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Effects of Chop and Lift Exercises on Kinetic Chain Control and Power in Pace and Spin Cricket Bowlers: A Randomized Trial

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ABSTRAT

BACKGROUND: The Effects of Chop and Lift Exercises on Kinetic Chain Control and Power in Pace and Spin Bowlers: A Randomized Trail.

PURPOSE: The aim of the study is to investigate the effects of chop and lift exercises on kinetic chain control in cricket pace and spin bowlers.

METHOD: Forty-two male participants were selected based on specific inclusion and exclusion criteria. Demographic data were collected, and written informed consent was obtained. Participants were categorized into pace and spin groups based on their bowling style. Both groups followed a standardized 6-week training program, consisting of 12 sessions of kettlebell-based chop and lift exercises. Kinetic chain control and power were measured using the upper quarter Y-balance test (UQYBT) and rotational medicine ball throw test (RMBT), with assessments performed on both dominant and non-dominant upper extremities before and after the intervention.

RESULT: Both pace and spin bowlers exhibited significant improvements in kinetic chain control and power, as evidenced by higher scores on the upper quarter y-balance test and the rotational medicine ball throw test ($p<0.05$). however, pace bowlers showed a greater mean improvement in the rotational medicine ball throw test compared to spin bowlers ($p<0.05$). no significant differences were found between groups in the upper quarter y-balance test for either dominant or non-dominant sides ($p>0.05$).

CONCLUSION: Chop and Lift exercises effectively enhanced kinetic chain control and power in both pace and spin cricket bowlers. while both groups experienced comparable gains in balance, pace bowlers achieved greater improvements in rotational power. these findings suggest that although chop and lift exercises are beneficial for both types of bowlers, they may be particularly effective in boosting explosive strength in pace bowlers.

KEYWORDS: chop and lift exercises,cricket, kinetic chain control, power, pace bowlers,rotational medicine ball throw test, spin bowlers, upper quarter y-balance test.

INTRODUCTION

Cricket bowling requires a coordinated and powerful movement of the kinetic chain, involving the lower body, core, and upper body. Proper control and power generation within the kinetic chain is crucial for effective bowling performance.[1]

The ability to throw at high velocity with accuracy is important for good performance in cricket.[2]

Overhead throwing is a movement that occurs in three dimensions, therefore rotational power and mobility can play an integral role in enhancing overhead throws in cricket.[3]

Throwing velocity may be impacted by a kinetic chain with insufficient rotational power and mobility because of the order of proximal to distal connection.[4]

Pace bowlers depend on speed to get a Batsman out, whereas spin bowlers depend on the degree of turn of the ball.[5]

Most pace bowlers are medium-fast to fast in top-level cricket. In general, bowlers of this type are described as "fast" or "fast-medium".[5]

Cricket bowlers depend on a bowling method known as spin bowling to release the ball slowly with the possibility of a sharp deflection after it bounces.[6]

The kinetic chain or kinetic link principle provides both the framework for understanding and analyzing human movement patterns as well as the rationale for the utilization of exercise conditioning and rehabilitation programs that emphasize the entire body, despite a target joint or anatomical structure being injured.[7]

The kinetic link principle describes how the human body can be considered in terms of a series of interrelated links or segments.[8]

The kinetic chain mechanism involves a coordinated series of motions that begin from the floor and progress up through the legs, hips, trunk, shoulder, arm, wrist, and fingers before the ball is finally released.[9]

The muscles and joints of the trunk, scapulothoracic, scapulohumeral, and distal arm segments make up the upper extremity kinetic chain.[10]

The lower extremity kinetic chain involves the interconnected system of joints and muscles in the lower limbs, including the foot and ankle, lower leg, knee, thigh, and hip. These segments work together to facilitate movement and force production.[11]

Movement of one segment affects segments both proximal and distal to the first segment.[12]

The upper extremity and trunk work together as a series of suggested linkages, with each region depending on the others to function efficiently. Dysfunction in any of these linkages can lead to movement impairments or compensatory patterns that may result in pain or injury. By identifying and addressing dysfunction in these linkages, it may be possible to improve movement efficiency and prevent pain or injury.[13]

In both pace and spin bowling, the kinetic chain mechanism is an important component of the bowling motion. It describes how various muscle groups in the body are sequentially activated so that they can combine to provide the most force and power possible during the bowling action.[1]

The kinetic chain mechanism involves a coordinated series of motions that begin from the floor and progress up through the legs, hips, trunk, shoulder, arm, wrist, and fingers before the ball is finally released.[1]

AIMS

1. To find the effects of chop and lift exercise on the kinetic chain control in cricket bowlers.
2. To find the effects of chop and lift exercise on power in cricket bowlers.

OBJECTIVES OF THE STUDY

1. To find the effects of chop and lift exercises on kinetic chain control in pace and spin bowlers using Upper Quarter Y Balance Test.
2. To find the effects of chop and lift exercises on power in pace and spin bowlers using rotational medicine throwball test.

METHODOLOGY

Participants:

- A randomized trial was performed on 42 cricket bowlers selected from local cricket academy, Bhubaneswar, Odisha. Ethical clearance was taken from the Institutional ethical committee of Abhinav Bindra Sports Medicine and Research Institute (ABSMARI), Bhubaneswar prior to the commencement of the study. The protocol ID for approval was ABS-IEC-2023-PHY-008. The participants selected were within the age group of 16-25 years and had at least 2-3 years of bowling experience. The purposive sampling method was used. Cricket bowlers both right-handed and left-handed. The players having any kind of recent injury, female cricket bowlers, or PARQ score less than 7 were excluded from the study.The sample were dividedequally into 2 groups. (Pace and Spin)

Sample size calculation:

Sample size was calculated in G-Power software using mean (91.63,84.51) and standard deviation (9.7,5.4), effect size (0.906), alpha (0.05), power (0.8).[25]

MATERIALS USED

1. Y Balance Test Kit(3 wooden boxes 10 cm)
2. Medicine ball weighing (4 kg)
3. Measuring tape
4. Agility cones
5. Performance recording sheet
6. Kettle bell weighing (2-8 Kgs)
7. Stopwatch (Mobile Application)

PROCEDURE

- An experimental study was undertaken at a local cricket academy, Bhubaneswar. 42 participants were selected based on the inclusion and exclusion criteria.
- A brief demographic data of all the participants was obtained, written consent was taken from all the participants, and the experimental protocol was explained with its benefits and Precautions. The study duration was 6 weeks which included 12 sessions of experimental protocol. 42 Participants, who cleared the Physical activity readiness questionnaire (PARQ), and the inclusion criteria weredivided to pace and spin groups respectively depending upon their bowling pattern.
- Both the groups underwent the same training regime i.e.chop and lift exercise with kettlebell. Power and kinetic chain control were assessed for each participant by rotational medicine ball throw test (RMBT) and upper quarter Y-balance test (UQYBT) respectively. The UQYBT was assessed for both dominant and non-dominant upper extremities. These two outcome measures were assessed prior to the commencement of the study and after 6 weeks.
- There were no adverse events during the training sessions.

❖ **Chop and lift exercise:**Exercises such chop and lift are innovative methods to improve functional strength and core stability by imitating commonplace movements. The lift is the opposite of the chop, lowering weight from above the shoulder to the hip on the same side. The chop is lifting a weight from a low position on one side of the body to a high position on the opposing side. These workouts are adaptable for varying fitness levels as they work several muscle groups, enhance balance, and can be done with a variety of equipment. They are very helpful in preventing injuries and addressing asymmetries in movement.

Setup for the Half Kneeling Chop and Lift Procedure:

1. Starting Position: Take a half-kneeling stance to start. This position places one knee on the floor and the other foot flat on the ground in front of you.

   -To create a 90-degree angle at both knees, place your left foot flat in front of you if your right knee is on the floor.

   -Make sure your left foot is pointed forward and your right knee is exactly beneath your right hip.

2. Kettlebell Position: - Beginning at the side of your body opposite the knee on the ground, hold the kettlebell with both hands. For example, hold the kettlebell with both hands on the left side of your body if your right knee is bent**.**

3. The Execution Chop Motion: Chop Down

   a. Throughout the exercise, keep your spine upright and your core active.

   b. Maintaining a straight arm position, rotate your torso to bring the kettlebell diagonally across your body and near the front pocket of your left hip.

   c. Pay attention to starting the action from your hips and core as opposed to only your arms.

   d. Return With control and a straight spine, slowly move the kettlebell back to the beginning position.

4. Lift Movement: -

   a. Lift Up: - After finishing the chop, move on to the lift. Begin with the kettlebell at your left hip. - Lift the kettlebell diagonally upwards across your body towards the right shoulder, maintaining your arms straight and using your core for stability.

   b. Return: - Lower the kettlebell back down to the starting position at your left hip in a controlled manner.

5. Repetitions:-

   a. 1.8 to 10 repetitions should be done for each side, switching the kneelingleg after each repetition.

   b. Make sure that movements are executed with control and appropriate form to optimize advantages and reduce the chance of harm.

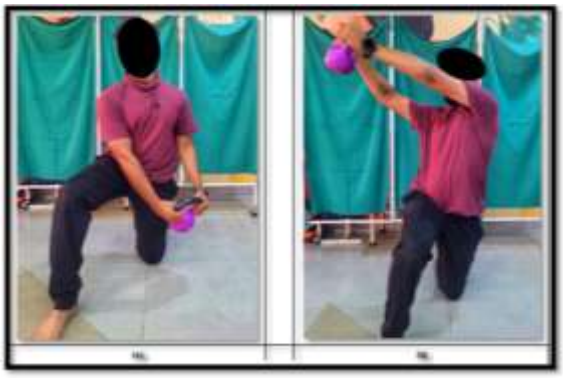


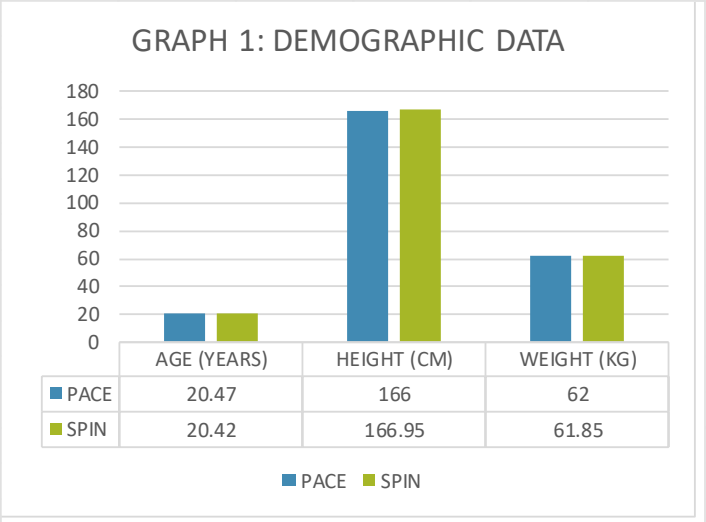
Figure 1 : hop and Lift Exercise with Kettle Bell in Half kneeling Position

RESULTS

The study sample comprised 42 participants ranging in age from 16 to 25 years. Demographic and baseline data are presented in **TABLE 2**. The distribution of data for the pace and spin groups was found to be normal **(p>0.05)**. **GRAPH 1** provides a visual representation of the demographic characteristics of both groups.

VARIABLES	PACE	SPIN	P-VALUE
AGE (YEARS)	20.47	20.42	>0.05
HEIGHT (CM)	166	166.95	>0.05
WEIGHT (KG)	62	61.85	>0.05
UQYBT_D_PRE (CM)	113.13	108.74	>0.05
UQYBT_ND_PRE (CM)	103.54	96.64	>0.05
RMBT_PRE (Meter)	7.59	6.98	>0.05

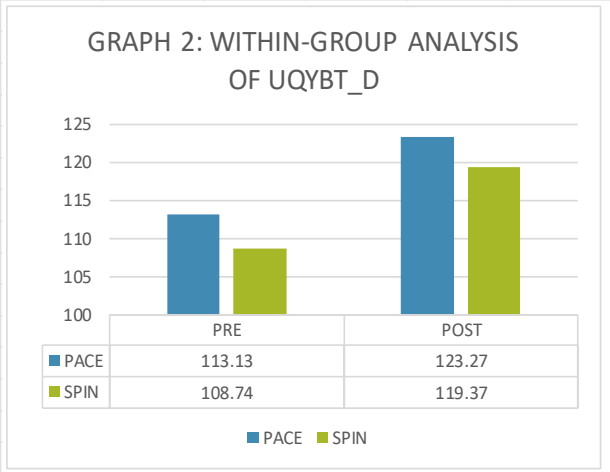
TABLE 2: DEMOGRAPHIC AND PRE-INTERVENTION DATA



In a within-group analysis comparing pre- and post-intervention results of the upper quarter Y-balance test on the dominant side, both the pace and spin groups demonstrated a statistically significant difference **(p<0.05)**. These findings are detailed in **TABLE 3** and visually represented in **GRAPH 2**.

GROUP	PRE	POST	MEAN DIFFERENCE	P-VALUE
PACE	113.13	123.27	10.14	<0.05*
SPIN	108.74	119.37	10.63	<0.05*

TABLE 3: WITHIN GROUP ANALYSIS OF UQYBT_D



In a within-group analysis of pre- and post-intervention performance on the upper quarter Y-balance test for the non-dominant side, both the pace and spin groups exhibited a statistically significant difference **(p<0.05)**. These results are presented in **TABLE 4** and illustrated in **GRAPH 3**.

GROUP	PRE	POST	MEAN DIFFERENCE	P-VALUE
PACE	103.54	113.41	9.87	<0.05*
SPIN	96.64	108.98	12.34	<0.05*

TABLE 4: WITHIN GROUP ANALYSIS OF UQYBT_ND

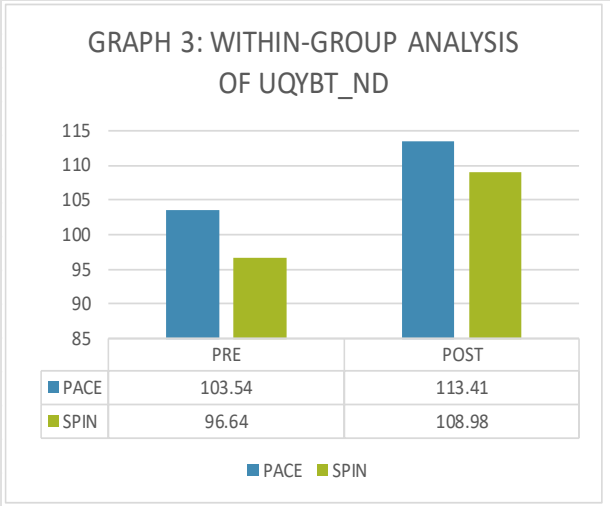


FIGURE 6

In the within-group analysis of pre- and post-intervention results for the rotational medicine ball throw test, both the pace and spin groups demonstrated statistically significant differences **(p<0.05)**. These findings are summarized in **TABLE 5** and depicted in **GRAPH 4**.

HYPOTHESIS

1. **Null Hypothesis (H01):**There will be no significant effects of chop and lift exercise on the kinetic chain control and power of pace bowlers.
2. **Null Hypothesis (H02):**There will be no significant effects of chop and lift exercise on the kinetic chain control and power of spin bowlers.
3. **Alternate Hypothesis (H1):**There will be significant effects of chop and lift exercise on the kinetic chain control and power of pace.
4. **Alternate Hypothesis (H1):**There will be significant effects of chop and lift exercise on the kinetic chain control and power of spin bowlers.

DISCUSSION

This study examined the effects of chop and lift exercises on kinetic chain control and power in cricket bowlers, offering valuable insights into the training adaptations of both spin and pace bowlers.

The intervention involved a six-week regimen of kettlebell chop and lift exercises, with outcomes measured through the upper quarter Y balance test and the rotational medicine ball throw test. While the between-group results indicated no significant differences (p>0.05) for upper quarter Y-balance test and

statistically significant difference ($p<0.05$) for rotational medicine ball throw test, the within-group analyses revealed significant improvements ($p<0.05$), highlighting the effectiveness of the intervention.

The kinetic chain was a crucial concept in understanding athletic performance, particularly in sports like cricket, where complex movements are involved. It refers to the interconnected groups of body segments, joints, and muscles that work together to produce movement. In cricket, efficient kinetic chain function is essential for actions such as bowling, batting, and throwing, where energy transfer from the ground through the body to the ball is vital for performance. Effective energy transfer is fundamental to maximizing performance in cricket. Any inefficiencies or "leaks" in the kinetic chain—such as excessive movement or instability—can result in decreased power output and increased injury risk.[7]

The significant improvement in the rotational medicine ball throw test among pace bowlers indicated that kettlebell chop and lift exercises were particularly effective in developing the explosive power required for high-velocity bowling.This finding aligns with the work of Fleisig et al. (1999), who highlighted the importance of explosive strength for generating the substantial force required in sports like baseball pitching, a demand that parallels the requirements of pace bowling. The focus of the chop and lift exercises on rotational stability and core engagement, especially in a half-kneeling position, likely enhanced the body's ability to efficiently produce and transfer force—key elements for optimal pace bowling performance.[15]

The effectiveness of these exercises in enhancing rotational power was reinforced by evidence showing the crucial role of proximal-to-distal sequencing in athletic movements. Kibler (1994) emphasized that this sequencing is vital for efficient force generation in sports. In this study, the focus on core stability and rotational force generation in a half-kneeling position likely improved performance in rotational tasks, which are essential for cricket bowlers.[16]

The lack of significant differences in the upper quarter Y-balance test suggested that chop and lift exercises enhanced balance and stability similarly for both pace and spin bowlers. This finding aligned with research indicating that balance exercises can effectively improve upper body stability across various athletic groups. The absence of varying results between the interventions suggested that both methods similarly affected balance, independent of the bowling style.[19]

Overall, this study's findings suggested that, although the comparison between spin and pace bowlers did not yield significant differences, the within-group improvements indicated that both types of bowlers benefited from the kettlebell exercises. This aligned with previous research that emphasizes the role of strength and conditioning in enhancing athletic performance through improved kinetic chain function and stability.[26]

The significant within-group improvements observed in the upper quarter Y balance test and the rotational medicine ball throw test suggested that the chop and lift exercises effectively enhanced both balance and power.These outcomes are critical for bowlers, as balance is essential for maintaining proper technique during delivery, and power is crucial for achieving higher bowling speeds and greater accuracy.[22,27]

The results of this study underscored the importance of incorporating specific strength and conditioning exercises, such as kettlebell chop and lift movements, into the training regimens of cricket bowlers. By improving kinetic chain control and power, coaches can help athletes enhance their performance while potentially reducing the risk of injury. This approach aligned with current best practices in sports science, which advocate for a comprehensive training strategy that addresses both strength and functional movement patterns. [2,4]

The study demonstrated that both groups improved in kinetic chain control and power, as evidenced by significant changes in the upper quarter Y-balance test ($p<0.05$) and the rotational medicine ball throw test ($p<0.05$).However, when comparing the mean differences in the rotational medicine ball throw test between groups, the pace group showed a greater mean difference between pre- and post-intervention values than the spin group, indicating that the pace group achieved more significant gains in this test **($p<0.05$)**. In contrast, the upper quarter Y-balance test for both the dominant **($p>0.05$)** and non-dominant **($p>0.05$)** sides revealed no statistically significant difference between the groups, suggesting that the pace and spin groups experienced similar improvements in this area.

CONCLUSION

In conclusion, the experimental study highlights the effectiveness of kettlebell chop and lift exercises in improving kinetic chain control and power in cricket bowlers. While the lack of significant differences between groups may suggest that both spin and pace bowlers respond similarly to the training intervention, the within-group improvements point to the potential benefits of targeted strength training. Future research could explore the long-term effects of such interventions and their impact on competitive performance in cricket.

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Appendix

Observation protocol definitions provided to observers

Future research could benefit from extending the duration of interventions to better understand the long-term impacts of chop and lift exercises on cricket bowlers' performance and injury prevention. Including a more diverse participant group, such as female bowlers and those with different injury histories, could offer a broader perspective on how chop and lift exercises affect various individuals. Adding more performance and biomechanical assessments could provide a deeper insight into how chop and lift exercises influence kinetic chain control and power. Comparative studies could evaluate how chop and lift exercises stack up against other strength and conditioning programs to identify the most effective strategies for improving performance and minimizing injury risk in cricket bowlers.

The study investigated how a structured training program featuring chop and lift exercises affected male cricket bowlers, both pace and spin types. Spanning six weeks, the program included 12 sessions where participants performed kettlebell exercises aimed at boosting their power and kinetic chain control. Forty-two male bowlers were chosen based on specific criteria, and their performance was assessed with two main tests: the rotational medicine ball throw test (RMBT) for power and the upper quarter Y-balance test (UQYBT) for kinetic chain control in both dominant and non-dominant arms. The results showed that both pace and spin bowlers improved their performance metrics significantly, with pace bowlers making more notable gains in the RMBT. However, no significant differences were found in the UQYBT scores between the two types of bowlers, suggesting that both groups experienced similar improvements in kinetic chain control. Overall, the study concluded that the training program was effective in enhancing the athletic performance of the participants, suggesting that such exercises could be beneficial in cricket training regimens.