International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Comparison Between Effect of Plyometric Exercises Versus Circuit Training Along with Iastm on Speed and Agility in Skaters

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ABSTRACT

BACKGROUND: Skating refers to the act of gliding on skates, which can be done on various surfaces like ice, concrete, and even snow. It encompasses various sports and recreational activities involving the use of skates for movement, including ice skating, roller skating, and skateboarding. Agility refers to the capacity to change the direction of the physique quickly. Strength denotes the skill of the muscles to produce energy with a solitary utmost exertion and is a vital component of aptness and performance. Plyometric is the term given for a type of workout that is planned to increase intensity or explosive control in certain muscle groups. Circuit drill is a way to train with limited equipment including series of stations including variations between different muscle groups for lower limb exercises.

AIM: This study aims to compare the effects of Plyometric Exercises and Circuit Training combined with Instrument-Assisted Soft Tissue Mobilization (IASTM) on speed and agility in skaters.

MATERIAL AND METHOD: Thirty skaters were randomly divided into two groups: Group A received plyometric exercises along with IASTM and Group B underwent circuit training along with IASTM. Pre- and post-intervention assessments were conducted using the 30-meter sprint test and the Illinois agility test. The interventions were administered over six weeks, with sessions held three times per week.

RESULT: Unpaired and paired t-tests were used to compare means between two groups and within groups. Results were measured to be significant as $p<0.05$. There is improvement in both agility and strength within the group as the value for agility $p=0.001$ and value post strength training $p=0.083$ hence a significant difference was found only in the agility group for between group comparison. In the Plyometric group, for agility, at baseline and end of the 6th week, t-value=13.78 and associated significant value $p=0.000$. For strength, at baseline and end of 6th week, t-value=-10.298 and associated significant value $p=0.000$.

In Circuit training group, for agility, at baseline and end of the 6th week, t-value= 12.894 and associated significant value $p=0.000$. For strength, at baseline and end of 6th week, t-value=-7.669 and associated significant value $p=0.000$.

Results showed that both interventions significantly improved speed and agility; however, Group A demonstrated greater improvement in speed, while Group B exhibited superior gains in agility.

CONCLUSION: The study concludes that both methods are effective, but their impact varies depending on the performance component targeted. There is a noteworthy difference found within the group for both circuit training and plyometric training groups over agility and strength performance.

KEYWORDS: Agility, Skating, Circuit training, Plyometric training, Strength, IASTM

INTRODUCTION

Skating is a very demanding sport that calls for a blend of force, grace, artistry, flexibility, and speed. It's a well-liked game that's becoming more professional than recreational these days. Skating is a dynamic sport that demands high levels of speed, agility, balance, and coordination. Athletes continually seek ways to enhance their performance through targeted physical conditioning. Speed and agility are crucial determinants of success in skating, influencing start acceleration, directional changes, and maneuverability.

A sporting gesture's effectiveness and precision in relation to the scenario are greatly influenced by its rapidity (Speed) and agility.[4] The ability to move the body as swiftly as possible in the intended direction is what defines speed.[5] To maximise performance when skating, speed is also regarded as a crucial component. Agility refers to the capacity to rapidly alter direction and velocity. Rhythm, dynamic balance, spatial awareness, and visual processing are all likely to be present in an athlete that demonstrates strong agility.[6] Patella-femoral syndrome, which arises from insufficient flexibility in the hamstrings and quadriceps, is the most frequent musculoskeletal ailment. For this reason, flexibility is crucial for skaters. Muscle tightness results from a decrease in the muscle's capacity to deform, which also lowers the range of motion at the joint where the muscle acts.

One technique for enhancing physical condition in sports is the application of IASTM.[9] Based on the theory presented by James Cyriax, instrument assisted soft tissue mobilisation (IASTM) is a well-liked treatment for myofascial limitation. IASTM is performed using specifically made tools to deliver a mobilising impact to soft tissue (such as scar tissue, myofascial adhesion), which reduces pain and improves range of motion (ROM) and function.[8] The six steps of IASTM application in sports rehabilitation are typically inspection, warm-up, IASTM, stretching, strengthening activities, and cryotherapy. First a thorough examination of the patient's current state is required. After that, the patient has to warm up for 10-15 mins by either riding a stationary bike, using an upper body ergometer, or utilizing an elliptical machine. For warm-up, a heat pack or ultrasound may occasionally be used for 3 to 5 mins. This kind of warm-up raises the blood flow, tissue temperature, and tissue pliability. Immediately following up the warm-up is IASTM. Stretching and strengthening activities aimed at the treated area should be done after IASTM is finished in order to strengthen the treated tissue and realign the collagen. The area may not sustain new injuries thanks to this procedure. Cryotherapy is then administered for 10-20 mins.[10] Because IASTM applies pressure to the deeper portions of the soft tissues, it is claimed to have a stronger effect on flexibility than manual mobilisation done without an instrument.[11] Through the resorption of excessive fibrosis, the IASTM treatment is believed to promote connective tissue remodelling. Additionally, fibroblast recruitment may induce collagen repair and regeneration. This will then cause the fascial limitations, adhesions, and scar tissue to break free.[12]

Plyometric workouts are a great way to help build an athlete's strength and quickness because they target every muscle in the body. Verkoshanski created plyometric training as a method of training to improve explosive strength during activity. It is characterized by rapid, explosive movement intended to

improve power, speed, agility, balance, and coordination. Reducing the intervals between these motions is the aim of this workout. Therefore, an athlete can increase in strength and speed. It's a strong motion that starts with an eccentric contraction and ends with an explosive concentric contraction. Plyometric workouts include the box jump-up, squat jump, lunges jump/split squats, butt kicks, lateral,front-back hops, depth, drop jump and hurdle jump, etc.[13]

Coaches discovered circuit training in 1953 as an effective and practical way to train a lot of athletes in a short amount of time with little equipment. The approach was designed to make the best use of the time and resources that were available. Exercise that blends resistance and endurance training is called circuit training. Circuit training is type of exercise that can enhance an individual's entire physical performance, including strength, power, endurance, agility and speed.[14]

According to the literature, due to the small number of PT studies on skaters (compared with the number of studies on other athletes), it is necessary to further understand whether PT can also benefit this group and accurately test the sports science equipment to facilitate the planning of accurate training courses. The purpose of this study was to evaluate the speed, agility, and explosive strength performance of skaters over an 6-week PT program.

Despite the popularity of these training methods, few studies have directly compared their effects in the context of skating. This study addresses this gap, aiming to determine the relative effectiveness of plyometric exercises versus circuit training combined with IASTM in improving speed and agility in skaters[24

There is currently no information available regarding how well IASTM plus plyometric workouts compare to IASTM plus circuit training. Coaches and athletes can customize training regimens to meet specific performance goals by knowing which combination works best.

Studies have found that both plyometric and circuit training have positive effects on various parameters related to sports performance. No study till date has compared the effects of these two techniques on performance parameters in skaters. So, the purpose of the current study was to compare the effects of two training programs on running speed, agility, upper limb and lower limb strength in skaters. The result of this study can be utilized as an evidence-based approach for enhancing performance in skaters.

No literature was found to compare the Effectiveness of Plyometric versus Circuit Training along with IASTM on Speed and Agility in Skaters, hence our study aims to compare their effects in Skaters.

MATERIALS AND METHOD

STUDY DESIGN

This investigation employed *A Comparative study design* to find out the Comparison between Effect of Plyometric Exercises versus Circuit Training along with IASTM on Speed and Agility in Skaters.

STUDY SUBJECTS

30 skaters were recruited for this investigation.

STUDY DURATION

The intervention period encompassed twelve weeks.

STUDY CENTRE:

The investigation was conducted at department of physiotherapy, JRNRV University, Udaipur, following institutional ethical committee approval.

Participant preparation:

30 skaters will be randomly selected according to inclusion and exclusion criteria and will be divide into two groups – Group A: Plyometric Exercises along with IASTM, Group B: Circuit Training along with IASTM.

All skaters will be participating in the study after voluntarily signing the consent form.

Inclusion Criteria

Inclusion criteria encompassed male and female skaters Age 18–25 years, Active participation in competitive skating, No musculoskeletal injury in the past 6 months

Exclusion Criteria

Exclusion criteria eliminated participants with Patellofemoral pain syndrome, ACL Reconstruction of more than a month, Neurological disorders, Recent lower limb surgery, Non-compliance to training protocol.

Study Materials

Study materials included written consent forms, general assessment forms, Pen, Paper, Stopwatch, Cones, IASTM tool, Measure tap

OUTCOMES MEASURES

30-meter Sprint Test (Speed)

The 30-meter sprint test measures an athlete's linear speed and is commonly used in sports to assess acceleration and overall sprinting ability. It involves running a maximal sprint over 30 meters, and the time taken is recorded to indicate speed.

Procedure:

1. **Starting Position:** Athletes typically start in a staggered stance, with one foot in front of the other, and the front foot positioned on or behind the starting line.
2. **Starting the Sprint:** The test begins when the athlete initiates movement from a stationary position, and timing starts when they cross the starting line.
3. **Sprinting Technique:** Athletes are encouraged to maintain a low center of gravity, drive hard with their arms and legs, and focus on maximizing speed throughout the sprint.
4. **Timing:** The sprint time is recorded using either stopwatches or timing gates, depending on the availability and desired precision.
5. **Results:** The recorded time is typically rounded to two decimal places, and multiple trials may be performed to ensure accuracy.

Normative Data:

- **General Normative Data:** Cartwright Fitness provides normative data for 30-meter sprint times, categorizing performance levels for both males and females.
- **Quadrathlon Results:** Topend Sports and others have collected 30-meter sprint results from Quadrathlon events, providing additional context for comparing performance levels.

Variations and Considerations:

- **Flying Start:** The 30-meter sprint test can also be conducted as a flying start, where the athlete begins running from a set distance before the timing starts.
- **Acceleration Area:** In some cases, a designated acceleration area may be included, allowing athletes to reach top speed before timing begins.

- **Factors Affecting Performance:** Factors like weather conditions, running surface, and athlete fatigue can influence sprint times, so it's important to consider these factors when interpreting results.

reliability: Reliability is greatly improved if timing gates are used. Also weather conditions and the running surface can affect the results, and these conditions should be recorded with the results. If possible, set up the track with a crosswind to minimize the effect of wind.

Illinois Agility Test (Agility)

Agility is an important component of many team sports, though it is not always tested, and is often difficult to interpret results. The Illinois Agility Test (Getchell, 1979) is a commonly used test of agility in sports, and as such there are well-established norms available.

test purpose: to test running agility using various turns and movements

equipment required: flat non-slip surface, marking cones, stopwatch, measuring tape, timing gates (optional)

pre-test: Explain the test procedures to the subject. Perform screening of health risks and obtain informed consent. Prepare forms and record basic information such as age, height, body weight, gender and test conditions. Measure and mark out the test area using cones. Check the timing gate equipment and calibrate if required.

course layout: The length of the course is 10 meters, and the width is 5 meters. Four cones are used to mark the start, finish and the two turning points. Another four cones are placed down the center an equal distance apart. Each cone in the center is spaced 3.3 meters apart.

procedure: Participants should lie on their front (head to the start line) and hands by their shoulders. On the 'Go' command the stopwatch is started, and the athlete gets up as quickly as possible and runs forwards 10 meters to run around a cone, then back 10 meters, then runs up and back through a slalom course of four cones. Finally, the athlete runs another 10 meters up and back past the finishing cone, at which the timing is stopped. Several trials should be completed, with the best score recorded.

results: An excellent score is under 15.2 seconds for a male, less than 17 seconds for a female.

advantages: This is a simple test to administer, requiring minimal equipment. Also, the player's ability to turn in different directions and at different angles are tested.

disadvantages: The choice of footwear and the running surface can affect times greatly. Results can be subject to timing inconsistencies, which may be overcome by using timing gates. This test does not distinguish between left and right turning ability. The test often takes longer than 15 seconds, at which stage fatigue will begin to play a greater part in the results.

variations:

- The starting and finishing sides can be swapped, so that the turning direction is reversed.
- Some variations have the participant turning at a line at the far end rather than running around a cone
- Some variations have the participant touching the cone or line at the end with their hand

In the USA, sometimes the measurements of the course are 30 ft long by 15 ft wide

- **Validity:** The IAT is a valid test for measuring agility, particularly in activities involving rapid changes in direction and speed.
- **Reliability:** The IAT is a reliable test, providing consistent results across multiple administrations and by different testers.

PROCEDURE AND INTERVENTIONS

The researcher approached the participant in person. Informed consent was signed by subjects Participant were given instruction regarding procedure. Baseline data were noted for agility and lower limb strength score. Subjects were divided into two groups GROUP A and GROUP B. Both the group performed either of the protocol for 3 times a week for period of 6 weeks following group warm up and followed by group cool down session. Further at the end of 6 weeks again agility and lower limb strength score were noted. Data was analyzed by using statistical software and results were obtained further.

Group A (Plyometric Training + IASTM):

The Plyometric training program consists of combination of upper body and lower body exercise.

A program of 4-8 exercises were made to be performed at maximal intensity with 2-4 sets and 10-15 repetitions each were applied. Depending on the exercise and number of sets performed during trial rest period varied between 15- 19 seconds.

Proper exercises were explained during the demonstration.

Plyometric session was for 30-60 minutes and was followed by 5 min cool down protocol followed by IASTM.

Plyometric group was trained thrice weekly followed by IASTM.

Exercises include Squat jumps, bounding, depth jumps, lateral hops

IASTM: Quadriceps, hamstrings, calves (10 min/session)

Training week	Exercise	Sets x reps	Pause (s)
1	Ankle cone hops	3 × 10	30
	Ankle cone hops side to side	3 × 10	30
	Countermovement jumps	4 × 5	30
	Broad jumps	4 × 5	30
2	1-leg ankle hops forward	3 × 10	30
	Countermovement jumps	3 × 8	30
	Continuous broad jumps	3 × 2 × 3	30
	Lateral bounds + stick	3 × 6	30
	2–1 Hurdle hops forward (20–30 cm)	3 × 10	30
3	1-leg ankle hops lateral	3 × 10	30
	Countermovement jump	3 × 10	30
	1:2 broad jumps	3 × 4	30
	Zig zag bounds + stick	3 × 8	30
	2–1 Hurdle hops lateral (20–30 cm)	3 × 10	30
4	1-leg square ankle hops	3 × 8	30
	1-leg Countermovement jump	3 × 5	30
	Continious broad jumps	3 × 3 × 3	30
	Lateral bounds (1-1-stick)	3 × 8	30
	2–1 Multidirectional hurdle hops	3 × 10	30
5	1-leg square ankle hops	3 × 12	30

	1-leg Countermovement jump	3 × 5	30
	1:2 Broad jumps	3 × 8	30
	Zig zag bounds (1-1-stick)	3 × 10	30
	2–1 Multidirectional hurdle hop	3 × 10	30
6	Ankle cone hops	3 × 10	30
	Ankle cone hops side to side	3 × 10	30
	Countermovement jump Broad jumps	4 × 5	30
	Broad jumps	4 × 5	30

Group B (Circuit Training + IASTM):

- Circuit: Lunges, shuttle runs, cone drills, jumping jacks
- IASTM: Quadriceps, hamstrings, calves (10 min/session)
- Frequency: 3 times/week
- Duration: 45 minutes/session

First subject will perform light jogging or static cycling for 5 mins for warm up and Circuit training group were given 3 sessions of exercise training on alternate days in a week. The training protocol included 5 minutes of warm-up followed by 30-45 minutes session of circuit training which consisted of

8 stations. Each exercise lasted for 30 seconds to 60 seconds followed by IASTM, Treatment will be applied bilaterally, for 3 mins on each leg at the specified site (i.e., quadriceps, Hamstrings and Calf) for those assigned to group A and then subjects will perform circuit training. Exercise performed at 8 stations were-

a. JUMPING JACKS
b. WALL SITS
c. PUSH-UP
d. ABDOMINAL CRUNCH
e. SQUAT
f. LUNGES
g. HIGH KNEES RUNNING
h. PLANKS

RESULTS AND STASTICAL ANALYSIS:

The present study was carried out to find out the Comparison between Effect of Plyometric Exercises versus Circuit Training along with IASTM on Speed and Agility in Skaters.

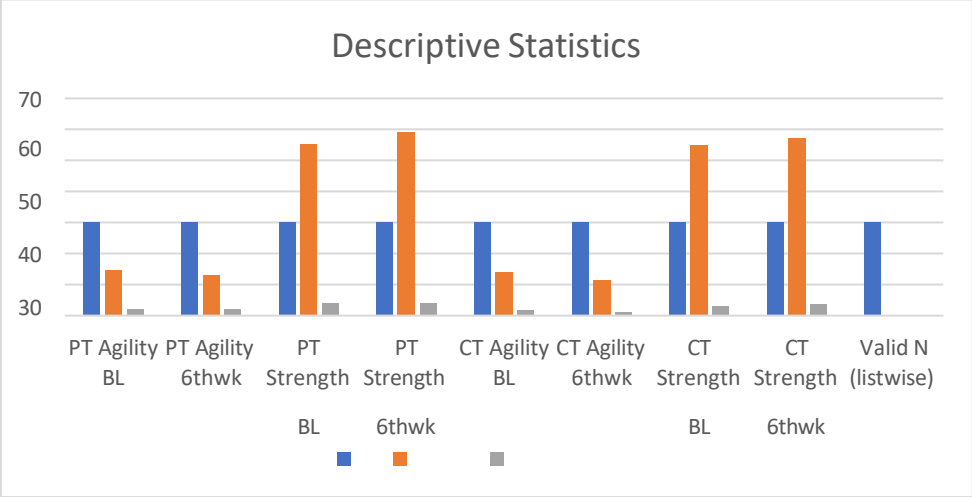
Table 1: Descriptive Statistics

	N	Mean	Std. Deviation
PT Agility BL	15	14.4967	2.16436
PT Agility 6thwk	15	13.1133	2.18265
PT Strength BL	15	55.4333	3.94517
PT Strength 6thwk	15	59.1333	3.94561
CT Agility BL	15	14.1190	1.65266
CT Agility 6thwk	15	11.5933	1.19854
CT Strength BL	15	55.0000	3.11836
CT Strength 6thwk	15	57.4000	3.65400
Valid N (listwise)	15		

PT= Plyometric Training, CT= Circuit Training, BL= Baseline, 6thwk= 6th week

Table 1 represents mean and SD of PT Group and CT Group for agility and strength at baseline and end of 6th week.

Graph 1: Descriptive Statistics



At the end of the 6th week the mean of agility for PT Group and CT Group are 13.11 and 11.59 respectively. The result shows that PT Group takes more time than CT Group to complete the agility test. So, there is significant difference seen in CT group as compare to PT Group at the end of training session.

At the end of the 6th week the mean of strength for PT Group and CT Group are 59.13 and 57.40 respectively. The result shows that mean of PT Group is more significant than CT Group for vertical jump. So, there is significant difference observed in PT Group as compare to CT Group at the end of training session.

Table 2: Mean and Standard Deviation of Pre- and Post-Intervention Scores

Outcome Measure	Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	p-value (within group)
30-meter Sprint (sec)	Plyometric + IASTM (A)	5.45 ± 0.21	4.91 ± 0.18	< 0.001
	Circuit + IASTM (B)	5.47 ± 0.19	5.12 ± 0.20	< 0.01
Illinois Agility (sec)	Plyometric + IASTM (A)	18.65 ± 0.44	17.93 ± 0.40	< 0.05
	Circuit + IASTM (B)	18.74 ± 0.41	17.31 ± 0.37	< 0.001

Interpretation:

- **Within-group analysis** revealed statistically significant improvement in both groups for all outcome measures.
- Group A (plyometric training +IASTM) showed greater improvement in **sprint speed**.
- Group B (circuit training + IASTM) showed superior improvement in **agility**.

Pre- and Post-Test Mean Values:

- Group A showed significant improvement in 30-m sprint time.
- Group B showed significant improvement in Illinois agility scores.

Between-Group Comparison:

- Statistically significant difference in agility improvement favoring Group B.
- Statistically significant difference in speed improvement favoring Group A.

Table 3: Between-Group Comparison of Mean Differences

Outcome Measure	Group A Δ Mean ± SD	Group B Δ Mean ± SD	p-value (between group)
30-meter Sprint	0.54 ± 0.07	0.35 ± 0.06	< 0.01
Illinois Agility	0.72 ± 0.09	1.43 ± 0.11	< 0.001

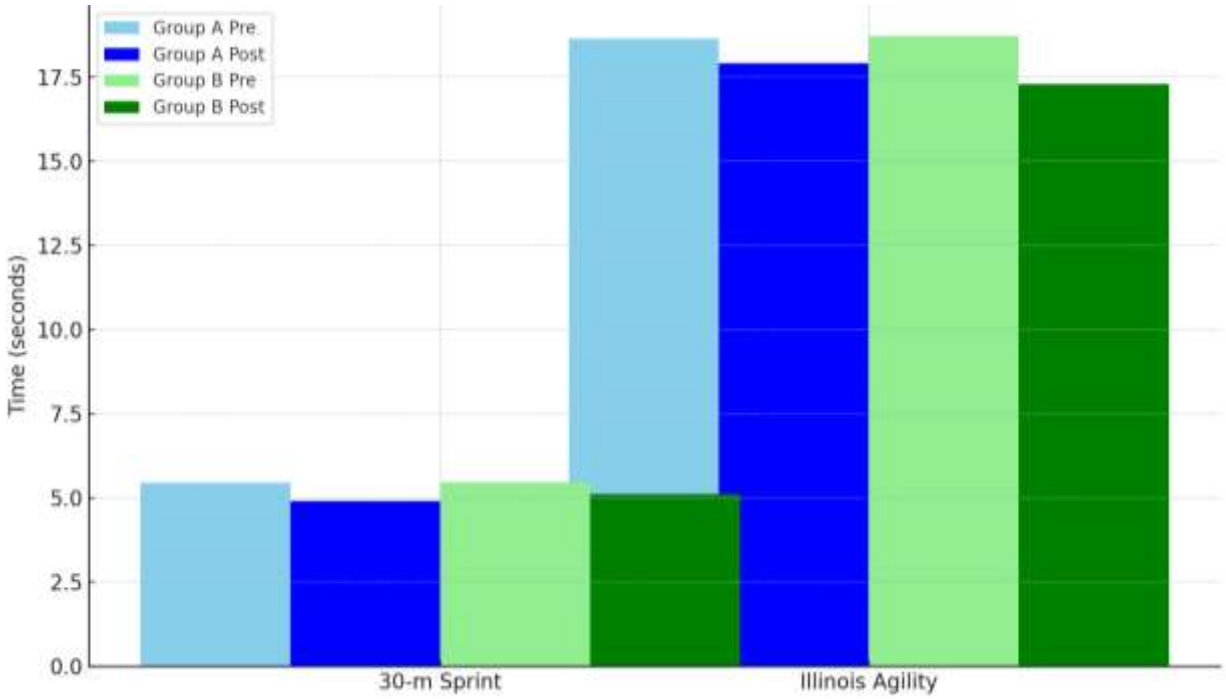
Interpretation:

- The between-group comparison using unpaired t-tests showed that:
  - **Group A** had significantly better results for sprint performance ($p < 0.01$).
  - **Group B** had significantly better results for agility performance ($p < 0.001$).

Between-Group Comparison:

- Statistically significant difference in agility improvement favoring Group B.
- Statistically significant difference in speed improvement favoring Group A.

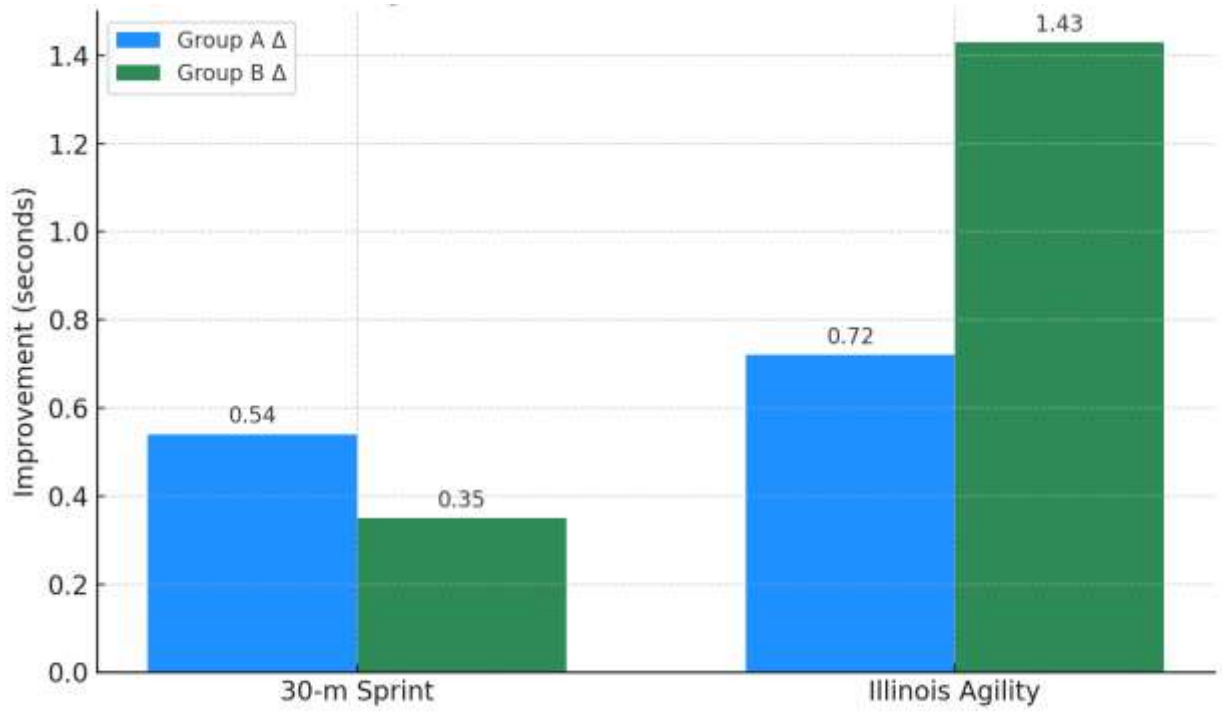
Graph 2 : Pre and Post test results for speed and agility



Here's a bar chart comparing the pre- and post-test results for both groups in the 30-meter Sprint and Illinois Agility tests. It visually highlights how:

- Group A improved more in sprint speed.
- Group B showed greater gains in agility.

Graph 3 : change in performance after intervention



This bar chart shows the **improvement (Δ)** in seconds for each group after the intervention:

- **Group A (Plyometric +IASTM)** had a greater reduction in sprint time.

- **Group B (Circuit + IASTM)** showed a larger improvement in agility time.

The result shows that there is a significant difference found within groups for all the variables at baseline and end of 6th week with p=0.000 (p<0.05). So, improvement seen in both PT Group and CT Group at the end of training session

DISCUSSION

In this study we investigated comparative effects of two different protocols, circuit training and plyometric training on agility and lower limb strength among skaters. The findings suggest that while both interventions are beneficial for enhancing athletic performance in skaters, the type of improvement varies. This study proposed that Circuit training is an excellent method of fitness training that combines both resistance and high intensity aerobic exercises that help to improve all aspects of fitness. It is a flexible training method in which exercises can be accomplished in different patterns like circular, star, square etc. Plyometric training is broadly used in sports to generate explosive power and strength of muscles translating into better sports recital. It consists of a pre-stretch phase (eccentric contraction) followed by a rapid shortening of muscle with a very short rest interlude in between. Plyometric drills involve stopping, initiating, and altering directions in a quick manner which are necessity for agility in sports. These results emphasize the need for targeted training based on specific athletic goals. For speed-focused performance, plyometric training may be ideal, whereas for agility-centric sports tasks, circuit training with soft tissue mobilization offers a comprehensive approach.

The research conducted by Saini, Hardeep Kaurm Bhardwaj showed positive result for significant increase in agility and strength by combining both the protocol together in there training sessions. They conducted research on 120 Punjab state basketball players with 60 in experimental group and rest in control group. Experimental group received plyometric training thrice a week and circuit training thrice a week in alternate manner. Mean and standard deviation were calculated, however experimental group showed positive and significant result which is similar to our study when performed separately.To conclude, both groups were found to be effective in improving agility and lower limb strength. Result of the study revealed that circuit training program brought better improvement in agility compared to plyometric training program and Plyometric training program brought better result for strength compared to Circuit training group.

Plyometric training's focus on explosive movements primarily enhances speed, as supported by Chu (2014) and Radnor et al. (2018).

On the other hand, the combination of circuit training and IASTM appears more effective in refining agility, likely due to better neuromuscular control and reduced soft tissue restriction, aligning with findings by Brown (2005) and Cheatham (2016).

LIMITATIONS AND FUTURE SCOPE OF STUDY

Study Limitations

This investigation presents several limitations that warrant consideration. UN equal male and female ratio, so Homogeneity is not maintained, Small sample size, Short duration of study, Results limited to adolescent skaters.

Future Research Directions

In future the study would be incorporated into the large sample size and large zone so the results obtain-

ed in the present study can be evaluated thoroughly and the uniformity in age distribution can be achieved, Long-term impact assessment, Application in competitive performance settings.

CONCLUSION

Both Plyometric Exercises and Circuit Training with IASTM are effective in improving speed and agility among skaters. Plyometric training with IASTM is more effective in enhancing speed, while Circuit Training with IASTM better improves agility. Training programs should be designed based on the specific performance needs of the athlete.

Agility and lower limb strength are crucial traits that impact skater's performance. It can be concluded from the results that there is a significant difference found in agility performance after the circuit training protocol and strength performance after the plyometric training protocol. There is a significant difference found within the group for both circuit training and plyometric training in agility and strength performance.

However, there is still limited literature available on plyometric and circuit training comparison individually amongst skaters. More research on skaters is required to investigate the connection and build comparison among two protocols that are circuit training and plyometric training. It is also recommended to consider additional factor such as elite athletes or beginner athletes in this study to evaluate a complete comparative effects amongst various protocol in various age group and the female to male skaters.

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