

Ice Hockey Fundamental Technical Skills in Cross-Ice 3-on-3 Game in Comparison to 5-on-5 Game

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<p>Ice hockey is a unique sport played on ice. In order for one to become a hockey player, one must first develop and master the fundamental technical skills involved with playing hockey. Hockey as a sport is rapidly growing and spreading throughout the world, yet still full ice sized ice rinks and ice time is unavailable or limited in many countries and places.</p> <p>The objective of this thesis is to make a comparison of the technical skills used in both 3-on-3 cross-ice and 5-on-5 normal sized hockey games. The 3-on-3 and 5-on-5 format means 3 players play against 3 players and 5 players against 5 players. The focus was to analyze the collected data and present the differences between these two formats.</p> <p>The theoretical basis contains review of both 3-on-3 and 5-on-5 game formats. This thesis also discusses what technical skills are required in ice hockey and the situations where those technical skill appear. Later, the thesis goes into data collection and comparison the skills used in both 3-on-3 cross-ice game and 5-on-5 normal sized games.</p> <p>The data was collected and analyzed on video footage. In total 12 teams and 36 individuals were monitored for the research. The data was gathered from both games formats where teams played in 3-on-3 and in 5-on-5 full strength situations. After, the data was examined, results were derived, and the ratio number was created for the comparison.</p> <p>The results of this study show when the size of the ice surface in ice hockey is reduced, more maneuvers and technical skills are required from individual players. Playing in small areas in 3-on-3 cross-ice hockey showed significant difference of technical skills use during game as compared to the 5-on-5 normal sized hockey game.</p>	
Keywords ice hockey, small area 3-on-3, technical skills, comparison	

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1 Introduction

Ice hockey is considered to be one of the most complex team sports. In order for one to be able to play ice hockey, players have to perform many athletic moves on the ice, especially when the speed of the game is high. To be able to meet the demand of athletic ability, ice hockey players are required to have a good base of fundamental technical skills. (Dosil, J. 2006, 403)

According to the Finnish Ice Hockey Association (International Ice Hockey Center of Excellence), the basic fundamental technical skills are skating, shooting, passing, and receiving. These skills represent the foundation of a player's development, and a player must know the fundamental skills before approaching more complex concepts such as team tactics and strategies. All of the skills are important to master, but from all of them, one of the most important is skating. In early stages of a player's learning, a big emphasis should be on skating because all the other skills in ice hockey rely on a player's ability to skate. For example, players need to master balancing on the ice and must learn the basic stances in order to pass or receive the puck (Valencic 2018, 2).

The International Ice Hockey Federation (IIHF) teaching progression pyramid presented in figure 1 illustrates that in order to play the game, the hockey players must focus on mastering the required fundamental skills. As figure 1 shows, all of the other phases required from players rely on the foundation of the fundamental hockey skills. The listed characteristics in the teaching progression pyramid is interpretable from bottom to top. No difference exists between the skills required to play the game when talking about small ice games.

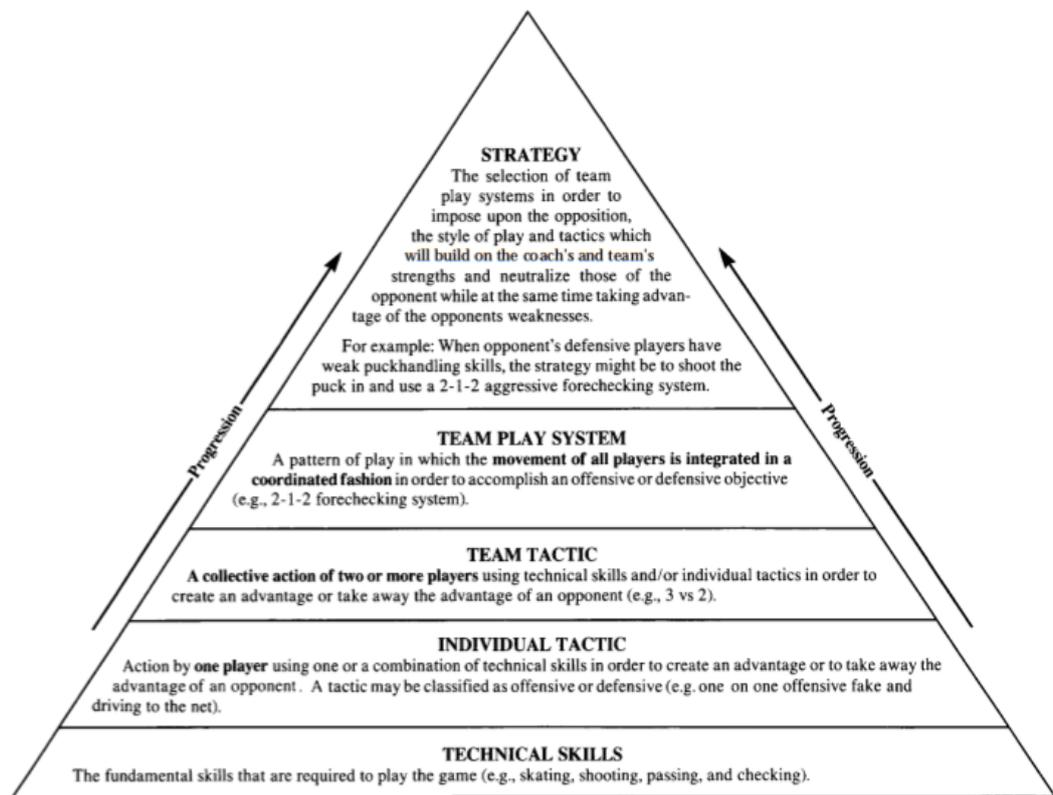


Figure 1. Teaching progression pyramid (IIHF coach development Program, level I, 2007)

In July 2018, IIHF gathered a group to Vierumäki, Finland to test a new competition format: playing 3-on-3 cross-ice games in the 2020 Youth Olympic Games. The working group consisted of nine people: Johan Bollue, Timo Bäckman, Pyry Eskola, Frauke Kubischta, Kevin McLaughin, Aku Nieminen, Kalle Väliaho, Marko Valencic and me, Hunor Marton.

The new format is played on a reduced ice surface with a decreased number of players compared to the ordinary 5-on-5 hockey game. However, the set-up of these two game formats is different from each other. The main principle of the hockey game is the same: whoever scores more goals is considered the winning team at the end of the game. To score goals and play the game well, both games require the same fundamental technical skills such as skating, passing/receiving, and shooting (IIHF Coach Development Program, Level I, 2007).

The small area games are most likely not a new concept for people who play or are familiar with hockey. The small ice games are commonly used by most ice hockey coaches during practices to focus and develop different aspects and skills required in the game.

While keeping these factors in mind, the question becomes whether or not the ice hockey technical skills of the 3-on-3 cross-ice games are the same as in 5-on-5. Further, does reducing the ice surface size and the amount of players have an effect on the technical skills used by players?

A study conducted with football states that by reducing the amount of players and the size of the pitch, an individual's technical skills and actions performed during a game will increase. (Owen, Twist & Ford. 2004, 52)

The idea of this research paper was crafted in conjunction with the IIHF because they wanted more information about playing the 3-on-3 cross-ice game format and how the 3-on-3 game supports the use of technical skills of the players in comparison to the 5-on-5 game. As mentioned previously, the 3-on-3 format requires the same technical skills of the game as the 5-on-5 format. With that being said, the skills used in 3-on-3 formats can be later implemented and utilized in 5-on-5 normal sized games.

The objective of the thesis was to compare the individual player's technical skills involved in normal sized 5-on-5 hockey and 3-on-3 cross-ice game format. This paper will provide information about the amount of the technical skills used in both formats of the game and portrays a comparison between these two.

In this thesis the data was collected and analyzed from recordings of repetitions of the technical skills used by an individual in both game formats.

The results collected from 3-on-3 cross-ice game were compared with the results collected from 5-on-5 normal sized ice hockey game. The conclusions derived from the results will indicate whether or not the repetition of the technical skills appear more often during 3-on-3 cross-ice game or playing 5-on-5 normal sized games.

With more repetitions, we can assume that the development of technical skills will be increased and possibly accelerated, but further research will be required.

This research shows that by playing the cross-ice 3-on-3 game, one can increase the use of technical skills per player in the game compared to 5-on-5 regular game. While playing small-ice games, players will not only have a lot of fun, but also their involvement in the game will be higher and the number of shots and time of possession of the puck will increase.

Playing the 3-on-3 cross-ice format is a valuable tool for everyone. This is especially true for people living in countries where the amount of the ice time is limited or normal size ice sheets are unavailable.

2 Ice hockey as a game

The history of ice hockey begins more than 100 years back in time, and the origin of the first organized hockey game was debated until in 2008. In that year, the International Ice Hockey Federation (IIHF) officially recognized that the first systematic ice hockey game was played on 3rd of March, 1875 in Montreal Canada. (Stanley, Fischler & Eskenazi 2020; Martel, J-P. 2019.)

Since that time, ice hockey has evolved tremendously. In 1920, hockey made its first debut in Summer Olympic Games and later became a Winter Olympic event in 1924 for men. Women joined the winter Olympic games later on in 1988. From its first appearance, ice hockey has been a part of all international events organized by the International Ice Hockey Federation. (Ice Hockey at the Olympics, s.a.)

According to Bellis (2019.), nowadays ice hockey is the most popular winter sport played on ice in the world. This supports the fact that ice hockey has been growing and expanding over decades. Today, the International Ice Hockey Federation (IIHF) consists of 81 member national associations. As a governing block, the IIHF main function is to spread and develop ice hockey throughout the world. (IIHF-Associations. 2020.)

Today, ice hockey is usually played inside a rink on an artificial ice surface that has the shape of a rectangle with rounded corners. The playing surface itself is divided into three different zones as listed below and illustrated in figure 2.

1. Defending Zone
2. Neutral Zone
3. Offensive Zone

The end zone of a playing area where a team tries to score goals and points is defined as the attacking zone or most commonly named the offensive zone.

The other end of the surface where the same team tries to prevent the opposing team from scoring goals is called the defending zone or defensive zone. The zone in the middle between the two blue lines is known as the neutral zone.

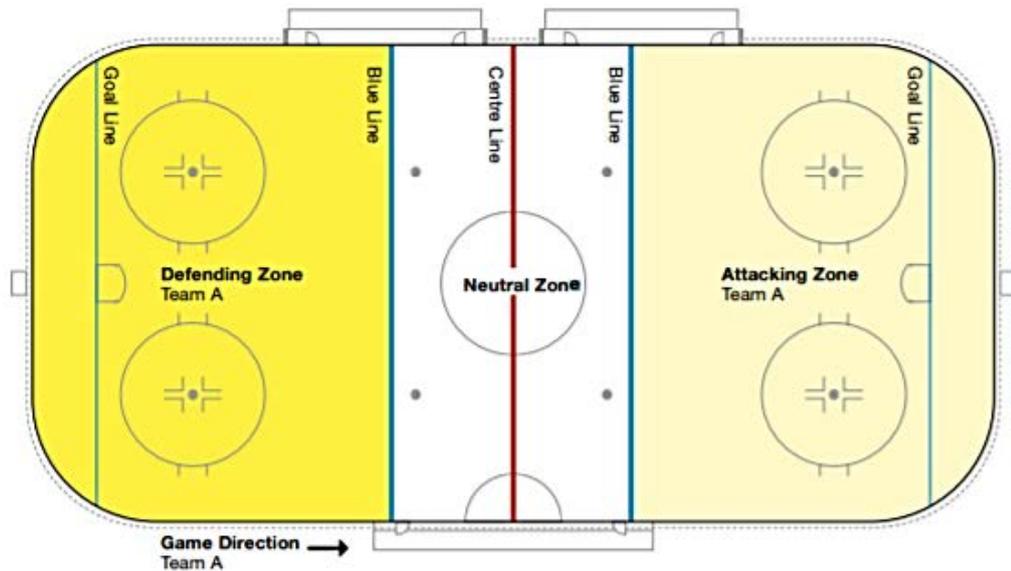


Figure 2. Ice hockey rink (adapted from IIHF 2019, 25)

During an ice hockey game, two teams are competing against each other. In a full strength game, (5-on-5) both team have six players on the ice at once, five normal players and one goaltender. The teams in total each consist of 21 players.

A hockey game entails 60 minutes of actual playing time, which is broken down into three 20 minutes periods with clock stoppages and two intermissions in between the periods. Clock stoppage happens for a variety of reasons including when the puck is no longer in play, the goaltender freezes the play by holding the puck, or after a team scores goals et-cetera. After each 20 minute period of playing time, a 15 minute intermission follows. The intermission is used to re-surface the ice with a machine called a Zamboni. During this time, the teams go back to their locker-room and rest or prepare for the next period of play. When the first intermission is over, the second 20 minutes of playing time called second period begins. Once the second period comes to an end, the second intermission occurs followed by the third period. If, after 60 minutes of standard playing time, the score between the two opposing teams is still tied, an additional over-time period takes place. Depending on the style of play, the over-time period can last anywhere from 5, 10, or 20 minutes. During an international event, teams play by the rules dictated by the IIHF. The preliminary round of games are played with a standard 5 minutes over-time like the National Hockey League (NHL). In the quarterfinals, semi-finals, and bronze medal games, the over-time played lasts 10 minutes if the game is still tied after the third period. In gold medal games, however, the over-time period lasts 20 minutes. (Steiss 2018.)

In the over-time period, teams play sudden death, which means whichever team scores the first goal during the over-time period wins the game. If none of the teams manage to

score, a penalty shootout takes place. The penalty shootout consists of 3 or more shooters who each have the opportunity for a one-on-one breakaway against the opposing goalie. The team who scores the most goals in the shootout wins the game. (IIHF 2019.)

The objective of an ice hockey game is to score more goals than your opponent while preventing the opponent from scoring. The team who scores the highest number of goals is declared as the winner. A goal is scored when either of the teams put the puck in the opposing team's net. The puck must entirely cross the red goal line in between the poles of the net, which are located at both ends of the ice surface.

In practice, the team who controls the puck plays offence with the primary goal of scoring. The other team who does not have control of the puck plays defense, with the primary goal of preventing the opposing team of scoring by protecting their own net. Similarly, in order to succeed, both teams try to attack and take advantage of the opponent's flaws in principal to score. On the other hand, in order to prevent the attacking team from scoring, teams put their focus on eliminating the opponent's strengths or talented players from scoring. (Westerlund in. Mero et al. 1997.532)

Additionally, for a player to achieve the above mentioned objectives in a game, the most important asset for that hockey player is his or her playing skills, which includes mastering the technical skills and game sense. (Arjala,Petäjä. 2013.)

3 Skill Development

The Composite Youth Development (CYD) model's main focus is physical and psychological development, and the model provides a framework for illustrating on which stage is a particular individual. The development for youth can be separated into three stages: the sampling years when children are between 6 to 12 years old, the specializing stage for youths aged 13 up to 15, and the investment stage which comes for youths 16 years of age and older. Lloyd (2015.) states that skills can be divided into two primary developmental stages: the fundamental movement skills and the sport specific skills. (Lloyd, Oliver et al. 2015)

At the early stages, children need to master the basic fundamental movement skills with the primary focus on providing an environment where children can play multiple sports and games. The result of which gives children the experiences from a wide range of movement and prepares them by developing an active lifestyle. (Lloyd, Oliver et al. 2015)

It has been already proven that the fundamental movement skills, which can be categorized into three groups, are some of the most important skills for a child to acquire in order to succeed in any sport and to make progress in developmental stages. The following categories include the fundamental movement skills:

1. Balance
2. Locomotor Skills
3. Ball Skills

These categories include the activities such as running, jumping, hopping, catching, throwing, kicking and galloping. (FMS 2019.) Players should first acquire the basic fundamental movement skills before moving into sport specific skills to achieve their full potentials. (Physiopedia 2019.)

Childhood is an indispensable time period to encourage children to do variety of different sports and develop the fundamental movement skills. Childhood also prepares athletes for learning and mastering more advance and complex skills later on. Once the fundamental skills are mastered, sport specific skills can be introduced. Without a good base of fundamental skills, it is very difficult to learn and develop sport specific skills (Lloyd, Oliver et al. 2015., Brewer 2017. 3). Fundamental movement skills can be learned and developed without knowing about sport specific skills. Sport specific skills, however cannot be learned without pre-acquired fundamental movement skills. (Aalto & Rähkä 2012).

Mastering these two skills opens a development path to learn new sports and help athletes to reach their full potential and live active lives. (Lloyd, Oliver et al. 2015)

At this early stage of development, using small-sided games helps the athletes learn how to play sports, develop their game sense, and teaches them to be creative at problem solving in certain game situations. (Balyi, Way et al. 2013, 211)

3.1 Technical Skills

As with any other sport, the most important element a player needs to master in order to play ice hockey is the fundamental skills: skating, passing/receiving, shooting etcetera. If an athlete builds a good foundation of fundamental movement skills in the early stages such as running, throwing, jumping and balancing in a number of ways, then he or she lays the foundational building blocks to have considerably improved skills for push, glide and balance on the ice. These foundational building blocks then helps athletes to learn other hockey skills, such as puck control, checking and shooting. (Parker, S. 2017)

The International Ice Hockey Center of Excellence divides the on-ice technical hockey skills into four categories: skating, puck handling, shooting, and passing/receiving. All players need to acquire these four hockey-specific technical skills to advance their game tactics and game perception. (International Ice Hockey Centre of Excellence 2009)
In the following chapters, these different ice hockey skills are explained in more detail.

In Canada, a development pyramid with a comprehensive coaching orientation was created with different sections focusing on the player's path (see Figure 3). This pyramid provides a framework for coaches, develops a practical plan, and emphasizes how to create a seasonal plan. By creating a plan, the development pyramid provides an approach to deciding which age categories should have more emphasis on certain skills.

Player Development in Canada's recommendations for drills and emphasizes on different ages are the following: initiation age groups 85 % focus on technical skills and 15 % of individual skills. Individual player skills will be explained later on this paper. For novice age groups, Player Development recommends 75% focus on technical skills, 15% on individual skills and 10% on team tactics. As the age groups change and players get older, so does the emphasis on the practice. (Ontario Minor Hockey Association 2015)

Figure 3 illustrates the foundational block of progression in early stages, and the biggest emphasis is on fundamental technical skills throughout development. Once a player perceives how the foundation climbs as illuminated in figure 3, the player can work towards approaching the apex of the development triangle to enhance his performance. High priority goes from the bottom up and not inversely. (Weiss 2011)

Fundamental technical skills, skating, puck handling, shooting, passing and receiving are the foundation of each player's success. (Ontario Minor Hockey Association 2015)

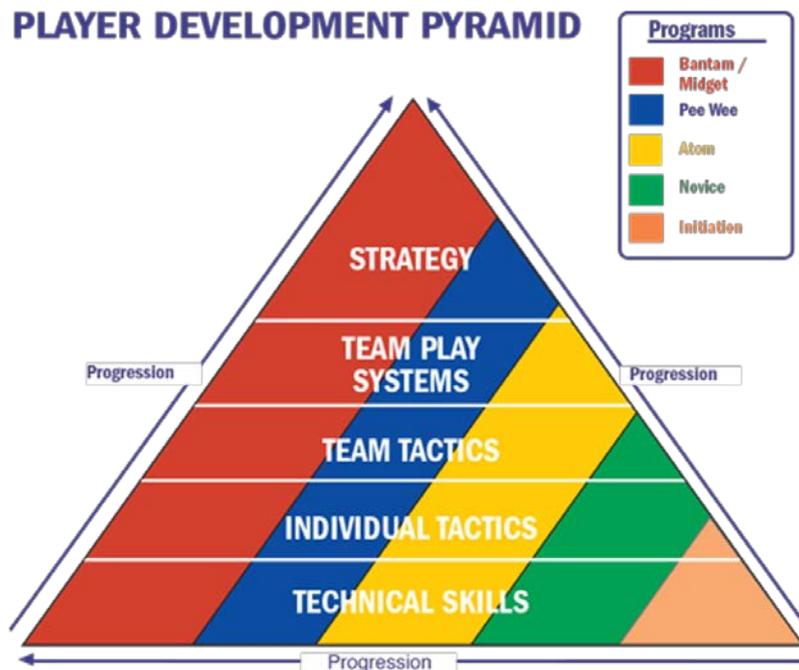


Figure 3. (modified from Ontario Minor Hockey Association 2015)

In ice hockey, players will need these basic technical skills, regardless of gender or age. Technical skills are not just the foundation to one become a hockey player, but also the requirements for further development. The progression and development prepares athletes to master the individual tactical skill. The combination of learning the skills and team tactics will lead the player to acquire team vision and strategy.

According to the International Ice Hockey Federation (2011.), technical skills can also be divided into two groups: offensive technical skills and defensive technical skills. Offensive technical skills are usually the skills performed when player carries the puck: skating, shooting, passing/receiving, puck control, fakes, blocking. (Westerlund in, Mero et al. 1997, 536). Defensive technical skills are performed against the puck carrier and non-puck carriers: skating, shot blocking, stick checking and body checking. (Westerlund in, Mero et al. 1997, 536).

In figure 4, the grey header illustrates the fundamental technical skills in ice hockey, and in the columns below, the table displays the skills needed to invest time in order to enhance skating skill, puck control skills, shooting, passing/receiving and body contact.

Figure 4. Technical Skills (Modified form Hoff 2018, USA Hockey Skills Progression Handbook).

Skating	Puck Control	Shooting	Passing/Receiving	Body Contact
Forward	Movement	Wrist Shot	Forehand	Angling
Backward	Protection	Slap Shot	Backhand	Tackle
Turns		Backhand Shot	Using Skate	Stick Check
Stops and Starts		One-Timers	Using Glove	

3.1.1 Skating

Because ice hockey is known to have the fastest tempo in team sport, learning and mastering the fundamentals of correct skating is essential (Pavlis 2003).

What really describes ice hockey is endurance, agility, and speed where players can reach up to 60 km/h and the puck can reach speeds up to 190 km/h. (Ron.C.Judd 2009).

From the above mention skills, skating is the most important skill to master because a player has to be able to skate well in order to execute more advanced ice hockey skills with high proficiency. Without strong fundamental skating skills, you cannot play hockey to your optimal level (Hockey Canada.2018.6).

Players in all positions: forwards, defensemen, and goaltenders are required to master proper skating. Without a good foundation of skating skills, one player will be limited when attempting to perform other skills such as shooting, passing or puck handling. In other words, these skills are related to and build upon one another for the purpose of player development. Effective skating is the best way to get from point A to point B as fast as possible with or without puck possession, and it also improves one's game. Players who are able to skate properly have an advantage over others to execute in more complex actions like winning 1-on-1 situations or getting open to create a passing line to his teammates. In order to achieve developmental goals in skating, players must attain three important concepts that will help one's ability to perform and be a better skater: glide, drive, and thrust. (Davidson, MacLean 2010) There is a lot of emphasis on skating skills, especially in the

early stages of development for an athlete. This emphasis on skating is confirmed by the Hockey Canada Skill Development (2019) who recommends that skating drills and skating improvement should be part of all practices and followed throughout a player's profession.

3.1.2 Shooting

Every hockey player has the dream of scoring goals, putting his team in an advantageous position, or scoring a winning goal. When it comes to practice, all player regardless of age category want to have the puck and have a couple of shots on the net. Shooting is fun and makes players happy. It is a fact that without shooting, normally one cannot score. As one of the greatest hockey players of all time, Wayne Gretzky, said : "You miss 100 percent of the shots you never take" (NHL, WHA 2020). Wayne Gretzky still holds the top position of the most goals scored of all time in the National Hockey League (NHL).

Shooting, like skating, is a basic hockey skill that all players need to master during their early stages of development, and it takes a lot of time to become a good shooter. Shooting is an important part of the game, and if a player wants to become a professional, then he needs to master two important factors that will help him become proficient with shooting: speed and accuracy. (Turku 2019)

There are various ways to shoot the puck, and the list shown below includes the basic 7 types of shots that are used to score goals (Shooting and Scoring Skill Development 2020a):

- Wrist shot
- Snap shot,
- Slap-shot,
- Backhand shot,
- One-timer,
- Flip shot,
- Tip-in.

Returning to speed and accuracy involved in shooting, generally, the faster the shot, the more difficult it is for the opposing players to block. A faster shot also makes the goal-tender's job even more difficult to catch the puck or make a save, which puts the shooter in a great advantage when shooting with speed and accuracy to score goals. However, releasing a fast shot is not always enough because the shooter also needs to put the puck

on target. So perhaps accuracy is even more important for a shooter to become an efficient goal scorer. (Ice Hockey System 2019)

As with all skills, mastering the fundamentals and getting familiar with the different types of shooting abilities is necessary before one can use it effectively in an actual game situation. (Lundberg 2015)

3.1.3 Passing and Receiving

In ice hockey, passing and receiving play a big role in creating space and assembling an effective offensive situation. While the game is played at high intensity, it is critical for players to master these skills in order to pass and receive the puck in fast-moving tempo. However, selecting the most convenient skill and asset is relative to the situation. (Lundberg, 2015)

There are various passing and receiving types, but essentially the two basic and most commonly used are forehand and backhand. On the other hand, depending on the situation, other types of passing and receiving can be used as well like receiving with skate, flip pass, and sweep pass. (Lifetime Hockey 2015)

Learning these methods thoroughly can effectively increase a player's ability to create chances for successful situations. For a player to pass the puck to desired target effectively, it is essential to pass blade-to-blade or most commonly used tape-to-tape pass. Before the pass is released from one player's stick blade, the puck carrier should read the situation and be aware of the receiver's stick position. The player should also determine whether the target player's stick blade is right handed or left handed because the easiest way to receive the pass is if it comes to the forehand side of the receiving player. (Ice Hockey System 2019) Excellent passers can complete hard tape-to-tape passes and receive the puck with both sides of the stick blade while skating at high tempos. (International Ice Hockey Centre of Excellence).

3.1.4 Checking

Checking is also a critical part of an ice hockey game. A proper check can help to create offensive situations or even give an advantage to regain puck possession. Just like other skills that were mentioned previously, checking is also a skill that requires progressive steps to learn and master (Rausch, 2019).

Checking can be divided into four progression stages:

1. Positioning/Angling
2. Stick Checking
3. Body Contact
4. Body Checking

Positioning and angling rely a lot on a player's ability to skate well. When one performs angling, timing, body position, and stick position are very important to learn in order to minimize the opponent's time and space without making contact.

Mastering angling skills will help one defend their net by forcing the opponent away from the center of the ice usually towards the boards. Angling a player towards the boards could also lead the defending team to regain the puck possession by forcing the puck possessor to lose control. (Hockey Canada 2019a)

Performing a stick check demands good situational reading, timing, and positioning from players. When stick checks are made properly, it can help one's team to delay the opponent's attack. Stick checks can force the adversary to lose possession of the puck and allow the other team to regain control of the puck. Stick checks can be beneficial especially when defenders play in 1-on-1 situations against the puck carrier. (Hockey Canada 2019b)

The third step in checking progression is body contact. Once a player positions himself for correct angling while using his stick to pressure the opponent, the next step is force body contact and gain possession by physically separating the puck carrier from the puck.

The final step in this checking progression is body checking. The purpose of body checking is to stop the attacking puck carrier and to separate him from the puck. To perform a good body check a player needs to master all three steps of the progression mentioned before. (Rausch, 2019)

3.2 Individual Tactical Skills

As soon as players manage to learn and master their basic fundamental skills, they can move on towards learning individual tactical skills. This progression step is shown in figure 3 in the player develop pyramid. Once one can perform the basic technical skills and feels comfortable on the ice, individual tactical skills can be introduced while maintaining a similar level of focus on technical skills. (Ontario Minor Hockey Association 2015)

These principles of the game can be separated into two different categories (IIHF Coach Development Manual, Level I, 2007):

1. Individual Offensive Skill
2. Individual Defensive Skill

Players who obtain a mastery of all fundamental skills at a high level will most likely succeed and perform individual tactical skills much more fluently. In other words, individual tactical skills are when an individual uses the combination of the learnt fundamental ice hockey skills to highlight the opposing team's weaknesses and to create advantages against them based on the given game situations. Tactics refers to the strategies used depending on if a team is either playing offense or defense. (IIHF Coach Development Manual, Level I, 2007)

Developing and properly learning these skills will help an individual succeed, and it prepares one to progress towards excellence and mastery of the upcoming skills such as team tactics, systems, and strategy. The development pyramid (2015) shown in figure 3 suggests that all related skills and steps need to be completed and learned gradually, from the foundation to the top and not the other way around. (Ontario Minor Hockey Association 2015)

3.2.1 Individual Offensive Skills

The objective of individual offensive play is to create an advantage for one's team by producing various scoring opportunities. A team is able to play offence while occupying the puck, or they are close to re-gaining possession of the puck. Therefore, it is crucial for an individual to have a good variety of technical skills from which he can choose for the right time and situation during the game. (IIHF Coach Development Program, Level I, 2007)

The following technical skills are used when an individual plays offence:

- Skating
- Shooting
- Passing and Receiving
- Puck Control
- Fakes
- Blocking

According to IIHF Coach Development manual (2007.), applying one or combination of these technical skills will boost an individual's actions, which could improve the team's offensive opportunities. (Teaching Player Roles, s.a.)

Figure 5 presents skills with and without puck possession that maximize one's offensive tactics. (IIHF Coach Development Program, Level I, IIHF 2007)

LEVEL I
Individual Offensive Tactics
<p style="text-align: center;">Attacking One-on-One</p> <ul style="list-style-type: none"> • Skating Fakes • Body Fakes • Shooting and Passing Fakes • Driving to the Net • Walkouts <p style="text-align: center;">Shaking a Defender One-on-One</p> <ul style="list-style-type: none"> • Turn-up • Delaying • Protecting the puck <p style="text-align: center;">Screening (Without the Puck)</p>

Figure 5. Based on (Individual Offensive Tactics, IIHF Level 1 Manual, IIHF 2007)

3.2.2 Individual Defensive Skills

When players are in a defensive position, they need to react and read the situation to defend their own net and win the puck back as soon as possible. This skill allows them to quickly transition from a defending position to an offensive situation. (Hockey Circles 2018)

The objective of an individual in a defensive position is to take away the time and space of the attacking offensive player by forcing the opposing players to positions on the ice where it is difficult for them to score, usually outside from the central ice slot area in front

of the net. When players are in defensive positions, they need to read and react to the situations with speed. In order to have success defensively an individual needs to use their technical skills to prevent the attacking team for scoring or creating scoring chances. (Individual Tactics, IIHF 2010)

The following technical skills are used when an individual plays defense:

- Skating
- Blocking Shots
- Stick Checking
- Body Checking

Applying one or a combination of these technical skills will increase a team's defensive play and performance, which can lead to winning the possession back and create attacking opportunities. (Kingston 1994)

Figure 6 introduces the skills used when teams are in defending positions:

LEVEL II Individual Defensive Tactics
Attacking One-on-One <ul style="list-style-type: none">• Positioning• Closing the gap• Body Contact
Defending the Opponent in the Defensive Corner <ul style="list-style-type: none">• Positioning• Closing the gap• Body Contact
Defending Along the Board <ul style="list-style-type: none">• Pinning
Back-checking

Figure 6 Based on (Individual Offensive Tactics, IIHF Level 1 Manual, IIHF 2007)

4 Game Situational Roles and Priorities

In the following chapter, two different description methods for the game of ice hockey are presented. Ice hockey is played with priorities and game situational roles.

During an ice hockey game, the main objective is to score more goals than the opponent does. In order to score goals, one's team needs to have possession of the puck. When a team does not have the puck, they play defense with the primary objective of protecting the net and getting the possession of the puck back. Situations when a team gains back the puck possession are called transitions. In ice hockey, transitions occur a lot throughout the entire game.

Transition refers when a team loses the possession of the puck and the team must change from offence to defense or vice-versa. (Shorey 2004)

A team on offence who loses the puck and transitions to defense can regain back the puck possession with numerous ways. Once an individual loses the puck, they require skills such as intercepting a pass, lifting, and stealing the puck from the opponent's blade (Saarinen 2009, Beashel, Taylor & Anderson. 1995).

During an ice hockey game, players need to be aware of and adapt quickly to the changing situation from offense to defense or from defense to offense.

According to Garner (2019), reading and reacting, also known as hockey sense, is indispensable for hockey players. Furthermore, hockey sense increases their awareness and creativity, which can be applied during the game.

Players interpret game situations based on their own experiences. They will make their decisions on how to react based on their training and fundamental skills. Whoever has possession of the puck establishes what roles the others on the ice will play.

In ice hockey, the game is played based on four game situation roles (Westerlund 1997, 536 & Swint 2006):

1. Offensive Player with the Puck
2. Offensive Player without the Puck
3. Defensive Player Defending Puck Carrier
4. Defensive Player Defending the Non-Puck Carrier

Each game situation roles have objectives that can be put in to action by utilizing the skill sets that each individual has developed. The players have acquired these technical and tactical skill sets during practices and training. (Developing Hockey Sense, IIHF 2008)

The situational roles are determined by a team depending on if they are playing offense or defense. During these situations, an individual will execute and play in one of these game situation roles. (Westerlund 1997, 536 & Swint 2006)

The following objectives characterize the different game situation roles (Developing Hockey Sense, IIHF 2008):

1. Offensive player with the puck – the 1st Attacker (Role 1)
 - Creating pressure on the opponent's net
 - Creating space and passing opportunities to his teammates
 - Shooting at the net
 - Give and go
 - Staying with the puck and challenging the opponents defender

2. Offensive player without the puck – 2nd, 3rd, 4th and 5th Attacker (Role 2)
 - Creating width and depth
 - Maintaining the balance of attack
 - Creating a passing option
 - Supporting the puck carrier

3. Defensive player, defending the puck carrier – 1st Defender (Role 3)
 - Making pressure and winning the puck back
 - Taking away time and space
 - Preventing shooting
 - Moving within a stick contact range and preventing the passing options
 - Staying in the play

4. Defensive player, defending the non-puck carrier – 2nd, 3rd, 4th and 5th Defender (Role 4)
 - Being active and moving
 - Readiness to support and attack
 - Position depends on the puck position and how threatening one's player is
 - Observing and communication with other teammates is key

According to Rautakorpi (2010) and Stan Van Gundy (Corp 2014) ice hockey is played with priorities. In each situation, players need to be aware of the priority of that specific situation. The priorities are based upon when an individual player makes a decision, which helps the team's strategy.

Priorities can be divided into two sections: offensive and defensive priorities.

Priorities change throughout the whole game depending on what situation an individual player finds him or herself in.

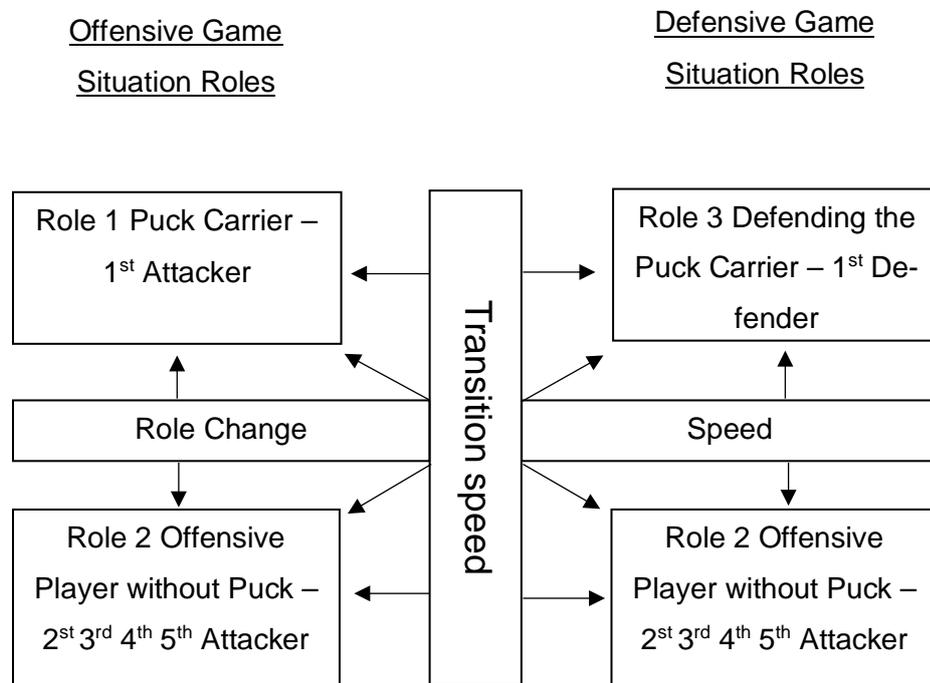
The following list will provide what priorities are supported in certain situations.

Offensive priorities: scoring, winning space, creating space, preparedness for transitioning to defense.

Defensive priorities: preventing the opponent from scoring, stealing the puck, preventing the opponent to win space, and preparedness for transitioning to offence (Rautakorpi 2010,).

In conclusion, game situational roles and priorities are two different concepts, but, as listed in figure 7, their objectives are similar.

Figure 7 represents the relationship between game situational roles and priorities (Developing Hockey Sense, IIHF 2008):



Priorities

- Scoring
- Winning Space
- Creating Space
- Preparedness of Defense

Priorities

- Prevent from Scoring
- Stealing the Puck
- Prevent the opponent to win space
- Preparedness of Offence

Figure 7, Game situation roles and priorities (adapted from Developing Hockey Sense, IIHF 2008)

5 Small Area Game

Small-area games, also known as small-sided games (SSG) are commonly used, and recognized in all ball games. Additionally, as the name indicates, small-area games are game-like drills or activities played on reduced ice surface. These small area games are most typically played at one end of the rink and are more broadly known as cross-ice games. (Small Area Games, IIHF 2007 & Cross-Ice Game Manual, IIHF 2020)

Small-area games are created so players can easily utilize their individual skills while also learning and trying out new skills.

The best format for a player to practice in and implement his skills are the cross-ice games. Moreover, the small cross-ice games are designed to mimic the situations happening during an actual full-ice game (Ice Hockey System 2019). Some small-area games are played in an even smaller area. For example, they could be played in an isolated corner of the ice surface as 1-on-1 or 2-on-2 game. They could also be set up between the two blue lines as 4-on-4 game.

The use of the ice depends on the skills that need to be practiced and taught through that particular small area game. (Grillo 2010)

The International Ice Hockey Federation (IIHF) has also implemented and used the cross-ice format for the first time as an international event in the 2020 Winter Youth Olympic Games in Lausanne. (IIHF - 3-on-3 hockey a hit, 2020)

The dimensions of a cross-ice hockey game were based on an international sheet of ice with a length of 60.0456 meters (197 feet) and a width of 29.99232 meters (98.4 feet).

The game is played on the ice surface at each end of the ice in between the blue line and the goal line and the side boards which stand for 22.86 meters (75 feet) long and 29.99232 meters (98.4 feet) wide, with an open space in the middle line (in neutral zone)(See figure 8 and 9). (Davidson 2018)

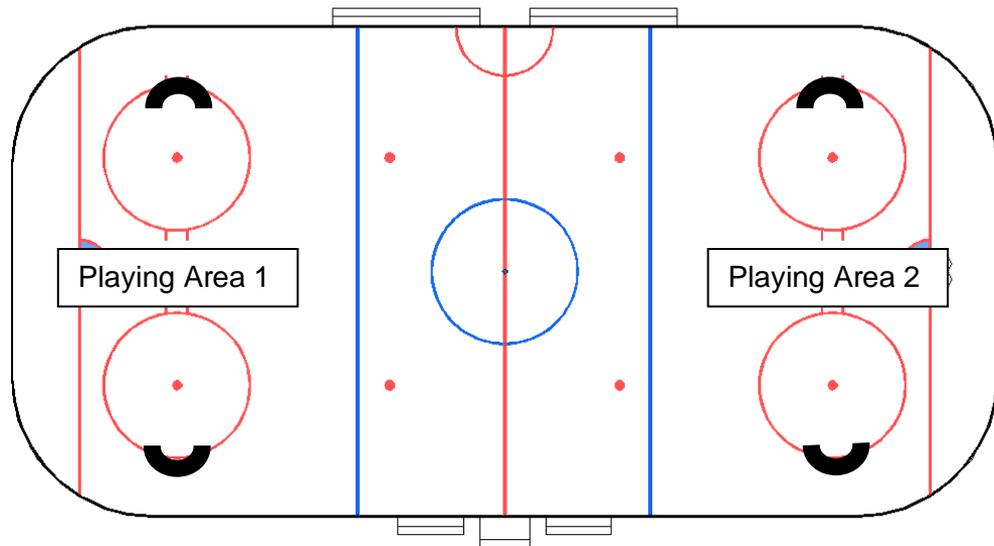


Figure 8. Cross-ice format set up on the hockey rink.

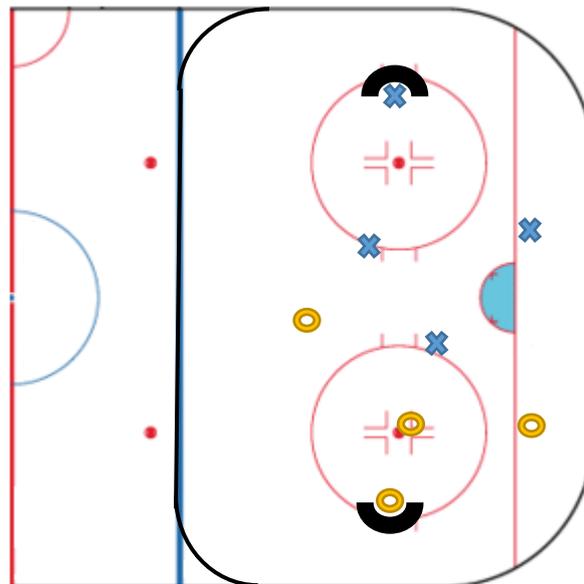


Figure 9. Cross-ice game set up in the zone.

Small area ice hockey games are not a new thing. Small area games actually existed for as long as the game has been played. These games that are played with reduced players then the normal hockey game can vary from one to four players.

In this study, we will have a closer look at the 3-on-3 cross-ice game, but before that we must expound upon why small area games are so important not just in youth level but also for professionals.

Small area games are fun to play, and coaches all around the world implement them into their practices. It does not matter if we talk about a 6 year old hockey player who is just learning and experiencing the game or a professional adult player, everybody can benefit from small area games. (USA Hockey 2014)

Cross-ice hockey metaphorically allows the game to be the teacher. With the reduced ice surface, players are forced to protect the puck in smaller places promoting faster decisions and more creativity. While these games are a smaller version of the normal 5-on-5 games, players continue to want to score creating competitiveness and increases the intensity of the game. (Davidson 2018)

Scientists all around the world agreed that small area games help one's development in long term. (Monette 2018a)

The following list provides some of the skills used during a small area game:

- Skating
- Shooting.
- Passing/Receiving
- Transitioning

A study made by small sided football games indicated that adding players to a small-sided game increased the use of technical skills but decreased the total number of technical actions per player. These results explained that varying the numbers of players in the same game can increase the technical demands of the game. For example, instead of playing 4-on-4, reducing one player from each team requires more technical skill use by each individual in a game. (Owen, 2004, 4)

Another football study showed that in addition to increasing passes, goals, and shots at the same time they found an escalation of the number of tackles and ball dribbles (Katis & Kellis 2009).

Small area games are highly recommended for incorporation into every day practices. (Hockey Canada s.a.) Using small area activities or games during a practice time even with a large amount of players will increase the activity level of individuals and will provide a larger amount of repetition per individual. (Davidson 2018)

5.1 Pond Hockey

Since hockey has existed, players have played ice hockey on frozen ponds and lakes. Those games are not played on an enclosed artificial ice surface with boards measuring 60 x 30 meters. Instead people play in small area games usually without any rules or referees included. During these pond hockey games, players deliberately develop and further their individual skills and they do it with fun. (Small Area Games IIHF 2007)

In pond hockey, it does not matter the skill level or age differences of the participants, the main focus is to play the game and to have fun.

In pond hockey, not only are the rules modified, but also the amount of equipment is reduced.

Compared with a normal 5-on-5 hockey game where the game is played with rules, referees, and full equipment, pond hockey is easily played with only a helmet, a pair of gloves, a pair of skates, and a puck.

The 3-on-3 small area game, on the other hand, is played with full protective equipment, and only the rules are adjusted. (Burke 2013) Many of the game's biggest players describe pond hockey as one of the best teachers and played a large part of their successes growing up as a hockey player (Why Cross Ice Hockey 2014)

Who else would have been a better example than one of the greatest players who ever played the game, Wayne Gretzky. Gretzky learned and improved his skating, shooting, and stickhandling skills on the on a small ice sheet that his father built for him in his backyard when he was six years old. In his childhood, he spent hours on this homemade ice rink developing his skills in addition to playing a multitude of other sports during his summer breaks, which helped him to become the greatest player ever in hockey history. (Gretzky 2015)

6 Comparison of the rules of 3-on-3 and 5-on-5 games

Both games, 5-on-5 and 3-on-3 cross-ice, are played on the ice surface with players wearing full equipment with the primary objective of scoring more goals than the other team does.

However, there are still differences between the different game formats.

As previously mentioned, a normal sized ice hockey game is played on the 60 meter long and 30 meters wide ice surface while the 3-on-3 small area game is placed usually in one end of the rink with a size of 30 meters long and 23 meters wide. (IIHF 2019)

Not only are the dimensions of the ice surface reduced in 3-on-3 cross-ice game compared to 5-on-5, but also, as the name of the two formats indicate, the amount of players are lessened. While playing in full strength in normal 5-on-5 ice hockey, both teams have five players and a goaltender on the ice at a time.

During the cross-ice 3-on-3 ice hockey, that number decreases and both teams have only three players and a goaltender on the ice.

How players change or substitute on and off the ice during play also makes a difference between these two game formats.

During 5-on-5 hockey, players can change with players on the bench by themselves while play ensues. This style of changing or substitution is known as changing on the fly. Shifts of players are also usually balanced between 30 to 40 seconds long before a change occurs. (Jones 2020)

Going further to 3-on-3 cross-ice game, the rules about player's changes are after the puck is dropped at the beginning of the game a buzzer will signal the players to change every 60 seconds creating even 60 second shifts. Not only the players but also the goal-tenders can change as well after every 8 minutes of the game. This rule provides players the same amount of ice time, and players will be able to play and be on the ice with the same skill level players according to skill level match ups. For example, the 1st line players always play against the 1st line players, 2nd unit players with the other 2nd unit and so on. (IIHF Cross-Ice, 3-on-3 Game Manual, 2020)

Example of the line rotations:

1 st Period			2 nd Period			3 rd Period		
Shift	Line	Players	Shift	Line	Player	Shift	Line	Player
1	3	GK, 8, 9, 10	17	2	GK, 4, 5, 7	33	1	GK, 1, 2, 3
2	2	4, 5, 6	18	1	1, 2, 3	34	3	9, 10, 11
3	1	1, 2, 3	19	3	8, 10, 11	35	2	5, 6, 7
4	3	8, 9, 11	20	2	4, 6, 7	36	1	1, 2, 3
5	2	4, 5, 7	21	1	1, 2, 3	37	3	8, 9, 10
6	1	1, 2, 3	22	3	9, 10, 11	38	2	4, 5, 6
7	3	8, 10, 11	23	2	5, 6, 7	39	1	1, 2, 3
8	2	4, 6, 7	24	1	1, 2, 3	40	3	8, 9, 11
9	1	GK, 1, 2, 3	25	3	GK, 8, 9, 10	41	2	GK, 4, 5, 7
10	3	9, 10, 11	26	2	4, 5, 6	42	1	1, 2, 3
11	2	5, 6, 7	27	1	1, 2, 3	43	3	8, 10, 11
12	1	1, 2, 3	28	3	8, 9, 11	44	2	4, 6, 7
13	3	8, 9, 10	29	2	4, 5, 7	45	1	1, 2, 3
14	2	4, 5, 6	30	1	1, 2, 3	46	3	5, 6, 7
15	1	1, 2, 3	31	3	8, 10, 11	47	2	9, 10, 11
16	3	8, 9, 11	32	2	4, 6, 7	48	1	1, 2, 3

Figure 10 (IIHF Cross-Ice, 3-on-3 Game Manual, 2020)

The 5-on-5 game itself consists of three 20 minutes periods with clock stoppage which means that when the goaltender holds the puck, the puck goes into icing, or leave the sight of the referee, the clock will stop. After the end of each period, a 15 minute intermission takes place. Meanwhile during 3-on-3 cross-ice game, the time spent on the game is reduced. Teams play three times for 16 minutes, which means the whole game is 48 minutes in total. The difference here is not just the reduced time but also the officiating clock. While in 5-on-5 hockey the clock stops every single time when the puck is no longer played, in 3-on-3 small area games, play continues with no clock stoppage unless an injury occurs. (IIHF 2019)

Other rules of the game such as icing and offside do not exist in 3-on-3 small area games, and even face-offs occur only in certain situations. Those faceoff inducing situations include a major penalty or if the puck leaves the ice surface.

The penalties of the small area games play like in women's ice hockey without body-checks, but the rest of the major penalties are the same as it is in 5-on-5 ice hockey indicated by the IIHF (IIHF 2019).

7 Research Objectives

In this research study, the 5-on-5 and cross-ice 3-on-3 games were analyzed from a technical skills point of view. The research was done by collecting data and analyzing these two game formats in U16 age categories.

The main purpose of this research paper was to find out about the repetition being used in both game formats.

Previous research has been made in different sports other than ice hockey and the research showed that by reducing the size of the games, one can increase the number of repetitions per individual. This research was curious if this applied also during a hockey game and if so what is the difference.

The research question will focus on the following questions:

- What are the quantitative differences of technical skill actions between 3-on-3 and 5-on-5 playing formats in different game situations?
 - The following technical skills have been analyzed:
 - Skating skills
 - Passing/Receiving
 - Shooting
 - Puck Possession

The benefit of this thesis is that it presents and collects the basic technical skills used in ice hockey in both game formats and compares the results between them. The thesis could give a better understanding of what skills are used in ice hockey and what are the repetition levels of certain situations and game formats.

8 Research Method

All of the data was collected when teams were playing in even strength situations without a penalty kill or player deficit situation. This means that in 3-on-3 cross-ice hockey game, the data was analyzed when both teams had an equal three players on the ice. This was kept that same in 5-on-5 full ice game, data was gathered when both teams had 5 players on the ice at the time at even strength. The results were calculated based on the average ice time that a player spent on the ice in even strength situations in 3-on-3 as in 5-on-5.

As previously mentioned, the duration of a cross-ice small area games is 48 minutes, while the 5on5 normal ice hockey game consists of 60 minutes play time. Due to this difference, a ratio number was created to be able to compare the results from both game formats. The following equation was used to make the data comparable. The average even strength ice time in 3-on-3 cross-ice game and in 5-on-5 full ice game was used to calculate the average overall ice time per player in one game. For example, the average ice time for one player per game in 3on3 cross-ice game was 11 minutes and 13 seconds, and the average time on the ice per player in all games (3-on-3 and 5-on-5 games combined) was 12 minutes and 4 seconds. The average time overall (12 minutes, 4 seconds) was divided by the average time in 3-on-3 games (11 minutes and 13 seconds) to calculate the ratio number (1.076).

All technical skills that were followed and recorded during 3-on-3 games was multiplied with the 1.076 ratio number.

The same procedure was used for the 5-on-5 games as well.

The following data collection is compared by the average of the total number of repetitions per player. The average per player was 12 minutes and 04 seconds spent on the ice in all games.

The data for 3-on-3 cross-ice game video footage was provided by the IIHF. The 5-on-5 videos came from the Finnish C-Nuorten SM Sarja league.

Both game formats were played in the same age category. The players who attended this study were within the age category of U16, which means that the players are aged 16 years old or younger.

Participants for the 3-on-3 games came from both the Pelicans U16 local team from Lahti and from the participants of the 2019 IIHF Development camp. These players played 3-

on-3 cross-ice games in one end of the ice rink, which was discussed in detail in chapter 5.

For the 5-on-5 games, C-SM junior league teams were analyzed during their regular season games. From both game formats, 3-on-3 cross-ice and 5-on-5 full ice, six games were analyzed (six games from 3on3 cross-ice hockey and six games in 5on5 games). This provided in total 12 full game videos for data analysis.

From all of the 12 games, three players were selected per game for whom the analysis was conducted. In total, 36 individual players were analyzed. 18 players were analyzed from playing 3-on-3 cross-ice game and 18 players from 5-on-5 normal hockey.

Both games were played according to the IIHF rules. However, in 3on3 games rules were adjusted as described in more detail in chapter 6.

The duration of the two game formats was also different. The 5-on-5 ice hockey was played in three 20 minutes periods separated by two 15 minute intermissions. The total actual playing time in a normal ice hockey game is 60 minutes.

The 3-on-3 on the other hand, was played with three 16 minutes periods separated by two minute intermissions between periods. Thus, in the 3-on-3 the playing time is 48 minutes.

The data was collected from both of the games' video footage by using the Steva Hockey Pro system. This video analysis software is built to analyze games and practices. One of the features of this program is that one can create their own coding or key codes and re-watch the clips where the user marked.

The next step for data processing was creating a separate key list by using letters indicated below:

- "P"-for pass attempt,
- "R"-for receiving,
- "S"-for shot attempt,
- "K"-for skating and
- "D"-for defending.

For every letter sub-event, and secondary sub-event, two functions were created by categorizing the event. For example, the "P" button was pressed for each pass attempt, and then in the sub-events that followed, the type of pass and the type of situation where the action was played was indicated by using the secondary subevent function. Every pass attempt was collected and separated as a succeeded pass or missed pass. Succeeded passes counted when the passer successfully completed a pass that his teammate could

receive. Missed passes stood for when the pass was intercepted or did not arrive to the receiver. Each of these actions were collected as repetitions.

The following flow chart presents the use of buttons and sub-event relations on the key board, while collecting and analyzing the data with the Steva System:

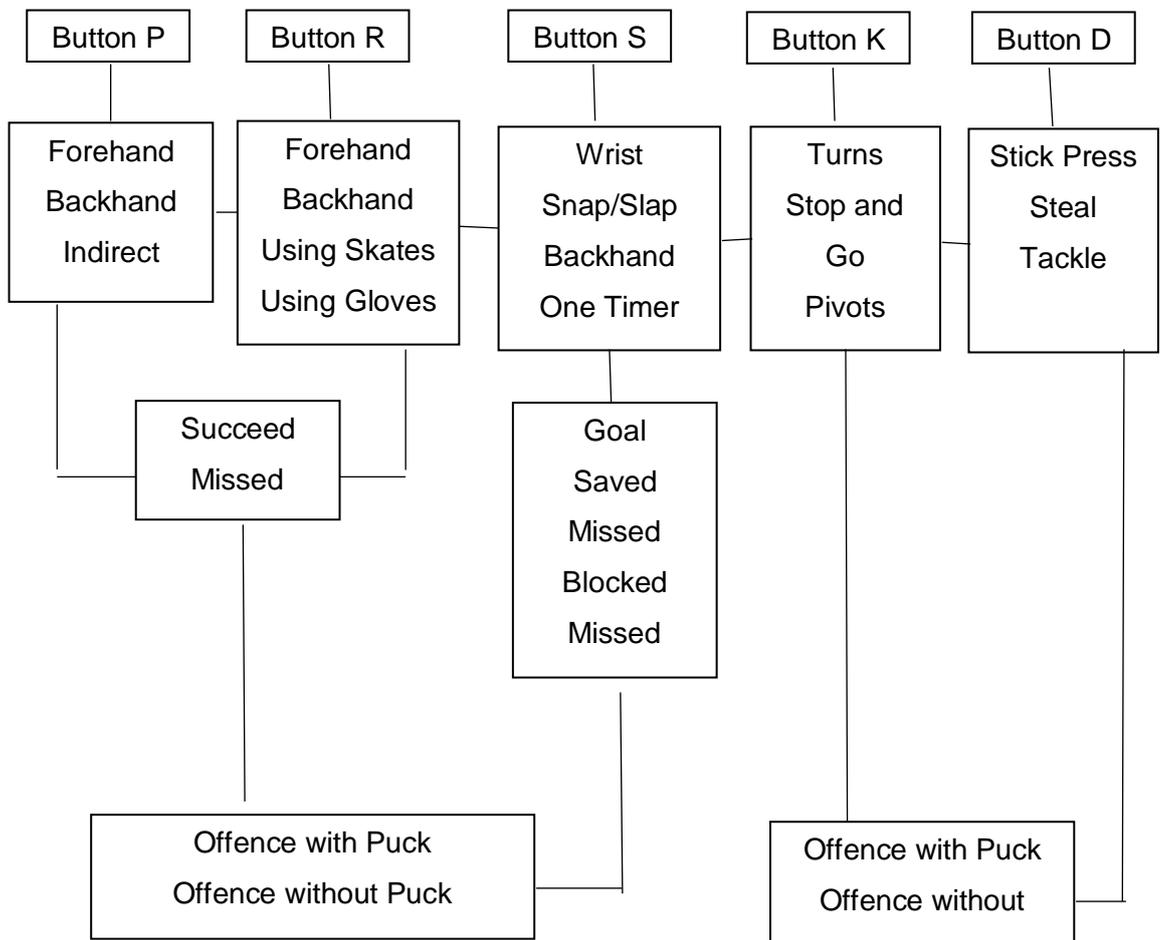


Figure 11. Keyboard buttons with sub-events.

The second or the next action that was followed and analyzed is puck possession and skating time spent in all of the players' different roles (role1, role2, role3, role4).

For this event, the Steva Software was also used with a new and different key list then the previously mentioned ones.

The key list for these actions responsible for the offensive were the following buttons:

- Q-for puck carrier skating forward,
- W-for offensive puck carrier backward,
- Z-as non-puck carrier forward,
- X-non puck carrier backward.

For the defensive activities:

- I-used for defending puck carrier forward,
- O-for defending puck carrier backward,
- N-defending non-puck carrier forward and
- M-for defending non-puck carrier backward.

To make the analysis easier, the buttons mentioned previously were colored and marked on the computer's keyboard as PF-for puck carrier forward, PB-puck carrier backward, and so on.

The offensive play was colored green and located in the left side of the keyboard, while orange stood for defensive play and was situated on the right side of the key board. Looking at the picture below in figure 12, the keyboard was not just divided vertically, but also horizontally. The top left corner of the keyboard was used for offensive actions with the puck, while the bottom left corner stood for offensive actions without puck. On the other side of the board, the top right corner stood for defensive actions against puck carrier and the bottom right corner for defending the non-puck carrier.

Figure 12 presents the structure of the key board for analyzing puck protection:

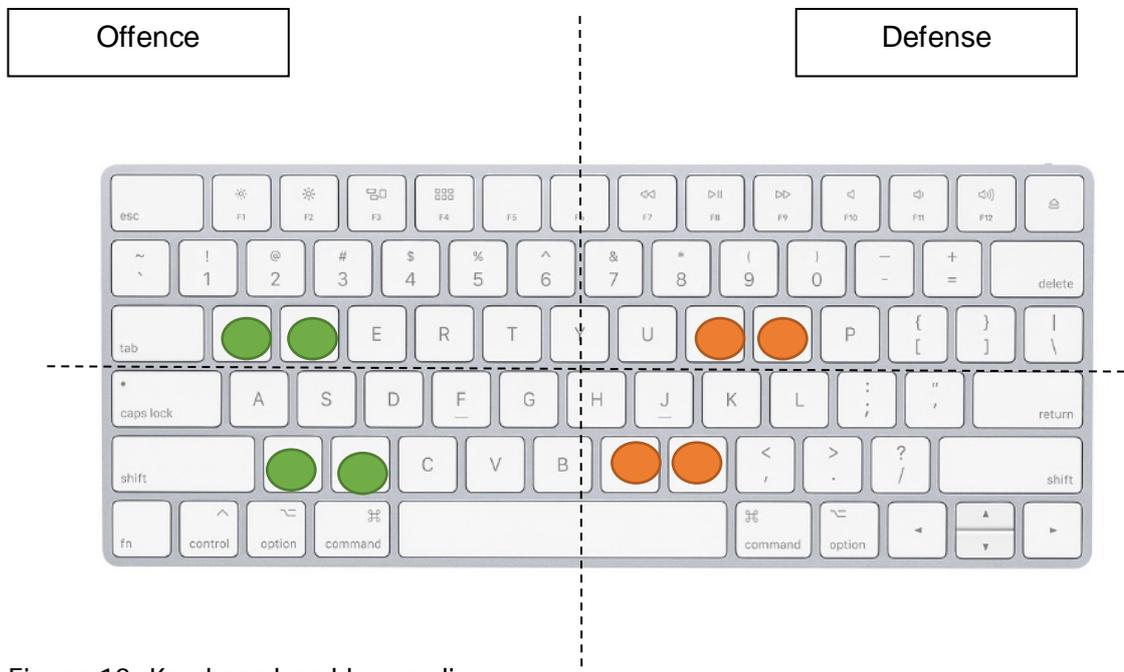


Figure 12. Key board and key-coding

These markings made the analyzing much easier because with the left hand one can mark the offensive situations while using the right hand for defensive markings.

Each game was watched and analyzed twice. During the first viewing, the repetition markings were analyzed while during the second viewing time the puck possession and skating time was observed.

9 Results

9.1 Difference in Skating in 3-on-3 and 5-on-5 Game Format

The following graphics present the findings of this paper starting with the skating actions in offence with the puck. To the test hypothesis that 3-on-3 and 5-on-5 format were associated with statistically different technical skills, students t-test was performed. As figure 13 shows, performing skating skills while carrying the puck after applying the ratio numbers in 3-on-3 cross-ice games are more than double comparing to a 5-on-5 ice hockey game. The independent samples t-test was associated with a statistically significant effect, $p < .001$. Thus, the skills used in 3-on-3 format were associated with a statistically significantly larger repetitions than in 5-on-5 format.

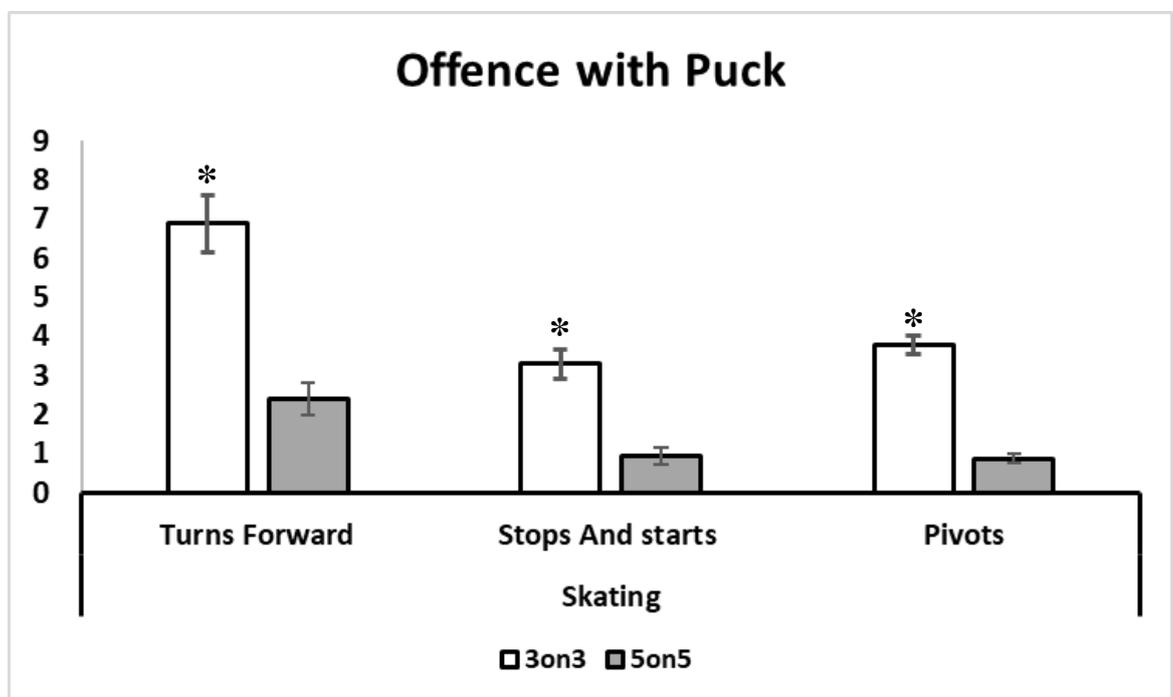


Figure 13. Skating action with the puck in offence

Staying on the skating skills, data was compared not just in offence with the puck but also in offence without puck.

Figure 14 highlights the numerical differences between these two game formats when a player is on offence but he does not have possession of the puck. All the repetitions collected from these three skills, the comparison of mean, $p < .001$ were associated with significance so the Null hypothesis was rejected.

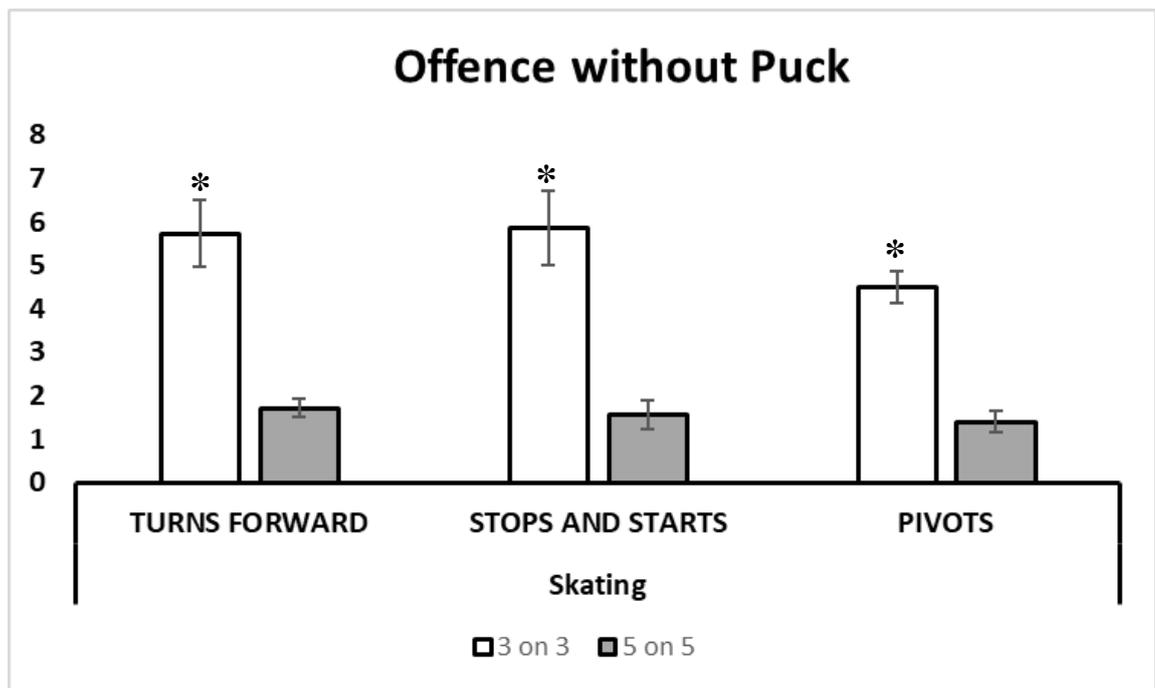


Figure 14. Skating skills in offence without puck.

The following chart exhibit the skating skills and defending skills while an individual plays against the opponent's puck carrier, so as called defending the puck carrier.

To the test hypothesis that 3-on-3 and 5-on-5 format were associated with statistically different technical skills, students t-test was performed as well. The result of turns forward, pivots, stick pressure and steal the probability value was $p < .001$, while the stops and starts $p < .048$ display there is a significant different between repetitions of these skills used in 3-on-3 cross-ice game compared to 5-on-5 normal game.

However, figure 15 shows that in tackle skills, the results of the data, $p = .50$, thus, the tackle skills used in both format were associated with no statistically significantly repetitions.

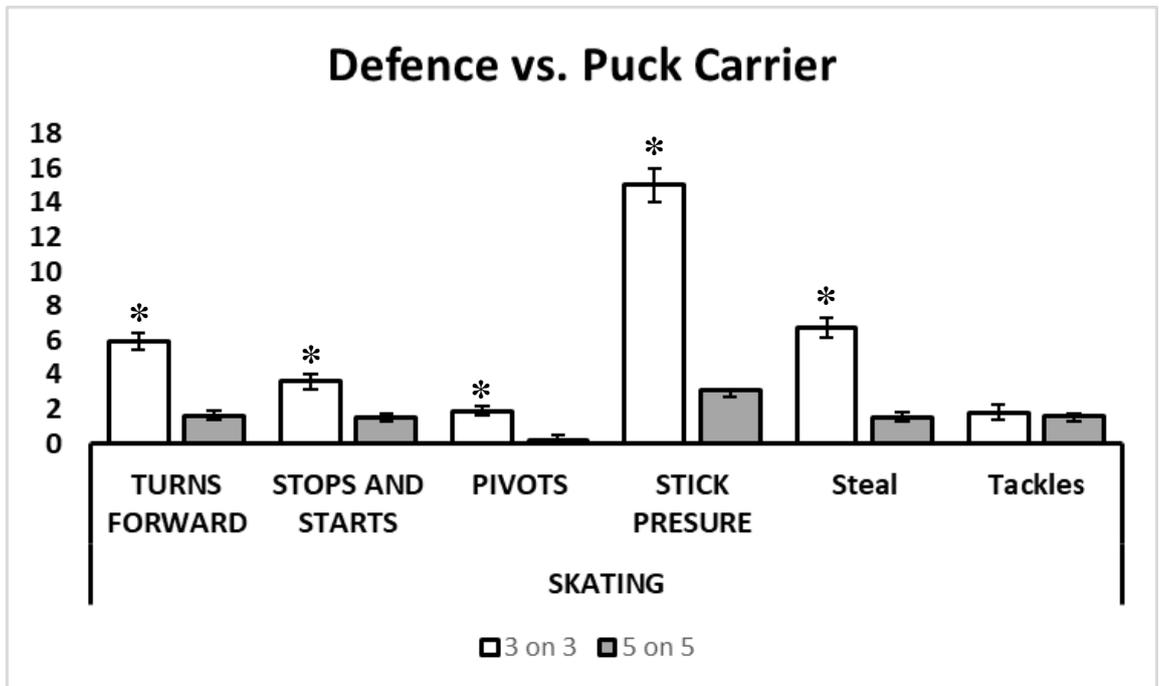


Figure 15. Skating, in defense vs puck carrier

The results were not surprising in defending the non-puck carrier either. The 3-on-3 cross-ice hockey results showed a big difference compared to 5-on-5 ice hockey. The probability values were turns forward $p=.002$, stop and starts $p=.033$, meaning that the null hypothesis was rejected. Despite the data of pivots ($p=.06$) showed slightly above the level of significance ($p=.05$) meaning that there were no significant difference between the repetitions is these two formats, so the null hypothesis is accepted.

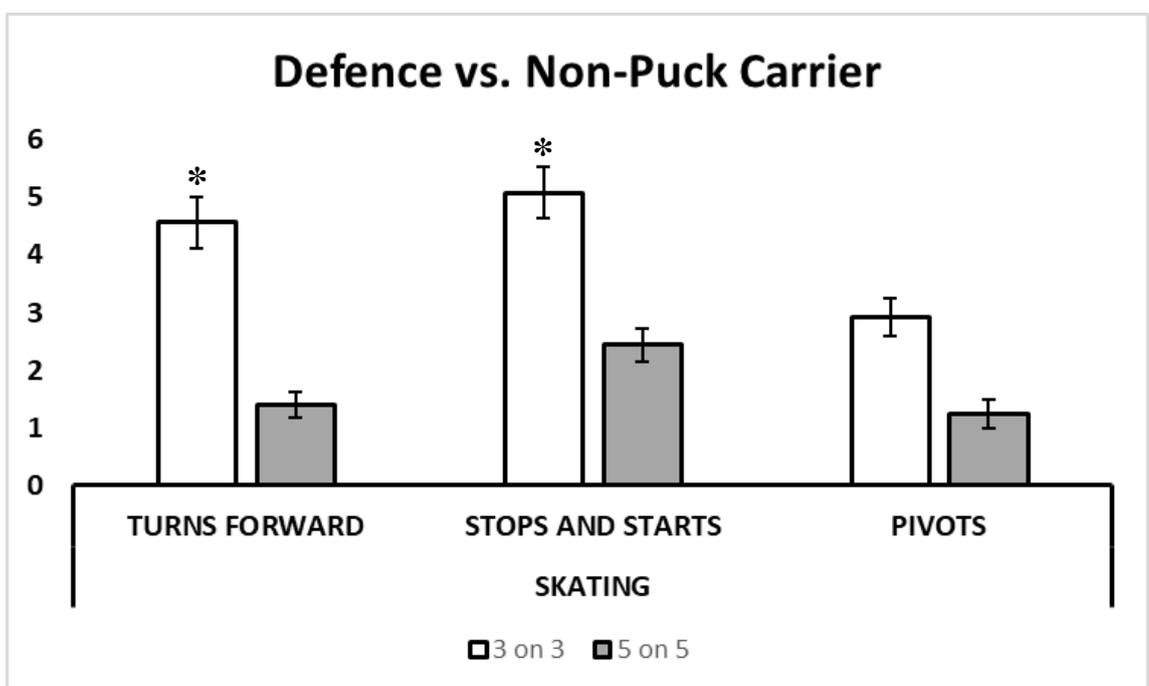


Figure 16. Skating in defense vs non puck carrier

When the data analysis was made, not only the skating skills were compared between the two game formats, but also the shooting and passing/receiving.

The following chart will represent the outcome of the collected data in each category comparing 3-on-3 cross-ice hockey and 5-on-5 full ice game.

9.2 Difference in Passing Skills in 3-on-3 and 5-on-5 Game Format

The passing figure 17 below points out the individual passing attempts (white column) compared with the grey column standing for successful passes. In the figure below PAT-stands for total passing attempts and SUC-as passes succeed.

The first chart represents the total amount of passes completed (PAT) in each of the 3-on-3 games compared with the 5-on-5 games.

As the results show, not only the total number of pass attempts (PAT) were higher by playing 3-on-3 cross-ice game than the 5-on-5 game, but also the amount of the successful passes (SUC).

Figures 18 and 19 present various skills used in passing and the differences between the two game formats.

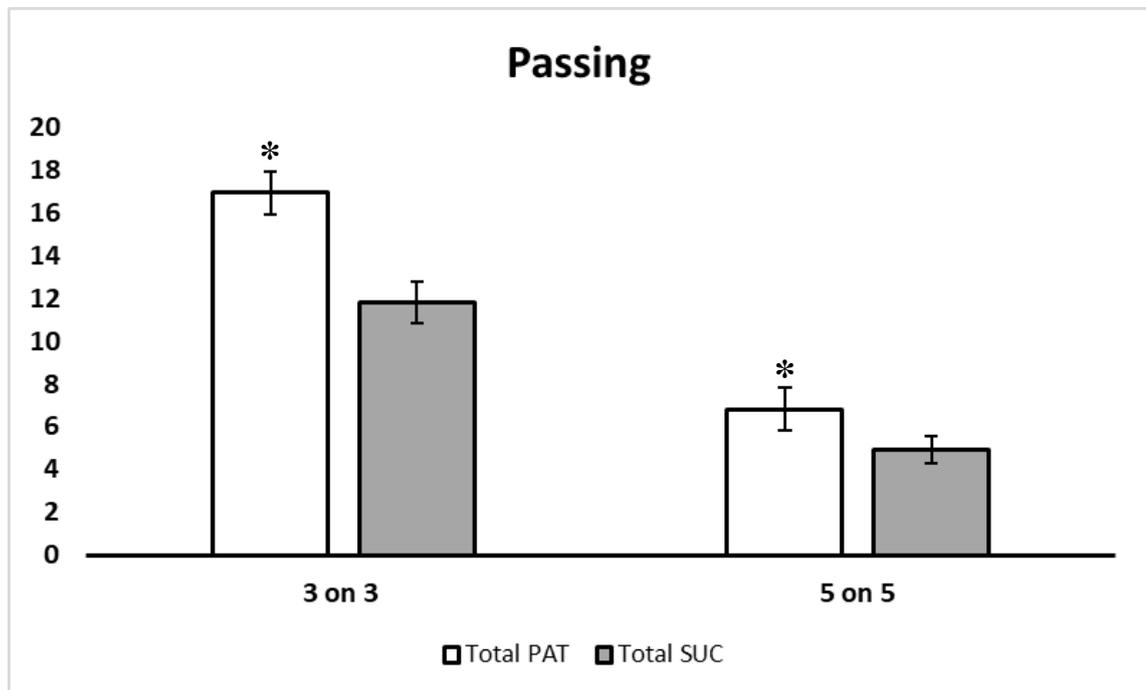


Figure 17. Total passing skills completed in 3-on-3 cross-ice game and 5-on-5 games.

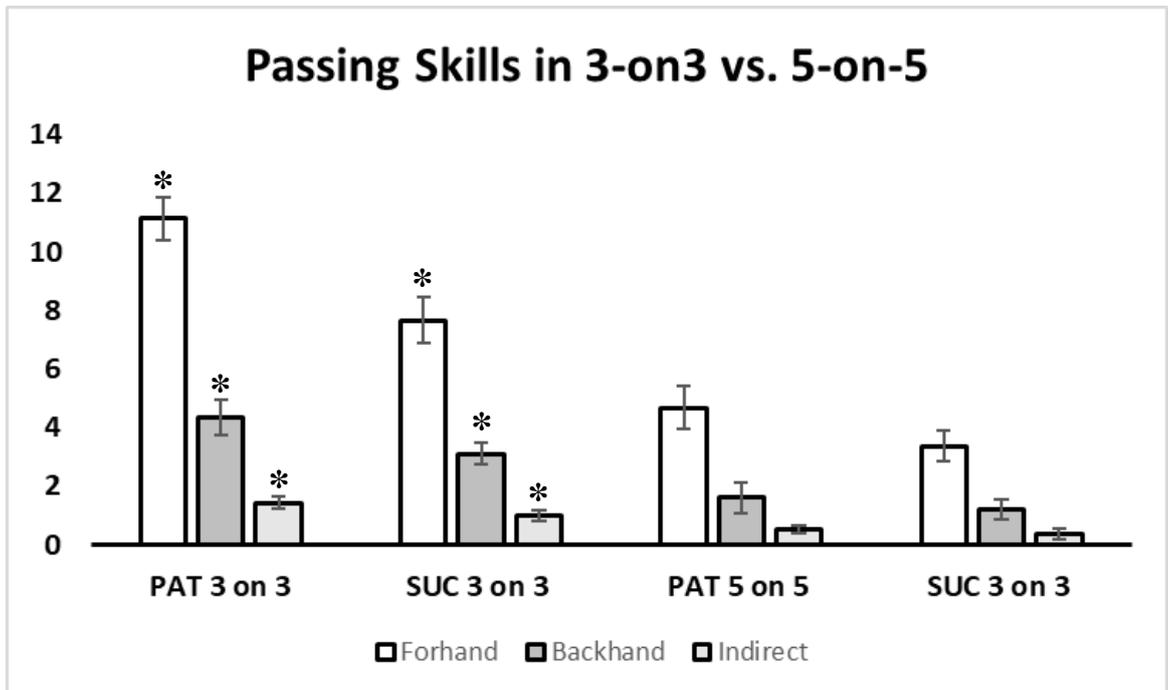


Figure 18. Various passing skills used by an individual player in 3-on-3 cross-ice game compared with 5-on-5 full ice game, considering the passing attempts (PAT) and success passes (SUC).

9.3 Difference in Receiving Skills in 3-on-3 and 5-on-5 Game Format

Not only did skating and passing show differences in favor of playing cross-ice 3-on-3 game, but also some of the receiving statistics showed an increased number compared to 5-on-5 full ice game.

Surprisingly, backhand receiving associated with no scientifically significant difference between 3-on-3 and 5-on-5 game formats, with a probability value of $p=.12$. On the other hand, using glove to receive a pass showed almost the same data, $p=.16$.

Although, backhand and using glove for receiving showed no significance, the for-hand ($p=.04$) and using skate ($p=.04$) associated with higher significance level than $p=.05$, meaning the null hypothesis was rejected.

Resembling the total amount of passes in figure 20, the independent samples t-test was associated with a statistically significant effect, $p<.01$. Thus, the total amount of passing actions in 3-on-3 were associated with a statistically significantly larger repetitions than in 5-on-5 format.

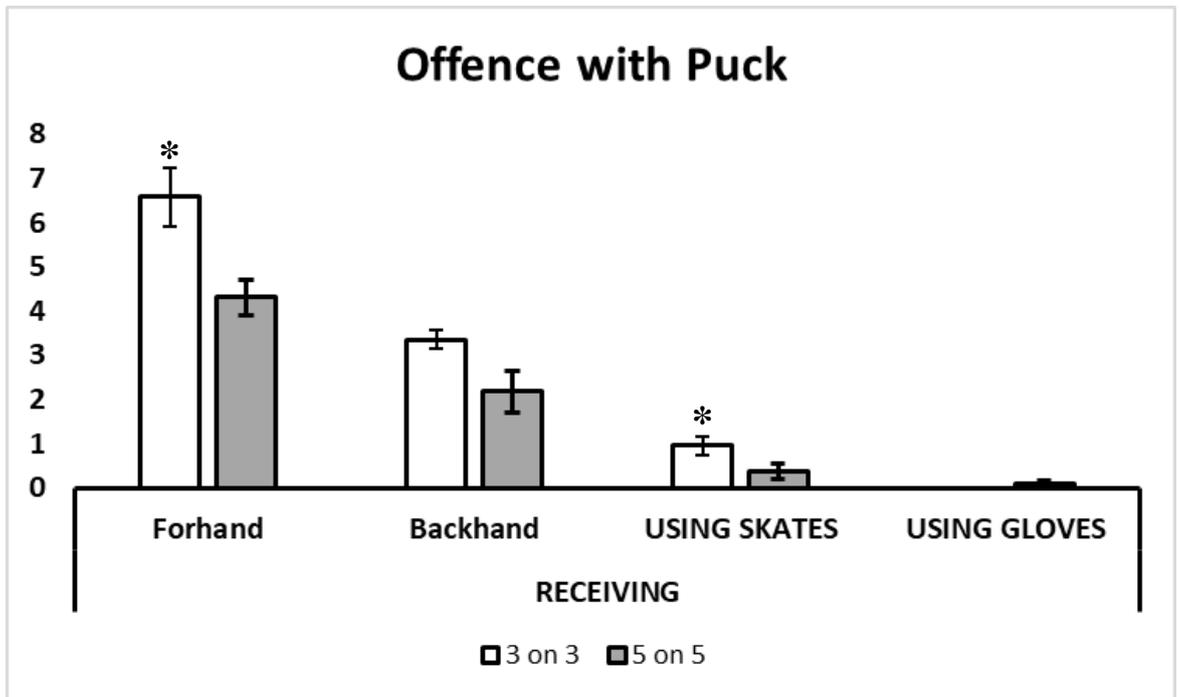


Figure 19. Receiving the puck in 3-on-3 and 5-on-5 ice hockey game.

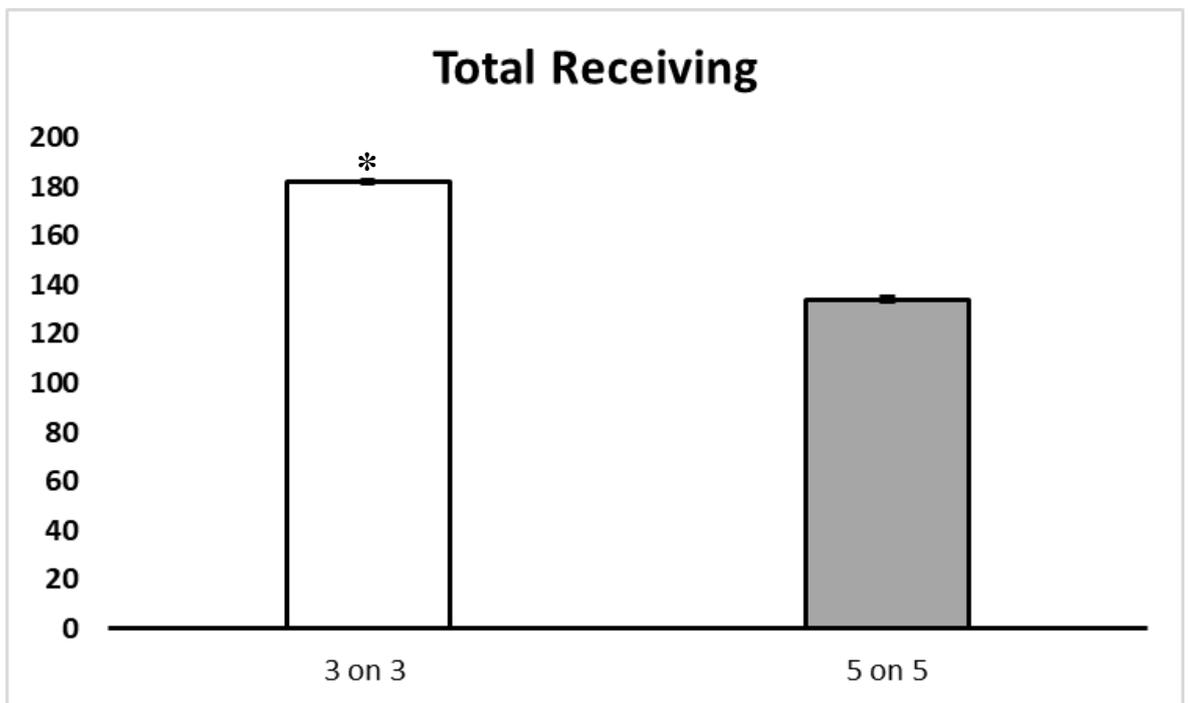


Figure 20. Total amount of receiving between 3-on-3 and 5-on-5 game formats.

9.4 Difference in Shooting Skills in 3-on-3 and 5-on-5 Game Format

The objective of the game is to score more goals than the opponent. Shooting is fun and everybody wants to score goals. In order to score goals one needs to take shots.

The following chart illustrates the total average number of shots and types of shots that an individual player took in 3-on-3 cross-ice games and 5-on-5 full ice hockey.

All skill actions, wrist shot ($p=.01$), slap shots ($p=.04$), backhand shot ($p=.01$) and one-times shots ($p=001$) were related with a statistically significant difference in 3-on-3 game compared with 5-on-5. However, data from slap shot repetitions $p=.53$ were accepted the no hypothesis.

Nevertheless, figure 22 highlights that the total amount of shots with a probability of $p<.001$ associated with a statistically significant higher repetitions.

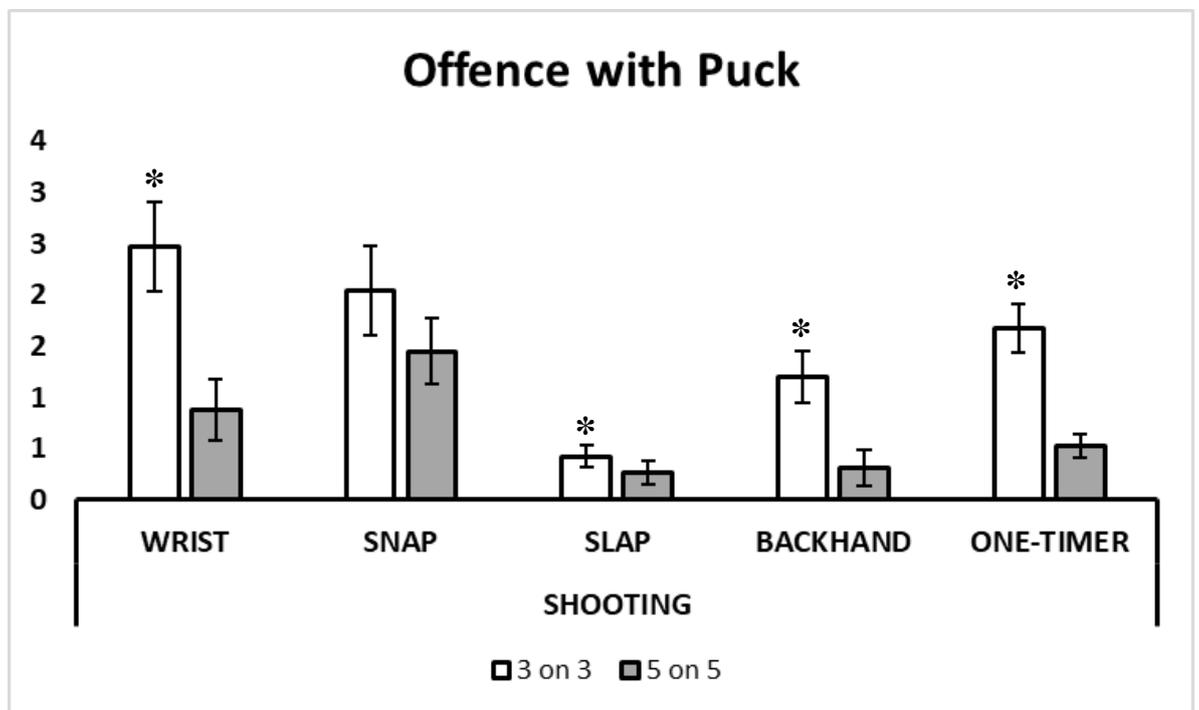


Figure 21. Different types of shooting used in 3-on-3 and 5-on-5 ice hockey game.

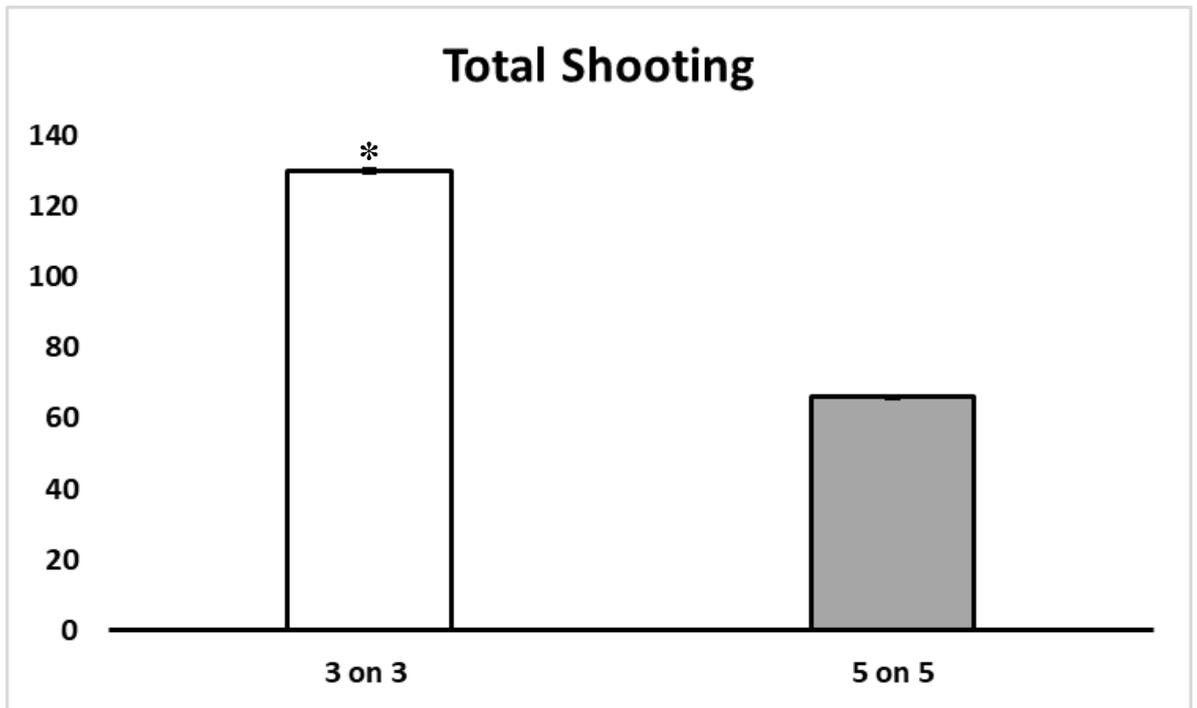


Figure 22. Total amount of shots compared with two game formats.

The subsequent bar chart, represents goal scored ($p < .001$), saved shots ($p = .002$), missed shots ($p = .15$) and blocked shots ($p = .17$). Thus, the goal scored and saved shots in 3-on-3 format were associated with a statistically larger number than in 5-on-5 game format. On the other hand, the missed and blocked shots showed no statistical significance towards one and other.

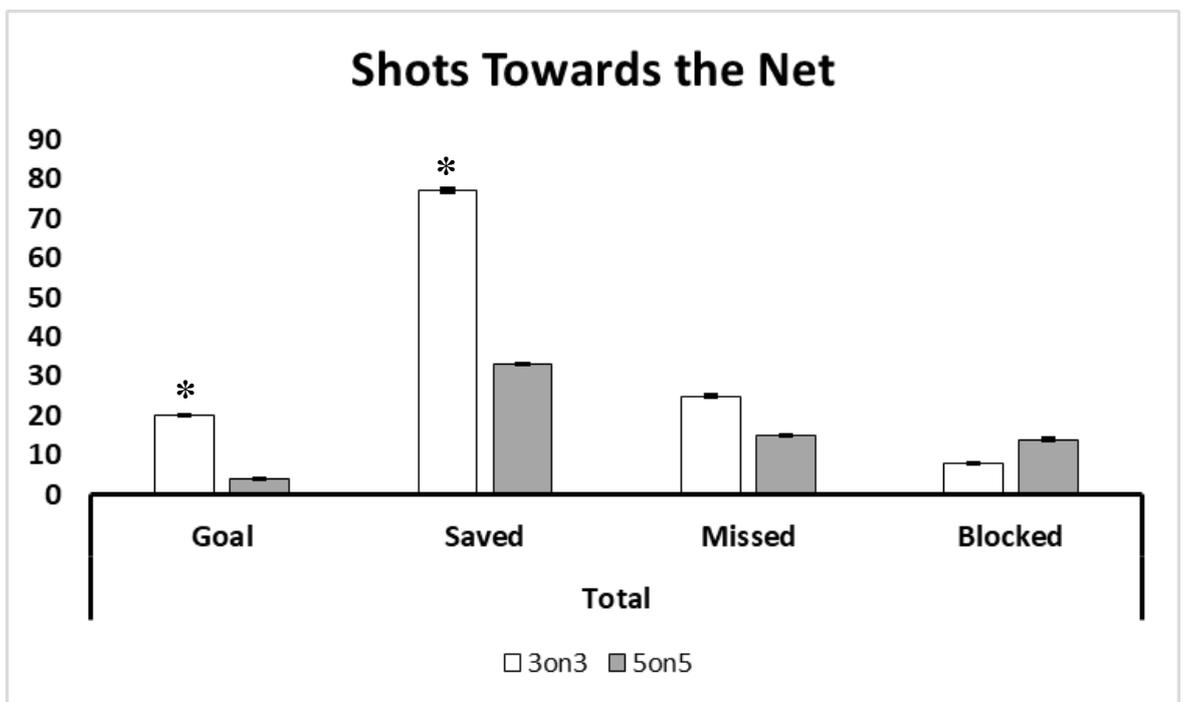


Figure 23. Total amount of goal scored, saved, missed and blocked shots

The following 18 (from Figure 24 to Figure 41) chart will present the shooting skills used by an individual in a total overall ice time 12 minutes and 4 seconds. On the chart x's axel the collected data will be highlighted, while on the y-axel shows the repetitions performed. For example, if on the y-axel shows 0,20 that means that one player in a 12 minutes and 4 seconds has scored goal with wrist shot average 0.20 times. The asterisk on top of the charts indicates that the no hypothesis was rejected, and there is a significant difference between the samples.

The independent samples t-test was associated only with four skills with a statistically significant effect, wrist shots saved puck ($p=.001$), goal scored with snap shot ($p=.004$), goal scored with one-time shots ($p=.02$) and one-timer shots saved by the goaltender ($p=.001$). The result of the rest collected samples were lower than the critical value, $p=.05$. Thus, the assembled data from 3-on-3 cross-ice game and 5-on-5 full ice game showed no statistically significant difference between the samples.

Two categories, blocked slap shots and blocked backhand shots due to zero repetition performed in both game formats, will not be presented in the following charts.

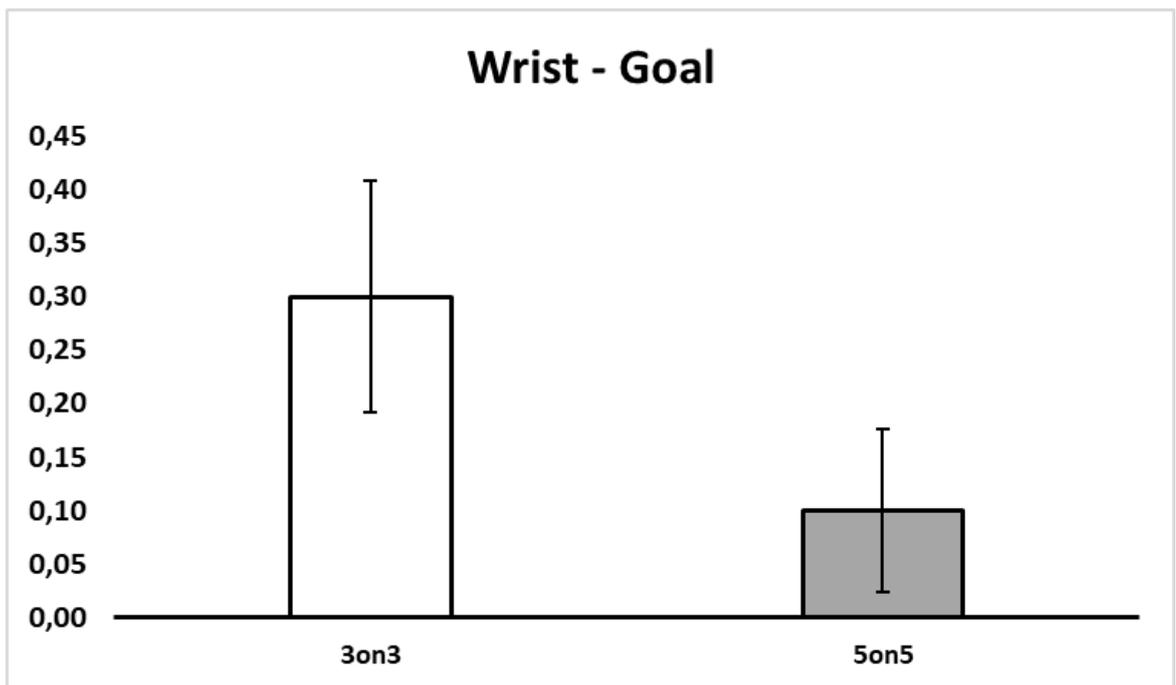


Figure 24. Goal scored with wrist shot ($p=.21$).

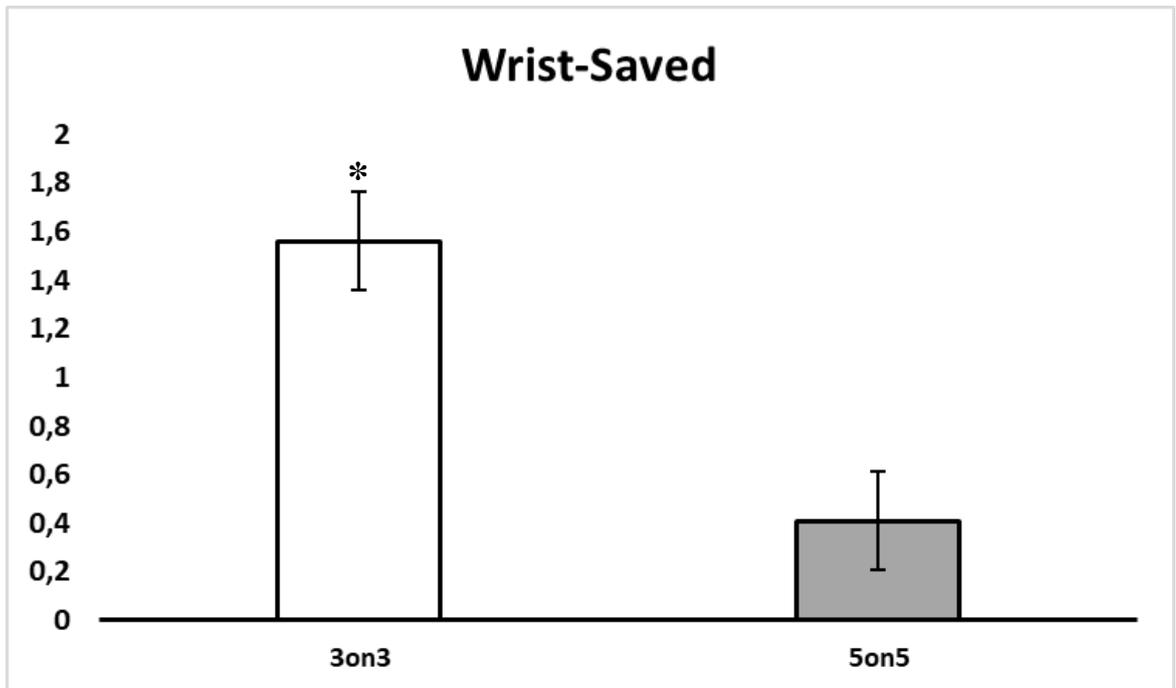


Figure 25. Wrist-shot saved by the goaltender ($p=.001$).

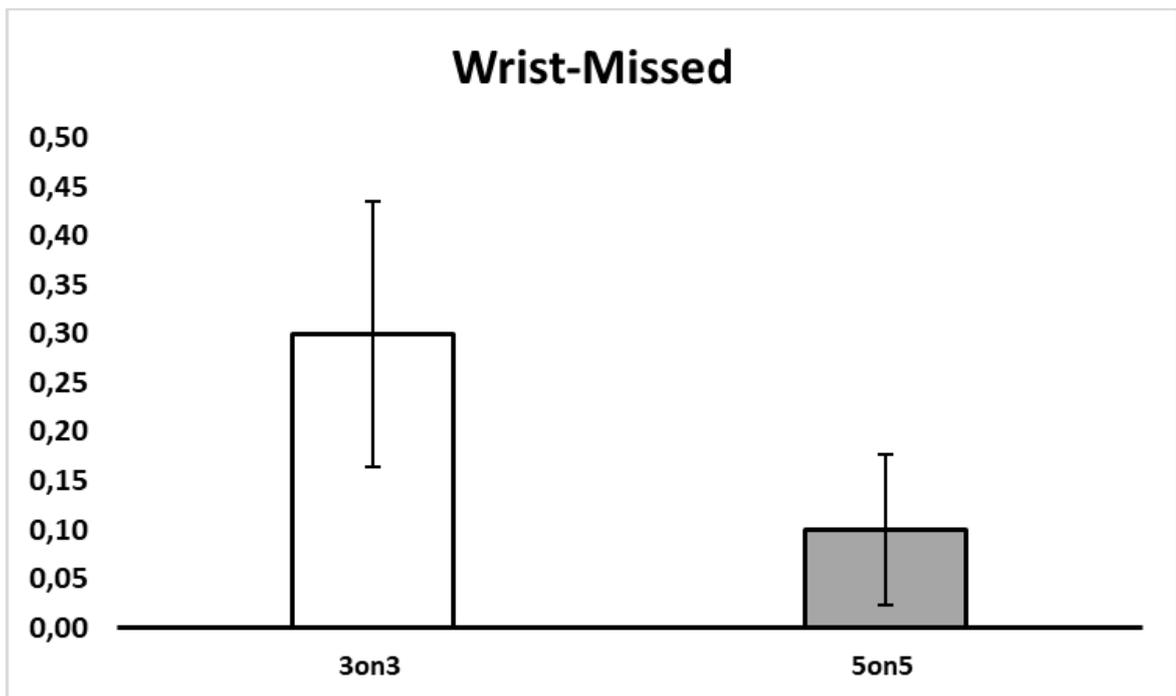


Figure 26. Shooting with wrist-shot and the puck misses the net ($p=.29$).

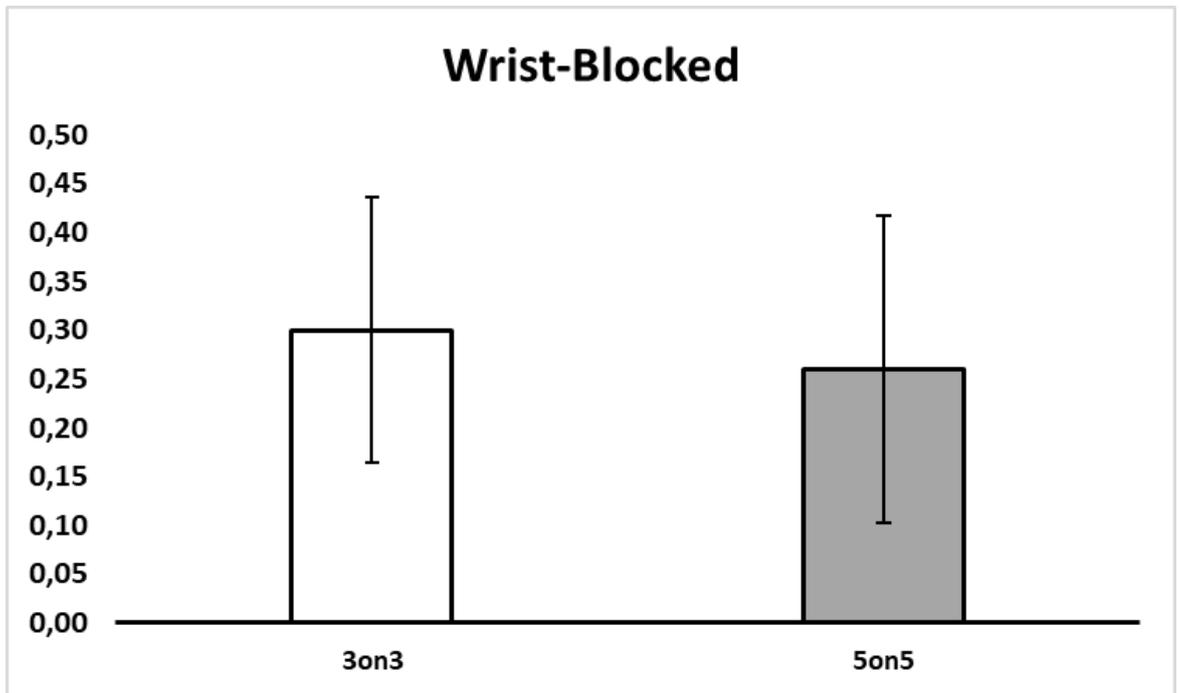


Figure 27. Wrist-shot, blocked by another player ($p=1$)

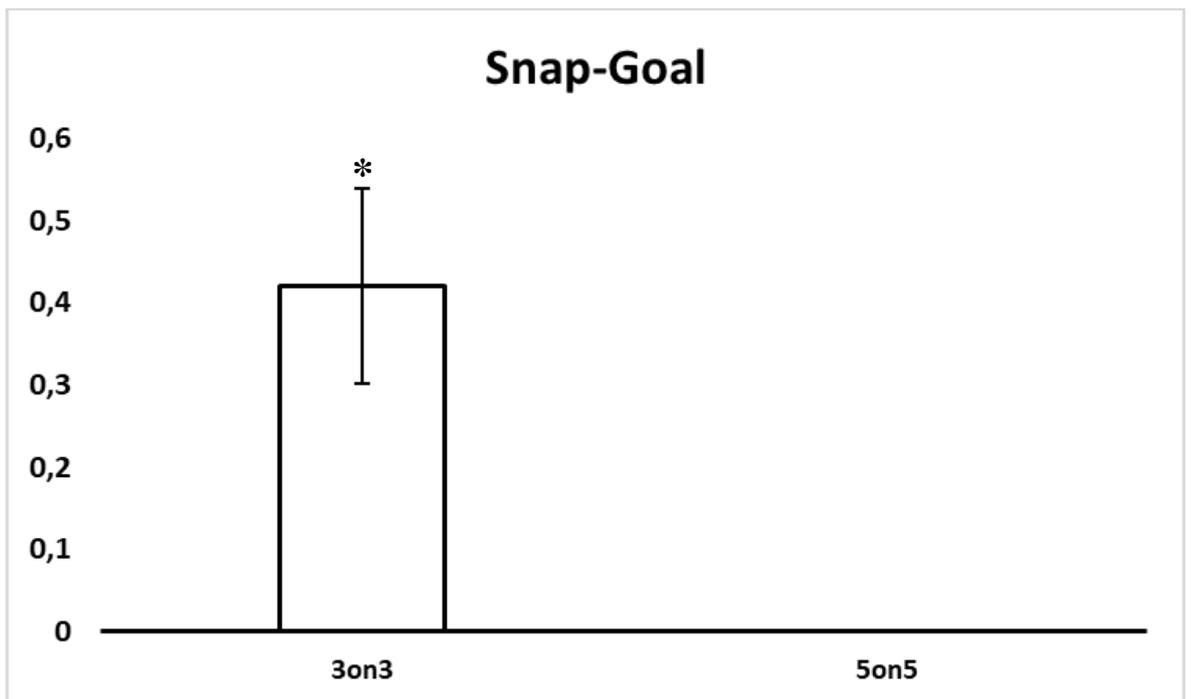


Figure 28. Goal scored with snap-shot ($p=.004$)

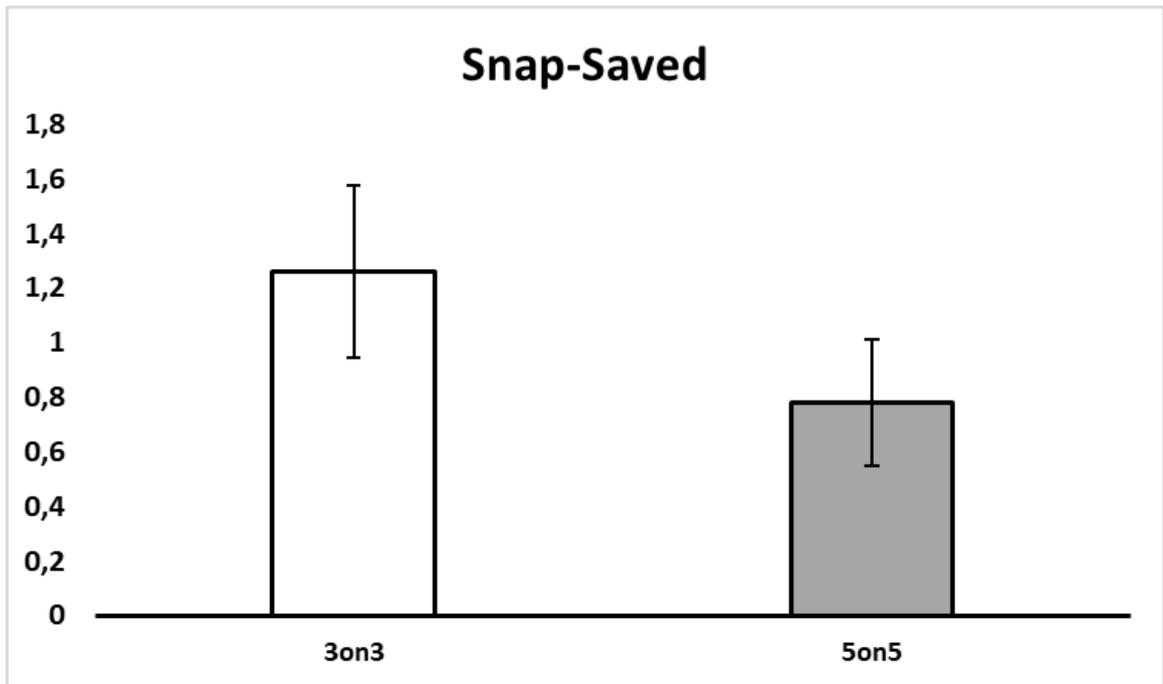


Figure 29. Saved puck, shot with snap-shot ($p=.40$)

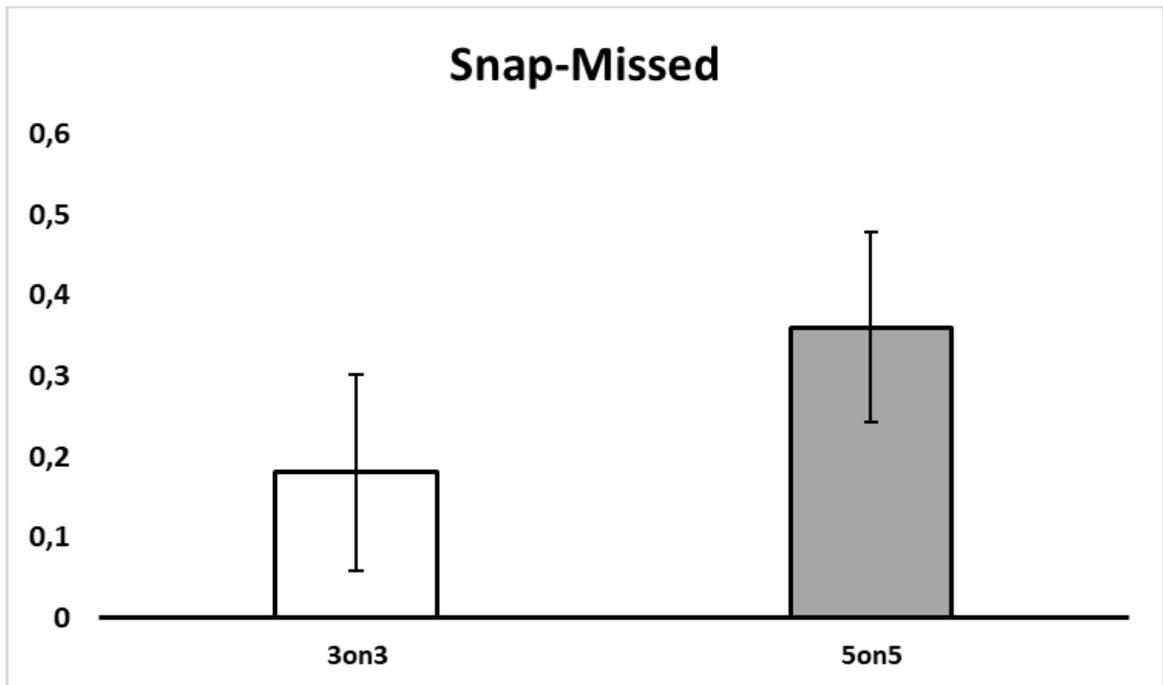


Figure 30. Missed shots with snap-shot ($p=.19$)

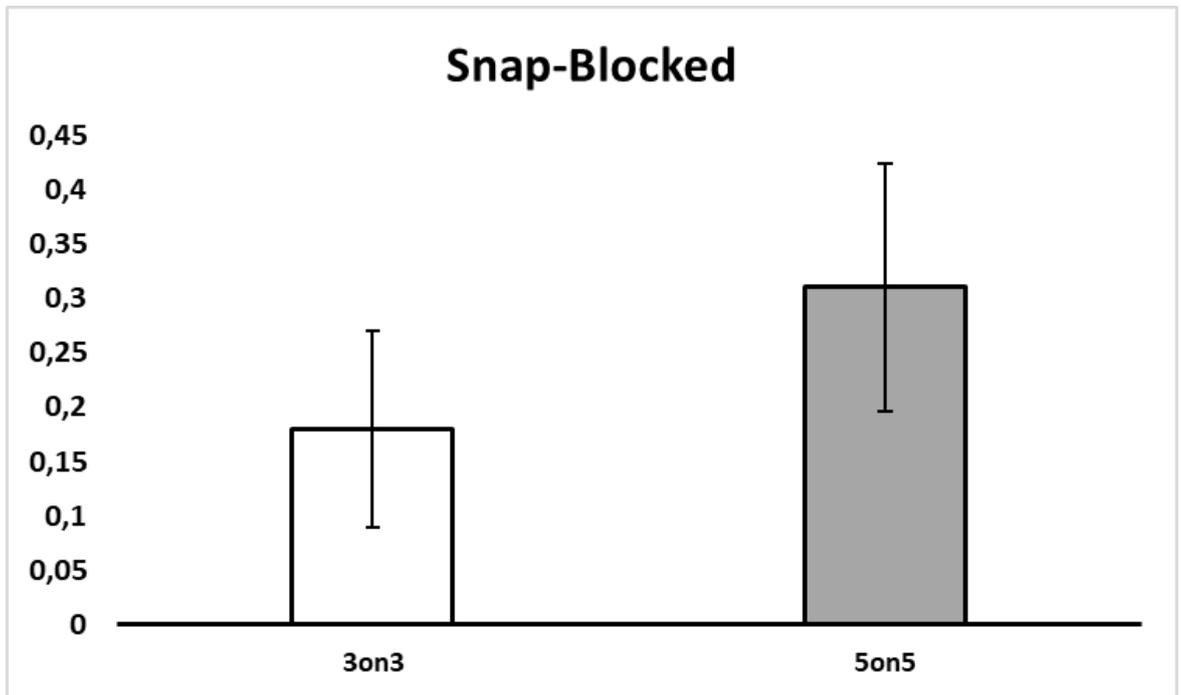


Figure 31. Snap shot, blocked ($p=.26$)

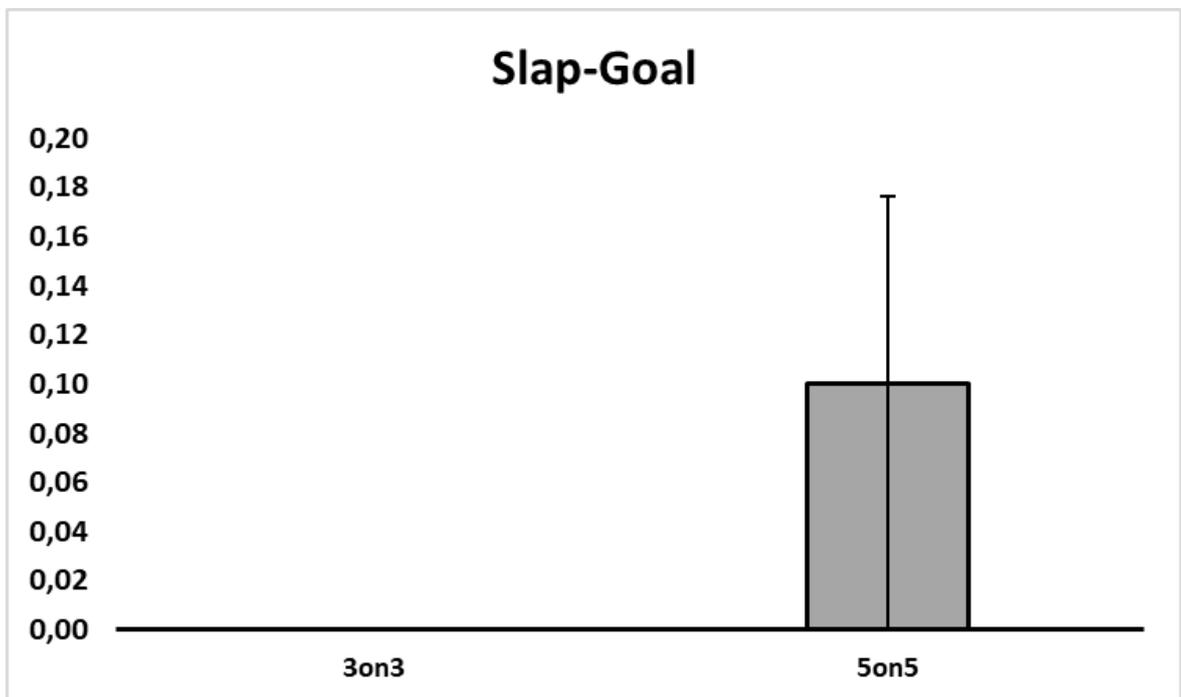


Figure 32. Goal scored with slap-shot ($p=.16$)

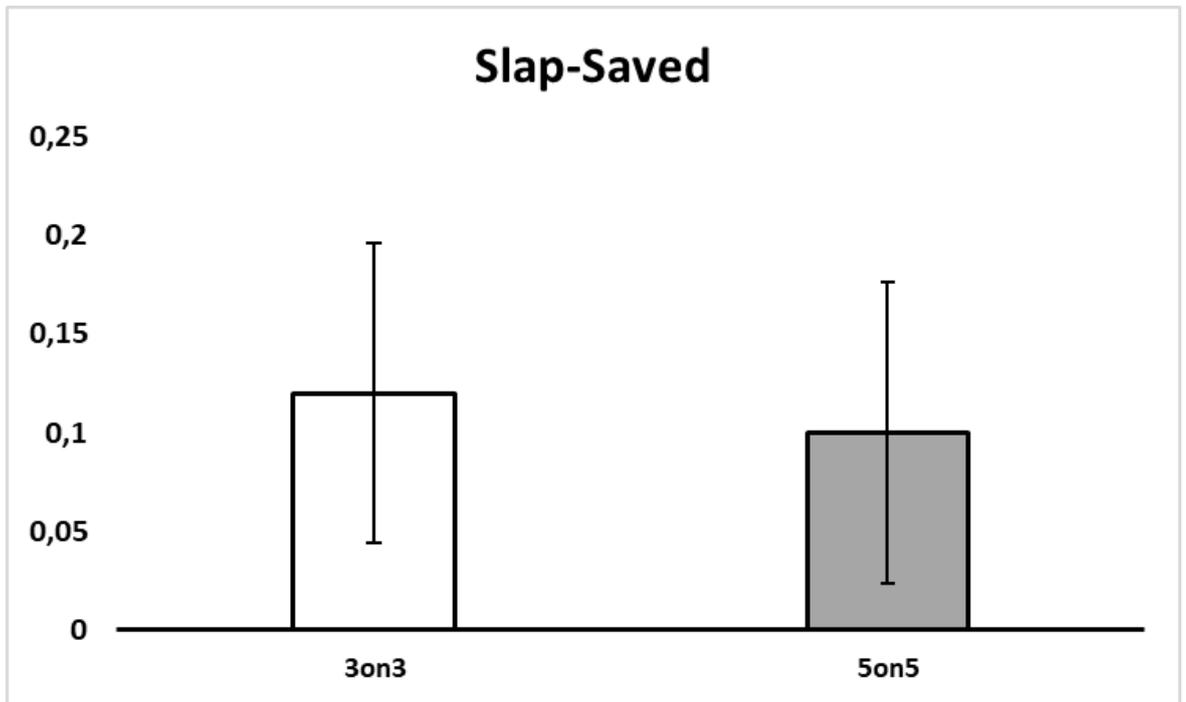


Figure 33. Saved slap-shots ($p=1$)

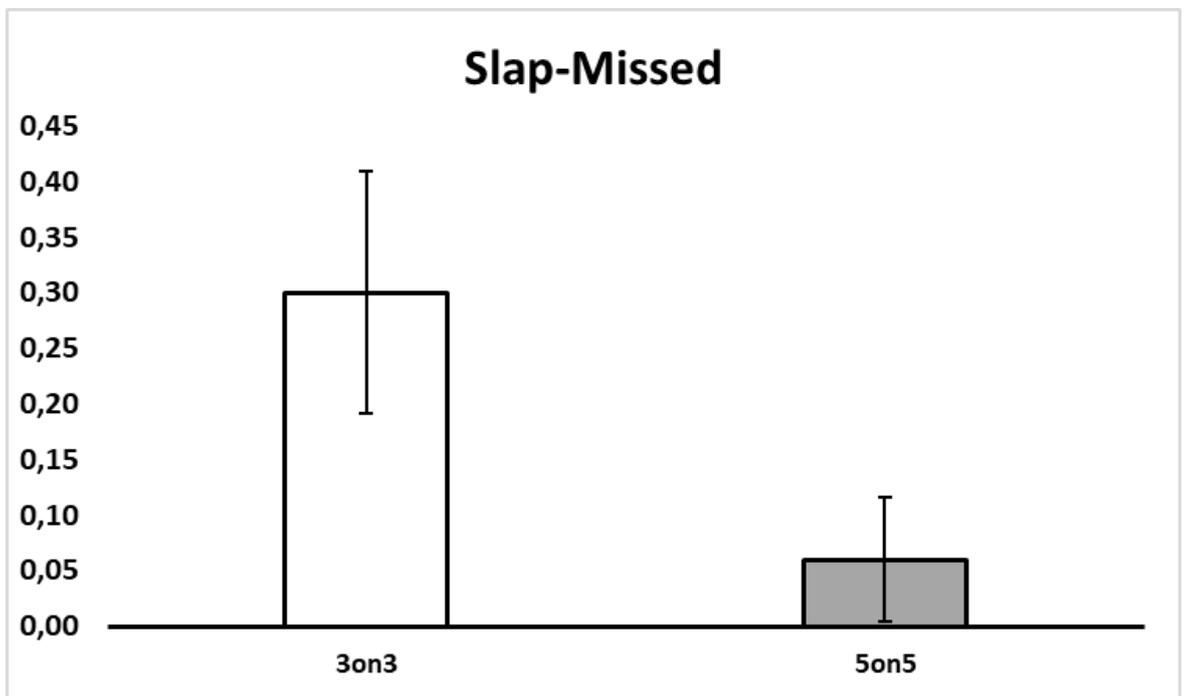


Figure 34. Missed shots, using slap-shot ($p=.08$)

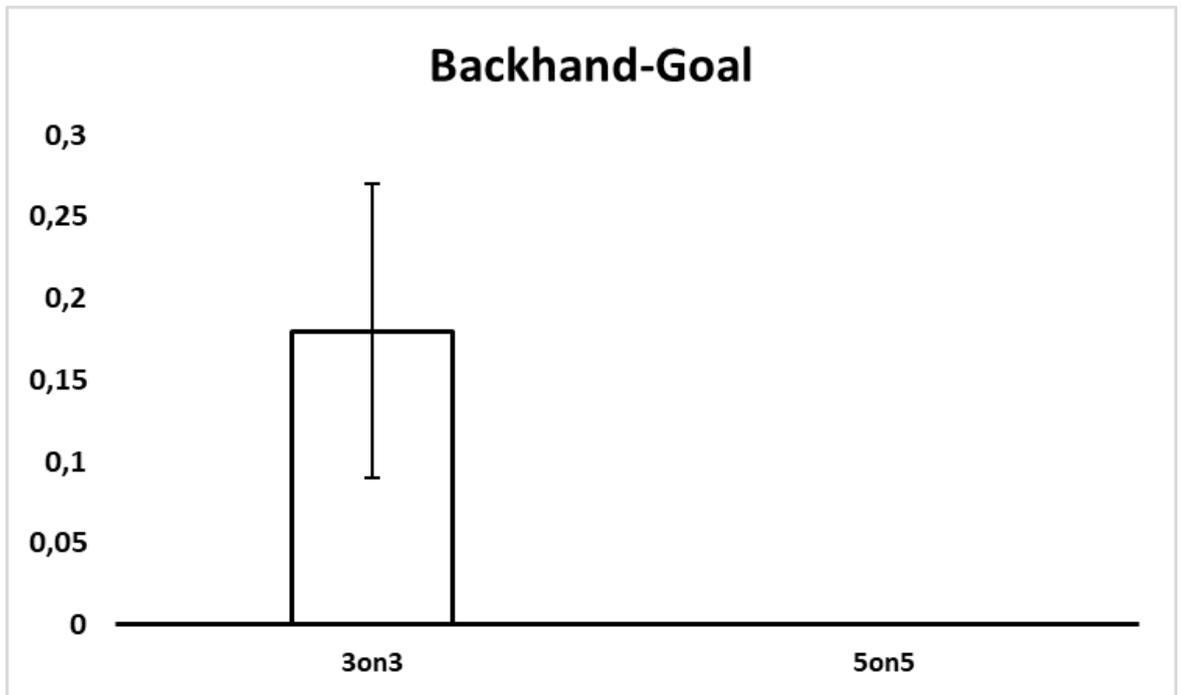


Figure 35. Goal scored with backhand shot ($p=.08$)



Figure 36. Saved backhand shots ($p=.27$)

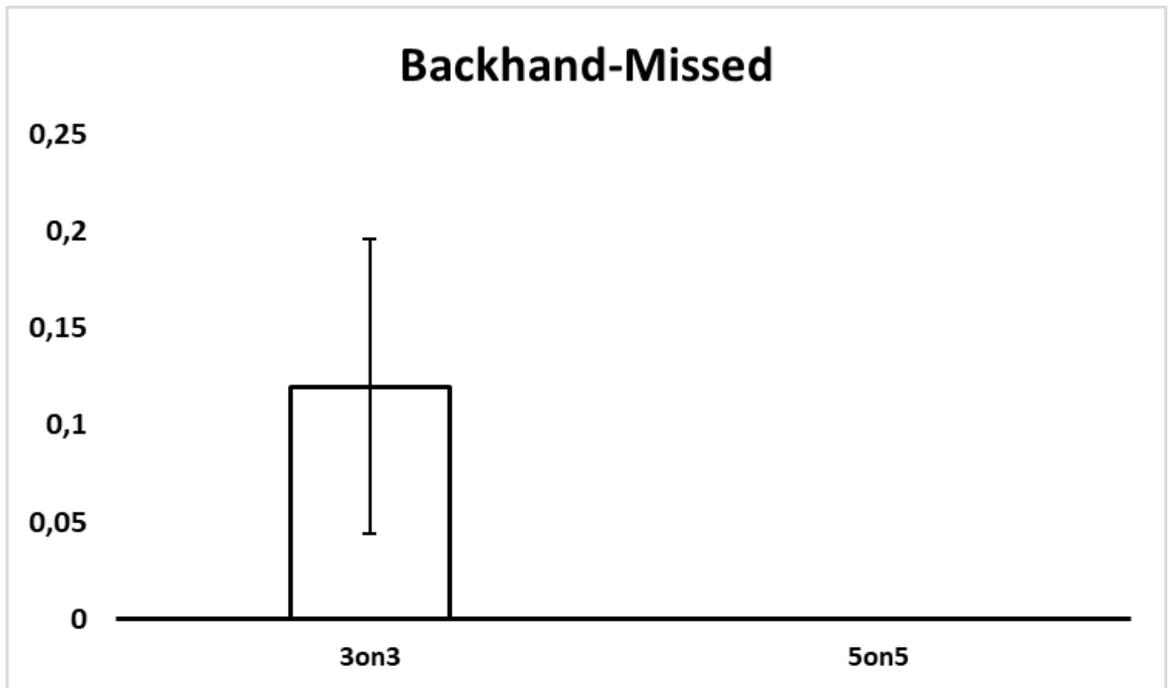


Figure 37. Missed shots with backhand ($p=.16$)

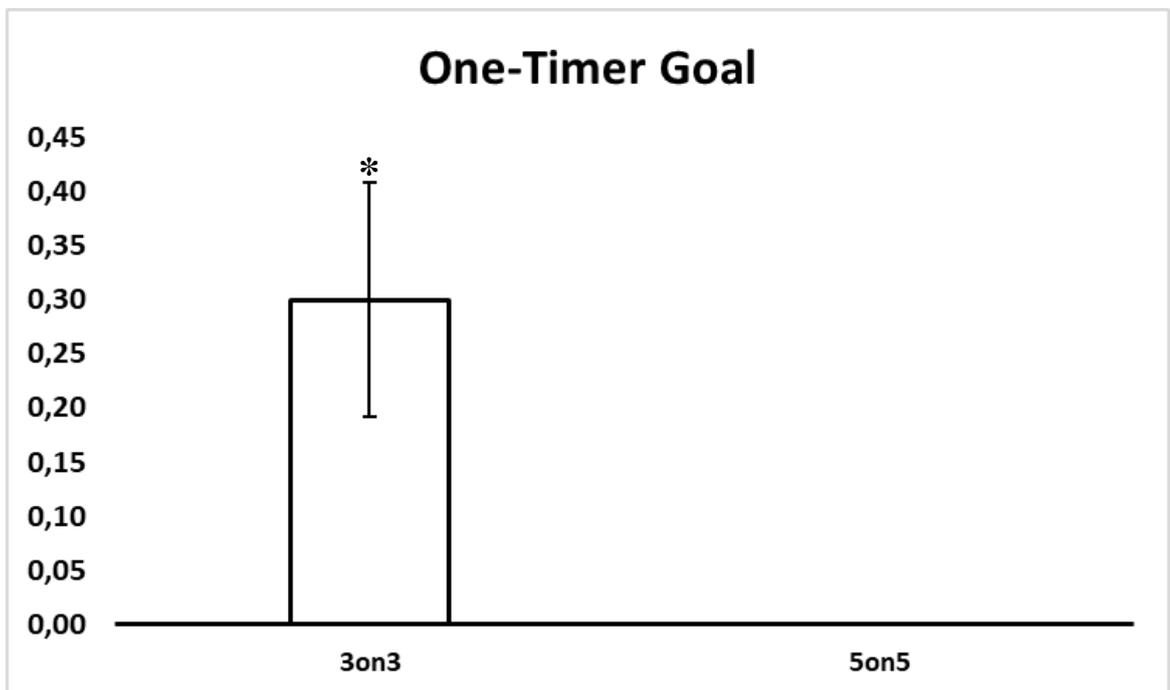


Figure 38. Goal scored with one-timer shots ($p=.02$)

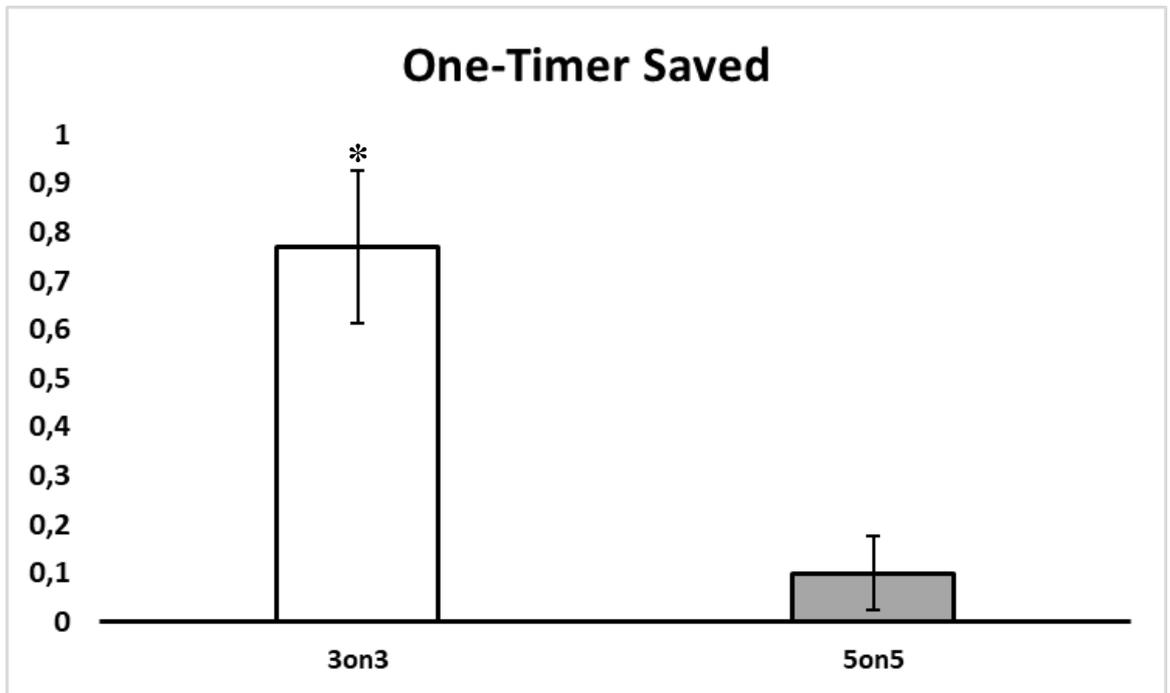


Figure 39. Saved one-timer shots ($p=.001$)

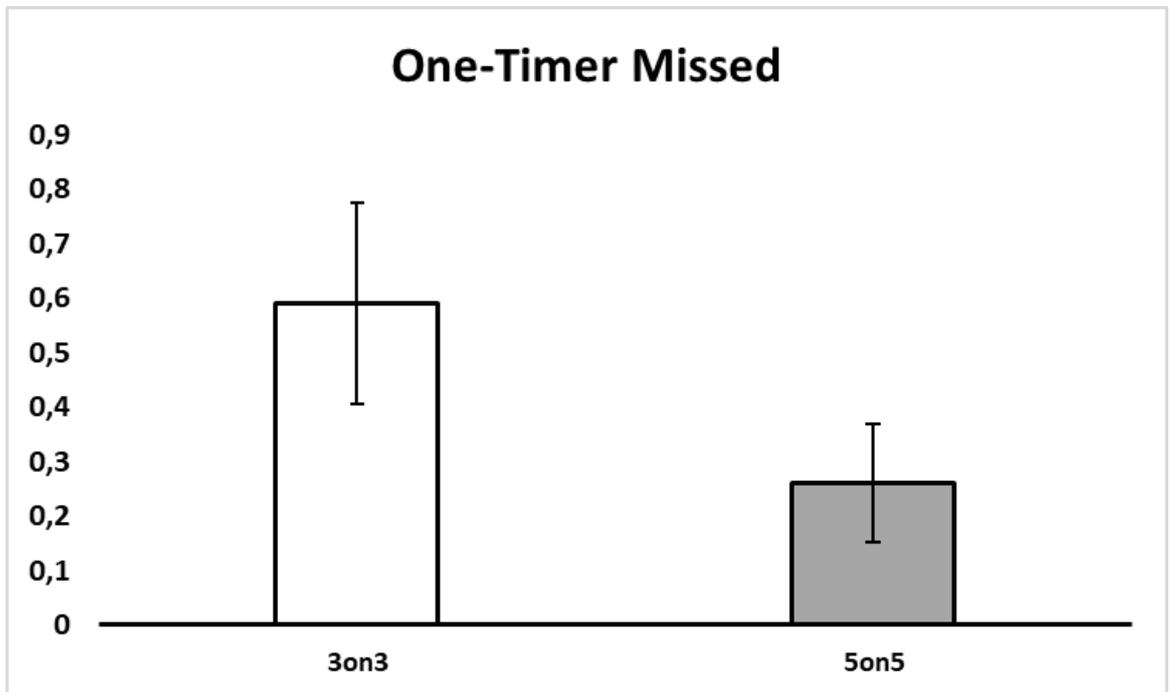


Figure 40. One-timer missed shots ($p=.20$)

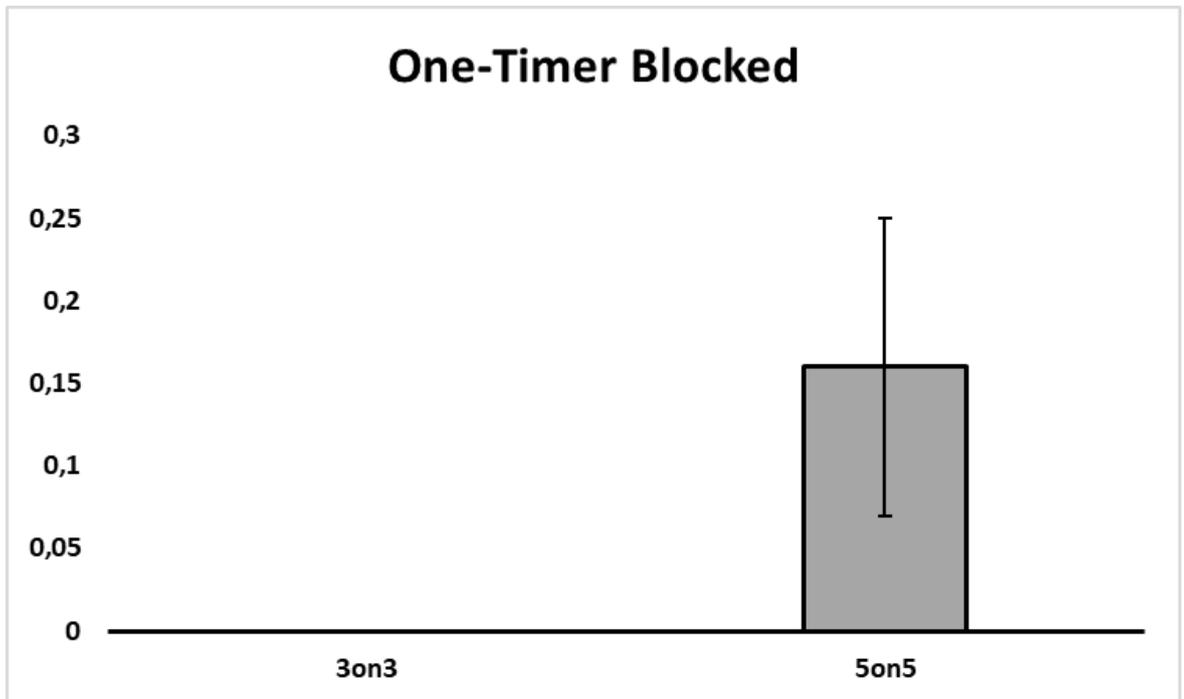


Figure 41. Blocked one-timer shots ($p=.08$)

9.5 Difference in Puck Possession in 3-on-3 and 5-on-5 Game Format

Another variable analyzed included puck possession of individual players. The results show the average number in all games per player's puck possession. Due to different ice time in these both formats, as mentioned earlier average ice time was calculated. The average time overall is 12 minutes, 4 seconds. Based on that, one player per game possesses the puck 1 minute and 67 seconds in 3-on-3 cross-ice game, whereas the average time compared to 5-on-5 game was .73 seconds. The x-axel in the chart responsible to the average time a players possessed the puck, while the y-axel identifies the time in minutes. For example 0,2 stands for 20 second, 1-as one minute and so on.

With significance of the collected result ($p<.001$), we can declare that the puck possession in 3-on-3 cross-ice game was more than twice as high as the results from the 5-on-5 hockey game.

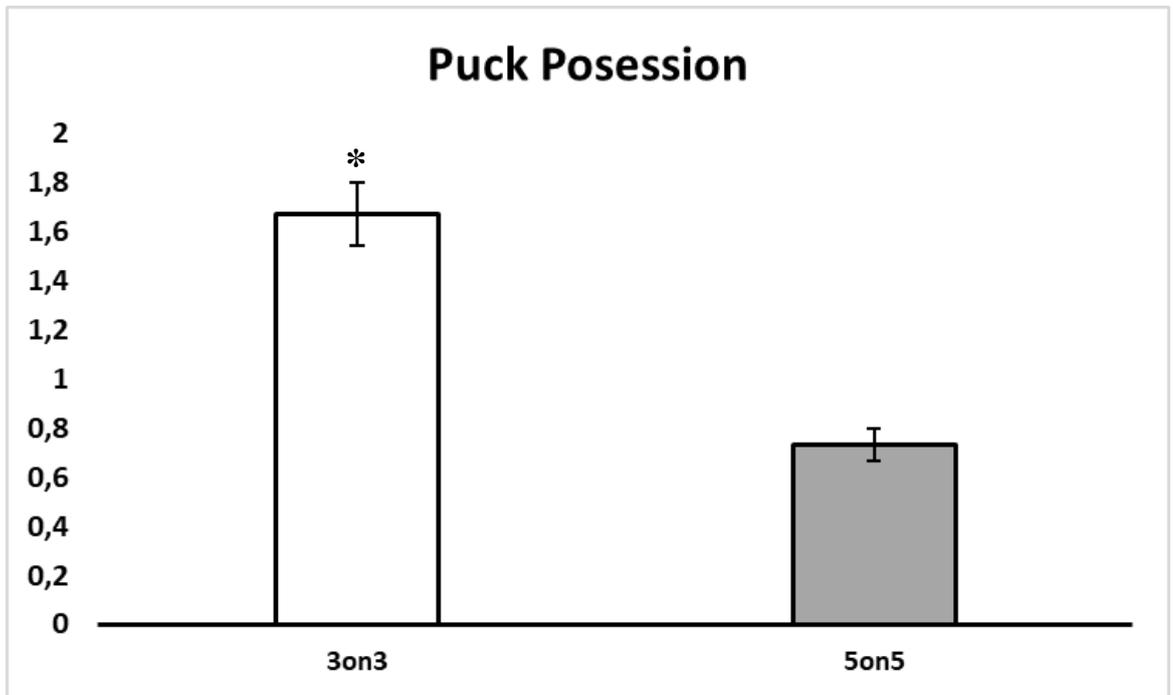


Figure 42. Average puck possession for an individual in 3-on-3 cross-ice game compared to 5-on-5 hockey.

10 Discussion

Ice hockey requires a high-level of technical skills in order to play the game. Every skill can be learned through repetitions and practice. Players are more willing to practice, learn new skills, and developing their techniques by playing games.

The collected results show that an individual playing the same amount of ice time in 3-on-3 cross-ice hockey and 5-on-5 hockey game results in a much higher use of skating skills. The skating skills included turns, tight turns, pivots, stops, and starts, and in a 3-on-3 game format, an individual player used more than double the amount of skating skill actions compared to the 5-on-5 full ice hockey. Surprisingly, the game situations did not change the outcome of the result as well. The small area 3-on-3 cross-ice games were dominating the collected data of individual skill actions compared to 5-on-5 normal sized hockey rink.

Referring to the collected data and to the outcome of the skating skills, we can see that the stops and starts in the 3-on-3 games were higher compared with the full sized hockey game meaning more changes of directions occurred during the game which has an effect also on the physical development of the athletes. These results can be associated with the area within which a player can use on the reduced ice surface. The small area 3-on-3 cross-ice games required more maneuvers from players while they played the game.

By improving skating skills, other skills can be performed, or learned much faster. By looking at the figure 15, one can see that it presents the data of skating vs. puck carrier. The amount of stick pressure was largely higher in cross-ice 3-on-3 games than the result in 5-on-5 hockey. When players can create pressure on the opponent, the chances to steal the puck and take the possession back are higher. The amount of steals were 4.55 times more in 3-on-3 cross-ice game in comparison to 5-on-5 game. Defending the puck carrier and stealing the puck back goes back again to changing the direction of play and changing the situation more quickly in the 3-on-3 game.

According to the presented results we can assume that transition of possession could be higher in 3-on-3 cross-ice game as compared to the 5-on-5 games.

When the two game formats were compared, not only the skating skills and defending skills showed higher repetition numbers in 3-on-3 cross-ice game, but also the amount and the quality of the passes increased. The reason for this might be that the space is limited and the pressure from opposing players comes much faster, and players are kind of forced to pass the puck in order to maintain the puck possession. The reduced ice surface also favors the quality passes. The reason for this is that players use short give-and-go passes to each other in the reduced ice surface of the 3-on-3 game.

In terms of passes, the amount of some of the received passes was also a larger number in 3-on-3 cross-ice games compared to the 5-on-5 games.

In this research, the results indicate that an individual have more shots to the net per game, which could lead to more scoring chances per game as well. Scoring chances than can turn into goals. The types of shots were also in favor of the 3-on-3 cross-ice game. The results show that the amount of shots are higher than compered to 5-on-5. The number of slap shots taken are close together in these two game formats. While the space is reduce in cross-ice 3-on-3 game, the time for players to prepare a big slap shot could explain why the results are close to each other.

With a high tempo and more shots produced in 3-on-3 game format allows not just the players to have high repetition of certain shots, but also keeps the goaltender awake and ready. The high amount of shots to the net requires more retention for goalkeepers as well to stop the puck, which could lead faster reaction time and more awareness.

Ice hockey is a game of puck possession. Whichever team controls the puck more dictates the game. This is the case no matter if the game is played in 3-on-3, 5-on-5, or other formats.

In 3-on-3 cross-ice game, the puck possession by an individual player was visibly higher. A single player in the 3-on-3 cross-ice format possessed the puck at an average of 1.67 times, while in 5-on-5 the number decreased and the puck possession per individual is 0.73.

When we are talking about the game of ice hockey, the course of the game fall into three categories: loose puck, when one's team have the puck and when the opponent has the puck. In order to one succeed in these situations, the use of technical skills are required which later can be implemented in team play system or strategies. One of the most important skill to master is skating. When one mastered a good skating skills have a higher chance to be first on the lose puck and re-gain the possession of the puck. The skating skills could include forward skating, backward skating, turns, pivots, stop and starts, and the combination of these will help players to rapidly change their direction, modify their phase and to be first on the puck.

Skating skills have a big part also not just to re-gain the possession, but also when one's team possess the puck and plays offence. By playing offence, the puck carrier is one of the most dangerous to the opponent's net. The puck carrier can shoot or pass the puck to a teammate in order to break down the opponent's defense. This paper presented the most common used shooting skills for an individual intending to score goals and to be more successful in offense. However, not just the puck carrier has job to do in offence,

players who play in offence without puck need to use also the skating skills, such as get separated for the defending defenders and create a passing line while supporting and offering more option to puck carrier. As soon as the role changes in offence, for example the puck carrier passes the puck to his/her teammate receiving skills take place.

The team who plays without the puck, or does not possess the puck plays defense. Their main focus is to prevent scoring the team who possess the puck. Thus, requires a good positioning between the opponent and own's net. To accomplish that, one needs to have a good base of skating skills. By preventing the opponent to score, defending team usually pressures the offensive team out from the area where the chances to score are higher, most commonly known as slot area. Thus, demands a good defending and using the technical skills presented in this research such as skating, stick pressure and tackle, in order to make pressure to the opponent. When the defender is one stick length from the puck carrier applies the stick pressure and tackles the opponent to separate him/her from the puck in pursuance of have the puck back and create offence.

Instantly when the puck possession, or the game situation role changes so does the use of technical skills. Regardless of the amount of player on the ice, these technical skills presented in this thesis plays a huge role in order to play ice hockey.

These data are valid and shows the use and the importance of the technical skills in both formats. The data was collected from 12 games, and 36 individual players were analyzed for this research. The end-results were analyzed and verified by using the Students T-test formula. Based on the students t-test the collected results showed a statistically significant difference comparing the technical skills actions in 3-on-3 compared to 5-on-5 game format. As the results presented in the chapter 10 show, we can say that by playing 3-on-3 cross-ice game, all the measured technical skills showed a higher number of repetitions compared to 5-on-5 game.

Playing small area 3-on-3 cross ice games develops the technical skills used in ice hockey, and the small area games are also a good format to have two simultaneously games at the same time on a normal ice surface. The utility of the ice is more appropriate and can be used or shared the ice surface with another team during practice. For example, by splitting the ice surface in two during practices, it can lead to having more ice times and reduce ice cost for all participants.

The 3-on-3 cross-ice game format could be a good tool for countries or clubs where the normal sized ice rink is unavailable or does not exist. Players and goaltenders can still have a chance to learn to play hockey and master the technical skills of ice hockey with possible rink size restrictions which they can implement later on when playing the 5-on-5 game.

As a conclusion, small area 3-on-3 cross-ice games are a great way to play hockey and at the same time develop one's technical skills. This research showed that by playing on a smaller surface, an individual player uses his technical skills in a same amount of playing time more often than in 5-on-5 game format. With the reduced ice surface, players are more active and rely more on their individual skills to succeed in the smaller games. By using only one part of the ice, more players could be on the ice at the same time which could provide more ice time for all players and allow them to learn hockey through small games.

In the future, conducting deeper research into certain specific technical skills could be accomplished. For example, breaking down skating into all of its small parts such as how many times a player use his inside or outside edge of his blade could be analyzed. Another research could focus on the decision making or communication between players through small area games.

The Steva System is a good tool to collect data about repetition, but improving the quality and the position of the camera and the video recording could help when analyzing individuals. A tracking system would be a good tool for future studies. A tracking system follows every player in the game and with this tool, the data acquired would be more precise, contain more detailed information, and have more validity.

The results of the study clearly suggests to the IIHF that 3-on-3 is a game format to promote to their MNAs to be played not just recreationally but even until U15 as a valid league format in order to increase the number of repetitions in technical skills and opportunities for youths to play hockey in game like situations.

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PLAYING SKILLS IN DIFFERENT ROLES

1 OFFENSIVE PUCK CARRIER

- Scoring**
- Shooting from the slot (the element of surprise; different shots)
 - Passing to an open player in the slot
 - Carrying the puck to a better place (challenges the defense; fakes)

Offensive pressure

- Carrying the puck from a tight space to an open one (or into another zone)
- Passing forward (to an open space, to a player in motion)
- Dumping the puck to move the game forward
- Switching roles to non-puck carrier (give and go)

Puck control

- Moving and protecting the puck
- Passing backwards or laterally to a player in an open space

Transition from Offense to Defense

- Dumping the puck out or in
- Quick role change into defensive player

2 NON-PUCK CARRIER

- Scoring**
- Getting open for a pass to the slot
 - Offensive pressure by blocking (for puck carrier/player without the puck)
 - Readiness for rebounds
 - Screening the goalkeeper

Offensive Pressure

- Getting open for a pass forward
- "Clearing" space in front of the puck
- Supporting the puck carrier by blocking

Puck control

- Getting open for back passes of lateral passes
- Making space for the puck carrier by blocking

Transition from Offense to Defense

- Supporting the puck carrier, supporting the attack
- Quick change into defensive roles

3 DEFENDING THE PUCK CARRIER

- Preventing the opponent from scoring (main responsibility lies with the goalkeeper)**
- Cooperating with the goalkeeper
 - Blocking shots

Regaining Possession of the Puck

- Playing defense against the puck carrier
- Playing defense against non-puck carrier

Preventing Offensive Pressure from the Opposition

- Staying between the opposition and your own goal (defensive side)
- Steering the puck carrier into a small space (protecting the middle)

Transition from Defense to Offense

- Quick change into offensive roles
- Depth in defense

DEFENDING PLAYERS WITHOUT THE PUCK

Preventing the Opponent from Scoring

- Covering opponents in the slot
- Defending blocking opponents

Regaining Possession of the Puck

- Positioning, man-to-man defense
- Cutting off potential passing lines
- Closest player ready to recover loose pucks

Preventing Offensive Pressure

- Staying between the opposition and your own goal
- Cutting off potential passing lines toward the center
- Supporting the defender that is on the puck; double-teaming the opponent
- Transition to defending the puck carrier

Transition from Defense to Offense

- Defensive depth: fourth player makes attacks possible
- Quick change into offensive roles

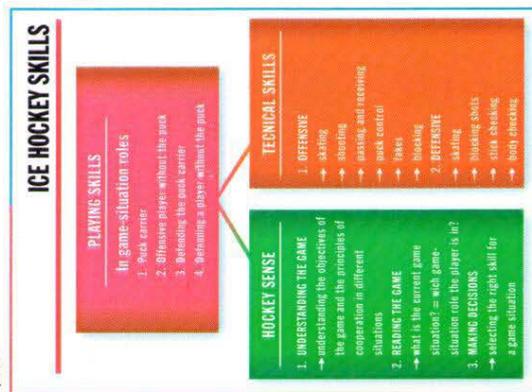


Figure. (adapted from thesis, Leppanen & Westerlund).