IMPACT OF MULTIDIMENSIONAL TRAINING ON AGILITY, BALANCE AND PERFORMANCE IN CLUB CRICKETERS COMPARED TO CONVENTIONAL TRAINING - A RANDOMISED CONTROLLED TRIAL

By

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IN
SPORTS

Under the Guidance of

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LIST OF ABBREVIATIONS USED

1. **ABSMARI -** Abhinav Bindra Sports Medicine And Research Institute
2. **BOMB -** Backward Overhead Medicine Ball
3. **CG -** Control Group
4. **CJT -** Chalk Jump Test
5. **EG -** Experimental Group
6. **KB -** Kettle Bell
7. **MB -** Medicine Ball
8. **PNF -** Proprioceptive Neuromuscular Facilitation
9. **SEBT -** Star Excursion Balance Test
10. **SLS -** Single Leg Squat
11. **SPSS -** Statistical Package of Social Science

ABSTRACT

TITLE: IMPACT OF MULTIDIMENSIONAL TRAINING ON AGILITY, BALANCE AND PERFORMANCE IN CLUB CRICKETERS COMPARED TO CONVENTIONAL TRAINING, A RANDOMISED CONTROLLED TRIAL

Background: This study aims to compare the effectiveness of multidimensional training over conventional training on agility, balance and performance in club cricketers.

Methods: Seventy subjects were assigned to: an experimental group (n=35, 6-week training sessions, 3 sessions per week, each lasting for 45-60 minutes) and a control group (n=35, regular conventional training). The outcome measures included tests were run a three test, single leg balance test, SEBT, BOMB throw, SLS, Sargent CJT.

Results: The multidimensional training group showed an improvement in run a three test ($p<0.05$, Mean Rank= 49.84), single leg balance test ($p<0.05$, Mean Rank= 51.93), SEBT ($p<0.05$, MD= 8.06), BOMB ($p<0.05$, MD= 2.06), SLS ($p<0.05$, MD= 18.82) and CJT ($p<0.05$, MD= 2.72). The control group showed an improvement in run a three test ($p<0.05$, Mean Rank= 21.16), single leg balance test ($p<0.05$, Mean Rank= 19.07), SEBT ($p<0.05$, MD= 3.18), BOMB ($p<0.05$, MD= 0.67), SLS ($p<0.05$, MD= 5.00) and CJT ($p<0.05$, MD= 0.89).

Conclusion: The results of this study concluded that EG (multidimensional training group) showed statistically significant improvement in agility, balance and performance compared to CG (conventional training group) in club cricketers.

Keywords: Agility; Balance; BOMB; Control group; Cricket; Multidimensional training; Performance

TABLE OF CONTENT

Sr.no	Content	Page No
1	INTRODUCTION	1
2	AIM AND OBJECTIVES	8
3	HYPOTHESES	10
4	REVIEW OF LITERATURE	12
5	METHODOLOGY AND PROCEDURE	18
6	STATISTICAL ANALYSIS	28
7	RESULTS	30
8	DISCUSSION	51
9	CONCLUSION	56
10	LIMITATIONS AND RECOMMENDATIONS	59
11	SUMMARY	61
12	STATEMENT OF FUNDING	64
13	BIBLIOGRAPHY	66
14	ANNEXURES	72

LIST OF TABLES

SL No	Table	Page No
1	WEEKLY PROGRESSION OVERVIEW	24
2	TEST OF NORMALITY	31
3	EG WITHIN GROUP COMPARISION (PARAMETRIC)	45
4	CG WITHIN GROUP COMPARISION (PARAMETRIC)	46
5	EG WITHIN GROUP COMPARISION (NON-PARAMETRIC)	47
6	CG WITHIN GROUP COMPARISION (NON-PARAMETRIC)	48
7	BETWEEN GROUP COMPARISION (PARAMETRIC)	49
8	BETWEEN GROUP COMPARISION (NON-PARAMETRIC)	50

LIST OF FIGURES

SL No	Figures	Page No.
1	CONSORT FLOW DIAGRAM	21
2	MIRROR DRILL	25
3	T DRILL	25
4	SINGLE LEG SQUAT	25
5	SINGLE LEG HOP AND HOLD	25
6	MEDICINE BALL OVERHEAD THROW	26
7	CONVENTIONAL TRAINING	26
8	RUN A THREE TEST	27
9	BOMB THROW TEST	27

LIST OF GRAPHS

SL No.	Graphs	Page No.
1	PRE DATA OF RUN A THREE TEST OF EG	32
2	PRE DATA OF RUN A THREE TEST OF CG	33
3	EG PRE DATA OF SINGLE LEG BALANCE	34
4	CG PRE DATA OF SINGLE LEG BALANCE	35
5	EG PRE DATA OF SEBT	36
6	CG PRE DATA OF SEBT	37
7	EG PRE DATA OF BOMB	38
8	CG PRE DATA OF BOMB	39
9	EG PRE DATA OF SINGLE LEG SQUAT	40
10	CG PRE DATA OF SINGLE LEG SQUAT	41
11	EG PRE DATA OF CHALK JUMP TEST	42
12	CG PRE DATA OF CHALK JUMP TEST	43

SL No.	Graphs	Page no.
13	EG WITHIN GROUP COMPARION (PARAMETRIC)	45
14	CG WITHIN GROUP COMPARISION (PARAMETRIC)	46
15	EG WITHIN GROUP COMPARISION (NON-PARAMETRIC)	47
16	CG WITHIN GROUP COMPARISION (NON-PARAMETRIC)	48
17	BETWEEN GROUP COMPARISION (PARAMETRIC)	49
18	BETWEEN GROUP COMPARISION (NON-PARAMETRIC)	50

1. INTRODUCTION

INTRODUCTION

Cricket is one of the most popular sports globally, especially in South Asia, Australia, the United Kingdom and increasingly across other nations. Beyond its cultural significance, cricket has evolved into a highly competitive sport that demands not only technical skills but also well-developed physical needs such as agility, balance, explosive power, coordination, and sustained endurance. Although historically perceived as less physically demanding compared to continuous high-intensity sports such as football or rugby, modern-day cricket places multidimensional physical challenges on athletes. The shorter formats of the game like Twenty20 and one-day cricket require greater speed, reaction time and power, while maintaining the traditional skills of precision and tactical play.[1,2]

Among the young adult group (18–25 years), which often represents the pathway from grassroots to professional cricket, the development of physical attributes through scientifically guided conditioning plays a crucial role in enhancing performance and preventing injury. Traditional or conventional training in cricket clubs often emphasizes skill-based drills, net sessions, and general conditioning or gym-based strength sessions, but usually with limited integration of multidimensional or physiologically varied training modalities. While such conventional methods maintain the technical essence of cricket, they may not sufficiently address the complexity of physical capacities needed in high-level performance.

This has led to growing interest in multidimensional training approaches. By combining proprioceptive training, neuromuscular training, proprioceptive

neuromuscular facilitation (PNF), and plyometrics in a structured training program, athletes can be better prepared for the unique physical demands of cricket. Such approaches aim to optimise the synergy of agility, balance, coordination, and power, while being supervised under the expertise of physiotherapists, strength and conditioning coaches, and professional cricket coaches to ensure both safety and sport-specific relevance.

Importance of Agility, Balance, and Performance in Cricket:

Performance in cricket depends upon a mixture of various motor abilities. Batsmen require quick decision-making paired with rapid directional changes to successfully complete runs between wickets, while fielders rely heavily on agility and dynamic balance to change direction, dive, and recover quickly. Bowlers similarly utilise proprioceptive control and explosive power to generate accuracy and pace in deliveries, while protecting themselves from repetitive stress injuries.[3]

- **Agility** allows quick multidirectional movements such as accelerating for a run, evading fielders, or chasing the ball across the field. Run-a-Three test closely simulates the cricket-specific demand of sprinting between wickets multiple times with rapid directional turns.

- **Balance** contributes to functional stability during shot execution, bowling strides, and fielding recoveries. Single leg balance test and the Star Excursion Balance Test (SEBT) measure both static and dynamic balance capacities relevant to performance.

- **Performance** specific power determines explosive actions like hitting a ball far, throwing accurately over long distances, or jumping powerfully to intercept catches. Tests such as the backward overhead medicine ball (BOMB) throw, single-leg squat (SLS), and Sargent chalk jump test (CJT) quantify these aspects.

Cricket players often encounter situations where these qualities arise simultaneously in unpredictable sequences, further reinforcing the need for integrated training strategies rather than isolated conditioning techniques.

Conventional vs. Multidimensional Training:

Conventional cricket training often prioritises skill-refinement and endurance through repetitive drills. While beneficial, these methods may not sufficiently challenge proprioceptive or neuromuscular mechanisms essential for enhanced motor control. On the other hand, **multidimensional training** integrates various methods, such as:

- **Proprioceptive training**: Improves joint position sense, body awareness, and muscular reflexes, enhancing injury resistance and movement efficiency.[5]
- **Neuromuscular training**: Focuses on restoring optimal movement patterns, addressing asymmetries, and improving motor unit recruitment for sport-specific tasks.[6]
- **PNF stretching and facilitation**: Enhances muscular flexibility, proprioceptive control, and synergistic coordination.[7]

- **Plyometrics**: Develops stretch–shortening cycle efficiency, explosive power, and rapid force production critical for batting drives, bowling run-ups, and fielding sprints.[8]

When combined, these elements enhance the overall physical performance rather than single components, offering athletes a more holistic developmental approach.

Theoretical Underpinning of Multidimensional Training:

The principle underlying multidimensional training derives from motor learning, neuromechanical adaptation, and the theory of specificity of training. By subjecting athletes to different yet controlled movement stimuli, the central nervous system (CNS) adapts through improved motor programming, intermuscular coordination, and neuromuscular efficiency.[9] Similarly, proprioceptive stimulation enhances afferent inputs from mechanoreceptors, enabling better postural adjustments and reflex stabilization, which are particularly vital during unpredictable game contexts.

PNF techniques expand the range of motion and promote reciprocal inhibition, paving the way for smoother neuromuscular transitions during cricket-specific sequences such as running between wickets or executing bowling follow-throughs.[10] Plyometric training, on the other hand, exploits the stretch–shortening cycle to boost explosive muscular power, translating directly into performance outcomes such as ball throwing distance or vertical jump height.[11] Thus, integrating these methods potentially improves both biomechanical effectiveness and functional sport-specific movements.

Agility, Balance, and Injury Prevention:

Agility and balance not only improve performance but also reduce the risk of musculoskeletal injuries. Lower-limb stability, proprioceptive feedback, and neuromuscular control are essential for preventing common injuries such as ankle sprains, hamstring strains, and knee ligament injuries, frequently observed in cricket due to sudden accelerations, pivoting, and diving.[12] Traditional training may overlook proprioceptive conditioning, leaving athletes vulnerable to preventable injuries. A structured, multidimensional program under professional guidance could therefore serve dual benefits: performance enhancement and long-term athlete health.

Rationale for the Study:

Despite the theoretical and practical benefits of integrated training, sport-specific research in cricket remains scarce. While multidimensional training models have gained recognition across sports like soccer, basketball, and rugby, cricket-specific empirical evidence regarding agility, balance, and power outcomes has been limited. Traditionally, club-level cricketers rely predominantly on coaching-led conditioning without adequate input from physiotherapists or strength coaches, potentially leading to gaps in physical preparation.

As the 18–25 years age group is critical for athlete development, implementing experimental approaches like multidimensional training may accelerate performance optimization at this formative stage. Additionally, the study addresses the lack of randomised controlled evidence comparing the effectiveness of such a program against conventional cricket training. The

chosen outcome measures balance scientific robustness with cricket-specific functional relevance, offering practical application for coaches, physiotherapists, and governing bodies.

Outcome Measures Justification:

1. **Run-a-Three Test**: Directly simulates cricket sprinting demands, evaluating agility and repeated accelerations.[16]

2. **Single Leg Balance Test**: Measures single-leg static balance, critical for batting stance stability and bowling action control.[13]

3. **Star Excursion Balance Test (SEBT)**: Widely validated for dynamic balance, assessing lower-limb control during multidirectional reach tasks with high sport relevance.[15]

4. **Backward Overhead Medicine Ball Throw**: Assesses upper-body and trunk explosive power, directly transferable to ball throwing and batting power.[18]

5. **Single-Leg Squat Test**: Gauges lower-limb functional strength, movement quality, and neuromuscular control.

6. **Sargent (Chalk) Jump Test**: A classic measure of explosive leg power, relevant for fielding jumps, vertical batting strokes, and bowling take-off actions.[17]

Together, these outcomes provide a comprehensive evaluation of agility, balance, and performance attributes in cricket athletes.

2. AIM AND OBJECTIVE OF THE STUDY

AIM OF THE STUDY

To study the impact of a 6-weeks multi-dimensional training program on agility, balance and performance of club cricket players.

OBJECTIVES OF THE STUDY

1. To assess Agility by **Run a three test**.

2. To examine static and dynamic balance utilizing the **Single Leg Balance Test** and the **Star Excursion Balance Test (SEBT)**, respectively.

3. To evaluate performance by using the **Backward Overhead Medicine Ball Throw (BOMB), Single Leg Squat (SLS), and Sargent Chalk Jump Test (CJT).**

3. HYPOTHESES

HYPOTHESES

1. Null Hypothesis (H_0):

   There will be no significant effect of a 6-weeks multidimensional training program on the agility, balance, and overall performance in club cricketers.

2. Alternate Hypothesis (H_a):

   There will be significant effect of a 6-weeks multidimensional training program on the agility, balance, and overall performance in club cricketers.

4. REVIEW OF LITERATURE

REVIEW OF LITERATURE

1. A systematic review was carried out by Yılmaz O et al on Effects of proprioceptive training on sports performance, the effects of proprioceptive training on athletic performance characteristics in athletes were investigated, whose results indicate that proprioceptive training can be an effective strategy for experts and coaches to enhance the physical performance of athletes. Firstly, the proprioceptive training exercises should be used both inside and outside the actual training sessions. It will therefore enable the athlete to interact effectively with his/her body, diminish the risk of injury, and improve power transfer.

2. A systematic review was carried out by Saddam Akber et al on the effects of neuromuscular training on athletes' physical fitness in sports in 2022. Researchers systematically reviewed 18 experimental studies out of 144 screened publications including both randomised and non-randomised trials with interventions such as plyometrics, strength, balance and proprioception training, targeting athletes of different ages and sports. It concludes that neuromuscular training significantly improves athletes' balance, agility, speed, muscular endurance, power, with benefits for both male and female athletes and recommended as a core part of training program.

3. A randomised clinical trial in 2024 was carried out by Safdar A et al on the effect of 8 weeks plyometric training vs conventional training on injury risk and functional movement in male domestic cricket players aged 18 to 25 years. 34 players were randomised to plyometric and conventional training group for 8 weeks, 3 sessions per week, each lasting 60 minutes. Functional movement and injury risk were assessed using 9TBS. Both interventions included structured protocols targeting strength, flexibility and specific movement patterns. The result indicated that plyometric training produced superior improvements in functional movement and injury prevention compared to conventional strength training with rapid advancement in explosive and rotational abilities. So they recommended integration of plyometric exercises for injury prevention and performance enhancement.

4. A randomised controlled trial was carried by Gidu et al on the Effects of Proprioceptive Training on Balance, Strength, Agility and Dribbling in Adolescent Male Soccer Players with the aim to determine the effects of proprioceptive training on balance, strength, agility and dribbling in adolescent soccer players. The progress of the experimental group in all tests was statistically significant, while the progress in the control group was mostly statistically insignificant for $p < 0.05$. The results indicate that a PT program conducted at approximately 14 years of age can be effectively incorporated into the training schedule of soccer players to enhance components of fitness in addition to dribbling ability. The

results of the experiment showed that sports training on the foam surfaces established a better progress of the development of proprioception than the increased training on the firm surfaces.

5. Federici et al investigated the Proprioceptive training and sports performance to outline and analyse the various weaknesses of this type of training as they are generally carried out, in order to constitute the basis for potential and necessary future developments and improvements of proprioceptive training that led Future research will have to criticize and deepen our knowledge of proprioceptive training from a different perspective. Thus, we should leave many of the proprioceptive exercises that are described in the literature and that are performed on unstable surfaces and, as we have observed, often negatively affect athletic performance.

6. Proprioception in Sports Medicine and Athletic Conditioning by Ogard WK discusses and clears the terminology and concepts of proprioceptive function, as well as how it is approached in sports medicine and athletic conditioning. Interventions challenging dynamic stability by various strengthening, balance, agility, and sport-specific activities could bring about improvements in performance, injury recovery, and prevention. The proper use of correct concepts and terminology should accompany descriptions of these concepts and activities.

7. Kataria J et al studied the relationship between core stability and performance in recreational cricket players to study the relationship between core stability and performance which showed positive Correlation between (SBRT, SBLT) and SLS and they recommended to implement these scores in training of athletes at various level of sports training to enhance the Specificity of training. According to the need of the sport we may use the result of present study to enhance the Performance in various sports like SLS test measure the endurance of lower leg used in ACL rehabilitation progression and football.

8. Lockie et al analysed specific speed testing for cricketers to determine the relationships between general and specific cricket speed tests, which included 30-m sprint (0- to 5-, 0- to 10-, 0- to 30-m intervals; general); 505 change-of-direction speed test with left and right foot turns
; 17.68-m sprint without and with (WB) a cricket bat (0- to 5-, 0- to 17.68-m intervals; specific); and run-a-three (specific). The run-a-three, and its components, were correlated with the 505, 30-m sprint, and 17.68-m sprints. All significant correlations were positive. The greatest correlations with the 505 were for turns 1 (505 Left r = 0.721;505 Right r = 0.627) and 2 (505 Left r = 0.702; 505 Right r =0.745); the third run (505 Left r = 0.728; 505 Right r =0.828); and total time (505 Left r = 0.712; 505 Right r =0.797).

9. Picot B et al studied The star excursion balance test: an update review and practical guidelines to provide a review of updated design, implementation, and interpretation of the SEBT and the proposal of some guidelines to standardize the procedure of SEBT for better cross-study comparison which indicates that SEBT is an appropriate and effective functional tool that can be applied to evaluate the dynamic postural control of the lower limb. However, transparency in reporting of the SEBT procedures are required to ensure comparable results across studies.

10. Olivier B et al investigated Static and dynamic balance ability, lumbo-pelvic movement control and injury incidence in cricket pace bowlers to determine the difference in lumbo-pelvic movement control, static and dynamic balance at the beginning and at the end of a cricket season in pace bowlers who suffered an injury during the season and those who did not. Poor performance in the single leg balance test and the star excursion balance test at the beginning of the cricket season may be an indication that a bowler is at heightened risk of injury.

5. METHODOLOGY AND PROCEDURE

METHODOLOGY

- **STUDY DESIGN:** Experimental Study
- **STUDY TYPE:** Randomised Controlled Trial
- **STUDY POPULATION:** Club Cricketers
- **SAMPLE SIZE:** 70
- **SAMPLING TECHNIQUE:** Purposive Sampling
- **STUDY SETTING:** Cricket Clubs in Bhubaneswar
- **STUDY DURATION:** 1 year
    - **Ethical clearance:**6 months
    - **Sample selection, data collection:** 2 months
    - **Statistical analysis, results analysis, discussion:** 4 months
- **INCLUSION CRITERIA:**

- Age – 18-25 years old
- Players actively participating for 1 year
- Male athletes

- **EXCLUSION CRITERIA:**

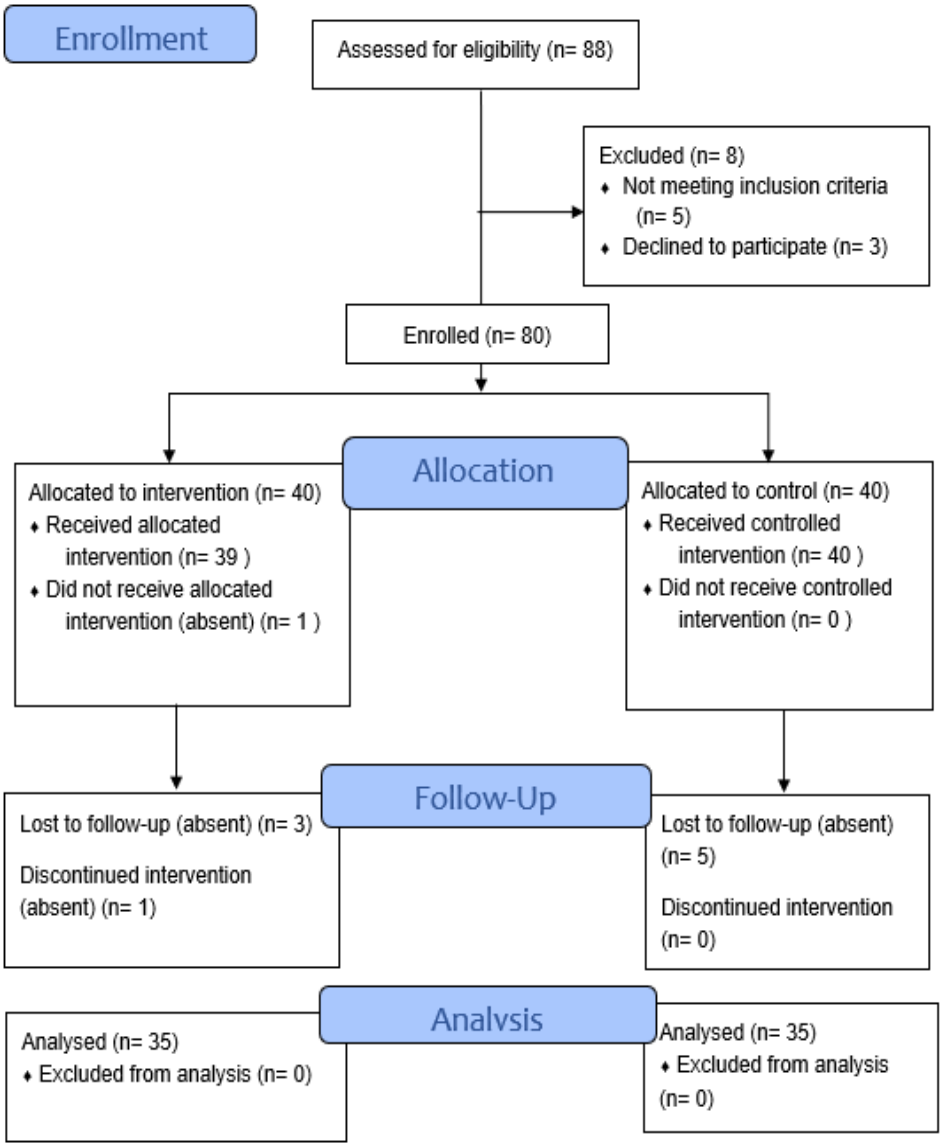
- History of any injury in the past 6 months that could affect performance
- Unable or unwilling to comply with training protocol
- Any acute or chronic conditions that could interfere with training or outcome
- Involved in any other structured training program

A randomised controlled trial was performed on 70 cricket players selected from cricket clubs in Bhubaneswar, Odisha. Ethical clearance was taken from the Institutional ethical committee of ABSMARI, Pahal, Bhubaneswar prior to the commencement of the study. The protocol ID for approval was ABS-IEC-2025-PHY-080. The participants selected were within the age group of 18-25 years male and actively participating for 1 year. The purposive sampling method was used for sampling. The players having any kind of recent injury, any chronic conditions that could interfere with training for outcome, involved in other structured training program were excluded from the study.

The sample size was calculated using G- Power software using a priori power analysis with effect size 0.80, alpha 0.05, power 0.90 of SEBT.

MATERIALS USED

1. Cones
2. Markers
3. Medicine Ball (3kg, 5kg)
4. Kettle Bell (2kg, 4kg)
5. Balance Board
6. Measuring tape
7. Chalk
8. Stopwatch



[FIGURE 1- CONSORT FLOW DIAGRAM]

PROCEDURE

This study was conducted as a randomized controlled trial to explore how a multidimensional training program influences agility, balance, and overall performance in club cricketers. Firstly, a 6-week Multidimensional training protocol was made by consulting two experienced sports physiotherapists, two experienced strength and conditioning coaches and a highly experienced cricket coach who was also a state level senior cricketer. After making the protocol, ethical approval was taken from institutional ethical committee of ABSMARI. After selecting the cricket clubs in Bhubaneswar, screenings of the subjects were done and selected according to the inclusion criteria. Informed consent was taken from all the participants after making them understand about the study and the procedures. Then participants were randomly divided into two groups, one followed the multidimensional training program as the EG, and the other continued with conventional regular training as CG. Both groups were assessed before and after the six-week training period to measure any changes.

After selecting eighty-eight participants, screening was done and from that, eighty club cricketers, aged between 18 and 25 years, were recruited from two different cricket clubs in Bhubaneswar. Out of these, 70 players completed the study. The experimental group and the control group each had 35 players, while ten dropped out due to personal reasons or inconsistencies in attendance. All participants were active club athletes without any injuries that would prevent them from training fully.

Participants were assigned to groups through a simple randomization process, with allocation handled by an independent researcher to ensure impartiality. One group completed the multidimensional training program designed specifically for six weeks, while the other group continued their usual training routines without any added specialized exercises.

The intervention consisted of 18 sessions across six weeks, with three sessions per week, each lasting about 45 to 60 minutes. The program was thoughtfully developed by physiotherapists, strength and conditioning coaches, and experienced cricket coaches to meet the sports specific physical demands.

The training was divided into three progressive phases:

- Phase 1 (Weeks 1–2) focused on foundational exercises to build basic control, with low to moderate intensity.
- Phase 2 (Weeks 3–4) increased in intensity and complexity with more dynamic and reactive drills.
- Phase 3 (Weeks 5–6) emphasized high-intensity, sport-specific exercises integrating agility, balance, and power.

Each session began with a 10-minute warm-up involving light jogging and dynamic stretches to prepare the body. The main session included around 15 minutes each of agility drills, balance training, and power exercises that progressed week by week. Sessions concluded with a 5-10minute cool-down involving static stretching and breathing exercises to promote recovery

.

WEEKLY PROGRESSION OVERVIEW

[TABLE - 1]

WEEK	FOCUS AREA	IINTENSITY	COMPLEXITY	SET × REPS / DURATION
1-2	Foundation phase	Low - Moderate	Basic control drills	2-3 sets × 10-12 reps / 20-30 sec
3-4	Development Phase (Progression)	Moderate – High	Dynamic reactive drill	3 sets × 8-10 reps / 30-40 sec
5-6	Performance Phase (Sports Specific)	High	Integrated complex drill	3-4 sets × 6-8 reps / 40-45 sec

Agility Drills (15 minutes) -

Week 1–2: Cone Shuffle Drill, Zigzag Cone Drill, T-drill, Mirror drill

Week 3–4: Backpedal cone drill, Reactive sprints, Shuttle runs, W-Drill

Week 5–6: Illinois Agility with Ball pick up, Reactive L-drill (Bat and Glove), Medicine Ball+ Sprint COD, 4- Corner reactive agility drill

[Session-to-session: Increase Speed, Reduce Rest, Add Instability, Sports Specific, Verbal to Visual command]

[Fig. 2 - Mirror Drill]

[Fig. 3 - T Drill]

Balance Training (15 minutes) -

Week 1–2: Single-leg stand, Single leg heel raises, Forward-reverse lunges, Glute Bridges, Balance board hold, Single leg deadlift

Week 3–4: Balance board squats, Balance Board reach, Skater Squat, Y-balance drill, Single leg deadlift, T-drill with balance stops

Week 5–6: Unstable single-leg tasks, Single Leg Hop and Hold, Single leg ladder drill, Medicine Ball lunge and twist on balance board

[Session-to-session: Increase Hold Time, Reduce Rest, Add Instability, Sports Specific]

[Fig. 4 - Single Leg Stand]

[Fig. 5 – Single Leg Hop and Hold]

Power Exercises (15 minutes) -

Week 1–2: Standing vertical jump, Medicine ball chest pass, Overhead throw, Kettlebell Swings, Lateral cone jump, Broad jump, Light KB deadlift

Week 3–4: Depth Jump, MB rotational throw, KB Power clean, jump squats, Single leg Cone Hops, backward overhead MB throw, lunge with twist

Week 5–6: Sprint+MB chest pass, Reactive MB rotational throw, Balance Board Jump Squat, Bounding into Sprint, MB jump throw, KB push-press, Game Simulation

[Session-to-session: Increase Load, Reduce Rest, Sports Specific]

[Fig. 6 - MB Overhead Throw]

[Fig. 7 - Conventional Training]

Participants of control group followed their regular training routines, primarily focused on technical skills and standard physical conditioning exercises, without added emphasis on proprioceptive, neuromuscular, or plyometric training elements.

Assessments were taken both before and after the training by blinded assessors who were not part of the training programmed to ensure unbiased results. The following measures were used:

- Run-a-Three Test: to assess cricket-specific agility involving sprinting and quick directional changes.
- Single Leg Balance Test: to evaluate static balance important for batting and bowling stability.
- Star Excursion Balance Test (SEBT): measuring dynamic balance and control during multidirectional reaching movements.

[Fig. 8 – Run a Three Test]

[Fig. 9 – BOMB Throw Test]

- Backward Overhead Medicine Ball (BOMB) Throw: to quantify explosive upper-body power critical for throwing and batting.
- Single-Leg Squat (SLS) Test: assessing unilateral lower limb strength and neuromuscular control, reflecting functional stability.
- Sargent Chalk Jump Test: to evaluate explosive lower-body power through vertical jump height.

6. STATISTICAL ANALYSIS

STATISTICAL ANALYSIS

Statistical analysis was performed using IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. Normality of the data was found using Kolmogorov-Smirnov test. The data of run a three test and single leg balance test did not follow a normal distribution ($p< 0.05$). However, SEBT, BOMB, SLS, CJT were normally distributed ($p> 0.05$). For run a three test and single leg balance test, Mann Whitney u test was performed for between group analysis and Willcoxon test for within group analysis. For SEBT, BOMB, SLS and CJT, an independent t test was used for between group analysis and paired t test for within group analysis.

7. RESULTS

RESULTS

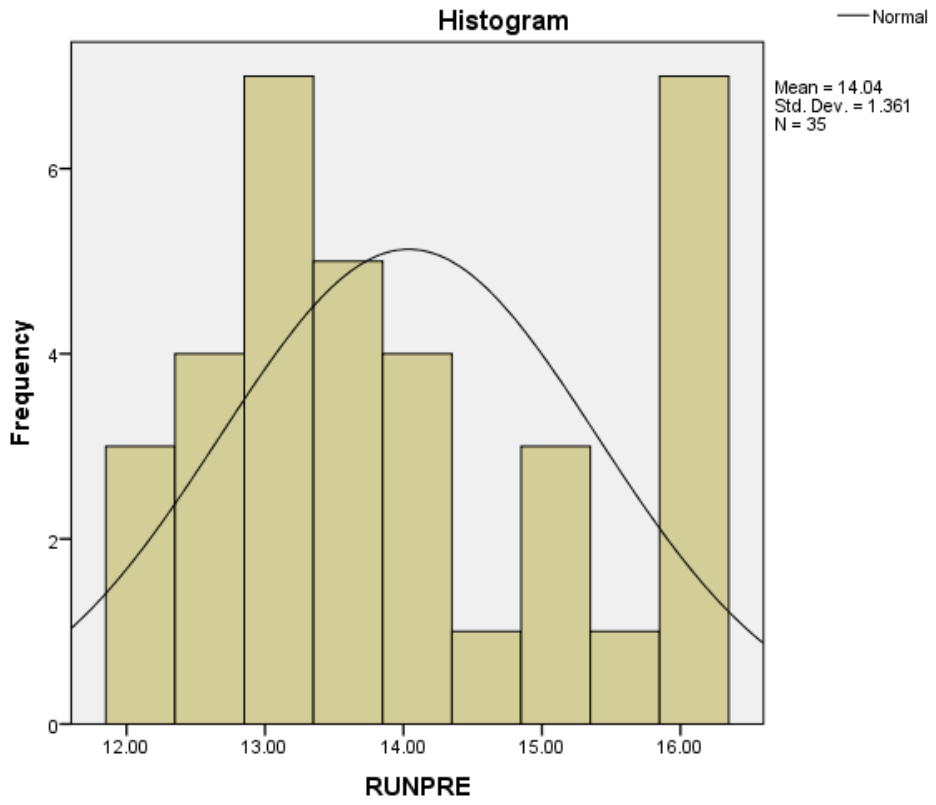
The current study included 70 participants aged 18 to 25 years. The baseline data are shown in TABLE 2.

TEST OF NORMALITY

[TABLE – 2]

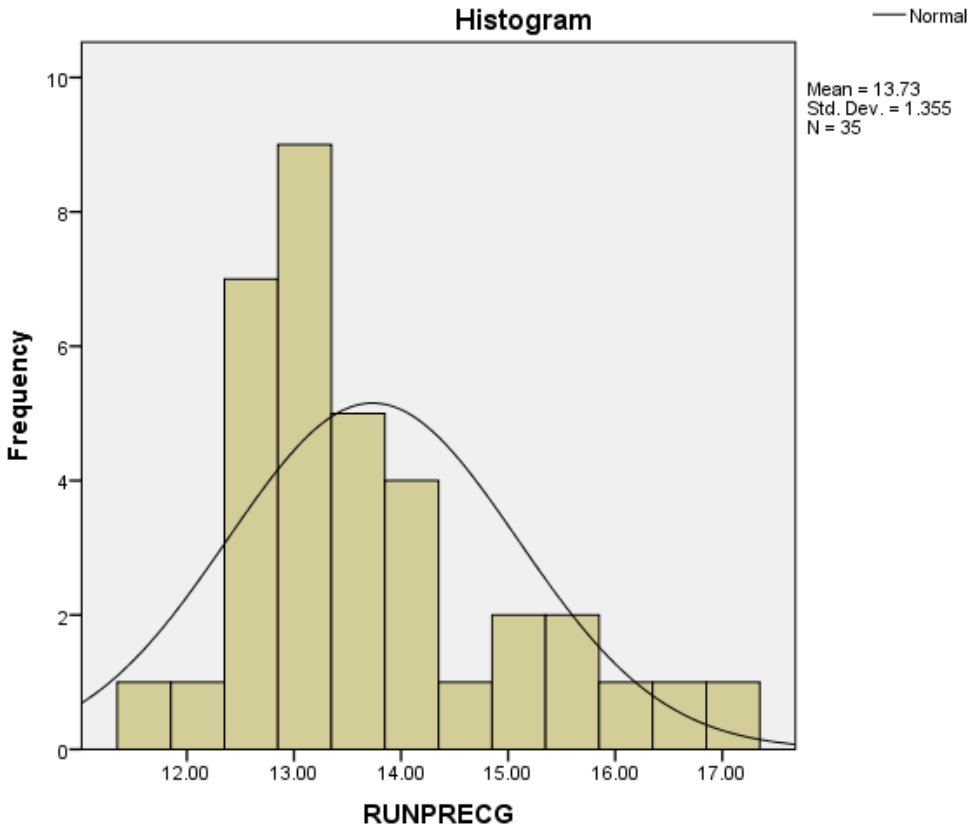
VARIABLES	EG MEAN ± SD	P VALUE	CG MEAN ± SD	P VALUE
AGE	21.37 ± 2.11	0.02	22.22 ± 1.91	0.089
RUN A THREE	14.03 ± 1.36	0.008	13.73 ± 1.35	0.01
SINGLE LEG STANCE	14.78 ± 6.9	0.02	12.84 ± 5.12	0.01
SEBT	114.40 ± 6.09	0.200	114.58 ± 6.25	0.200
BOMB	30.02 ± 3.52	0.200	29.66 ± 3.36	0.141
SINGLE LEG SQUAT	33.97 ± 12.08	0.200	25.77 ± 12.25	0.200
SARGENT CHALK JUMP TEST	15.18 ± 3.12	0.200	16.25 ± 3.23	0.114

The baseline data shows homogeneity between EG and CG in age and pre intervention data values, with no significant initial differences.



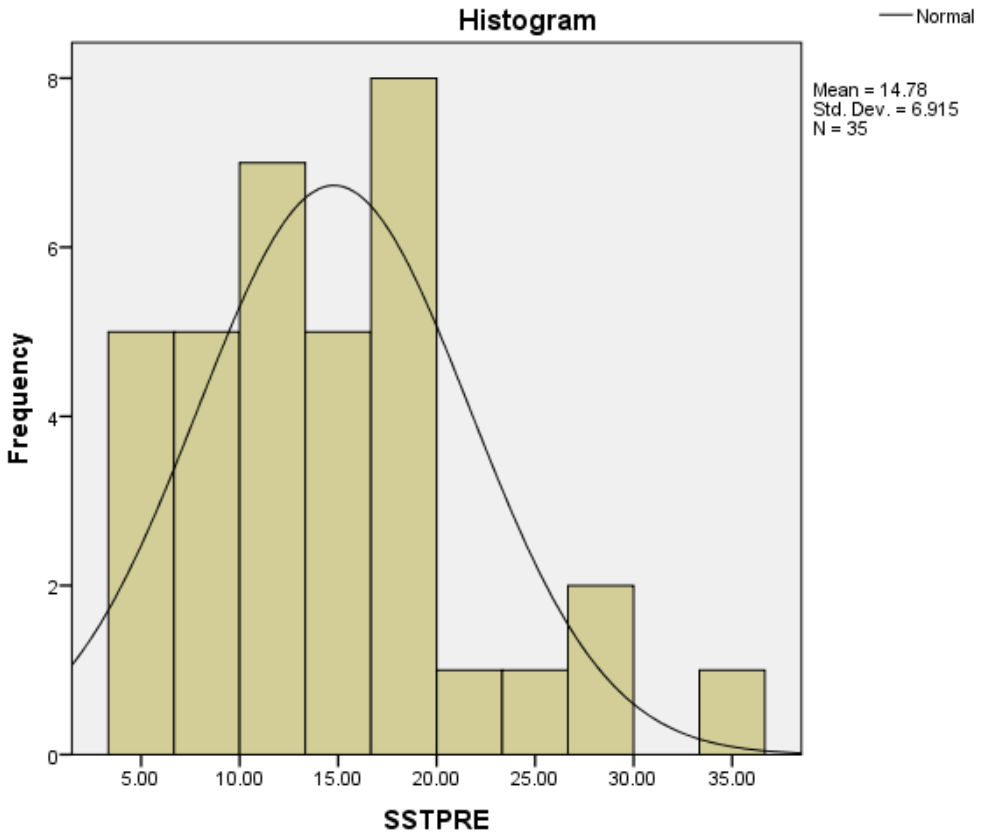
[GRAPH - 1]

Above graph shows the pre intervention data of run a three test of experimental group. The distribution shows the mean of the baseline data of EG for run a three test is 14.03 with the standard deviation of 1.36 and $p< 0.05$ shows the data is not normally distributed.



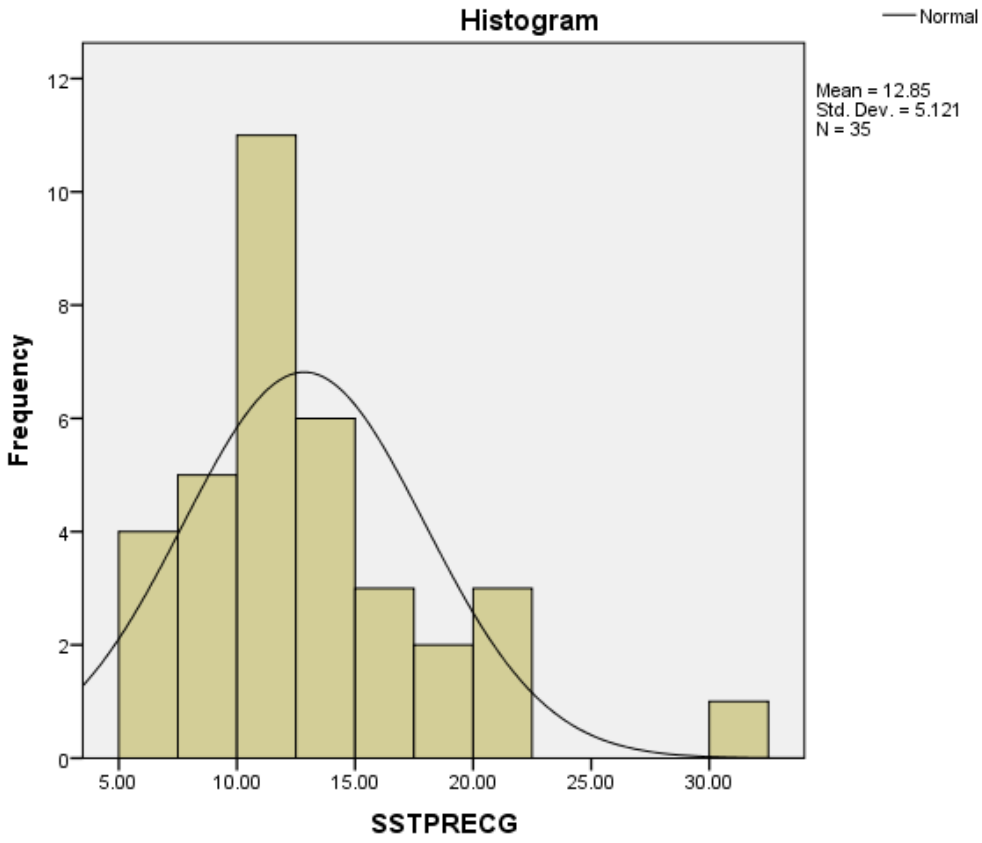
[GRAPH - 2]

Above graph shows the pre intervention data of run a three test of control group. The distribution shows the mean of the baseline data of CG for run a three test is 13.73 with the standard deviation of 1.35 and $p< 0.05$ shows the data is not normally distributed.



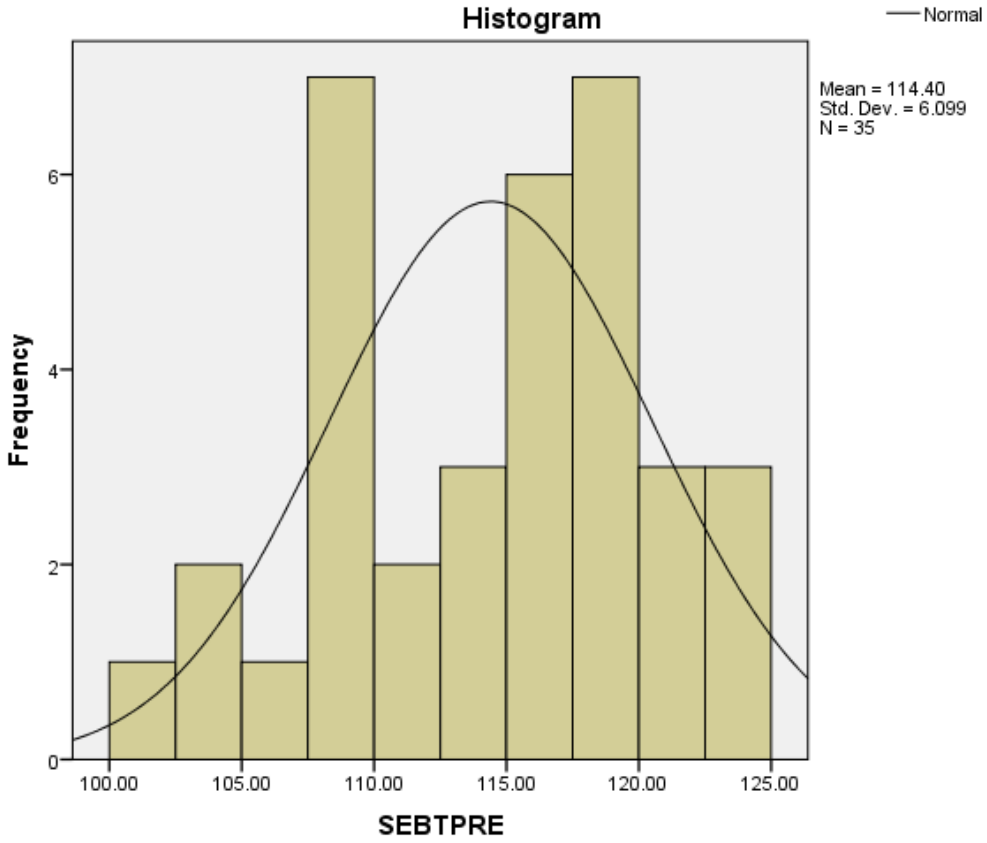
[GRAPH - 3]

Above graph shows the pre intervention data of single leg balance test of EG. The distribution shows the mean of the baseline data of EG for single leg balance is 14.78 with the standard deviation of 6.9 and $p< 0.05$ shows the data is not normally distributed.



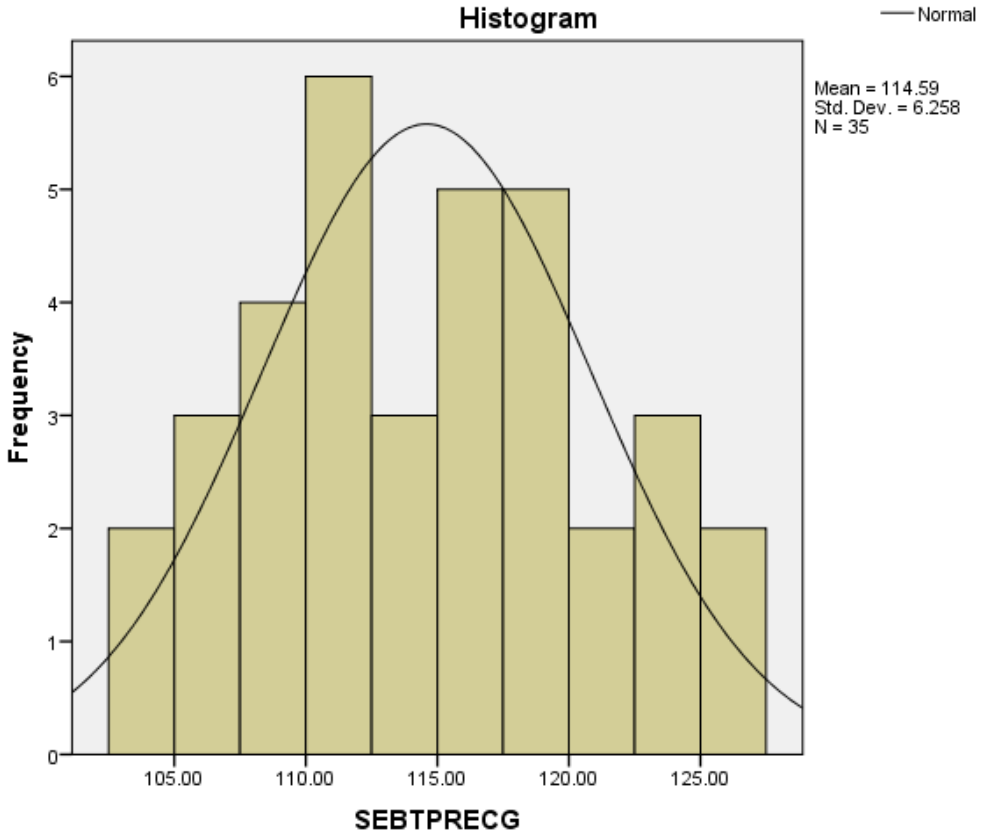
[GRAPH - 4]

Above graph shows the pre intervention data of run a three test of control group. The distribution shows the mean of the 12.84 with the standard deviation of 5.12 and $p < 0.05$ shows the data is not normally distributed.



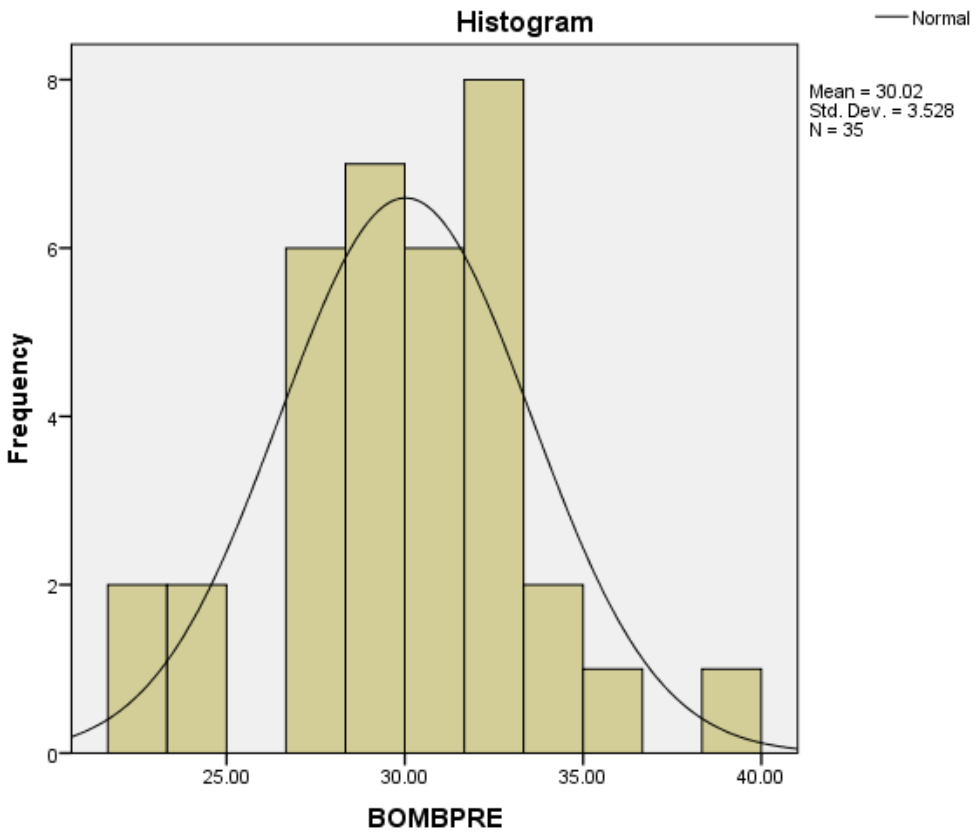
[GRAPH - 5]

Above graph shows the pre intervention data of SEBT of experimental group. The distribution shows the mean of 114.40 with the standard deviation of 6.09 and $p > 0.05$ shows the data is normally distributed.



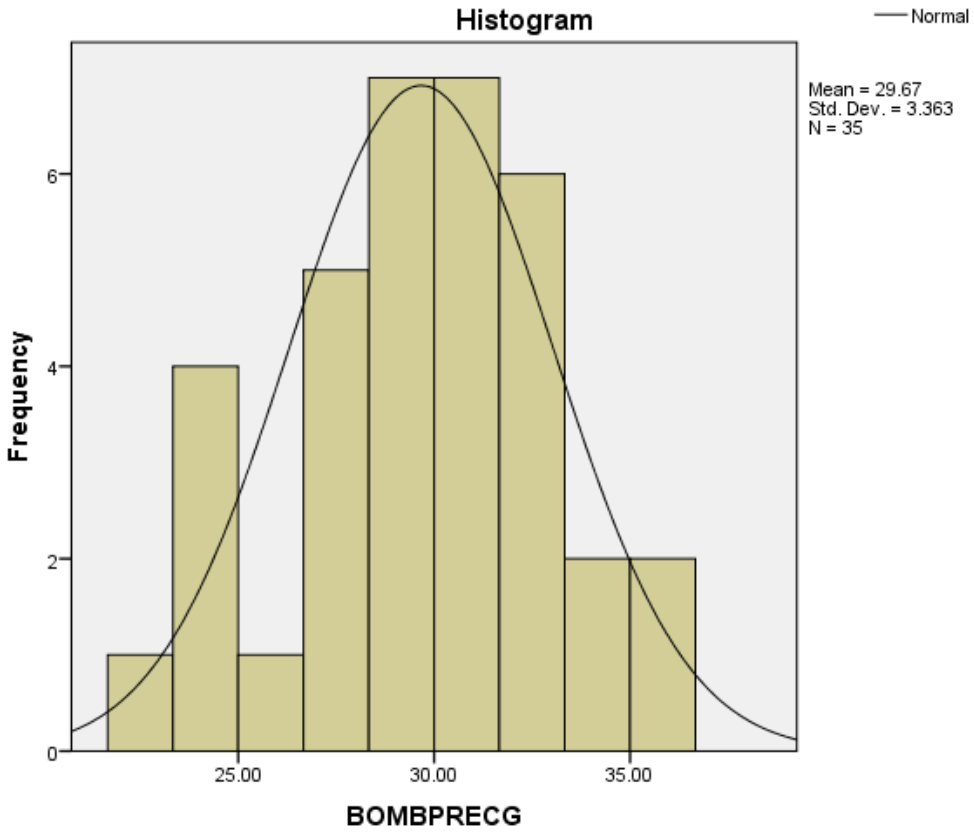
[GRAPH - 6]

Above graph shows the pre intervention data of SEBT of control group. The distribution shows the mean of 114.58 with the standard deviation of 6.25 and $p > 0.05$ shows the data is normally distributed.



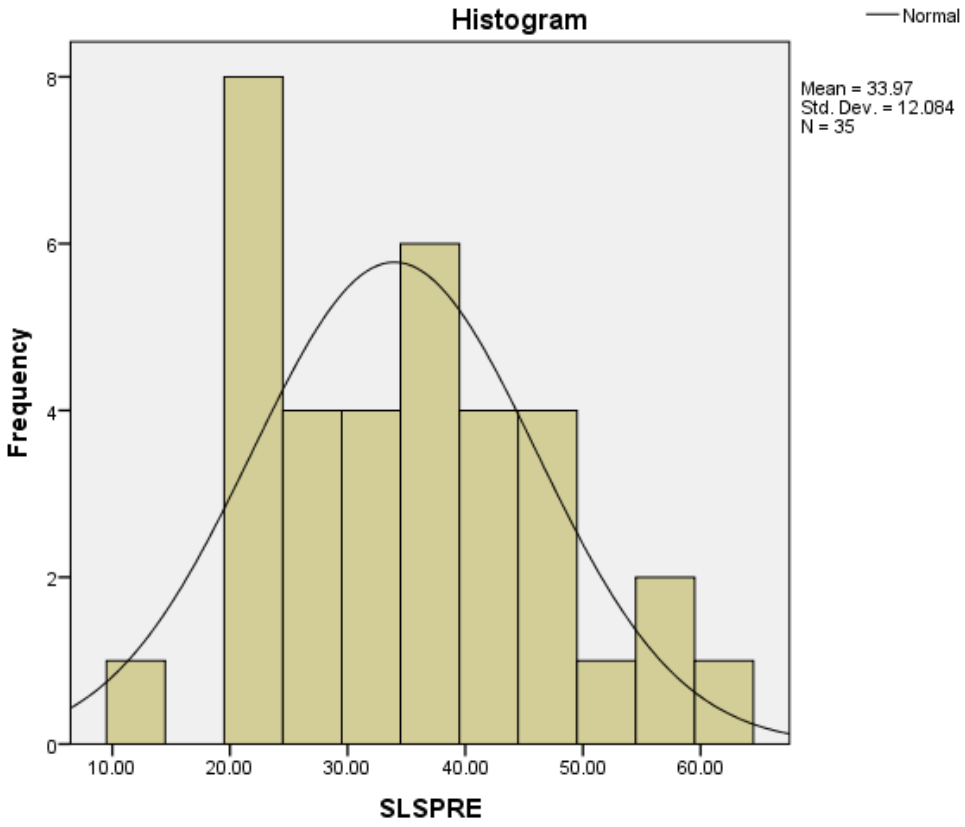
[GRAPH - 7]

Above graph shows the pre intervention data of BOMB throw test of experimental group. The distribution shows the mean of 30.02 with the standard deviation of 3.52 and p> 0.05 shows the data is normally distributed.



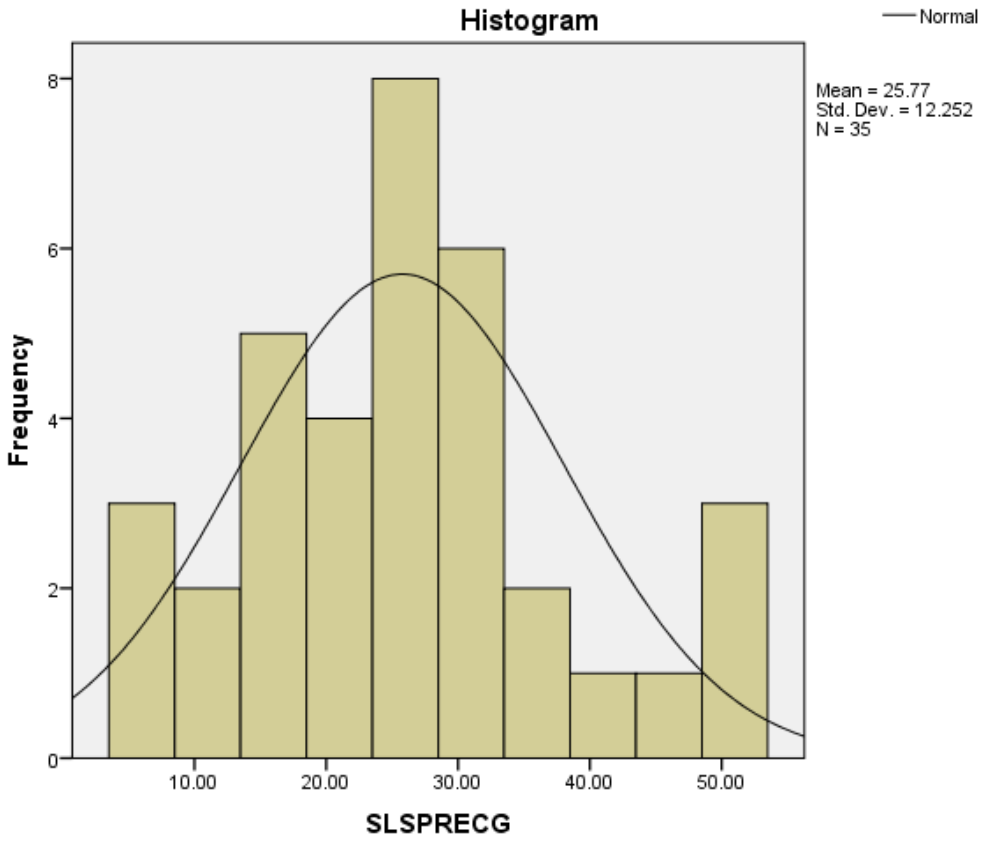
[GRAPH - 8]

Above graph shows the pre intervention data of BOMB throw test of control group. The distribution shows the mean of 29.36 with the standard deviation of 3.36 and p> 0.05 shows the data is normally distributed.



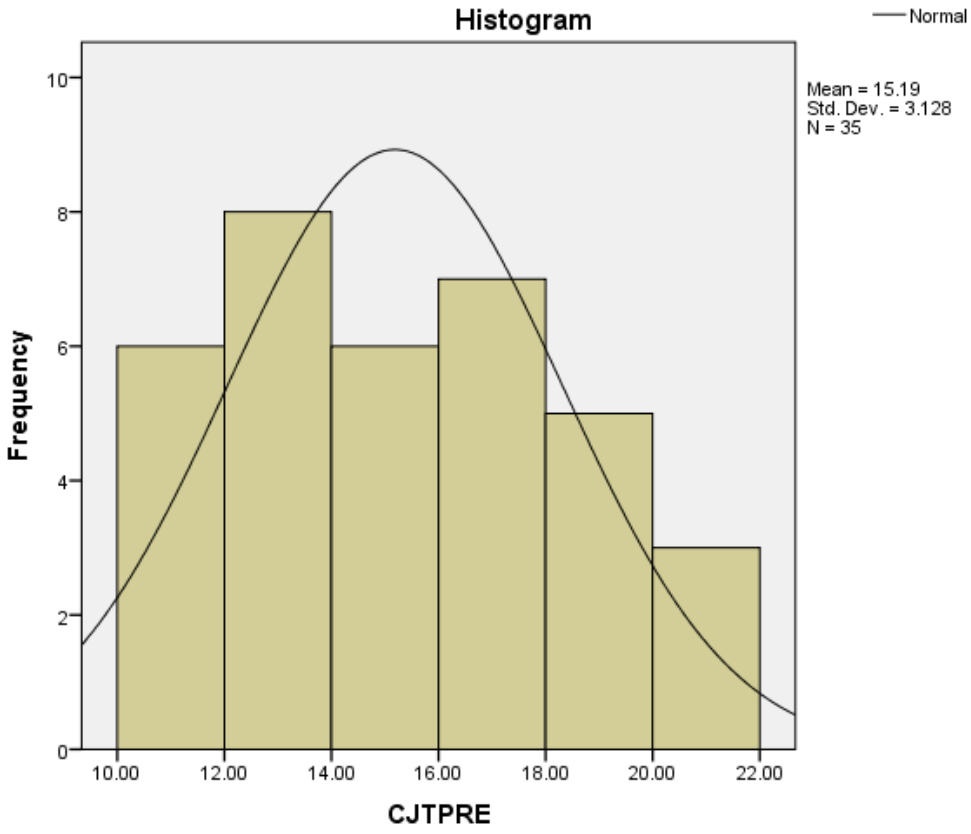
[GRAPH - 9]

Above graph shows the pre intervention data of SLS test of experimental group. The distribution shows the mean of 33.97 with the standard deviation of 12.08 and p> 0.05 shows the data is normally distributed.



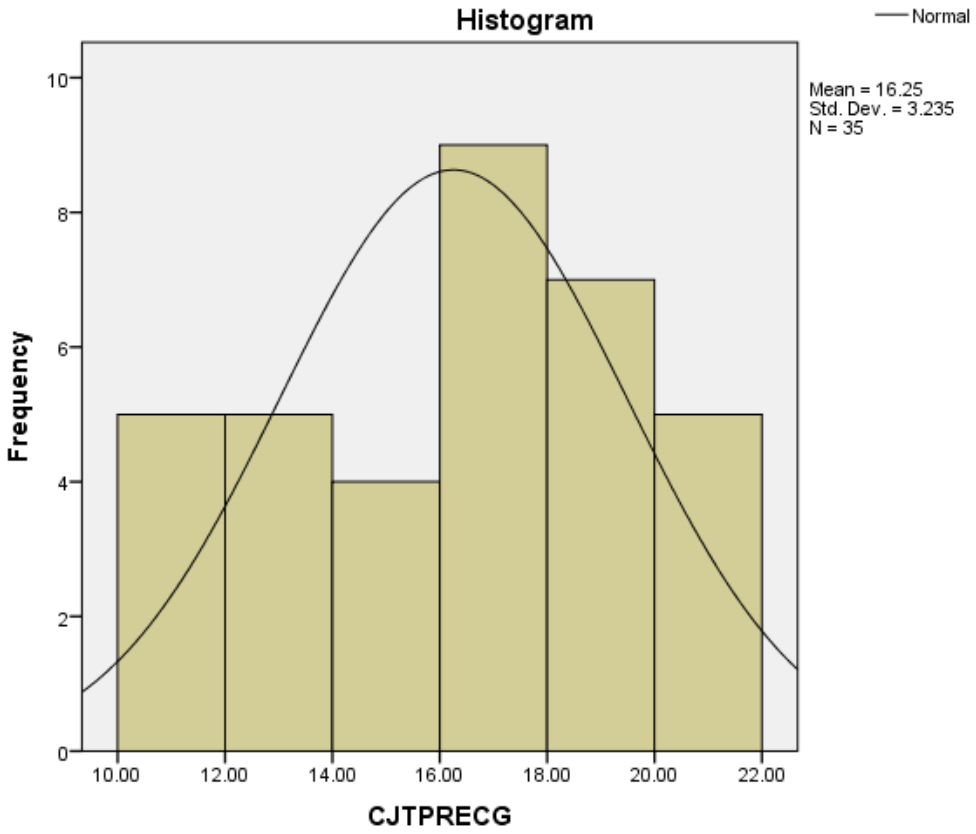
[GRAPH - 10]

Above graph shows the pre intervention data of SLS test of control group. The distribution shows the mean of 25.77 with the standard deviation of 12.25 and $p > 0.05$ shows the data is normally distributed.



[GRAPH - 11]

Above graph shows the pre intervention data of Sargent CJT of experimental group. The distribution shows the mean of the baseline data of EG for run a three test is 15.19 with the standard deviation of 3.12 and p> 0.05 shows the data is normally distributed.



[GRAPH - 12]

Above graph shows the pre intervention data of Sargent CJT of control group. The distribution shows the mean of 16.25 with the standard deviation of 3.23 and $p > 0.05$ shows the data is normally distributed.

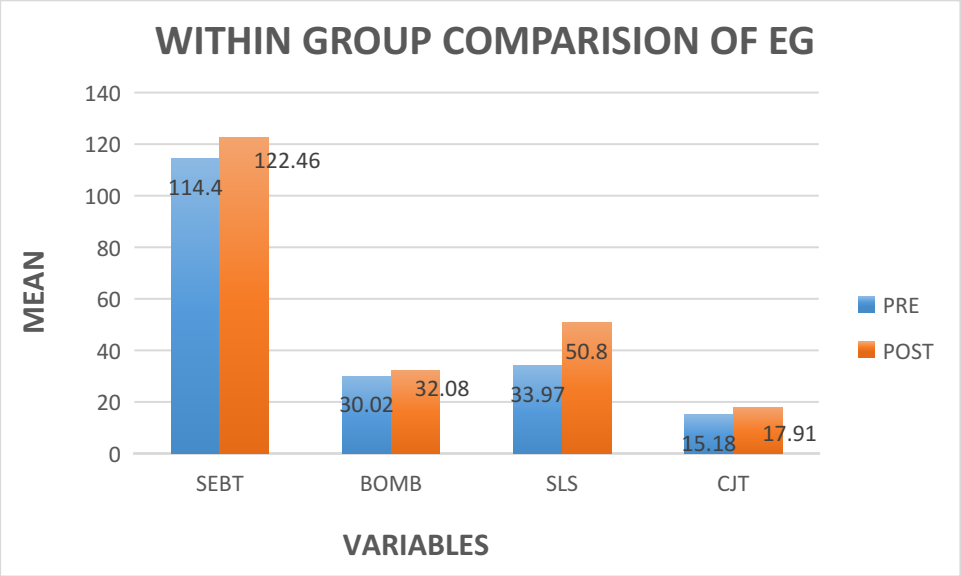
Significant within group improvements were found in both the groups post intervention. However, the experimental group that received multidimensional training shows marked improvements.

In parametric analysis, variables including SEBT, BOMB throw, SLS and SCJ test showed substantial pre-post differences in experimental group, with mean SEBT distance increasing by 8.06cm ($t = 18.86$, $p < 0.001$), BOMB throw by 2.06 m ($t = 6.14$, $p < 0.001$), SLS by 16.82 reps ($t = 12.92$, $p < 0.001$) and SCJ by 2.72 cm ($t = 23.41$, $p < 0.001$).

WITHIN GP COMPARISION OF EG

[TABLE – 3]

VARIABLES	PRE MEAN ± SD	POST MEAN ± SD	MEAN DIFF.	T VALUE	P VALUE
SEBT	114.40 ± 6.09	122.46 ± 5.28	-8.06	18.86	0.000
BOMB	30.02 ± 3.52	32.08 ± 3.60	-2.06	-6.14	0.000
SLS	33.97 ± 12.08	50.80 ± 11.65	-16.82	-12.92	0.000
CJT	15.18 ± 3.12	17.91 ± 3.15	-2.72	-23.41	0.000



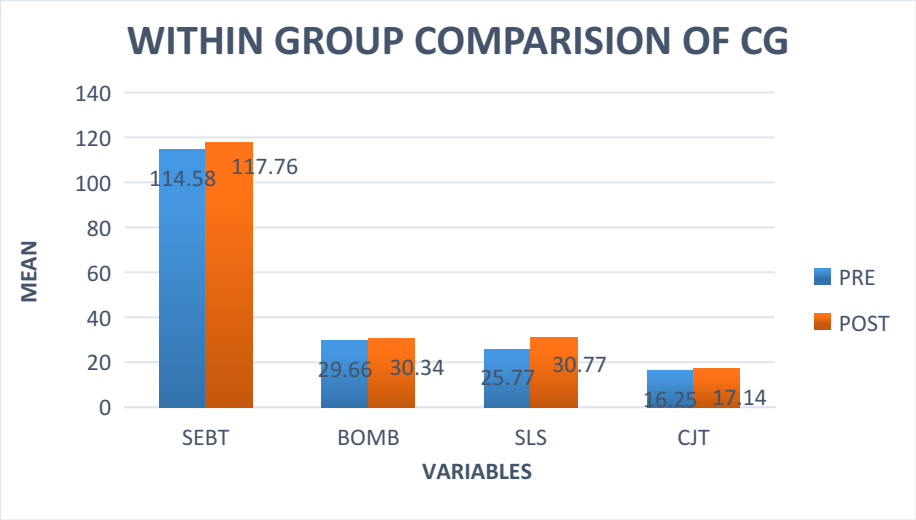
[GRAPH – 13]

The control group also shown improvement, though to a lesser extent, with SEBT distance increasing by 3.18 cm (t =8.30 p <0.001), BOMB throw by 0.67 m (t =3.78, p <0001.), SLS by 5.00 reps (t =4.53, p <0.001) and SCJT by 0.89 cm (t =8.53, p <0.001).

WITHIN GP COMPARISION OF CG

[TABLE – 4]

VARIABLES	PRE MEAN ± SD	POST MEAN ± SD	MEAN DIFF.	T VALUE	P VALUE
SEBT	114.58 ± 6.25	117.76 ± 5.32	3.18	8.30	0.00
BOMB	29.66 ± 3.36	30.34 ± 3.06	-0.67	-3.78	0.001
SLS	25.77 ± 12.25	30.77 ± 10.22	-5.00	-4.53	0.000
CJT	16.25 ± 3.23	17.14 ± 3.05	-0.89	-8.53	0.000



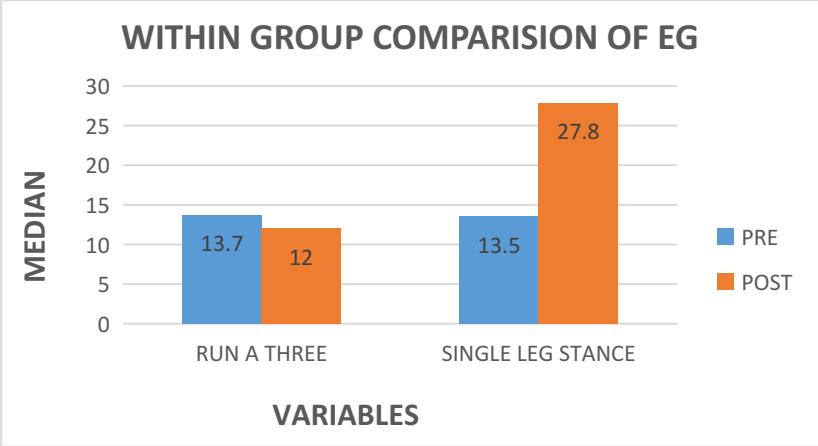
[GRAPH – 14]

Nonparametric analysis confirmed significant improvement in run a three test, whose median improved from 13.7 seconds to 12.0 seconds ($p < 0.001$) and single leg balance, whose median improved from 13.5 seconds to 27.8 seconds ($p < 0.001$) in experimental group.

WITHIN GP COMPARISION OF EG

[TABLE – 5]

VARIABLES	PRE MEDIAN (IQ)	POST MEDIAN (IQ)	P VALUE
RUN A THREE	13.7 (1.2-2.3)	12.0 (11.7-12.8)	0.00
SINGLE LEG STANCE	13.5 (9.7-13.6)	27.8 (19-31.3)	0.00



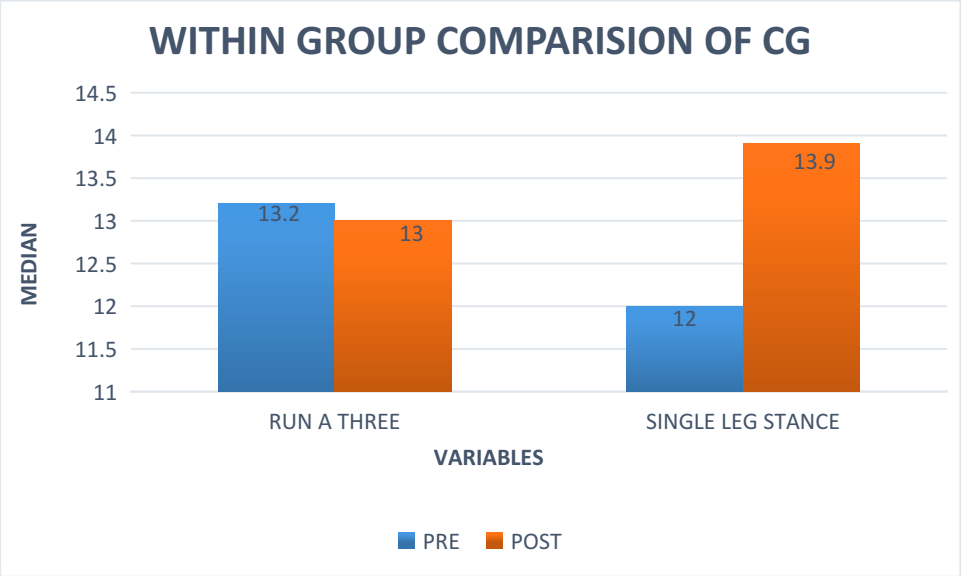
[GRAPH – 15]

The control group shown less pronounced changes. Run a three-test median improved from 13.2 seconds to 13 seconds with p <0.001, and in single leg balance test, the median value went from 12.0 seconds to 13.9 seconds with p <0.001.

WITHIN GP COMPARISION OF CG

[TABLE – 6]

VARIABLES	PRE MEDIAN (IQ)	POST MEDIAN (IQ)	P VALUE
RUN A THREE	13.2 (0.3-0.6)	13 (12.4-13.8)	0.00
SINGLE LEG STANCE	12.0 (2-4.2)	13.9 (13-20)	0.00



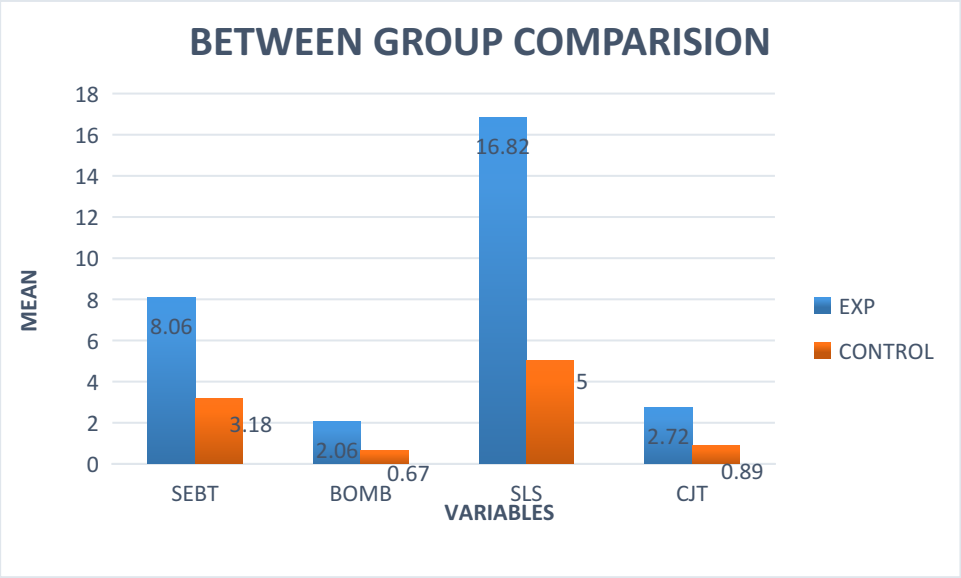
[GRAPH – 16]

Between group comparison revealed statistically significant superiority of multidimensional training. In SEBT, EG mean difference is 8.06 cm vs 3.18 cm in CG ($t = 8.51$, $p < 0.001$). BOMB test shown the mean difference of 2.06 m in EG and 0.67 m in CG ($t= 3.64$, $p = 0.001$). In SLS, EG has mean of 16.82, while CG has 5.00 reps ($t= 6.93$, $p <0.001$). SCJ test resulted the mean of 2.72 in EG and 0.89 cm in CG ($t =11.69$, $p <0.001$), favouring all the results towards EG.

BETWEEN GP COMPARISION

[TABLE – 7]

VARIABLES	EG MEAN ± SD	CG MEAN ± SD	T VALUE	P VALUE
SEBT	8.06 ± 2.52	3.18 ± 2.26	8.51	0.000
BOMB	2.06 ± 1.98	0.67 ± 1.05	3.64	0.001
SLS	16.82 ± 7.70	5.00 ± 6.52	6.930	0.000
CJT	2.72 ± 0.68	0.89 ± 0.61	11.694	0.000



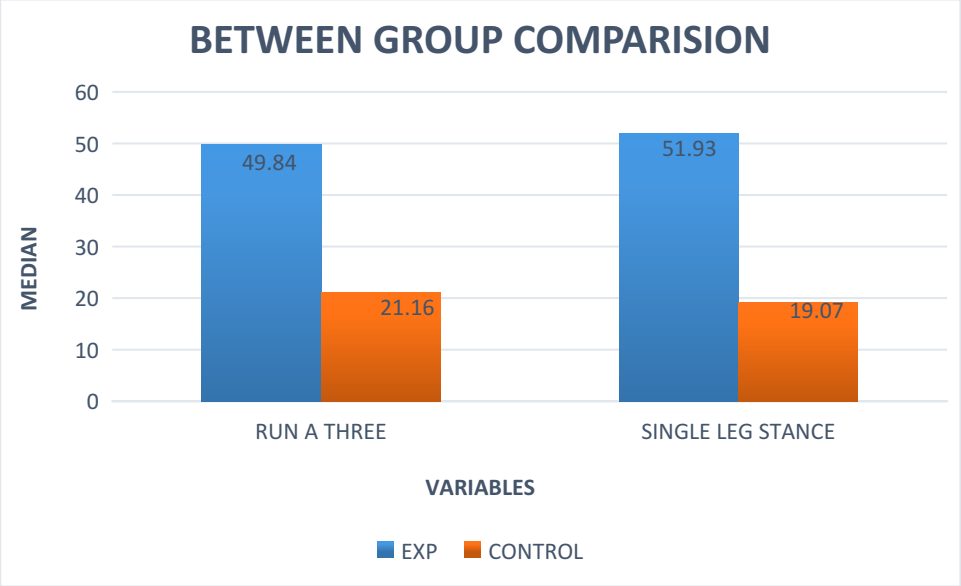
[GRAPH – 17]

The Run-a-Three and Single Leg Stance also showed significantly greater improvements for the EG, with null hypotheses rejected for both tests ($p < 0.001$). EG mean difference was 49.84 and CG mean difference was 21.16 for run a three test. While for SLS, EG has mean of 51.93 and CG has mean of 19.07.

BETWEEN GP COMPARISION

[TABLE – 8]

VARIABLES	MEAN RANK	MEAN RANK	P VALUE	NULL HYPOTHESIS
RUN A THREE	49.84	21.16	0.00	REJECTED
SINGLE LEG STANCE	51.93	19.07	0.00	REJECTED



[GRAPH – 18]

These findings indicate that the multidimensional training resulted superior improvement in agility, balance and performance measures in club cricketers compared to conventional training, supporting the efficacy of the intervention.

8. DISCUSSION

DISCUSSION

The aim of the current study was to compare the effectiveness of multidimensional training over conventional training on improving agility, balance and performance in club cricketers. The agility was measured using run a three test. For balance, static and dynamic balance were measured using single leg balance test and star excursion balance test (SEBT) respectively. For performance, upper limb power, lower limb power and explosive power were accessed using backward overhead medicine ball (BOMB) throw, single leg squat (SLS) and Sargent chalk jump test (CJT) respectively. Pre and post intervention data were taken for all six outcome measures of dominant side. The participants selected were within the age group of 18-25 years and had active participation for last 1 year.

The result of this study revealed statistically significant improvements for multidimensional training group over conventional training group, though both EG and CG shown improvements in all the outcome measures.

Thus, from the results of this study it can be stated that agility, balance and performance can be improved significantly by multidimensional training in club cricketers, supporting the hypothesis that integrating plyometric, proprioceptive, neuromuscular components more effectively enhances cricket related athletic abilities than conventional training alone.

The EG showed significantly superior improvements in tests measuring balance (Single leg balance, SEBT), power (BOMB, SLS, CJT) and agility (Run-a-Three test). Statistically, agility times in the Run-a-Three test

decreased significantly more in the intervention group (median from 13.7 to 12.0 seconds) than in controls (13.2 to 13.0 seconds), showing superior gains with multidimensional training.

The SEBT mean increased by 8.06 cm in the multidimensional group compared to 3.18 cm in controls, a highly significant difference ($p < 0.001$). Similarly, the single leg stance time significantly improved in EG (from 13.5 to 27.8) than CG (from12.0 to 13.9). BOMB throw test has shown tremendous improvement in EG (from 30.02 to 32.08) compared to CG (from 29.66 to 30.34). The SLS improved by 16.82 repetitions in EG versus 5.00 in the CG ($p < 0.001$). The jump height difference assessed by Sargent CJT suggested the superiority of EG (from 15.8 to 17.91) over CG (from 16.25 to 17.14). Together, these findings support the primary hypothesis that multidimensional training produces superior enhancement in components essential for cricket performance compared to conventional training programs alone.

The multifaceted nature of the training program likely explains the broad-spectrum improvement observed. Multidimensional training incorporates various physical domains simultaneously; plyometrics for explosive power, balance drills for neuromuscular control, and agility exercises for rapid directional changes, all critical for cricket specific movements such as running between wickets, fielding, and bowling.

Plyometric training can enhance muscle power via improved rate of force development and stretch-shortening cycle efficiency, facilitating explosive movements essential for sprinting and jumping.[30] Balance and proprioceptive exercises promote joint stability and neuromuscular coordination, key factors

in preventing injuries and supporting complex cricket motions.[31] Agility training improves reactive and change-of-direction speed, which directly translates to functional cricket skills.[32]

Conventional training, often focusing singularly on strength or endurance, may not sufficiently stimulate these integrated neuromotor pathways. The multimodal approach engages multiple physiological systems simultaneously, leading to greater transferability to sport-specific tasks.

These results align with previous research demonstrating the efficacy of multidimensional programs in sports requiring agility and balance. Myer et al. (2006) found that neuromuscular and plyometric training reduced injury rates and improved performance in young athletes by enhancing biomechanical control and explosive power.[33] Similarly, Impellizzeri et al. (2008) reported that integrated balance and agility training produced superior improvements in change-of-direction speed in soccer players versus isolated strength training.[34]

In cricket specifically, Mann and Herman (1985) emphasized the importance of dynamic muscle control and agility for optimal performance in running between wickets and fielding. Our findings extend this by providing empirical evidence that multidimensional interventions targeting these capabilities yield measurable performance gains.[35]

The significant improvements observed in SEBT, and single-leg balance tests also support the concept that balance is foundational not only to injury prevention but also to athletic performance. As shown by Hrysomallis (2011), enhanced balance is associated with improved kinetic chain function and

movement efficiency in athletes. This improved stability likely contributed to performance improvements noted in the agility and power tests.[36]

The significant outcomes in the multidimensional training group have important practical relevance for sport physiotherapists, strength and conditioning coaches and professional cricket coaches. An integrated training program can be effectively used in preseason conditioning and in-season maintenance to elevate functional capabilities critical for cricket performance. It may also bolster injury resilience by improving neuromuscular control and muscular strength around key joints. This is crucial in cricket, where lower limb injuries are prevalent.[37] Employing such multidimensional programs may reduce injury risk while simultaneously improving performance.

Additionally, the high transferability of these gains to actual on-field skills means cricket clubs and academies could benefit from restructuring their physical conditioning programs to prioritize multidimensional, sport-specialized training rather than conventional, less comprehensive routines.

9. CONCLUSION

CONCLUSION

This study shows compelling evidence for the superiority of multidimensional training over conventional training methods among club cricketers in improving agility, balance, and overall performance. It involved 70 participants aged 18-25, who were randomly assigned to either EG or CG, 35 participants in each. The EG underwent 6 weeks multidimensional training, while the control group continued their conventional training. Both groups registered significant gains in post intervention, but the experimental group's improvements were consistently greater across all measures, with strong statistical support.

Enhanced agility (Run-a-Three), dynamic and static balance (SEBT, Single Leg Stance) and performance [lower limb power (SLS), upper limb power (BOMB) and explosive power (SCJT)] were most significant in the multidimensional intervention, underscoring its overall impact. The results are congruent with literatures of current sports science, which recognizes the value of integrative proprioceptive, neuromuscular, plyometric, pnf and strength modalities for field-sport athletes.

Despite certain limitations - including sample size, intervention duration, and lack of direct match performance outcomes - the data signal clear clinical and performance advantages, with the experimental protocol serving as a template for practitioner adoption in cricket conditioning.

In summary, the trial supports embedding multidimensional training as foundational in club level cricket, giving rise to improved athleticism, sport-specific resilience, and potentially lower injury risk. Future studies should expand scope to long-term retention, skill-specific transfer, and broader population segments to reinforce and refine these findings.

10. LIMITATIONS AND RECOMMENDATIONS FOR FUTURE STUDY

LIMITATIONS

1. The study exclusively involved male cricketers due to lack of availability.
2. The training interventions were applied over a defined period, but long-term research could provide insights into how sustained agility, balance and performance improvements persist over extended seasons or years.
3. With a sample size of 70, the finding may not be generalizable to larger population.

SCOPE OF FUTURE STUDIES

1. Conduct longitudinal studies to assess the sustainability of gains in agility, balance and overall performance over an extended period following the cessation of training programs.
2. Investigate the potential synergistic effects of including other exercise protocols in the intervention using various modern equipment.
3. Extend similar studies to include female cricketers to understand gender specific responses to multidimensional training.

11. SUMMARY

SUMMARY

1. Both multidimensional training and conventional training improved the agility, balance and performance of club cricketers but the multidimensional training group improvements are way more significant, as measured by run a three test for agility, single leg balance test for static balance, star excursion balance test (SEBT) for dynamic balance and performance combining single leg squat (SLS) for lower limb power, backward overhead medicine ball (BOMB) throw for upper limb power and Sargent chalk jump test (CJT) for explosive power.

2. The study demonstrated that the multidimensional training is effective in enhancing the agility, balance and performance in club level cricketers.

3. Participants in the experimental group showed significantly greater improvements in agility, balance and performance compared to those in control group, who did not receive any additional training beyond the conventional training.

4. The finding suggest that cricket coaches and trainers can utilize multidimensional training protocol to enhance the agility, balance and overall performance of their athletes in clubs along with the conventional training.

In conclusion, the multidimensional training led to significant improvements in agility, balance and performance in the experimental group compared to control group. Thus, the multidimensional training protocol found to be more effective than the conventional training protocol. Coaches and trainers can use this protocol during training of athletes in club level.

DATA AVAILABILITY STATEMENT

The datasets produced and/or analysed in this study are not publicly accessible due to privacy and confidentiality concerns but can be obtained from the corresponding author upon reasonable request. The detailed original data underlying the finding of this study, including raw measurements and analysis files are securely stored and can be accessed upon request for research and verification purposes.

12. STATEMENT OF FUNDING

STATEMENT OF FUNDING

The authors state that the research was carried out without any commercial or financial ties that could be interpreted as a potential conflict of interest.

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ANNEXURE: 1

INFORMED CONSENT

Study Title: **Impact of Multidimensional Training on Agility, balance and Performance in club cricketers compared to conventional training: A Randomised Controlled Trial**

Subject 's Name: _____ Subject 's Initials: _____

Date of Birth: _____ Age: _____ Years

Address of the Subject: _____

Qualification: _____

Occupation: Student/Self-Employed/ Service/Housewife/Others (Please tick as appropriate)

(i) I confirm that I have read and understood the information sheet for the above study and have had the opportunity to ask questions.

(ii) I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.

(iii) I understand that -

The Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published.

(iv) I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).

(v) I agree to take part in the above study.

_____

Signature (or Thumb impression) of the Subject/Legally Acceptable Representative:

Date: _____/ _____/ _____

Signatory 's Name: _____

Signature of the Investigator

Date: _____/_____/_____

SUBHENDU KUMAR PRADHAN
Investigator 's Name

Signature of the Witness

Date: _____/ _____/ _____

Name of the Witness

ANNEXURE: 2

ASSESSMENT FORM

NAME-

AGE- **GENDER-**

1. RUN A THREE TEST (AGILITY) -

TRIALS (IN SECONDS)	PRE	POST
1		
2		
FINAL (HIGHEST)		

2. SINGLE LEG BALANCE TEST (STATIC BALANCE) –

TRIALS (IN SECONDS)	PRE	POST
1		
2		
3		
FINAL (HIGHEST)		

3. STAR EXCURSION BALANCE TEST (DYNAMIC BALANCE)-

TRIAL (IN CM)	PRE ANTERIOR	PRE POSTERO-MEDIAL	PRE POSTERO-LATERAL	POST ANTERIOR	POST POSTERO MEDIAL	POST POSTERO LATERAL
1						
2						
3						
AVERAGE						

4. BACKWARD OVERHEAD MEDICINE BALL THROW (UPPER LIMB POWER) –

TRIALS (IN METER)	PRE	POST
1		
2		
3		
FINAL (HIGHEST)		

5. SINGLE LEG SQUAT TEST (LOWER LIMB POWER) –

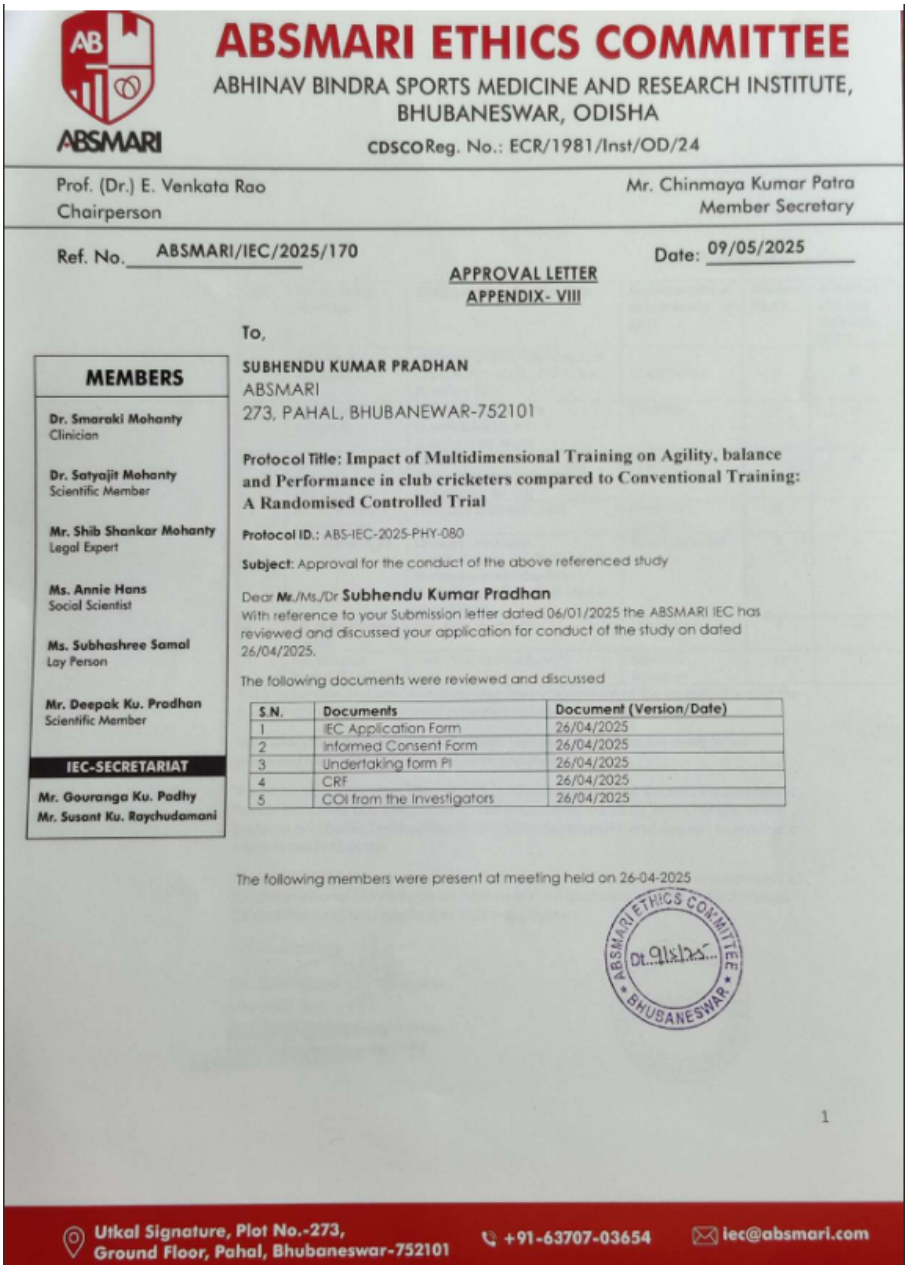
TRIALS (IN SECONDS)	PRE	POST
1		
2		
FINAL (HIGHEST)		

6. SARGENT CHALK JUMP TEST (EXPLOSIVE POWER) –

	PRE	POST
JUMP HEIGHT (IN CM)		

ANNEXURE: 3

IEC APPROVAL CERTIFICATE



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Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2025/170

Date: 09/05/2025

APPROVAL LETTER
APPENDIX- VIII

To,

SUBHENDU KUMAR PRADHAN
ABSMARI
273, PAHAL, BHUBANEWAR-752101

MEMBERS

Dr. Smaraki Mohanty
Clinician

Dr. Satyajit Mohanty
Scientific Member

Mr. Shib Shankar Mohanty
Legal Expert

Ms. Annie Hans
Social Scientist

Ms. Subhashree Samal
Lay Person

Mr. Deepak Ku. Pradhan
Scientific Member

IEC-SECRETARIAT

Mr. Gouranga Ku. Padhy
Mr. Susant Ku. Raychudamani

Protocol Title: Impact of Multidimensional Training on Agility, balance and Performance in club cricketers compared to Conventional Training: A Randomised Controlled Trial

Protocol ID.: ABS-IEC-2025-PHY-080

Subject: Approval for the conduct of the above referenced study

Dear Mr./Ms./Dr **Subhendu Kumar Pradhan**
With reference to your Submission letter dated 06/01/2025 the ABSMARI IEC has reviewed and discussed your application for conduct of the study on dated 26/04/2025.

The following documents were reviewed and discussed

S.N.	Documents	Document (Version/Date)
1	IEC Application Form	26/04/2025
2	Informed Consent Form	26/04/2025
3	Undertaking form PI	26/04/2025
4	CRF	26/04/2025
5	COI from the Investigators	26/04/2025

The following members were present at meeting held on 26-04-2025

ABSMARI ETHICS COMMITTEE Dt. 9/5/25 BHUBANESWAR

1

Utkal Signature, Plot No.-273, Ground Floor, Pahal, Bhubaneswar-752101 +91-63707-03654 iec@absmari.com

ANNEXURE: 4

MASTER CHART

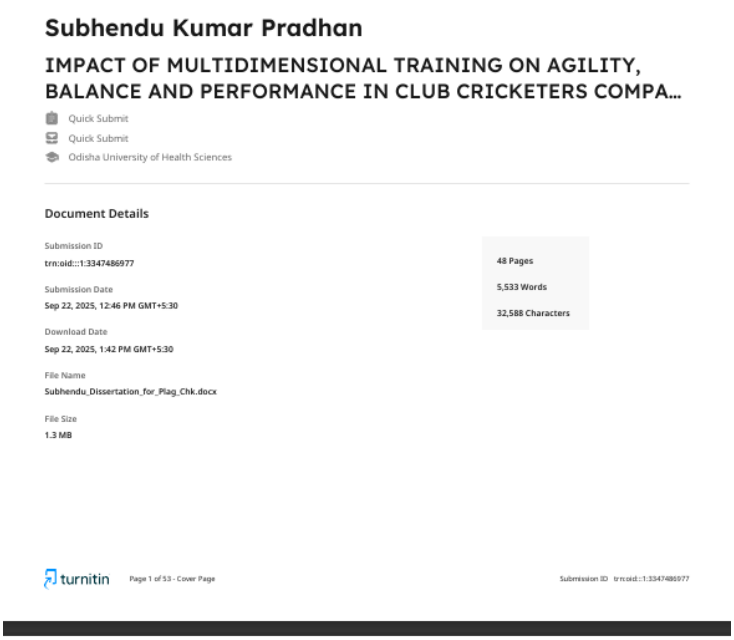
SL NO.	NAME	AGE	GROUP	RUNPRE	RUNPOST	SSTPRE	SSTPOST	SEBTPRE	SEBTPOST	BOMBPRE	BOMBPOST	SLSPRE	SLSPOST	CJPRE	CJPOST
1	S1	18	1	13.1	10.2	15.76	27.8	114.2	126.4	24	29	47	60	13.8	16.5
2	S2	19	1	13.8	11.8	5.58	19.2	121.3	127.5	30.1	34	20	30	13.2	16
3	S3	20	1	14.3	12.7	6.5	18.7	101.5	116.3	30.1	32.1	20	35	12.5	15.5
4	S4	21	1	13.7	11.4	16.58	30	107.7	117.4	23	27	38	50	14.6	17.1
5	S5	22	1	14.2	12.5	12.5	23.1	116.2	124.2	31.6	35.7	20	40	11	14
6	S6	23	1	13.9	11.7	7.5	16.3	116	120.7	39.1	42.3	12	30	13	15.3
7	S7	22	1	13.6	12.4	27.24	38	124.3	131.1	33.3	35	55	60	10	13
8	S8	20	1	12.5	11.9	13.5	17.4	113.6	119.2	32.1	34	46	70	20.9	23.5
9	S9	22	1	12.3	12	12.26	21.4	119.7	125.6	29.8	37.3	20	40	14	17
10	S10	25	1	12.9	10.5	18.6	29	109.8	115.3	30.8	32.8	31	45	11.5	13
11	S11	18	1	15.2	11.6	11	18	112.1	119.9	27.1	29.7	20	43	12.5	16
12	S12	19	1	16.1	14.9	11.4	20	118.3	126.8	29.4	31.7	35	50	12.8	15.3
13	S13	20	1	13.3	11.5	19.1	31.3	117.3	122.9	33.2	34.6	24	46	11	14.8
14	S14	21	1	12.9	11.7	29	42	122.5	131	32.3	34.5	25	57	15.1	18
15	S15	22	1	12.1	10.4	9.1	18.5	108.4	115.9	23	30	40	60	14.7	17.2
16	S16	23	1	16.3	14.4	18.1	33.3	121	124.7	29.2	31.3	45	53	17	20.1
17	S17	24	1	13.4	12	15	28.2	102.6	112.3	31.6	34	30	58	14.1	16.9
18	S18	25	1	13.9	12.8	6.6	16.3	119.9	128.1	33.6	35.1	35	56	13.9	16.3
19	S19	18	1	14.9	12.3	9.1	21.1	117.8	124.2	26.7	27.1	50	67	15	18.9
20	S20	19	1	15.3	13.2	9.1	20	108.9	117.2	28	30	20	50	16.2	19.8
21	S21	20	1	13.7	12	19.9	30	116.1	127.7	26.7	29	32	43	18	21.6
22	S22	21	1	12.3	11.7	14	29.2	109.2	120.9	27.3	30.6	46	50	19.1	23.1
23	S23	22	1	16.2	13.2	9.3	19.3	114.6	121.5	34.2	34	32	42	21	24.1
24	S24	22	1	15.4	12.5	35	60	119.1	124	24.5	22.7	37	40	16.7	18.1
25	S25	22	1	14.7	12.7	20	36.6	117.6	125.6	36.3	38.9	29	47	19	21.6
26	S26	23	1	13	10.6	19	31	104.5	112.7	29.3	31.3	25	46	11	13.8
27	S27	24	1	15.9	13.2	13.2	24.5	123.7	129.5	32.3	31.5	40	65	13.6	15.9
28	S28	25	1	16.3	14	18	34.4	119.8	127.1	31.7	31.9	35	53	16	18.2
29	S29	18	1	13.1	11.9	5.9	19	105.9	119.8	29.7	31.5	40	55	10.9	14
30	S30	19	1	12.7	11.4	13	29.2	115.3	124.7	28.4	29.9	25	60	17.4	19.8
31	S31	20	1	12.6	11.9	11.1	18.2	108.1	114.8	31.7	30.6	37	45	21	23.9
32	S32	22	1	13.1	12.5	17.4	34.5	116.8	127.1	30.7	32.8	40	55	16.2	18
33	S33	23	1	15.9	13.9	17	27.8	120.2	128.3	27.6	28.6	58	70	19.7	22
34	S34	22	1	16.2	14.3	25	43.2	110.7	119.2	29.8	29.2	60	77	17.1	19.8
35	S35	24	1	12.5	12.1	6.1	8.5	109.4	116.6	32.5	33.1	20	30	18	18.8

[EXPERIMENTAL GROUP DATA]

ANNEXURE: 5

[CONTROL GROUP DATA]

36	S36	23	2	13.2	12	12	13.3	118.8	119.6	23.4	22.7	27	34	15.5	16.7
37	S37	25	2	12.9	12.5	13	19	112.2	115.9	27.2	28	38	35	19	20.1
38	S38	22	2	12.6	12.2	6.9.1	10.5	110.5	116.6	29.8	29.9	16	20	11.5	12.1
39	S39	24	2	15.3	12.9	13	15.1	106.4	114	30	31.3	18	32	17.3	18
40	S40	20	2	13.7	13.2	22	23	125.4	129	31.3	32.7	6	23	13	14.2
41	S41	25	2	13.2	12.9	18.2	20	117.1	118.2	30.3	30.1	19	35	20	20.2
42	S42	25	2	13.9	13	16.3	18	123.7	122.6	33.5	35.2	20	20	11.4	13
43	S43	22	2	12.7	12.4	10	13.3	103.6	109.7	24.2	26.2	25	30	21	22.8
44	S44	21	2	13.2	12.9	10	12.6	110.2	113.8	34.5	33.2	6	10	18.1	18.7
45	S45	19	2	13.8	13.4	17.2	23.1	116.7	119.7	35.2	36.3	26	25	16.1	17
46	S46	24	2	12.5	12	9	13.2	110.8	114.4	29.4	30	25	31	17	17.5
47	S47	24	2	14.3	14.7	11	13.7	105.9	117.4	30.4	29.9	30	35	19.2	20
48	S48	23	2	13.6	13.2	11	13	119.4	121.1	27	29	25	20	14	15.2
49	S49	23	2	13.2	13	30	34	120.1	122.3	31.7	31.3	16	35	13	13.2
50	S50	21	2	15.2	14.7	14.2	16.2	113.2	115.3	29.8	31.2	28	34	12.7	13
51	S51	22	2	12.5	13	8.9	13	122.6	126.9	33	34	6	13	17.1	18.2
52	S52	22	2	13.7	13	14	20	104.5	110.2	27.5	26.9	30	30	16.2	17
53	S53	22	2	12.4	12	20	23.3	118.2	120.7	29.2	30.3	31	35	17	17.3
54	S54	18	2	12.9	12.7	13.3	14.1	110.3	115.1	22.3	24.2	20	20	14.1	16
55	S55	25	2	14.7	14	6.3	8.9	116.9	119.1	31.4	31.7	9	19	10	11.5
56	S56	23	2	16.3	16	8.6	11.2	117.4	118.6	32	31.9	16	20	11.9	13
57	S57	22	2	17.2	16.6	10	10.7	107.8	109.2	27.3	28.1	30	40	21	22
58	S58	20	2	16.7	16	12.1	13.6	124.1	125.8	29.6	31.3	21	35	17.3	18
59	S59	22	2	15.6	15	11.2	13.2	109.5	114.8	24.3	26.5	25	30	19.1	20
60	S60	25	2	13.2	13	6.9	10	119.3	122.6	31.7	32.1	36	40	21	20.1
61	S61	22	2	14.1	13.8	10	12.6	106.5	109.4	32.4	33.1	13	20	13.7	15
62	S62	20	2	13.4	13	7.9	13	126.1	128.2	27.5	29.3	25	20	18	18.6
63	S63	23	2	12.9	12.4	18	25	108.6	110.9	31.2	31.4	50	55	17.6	18
64	S64	20	2	11.6	11	12.1	20.3	113.4	116.4	24.5	26.3	45	45	14.5	16.1
65	S65	22	2	14.3	13.4	5.5	9.8	117.8	119.5	32.5	33.1	32	40	19	21.1
66	S66	25	2	11.9	12	20	24.2	113.1	115.2	30.3	28.5	15	30	17.4	18
67	S67	21	2	12.4	11.9	8.9	15	117.3	120.5	29.9	31.1	40	40	21	21.1
68	S68	21	2	13.2	12.6	11	13.9	109.8	111.7	31.3	30.9	53	45	19.8	20
69	S69	23	2	12.8	12	14.1	16.7	121.5	123.6	36.4	35.7	30	33	13.4	15.2
70	S70	19	2	15.6	15	17	15	111.9	113.9	26.4	28.7	50	48	11	12.3



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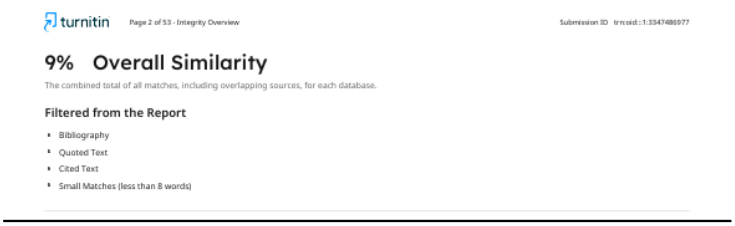

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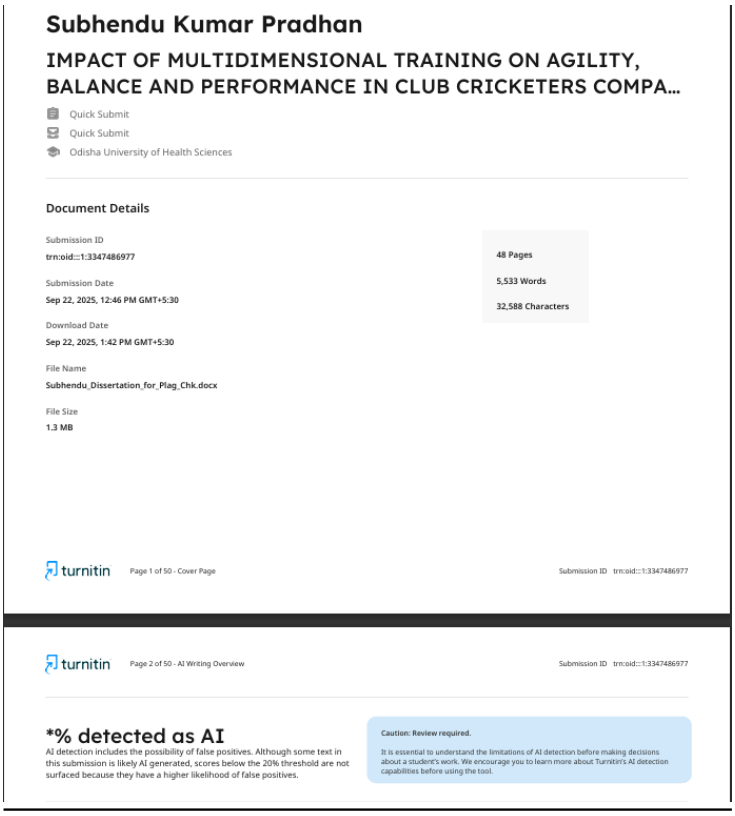

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