

# **Defining skill variables between U16 national team and non-national team ice hockey players**

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<p>The purpose of the research is to determine does sport specific technical skill tests separate U16 national team players from those who are not selected to U16 national team. When the research started, was assumed three things: 1. The U16 male ice hockey national team players have better results in sport specific technical skill tests than those who are not selected in the U16 national team, 2. Height or weight of the player doesn't affect to the results of the sport specific technical skill tests, and 3. Date of birth doesn't affect to the selection of national team.</p> <p>Investigated subjects (N=230) constituted of 1995 born male ice hockey players. One group (N1=43) is U16 national team players and second group (N2= 187) is rest of 1995 born male ice hockey players who belonged to the C1- juniors SM- league teams. There were 13 teams that were tested, plus the U16 national team. Finnish Ice hockey Association decided these 13 teams. These 13 teams were tested in their own operating environment, during September and October of 2010. U16 national team players were tested in Sport Institute of Finland in Vierumäki, during national team camp in October 2010.</p> <p>The material of this thesis is constructed from broader research. This broader research is funded by Ministry of Education and it includes test results of football and basketball as well as ice hockey. The research includes sport specific technical skill tests, anthropometrical test, physical tests, and questionnaires related to players' training background, self-evaluation and coach assessment. Only the results of height, weight, date of birth, and sport specific technical skill tests of ice hockey are analyzed in this thesis.</p>	
<b>Keywords</b> Skill, sport specific technical skills, ice hockey, motor learning, developmental stages.	

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# 1 Introduction

The development of fundamental movement skills starts a continuous and long-term process of skill learning. An individual has to face three different stages of skill learning, and has to be able to move through gross motor errors with the help of feedback of the coach and own self-evaluation abilities. The steps of skill learning process cannot be skipped, and the skill cannot be mastered with a short-sighted attitude, and without open-mindedness. The instructor and the teacher have to be educated to understand different motor skills, and how these skills vary, develop, and improve. Also the teacher has to be informed about the developmental stages and educate him or her to take the most out of the optimal training windows.

This research is a part of Kilpa ja huippu-urheilun tutkimuskeskus, KIHU, research that is supervised by Niilo Konttinen, and his workshop. KIHU's organized research collects data from basketball, football, and ice hockey. KIHU's research is funded by Ministry of Education, and its purpose is to determine the factors that influence to the development of elite players in team ballgames. Test situation included sport specific technical skill tests, physical tests, and questionnaires related to players' training background, self-evaluation, and coach assessment. Before the test day, subjects received agreement form where they had to ask guardian's approval to participate to test situation. During the test situation players' height and weight were measured. In ice hockey, teams made physical tests by them selves. Hannele Frosman is the main researcher of the research, and she is doing her doctoral thesis of this data.

Data of this thesis covers selected sport specific technical skill tests of ice hockey, players' height and weight, and date of birth. By doing this research the answer is looked for the questions: 1. Do sport specific technical skill tests separate the U16 male ice hockey national team players from those who are not selected in the U16 national team? 2. Does height or weight affect to the results of sport specific technical skill tests? 3. Did the date of birth have a meaning when U16 national team was selected?

## 2 Skill

Childhood is critical period for skill learning, and especially the ages between 0-7 and 7-14 years. To become skilful, athlete must have had versatile sport background with thousands of repetitions. By the sport versatility it is not meant that the athlete has to do 30 different sports. Sport versatility comes when athlete does few different kinds of sports and learns new skills thru thousands of repetitions. Scientific research of Ericsson, Krampe & Tesch-Römer, (1993, 363-404) has shown the evidence that it takes about eight to twelve years or 10000 hours practice for a talented player to reach elite level in particular skill. Based on that study Ericsson and Charnes (1993) introduced 10 years and 10 000 hours rule for deliberate practice. It means that it takes 10 years or 10 000 hours intensive practice to achieve excellence. Skill learning is based on repetitions. The amount of repetitions should be monitored and followed during training, and the amount of repetitions should be taken under consideration when periodization is done. (Kemppinen, 2003, 162) Still the skill learning process requires much more than just the repetitions, for example use of different kinds of senses, suitable environment, past experiences, and cognitive abilities of individual. (Jaakkola, 2010, 55-72).

Usually sport versatility is understood too much through skill. Sport versatility takes place when training concentrates on both physical and technical training. Through millions of repetitions athlete has developed large, automatic, movement model capacity to the brain and muscle nerves, to the central nervous system. This large movement capacity can be noticed when athlete is older and learns new skills fast. Athlete can apply the skills, and athletes' skill implementation is exact. To master the learned skill athlete has to be able to perform it in changing environment. (Lampinen, 1999, 47-49; Hakkarainen, Jaakkola, Kalaja, Lämsä, Nikander & Riski, 2009, 140-141; Lampinen & Forsman, 2008a, 435-436; Lampinen & Forsman, 2008b, 77-78; Hakkarainen 2009 Hyvä harjoittelu analyysi; Zelasnik, 1996, 67-71; Wulf, 2007, 4; Kemppinen, 1998, 53)

Good example of sport versatility is alpine skier Kalle Palander. He is good at gymnastics, he can perform aerobic series in the rhythm of music, he is excellent skater, skilful tennis player, he can perform different skills on balance board, and he is good soccer player. He is good at every ball-

game, and at every game that requires accurate movements. That background has enabled his development in sport specific skills of alpine skiing. (Lampinen ,1999, 48)

## **2.1 What is skill**

The skill means that movements are done in rhythmically correct order. Skilful performance requires continuous movement that combines different phases one after another. Skill has to be mastered to that level that athlete doesn't have to think of the particular technique of the skill while performing. (Hakkarainen et al, 2009, 237) After learner has learned the skill, the outcome of the learning process cannot be noticed externally from the learner. Skill learning occurs internally, and it is difficult to measure results of the learning process externally. When an individual uses time to think of the technique, while producing the movement, the performance will be disturbed and the result is not what is wanted. According to the study made by Gabrielle Wulf, individual who adopts external focus enhances the accuracy of performed or learned skill (Wulf 2007, 7). According to Wulf, McConnel, Gärtner & Schwarz (2002, 171-182) the real life skills such as sport specific skills will be enhanced when people adopt external focus. The better the skilled performance is the less it requires conscious thinking. Skill learning develops permanent connection to our central nervous system, and because of that it is quite easy to return the mastered skill in to our mind even though we hadn't have practiced the skill for a long time. (Lampinen & Forsman, 2008, 435; Miettinen & Vuohiniemi, 1999, 156)

Skill learning process means series of events in our body which are reached through many repetitions and which leads to permanent changes to produce movement. During the learning process our body contains many parallel processes. (Lampinen & Forsman, 2008, 435) Howard N. Zelasnik (1996, 68) stated that the most important parts of the brain for motor skill learning are: the cerebral cortex, the cerebellum, and the basal ganglia. Anticipation is part of the skill and the skilful performance, as well as the ability to maintain high-level performance in hard circumstances. Skilled performance is always a result of thousands of repetitions. (Hakkarainen et al 2009, 237)

## **2.2 Motor learning**

Learning in general has been defined in variety of ways. First, learning is a process of acquiring the capability of producing skilled actions. Second, learning occurs as a direct result of practice or experience. Third, learning cannot be observed directly, as the processes leading to changes in behavior are internal and usually not available of direct examination. Fourth, learning is assumed to produce relatively permanent changes in the capability of skilled behavior. (Schmid & Lee, 2005, 302) Typically motor skills are classified into two general categories, gross motor skills and fine motor skills (Magill, 1993, 9-11). Because of skill learning process is a continuum (figure 1 and figure 2) (Fitts & Posner, 1967, 12-14), skill is hard to categorize into two categories. In addition to these two categories motor skills can be divided into discrete motor skills, serial motor skills, continuous motor skills, open motor skills, and closed motor skills. (Magill, 1993, 10-12)

### **2.2.1 Gross motor skill**

Gross motor skills are characterized as involving large musculature and a goal where the precision of movement is not as important to the successful execution of the skill. Fundamental of movement skills are categorized to belong under gross motor skills. (Magill, 1993, 10)

### **2.2.2 Fine motor skill**

These are the skills that require control of the small muscles of the body. Generally these skills involve hand – eye coordination and require a high degree of precision of movement for the performance of the particular skill at a high level of accomplishment. For example writing and sewing are fine motor skills. (Magill, 1993, 11)

### **2.2.3 Discrete motor skill**

Discrete movements are those where there is recognizable beginning and end, like shooting a puck or light switch. The performer must adhere these beginning and end point boundaries if the task is to be performed successfully. Discrete skills can be very rapid, requiring only a fraction of a second. They can also require considerable time for completion, like writing a signature. (Schmid & Lee, 2005, 2; Magill, 1993, 11).

### **2.2.4 Serial motor skill**

Discrete motor skills can be put together in a series. If this occurs, it is considered that the skill is serial motor skill. For example playing a piano is a discrete motor skill that requires pushing the keys of piano, and when an artist starts to play a song he or she puts series of keys pushing together. (Schmid & Lee, 2005, 21; Magill, 1993, 11)

### **2.2.5 Continuous motor skill**

Continuous motor skills have arbitrary beginning and end point. Individual determines the beginning and end points of the skill. The performer, or some external agent, rather than the characteristics of the skill itself, determines the beginning and end points of the skill. In addition continuous skills are repetitive in nature in that they require the person to repeat movements during course of performing the skill. Good examples of continuous motor skills are swimming and running. (Magill, 1993, 11)

### **2.2.6 Open motor skill**

Open motor skills are those skills where the environment is constantly changing. The performer must act according to the action of the object or the characteristics of the environment. Open skills are typically externally - paced because the performer cannot initiate the action at will but must initiate action on the basis of the characteristics of an external source. (Magill, 1993, 12)

### 2.2.7 Closed motor skill

Closed motor skills take place under unchanging environmental conditions. The object or environment in closed motor skills waits to be acted upon by the performer. For example skills like bowling and shooting an arrow are closed motor skills. For these activities it is typical that environment is not changing and movement can be planned in advance. (Magill, 1993, 13; Schmid & Lee, 2005, 21)

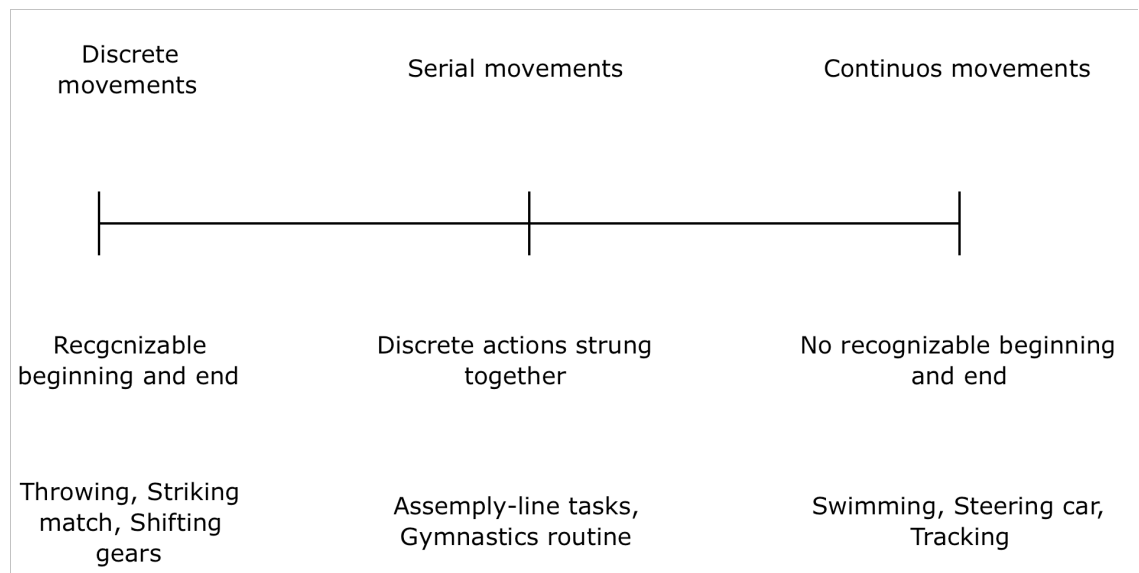


Figure 1. Modified from Schmid and Lee (2005,21). Continuum of discrete, serial, and continuous classification to motor behavior.

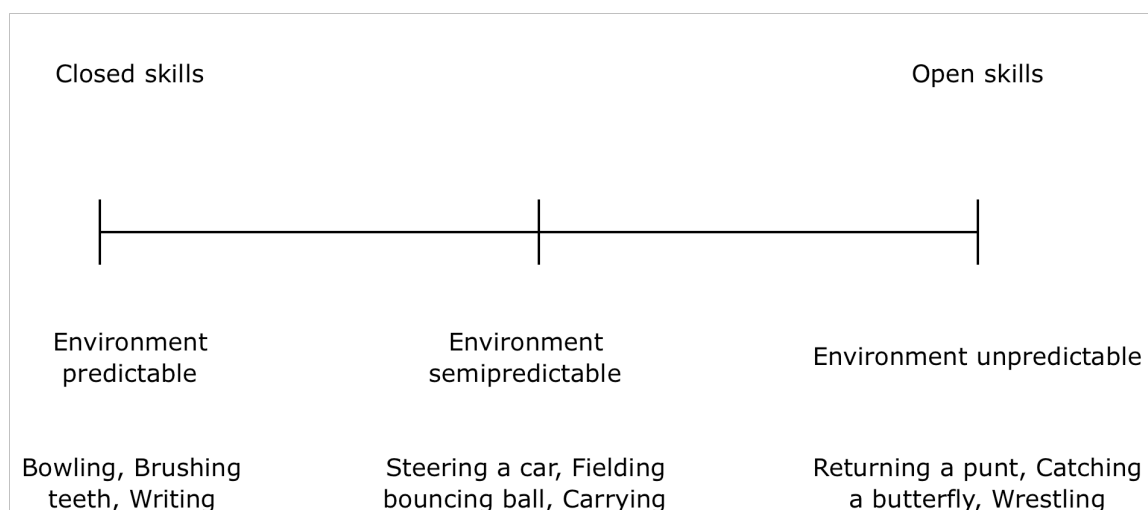


Figure 2. Modified from Schmid and Lee (2005,22). Continuum of open and closed motor behavior.

During the learning process, learning proceeds differently in closed motor skills and in open motor skills. As a result of practicing the same kind of skill as a closed motor skill and as open motor skill. Practicing of open motor skill develops more motoric programs to the nervous system than practicing the skill as closed motor skill. (Jaakkola, 2010, 107-108) According to Hämäläinen (14.03.2011) high level games or high intensity practices where players has to use their open motor skills, will prepare players more towards international ice hockey.

### 2.3 Steps of skill learning

Before the development of sport specific skills and large movement capacity, athlete must learn the fundamental of movement skills. The age period for the development of fundamental movement skills is age between two and seven years old. (Hakkarainen et al 2009, 141; Miettinen, 1999, 55-56) Fundamental movement skills are: balance, the handle of instrument, and movement skills such as jumping, kicking, and hitting. (Autio, 2001, 29-30; Miettinen, 1999, 56) These fundamental movement skills are the foundations of sport specific skill learning. Usually child learns these skills before he or she starts the elementary school. When a child reaches the age of six, usually nervous



system is developed 80-90% of its maximum. After this point brains continues developing but this development is based on improvement between neural connections. Versatile motor stimulus should be emphasized until a child reaches the age of seven. At the age of seven to eight child starts to learn specialized movements. This period lasts until the child starts pubertal age. After child has reached pubertal age it is still recommended to maintain and develop these abilities in the terms of sport analysis. (Hakkarainen et al 2009, 141; Miettinen, 1999, 55-56; Sinclair, 1989, 76, Jaakkola, 2010, 76-78) Figure 3 describes the general time periods for skill learning.

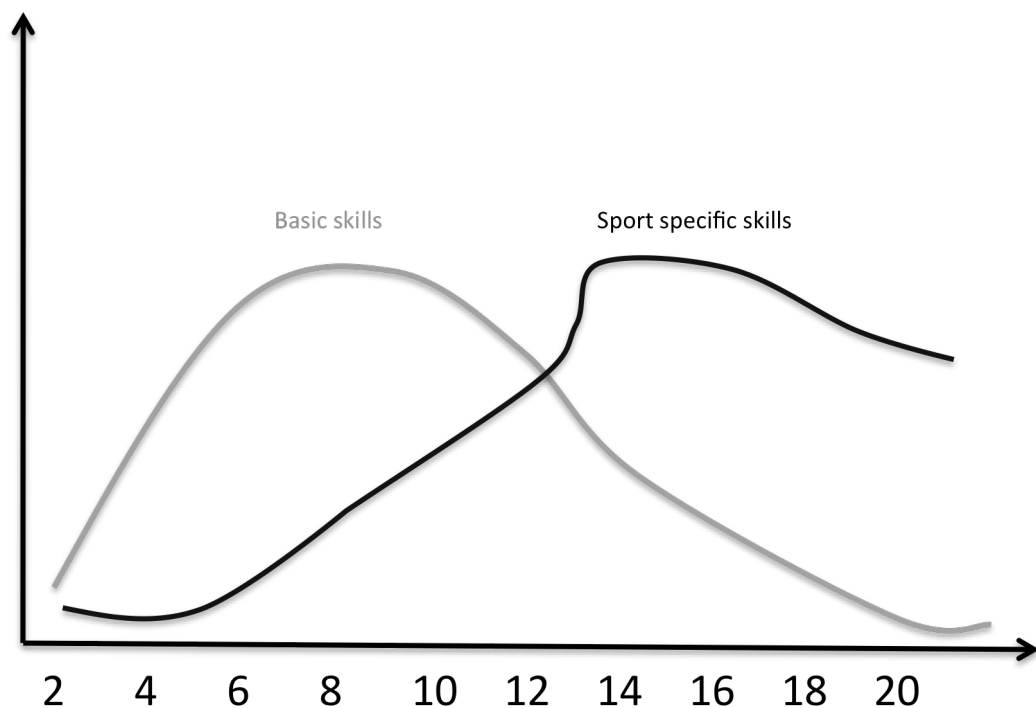


Figure 3. Modified from Mero, (1990). The picture describes basic skills and sport specific skills emphasized training periods, based on the age, to ensure the best outcome of the skill training. Grey line is basic skills, black line is sport specific skills, and the horizontal arrow describes years.

Even though motor skills vary from hard to easy, the learning process is similar that individuals have to go through. Terry McNorris (2004, 175) and Richard A Magill (1993, 58-81) divided skill learning in three stages. These stages are cognitive, associative, and autonomous stage. Fitts and Posner (1967, 12-14) proposed that there is high similarity between highly practiced skills and reflexes. Fitts and Posner proposed (1967,

15) also that the cognitive stage represents the first portion of continuum of learning process, and the learner is not able to move rapidly from stage to stage. According to Kempainen (2003, 76) learned skill stays in movement memory. So after a long time of not performing a particular skill, it is easy for an individual to perform the skill. For example riding a bicycle.

The ability to learn a new skill depends on several factors. These factors are; Capacity factors such as coordination or accuracy, attitude like open mindedness, body type, cultural background, emotions, physical fitness, learning style, body's level of maturation, motivation, and previous physical and social experiences. Also properly used feedback creates a belief to an athlete that he or she has the skills to successfully meet of the physical, and mental challenge faced. (Weinberg & Gould, 2007, 147; Lampinen & Forsman, 2008, 435; Wulf, 2007, 4)

The teaching of skill should be divided into sequences. For example mathematics provides a very useful example. Algebra is not taught before geometry, and trigonometry is not taught before geometry. Learner has to be able to transfer and apply learned information into new information. Transfer of learning is generally defined as the influence of having previously practiced skills transferred to the process of learning a new skill or performing the skill in new context. A learner is able to apply a learned skill or knowledge from one situation to another learning situation. It appears that this influence may be positive, negative, or neutral. (Magill, 1993, 70-72) Positive transfer occurs when learning in one context improves performance in some other context. Negative transfer occurs when learning in one context impacts negatively on performance in another. (Perkins & Salomon, 1992, 3-4) According to Magill (1993, 71) negative transfer effects are typically temporary and are usually overcome rather quickly with practice. Neutral transfer occurs when experience of a previous skill has no effect on the learning of a new skill. (Magill, 1993, 71)

## **2.4 Three stages of skill learning**

Skill learning process progresses always from the easy performance to the difficult performance. Learning a new skill begins first by visualization, athlete shapes an image of the procedures included in the new skill and especially of the objectives that these procedures aim to achieve. (Lampinen & Forsman, 2008, 435; Autio, 2001, 56; Kempinen, 1998, 69-73) As learners begin to acquire a new skill, they confront some specific cognitive oriented problems. What is the basic task? How do you score in this game? Each of these example questions indicates the basic and cognitive level at which the new learner is operating in early part of learning process. (Magill, 1993, 59) The ultimate goal of skill learning process is that a learner is able to perform the required skill in disturbed, and still the movement pattern of the skill is pure (Kempinen, 2003, 148)

### **2.4.1 Cognitive stage**

At the beginning of the learning process a learner shapes an image of the new skill. This stage is marked by a large number of errors. As a result of making mistakes and experimenting, different parts are going to fit to each other. With these different parts athlete starts to form continuous movement chains. So the importance of a proper feedback is emphasized because the learner makes mistakes. The stage is marked by performances that are highly variable. The beginners may know that they are doing something wrong, but they are not able to improve their performance for the next time by them selves. It is important that the coach is able to demonstrate the right technique. The learners need specific information what they have to do, for the skill been performed correctly. So teachers use of instructions, models, augmented feedback, and various other training techniques is most effective during this phase. (Lampinen & Forsman, 2008, 435; Magill, 1993, 59; Schmid & Lee, 2005, 403)

### **2.4.2 Associative stage**

Autonomous stage begins after the individual has determined the most effective way of doing the task. During the second stage the errors are fewer, and the movements are more gradual and more consistent. This stage requires a lot of right repetitions and the performance starts to work and skill starts to develop. After countless correct repetitions the performing of the skill gets easier, and gross errors starts to disappear. The learners are able to detect errors by them selves, but the ability to locate the errors is not perfect. During associative stage variability of the movement from attempt to another also begins to decrease. (Lampinen & Forsman, 2008, 435; Autio, 2001, 56; Magill, 1993, 59; Schmid & Lee, 2005, 403)

### **2.4.3 Autonomous stage**

In this stage the skill has become almost automatic or habitual. The learner has learned to perform most of the skill without thinking of it at all. Skilled performers are able to detect their own errors, and they are also able to make proper adjustments to correct them. Variability of performances are very small. This stage is a result of tremendous amount of practice, countless amount of repetitions. This stage allows the performers to produce the skill without having to concentrate on the entire movement. They are able to attend to other aspects that will permit optimal performance. (Lampinen & Forsman, 2008, 435; Magill, 1993, 59)

## **2.5 Elements of skill**

The accurate and versatile use of different skills requires various abilities, elements, of the athlete. These abilities are called the elements of skills. These elements are: 1. Orientation: an athlete is able to realize his or her limbs and body postures and their changes. 2. Separation: an athlete is able to control muscle tension and relaxation as well as the athlete is able to control the fluidity of the movement and economy of the movement. 3. Reaction: an athlete has the ability to respond appropriately and quickly

in different senses received stimuli. 4. Balance: an ability to maintain balance and an ability to achieve balance once the athlete has lost it. 5. Rhythm: an athlete has the ability to perform the movement in appropriate rhythm and timing. 6. Combining: the ability to perform movements at the same time and ability to combine different movements in to the one movement, like hand and feet movements simultaneously. 7. Variability, adaptability, and adaptation: an athletes abilities to adapt the use of force and range of movements in the changing situations and conditions. 8. Ability to control: an accuracy and stabilization of movement. 9. Ability to differentiation: an ability to make a difference between the movements that are closely similar. 10. Agility: an athletes ability to change the direction of body movement quickly. 11. Anticipation: an ability to create large movement capacity and ability to take advantage of it. (Lampinen & Forsman, 2008, 437; Miettinen & al, 1999, 58; Autio, 2001, 49-51) Table 1 describes the elements of skill implemented in ice hockey.

Table 1 is modified from Finnish ice hockey association Herkkyyskausivalmentaja kurssi, (2010).

<b>Element of skill</b>	<b>Relevance of specific element in ice hockey</b>
Orientation	Opponent has knocked down the puck carrier and still puck carrier is able to perform exact and accurate shot
Separation	In front of the net puck carrier is able to tense his or her legs and middle body to maintain balanced position, and at the same time puck carrier is able to relax his or her hands to relaxed puck handling.
Reaction	Player is able to react to the rebound situation fast
Balance	In front of the net player is able to keep balanced game stance even though the opponent tries to distract the game stance
Rhythm	Fluent and accurate wrist shot directly from skating
Combining	Player is able to combine for example a shot and deke or player is able to combine skating, dekeing, and shooting
Variability, adaptability, and adaptation	Player is able to modify the range of the movement of the shot
Ability to control	Player is able to shoot exact shot to the place where he or she wants
Ability to differentiation	Player is able make difference with to different techniques, for example between the old and new skating technique
Agility	Player is able to change the movement direction in one on one situation
Anticipation	Player is able to score from the rebound that will come out from the goalie surprisingly

### 3 Developmental stages

Developmental stages are periods in child's growth and development when development and improvement of particular attribute is the most effective. Body's growth is quite steady during childhood. When the child reaches puberty, the growth spurt starts. In both sexes the greatest growth factors that influence to body's growth during pubertal age are anabolic hormones, testosterone, and growth hormone. Body system maturation is described in figure 4. (Mero & Jaakkola, 1990, 45) It gives guidelines to periodization for coaches when planning individual training programs for children and adolescents. (Hakkarainen, Niemi-Nikkola, Mäenpää, Potinkara, Kujala, Jaakkola & Kantosalo, 2006, 8). Early maturation of nervous system allows improvement of basic skills and coordination during ages between 1-10. (Mero & Jaakkola, 1990, 45; Finnish ice hockey association, 18.12.2010) Growth of the central nervous system in the early stages of childhood is so rapid that the structures reach about 90% of their adult size at the age of six (Sinclair, 1989, 76). Biological maturation of muscles, tendons, ligaments, respiratory, and cardiovascular systems during puberty enables efficient initiation of power, speed, and endurance training. Puberty usually begins for girls between the ages of 12-14, and boys between 13-15 years. Nevertheless, when we take into consideration the maturation level of the body, puberty does not start at the same time for everybody. (Mero & Jaakkola, 1990, 45; Finnish ice hockey association, 18.12.2010)

Lampinen and Forsman (2008, 415) have introduced in their book called *Laatua käytännön valmennukseen* the developmental stages. First stage is during the years between 6-12, the second stage is during the years between 12-15, and the third stage is during the years between 15-20. Before the age of six, it is important to practice fundamental movement skills such as jumping and handling the instrument (Miettinen, 1999, 156).

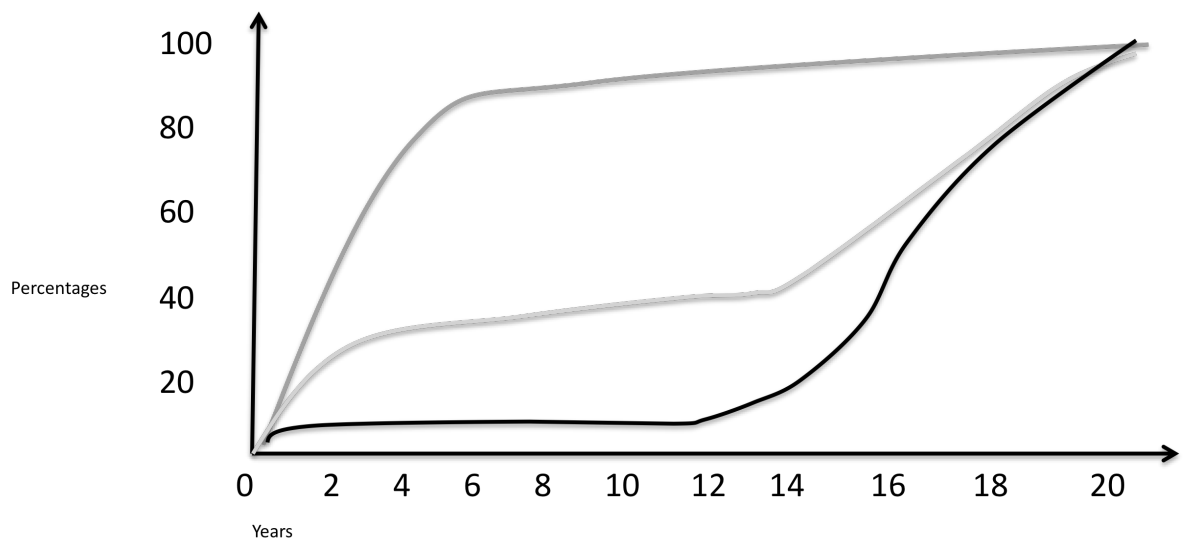


Figure 4 is modified from Sinclair (1989, 77). The growth and development of main human body systems are described as percentage of the final level of development. The horizontal arrow describes years. Dark grey describes nervous system, light grey describes general growth, and black describes genital size. The vertical arrow describes years.

Currently most athletic training and competition programs are based on chronological age. Figure 6 describes three types of developers. Late developers have high probability to not be selected to first national team. Also for the late developer and the early developer the developmental stages are different. For example individual who has late puberty, have longer developmental stage for sport specific skill learning. (American development model, 2009) Rapid development of physical characteristics in children and adolescents may easily convey a false impression. Because of that skill learning is easily neglected. (Kemppinen, 2003, 144). Skill learning does not occur if development of physiological attributes of the athlete has contributed to the better results in assessed skills (Jaakkola, 2010, 17).



Musch and Gronding (2001, 156) suggested that child who is born in January has an 11-month physical and developmental advantage compared to those who are born in December (figure 5). Barnsley and Thompson (1988, 174-176) came to conclusion that older players (born in January) continue to play minor hockey till a later age than do the younger players (born July – December), and they proposed that players born at the later half of the year had stronger tendency to drop out than does the players born at the first half of the year. They found that large proportion of players of higher caliber teams are born early in the year. Musch and Gronding (2001, 148) presented also that in NHL those who are born at the first months of the year were overrepresented, whereas there is a lack of players born in the last half of the year. Study made by Barnsley, Thompson and Barnsley (1985, 23-28) supports the idea that ice hockey players born in the first half of the year, benefits from their early maturation compared to their peers born at the later half of the year. They found that professionals playing in the NHL were twice as likely to have been born in the first quarter of the year compared to last quarter. Wainwright (2007) proposed that investigations into highest level of amateur hockey leagues reveal similar findings. Wainwright proposed also that the relative age effect influence also to education system. According to Wainwright 72% of the children who are held back in the grade one are born in the second half of the calendar year, and 41% of them are born in the last three months. Cote, Baker and Abernethy discussed (2007, 194) that in sports, where strict age group structuring based on the calendar year is followed, players born in the first half of the year might benefit from their date of birth when teams are selected because of their early maturation compared to their later born peers. Baker, Horton, Robertson- Wilson, and Wall (2003) suggested that categorizing children by age can create training inequalities and reduced opportunities for younger children.

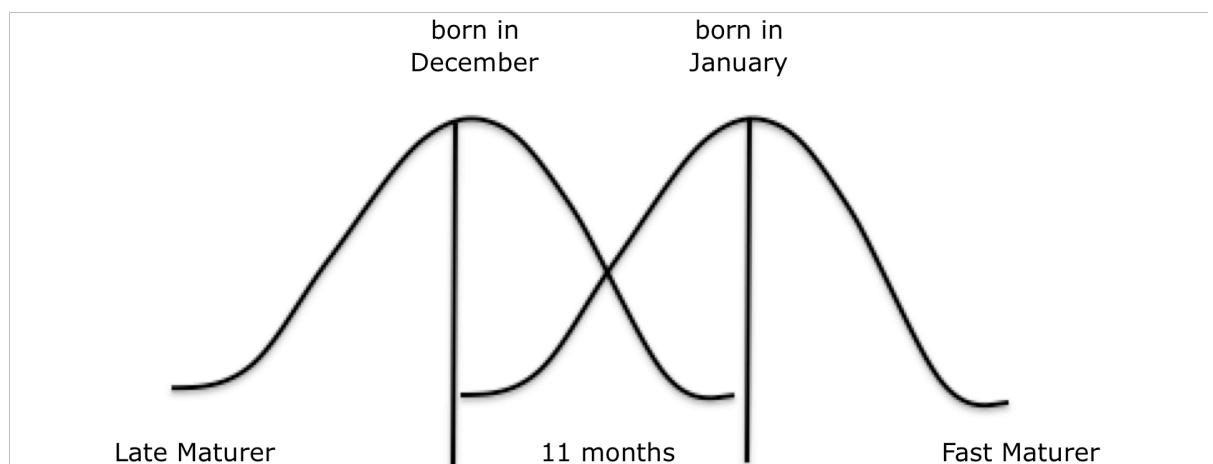


Figure 5. Modified from Musch and Gronding (2001, 156). Figure describes the illustration of the physical maturity advantage of children born in January over those born in December of the same year. Children born in January have 11 months advantage to those who are born in December.

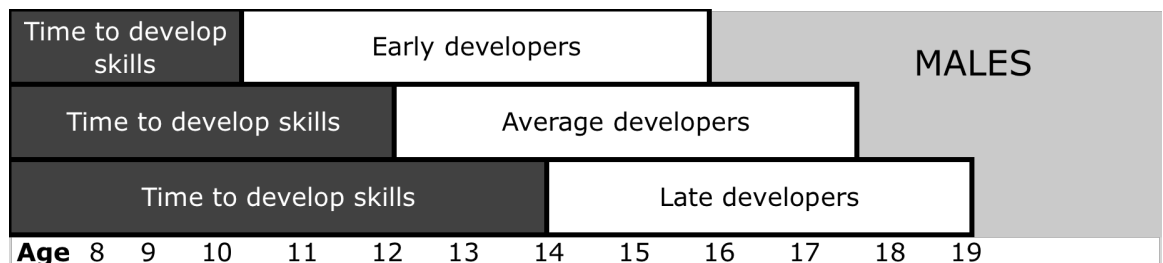


Figure 6. Modified from American Development Model (2009). Black bars describes the time when the skill development should be emphasized, white bars describes the time when individual starts their pubertal age, and grey describes when the individuals' childhood is considered to be over.

### 3.1 6-12 years old

According to Lampinen and Forsman (2008, 415) improvement of coordination, flexibility, balance, and agility is important during this stage to ensure the basement for sport specific skill learning for the future. It is also important to do versatile exercises

for different elements of skill. During this stage one should also start preparatory training for speed, speed power, and aerobic endurance. Even though developmental stages for those attributes come only later. Anaerobic endurance training and strength training should be avoided.

### **3.2 12-15 years old**

According to Lampinen and Forsman (2008, 415) the developmental stages for coordination, flexibility, balance, and agility are over. From physical characteristics, developmental stages of speed, elasticity, and speed power are at in this stage. Efficient training is possible if the preparatory training, during last stage, is done correctly. Also developmental stage of aerobic endurance starts at this stage and continues until the age of 20. Aerobic endurance training should be done, so that it doesn't descent the efficiency of speed or elasticity training. Anaerobic endurance training and strength training can be started during this stage, even though the developmental stages for those are after 15 years.

### **3.3 16-20 years old**

According to Lampinen and Forsman (2008, 415) an individual should concentrate to master his or her skills to the top level. The base of the motoric skills has to be broad and the sport specific skills should be handled well at this stage. This allows sport specific skill practicing in changing situations, and mastering sport specific skills to the high level. During this stage training should be done in the terms of sport.

### **3.4 Developmental stages of skill learning**

The skill is divided under fundamental movement skills and sport specific skills categories. Fundamental movement skills are balance, the handling of an instrument, and movement skills. (Miettinen, 1999, 56) Motoric development starts during the first year when child starts to learn automatic movements such as diving reflex or sucking reflex (Jaakkola, 2010, 77). Ages between one to two child starts to learning basic movements

such as running, throwing, and jumping. During this period performances are very un-coordinated. The time period in children growth between the birth to age of two is very important. Children will gain his or her first experiences related to movement skills during this period. (Jaakkola, 2010, 76-79) During the ages between three to seven basic movement skills are learned. (Miettinen, 1999, 56; Lampinen & Forsman, 2008, 76; Hakkarainen et al, 2006, 8) Neural pattern reach about 90% of its adult size by the age of five to six, and during the development of neural pattern fundamental of movement skills should be learned. (Sinclair, 1989, 88) Developmental stage of movement capacity is between the years of seven to 12. Years between 12 to 15 sports specific skill training should be emphasized, and after 15 sports specific skills should be mastered to the high level. (Lampinen & Forsman, 2008, 414-415; Finnish ice hockey association, 2010) Developmental stages are not exact time periods, so usually the developmental stage of sport specific skill training starts after the basic skills are stabilized. If fundamental movements are not stabilized it is recommended to practice those even though the actual developmental stage is over. (Hakkarainen et al, 2006, 8-9) Even though the developmental stages for skill learning are between 2 and 15, the skill practicing continues to adult life (Sinclair, 1989, 89) Table 2 describes developmental stages, when the improvement of particular attribute is the most effective.

Table 2. Modified from Lampinen and Frosman, (2008, 416).

<b>Practice stages for skill learning</b>	<b>General Skill requirements</b>	<b>Sport specific Skill learning</b>	<b>To the top Mastering the sport specific skills</b>
---- Preparatory training	6-12 years Coordination, Basic skills	13-15 years Speed	16-20 years Endurance
xxxx Developmental stage	Versatility, balance	Elasticity	Power
oooo Training type			

## 4 Specialization models

The basic idea of skill learning is that fundamental movement skills and movement patterns are learned during the childhood, between the years of 2 - 12. After this point sport specific skill training should be emphasized. Of course before the age of 13 it is recommended to do sport specific skill training. (Finnish ice hockey association, 14.3.2011; Finnish ice hockey association, 18.12.2010) Primarily the most important thing for children sports is to teach children to engage in the variety of sports (Miettinen, 1999, 55). Through large movement capacity it is easier for an individual to learn sport specific skills that need accurate implementation. Stabilization of particular skill is always a result of thousands of repetitions. (Lampinen & Forsman, 2008, 436)

Sports are classified to early specialization and late specialization sports. As an example early specialization sports are gymnastic, rhythmic gymnastics and figure skating. In these sports athletes reach their full potential during the years 14 to 22. Late specialization sports include for example ice hockey and track and field. The late specialization sports' main emphasis of training in early years is to development of general motor and technical skills. (American Development Model, 2011; Balyi, 2001, 25-28; Canadian Sport for life, 2007) Typical characteristic for early specialization sports is that deliberate practice starts during the sampling years, because of the nature of the sport. It requires early sport specific specialization in training. In late specialization sports number of deliberate practices increases while child gets older. It is typical for late specialization sports that during the sampling years deliberate play plays important role in training. (Cote & Hay, 2002, 496; Cote, Baker & Abernity, 2007, 193)

Ericsson, Krampe and Tesch-Römer (1993, 399-400) came to conclusion that despite of the sport and its requirements to start deliberate practice, deliberate practice is needed to improve and excel in specific domain. Also they found out that performer who reached higher levels tended to start deliberate practicing from two to five years earlier than did the less accomplished performer.

## **4.1 Early specialization model**

Early specialization sports require a four-phase model. This four-phase model includes: 1. Training to train stage, 2. Training to compete stage, 3. Training to win stage, and 4. Retirement stage. The challenge of early specialization model is to avoid over simplifications in training. Every early specialization sport has to create a model of its own based on the four- stages. (Balyi, 2001, 25-28) It is common that in early specialization sports sampling years are replaced by specializing years (Cote & Hay, 2002, 487, 498).

## **4.2 Late specialization model**

Ice hockey is classified to be a late specialization sport (American Development Model, 2011; Hockey Canada, 2011). The main emphasize of training in late specialization sports during the first two phases, during the sampling years, is in development of general motor and technical skills. Late specialization model includes six- stages. (Balyi, 2011) Based on Balyis' model for example Canadian sport for life (18.02.2011) and USA Hockey (American development model, 2009) have made their own long term athlete development models. Next can be found Balyis six- stages model added with ADM guidelines and Canadian sport for life guidelines.

### **4.2.1 FUNDamentals**

The stage is directed to 6 – 9 years old males and 6 – 8 years old females. The objective of the stage is to learn all fundamental movement skills and built overall motor skills. This stage should be well structured and fun. This is the time when a foundation is laid for future acquisition of more advanced skills. (Balyi, 2003) At this stage it is important to create an environment where participants want to play hockey. They need to enjoy being at the rink and the learning of basic skills. (American development model, 2009) No periodization based competitions take place during this stage, but all programs are structured and monitored (Balyi, 2003). USA Hockeys American development model, ADM, guidelines advices that children should have 2 – 3 structured ice practices per week, the duration of 50 minutes per practice. Season lasts 20 weeks and includes

about 50 – 60 ice practices. According to ADM children should concentrate 75% of the time to other sports and 25% of the time to ice hockey. (American development model, 2009)

#### **4.2.2 Learning to train**

The stage is directed to 9 – 12 years old males and 8 – 11 years old females. The objective of the stage is to learn all fundamental movement skills. By replacing the fundamental movement skills training with sport specific skill training can be detrimental to child development in late specialization sports. During this stage all fundamental movement skills should be further developed and general overall sports skill training should be started. If fundamental motor skill training is not developed between the ages of 8 - 11 and 9 - 12 respectively for females and males, a significant window of opportunity has been lost, compromising the ability of the young player to reach his/her full potential. (Balyi, 2003) ADM training guidelines for this stage are: Four times per week structured ice practice, duration of 60 minutes, and all together 105 – 120 structured ice practices during seven months season. (American development model, 2009)

#### **4.2.3 Training to train**

The stage is directed to 12 – 16 years old males and 11 – 15 years old females. During this stage young athletes usually begin their major growth spurt during maturation. Because of that the coach should plan periodization to meet every individuals' needs and physical capability. The objective of this stage is to build the strong aerobic base, build strength towards the end of the phase and further development in sport specific skills. (Balyi, 2003) ADM recommendation is three to four structured ice practices per week, duration of 60 to 80 minutes. Total amount of ice practices per 7 - 8 month season is 120. ADM guideline for off-ice training is that individual should have 80 to 85 structured off-ice session during the season. Balyi (2003) recommends a 60% training and 40% of competition ratio during training to train stage. USA Hockey's member clubs offer Tier 1 and Tier 2 competitive teams as well as Hockey for Life programs that

meet each individual's ability and commitment levels in both the under 14 and under 16 classifications. At the ages of 14, 15 and 16, USA Hockey also runs National Player Development Camps for both boys and girls. This is also the stage where USA Hockey has its National Team Development Program - High Performance Clubs. Also at this stage USA Hockey offers opportunity to players to make a youth level U.S. National Team, either through the National Player Development Camp or the National Team Development Program. ADM model encourages athletes to participate in at least one complimentary sport. (American development model, 2009)

#### **4.2.4 Training to compete**

This stage is directed to 16 – 18 years old males and 15 – 17 years old females. This phase is introduced only after the objectives of training to train stage have been reached. Training – competition ratio changes now to 50:50. During the training to compete phase, high intensity individual event and position specific training is provided to athletes year-round. Athletes, who are now proficient at performing both basic and sport specific skills, learn to perform these skills under a variety of competitive conditions during training. (Balyi, 2003) ADM training and competition guidelines for training are that individual has about 200 structured ice practices per season, about 5 – 6 times per week. Season length is 10 months and it includes about 60 games. (American development model, 2009)

#### **4.2.5 Training to win**

The stage is directed to 18 years old and older males, and 17 years old and older females. In periodization competitions are taken under consideration. The objective of the stage is to maximize fitness preparation, and individual and position specific skills as well as performance outcome. This is the final phase of athletic preparation. All of the athlete's physical, technical, tactical, mental, personal and lifestyle capacities are now fully established and the focus of training has shifted to the maximization of performance. Training is characterized by high intensity and relatively high volume. Training to competition ratio in this phase is 25:75, with the competition percentage includ-



ing competition-specific training activities. (Balyi, 2003) According to Canadian sport for life (2011) a world-class athlete needs world-class training methods, equipments, and facilities that meet the demands of the sport and of the athlete.

#### **4.2.6 Retirement**

The objective of this stage is to retain athletes for coaching, administration, officials, or anything else that is related to sports. (Balyi, 2003) Canadian sport for life has named this stage as Active for life stage. Athletes can enter at this stage essentially any age. According to long-term athlete development plan, if children have been correctly introduced to activity and sport through first five stages, they will have the necessary motor skills and confidence to remain active for life in virtually any sport they like. (Canadian sport for life, 2007)

## 5 Ice hockey as a game

### 5.1 Game analysis

Ice hockey is a goal scoring game with two objectives, to produce a goal to the own team and prevent the opponent from scoring. These objectives have divided ice hockey to defensive game and offensive game. (Westerlund, 1997, 532) These categories are divided as defensive zone defensive game, defensive zone offensive game, neutral zone defensive game, neutral zone offensive game, attacking zone defensive game, and attacking zone offensive game. (Savolainen, 18.09.2008) The individuals' game is built around game situation roles. These roles are: 1. Puck carrier, 2. Non- puck carrier, 3. Defending puck carrier, and 4. Defending non- puck carrier. (Savolainen, 4.9.2008; Westerlund, 1997,533) Every team has a team tactics in ice hockey. Team tactics are co-operation between the players to achieve common goals against the opponent in the game. Co-operation between the players requires abilities to perform in different game situation roles. This requires good sport specific technical skills and game sense from the player. Figure 7 provides overall picture of the ice hockey, and player development. In the center of the game is player. Figure 7 is a framework for player and team development. (Westerlund, 1997, 531-532)

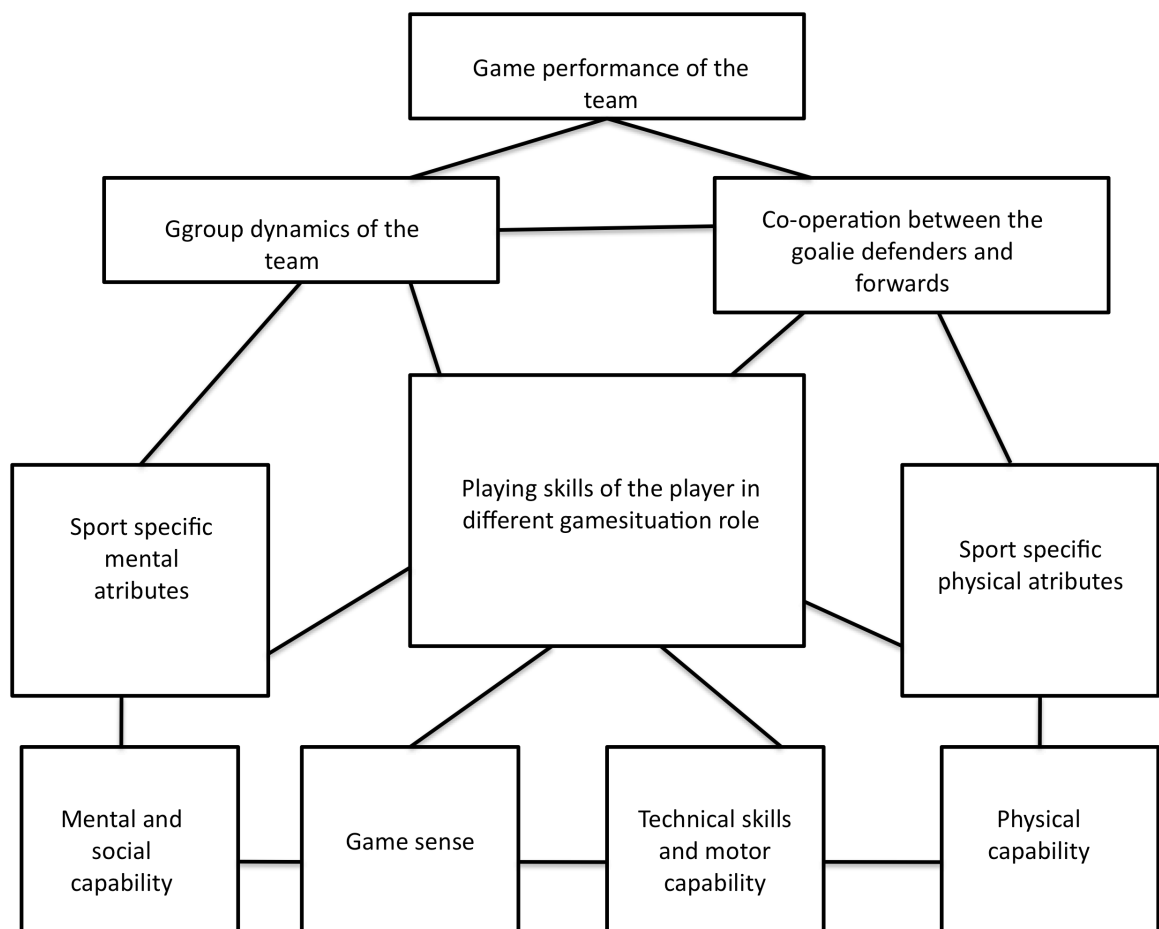


Figure 7. Modified from Westerlund, (1997, 531).

### 5.1.1 Individual analysis

Individual player has to have technical abilities to perform in different game situation roles (Westerlund, 1997, 531). Westerlund (1997, 536) presented game situation roles and required game skills that player needs for efficient play. A player has to have abilities to make fast decisions during the game in different game situation roles. A player has to choose the correct technique in correct situation. That's why the game sense is required from the player. The game sense means players abilities to make fast decisions that benefits teams play and team tactics. When sport specific technical skills are mastered to be high level, the decisions making gets easier. Game sense can be divided in to three categories: understanding the game, reading the game, and decision making skill. A player needs also physical abilities to perform. By physical abilities are meant

physiological, for example the ability to produce power, and sportive attributes. Those attributes will work as foundation for later stages sport specific physical training. (Westerlund, 1997, 527-544) Westerlund (1997, 536) presented hockey skills in the book “Nykyaikainen urheiluvalmennus”. In the figure 8 hockey skills are divided into three categories: game skills, game sense, and technical abilities. It describes the skills that player needs for efficient play in different game situation role.

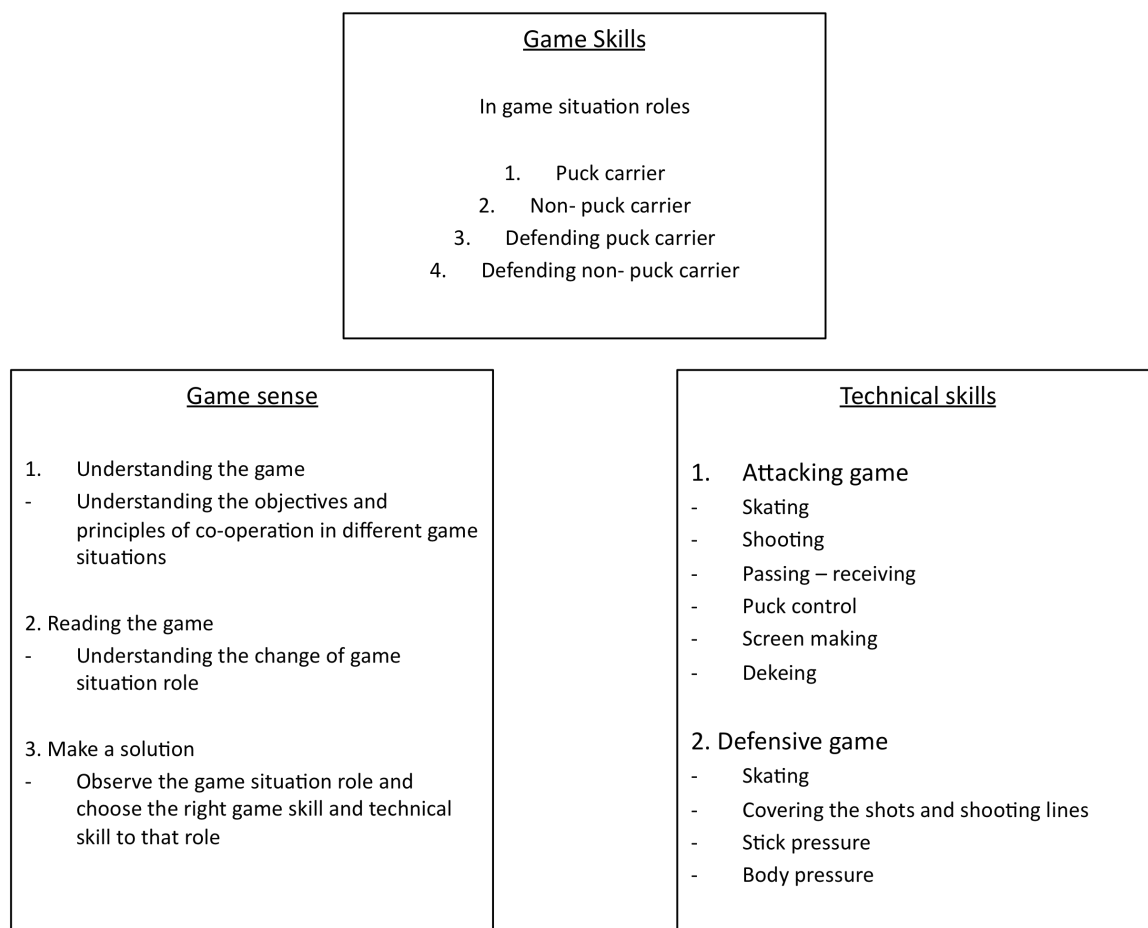


Figure 8. Modified from Westerlund, (1997, 536)

### 5.1.2 Team analysis

The basic idea of team tactics is to get the best performance out of the team and to prevent utilization of teams' weaknesses. Correspondingly it is attempted to strike for opponents' weaknesses. In team tactics it is essential that players will work together and are willing to do co-operation to achieve team goals in various game situations and game situation roles. One characteristic of effective team is that players are placed into

right roles in team tactics. Players are placed into roles based on their individual abilities such as technical skills, game sense, and physical abilities. (Westerlund, 1997, 532) According to Pekka Härmäläinen (14.03.2011) junior national teams are constructed so that the players whose technical skills, game skills, and understanding of the game are at the same level are paired or grouped in to the same line. Players who are put into same line must be in the same playing rhythm. Härmäläinen stated that if more skilled player is put next to weaker player, the better player adapts the rhythm of the weaker player. According to Härmäläinen powerful forward skating is the first limiting factor in national teams.

## **5.2 Technical skills of ice hockey**

Technical skills of ice hockey are divided under four categories: skating, puck control, passing and receiving, and shooting. Skating includes forward skating, backward skating, turns, crossovers, and stop and starts. (International Ice Hockey Centre of Excellence, 08.02.2011) When speaking puck control it consists of stationary puck control and moving puck control. Passing and receiving consists of stationary passing and receiving and moving passing and receiving. Shooting includes sweep shot, wrist shot, flip shot, snap shot, and slap shot. (Hockey Canada, 2005)

The essential foundation of specialized sport specific technical skills are created during the years of six to 12 through diversified sport specific skill and basic motor skill training. Because of good sport specific skills and their diverse management player is able to adapt technical skills to fit to game skills, player is able to make decisions, and player has the abilities to improve his or hers game skills combined to game sense. The player is able to utilize and adapt sport specific skills to fit into playing situation roles. (International Ice Hockey Centre of Excellence, 2011; Lampinen & Forsman, 2008, 76 & 415)

### **5.2.1 Skating**

A hockey player has to skate fast in different game situation roles. Skating power, skating speed, and skating versatility are needed repeatedly in short, powerful, and all out efforts with and without the puck. A player has to be able to change direction, stop, accelerate, and turn fast. (Westerlund, 1997, 540) Finnish Ice hockey Association presented Suomi Kiekko – tests (International Ice Hockey Centre of Excellence, 11.02.2011). In these tests skating has been tested three different ways: 1. 30m skating speed test, 2. Skating versatility track, and 3. 500m skating endurance test. Key points of skating are: 1. Skating stance, 2. Skating kick, 3. Leg return under the body, and 4. Glide. (International Ice Hockey Centre of Excellence, 31.01.2011) According to Jaakkola (2010, 166) the core skill of the skating skill is balance on the blade. In this study the skating is tested at skating versatility track.

### **5.2.2 Puck control**

Versatile puck control in different stances, and puck carrying and control in motion are the basic elements of puck control. These puck control elements allow the player to improve game performance. The key points of puck control are: 1. Contact with the puck, 2. Rhythm of the hands and the legs, 3. The range of movement, and 4. Observation of the game. (International Ice Hockey Centre of Excellence, 10.02.2011) In Suomi Kiekko – tests puck control is tested at puck control track.

Puck control can be divided in to stationary puck control, moving puck control, and puck control in motion. Stationary puck control reflects the situation usually where a player controls the puck in front of the body or next to body. The player changes the rhythm of the hands and legs occasionally. Moving puck control reflects the situation where a player pushes the puck while skating forwards, or drags the puck while skating backwards. Puck control in motion reflects the situation usually where a player maintains the readiness to pass or shoot. Player has to be able to observe the game and to be able to make fast decisions at the same time. (International Ice Hockey Centre of

Excellence, 10.02.2011) In this research the moving puck control is tested at puck control track.

### **5.2.3 Passing – Receiving**

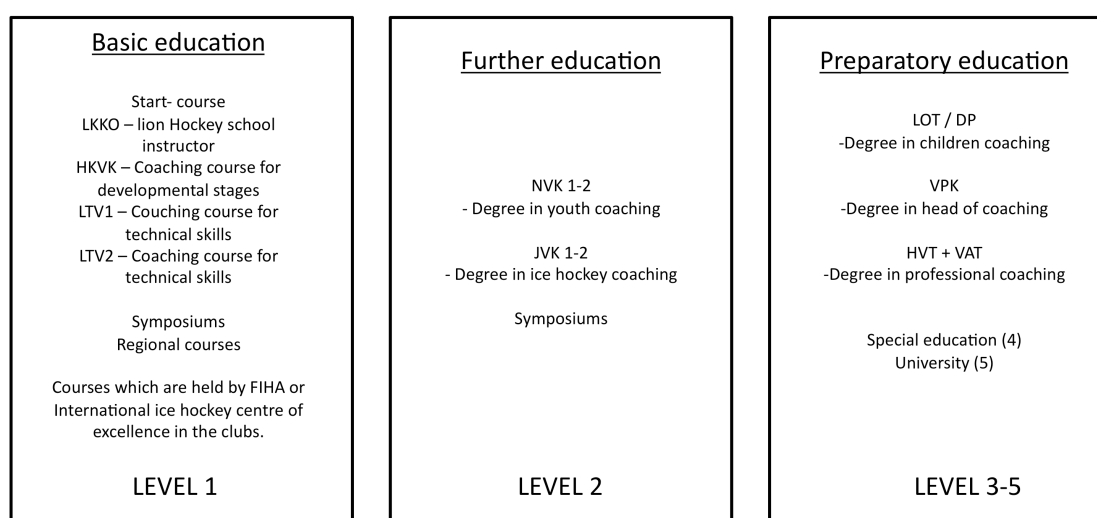
One part of the individual skill, and the puck control skill, is passing. (Hockey Canada, 2005) Passing can be divided into passing as a technical skill and passing as a game skill. (Rautakorpi, 17-18.12.2010) The most important thing of the technical skills of passing and receiving is to pass and receive the pass directly from skating (Tapola, 15.02.2011). Passing is related to the offensive game and it is one form of co-operation between the players. The objective of passing is to break opponents defensive game. Passing as a game skill for puck carrier can be divided in 1. Passing for creating space, 2. Passing for winning the space, and 3. Passing for creating the scoring chance. To receive the pass in order to continue the game non- puck carrier must read the game so that he or she enables the co-operation between the puck carrier and non- puck carrier. When creating / offering chance to pass for puck carrier, non- puck carrier has three objectives: 1. Offer a place to pass for winning the space, 2. Offer a place to pass for creating the space, and 3. Offer a place to pass for creating the scoring chance. (International Ice Hockey Centre of Excellence, 10.02.2011) Passing and receiving is not tested in this research.

### **5.2.4 Shooting**

Shooting is a technical skill that can win a game for a team. A player needs to know how to pick a right shot for the right opportunity. Shooting quick, hard, and accurate is the goal for any player on offence. Shooting can be divided into: 1. Slap shot, 2. Wrist shot, 3. Sweep shot, 4. Flip shot, and 5. Snap shot. (Hockey Canada, 2005) Shooting is not tested in this research.

### 5.3 Finnish Ice Hockey Association teaching skills

Figure 9 illustrates Finnish Ice Hockey Association education system for coaching and player development. According to Finnish Ice Hockey Association (4.9.2009) the basic principles of skill development are: versatile training on ice and out side of the ice prepares the players abilities for further year's sport specific skill development. Most of all through versatile training it is easier for a player to apply learned skills in to the game situation. The goal is that a player handles sport specific skills of ice hockey before puberty. Teaching sport specific skills is a long lasting process in which should be proceeded systematically. Learning sport specific skills before puberty allows player to learn to apply the sport specific skills in to game situations, and also it allows the player to learn to make decisions in the game situation. In order to develop and improve skill, the player should practice already learned skills in various and changing environment. Under 14 years old children training should be focused on basic skills and sport specific skills. The purpose of on ice practicing is to learn how to combine technical skills and game skills. Like stated earlier the main emphasize of 14 years old and younger training should be focused on sport specific skills and development of basic skills, but still it should be remembered that different games on and off the ice will improve players abilities to apply learned technical skills into game skills. In addition to playing, skill development should be monitored with various tests and performance controls.



6 years old - Adults

14 years old - Adults

6 years old - Adults

Figure 9. Modified from Finnish Ice Hockey Association (4.9.2009).



#### **5.4 Demands of international ice hockey / Demands of winning ice hockey**

Figure 10 describes the abilities that individual has to know and internalize to play successfully in international ice hockey. Hämäläinen (14.03.2011) stated that skilled players would easily adapt the requirements of international ice hockey. The player who has inadequate skills to play international ice hockey, have difficulties to internalize the demands of international ice hockey. Hämäläinen said that the best coach for developing junior are high level games where the junior has to perform at the limits of his or hers skills. He demands also that coaches will challenge them selves to held more demanding practices where players has to develop their motoric programs through open motor skill practicing. According to him there is always demanding coach behind the good and skilled age group in junior organization.

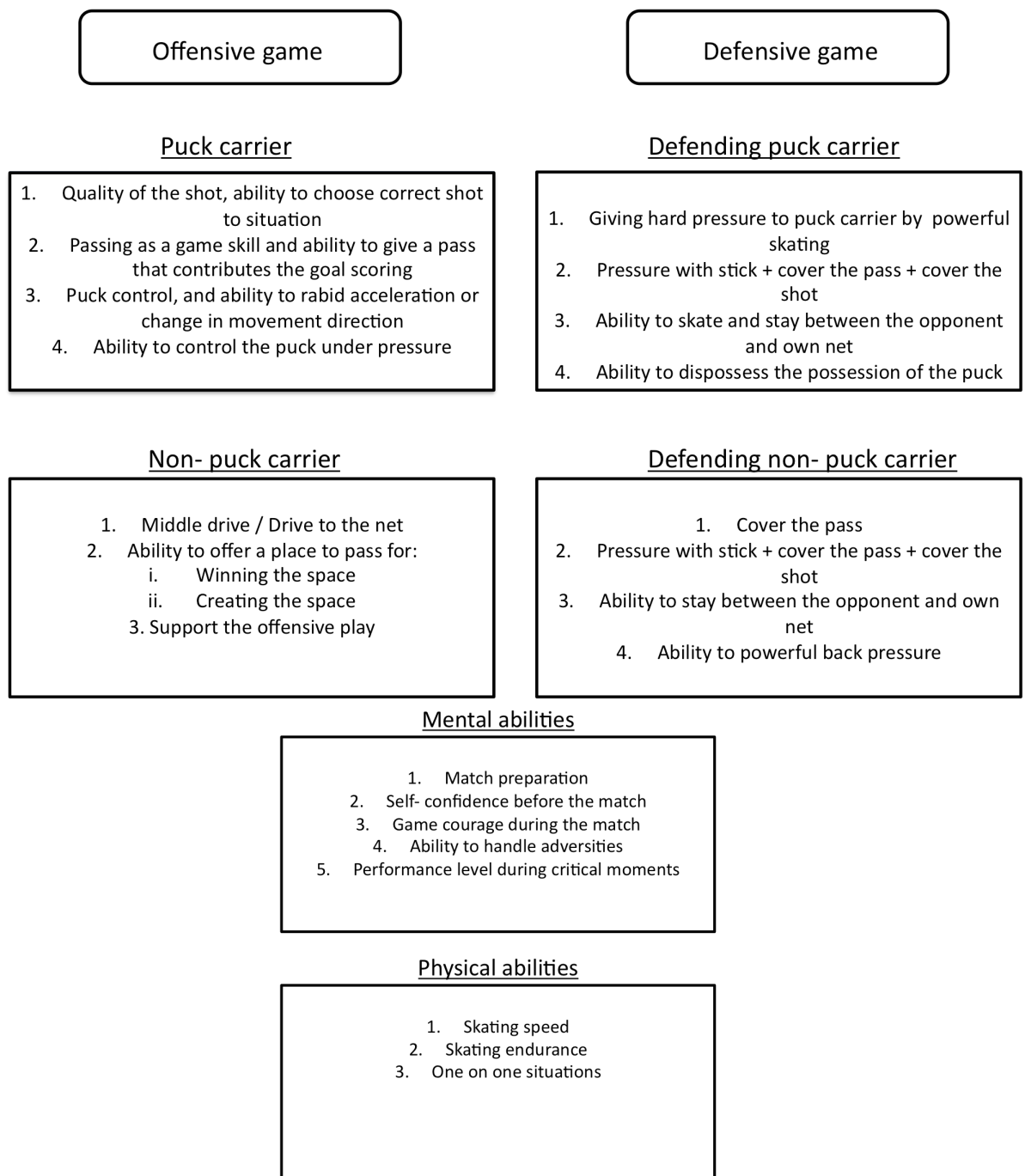


Figure 10. Modified from IIHCE and Pekka Hämäläinen. (International ice hockey centre of excellence, 08.02.2011a; International ice hockey centre of excellence, 08.02.2011b; Hämäläinen, 14.03.2011).

## **6 Aim of the study, study problems, and hypothesis**

In this research, 1995 born male ice hockey players' sport specific technical skill tests results, players heights and weights, and players date of births were examined. The purpose of the study was to determine if the U16 male ice hockey national team players have better results in sport specific technical skill tests than those who are not selected in the national team but played in the highest level in U16 SM- League. In the research the answer is searched for the following questions:

1. Do sport specific technical skill tests separate the U16 male ice hockey national team players from those who are not selected in the U16 national team?
2. Does height or weight affect to the results of sport specific technical skill tests?
3. Did the date of birth have a meaning when U16 national team was selected?

Based on the questions hypothesis are:

1. The U16 male ice hockey national team players have better results in sport specific technical skill tests than those who are not selected in the U16 national team.
2. Height or weight of the player doesn't affect to the results of sport specific technical skill tests.
3. Date of birth doesn't affect to the selection of national team.

## **7 Research methods**

### **7.1 Target group of the research**

The number of subjects in the research is 262. The group was constructed from 1995 born male ice hockey players, who belonged to the U16 national team or players who played at the highest U16 league in Finland. The group consists of both goalkeepers and field players. Results of the goalkeepers did not influence in this study. The number of investigated subjects in the thesis is 230 (N=230). This group consists 43 (N1) U16 national team players, and 187 (N2) non- national team players. Tested U16 teams were 1. Pelicans, 2. HPK, 3. KalPa, 4. Jokerit, 5. HIFK, 6. Blues, 7. TPS, 8. Lukko, 9. Ässät, 10. Kärpät, 11. Jyp, 12. Ilves, and 13. Tappara. Finnish ice hockey association made the selection of the teams, selected teams are men SM- League organization junior organizations C1- junior top teams. One team refused to participate in the research.

### **7.2 Study design**

The data collection was made through visits to the hometowns of U16 SM- league teams, into their own operating environment. Data collection was made during September and October of 2010. At the same time teams played qualification round to C-juniors SM- league (Finhockey, 2011). National team players were tested in the Sport institute of Finland during the national team camp at the end of October 2010. The test included two types of on ice sport specific skill tests, and questionnaires related to players' training background, self-evaluation and coach assessment. During the test situation players' height and weight was measured. In this thesis are analyzed only the results of sport specific technical skill tests, players height and weight, and players data of birth. Order of the on ice test and questionnaires varied depending on the team schedule.

The test day was arranged so that it would fit to both the researchers' and the team schedule. Before the test date, the agreement forms of the tests were sent to the clubs. The players had to ask a guardian's approval to participate to the tests.

### 7.3 Measurements

Analyzed on ice sport specific technical skill tests included skating versatility track and puck control track. On ice test were standardized so that the puck control track was made first on the neutral zone of the rink in two stations. These two tests are part of Finnish ice hockey associations Suomi Kiekko- tests.

#### 7.3.1 Skating versatility track

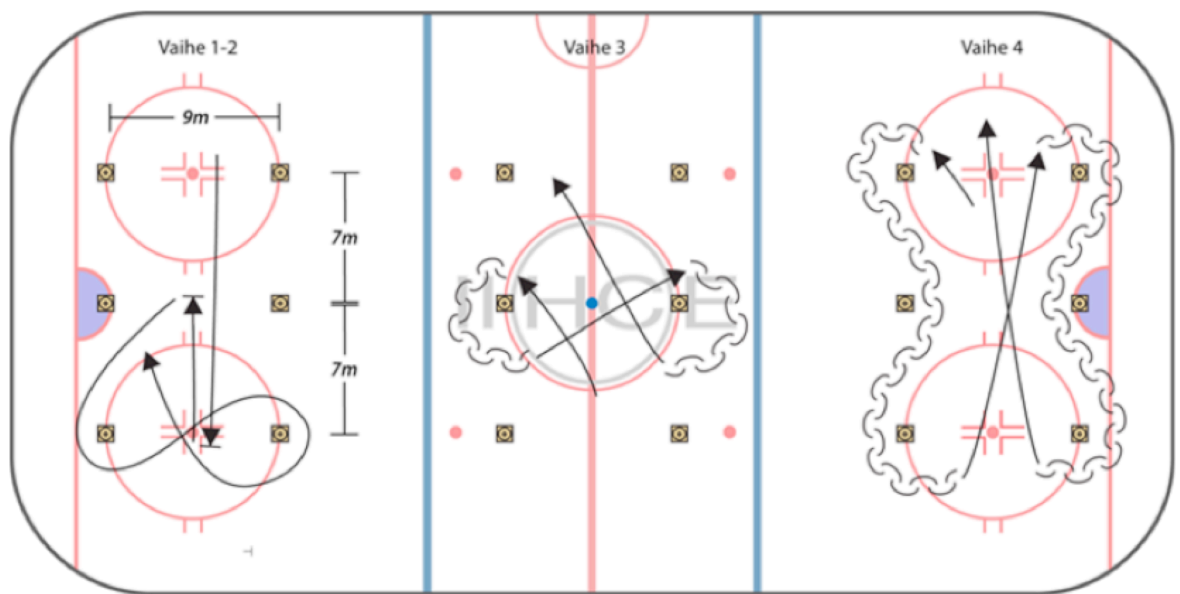


Figure 11 is modified from International Ice Hockey Centre of Excellence (11.02.2011), figure illustrates skating versatility track.

To gain a better understanding of the track the figure is drawn on the every zone of the rink (figure 11). The track is performed on the end zones of the rink. The track is four phased: 1. A player skates forward, and stops on the farthest line facing the end board of the rink. Then the player skates forward to midpoint of the track and stops facing the end board of the rink. 2. The player does speed turns first the left side turn and then the ride sided turn. 3. Then the player goes around the middle cones and does winger turns, first the ride sided turn and then the left side turn. 4. After that the player

continues forward skating and crosses the starting line and turns to backward skating, and zigzags three cones line. Then the player turns to forward skating and does the same thing from the right side. After zigzagging the cones the player skates forward and crosses the finishing line.

Skating versatility track test is standardized to hold on the end zones of the ice hockey rink, and in two stations that are reflection from each other. Standardized instructions of the measurement of the track and performance of skating versatility track in this research was:

1. The test is performed mainly at two times, so that the better time is marked. If the player is not able to get a result with two tries, the player can try to perform the track as long as the player is able to get a result.
2. Between the tries there has to be at least two minutes break.
3. Each test track was measured using the ropes that were made based on the distances of the figure 11. Place of the cones were marked on the ice with a spray paint. Each test was held with the same cones. Starting line / finish line, and the midpoint were marked on the ice with a spray paint.
4. A player places his front skate on the starting line, and stopwatch is started after a player moves his back leg.
5. The track is finished after a player has crossed the finishing line. A player is not aloud to dive over the finish line.
6. Time is marked hundredth second accuracy.

### 7.3.2 Puck control track

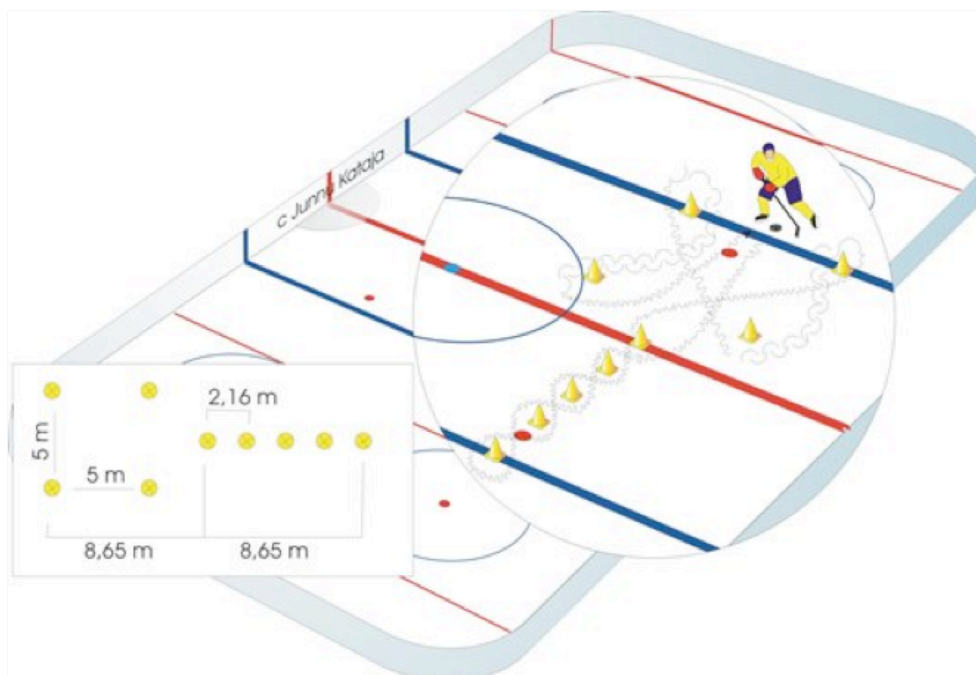


Figure 12 is modified from International Ice Hockey Centre of Excellence (11.02.2011), figure illustrates puck control track.

Puck control track test is standardized to held on the neutral zone of the ice hockey rink (figure 12), and in two stations that are reflection from each other. Standardized instructions for measurements of the track and performance instructors of puck control track in this research are:

1. The test is performed mainly at two times, so that better time is marked. If the player is not able to get a result with two tries, the player can try to perform the track as long as the player is able to get a result.
2. Between the tries has to be held at least two minutes break.
3. Each test track was measured using the ropes that were made based on the distances of the figure 12. Places of the cones were marked on the ice with a spray paint. Each test was held with the same cones.

4. Puck is placed on the blue line, in the middle of the cones, and to the same line than the first cone of the five cones line is. Forehand side of the sticks' blade touching the puck. Player places the front skate also on the blue line.
5. Stopwatch is started when player moves the puck.
6. First cone is gone around from the lower hand side. Left handed and right handed players do the track like a reflection from each other.
7. Puck and skates must go around the cone from the same side.
8. Vertical eight is started from the upper hand side, and between the cones. Player skates forward until he crosses the blue line. Player must turn to the backward skating before he or crosses the blue line again. After the player has done the vertical eight from upper hand side he will do it from the lower hand side.
9. If player loses the possession of the puck, in anywhere during the track. Player must get it back, and continue from where the possession of the puck was lost.
10. Track is finished after player has crossed the blue line, between the cones and with the puck. Player can't shoot the puck over the blue line after last cone. Player can't dive over the blue line.
11. Time is marked hundredth second accuracy.

#### **7.4 Statistical methods**

The statistical analysis was performed using Microsoft Excel 2008 for Mac spreadsheet program. To analyze the results significant value  $p < 0.05$  is used. The statistical significance is described using following symbols '\*' =  $P < 0.05$ , '\*\*' =  $P \leq 0.005$ , '\*\*\*' =  $p \leq 0.001$ . The results are described as averages and standard deviations (sd). Results of the height and weight are described using following symbols 'h1' = average height of the group N, 'w1' = average weight of the group N, 'h2' = average height of the group N1, 'w2' = average weight of the group N1, 'h3' = average height of the group N2, and 'w3' = average weight of the group N2. Averages and standard deviations of the sport specific technical skill test results based on heights and weights of the group N are analyzed and described in the following way: 'mw' = heavier than the average of the group N, 'ml' = lighter or as light as the average of the group N, 'mh' = taller than the aver-



age of the group N, 'ms' = shorter or as short as the average of the group N. Groups N1 and N2 own averages and standard deviations based on heights and weights are described following way: 'hw' = heavier than the groups own average weight, 'lw' = lighter or as light as the groups own average weight, 'th' = taller than the groups own average height, and 'sh' = shorter or as short as the groups own average height. Date of birth is described following symbols 'd1' = player is born at the first half of the calendar year, 'd2' = player is born at the second half of the calendar year.

## 8 Results

### 8.1 Skating versatility track

#### 8.1.1 Results of U16 national team(N1), non- national team(N2), and the whole mass(N) in skating versatility track

Average result of the whole mass (N) in skating versatility track is 35,32s,  $\pm 1,36$ s (figure 12).

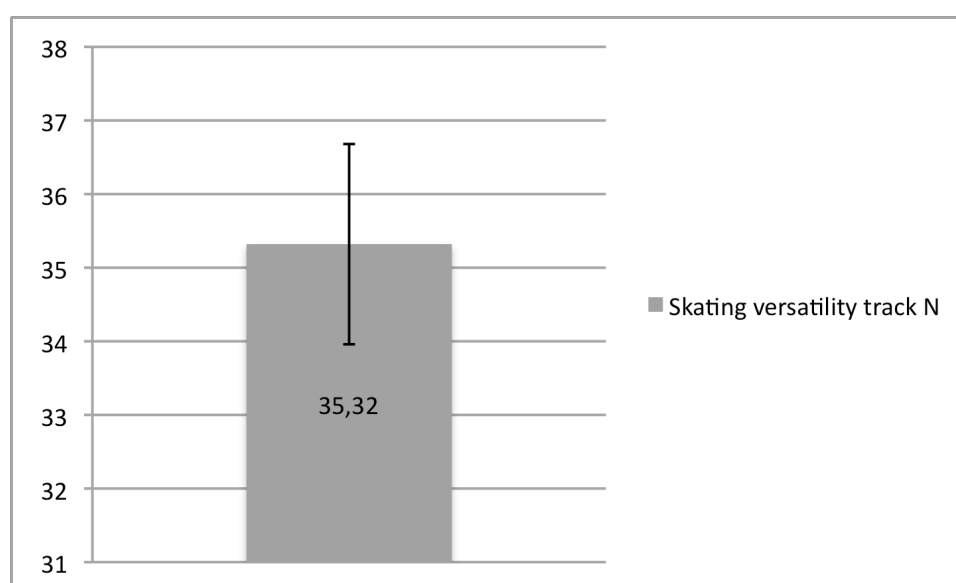


Figure 12. Time is marked in seconds on vertical axis. Figure describes average result (35,32s  $\pm 1,36$ s) of the group N in skating versatility track.

Average result of U16 national team (N1) in skating versatility track is 34,69s  $\pm 1,32$ s, and average result of non- national team (N2) in skating versatility track is 35,48s  $\pm 1,32$ s. Statistically the difference is significant between groups N1 and N2,  $p \leq 0,001$ . (Figure 13)

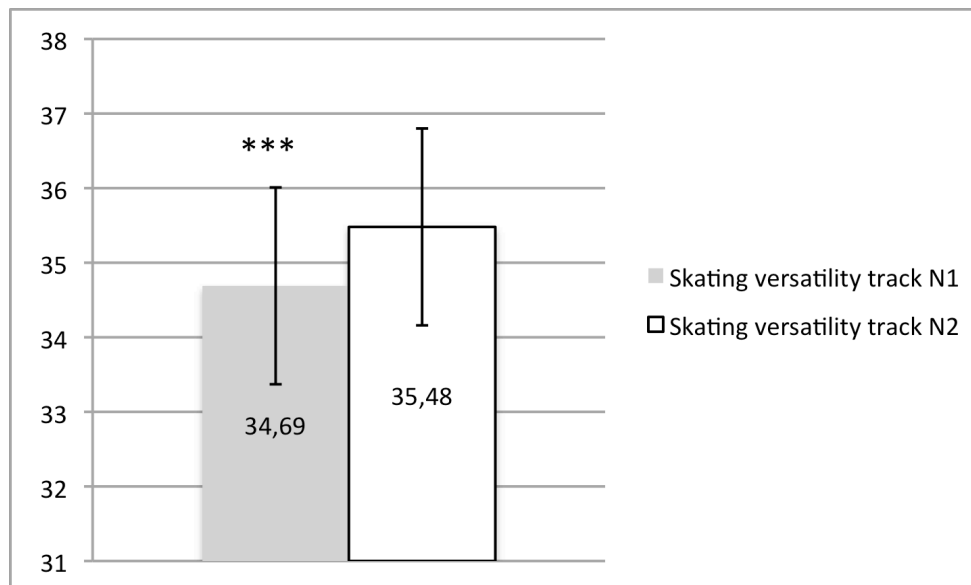


Figure 13. From the figure 13 can be noticed average results, sd, and statistical difference  $p \leq 0.001$  (\*\*\*) of the groups N1 and N2 in skating versatility track. Time is marked in seconds on vertical axis. Light grey describes average result ( $34,69 \pm 1,32s$ ) of N1 and white describes average result ( $35,48s \pm 1,32s$ ) of N2.

### 8.1.2 Results of N1 and N2 in skating versatility track based on date of birth

Table 3 describes the number of players of groups N1 and N2 who belong into the groups of players who are born during the first half of the year (d1), players who are born during the second half of the year (d2), and average weight(kg) and average height(cm) of the groups d1 and d2. Same distribution is followed when the results of puck control track is analyzed based on players date of birth. Five players from the group N2 didn't inform their date of birth.

Table 3. Table 3 describes the player distribution into the groups of d1 and d2, and average weight (kg) and average height (cm) of those groups.

		N1	N2
<b>d1</b>		<b>31</b>	<b>123</b>
	Average weight	70,96kg	67,42kg
	Average height	176,21cm	175,55cm
<b>d2</b>		<b>12</b>	<b>59</b>
	Average weight	69,0kg	64,64kg
	Average height	175,24cm	173,25cm

Player distribution of d1 and d2 based on the hw (heavier than the groups own average weight), lw (lighter or as light as the groups own average weight), mw (heavier than the average of the group N), ml (lighter or as light as the average of the group N), th (taller than the groups own average height), sh (shorter or as short the groups own average height), mh (taller than the average of the group N), and ms (shorter or as short as the average of the group N)

Table 4. Table 4 describes the number of players belonging to the group of hw, lw, mw, ml, th, sh, mh, and ms. From the table 4 can be found the explanations of abbreviations.

	N1	N2		N1	N2
<b>d1 / hw</b>	13	64	<b>d1 / th</b>	19	66
<b>d1 / lw</b>	18	59	<b>d1 / sh</b>	12	57
<b>d1 / mw</b>	20	65	<b>d1 / mh</b>	19	59
<b>d1 / ml</b>	11	58	<b>d1 / ms</b>	12	64
	N1	N2		N1	N2
<b>d2 / hw</b>	5	19	<b>d2 / th</b>	6	24
<b>d2 / lw</b>	7	40	<b>d2 / sh</b>	6	35
<b>d2 / mw</b>	7	18	<b>d2 / mh</b>	6	23
<b>d2 / ml</b>	5	41	<b>d2 / ms</b>	6	36

hw=heavier than the groups own average weight lw=lighter or as light as the groups own average weight

mw=heavier than the average of the group N ml=lighter or as light as the average of the group N

th=taller than the groups own average height sh=shorter or as short as the groups own average height

mh=taller than the average of the group N ms=shorter or as short as the average of the group N

Average results and sd of U16 national team (N1) and non- national team (N2) in skating versatility track based on d1 and d2 are: N1d1 34,61s  $\pm$ 1,34s and N1d2 34,90s  $\pm$ 1,29s, N2d1 35,41s  $\pm$ 1,28s, and N2d2 35,61s  $\pm$ 1,42s, (figure 14). Statistically the difference is significant between the groups N1d1 and N2d1  $p \leq 0,005(**)$ , and N1d2 and N2d2  $p \leq 0,005(**)$ .

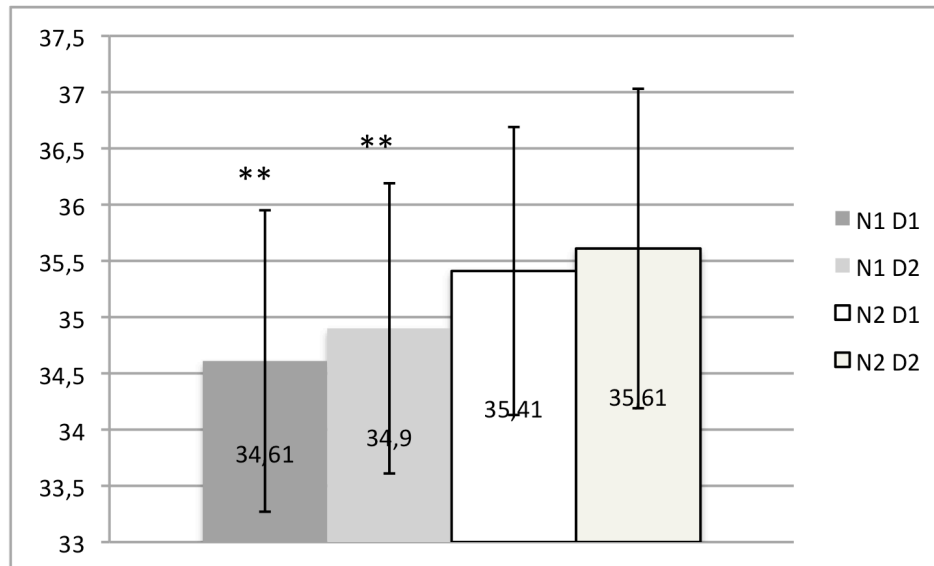


Figure 14. Describes the average results, sd, and statistical differences between the groups N1 and N2 based on players date of birth in skating versatility track. Time is marked in seconds on vertical axis. Dark grey describes the average result of N1d1 (34,61s  $\pm$ 1,34s), light grey describes the average result of N1d2 (34,90s  $\pm$ 1,29s), white describes the average result of N2 d1 (35,41s  $\pm$ 1,28s), and dark blond describes the average result of N2 d2 (35,61s  $\pm$ 1,42s). Statistically the difference is significant between the groups N1d1 and N2d1  $p \leq 0,005(**)$ , and N1d2 and N2d2  $p \leq 0,005(**)$ .

### 8.1.3 Results of N1 and N2 in skating versatility track based on weight

Average results of the groups N1 and N2 in skating versatility track based on the average weight of the group N 67,3kg,  $\pm$ 8,48kg (w1), based on the average weight of the group N1 70,41kg  $\pm$ 8,32 (w2), and based on the average weight of the group N2 66,54kg  $\pm$ 8,37kg (w3) can be found from the table 5. Statistically the difference is significant in the results of lw  $p \leq 0.005(**)$ , mw  $p \leq 0.05(*)$ , and ml  $p \leq 0.005(**)$ .

Table 5. Table 5 describes the average results of the groups N1 and N2 in skating versatility track based on the averages of hw (heavier than the groups own average weight), lw (lighter or as light as the groups own average weight), mw (heavier than the average of the group N), and ml (lighter or as light as the average of the group N). Statistically the difference is significant in the results of lw  $p \leq 0.005(**)$ , mw  $p \leq 0.05(*)$ , and ml  $p \leq 0.005(**)$ . From the table 5 can be found the explanations of abbreviations.

	<b>N1</b>	<b>N2</b>		<b>N1</b>	<b>N2</b>
<b>hw</b>	<b>35,08</b>	<b>35,58</b>	<b>mw</b>	<b>35,02 '*'</b>	<b>35,65</b>
sd	+1,29	+1,44	sd	+1,23	+1,50
Amount of players	18	86	Amount of players	27	74

<b>lw</b>	<b>34,41 '***'</b>	<b>35,39</b>	<b>ml</b>	<b>34,13 '***'</b>	<b>35,36</b>
sd	+1,29	+1,21	sd	+1,32	+1,18
Amount of players	25	101	Amount of players	16	113

hw=heavier than the groups own average weight lw=lighter or as light as the groups own average weight  
mw=heavier than the average of the group N ml=lighter or as light as the average of the group N

th=taller than the groups own average height sh=shorter or as short as the groups own average height  
mh=taller than the average of the group N ms=shorter or as short as the average of the group N

#### 8.1.4 Results of N1 and N2 in skating versatility track based on height

Average results of the groups N1 and N2 in skating versatility track based on average height of the group N is 175,03cm  $\pm 6,95$ cm (h1), average height of the group N1 is 175,94cm  $\pm 5,81$ cm (h2), and average height of the group N2 174,82cm  $\pm 7,18$ cm (h3) can be found from the table 6. Statistically the difference is significant in the results of th  $p \leq 0.05(*)$ , sh  $p \leq 0.05(*)$ , mh  $p \leq 0.05(*)$ , and ms  $p \leq 0.05(*)$ .

Table 6. Table 6 describes the average results of the groups N1 and N2 in skating versatility track based on the averages of th (taller than the groups own average), sh (shorter or as short as the groups own average, mh (taller than the average of the group N), and ms (shorter or as short as the average of the group N). Statistically the difference is significant in the results of th  $p \leq 0.05(*)$ , sh  $p \leq 0.05(*)$ , mh  $p \leq 0.05(*)$ , and ms  $p \leq 0.05(*)$ . From the table can be noticed number of players belonging into the group and the explanations of abbreviations.

	<b>N1</b>	<b>N2</b>		<b>N1</b>	<b>N2</b>
<b>th</b>	<b>34,96 '*'</b>	<b>35,62</b>	<b>mh</b>	<b>34,96 '*'</b>	<b>35,64</b>
sd	+1,27	+1,50	sd	+1,27	+1,47
Amount of players	25	91	Amount of players	24	97

	<b>sh</b>	<b>34,31 '*'</b>	<b>35,35</b>		<b>ms</b>	<b>34,31 '*'</b>	<b>35,31</b>
sd	+1,32	+1,12		sd	+1,32	+1,13	
Amount of players	18	96		Amount of players	19	90	

hw=heavier than the groups own average weight lw=lighter or as light as the groups own average weight  
mw=heavier than the average of the group N ml=lighter or as light as the average of the group N  
th=taller than the groups own average height sh=shorter or as short as the groups own average height  
mh=taller than the average of the group N ms=shorter or as short as the average of the group N

## 8.2 Puck control track

### 8.2.1 Results of N1, N2, and N in puck control track

Average result of the whole mass (N) in puck control track is 20,55s,  $\pm 1,92$ s. (Figure 15)

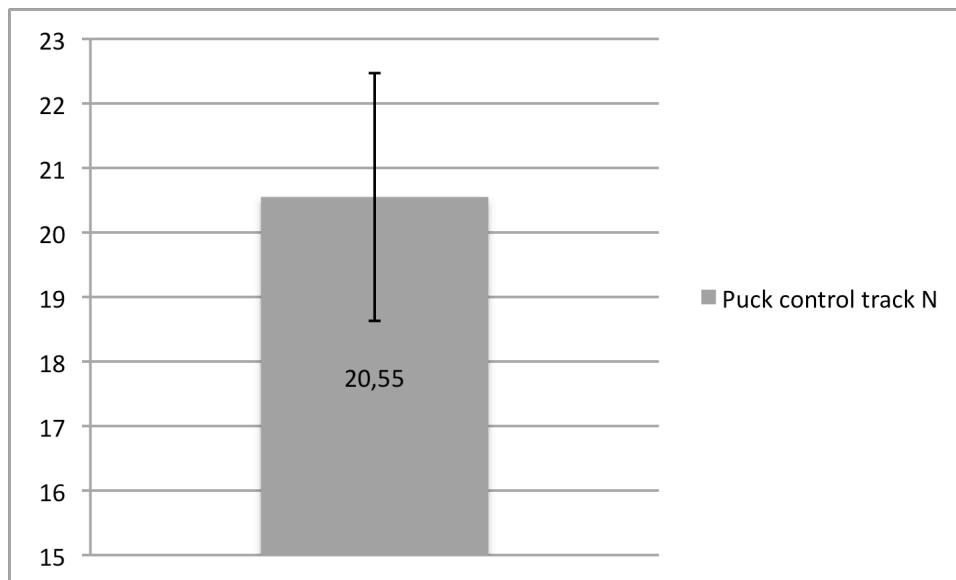


Figure 15. Time is marked in seconds on vertical axis. Figure describes average result (20,55s  $\pm$ 1,92s) of the group N at puck control track.

Average results of N1 in puck control track is 20,18s  $\pm$ 1,76s and average results of N2 in puck control track is 20,73  $\pm$ 1,14s, (figure 16). There are no statistical differences between the groups.

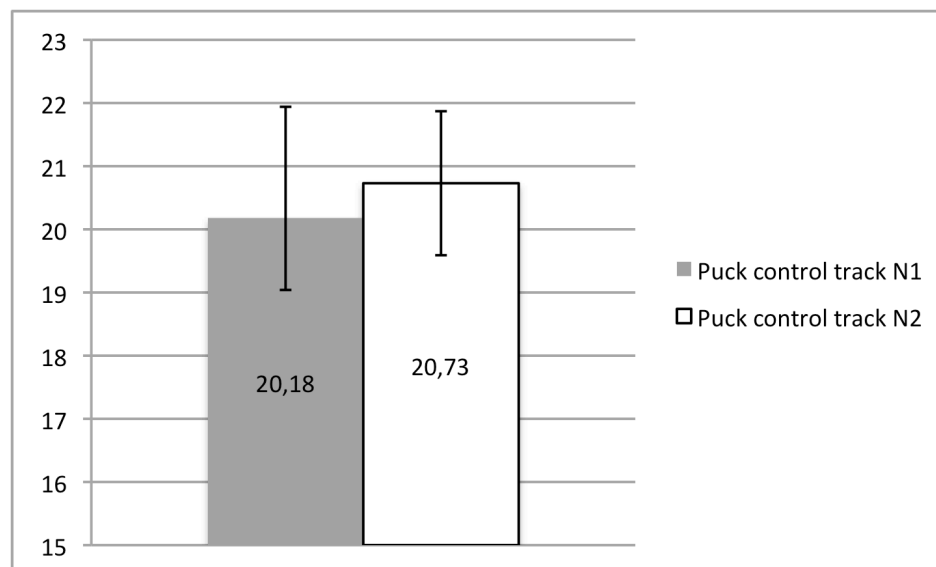


Figure 16. From the figure 16 can be noticed average results and sd of the groups N1 and N2 in puck control track. Time is marked in seconds on vertical axis. Dark grey describes average result of N1 and white describes average result of N2.



### 8.2.2 Results of N1 and N2 in puck control track based on date of birth

Average results and sd of N1 and N2 based on d1 and d2 are: N1d1 20,18s  $\pm$ 1,97s, N1d2 20,19s  $\pm$ 1,10s, N2d1 20,78s  $\pm$ 1,04s, and N2d2 20,66s  $\pm$ 1,35s, (figure 17). There are no statistical differences between the groups.

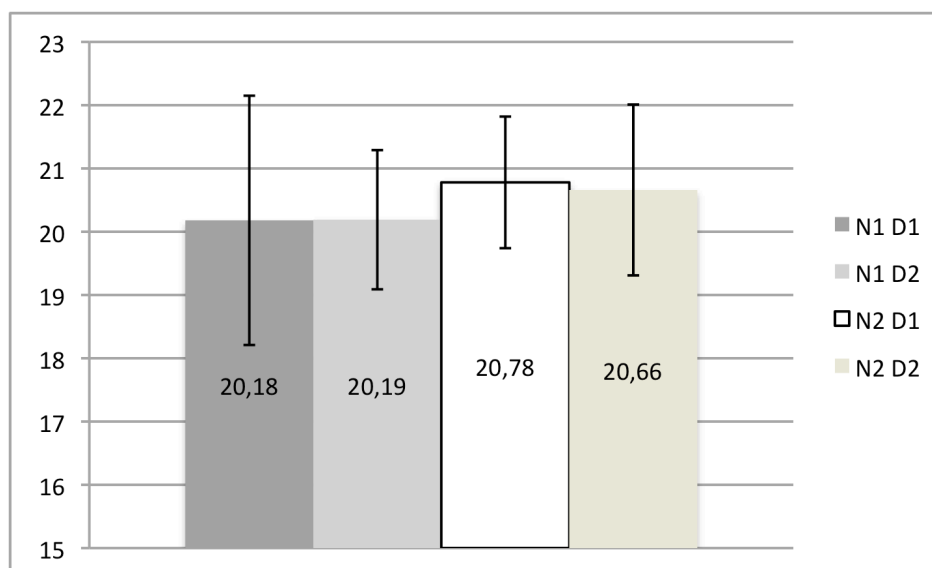


Figure 17. Describes the average results and sd of the groups N1 and N2 based on players date of birth in puck control track. Time is marked in seconds on vertical axis. Dark grey describes the average result of N1d1 (20,18s  $\pm$ 1,97s), light grey describes the average result of N1d2 (20,19s  $\pm$ 1,10s), white describes the average result of N2d1 (20,78s  $\pm$ 1,04s), and dark blond describes N2d2 (20,66s  $\pm$ 1,35s).

### 8.2.3 Results of N1 and N2 in puck control track based on weight

Average results of the groups N1 and N2 in puck control track based on the average weight of the group N 67,3kg,  $\pm$ 8,48kg (w1), average weight of the group N1 70,41kg  $\pm$ 8,32 (w2), and average weight of the group N2 66,54kg  $\pm$ 8,37kg (w3) can be found from the table 7. Statistically the difference is significant in the result of ml  $p \leq 0.05$ (\*).

Table 7. Table 7 describes the average results of the groups N1 and N2 in puck control track based on the averages of hw, lw, mw, and ml. Explanations of abbreviations can be found from the table 7.

	<b>N1</b>	<b>N2</b>		<b>N1</b>	<b>N2</b>
<b>hw</b>	<b>20,42</b>	<b>20,86</b>	<b>mw</b>	<b>20,37</b>	<b>20,85</b>
sd	+2,32	+1,23	sd	+2,04	+1,25
Amount of players	18	86	Amount of players	27	74

	<b>N1</b>	<b>N2</b>		<b>N1</b>	<b>N2</b>
<b>lw</b>	<b>20,01</b>	<b>20,61</b>	<b>ml</b>	<b>19,85 '*'</b>	<b>20,65</b>
sd	+1,23	+1,04	sd	+1,13	+1,05
Amount of players	25	101	Amount of players	16	113

hw=heavier than the groups own average weight lw=lighter or as light as the groups own average weight  
mw=heavier than the average of the group N ml=lighter or as light as the average of the group N  
th=taller than the groups own average height sh=shorter or as short as the groups own average height  
mh=taller than the average of the group N ms=shorter or as short as the average of the group N

#### 8.2.4 Results of N1 and N2 in puck control track based on height

Average results of the groups N1 and N2 in puck control track based on the average height of the group N 175,03cm  $\pm$ 6,95cm (h1), average height of the group N1 175,94cm  $\pm$ 5,81cm (h2), and average height of the group N2 174,82cm  $\pm$ 7,18cm (h3) can be found from the table 8. Statistically the difference is significant in the result of mh  $p \leq 0.05$ (\*).

Table 8. Table 8 describes the average results of the groups N1 and N2 in puck control track based on the averages of th, sh, mh, and ms. Explanations of abbreviations from the table 8. Statistically the difference is significant in the result of mh  $p \leq 0.05$ (\*). Explanations of abbreviations can be found from the table 8.

	<b>N1</b>	<b>N2</b>		<b>N1</b>	<b>N2</b>
<b>th</b>	<b>19,93</b>	<b>20,79</b>	<b>mh</b>	<b>19,93 '*'</b>	<b>20,79</b>
sd	+0,99	+1,19	sd	+0,99	+1,16
Amount of players	25	91	Amount of players	24	97

	<b>sh</b>	<b>20,53</b>	<b>20,68</b>		<b>ms</b>	<b>20,53</b>	<b>20,67</b>
sd	+2,46	+1,09		sd	+2,46	+1,12	
Amount of players	18	96		Amount of players	19	90	

hw=heavier than the groups own average weight lw=lighter or as light as the groups own average weight

mw=heavier than the average of the group N ml=lighter or as light as the average of the group N

th=taller than the groups own average height sh=shorter or as short as the groups own average height

mh=taller than the average of the group N ms=shorter or as short as the average of the group N

## 9 Discussion

Based on the average result of the group N1 (national team players) and N2 (non-national team players), group N1 has better results in sport specific technical skill tests. It seems that the biggest separating factor between U16 national team players and non-national team players are skating skills. According to Westerlund (1997, 540) hockey player has to skate fast in different game situation roles. Skating power, skating speed, and skating versatility is needed repeatedly in short, powerful, and all out efforts with and without the puck. Player has to be able to change direction, stop, accelerate, and turn fast. The individuals' game is built around game situation roles. These roles are: 1. Puck carrier, 2. Non-puck carrier, 3. Defending puck carrier, and 4. Defending non-puck carrier. (Savolainen, 4.9.2008; Savolainen, 18.09.2008; Westerlund, 1997, 533) Every team has a team tactics in ice hockey. Team tactics are co-operation between the players to achieve common goals against opponent in the game. Co-operation between the players requires abilities to perform in different game situation roles. (Westerlund, 1997, 532) Based on Westerlund and Savolainen it makes sense that skating skills are the separating factor between the U16 national team players and non-national team players. According to the name of skating versatility track, this test measures abilities in versatile skating. Player has to be able to turn different ways, turn fast, and skate backwards. In the research powerful forward skating was not measured. Powerful forward skating is measured by 500m skating track (International Ice Hockey Centre of Excellence, 2011). It would be good to find out how much straight and powerful forward skating separates U16 national team players from U16 non-national team players. According to Hämäläinen (14.03.2011) powerful forward skating is the first limiting factor between the players in international ice hockey. More research is necessary to determine; If the U16 national team players have better balance skills than non-national team players? According to Jaakkola (2010, 166) the core skill of skating is balance.

According to Finnish Women's national team head coach Pekka Hämäläinen (14.03.2011) and International ice hockey centre of excellence (08.02.2011) the main demands of successful performing in international ice hockey are acceleration speed

and powerful forward skating, quality to the hard and fast pass, and abilities to give and receive hard hits. Hämäläinen stated (14.03.2011) in his interview that players who have difficulties to perform in international ice hockey have difficulties to internalize the demands of international ice hockey and winning ice hockey. Also Hämäläinen prompts coaches to demand more from the players. If there is a skilled age group in a junior organization, invariably there is also demanding coach behind the players. If players are guided and developed towards international ice hockey, coach has to place players into situation where they must perform at the limits of his or her skills. According to Hämäläinen (14.03.2011) high level games are the best coach for developing junior. During high level games player must perform and use the abilities of versatile movements and the player has to use the motoric programs of open motor skills. Through high level games player will also improve fast decision making skills in game situation that is required by Westerlund (1997, 536). Through there could it be concluded that games where player plays and performs in the limits of his or hers technical skills and game skills player develops the most. Hämäläinen has worked with 1980 and 1983 born males national teams and according to his experiences national teams are build so that players whose understanding of the game, technical skills, and game skills are at the same level are put together. Players in same playing rhythm are collected to one unit. Based on Hämäläinen, the results of the skating versatility track, and the demands of international ice hockey it is effective to put the players together whose skating skills are at the same level.

U16 national team is 1,12cm taller and 3,87kg heavier than the non- national team, and 0,91cm taller and 3,11kg heavier than the whole mass (N). When comparing the results of the technical skill tests to the N1 and N2 own height and weight averages, it seems that based on these results taller and heavier players who are selected in U16 national team are more skilled than the taller and heavier player in non- national team group. U16 national team is constructed so that there is 25 players who are taller than the groups own average, and 18 are shorter or as short as the groups own average. 18 of the players in U16 national team are heavier than the groups own average, and there is 25 lighter players or as light as the groups own average. When U16 national team is compared based on the average height of the group N ( $h_1$ ), can be noticed that 27

players are heavier than the h1. At this basis can be concluded that U16 national team is constructed from taller and heavier players. Could this distribution of players in N1 be a result from the growth spurt, and that when growth spurt starts individuals won't gain weight as much as height? According to Kemppinen (2003, 144) rapid development of physical characteristics in children and adolescents may easily convey a false impression. To support Kemppinen, Jaakkola wrote (2010, 17) that physical growth contributing to the improvement in skill test results is not considered as learning of new skill. Because of the false impression of the players skills based on physical growth, skill learning is easily neglected.

25 players are taller than the groups own average in N1, and 19 of them are born before July in 1995. The total amount of players who are born before July in N1 is 31 individuals. Based on this could it be that taller player who is born during the first half of the year have better likelihood to be selected to the U16 national team? It is natural that players who have born at the beginning of the year have the advance through early physical development (Barnsley & Thompson, 1988, 174-176). Players born during the first half of the year have notably better results in skating versatility track than does players who are born during the second half of the year. Could this be a result from the better physical abilities of the players born during the first half of the year compared to players born during the second half of the year? According to Jaakkola (2010, 17) skill learning does not occur if development of physiological attributes of the athlete has contributed to the better results in assessed skills. So based on Jaakkola statement and the results of the players who are born during the first half of the calendar year (d1) compared to the results of the players who are born during the second half of the calendar year (d2). Could it be that players in the group d1 are more skilled than players in d2? Or do they have better physical abilities?

Children who are born between July - December are not born with a less talent than children in January - June. One factor that separates those two groups could be that child who is born at the beginning of the year have lived one summer more than the child born in September. Child who is born in January can spend the coming summer outside starting to observe the surroundings and trying to find touch surfaces with the

hands. Child who is born in September starts to observe and find these things during winter. In the summer the nature is much more variable than during the winter. Could it be that time spent outside at this age is related to time that parents spend outside? Could it be that parents spend more time outside during the summer than winter? Because of that child who is born in September won't probably spend as much time outside during the first half of his or hers life than does the child born in January. According to Jaakkola (2010, 76-77) the most important time for the children development is between the first two years of his or hers life. Like Jaakkola stated (2010, 55-72) one of the powerful factors for skill learning are the past experiences of individuals. Could it be so that based on Jaakkola statements child who is born during the first half of the year, will have the benefit to skill development compared to child born during the second half of the year, if he or she has got the earlier positive experiences of different kinds of movements.

Researches Wainwright (2007), Barnsley & Thompson (1988, 174-176), and Barnsley et al. (1985, 23-28) show that in the highest level of amateur hockey the relative age effect can be seen, the majority of the players are born during the first half of the year. This can be seen when the group N is examined based on players date of births. 71 players of the group N are born during the second half of the year. 154 players of the group N are born during the first half of the year. Further research is needed to determine Barnsley & Thompson (1988, 174-176), Barnsley et al. (1985, 23-28), Musch and Gronding (2001, 147-167), Wainwright (2007), Cote et al. (2007, 194), and Baker et al. (2003) findings in Finland. Especially in Finland should be seek the solution, how the group of d2 are taken better into account.

U16 national team had better averages in both sport specific technical skill tests. It could be that puck control track is directed to require more exact performance, and successful performing in puck control track requires more elements of skill than skating versatility track. On this basis could it be possible that individuals whose sport background is more versatile have better opportunities to perform in puck control track. More research is needed to determine this. Also more research is needed to determine the differences in sport versatility backgrounds between national team and

non- national team players are required. Statistically there was no significant difference between N1 and N2 in puck control track. Based on that, could it be that the present puck control track is not the best way to test players abilities to control the puck? According to Westerlund (1997, 536) players fast decisions making is required for efficient play in game situations roles. Still that the difference is not statistically significant, for example during the game situation the difference of 0,5 seconds is significant. 0,5 seconds delay or error during the game situation could mean missed scoring chance or missed pass. It would be useful to replace the puck control track another test, to respond more the requirements of international ice hockey. Then the test could distinguish players more. Players who have better skills to play international ice hockey could be discovered, and their superiority could reach out more. Is stated (Lampinen & Frosmann 2008, 435; Miettinen & Vuohiniemi, 1999) that skill learning develops permanent connection to our central nervous system, and Fitts and Posner (1967, 12-14) proposed that highly mastered skills and reflexes have similarities. Further research is needed to determine if late developers have faster decision making skills during game situation or do they have better abilities to develop fast decision making skills based on Lampinen and Frosmann (2008, 435) statement, and Fitts and Posners (1967, 12-14) result of their research. According to Hämäläinen (14.03.2011) skilled players will easily adapt the requirements of faster ice hockey, during high- level games.

The ability to learn a new skill depends on several factors. These factors are; Capacity factors such as coordination or accuracy, attitude like open mindedness, body type, cultural background, emotions, physical fitness, learning style, body's level of maturation, motivation, and previous physical and social experiences. (Lampinen & Forsman, 2008, 435; Wulf ,2007, 4) To ensure the development of fundamental of movement skills and basic motor skills, and through there the development of sport specific skills, ice hockey player needs versatile training where requirements of all body systems are taken into account, players optimal training windows are taken into account, and player has done thousands of repetitions. Developmental stages are not exact time periods, so usually the developmental stage for sport specific skill training starts after the basic skills are stabilized. If fundamental movements are not stabilized, it is recommended to practice those even though the actual developmental stage is over. (Hakkarainen et al,



2006, 8-9). Still that the developmental stages for skill learning are between 2 and 15, the skill practicing continues to adult life (Sinclair, 1989, 89). Based on this it is important that Finnish Ice Hockey Association develops and improves their coach education system continuously. Clubs need to be aware of the importance of coaching education and the knowledge that the coach who is coaching children, ages of 2-15, has to have. Sport organization should concentrate their programs to the development of individuals instead of development of team activities. In the center of the programs should be the player (Westerlund, 1997, 532). Emphasizing the broad concept of skill learning the value of coaching profession could be improved. Through that can be recruited more specialized coaches to the most important years of skill training. According to Hämäläinen (14.03.2011) high standard coaching shouldn't be underestimate.

Ericsson, Krampe and Tesch-Römer (1993,399-400) came to conclusion that elite performers in adulthood tended to start deliberate practice earlier than did the less accomplished performers. Further research is needed to determine this among 1995 born males national team. For example U16 national team players training background should be investigated now, and then when they are at age of U20 national team. Did U20- national team player start deliberate practice earlier than did the player who dropped out from national team during 1995 born males' Lion- road.

Good example of sport versatility is alpine skier Kalle Palander. He is good in gymnastics, he can perform aerobic series in the rhythm of music, he is excellent skater, skilful tennis player, he can perform different skills on balance board, and he is good soccer player. He is good in every ballgame, and in every game that requires accurate movements. That background has enabled his development in sport specific skills of alpine skiing. (Lampinen ,1999, 48)

When comparing the results between smaller and taller players, and between lighter and heavier players in U16 national team and non- national team can be noticed that shorter and lighter players have better average results in measured sport specific technical skill test than heavier and taller players. Except in U16 national team group, taller players have better results in puck control track. Through millions of repetitions athlete has developed large, automatic, movement model capacity to the brain and muscle nerves, to the central nervous system. This large movement capacity can be noticed when athlete is older and learns new skills fast, and athletes' skill implementation is

exact. Ice hockey is late specialization sport, and main emphasize of late specialization sports is engage player to have many different sports during the sampling years. Previous example of Kalle Palander is great example of sport versatility during the sampling and specialization years. Puck control track and skating versatility track require versatile performing. More research is needed to determine does the athlete sport versatility background have an effect to the results of selected Suomi Kiekko- tests. On this basis could it be that heavier and taller players are selected to U16 national team based on their physical superiority. Could it be that taller and heavier players are just passed their major growth spurt and because of that they have gross motor errors in their performances, and that's why their test results in skating versatility track are mainly slower than lighter and shorter players. Long- term follow up is necessary to determine this.

In this research results are gathered so that subjects performed sport specific technical skill tests twice or as long as the subject was able to get a result. There was only one track that measured versatile skating and one track that measured puck control track. When organizing the sport specific technical skill tests like this only the performance of the individual was observed and marked, not the ability or knowledge of skilled performing of measured skill. For example physical factors and the arousal level during the performance played important role during the test situation. Puck control track didn't separate statistically players of N1 and N2, although the statistical significance was close. To gain better knowledge of the differences of N1 and N2 in sport specific puck control skills, there could have been done two kinds of puck control tracks. The results of these two tracks should be compared first together and then between the groups N1 and N2. Through this way the puck control abilities could separate more players statistically. Based on this, it might be useful to do two kinds of skating versatility tracks. Skill learning process is long and it requires much more than just the repetitions. For example skill learning requires psychological abilities such as open mindedness (Lampinen & Forsman, 2008, 437). Also measurement of pure skill is difficult because of the physical factors of the player that are contributing to the results. More researches are necessary to determine the contribution of psychological and physical characteristics to the selected Suomi- Kiekko tests.

At the end of the research can be concluded that U16 national team players have better average results in sport specific technical skill test than the non- national team players. Puck control track didn't separate players statistically, so the ability of puck control track to separate national team players from non- national team players can be argued. The difference is significant between the group N1 and N2 in skating versatility track. It seems that lighter players will perform better in sport specific technical skill tests. In national team, taller players will perform better in puck control track, but in the group N2 shorter players will perform better in puck control track. Based on this can be concluded that height and weight will affect to the final result of sport specific technical skill tests. At this point of 1995 born males Lion- road it seems that national team is constructed from tall players, from players who are heavier than the average of N, and from players who are born at the beginning of the year 1995. In the national team, players who are born during the first half of the year have better results in skating versatility track than does the players born during the second half of the year. So player's date of birth has a meaning when national team is selected. More research is needed to determine the changes in team structure during 1995 born males Lion- road. Based on Westerlund (1997, 536) and Fitts and Posners (1967, 12-14) statements should be made further research to determine if late developers have better abilities to make fast decision during the game, if they have used right their longer optimal training windows for skill learning brought by late physical development. According to ADM (2011) and Hockey Canada (2011) ice hockey is classified to be late specialization sport. According to Ericsson, Krampe and Tesch-Römer (1993, 399-400) elite performers have started deliberate practices earlier than less accomplished performers. More research is needed to determine if Ericsson, Krampe and Tesch-Römer research results are valid in development of ice hockey player, and how to obtain appropriate deliberate practice guidelines to the late specialization model of ice hockey. Further research is necessary to determine statistically the meaning of high- level games for development of sport specific skills of ice hockey and over all development of skilled international ice hockey player. In the future should be researched what kind of differences in coaching, national team players and non- national team players have had. For the future in Finland, should be find the answer to question how players who are born at the end half of the year could be taken better into account. Based on the affect of relative age, the solution

could be that instead of distribution based on calendar year made team selections, teams and series could be formatted based the seasons. Players who are born during the same season could form one age group, for example players who are born between, July 1. and December 31. in 1997., and January 1. and June 30. in 1998 could form a one age group.

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# Appendices

## Attachment 1. The expert interview of Pekka Hämäläinen.

14.03.2011

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Ilkka Haapea

### Asiantuntija haastattelu

**Pekka Hämäläinen**

**Suomen naisten maajoukkueen vastuvalmentaja**

1. Mitkä ovat mielestäsi kansainvälisen jääkiekon vaatimukset?
  - Lajitekniset
  - Pelitaidolliset
  - Psykologiset
2. Mitkä tekijät erottelevat mielestäsi kansainväliseen jääkiekkoon kykenevän ja kykenemättömän pelaajan toisistaan?
  - Lajitekniikassa
  - Pelitaidoissa
  - Psykologiset
3. Kuinka paljon katsot ohjatulla harjoittelulla olevan merkitystä alle 15-vuotiaiden taitoharjoittelussa?
4. Entä, kuinka paljon katsot omatoimisella harjoittelulla olevan merkitystä alle 15-vuotiaiden taitoharjoittelussa?
5. Kuinka paljon mielestäsi tulisi joukkueharjoittelussa keskittyä yksilön taidon harjoittamiseen ennen ensimmäisiä maajoukkue valintoja?
6. Onko valmentajan vaatimustasolla mielestäsi merkitystä taitojen oppimisessa?
7. Näetkö eroja rauhallisella harjoitus temmolla ja kovalla harjoitus temmolla taitojen oppimiseen alle 15-vuotiailla?
8. On sanottu kovatasoisten otteluiden kehittävän. Näetkö tällä yhteyttä lajitaitojen oppimiseen / kehittymiseen?

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9. Millä tavoin maajoukkuevalinnoissa huomioidaan pelaajan perustaitotaso;  
lajitekniset taidot, motoriset taidot?
10. Millä tavoin pelaajien erilaiset taitotasot pyritään hyödyntämään maajoukkueessa?  
Onko maajoukkue pelaajilla eroja perustaidoissa?
11. Suositaanko Suomessa mielestäsi aikaisemmin fyysisesti kehittyneitä pelaajia  
nuoriso maajoukkueita valitessa?

Jos suositaan niin:

- Millä tavoin myöhäisheränneet voitaisiin ottaa paremmin huomioon?

## Attachment 2. Players agreement form to the test situation.



SUOSTUMUS



Kansainväliset sopimukset ihmisillä tehtävistä tutkimuksista edellyttävät, että tutkimuksiin osallistuville selvitetään mittauksiin ja testeihin liittyvät riskit ja hyödyt, ja että tutkittavat antavat kirjallisen suostumuksensa tutkimukseen osallistumisesta. Myös henkilökohtaisten tietojen keräämiseen, rekisteröintiin ja julkaisemiseen tarvitaan henkilötietolain mukaan ko. henkilön kirjallinen suostumus.

Kilpa- ja huippu-urheilun tutkimuskeskuksessa (KIHU) tehdään jatkuvasti tutkimuksia, joissa ammattitaitoiset työntekijät mittaavat urheilijoiden ja muiden tutkittavien fysiologisia, biomekaanisia ja psykologisia muuttujia levon ja kuormituksen aikana. KIHU on vakuuttanut tutkittavat ja tutkijat mittaustapahtumiin liittyvien ulkoisten syiden aiheuttamien tapaturmien, vahinkojen ja vammojen varalta. Tutkittavalla on kuitenkin suotavaa olla oma henkilökohtainen tapaturma/sairaus- ja henkivakuutus, koska vakuutusyhtiöt eivät myönnä tutkimusprojekteja varten täysin kattavaa vakuutusturvaa esim. sairauskohtauksia ja äkillisen ponnistuksen aiheuttamia lihaskramppeja tai jännevammoja varten. Osallistuminen mittauksiin on täysin vapaaehtoista ja tutkittava voi kieltäytyä mistä tahansa kokeista ja mittauksista, ja hän saa keskeyttää kokeen milloin tahansa. Mittaushenkilökunnalla on koulutus, ohjeistus ja välineistö tapaturmien ja sairaskohtausten ensiapuun. Mittaajat selvittävät ennen kutakin mittausta tarkemmin suoritusohjeet ja testin turvalliseen suorittamiseen liittyvät seikat. Mittaushenkilökunta antaa tarvittaessa lisätietoa testeihin liittyvistä riskeistä ja niistä saatavasta hyödyistä. Tutkijat raportoivat mittauksista suoraan tutkimuksiin osallistuville henkilöille näiden kanssa sovitulla tavalla, sekä tieteellisissä ja valmennuksellisisissa julkaisuissa siten, että yksityiseen henkilöön identifioitavissa olevia tietoja ei julkaista. Tutkimuksesta saatavaa tietoa voidaan edelleen käyttää hyväksi harjoitusmenetelmien kehittämisessä ja urheilusuoritusten parantamisessa. Vastuullinen tutkija vastaa kerätyn aineiston turvallisesta säilyttämisestä.

### Väitöskirjatutkimus – pelaajan kehittymiseen vaikuttavia tekijöitä

Tämän tutkimuksen tavoitteena on selvittää pelaajan kehittymiseen vaikuttavia tekijöitä joukkuepallolajissa. Tutkimuksen tavoitteena on antaa käytännönläheistä tietoa suomalaisesta valmennuksesta ja suomalaisten junioripelaajien ominaisuuksista, harjoittelusta ja kehittämisestä. Tutkimukseen on valittu 12-14 seurajoukkuetta jalkapallosta, jääkiekosta ja koripallosta. Tutkimus on osa laajempaa KIHU:n nuorisourheilututkimusta.

Tutkimus antaa koko suomalaiselle palloiluvalmennukselle kokonaisvaltaista tietoa pelaajien ominaisuuksista, harjoittelusta ja kehittämisestä. Tulosten perusteella voimme ohjata suomalaista juniorivalmennusta oikeaan suuntaan ja kehittää pelaajiamme laadukkaammin. Tutkimuksen tuloksia julkaistaan kansallisissa ja kansainvälisissä julkaisuissa sekä käytetään hyväksi Suomen Urheiluopiston ja mukana olevien lajiliittojen valmennuksen ja valmentajakoulutuksen kehittämisessä.

### Tutkimuksen hyödyt pelaajalle ja valmentajalle

Tutkimus antaa yksittäiselle joukkueelle, pelaajalle ja valmentajalle arvokasta tietoa pelaajien kehittämisestä sekä harjoittelun laadusta ja määrästä suhteessa muihin suomalaisiin pelaajiin. Tutkimukseen osallistuva pelaaja saa vastineeksi tutkimukseen osallistumisesta käyttöönsä omat testituloksensa sekä yhteenvetoon harjoittelustaan ja kehittämisestään tutkimuksen aikana suhteessa muihin samanikäisiin pelaajiin Suomessa.

### Suostumus testitilaisuuteen osallistumiseen

Tutkimukseen valittujen seurajoukkueiden pelaajat osallistuvat urheilussa yleisesti käytettyihin taito- testeihin sekä lomakyselyihin. Testit toteutetaan seurajoukkueen omassa harjoitusympäristössä syyskuussa 2010. Tutkijoilla on kokemusta testien toteuttamisesta ja he ovat ammattilaisia asiassa.

Tutkimuksessa tehtävät mittaukset:

- pituus, paino
- lajitaitotestit
- lomakkeet: pelaaja- ja valmentaja-arviointi, harjoitushistoria ja harjoittelun seuranta

**Olen tutustunut suoritettaviin testeihin ja mittauksiin, ja olen ymmärtänyt mittausten tarkoituksen ja niihin liittyvät riski- ja hyötynäkökohdat. Voin kuitenkin halutessani keskeyttää kokeen tai kieltäytyä mittauksista tai harjoittelusta missä tutkimuksen vaiheessa tahansa.**

Tällä lomakkeella vahvistan, että...

- Suostun yllämainitun projektin mittauksiin annettujen ohjeiden mukaisesti
- Annan luvan tulosteni käyttöön tutkimuksen raportoinnissa
- Annan luvan tulosteni säilyttämiseen KIHUn tutkimusrekistereissä
- Annan luvan tulosteni lähettämiseen henkilökohtaiselle ja liiton valmentajalle
- Annan luvan tulosteni käyttöön tuotekehitystoiminnassa
- Annan luvan mittausten yhteydessä otetun video/valokuvani käyttöön tutkimuksen kirjallisessa ja suullisessa raportoinnissa

**Yhteystiedot:**

Pelaajan nimi: \_\_\_\_\_

Äidin/ Isän nimi: \_\_\_\_\_

Äidin/ Isän puhelinnumero: \_\_\_\_\_

Paikka ja aika \_\_\_\_\_ Huoltajan allekirjoitus \_\_\_\_\_

Tutkimuksen vastuullinen tutkija

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