limitation and Recommendations:

This study had several limitations that should be considered when interpreting the findings. The participants' initial levels of fitness, prior exposure to Pilates or calisthenics, and snooker proficiency were not the same, which may have affected the outcomes, and uncontrolled variables, including participants' diet, sleep patterns and other physical activities, were also not evaluated. In addition, the quasi-experimental design with convenience sampling and no prior trial registration may have introduced some selection bias. Extended intervention duration is recommended to yield more convincing proof of the advantages of Pilates and calisthenic workouts, and individuals from a wider spectrum of demographics should be incorporated to enhance the relevance of the results to the whole snooker playing community. Future comparison research is also needed to ascertain which exercise intervention modalities, or which combination of them, are most beneficial in enhancing snooker players' abilities and static balance.

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Authors Contribution Statement

All authors have made substantial contributions and are accountable for the integrity of the study. Revised manuscript has been proofread and approved by all authors.

SS, AU, and SR: Conception of idea, data acquisition and analysis, review of the manuscript

AS and SAH: Literature search, data interpretation and manuscript writing and revision