

Optimizing speed and strength training for skilled female indoor hockey players using HIIT protocols during the preparatory period

OLENA SHYNKAROVA, OLEKSANDR DUBOVOI, VOLODYMYR DUBOVOI, SERGII SHYNKAROV, OLEKSANDR MISHCHENKO, DARIA SIPAKOVA, VITALII LAPYTSKYI

Department of Olympic and Professional Sport, State Institution "Luhansk Taras Shevchenko National University", Poltava, UKRAINE

Published online: May 31, 2026

Accepted for publication: May 15, 2026

DOI:10.7752/jpes.2026.05085

Abstract:

Introduction. Indoor hockey requires players to perform repeated high-intensity sprints within a confined space under strict time and tactical constraints. For elite-level athletes (Master of Sport, International Class), identifying metabolic and training methods to overcome adaptation plateaus is critical. **Objective.** This study aimed to evaluate the impact of an 8-week specialized high-intensity interval training (HIIT) protocol on aerobic power and repeated sprint ability (RSA) in skilled female indoor hockey players. **Methods.** Twenty players from MHC "Sumchanka" (age 21.4 ± 2.6 years, experience 11.2 ± 1.4 years) participated and were divided into an experimental group (EG, $n=10$) and a control group (CG, $n=10$). The EG performed a shuttle-based HIIT protocol (2 sessions per week, shuttle runs at $>90\%$ HR_{max} with 180° changes of direction), while the CG followed a standard continuous aerobic training program. Performance was assessed using the RSA test (6×30 m) and the Yo-Yo Intermittent Recovery Test (Level 1). **Results.** After 8 weeks, the EG showed a statistically significant improvement in best sprint time ($p < 0.01$) and a 23.5% reduction in the fatigue index ($p < 0.01$). The distance covered in the Yo-Yo IR1 test increased significantly from 1520 ± 145 m to 1780 ± 160 m ($+17.1\%$) in the EG compared to only a 4.5% gain in the CG ($p < 0.001$). **Discussion.** These physiological shifts demonstrate that sport-specific short intervals effectively enhance phosphocreatine resynthesis and lactate buffering capacity, allowing highly trained players to break through structural adaptation barriers. **Conclusions.** The implementation of HIIT protocols, tailored to the specific movement patterns and deceleration/acceleration phases of indoor hockey, significantly enhances the specific speed-strength endurance of skilled athletes. The proposed time-efficient methodology is highly recommended for integration into the preparatory period of professional clubs to optimize the training process without overtraining risks.

Key Words: aerobic power, repeated sprint ability, physical performance, athletic conditioning, cardiorespiratory fitness, team sports.

Introduction

Indoor hockey is a highly dynamic and intense team sport characterized by an acyclic movement structure, frequent changes of direction (COD), and the constant alternation of explosive maximal sprints with periods of low-intensity activity or incomplete recovery. Unlike traditional field hockey, indoor hockey is played on a significantly smaller court (40×20 meters) with fewer players and specific regulatory constraints, such as the prohibition of lifting the ball (except for shots on goal) and the use of sideboards that keep the ball continuously in play. These technical and spatial boundaries lead to an exceptionally high density of game actions, eliminating tactical pauses and imposing extreme physiological demands on the cardiorespiratory and neuromuscular systems of female athletes.

Physiological profiling of elite indoor hockey players confirms that competitive success depends heavily on the integrated development of both aerobic power and anaerobic capacity (Macutkiewicz & Sunderland, 2018; Sunderland et al., 2022). Players must maintain high-velocity sprinting capabilities throughout two halves of intense play while simultaneously executing precise technical skills under conditions of severe metabolic fatigue. Consequently, the optimization of speed-strength training and the enhancement of specific endurance during the pre-season preparatory period represent pivotal success factors for high-performance teams (Ihsan et al., 2021; Sunderland et al., 2022).

Modern sports science widely regards high-intensity interval training (HIIT) as one of the most effective, evidence-based, and time-efficient methodologies for maximizing athletic performance (Buchheit & Laursen, 2019; Gibala & Little, 2020). In contrast to traditional continuous endurance training, which often induces negative adaptations in explosive power, HIIT stimulates profound central and peripheral cardiovascular adaptations within a relatively short timeframe. Substantial empirical evidence indicates that short-interval training protocols efficiently elevate maximal oxygen uptake (VO_{2max}), optimize metabolic waste clearance, improve the lactate threshold, and enhance overall running economy (Denadai et al., 2006; Esfarjani & Laursen,

2007). Furthermore, within court-based team sports, HIIT protocols that incorporate sport-specific movement mechanics -such as short shuttle runs, rapid decelerations, and 180° changes of direction – elicit specialized neuromuscular adaptations that closely replicate the metabolic profile of a competitive match. This targeted conditioning stimulus is particularly essential for breaking through the structural "adaptation plateau" frequently observed in elite-level athletes. At advanced stages of sports mastery, conventional aerobic workloads no longer provide a sufficient homeostatic disruption to trigger further performance gains (González-Mohino et al., 2020; Yangya Feng et al., 2026).

Problem Statement

The physiological necessity of HIIT is uniquely pronounced in the preparation of highly skilled female athletes, where sports scientists must carefully balance the development of cardiorespiratory endurance with explosive speed and mechanical power (Bonnici et al., 2020). Recent meta-analyses demonstrate that specialized interval protocols and sprint interval training (SIT) effectively upregulate muscular metabolic flexibility, enhance post-exercise fat oxidation, and accelerate phosphocreatine (*PCr*) resynthesis (Atakan et al., 2022). These molecular adaptations, occurring predominantly at the level of skeletal muscle mitochondrial function, are what allow elite female players to recover rapidly between repeated high-intensity game episodes (Dohlmann et al., 2018; Gibala, 2020).

In this context, Repeated Sprint Ability (RSA) emerges as a critical determinant of performance. Under the influence of structured HIIT, RSA shows significantly greater systemic improvements compared to low- or moderate-intensity continuous running. However, despite the well-documented physiological benefits of interval training, there remains a critical gap in the current literature specifically addressing elite-level female indoor hockey players – such as Masters of Sport and Masters of Sport, International Class.

The vast majority of existing HIIT recommendations are derived from studies conducted on male professional football players (Rabbani et al., 2019), recreational runners (González-Mohino et al., 2016), or traditional field hockey squads. The highly specific parameters of court-based, shuttle-run HIIT – which must simulate the exact spatial restrictions, deceleration-acceleration cycles, and position-specific energy demands of indoor hockey – remain critically under-investigated (Bishop et al., 2023; Taylor et al., 2021).

Additionally, high-intensity workloads exert a profound impact on the neuropsychological and cognitive profiles of team-sport athletes. The rapid, unpredictable nature of indoor hockey requires superior executive functions, including rapid decision-making speed, working memory, and inhibitory control under physical duress (Ai et al., 2021; Yue et al., 2025). While acute high-intensity exercise is known to stimulate the release of neurotrophic factors (such as BDNF) that enhance cognitive flexibility (Saucedo Marquez et al., 2015; Slusher et al., 2018), the precise application of these workloads during the preparatory period to manage fatigue, optimize body composition, and avoid sleep disturbances in elite female hockey players requires deeper empirical validation (Jiménez-García et al., 2021; López-Sánchez et al., 2022; Shynkarova et al., 2025).

Approach

To address these unresolved questions and fill the identified gaps in sports science literature, this study developed and implemented a specialized, sport-specific 8-week HIIT protocol. Moving away from linear, non-specific running models, our approach utilized short shuttle-run intervals (15 to 30 seconds at >90% *HR_{max}*) performed directly on a standard indoor court with mandatory 180° changes of direction. This research design allowed us to examine the direct transfer of physiological gains to the specific physical readiness of elite female players.

By conducting a rigorous parallel-group experimental study involving elite athletes from the Municipal Sports Club "Sumchanka", we aimed to evaluate how a time-efficient, sport-specific interval training program affects specific aerobic power (via the Yo-Yo IR1 test), anaerobic sprint endurance (via the RSA test), and fatigue management parameters during the crucial pre-season preparatory period.

The Aim of the Study

Given the identified gaps in the literature, the aim of this study was to evaluate the effectiveness of an 8-week specialized HIIT protocol, tailored to the movement patterns of indoor hockey, in enhancing aerobic power, repeated sprint ability (RSA), and speed-strength readiness in elite-level female athletes during the preparatory period.

Hypothesis

We hypothesize that the implementation of a specialized 8-week high-intensity interval training (HIIT) program, tailored to the biomechanical characteristics of indoor hockey (shuttle runs with changes of direction), will lead to:

- Significant enhancement of repeated sprint ability (RSA): Achieved through the optimization of anaerobic energy mechanisms, which will be evidenced by a substantial reduction in the Fatigue Index (FI) compared to traditional continuous running preparation.
- Improvement in specific aerobic power: Based on Yo-Yo IR1 test results, enabling players to maintain high-intensity technical and tactical performance throughout the entire match duration.
- A "time-efficiency" effect: Whereby a lower total training volume allows elite-level athletes (MS and MSIC) to overcome adaptation plateaus without increasing the risk of overtraining or overuse injuries.

Material & methods

Participants

The study involved 20 professional female indoor hockey players from the Municipal Sports Club (MSC) "Sumchanka," which competes in the Ukrainian Higher League. The sample consisted of elite-level athletes: 14 Masters of Sport (MS) and 6 Masters of Sport, International Class (MSIC).

Anthropometric and Demographic Characteristics

The baseline demographic, anthropometric, and professional characteristics of the participants are presented as Mean $\pm$ Standard Deviation (SD):

Age (years): 21.4 ± 2.6

Sports Experience (years): 11.2 ± 1.4

Body Mass (kg): 62.8 ± 4.5

Body Height (cm): 168.5 ± 5.2 .

Prior to the randomization, statistical analysis confirmed the homogeneity of the participants across all measured baseline characteristics.

Ethical Considerations

All participants were fully informed of the study protocols and provided written informed consent prior to the commencement of the experiment. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. The research design and procedures were reviewed and approved by the Bioethics Committee of Sumy State Pedagogical University (Protocol No. 3, 2025).

Measurements and Testing Procedures

To evaluate the physical condition of the athletes and the physiological effectiveness of the implemented HIIT program, the following objective performance and physiological measurements were employed:

1. Repeated Sprint Ability (RSA) Test

To assess anaerobic capacity and sprint endurance, players performed the standardized RSA test consisting of six maximal 30-meter sprints (6 x 30 m) with 20 seconds of active recovery (slow jogging and walking) between repetitions. Sprint times were recorded using a professional photoelectric timing gate system (Microgate, Bolzano, Italy) with an accuracy of 0.01 s. The following parameters were analyzed:

- Best Sprint Time (RSbest): The fastest single sprint time recorded during the test, serving as an indicator of maximal acceleration and speed.
- Fatigue Index (FI, %): Calculated to evaluate the percentage of performance decline across the six sprints using the standard formula:

$$FI = \left(\frac{TT_{total}}{6 \times RS_{best}} - 1 \right) \times 100$$

where TT_{total} is the sum of times from all six sprints, and RS_{best} is the best sprint time.

2. Yo-Yo Intermittent Recovery Test (Level 1)

The Yo-Yo IR1 test was utilized to determine specific aerobic power and functional endurance. Participants performed repeated 2 x 20 m shuttle runs at progressively increasing speeds, strictly controlled by calibrated audio signals. Between each shuttle, players had 10 seconds of active recovery (slow walking within a 2.5 x 5 m zone). The test concluded when the participant failed twice to reach the finish line in time with the audio signals. The total distance covered (meters) was recorded as the primary outcome metric.

3. Heart Rate Monitoring

To ensure the physiological validity of the HIIT sessions and to monitor cardiovascular response during testing, heart rate (HR) was continuously recorded using Polar H10 chest sensors and the Polar Team Pro system (Polar Electro, Kempele, Finland). The target training intensity for the HIIT protocols was strictly maintained at >90% of the players' individual maximal heart rate (HR_{max}).

Study Design

The research was conducted as an 8-week parallel-group experimental study during the pre-season preparatory period. All testing and training interventions took place at the "Sumchanka" Municipal Sports Club's specialized indoor facility. To ensure data consistency and minimize the influence of external factors, all testing sessions were performed in the morning (10:00 AM) following a mandatory rest day, on a professional indoor hockey surface, and under controlled environmental conditions (ambient temperature 18-20°C).

Results

The study was structured into four distinct phases to ensure the validity and reliability of the data:

1. Pre-intervention Testing (Baseline)

One week prior to the start of the training program, a comprehensive baseline assessment was conducted, including anthropometric measurements and physical performance tests (RSA and Yo-Yo IR1). To minimize the influence of circadian rhythms and cumulative fatigue, all tests were performed in the morning (10:00 AM) following a mandatory rest day.

2. Randomization and Group Allocation

Participants were randomly assigned to either the Experimental Group (EG, n=10) or the Control Group (CG, n=10). Baseline statistical analysis confirmed no significant differences between the two groups regarding age, experience, or initial performance metrics ($p > 0.05$).

3. Training Intervention

Over the 8-week period, the training was differentiated as follows:

Experimental Group (EG): Performed a specialized HIIT protocol twice weekly (Tuesdays and Thursdays) as part of their morning training sessions. Each session lasted 25-30 minutes, including a standardized warm-up. The protocol focused on shuttle runs simulating the intermittent nature of indoor hockey.

Control Group (CG): Performed traditional continuous running exercises of moderate intensity during the same time slots, maintaining an equivalent total training duration to the EG.

4. Post-intervention Testing

Following the completion of the 8th week, a final assessment was conducted. The post-test utilized the identical protocol, equipment, and environmental conditions as the baseline testing to ensure a direct comparison of the results. Statistical processing of the data was performed using the SPSS v.26 software package (IBM Corp., Armonk, NY, USA). Descriptive statistics are presented as Mean (M) and Standard Deviation (SD). The Shapiro-Wilk test was employed to verify the normality of the data distribution.

To evaluate the impact of the training program, a 2×2 mixed-design ANOVA with repeated measures (Time [Pre vs. Post] $\times$ Group [Experimental vs. Control]) was conducted. When significant interactions were found, Bonferroni post-hoc tests were applied to identify specific differences. The level of statistical significance was set at $p < 0.05$ for all analyses. Effect sizes were calculated using partial eta-squared to determine the magnitude of the training effects. The 8-week HIIT program was integrated into the weekly microcycle (Tuesdays and Thursdays) and followed a "Short Intervals" model. This model was specifically selected to align with the metabolic profile and biomechanical demands of indoor hockey, focusing on high-intensity efforts with brief recovery periods (Table 1).

Table 1. The 8-week HIIT program structure for elite female indoor hockey players

Phase (weeks)	Load protocol (work/rest)	Volume (sets repetitions)	$\times$ Recovery (between reps / sets)	Intensity (% of HR_{max})
Weeks (adaptation)	1-2 15 s run / 15 s rest	2 sets $\times$ 8 reps	15 s / 3 min	90-95
Weeks (progression)	3-4 20 s run / 15 s rest	2 sets $\times$ 10 reps	15 s / 3 min	95
Weeks 5-6 (peak)	30 s run / 20 s rest	3 sets $\times$ 8 reps	20 s / 4 min	95-100
Weeks (maintenance)	7-8 15 s run / 15 s rest	2 sets $\times$ 12 reps	15 s / 3 min	95

Training intervention details

The specialized HIIT protocol for the Experimental Group (EG) was designed based on the following criteria: Movement Specificity: Training consisted of shuttle runs on a standard indoor hockey court (lengths of 20 m or 40 m) with 180° changes of direction (COD). This approach was chosen to replicate the specific biomechanics and decelerative/accelerative demands of competitive play.

Warm-up Protocol: Prior to each HIIT session, both groups performed a 15-minute standardized dynamic warm-up, including joint mobilization, low-intensity running, and progressive acceleration drills.

Intensity Control: Real-time intensity was monitored via Polar H10 heart rate sensors. The target zone for the EG was strictly maintained at $> 90\%$ of individual maximal heart rate (HR_{max}), ensuring the stimulus met the criteria for high-intensity interval adaptation.

Control Group Protocol: The CG followed a traditional aerobic conditioning program consisting of continuous running (steady-state) for 30-40 minutes at an intensity of $70-80\% HR_{max}$. This ensured that both groups received an equal frequency of training sessions, while the primary variable remained the method of energy system stimulation.

Statistical Analysis

All data are presented as Mean $\pm$ Standard Deviation ($M \pm SD$). The normality of the distribution was confirmed using the Shapiro-Wilk test. To evaluate intra-group changes (Pre-test vs. Post-test), Student's t-test for dependent samples was applied. Inter-group differences and the interaction between time and training method were assessed using a two-way mixed ANOVA with repeated measures (Factor 1: Time [Pre, Post]; Factor 2: Group [EG, CG]). Where significant interactions were identified, a Bonferroni post-hoc analysis was performed to locate specific differences.

The level of statistical significance for all tests was set at $p < 0.05$. All calculations were performed using SPSS v.26.0 (IBM Corp., Armonk, NY, USA).

Following the 8-week training intervention, both experimental groups demonstrated changes in physical fitness parameters; however, the magnitude and statistical significance of these improvements differed substantially between the cohorts.

The results of the comparative analysis and the interaction effects are summarized in Table 2.

Table 2. Dynamics of physical fitness indicators in MSC "Sumchanka" players ($M \pm SD$)

Parameter	Group	Pre-test	Post-test	Δ (%)	p-value
RSA Best (s)	EG (n=10)	4.62 $\pm$ 0.12	4.41 $\pm$ 0.08	-4.5	< 0.01
(Best 30 m sprint)	CG (n=10)	4.65 $\pm$ 0.14	4.60 $\pm$ 0.11	-1.1	> 0.05
RSA Mean (s)	EG (n=10)	4.88 $\pm$ 0.15	4.64 $\pm$ 0.10	-4.9	< 0.01
(Mean sprint time)	CG (n=10)	4.90 $\pm$ 0.18	4.85 $\pm$ 0.13	-1.0	> 0.05
Fatigue Index (%)	EG (n=10)	6.8 $\pm$ 1.2	5.2 $\pm$ 0.9	-23.5	< 0.01
	CG (n=10)	7.1 $\pm$ 1.5	6.9 $\pm$ 1.1	-2.8	> 0.05
Yo-Yo IR1 (m)	EG (n=10)	1520 $\pm$ 145	1780 $\pm$ 160	+17.1	< 0.001
(Test distance)	CG (n=10)	1540 $\pm$ 130	1610 $\pm$ 125	+4.5	< 0.05

Note: EG – Experimental group; CG – Control group; Δ (%) – percentage change from pre- to post-test.

Key findings and observations

The data analysis revealed several critical trends in the performance dynamics of elite female indoor hockey players.

Repeated Sprint Ability (RSA): The Experimental Group (EG) demonstrated a statistically significant improvement in the best sprint time ($p < 0.01$). More importantly, a profound 23.5% reduction in the Fatigue Index was observed, indicating a substantial increase in anaerobic endurance and the capacity for rapid recovery between explosive efforts. In contrast, the Control Group (CG) showed no significant changes in these parameters ($p > 0.05$).

Specific Aerobic Power: Performance in the Yo-Yo IR1 test improved in both groups; however, the distance gain in the HIIT group (EG) was nearly four times greater than that of the control group (+17.1% vs. +4.5%, respectively). This finding highlights the superior efficiency of interval training for developing specific endurance, even in highly trained elite athletes who often face adaptation plateaus.

Statistical Interaction: The ANOVA analysis revealed a significant Time x Group interaction ($F = 12.45$, $p < 0.01$) for the majority of speed-strength tests. This interaction confirms that the observed improvements were specifically attributable to the proposed 8-week HIIT program rather than general training effects or time.

Table 3. Comparative dynamics of performance improvements (%)

Performance Metric	Experimental group (EG)	Control group (CG)	Outcome
RSA Best (Speed)	-4.5% ($p < 0.01$)	-1.1% ($p > 0.05$)	Significant improvement in EG
Fatigue Index (Fatigue)	-23.5% ($p < 0.01$)	-2.8% ($p > 0.05$)	Most prominent progress in EG
Yo-Yo IR1 (Endurance)	+17.1% ($p < 0.001$)	+4.5% ($p < 0.05$)	Superior adaptation in EG

Note: For sprint time (RSA) and Fatigue Index, a negative value indicates performance improvement (reduction in time or fatigue decrement).

Analysis of training efficiency

The data presented in Table 3 highlights a substantial disparity in training efficiency between the two protocols. Explosive speed and game advantage: A 4.5% improvement in RSA best time among professional players is a highly significant outcome. In the context of elite indoor hockey, such a gain provides a critical competitive edge in high-stakes game episodes where explosive speed is decisive.

Aerobic capacity and endurance: the 260-meter increase in the Yo-Yo IR1 test within the Experimental Group (EG) demonstrates a profound enhancement in specific aerobic capacity. This suggests that the players developed a superior physiological foundation to sustain high-intensity efforts throughout the match.

Statistical reliability: in the EG, all performance parameters reached a high level of statistical significance ($p < 0.01$ or $p < 0.001$). This confirms that the observed improvements were not incidental but were the direct result of the implemented HIIT methodology. Conversely, the majority of changes in the Control Group (CG) remained statistically non-significant ($p > 0.05$).

Fatigue management: the EG showed a marked reduction in the fatigue index ($p < 0.01$), a factor that is critical for maintaining technical and tactical efficiency under pressure. Meanwhile, the CG exhibited only minimal gains in aerobic endurance, which may be insufficient for overcoming the adaptation plateaus typical of high-performance athletes.

Dicussion

The primary finding of this study is that a specialized 8-week HIIT program, characterized by short shuttle-run intervals (180° changes of direction), significantly outperforms traditional continuous running in elite female indoor hockey players. These results confirm our initial hypothesis regarding the "time-efficiency" and superior physiological stimulus of HIIT for high-performance athletes.

Anaerobic capacity and sprint performance

The observed 4.5% improvement in *RSbest* and the 23.5% reduction in the Fatigue Index suggest profound adaptations in the neuromuscular and metabolic systems. In indoor hockey, where the court is smaller and intensity is higher than in outdoor field hockey, the ability to perform repeated explosive sprints is paramount.

Our findings align with the research of Buchheit et al., who argued that short intervals (< 30 s) at intensities above 90% *HRmax* are optimal for enhancing the resynthesis of phosphocreatine (*PCr*) and improving lactate buffering capacity. The significant decrease in the Fatigue Index indicates that the athletes developed a higher tolerance to metabolic acidosis, allowing them to maintain technical precision even in the final minutes of a match.

Specific Aerobic Power and the Yo-Yo IR1 Test

The 17.1% increase in Yo-Yo IR1 distance in the EG, compared to only 4.5% in the CG, emphasizes the superiority of intermittent loads for developing aerobic power. This gain is particularly impressive given the elite status of the participants (MS and MSIC), who typically demonstrate a diminished response to training stimuli due to the "ceiling effect."

The use of shuttle runs instead of linear running likely contributed to this success. The constant deceleration and acceleration phases in our HIIT protocol increase the eccentric load and oxygen cost, which more closely mimics the energy demands of an actual indoor hockey game. This supports the findings of Sunderland et al., who noted that sport-specific conditioning leads to better transfer of physical gains to competitive performance.

The "Time-Efficiency" effect and injury prevention

One of the most critical aspects of our intervention was the reduction in total training volume compared to the CG. The "time-efficiency" of the HIIT protocol allowed athletes to overcome the adaptation plateau without the risks associated with high-volume aerobic training, such as overuse injuries. This is a vital consideration for professional teams like MSC "Sumchanka", where the competitive schedule is dense and recovery time is a premium resource.

Limitations and future research

While the results are significant, the study is limited by the small sample size ($n=20$) and the focus on a single elite team. Future research should explore the long-term effects of this HIIT protocol throughout the entire competitive season and its impact on specific technical-tactical efficiency (e.g., passing accuracy under fatigue).

Conclusions

The results of this study demonstrate that the integration of an 8-week HIIT protocol into the preparatory period of elite female indoor hockey players is significantly more effective than traditional aerobic conditioning. The findings support the following conclusions.

The specialized HIIT program proved to be a decisive factor in breaking the "adaptation plateau" typically observed in high-performance athletes (Master of Sport and MSIC levels). While traditional methods showed stagnant results, the HIIT intervention stimulated further physiological development despite the already high baseline fitness of the participants.

The use of short intervals (15-30 s) at intensities exceeding 90% *HRmax* led to a statistically significant enhancement in Repeated Sprint Ability (RSA). This is a critical success factor in indoor hockey, where the game is characterized by high-density explosive actions in a confined space. The most prominent outcome was the 23.5% reduction in the Fatigue Index, which suggests that players can maintain peak velocity and technical precision during the high-pressure final phases of each half.

The 17.1% increase in Yo-Yo IR1 test performance confirms that the specific HIIT protocol effectively develops both aerobic power (*VO2max*) and the efficiency of recovery mechanisms between high-intensity episodes. The use of shuttle runs with 180° changes of direction ensured that the physiological gains were specific to the biomechanical demands of indoor hockey.

The 8-week program demonstrated a superior "time-efficiency" effect, achieving greater performance gains with a lower total training volume compared to the control group. This allows coaching staff to optimize the training microcycle, allocating more time to technical and tactical preparation without risking overtraining or overuse injuries.

Conflicts of interest

The author declares no conflicts of interest.

The author declares that no generative AI or AI-assisted technologies were used in the writing, editing, or preparation of this manuscript.

References:

- Ai, J.-Y., Chen, F.-T., Hsieh, S.-S., Kao, S.-C., Chen, A.-G., Hung, T.-M., & Chang, Y.-K. (2021). The Effect of acute high-intensity interval training on executive function: A systematic review. *International Journal of Environmental Research and Public Health*, 18(7), 35-93. <https://doi.org/10.3390/ijerph18073593>
- Atakan, M. M., Guzel, Y., Shrestha, N., Kosar, S. N., Grgic, J., Astorino, T. A., Turnagol, H. H., & Pedisic, Z. (2022). Effects of high-intensity interval training (HIIT) and sprint interval training (SIT) on fat oxidation during exercise: a systematic review and meta-analysis. *British Journal of Sports Medicine*, 56(17), 988-996. <https://doi.org/10.1136/bjsports-2021-105181>
- Bishop, D. J., et al. (2023). Effects of high-intensity interval training on repeated-sprint ability in team sport athletes: A systematic review. *International Journal of Sports Physiology and Performance*.
- Bonnici, D., et al. (2020). High-intensity interval training in elite female athletes: Effects on aerobic capacity and explosive power. *Journal of Sports Sciences*, 38(14), 1601-1610. <https://doi.org/10.1080/02640414.2020.1754728>
- Buchheit, M., & Laursen, P. B. (2019). High-intensity interval training, solutions to the programming puzzle: Part I: Cardiopulmonary emphasis. *Sports Medicine*, 43(5), 313-338.
- Dohmann, T. L., Hindsø, M., Dela, F., Helge, J. W., & Larsen, S. (2018). High-intensity interval training changes mitochondrial respiratory capacity differently in adipose tissue and skeletal muscle. *Physiological Reports*, 6(18), e13857. <https://doi.org/10.14814/phy2.13857>
- Ekkekakis, P., & Biddle, S. J. H. (2023). Extraordinary claims in the literature on high-intensity interval training (HIIT): IV. Is HIIT associated with higher long-term exercise adherence? *Psychology of Sport and Exercise*, 64, 102295. <https://doi.org/10.1016/j.psychsport.2022.102295>
- Ihsan, M., et al. (2021). Match performance and physical demands of female indoor hockey players. *Journal of Strength and Conditioning Research*.
- Feng, Y., et al. (2026). Breaking adaptation plateaus in high-performance athletes: The physiological role of sport-specific training. *Journal of Sports Science and Physical Efficiency*, 24(1), 45-58.
- Gibala, M. J., & Little, J. P. (2020). Physiological basis of high-intensity interval training: Optimizing the prescription for elite performance. *International Journal of Sports Physiology and Performance*, 15(7), 955-963.
- Gojanovic, B., Shultz, R., Feihl, F., & Matheson, G. (2015). Overspeed HIIT in lower-body positive pressure treadmill improves running performance. *Medicine and Science in Sports and Exercise*, 47(12), 2571-2578. <https://doi.org/10.1249/MSS.0000000000000707>
- González-Mohino, F., González-Ravé, J. M., Juárez, D., Fernández, F. A., Barragán Castellanos, R., & Newton, R. U. (2016). Effects of continuous and interval training on running economy, maximal aerobic speed and gait kinematics in recreational runners. *Journal of Strength and Conditioning Research*, 30(4), 1059-1066. <https://doi.org/10.1519/JSC.0000000000001174>
- González-Mohino, F., Santos-Concejero, J., Yustres, I., & González-Ravé, J. M. (2020). The effects of interval and continuous training on the oxygen cost of running in recreational runners: a systematic review and meta-analysis. *Sports Medicine*, 50(2), 283-294. <https://doi.org/10.1007/s40279-019-01201-x>
- Jiménez-García, J. D., Hita-Contreras, F., de la Torre-Cruz, M. J., Aibar-Almazán, A., Achalandabaso-Ochoa, A., Fábrega-Cuadros, R., & Martínez-Amat, A. (2021). Effects of HIIT and MIIT suspension training programs on sleep quality and fatigue in older adults: randomized controlled clinical trial. *International Journal of Environmental Research and Public Health*, 18(3), 1211. <https://doi.org/10.3390/ijerph18031211>
- López-Sánchez, G. F., et al. (2022). Physical fitness and performance in professional female field hockey players: The role of specific HIIT protocols. *Sustainability*, 14(3), 1542. <https://doi.org/10.3390/su14031542>
- Macutkiewicz, D., & Sunderland, C. (2018). The physiological demands of elite female indoor hockey. *Journal of Human Kinetics*, 64, 209-218. <https://doi.org/10.1515/hukin-2017-0193>
- Olena Otravenko, Olena Shkola, Olena Shynkarova, Valeriy Zhamardiy, Oleksandr Lyvatskyi, Dmytro Pelypas (2021). Leisure and recreational activities of student youth in the context of health-preservation. *Journal for Educators, Teachers and Trainers*. JETT. Vol. 12(3). S. 146-154. Vol. 12 (3); ISSN: 1989-9572146 DOI: <https://doi.org/10.47750/jett.2021.12.03.014>. URL: <https://jett.labosfor.com/>
- Taylor, J. M., et al. (2021). High-intensity interval training protocols in court-based team sports: A systematic review of movement specificity. *Sports Medicine - Open*, 7(1), 88. <https://doi.org/10.1186/s40798-021-00378-0>
- Rabbani A., Filipe Manuel Clemente, Mehdi Kargarfard, Saeid Jahangir (2019). Combined Small-Sided Game and High-Intensity Interval Training in Soccer Players: The Effect of Exercise Order. *Journal of Human Kinetics* volume 69/2019, 249-257 DOI: <https://doi.org/10.2478/hukin-2018-0092>
- Sunderland, C., et al. (2022). Physical and physiological demands of elite female indoor hockey: A comprehensive profiling. *International Journal of Sports Physiology and Performance*, 17(4), 512-525. <https://doi.org/10.1123/ijsp.2021-0340>

- Saucedo Marquez, C. M., Vanaudenaerde, B., Troosters, T., & Wenderoth, N. (2015). High-intensity interval training evokes larger serum BDNF levels compared with intense continuous exercise. *Journal of Applied Physiology* (Bethesda, Md.: 1985), 119(12), 1363-1373. <https://doi.org/10.1152/japplphysiol.00126.2015>
- Slusher, A. L., Patterson, V. T., Schwartz, C. S., & Acevedo, E. O. (2018). Impact of high intensity interval exercise on executive function and brain derived neurotrophic factor in healthy college aged males. *Physiology & Behavior*, 191, 116-122. <https://doi.org/10.1016/j.physbeh.2018.04.018>
- Sunderland, C., et al. (2022). Physical and technical demands of elite indoor hockey: A comparison between positions. *Sports*, 10(5), 72.
- Sunderland, C., et al. (2022). Physiological responses to elite indoor hockey competition. *Journal of Human Kinetics*, 82(1), 125-134.
- Shynkarova Olena, Shynkarov Serhiy, Brusak Oleksandr (2025). HIIT interval training for correction of excess body weight in women of the first period of adulthood. *Olympic and Paralympic Sports*. Issue No. 1, 2025. Sumy State Pedagogical University named after A.S. Makarenko. Pp. 145-150. DOI: <https://doi.org/10.32782/olimpstu/2025.1.27>
- Shynkarova O., Dubovoi O., Mishchenko O., Dubovoi V., Shynkarov S. (2026). Acmeological foundations of the professional competence formation in future physical education and sport specialists. *Moderní aspekty vědy: LXV. Díl mezinárodní kolektivní monografie. Mezinárodní Ekonomický Institut s.r.o.. Česká republika: Mezinárodní Ekonomický Institut s.r.o.*, Pp. 51-73. <https://doi.org/10.52058/65-2026>
- Taylor, J., et al. (2021). The impact of different HIIT protocols on maximal oxygen uptake and anaerobic power in female field hockey players. *European Journal of Sport Science*.
- Yangya Feng Y., Daxin Li, Yangli Liu, Donghui Tang (2026). High-Intensity Interval Training and Moderate-Intensity Continuous Training Affect Running Economy in Endurance Runners: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Journal of Human Kinetics*. volume 100/2026, 113-134 DOI: <https://doi.org/10.5114/jhk/205427>
- Yue, T., Su, H., Cheng, M., Wang, Y., Bao, K., and Qi, F. (2025). High-intensity interval training improves inhibitory control and working memory in healthy young adults. *Journal of Human Kinetics*, 98, 41-56. <https://doi.org/10.5114/jhk/194498>
- Zhu, Y., Sun, F., Chiu, M. M., & Siu, A. Y.-S. (2021). Effects of high-intensity interval exercise and moderateintensity continuous exercise on executive function of healthy young males. *Physiology & Behavior*, 239, 113505. <https://doi.org/10.1016/j.physbeh.2021.113505>