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Original Research Article

A Longitudinal Study on the Effects of Combined Open and Closed-Kinetic Chain Exercise Interventions on Selected Physical Performance Variables among Inter-Collegiate Cricketers

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Abstract

Objectives**:* This study aimed to examine the effects of open and closed kinetic chain exercise interventions and to determine how these structured training programs influence selected physical performance variables, specifically flexibility, among inter-collegiate cricketers. ***Materials and Methods: A total of inter-collegiate male cricketers aged 18–25 years from AAA College of Engineering and Technology, Amathur, Sivakasi, Tamilnadu were selected for the study. The participants were randomly assigned into three groups: An Open Kinetic Chain Exercise Group (OKCEG), a Closed Kinetic Chain Exercise Group (CKCEG), and a Control Group (CG). The experimental groups underwent their respective structured kinetic chain training programs for a specified intervention period, while the control group continued with their regular physical activities without any specialized training. Flexibility was selected as the dependent physical performance variable and was assessed using a standardized flexibility test. Pre- and post-intervention data were statistically analyzed using appropriate inferential statistical techniques to determine significant differences among the groups. The level of significance was set at $p < 0.05$. ***Results:*** The results revealed significant improvements in flexibility in both the open and closed kinetic chain exercise groups when compared to the control group ($p < 0.05$). The control group did not exhibit any significant change in flexibility. Comparative analysis between the experimental groups indicated differences in the magnitude of improvement, with kinetic chain–based training demonstrating a positive influence on flexibility development. ***Conclusions**:* The findings of the study indicate that structured open and closed kinetic chain exercise interventions are effective in enhancing flexibility among inter-collegiate cricket players. Both training methods proved superior to regular activity alone, highlighting the importance of incorporating kinetic chain exercises into cricket training programs to improve physical performance.

Keywords: Open kinetic chain exercises; closed kinetic chain exercises; flexibility; physical performance; inter-collegiate cricket players.

INTRODUCTION

Flexibility is a vital physical performance component that supports efficient movement, optimal joint range of motion, and injury prevention in athletes. In cricket, flexibility is especially important due to the repetitive and high-velocity movements involved in batting, bowling, and fielding, which require coordinated action across multiple body segments. Enhancing flexibility can therefore contribute to improved performance and long-term athletic sustainability.

Kinetic chain–based exercise training has gained attention in recent years for its role in improving functional movement and physical performance. Open kinetic chain exercises allow isolated joint movement and are effective in improving joint mobility, whereas closed kinetic chain exercises involve multi-joint, weight-bearing movements that enhance neuromuscular coordination and functional flexibility (Adeel *et al.,* 2024). Recent evidence suggests that both training modalities positively influence range of motion and movement efficiency when applied systematically.

Menek and Dansuk (2025) reported significant improvements in joint range of motion following closed kinetic chain exercise interventions, highlighting their effectiveness in enhancing flexibility-related outcomes. Similarly, (Forelli *et al.,* 2025) emphasized that both open and closed kinetic chain exercises contribute to improved physical function, with differential effects depending on training objectives. Despite these findings, limited longitudinal research has examined and compared the effects of open and closed kinetic chain exercise interventions on flexibility among inter-collegiate cricket players. The present study addresses this gap by investigating the influence of structured kinetic chain training programs on flexibility.

MATERIALS AND METHODS

Participants

A total of 60 male inter-collegiate cricket players, aged 18–25 years, from AAA College of Engineering and Technology, Amathur, Sivakasi, participated in this study. All participants were healthy, physically active, and free from musculoskeletal injuries or medical conditions that could interfere with exercise performance. Eligibility was confirmed through comprehensive health screenings and physical assessments. Individuals with recent injuries, chronic illnesses, or any condition restricting participation in physical activity were excluded to ensure both participant safety and validity of intervention outcomes. Previous research has shown that exclusion of participants with underlying health conditions is necessary to reduce confounding variables in exercise intervention studies (Ramasamy *et al.,* 2023). Additionally, comparative kinetic chain studies emphasize rigorous participant screening to ensure reliability and generalizability of training effects (Sreeji & Biju, 2025). Before the commencement of the study, all participants received detailed information about the study's objectives, procedures, and potential risks, and written informed consent was obtained.

Experimental Design

The study utilized a longitudinal experimental design. Sixty participants were randomly divided into three groups, with 20 individuals in each group: Experimental Group I – Open Kinetic Chain Exercise Group (OKCEG), Experimental Group II – Closed Kinetic Chain Exercise Group (CKCEG), and Group III – Control Group (CG). The OKCEG and CKCEG groups participated in structured kinetic chain exercise programs for a duration of 12 weeks, whereas the control group continued their usual physical activities without engaging in any specialized training. Pre- and post-intervention assessments were conducted to measure changes in the dependent variable, flexibility, allowing comparison of the effects of the interventions. A flow chart outlining the study procedure is provided below.

Training Protocol

The experimental groups participated in a 12-week structured training program, with sessions held six days per week and a 60-minute main exercise period, excluding warm-up and cool-down. Each session began with a warm-up consisting of dynamic stretching and light aerobic activities to prepare the participants for the main workout. The Open Kinetic Chain Exercise Group (OKCEG) performed exercises emphasizing isolated joint movements, such as leg extensions and arm curls, while the Closed Kinetic Chain Exercise Group (CKCEG) carried out multi-joint, weight-bearing exercises, including squats, lunges, and push-ups. Each session ended with a cool-down involving static stretching and relaxation exercises. Exercise intensity and progression were carefully monitored and adjusted for each participant to ensure safety and maximize training benefits. The control group did not engage in any structured kinetic chain exercises and continued with their regular physical activities throughout the study.

Criterion Measures

Flexibility was evaluated as the primary physical performance variable. It was assessed using standardized methods, including the sit-and-reach test to measure hamstring and lower back flexibility, as well as goniometer-based assessments to determine the range of motion in major joints. All tests were conducted following established protocols to ensure accuracy and consistency.

Statistical Analysis

To determine baseline differences in flexibility among the three groups, independent sample t-tests were conducted. This allowed for the comparison of mean flexibility scores before the intervention to ensure that all groups were comparable at the start of the study. Following the 12-week training program, paired sample t-tests were used to analyze within-group changes in flexibility, assessing the effectiveness of the Open Kinetic Chain and Closed Kinetic Chain exercise interventions. The level of statistical significance was set at $p < 0.05$ for all analyses. Data were expressed as mean ± standard deviation, and all analyses were performed using SPSS version 20 to ensure precision and reliability of the results.

Experimental Design Flow Chart

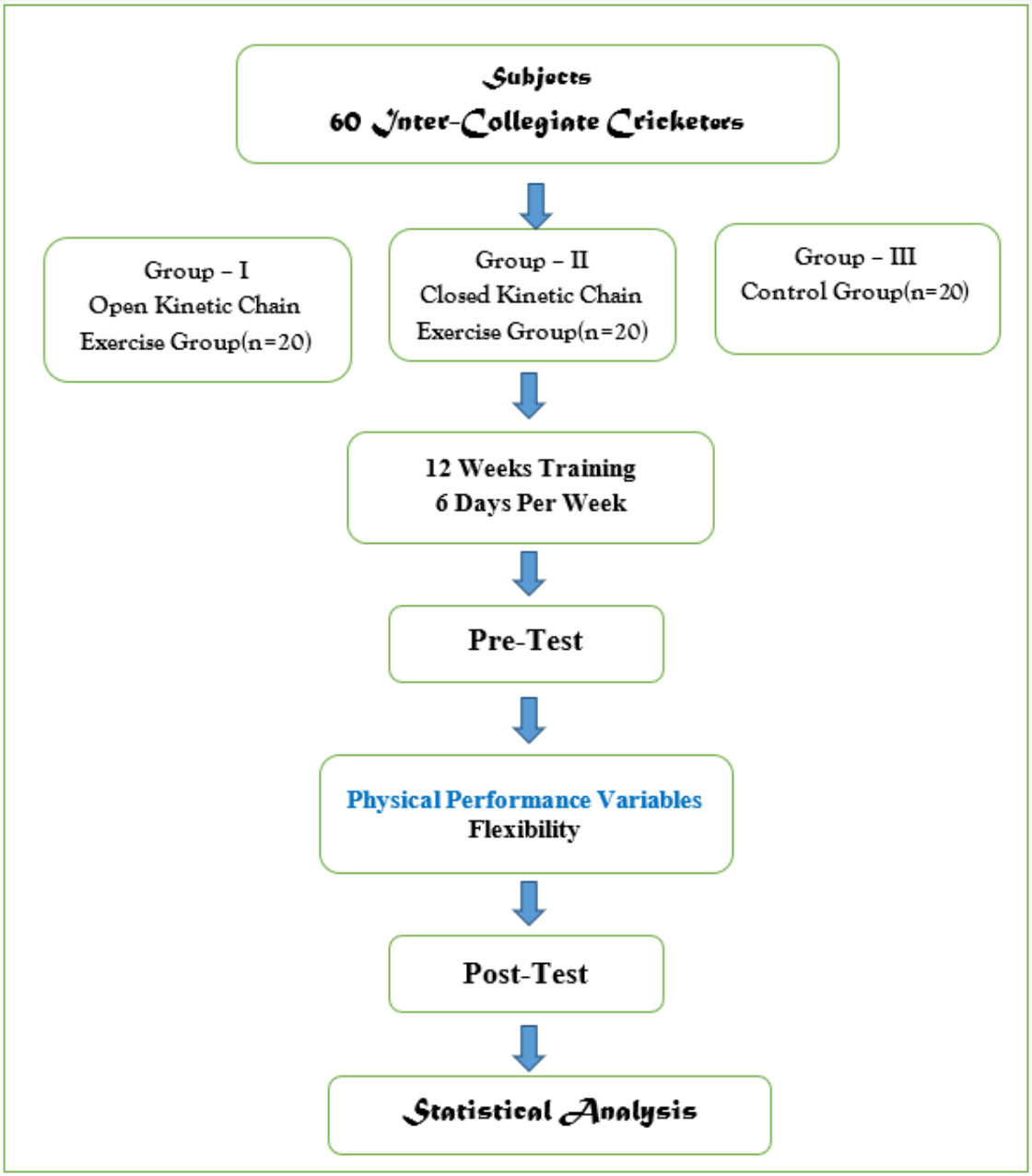

Table – I

S. No	Variables	Group	Pre-Test Mean (± SD)	Post-Test Mean (± SD)	t	p
1	Flexibility	OKCEG	30.30 ± 2.63	35.60 ± 1.93	8.11	0.000
		CKCEG	31.00 ± 3.16	33.70 ± 2.93	4.29	0.000
		CG	29.95 ± 2.11	29.00 ± 2.93	1.52	0.143

OKCEG refers to the Open Kinetic Chain Exercise Group, CKCEG represents the Closed Kinetic Chain Exercise Group, and CG denotes the Control Group. All values are presented as mean ± standard deviation (SD). Flexibility was assessed using the sit-and-reach test, with the degrees of freedom (df) = 19 and the significance level set at 0.05.

Table I (paired sample t-test results) summarizes the pre- and post-test mean flexibility scores for OKCEG, CKCEG, and CG. Significant improvements in flexibility were observed in both experimental groups, while the Control group showed no meaningful changes. The OKCEG demonstrated a marked increase in flexibility from 30.30 ± 2.63 to 35.60 ± 1.93, which was statistically significant ($t = 8.11$, $p = 0.000$). The CKCEG also showed a significant improvement from 31.00 ± 3.16 to 33.70 ± 2.93 ($t = 4.29$, $p = 0.000$). In contrast, the Control group exhibited a

non-significant change in flexibility, decreasing slightly from 29.95 ± 2.11 to 29.00 ± 2.93 (t = 1.52, p = 0.143). Overall, the results indicate that Open Kinetic Chain exercises were more effective in enhancing flexibility among inter-collegiate cricket players, followed by Closed Kinetic Chain exercises, whereas the Control group showed no statistically significant improvement.

DISCUSSION

The purpose of the present study was to examine the effects of Open Kinetic Chain (OKCEG) and Closed Kinetic Chain (CKCEG) exercises on flexibility among inter-collegiate male cricketers. Paired-sample t-test results demonstrated that both experimental groups experienced statistically significant improvements in flexibility, whereas the Control group exhibited no meaningful change.

The OKCEG showed a highly significant increase in flexibility (p = 0.000), indicating that exercises involving isolated joint movements are particularly effective in enhancing static flexibility. The CKCEG also demonstrated significant improvements (p = 0.000), suggesting that multi-joint, weight-bearing exercises can improve flexibility, though to a lesser extent compared to OKCEG. The Control group showed no significant change (p = 0.143), confirming that routine physical activity alone may be insufficient to induce measurable flexibility gains.

These findings align with previous studies reporting that Open Kinetic Chain exercises improve joint-specific flexibility due to the greater range of motion achievable in isolated movements (Aguirre *et al.,* 2022; Kumar & Singh, 2023). Closed Kinetic Chain exercises, while primarily aimed at improving functional strength and stability, also contribute to flexibility, especially in dynamic, multi-joint movements, but their impact on static flexibility measures may be limited.

The greater improvements observed in OKCEG may be attributed to the ability of OKC exercises to stretch muscles through their full length without weight-bearing constraints, enhancing hamstring, hip, and lower back flexibility critical for cricket-specific actions such as bowling, batting, and fielding. CKCEG exercises, although slightly less effective in isolated flexibility, complement OKCEG by improving functional mobility, joint coordination, and stability, which are essential for overall sports performance.

Despite the positive outcomes, several limitations should be noted. The sample size was relatively small, limiting the generalizability of the findings. Lifestyle factors such as diet, sleep, and additional training were not controlled, which could influence flexibility outcomes. Moreover, only flexibility was assessed; other performance variables such as strength, balance, and injury risk were not included. Future research should include larger samples, longer interventions, and additional performance and physiological measures to provide a more comprehensive understanding of the effects of kinetic chain exercises on cricket players.

CONCLUSION

The present study demonstrates that both Open Kinetic Chain (OKCEG) and Closed Kinetic Chain (CKCEG) exercises effectively enhance flexibility among inter-collegiate male cricket players, with OKC exercises producing greater improvements in static flexibility. These findings indicate that isolated joint movements in OKC exercises are particularly beneficial for improving hamstring, hip, and lower back flexibility key components for cricket-specific actions such as bowling, batting, and fielding. CKC exercises, while slightly less effective in static flexibility, contribute to functional mobility, joint stability, and coordination, which are essential for overall sports performance. The Control group, which followed routine physical activity, showed no significant changes, highlighting the importance of structured exercise interventions.

Overall, the study supports the inclusion of both OKC and CKC exercises in cricket training programs, with a focus on OKC exercises for targeted flexibility improvements. Future research should explore longer intervention periods, larger sample sizes, and additional performance variables such as strength, balance, and injury prevention to provide a more comprehensive understanding of the benefits of kinetic chain exercises for cricket players.

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