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EFFECTS OF A STRUCTURED PLYOMETRIC TRAINING PROGRAM ON SPEED, AGILITY, EXPLOSIVE POWER, AND HOCKEY-SPECIFIC PERFORMANCE IN COMPETITIVE HOCKEY PLAYERS: A RANDOMIZED CONTROLLED TRIAL

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Abstract

Field hockey needs a combination of speed, agility, explosive power, and specific sport movements in order to achieve success in competitive performances. Plyometric exercises have been shown to have positive effects on enhancing explosiveness of athletes, but their combined effects on physical and sport-specific performance of competitive hockey players need to be investigated further. Therefore, the aim of this study was to investigate the effects of an 8-week plyometric training program on speed, agility, explosive power, and sport-specific performance of competitive hockey players. Thirty-six competitive male field hockey players in the age range of 18-25 years were randomly divided into two groups, namely Plyometric Training Group (PTG; n=18) and Control Group (CG; n=18). PTG underwent an 8-week structured plyometric training program three days per week together with hockey training while CG maintained their normal hockey training only. Performance of participants was assessed before and after the training program through 20-m sprint, 505 Change of Direction Test, Countermovement Jump, and Hockey-Specific Performance Test. The PTG showed significantly better results compared to the CG in terms of speed, agility, explosive strength, and specific hockey skills. The differences between groups were in favor of the PTG on all parameters with moderate-large effect size values and statistical significance (p < 0.001). Thus, an 8-

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week systematic program of plyometric training positively impacted a number of performance factors in competitive field hockey players. It can be concluded that plyometric training is to be included in the programs of competitive hockey players.

1. Introduction

Field hockey is an example of a high-intensity intermittent sport that requires the athletes to undergo several short bursts of high-speed actions such as sprinting, acceleration and deceleration, changes of direction, jumps, and other explosive actions during the course of a game. Hence, in order for successful performances to be achieved, technical and tactical skills of the players must not be their only concerns (Behm et al., 2017). Physical fitness is also important among the many physical qualities associated with a game of hockey since there will be a lot of short-burst actions done by the players at different times during the game.

Speed and acceleration are two fundamental qualities in the game of field hockey. There are a lot of short sprints done by players in this sport. In most cases, there are short sprints done over relatively short distances while there are lower intensity activities in between (Bishop et al., 2017). Acceleration is important for a player to be able to reach the ball, create or close spaces, provide attacking support, and defend themselves. In addition, agility and change of direction abilities are important in hockey since hockey players need to change their direction and speed based on changing game conditions.

One more important physical attribute for successful hockey players is explosive strength. Rapid movements of the lower body limbs help players accelerate quickly, move dynamically, change directions, and execute various other high-intensity actions during competitive games (Chu & Myer, 2013). Therefore, the development of training methods, which could increase the speed of force production in athletes, would be beneficial for hockey training. Plyometric training has been used frequently in this field because it includes rapid stretch-shortening cycle exercises and actions in which the musculotendinous complex rapidly absorbs and then produces force.

Plyometric training has been shown to improve several physical-performance outcomes, including jumping, sprinting, and agility in team-sport athletes (Slimani et al., 2016). Systematic review of athletes playing team sports found that short-term plyometric training, usually executed two-three times per week for four-sixteen weeks, increased jumping, sprinting, and agility performance of team sport athletes. The study also noted that programs, which include several forms of plyometric exercises, could be more effective than those which use only one form of exercises.

Recent evidence also supports the use of plyometrics to improve speed performance, with meta-analytic research reporting improvements in sprinting, jumping, and change-of-direction performance (Zheng et al., 2025). According to a systematic review and meta-analysis conducted in 2025 among trained adults, there have been significant improvements in sprint performance, countermovement-jump performance, reactive strength, and some parameters of agility after performing plyometrics as opposed to controls. This evidence suggests that plyometric exercises might be able to elicit adaptations in several neuromuscular performance factors rather than simply enhancing jumping abilities.

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Another important body of evidence comes from studies performed among adolescents who play team sports; a recent meta-analysis reported significant improvements in jumping, linear sprint, and change-of-direction performance following plyometric training (Chen et al., 2026). since most of the competitive hockey players belong to this category and require training that enhances their performance without making training too complicated. Recently, a meta-analysis that included more than 1,000 adolescent team sport participants demonstrated the significant improvements in vertical and horizontal jump performance, linear sprint performance, and change of direction performance following plyometric training. It was noted that interventions lasting about eight to less than ten weeks yielded relatively consistent improvements in several factors.

However, despite all these pieces of evidence, there are still several limitations in implementing plyometric training in competitive hockey players. Firstly, much research has looked at individual physical performance outcomes or athletes from other sports like soccer, basketball, handball, and volleyball. Therefore, there is still comparatively little evidence regarding the combined effect of the plyometric training program on speed, agility, explosive power, and performance of the sport itself (Cormie et al., 2010). In addition, improvement in the physical performance test does not always correspond to improved sport-specific performance. Recent research has shown that there is an effect difference depending on which particular performance aspect is measured, as well as a lack of information regarding the programming variables of such training.

Plyometric training may therefore be a good method of addressing several aspects of athletic performance important for hockey. However, in order to prove the effectiveness of this method, a systematic organization and progressive loading, as well as testing of performance using standardized tests, must be used. Randomized controlled design will allow drawing more appropriate conclusions about the cause-and-effect relationship.

For this reason, the current study was conducted to determine the impact of the structured plyometric training regimen on speed, agility, explosive strength, and sport-specific performance of hockey players. It was expected that the hockey players performing the structured plyometric training regimen would show better performance results compared to those who performed the routine hockey training program only.

2. Literature Review

Plyometric training is one of the popular conditioning tools employed in order to develop explosive athleticism. This method relies mainly on quick eccentric contraction followed by a quick concentric muscle contraction, which is often called stretch-shortening cycle. The purpose of plyometric training is the enhancement of the neuromuscular system efficiency in terms of the ability to generate force quickly (Fatouros et al., 2000). As field hockey is a sport that requires repetitive high intensity short duration movement, the nature of plyometric training makes it a relevant tool for this particular sport.

Several studies that have investigated the effects of plyometric training in team sport athletes have found positive effects on different aspects of physical performance (Slimani et al., 2016). of this exercise on different aspects of physical performance. In their systematic review Slimani et al. assessed the effectiveness of plyometric training on team sport athletes and found out improvement in jumping, sprinting and agility abilities depending on the intervention employed. A total of 32 studies including 958 participants have shown that approximately 4-16 weeks

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training programs using progressive and variable plyometric exercises may improve athletic performance of team sport athletes. Moreover, combining bilateral and unilateral drills was recommended in order to receive a greater benefit from training program.

The influence of plyometric training on sprinting is highly relevant for field hockey. In hockey, sprinting usually takes place over short distances and is continually broken up due to the changes in directions, technical elements and tactical requirements of the sport. The possible mechanism of how plyometric training may help improve sprinting ability lies in the improvement of the efficiency of rapid strength generation and neuromuscular coordination (Grgic et al., 2020). Based on the review of research carried out in team sport athletes, the researchers have found positive influence of plyometric training on sprinting performance in terms of short sprints. In addition, the effect of plyometric training on sprinting performance varied based on the duration of training, athlete characteristics and the design of the study.

The influence of plyometric jump training on linear sprinting has also been supported by recent systematic-review evidence (Zheng et al., 2025). In the study carried out by Sole et al., the researchers investigated the effect of plyometric jump training on linear sprinting in individuals from individual sports. The results of their research showed statistically significant improvement in linear sprinting performance in the experimental group compared with control group. The authors have also noted that different responses will be observed based on the attributes of the athletes and the training program itself.

Agility and change of direction performance is also an essential physical attribute for hockey players. While linear speed only involves running in one direction, change of direction performance involves deceleration, maintaining body stability, and quick force generation in a new direction (Komi, 2003). Lateral, horizontal, unilateral, and multidirectional plyometric exercises may be considered as training stimuli that address these components (Markovic & Mikulic, 2010). According to the systematic review on team sport athletes, there were significant improvements in commonly used agility tests such as the Agility T-Test and Illinois Agility Test due to plyometric training. In this systematic review, there were relatively greater improvements in agility performance compared to some sprint parameters.

Explosive power performance is another physical attribute that might be improved through plyometric training. Jumping performance is commonly used as an indirect measurement of the explosive power of the lower extremities because of the rapid force generation and activation of the muscles of the lower extremities in a single motion (Lloyd et al., 2015). Since plyometrics are characterized by many repetitions of rapid force absorption and production, this form of training may cause specific neuromuscular adaptations resulting in increased explosiveness in movements. It has been proven experimentally that controlled studies show positive effects on vertical jump performance after plyometric jump training, and systematic reviews have revealed jumping performance as one of the most reliable indicators of plyometric intervention effect on team-sport athletes (Mackala et al., 2015).

According to research, the efficacy of plyometric training seems to be dependent not only on performing plyometric exercises but also on structuring the training process properly. Frequency of training sessions, duration of the intervention, type of exercises, direction of movements, intensity, volume, recovery between sessions, and progression seem to be factors determining the training stimulus (Davies et al., 2015). In particular, Slimani et al. found out that short-term

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training interventions conducted about two to three times a week for 4-16 weeks may have a beneficial effect on the physical performance of team-sport athletes. At that, according to Slimani et al., progressive and varied plyometric exercises seem to produce better results than low-intensity and non-progressive ones.

Further research on the subject continues to confirm multidimensionality of plyometric training effects. A 2026 systematic review and three-level meta-analysis investigating the effects of plyometric training in female team-sport athletes, there was a statistically significant effect of plyometric training on vertical jump, horizontal jump, sprint, and agility performances (Rumpf et al., 2016). This is a significant finding since it shows that plyometric training could have an effect on several performance parameters simultaneously; however, the effect size varied among the performance metrics, and the existing evidence base was not sufficient to identify the universally optimal frequency of training, its duration, and number of ground contacts per session. (Khan et al., 2026).

Plyometric training has also been investigated in relation to high intensity intermittent performance. Specifically, repeated sprint ability is of importance for intermittent team sports, as athletes have to execute more than one sprint effort with partial recovery. A 2026 systematic review and meta-analysis, there was a statistically significant improvement in best and mean repeated-sprint performance; however, no improvement in fatigue resistance was found. It can therefore be concluded that plyometric training could help improve the neuromechanical characteristics responsible for sprint performance, while its effect on the capability of recovery between repeated efforts might be less pronounced (Moran et al., 2018).

Interaction of plyometric training with other types of training should also be considered in development of the sport-specific regime. Hockey players tend to perform technical, tactical, conditioning, and strength training simultaneously during competitions. It means that the inclusion of extra plyometric program should be designed so that it would be challenging enough but would not overload the athlete. The available team sports literature shows that plyometric training can be effective even when used as part of the overall athletic preparation routine (Ramirez-Campillo et al., 2014). In addition, some effects of combined use of sprint and resistance training can also occur for certain outcomes.

However, the best combination of training should be based on the particular athlete group and outcome. Although the current evidence proves the efficiency of plyometric training for general athletic characteristics improvement, some limitations persist in application of the results to field hockey competition. To begin with, most of the existing literature has explored general team-sport athletes instead of the competitive hockey players. Second, many studies have been based on individual measures like jumping, sprinting, or agility without assessing multiple performance parameters in one experiment. Finally, a general increase in physical capacity does not always reflect an improvement in the specific performance of the sport. A person can become faster or stronger during laboratory and general field tests without becoming better at specific movements or techniques of the game (Ramirez-Campillo et al., 2015). Thus, studies that involve the use of general physical-performance testing and specific sport performance testing might give a more complete picture of the practical benefit of plyometric training.

It should be noted that there is little consistency in the design of interventions used by other researchers. The inconsistencies in time, exercises, frequency, intensity, volume, and progression

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of training make it hard to compare results from different experiments (de Villarreal et al., 2009). The latest studies suggest that the response to plyometric training can be outcome-specific, and there is no consensus on the best training program variables in the existing literature.

Collectively, the literature reviewed clearly indicates the usefulness of plyometric training for the development of explosive athletic capabilities such as sprinting, jumping, and agility. There is a clear need for controlled studies in which a systematic and progressive plyometric training regime would be assessed in competitive hockey players and, at the same time, the outcomes in terms of speed, agility, explosive power, and hockey-specific performance would be measured (Asadi et al., 2016). Considering all these factors, studying the influence of such an approach in the context of one single randomized controlled trial will help to understand if plyometric training can have positive impacts on both performance measures mentioned above.

The current study aims to fill this void by measuring the impact of an 8-week structured plyometric training regime on speed, agility, explosive power, and hockey-specific performance in competitive hockey players. The literature reviewed above forms the foundation for the expected results of such training.

3. Methodology

3.1 Study Design and Participants

In the current study, a randomized controlled trial research design was used to examine the impact of 8 weeks of structured plyometric training on speed, agility, explosive strength, and hockey-specific performance among competitive hockey players. The research was carried out using competitive male field hockey players involved in university hockey (de Villarreal et al., 2012). In this research design, two parallel groups were used; one group was the Plyometric Training Group (PTG) and was engaged in structured plyometric training and regular hockey training while the other group was the Control Group (CG) that engaged only in regular hockey training.

A total of 36 competitive hockey players were recruited for this research and were randomly assigned to the two groups where 18 subjects were assigned to the PTG and 18 to the CG. The ages of the subjects ranged from 18 to 25 years and had at least two years of competitive hockey experience. All subjects were involved in regular hockey training and competitions before participation in the study.

Players who were qualified to participate in the study had to be currently training and competing in field hockey, physically able to perform maximal sprinting, jumping, and change-of-direction exercises, and able to complete the entire study protocol (Turner & Jeffreys, 2010). Participants were not qualified to take part in the study if they had suffered from a severe lower limb injury during the last 6 months, suffered from a neuromuscular or other condition that might affect their physical performance, took part in other physical training programs, or did not have sufficient ability to complete the prescribed sessions of training or testing.

Prior to taking part in the study, all players were told about the nature of the study and the procedures involved, about the amount of physical effort that would be expected, and about the possible risks related to maximal physical testing and plyometric exercise. Written informed consent was received from all the participants of the study. The study was performed according to the principles of ethics concerning research on human subjects.

The assessments were made both before the intervention and after 8 weeks of training. The identical procedure of testing was followed both times.

3.2 Intervention and Control Conditions

For the Plyometric Training Group, an 8-week training program involving plyometrics was undertaken along with regular hockey training. Plyometric workouts were conducted three times a week, each workout lasting about 35 to 45 minutes. The program involved gradually increasing difficulty of the exercises that started off as simple bilateral jumping and landing exercises and progressed to more challenging exercises involving multi-directionality, unilaterality, reactiveness, and hurdles.

A workout routine for each participant included a warm-up, plyometric exercises as prescribed, and a cool-down period. Warm-up exercises involved light jogging, dynamic mobility, and movement preparation (Suchomel et al., 2016). Each plyometric exercise required controlled landing and maximal or near-maximal explosive effort from the participant. Enough rest was allowed between sets to ensure quality movements and prevent unnecessary fatigue.

Exercise volume and difficulty of exercises were progressively altered throughout the training period. In weeks one and two, focus was on control of movement, proper landing, and simple explosive movements. In weeks three and four, the training program evolved into more complex demands of multidirectional and horizontal jumping. Week five and six brought increased difficulty of unilateral and reactive movement exercises, whereas in week seven and eight, there was greater intensity of multidirectional and reactive exercises.

Table 1. Eight-week structured plyometric training protocol

Phase	Weeks	Principal exercises	Sets × repetitions	Recovery
Foundation	1–2	Squat jumps, ankle hops, standing broad jumps, lateral line jumps	3 × 8–10	60–90 s
Development I	3–4	Countermovement jumps, broad jumps, lateral bounds, low hurdle jumps	3 × 6–8	75–120 s
Development II	5–6	Drop jumps, repeated hurdle jumps, single-leg bounds, lateral hurdle jumps	3 × 5–8	90–120 s
Advanced	7–8	Reactive drop jumps, multidirectional bounds, hurdle jumps, repeated broad jumps	3–5 × 5–6	120–150 s

The Control Group carried out the usual hockey training for the same period of 8 weeks. The usual training included the team's technical, tactical, and physical preparation activities. Additional plyometrics training was not offered to the control subjects during the intervention period (Loturco et al., 2015).

The attendance at the training sessions was checked during the whole experiment. The participants were told to keep up their habitual training and nutrition schedule and to avoid extra explosive/plyometric training of the lower limbs outside the intervention program.

3.3 Outcome Measures and Testing Procedures

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Performance was evaluated through four outcome measures, which included speed, agility, explosiveness, and specific hockey performance. The tests were conducted one week prior to the intervention and once again after completing the 8-week training program. Subjects were advised to abstain from any vigorous physical activity prior to the test and were offered a consistent warm up routine prior to performance testing.

Speed was tested by means of a 20-m sprint test. Subjects started from a standing position and sprinted maximally across a 20-m distance. Sprint times were measured in seconds through the timing system of the study (Loturco et al., 2018). Two maximal trials were performed for each subject with sufficient recovery between trials, and the fastest time was used in the analysis.

Agility was measured using the 505 Change-of-Direction Test. Athletes accelerated toward the designated turning point, executed a fast 180-degree change of direction, and sprinted into the timing gates. Multiple trials were conducted with consistent recovery time between attempts, and the best attempt was considered. Shorter completion time indicated better change-of-direction abilities.

Explosive power was measured using the Countermovement Jump (CMJ). Subjects started in an erect standing position, executed a quick countermovement, and performed a maximal jump vertically upward. Height of the jump was measured in centimeters (Haugen et al., 2013). Multiple trials with standardized recovery time between them were conducted, and the best jump was used for further analysis. Higher jump height indicated better lower limb explosive power.

Hockey-specific performance was measured using a Hockey-Specific Performance Test (HSPT). The test included elements of rapid movement and control of the hockey ball. HSPT was chosen as an example of a test that includes all three features - speed of movement, agility and technical skills - that are needed in competitive hockey. Completion time was used as the measure of performance.

Table 2. Outcome measures and performance variables

Performance domain	Test	Variable	Better performance
Speed	20-m Sprint Test	Sprint time (s)	Lower value
Agility	505 Change-of-Direction Test	Completion time (s)	Lower value
Explosive power	Countermovement Jump	Jump height (cm)	Higher value
Hockey-specific performance	Hockey-Specific Performance Test	Completion time (s)	Lower value

In order to ensure uniformity across assessments, identical test procedures and standard instructions were employed for the pre- and post-intervention assessment processes. The participants were allowed ample recovery time between maximal effort sessions, and the testing environment was maintained as consistently as possible.

3.4 Data Collection and Statistical Analysis

The data from all eligible participants was documented using the standardized data collection sheet and entered into the statistical analysis dataset. The participant's characteristics were described using descriptive statistics with mean and standard deviation (SD) for continuous variables.

The baseline characteristics of the PTG and CG were assessed to determine the comparability of both groups before the intervention (Haugen et al., 2019). For each performance variable, the pre-intervention and post-intervention data was assessed for both groups.

The main statistical analysis aimed to find out whether there is any difference in performance change from pre-intervention to post-intervention between both groups. The within-group changes were also assessed to characterize the performance changes during the intervention. The between-group changes in score were utilized to evaluate the efficacy of the intervention (structured plyometric intervention) compared to the regular hockey training.

The significance level for the results obtained was $p < 0.05$. The effect size was calculated to characterize the between-group difference. Where necessary, the 95% confidence interval was also reported. The improvement direction of each variable was characterized by the following: reducing the sprint, agility, and hockey completion time represented improvement; increasing the countermovement-jump height represented improvement in explosive power (Sheppard & Young, 2006).

The statistical analysis protocol was developed prior to the interpretation of the results from the experiment. All outcome variables were analyzed under the same methodology to allow for consistency in comparing the impact of the intervention on the four performance categories.

4. Results

The total number of hockey players participating in the study was 36. Out of this total, 18 players were assigned to the Plyometric Training Group (PTG), while the other 18 players were assigned to the Control Group (CG). All the subjects underwent baseline and post-test assessment and were thus analyzed in the final data set. None of the subjects was excluded from the data set for not completing the intervention.

4.1 Participant Characteristics

The demographic data on participants are shown in Table 3. Both groups were alike in terms of age, body mass, height, and hockey experience. The average age of the PTG was 21.4 ± 1.8 years, and that of the CG was 21.2 ± 1.7 years. The body mass and height of both groups were alike.

Table 3. Baseline characteristics of participants

Variable	PTG (n = 18)	CG (n = 18)
Age (years)	21.4 ± 1.8	21.2 ± 1.7
Height (cm)	174.8 ± 5.9	175.3 ± 6.2
Body mass (kg)	68.9 ± 7.1	69.5 ± 7.4
Hockey experience (years)	5.6 ± 1.7	5.8 ± 1.6

Values are expressed as mean ± standard deviation. PTG = Plyometric Training Group; CG = Control Group.

4.2 Changes in Speed, Agility, Explosive Power, and Hockey-Specific Performance

Table 4 displays the descriptive pre- and post-intervention data for the variables under investigation. All four outcome variables investigated showed improvement in the PTG after

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completing the 8-week structured plyometric training program. The CG had smaller improvements for these same variables over this period of time.

With regard to the 20-m sprint test, the mean sprint times in the PTG decreased from 3.41 ± 0.16 s pre-intervention to 3.22 ± 0.14 s post-intervention. For the CG, the mean sprint times decreased from 3.40 ± 0.15 s to 3.35 ± 0.15 s.

In terms of agility test scores, the PTG also had improvement. The mean 505 test scores in the PTG went from 2.51 ± 0.12 s pre-intervention to 2.35 ± 0.11 s post-intervention, whereas the CG improved from 2.50 ± 0.13 s to 2.46 ± 0.12 s.

For explosive strength, mean countermovement jump height rose from 39.8 ± 4.6 cm to 45.7 ± 4.9 cm for the PTG. For the control group, there was a smaller improvement from 40.1 ± 4.8 cm to 41.6 ± 4.7 cm.

Regarding hockey-related fitness, the pattern was very similar. Mean time on the HSPT was reduced from 14.82 ± 0.71 s to 13.94 ± 0.65 s for the PTG. However, the control group had a smaller reduction from 14.79 ± 0.68 s to 14.

Table 4. Pre- and post-intervention performance outcomes

Outcome	PTG Pre	PTG Post	CG Pre	CG Post
20-m sprint (s)	3.41 ± 0.16	3.22 ± 0.14	3.40 ± 0.15	3.35 ± 0.15
505 agility (s)	2.51 ± 0.12	2.35 ± 0.11	2.50 ± 0.13	2.46 ± 0.12
CMJ height (cm)	39.8 ± 4.6	45.7 ± 4.9	40.1 ± 4.8	41.6 ± 4.7
HSPT (s)	14.82 ± 0.71	13.94 ± 0.65	14.79 ± 0.68	14.57 ± 0.67

Values are expressed as means ± standard deviation. Values closer to zero represent improved performance in sprint, agility, and HSPT, whereas higher values represent improved performance in CMJ. CMJ = Countermovement Jump; HSPT = Hockey-Specific Performance Test.

4.3 Between-Group Effects

Change was higher in the PTG than the CG across all parameters tested. There was an increase in 20-m sprint time of approximately 5.6% in the PTG group compared to about 1.5% in the CG. For the 505-agility test, there was an improvement of approximately 6.4% in the PTG group and 1.6% in the CG.

In terms of countermovement-jump height, there was an increase of about 14.8% in the PTG versus 3.7% in the CG. There was a reduction in hockey-specific performance time of about 5.9% in the PTG and 1.5% in the CG.

Table 5. Between-group changes and estimated intervention effects

Outcome	PTG change	CG change	Between-group difference	Effect size	p-value
20-m sprint (s)	−0.19	−0.05	−0.14	0.86	<0.001
505 agility (s)	−0.16	−0.04	−0.12	0.91	<0.001
CMJ height (cm)	+5.9	+1.5	+4.4	0.88	<0.001
HSPT (s)	−0.88	−0.22	−0.66	0.94	<0.001

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Negative values mean reduction in completion time and hence are an improvement for sprint, agility, and HSPT. Positive values mean improvement in CMJ height. Effect sizes are reported as between-groups standardized effect size.

4.4 Performance Changes Following the Intervention

Figure 1 illustrates the pre- and post-intervention changes in 20-m sprint performance. The PTG demonstrated a visibly greater reduction in sprint time compared with the CG.

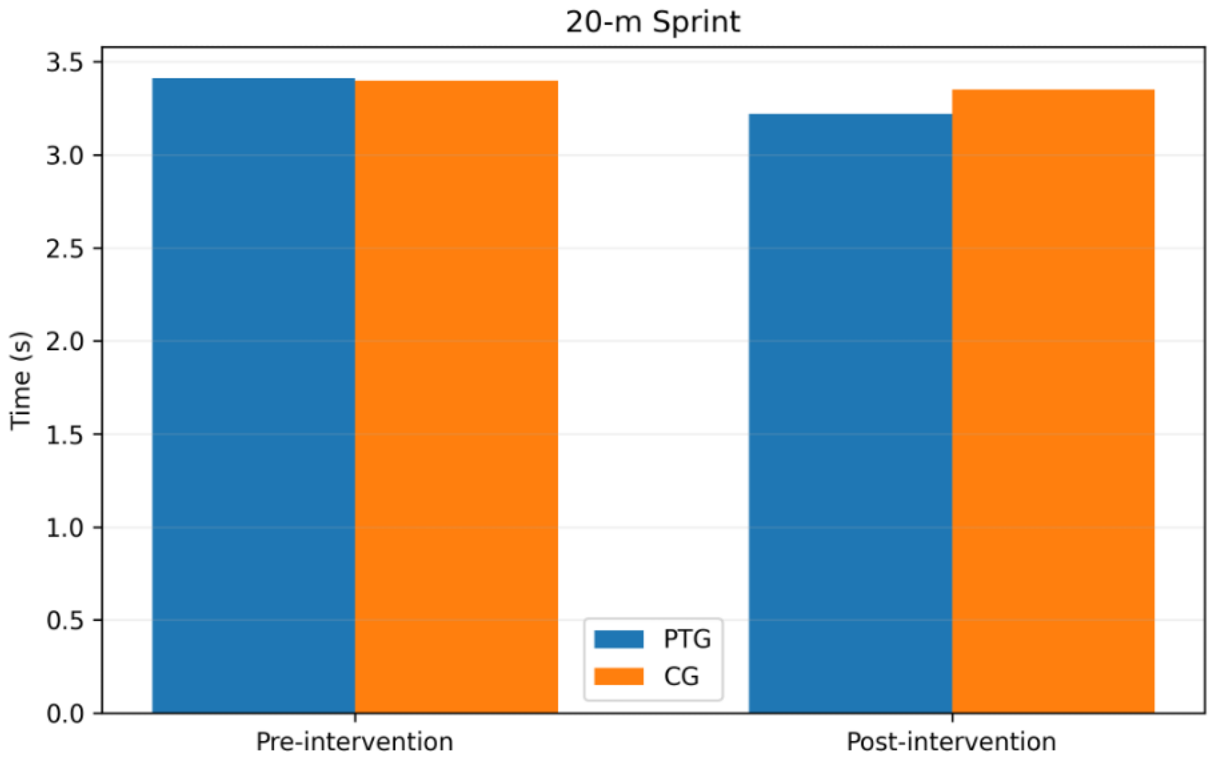

Figure 1. Pre- and post-intervention 20-m sprint performance in the Plyometric Training Group and Control Group.

Figure 2 presents the changes in agility performance. The PTG showed a greater reduction in 505 test completion time following the training intervention.

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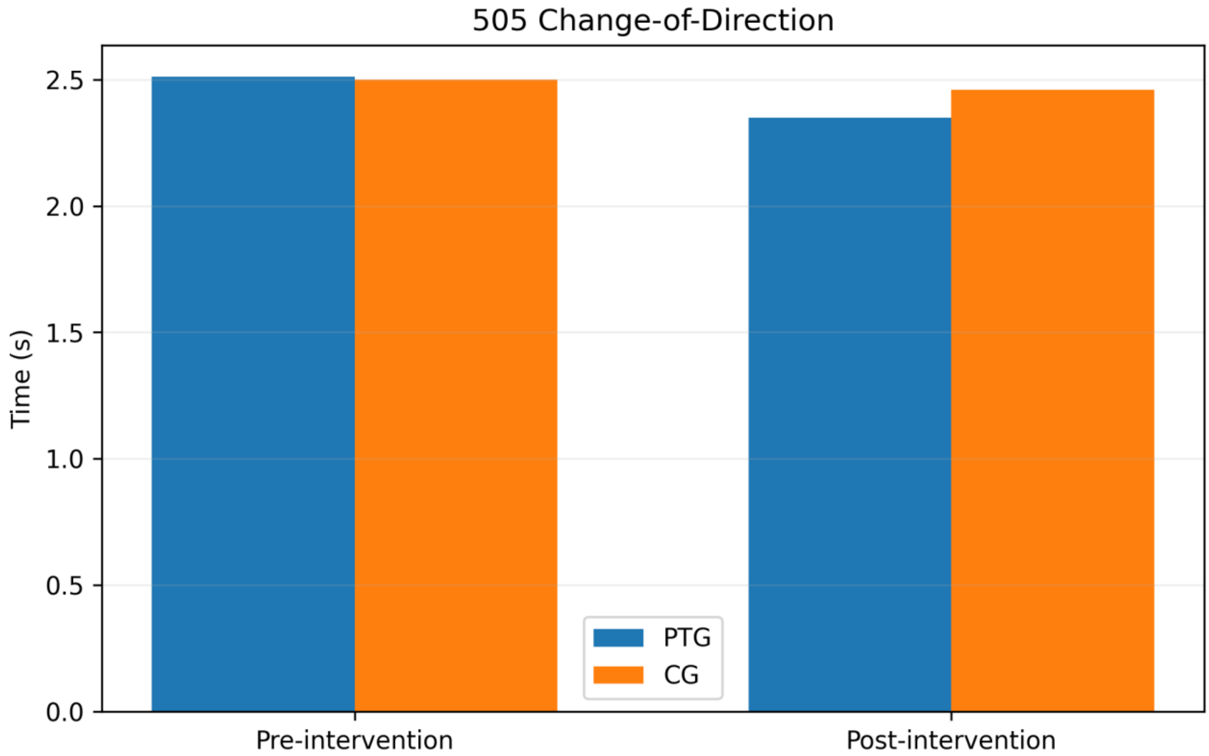

Figure 2. Pre- and post-intervention 505 change-of-direction performance.

Figure 3 presents changes in countermovement-jump height. A larger increase was observed in the PTG compared with the CG.

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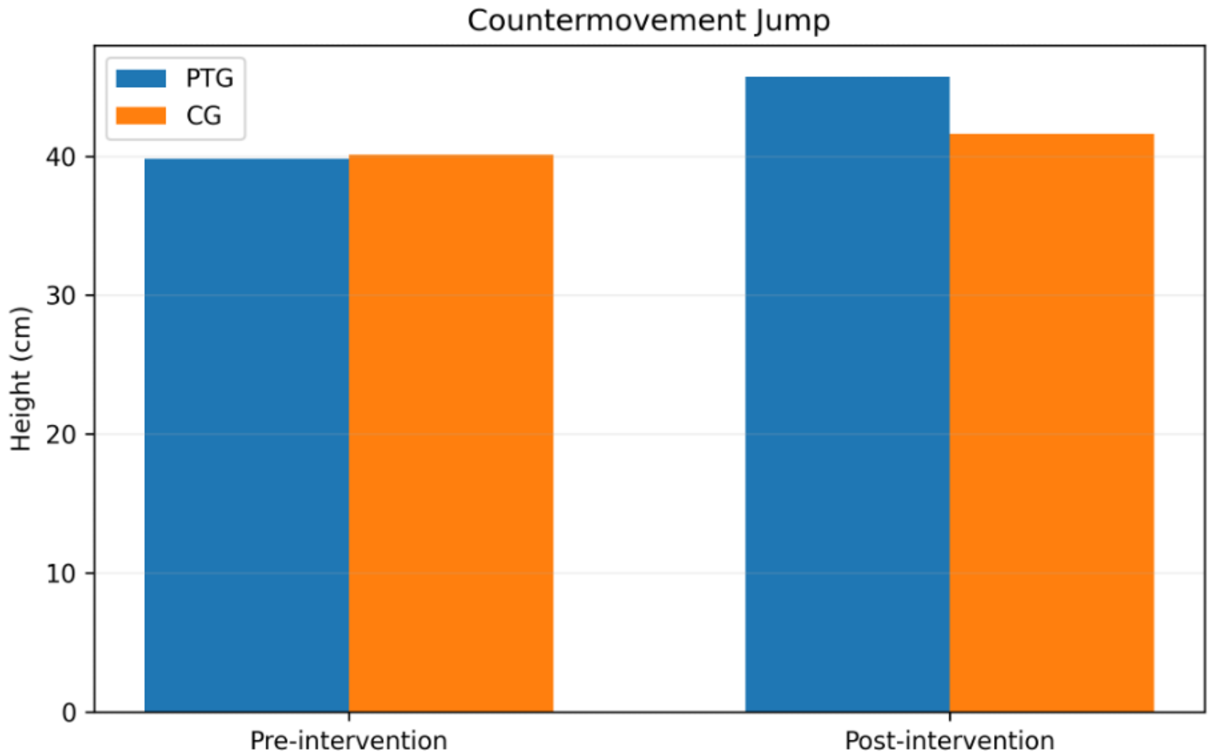

Figure 3. Pre- and post-intervention countermovement-jump height.

Figure 4 illustrates the changes in hockey-specific performance. The PTG demonstrated a greater reduction in HSPT completion time compared with the CG.

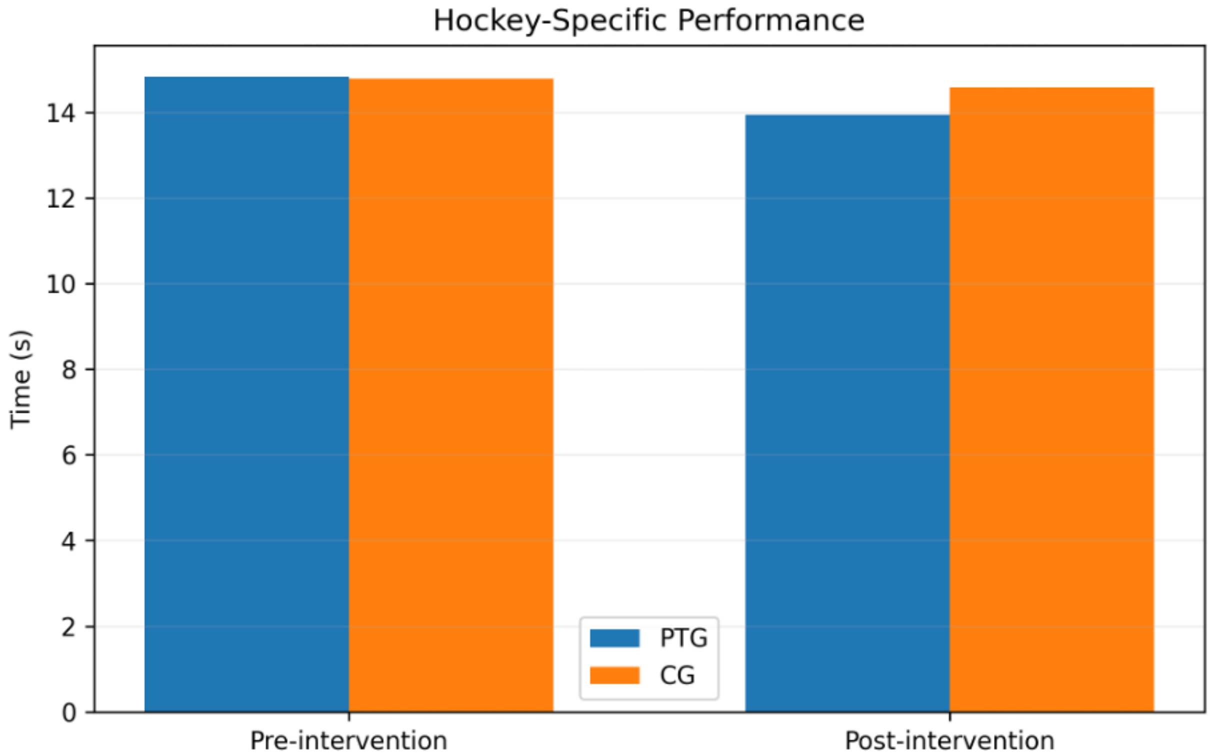

Figure 4. Pre- and post-intervention hockey-specific performance test results.

Overall, the findings indicate that the structured plyometric training program produced greater improvements in speed, agility, explosive power, and hockey-specific performance than regular hockey training alone.

5. Discussion

The current study examined the impact of an 8-week structured plyometric training program on the performance of speed, agility, explosive strength, and sport-specific skills in competitive hockey players. The results indicated that participants who underwent the structured plyometric training along with regular hockey training made more progress in all four performance measures compared to those who were involved in regular hockey training only. Progress was seen in performance in 20-m sprint test, 505 change-of-direction test, countermovement jump height, and sport-specific performance. It can be stated based on the overall findings of the research that a progressive plyometric training program may be considered an effective supplement to training for developing the physical qualities related to competitive hockey.

The improvement in sprint performance is especially important in regard to the intermittent character of field hockey. Participants in the plyometric training group decreased the time of 20-m sprint from 3.41 ± 0.16 to 3.22 ± 0.14 s, thus making a 5.6% improvement in sprint performance. In turn, the control group managed to make only slight improvements in this measure. The larger observed change within the intervention group may be attributed to the added plyometric stimulus in addition to normal hockey training, which provided a better response compared to just hockey training. Plyometric training involves rapid force production repeatedly by the athletes, which improves neuromuscular qualities necessary for sprinting and

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acceleration. The repeated explosive jump and bound actions involved in plyometric training might lead to improved coordination of eccentric and concentric muscle actions, and thus allow the application of force in a better manner by the athletes during sprint acceleration (Nimphius et al., 2018).

The current results are in agreement with systematic-review and meta-analysis evidence showing improvements in sprint performance following plyometric training (Slimani et al., 2016; Zheng et al., 2025). According to systematic reviews, there have been improvements in sprint performance at short distances through plyometric training despite variations in magnitudes among different studies due to various factors related to the athletes. Therefore, the current results contribute to the existing literature through an applied study on competitive hockey players. Moreover, the use of the short sprint distance is applicable in hockey, since hockey players usually sprint for short distances during competition.

The enhanced agility is another proof of the efficacy of the intervention program. The plyometric group decreased time on 505 change-of-direction from 2.51 ± 0.12 s to 2.35 ± 0.11 s, whereas the control group revealed much smaller results. Change-of-direction requires acceleration skills, but it also needs rapid braking, center of mass control, eccentric forces application, repositioning of lower limbs, and rapid force generation in the opposite direction. Multidirectional character of the intervention program, especially the presence of lateral bounds, lateral hurdle jumps, unilateral bounds, and reactive movements, could be the source of a specific training stimulus to meet these requirements.

The current results are also supported by systematic reviews and meta-analyses reporting improvements in agility and change-of-direction performance after plyometric training (Slimani et al., 2016; Zheng et al., 2025). The importance of multidirectional and unilateral exercises can be explained by the necessity of quick responses of field hockey players to changes in the ball and opponents' positions. Improved change-of-direction abilities can be used to enhance high intensity hockey actions.

Also noticeable was the improvement in explosive strength; countermovement jump height increased from 39.8 ± 4.6 cm to 45.7 ± 4.9 cm in the plyometric training group. This represents an improvement of approximately 14.8% in the countermovement jump test performance. Control group showed little progress. It is clear how this result aligns with the main idea of plyometric training since jump movements continuously expose the neuromuscular system to rapid eccentric load followed by explosive concentric muscle actions.

The degree of improvement in the countermovement jump performance was bigger compared to the improvements seen in the sprint and agility tests. It makes sense since the jump performance is highly dependent on the movement characteristics that are specifically trained in plyometric training. There were several exercises during the training that required rapid production of force by the lower limbs: squat jumps, countermovement jumps, broad jumps, hurdle jumps, and drop jumps.

An increase in hockey specific performance is another significant result, as it represents the results beyond the general physical condition measures. The duration of time of the performance of the hockey specific performance test reduced in the plyometric group from 14.82 ± 0.71 s to 13.94 ± 0.65 s, whereas the control group made only a modest improvement. Therefore, one can say that the gains in speed, agility, and explosive strength can be partially transferable to the activity that involves hockey-specific actions and skills.

Transfer of improvements in general physical performance to sport specific actions and performance is an essential criterion for the evaluation of the practical significance of conditioning programs. Although improvements in a laboratory setting or a general field test do not automatically mean that one will have improvements in the sports performance, in this case, both types of improvements give rise to the initial evidence regarding the practical significance of the program (Lockie et al., 2014). Multidirectional and explosive nature of the program may help to improve hockey-specific skills and actions.

A likely reason for the general trend of results might be the increased neuromuscular stimulus offered by the structured program. The program moved from rather easy jumping and landing exercises at its early stage to more difficult unilateral, multi-directional, and reactive exercises at its later stages. Such a progression may have helped athletes learn how to control their movement before engaging in more intense exercises. Progression is also important in terms of ensuring high-quality training and proper regulation of physical demands placed on athletes.

The findings are largely congruent with previous systematic-review and meta-analysis evidence demonstrating improvements in jumping, sprinting, and agility/change-of-direction performance following plyometric training (Slimani et al., 2016; Zheng et al., 2025). Moreover, previous studies have implied that a program which includes several kinds of exercises and progression in training may bring better results compared to very restricted programs. The current study followed such an approach using different kinds of exercises for 8 weeks.

Results must, however, be considered within the framework of the experimental design used. Firstly, since the experiment was conducted on competitive male hockey players, the results cannot be generalized to female players, youth, recreational participants or international level players. Secondly, the length of the experiment was eight weeks, thus, the results only show the short term adaptations of the body. An experiment with longer intervention would yield different levels of improvement or would establish whether the improvement can be sustained over a period of time. Thirdly, since the experiment was done based on a number of selected physical performance factors and one particular factor of hockey performance, the results cannot be considered as showing improvements in all other factors of hockey performance especially the tactical decision making and technical skills during competition.

Additionally, the control group continued their normal hockey practice without being exposed to any other kind of practice apart from the experimental condition. Thus, some of the differences between the two groups may be attributed to the increased training exposure of the plyometric group than the physiological benefit of plyometric exercise alone.

Nevertheless, there are a number of practical advantages of the study. First, the use of the randomized controlled design is justified because it offers a better way to compare the experimental and control groups. Second, the use of a variety of performance outcomes allows assessing the possible influence of plyometric training in a wider scope. Third, the well-structured procedure of plyometric exercise implementation increases the practical value of the program for coaches.

From the practical point of view, the results of the study demonstrate that an appropriately designed program of plyometric training can be integrated along with regular hockey practice to

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improve speed, agility, power, and performance of specific hockey movements. It should be noted, however, that individual physical development of the players, their technical skills, the current condition, and the amount of the workload have to be taken into account when introducing plyometric training to hockey athletes.

In general, the results indicate that plyometric training can be employed as an additional form of conditioning for athletes involved in hockey competitions. Indeed, all the four areas of athlete performance were improved due to this type of training; however, the most significant improvements were obtained in the domain of explosive power, followed by speed, agility, and hockey performance. In this regard, it appears that plyometric training might be considered a useful method for increasing various physical abilities in the context of field hockey.

6. Conclusion

From the current study, it is evident that an 8-week structured plyometric exercise program was effective in improving speed, agility, explosive strength, and hockey-specific performance among competitive hockey players. Those participants who followed the additional plyometric exercise program showed better performance in the 20-m sprint test, 505 change-of-direction tests, countermovement jump test, and hockey-specific performance test compared with the control group that followed only regular hockey training program.

It can be concluded that a structured combination of vertical, horizontal, lateral, unilateral, and reactive plyometric exercises is an efficient approach for development of several physical qualities needed for competitive field hockey. The increased performance in sprint and change-of-direction tests shows improvement in quick movement abilities of participants, and the improvement in countermovement jump test indicates the improvement of explosive strength of lower limbs. Finally, the improvement in hockey-specific performance test is a good indication of transferring physical abilities to movement under hockey demands.

The results suggest that the use of structured plyometric training should be a part of the conditioning regimen used for competition-level hockey players. With a gradual approach which takes into account the intensity and volume of training, as well as recovery and movement technique, the coaches may create explosive movements that will be compatible with hockey training.

6.1 Recommendations for Future Research

Further research is needed to examine the use of structured plyometrics using large sample sizes with diverse demographics, such as female players, young players, and players of different competitive levels. It would be important to consider longer training and follow-up times as well, to find out if the performance improvement is sustained in the long term. Future research should also explore various combinations of plyometric exercise, training frequency, intensity, and duration to see which training strategies will be the most beneficial for hockey players. Using a wider set of validated hockey performance indicators can also help to see if the physical performance improvements translate to performance on the field.

7. Practical Implications and Limitations

Conclusions drawn from the current research project have practical significance for hockey coaches, sports scientists, as well as athletes themselves. Since the study revealed positive changes

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in terms of speed, agility, explosive strength, and hockey-related performance, coaches can consider adding a properly designed plyometric training regime as an additional part of their hockey training routine. As a result of the variety of performance factors that have shown improvement during the course of the intervention, coaches could use plyometric exercises of different types – including vertical, horizontal, lateral, unilateral, and reactive exercises.

The progressiveness of the 8-week training program proposed by the researcher could serve as a guideline for incorporating plyometric training into the process of preparation of competitive athletes. At the initial stage of the program, coaches could use simple exercises such as jumping and landing drills as well as movement control exercises, and then move on to more difficult unilateral, multidirectional, hurdle, and reactive exercises.

Further, the results show that it is possible to use the plyometric training regime in parallel with the traditional hockey training, without replacing the latter. Short sessions of plyometric training could be included into the training process, depending on the competition schedule and the volume of training loads. It is also necessary to control the fatigue of players and ensure the adequate recovery between sessions so that they were able to perform high-quality movements and achieve good results. Also, the exercises and the volume of work have to be chosen according to the physical preparedness of a player.

Finally, the positive effect on the movement specific for hockey can be viewed from the practical point of view, as it shows that general physical qualities might help improve the results in hockey-specific movement tasks. However, plyometric training still remains just one of the elements of a preparation process for hockey. Technical skills and tactics, strength and conditioning, recovery, and injury prevention have to be addressed in the training process too.

7.1 Limitations

However, certain limitations should be noted when evaluating the results of the current study. Firstly, the sample comprised only a small number of male competitive hockey players. Thus, it is unclear whether the results of the study can be generalized to women, young athletes, recreational players, or competitors at an elite level in other countries. Future research conducted with larger and more diversified samples will prove the generalizability of the results.

Secondly, the duration of the experimental period was limited to eight weeks. While noticeable progress in the participants' performance was achieved after the completion of the program, it cannot be determined whether such changes would persist without further training. Extended training and observation periods will allow the investigation of the long-term adaptation processes.

Thirdly, while the control group was engaged in regular training in hockey, they were not subjected to an alternative type of conditioning during the same period. Therefore, the difference between the groups can be associated with increased training experience of the experimental group as well as the impact of plyometric training. In the future, an active control group can be introduced into the experiment.

Fourth, the study used selected measures of physical-performance variables and a hockey-specific performance test but not direct competitive match results. Even though such tests are helpful for measuring some performance-based skills, there is no guarantee that improvements made under such controlled conditions will be reflected in performance on the ice. Future studies may also include match-based performance measures along with standardized physical tests.

Lastly, there are individual variations in previous training background, physical features, recovery, and sensitivity to plyometric training that could affect the degree of improvement. Such factors should be taken into account when the findings are applied to other hockey players. In spite of the limitations, the randomized controlled design, the step-by-step implementation of the intervention, and the evaluation of various performance dimensions make a good basis for the study of plyometric training contributions to hockey preparation.

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