Satakunnan ammattikorkeakoulu
Satakunta University of Applied Sciences

ELMIRA SAKHINA

Exercise program to strengthen gluteal muscles in 10-12-year-old figure skaters

Injury prevention guidebook for coaches

DEGREE PROGRAMME IN PHYSIOTHERAPY
2021

<table>
<tr><td rowspan="2">Author(s)
Sakhina, Elmira</td><td>Type of Publication
Bachelor’s thesis
ThesisAMK</td><td>Date Month Year
25th of November 2021</td></tr>
<tr><td>Number of pages:
41</td><td>Language of publication:
English</td></tr>
<tr><td colspan="3">Exercise program to strengthen gluteal muscles in 10-12-year-old figure skaters: Injury prevention guidebook for coaches</td></tr>
<tr><td colspan="3">Degree programme in physiotherapy</td></tr>
</table>

Abstract

The aim of the thesis was to develop an exercise program for figure skaters, aged 10-12, to maintain and improve gluteal muscle strength to reduce the risk of future injuries. The exercise program is based on evidence and guidelines. The exercise program is included in a guidebook and will be used by the coaches of KooKoo Jäätaiturit.

The operational thesis consists of both theory and practice. Theory part of the thesis was gathered through literature searches about figure skating and anatomy. Evidence for the guidebook was gathered through searches about figure skating injures, risk factors, injury prevention, and resistance training. Literature was gathered using two databases, PubMed and SamkFinna. Based on literature and guidelines a guidebook was formed as a product of this thesis. It included information about figure skating, injuries, injury prevention, risk factors, and an exercise program to strengthen gluteal muscles. Exercises were selected based on electromyography research, and the selected exercises mimic movement patterns of figure skating. Guidebook was piloted with skaters and coaches of KooKoo Jäätaiturit.

In figure skating overuse injuries are more common compared to acute injuries. Back and lower limb injuries are more common due to the characteristics of the sport. Off ice training including balance, coordination and strength training could reduce the risk of injury. Specific strengthening exercises for trunk, hip, and lower extremity could benefit figure skaters to prevent injuries and enhance performance. Focus should be placed on strengthening the transverse abdominis, multifidus, and gluteal muscles followed by balance and power training.

Skating, Primary prevention, Buttocks, Resistance training, Child

CONTENTS

1 INTRODUCTION

Figure skating is one of the most followed winter sports worldwide. In Finland figure skating can be started at any age. Youngest ones in skating school are usually around 3-years old, but also adults can join the sport at any age. Some clubs have groups for children and adults with special needs. After skating school, a child can continue to skate competitively or recreationally. Figure skating is divided into single skating, synchronized skating, ice dance and pair skating. Competitions in each discipline are organized both in Finland and abroad, for all age groups. (Suomen Taitoluisteluliitto, 2021a.) This thesis is focusing on single skating.

Figure skating has been gaining popularity and demands of the sport have been increasing, athletes presenting with sports related problems have also increased in number. In a retrospective review, lifetime injury prevalence rate in elite single, pairs and ice dance skaters were found to be 80 percent, and in synchronized skaters approximately 40 percent. Longer training hours and more difficult jumps have led to the predominance of overuse injuries in singles disciplines. Overuse injuries cover 68,9 percent of all injuries and the remaining 31,1 percent are acute injuries. Lower extremities and back are the most commonly injured body parts. (Han et al., 2018.; Kowalczyk et al., 2019)

Specific strengthening exercises for trunk, hip, and lower extremity could benefit figure skaters to prevent injuries and enhance performance. Focus should be placed on strengthening the transverse abdominis, multifidus, and gluteal muscles followed by balance and power training. (Mohney et al., 2017, p. 58.) Gluteal muscles are the most powerful muscle group in the human body. Strengthening gluteal muscles can reduce the risk of knee, hip, and lower back injuries, and assist in jumping higher and sprinting faster. (Contreras & Cordoza, 2019, p. 21.)

2 AIMS AND OBJECTIVES

The aim of this thesis is to develop an exercise program for figure skaters, aged 10-12, of KooKoo Jäätaiturit, to maintain and improve gluteal muscle strength to reduce the risk of future injuries. Exercise program will be included in a guidebook.

The objective of this thesis is to collect theoretical knowledge regarding injury prevention, exercise methods, and exercises for gluteal muscles, based on evidence and guidelines.

Research question of the thesis is "How to implement gluteal exercises to reduce the risk of injury in youth figure skaters?"

3 FIGURE SKATING

Figure skating can be described as a sport that requires constant control of balance (Aalto, 2017, p. 5). A single skater is required to have explosiveness, strength, and endurance. Single skating includes jumps, spins, and skating skills. The repetitive movements required to perfect the elements may cause overuse injuries to the back and knees. (Terveystalo, 2013.) In figure skating 100 000 repetitions are required for the anticipation and adaptation skills to be on a required level (Aalto, 2017, p. 30).

Many external forces influence on a figure skater. During take-off and landing of a triple jump skater's body is exposed to forces seven times greater than their body weight. During landing phase forces are slightly greater than during take-off. It is known that during take-off of toe jumps, greater forces are produced compared to edge jumps. Toe jumps are jumps in which skater uses toe pick part of the blade to send themselves into the air. Edge jumps are jumped straight from the edge on which the skater is gliding. There are three jumps of both types, toe loop, flip and lutz are toe jumps, and loop, salchow and axel are edge jumps. (Aalto, 2017, pp. 5-6.) Ankle, knee and low back are exposed to great forces during landing phase of jumps. Bones of the lower limbs are exposed to forces 8-10 times greater to those during walking. (Aalto, 2017, p. 33.) Another integral part of figure skating is spinning on ice. It was found that spins require more energy than jumps. Upper body, lower body and core strength are required to keep the arms and legs close to the axis of rotation to counteract the centrifugal force. (Lipetz & Kruse, 2000, pp. 370-371.)

Figure skaters are one side dominant, rotate to the same direction in all jumps and spins, and always land on the same leg. The strength of the athlete's knee extension and flexion, hip extension and flexion, and shoulder abduction and adduction, has been shown to correlate with the height of single and double axels, which is a jump with one and a half or two and a half rotations. To perform even more difficult triple or quadruple jumps, the jump height is not increasing but the athlete is exploding into and out of the jump and rotating faster. (Lipetz & Kruse, 2000, pp. 370-371.)

In KooKoo Jäätaiturit figure skaters aged 10 to 12 practice 12 times per week. Practices consist of ice, off ice and dance trainings. On ice the practices are focusing on improving skating skills, speed and technique in steps, changes of feet and different variations of positions in spins, and in jumps the goal is to learn all double jumps and combine them into combinations of two to three jumps. Off ice trainings are focusing on explosiveness, speed, mobility, coordination, endurance, and strength, depending on the time of the season. Dancing is aiming to improve rhythm and performance creativity. (KooKoo Jäätaiturit, 2020.)

In KooKoo Jäätaiturit 10- to 12-year-old figure skaters compete in minit, silmut or novice categories (KooKoo Jäätaiturit, 2020). Minit competitive program is 2 minutes and 30 seconds long (±10 seconds) and consists of 5 jumps, 3 spins and a step sequence. Silmut competitive program is 2 minutes and 30 seconds long (±10 seconds) and consists of 5 jumps, 2 spins and a step sequence. Novice competitive program is 3 minutes long (± 10seconds) and consists of 6 jumps, 2 spins and a step sequence. (Suomen Taitoluisteluliitto, 2021b.)

4 INJURIES IN FIGURE SKATING

The number of athletes presenting with sport-related problems will increase as the technical demands increase. Longer training hours with more difficult jumps reflect on the predominance of overuse injuries in singles disciplines. (Han et al., 2018, pp. 532-537.)

A literature review was conducted to evaluate epidemiology of figure skating injuries, which found an increase in incidence of injuries in figure skating. The proportion of acute and overuse injuries were similar when combining all disciplines of figure skating. In singles skating overuse injuries appear to be more common. In all disciplines, injuries affecting lower limbs are more common compared to upper limbs. The most common skating injury appears to be ankle sprains, and across all disciplines, patellar tendinopathy is the most common overuse injury. In female single skaters, the most common overuse injuries are stress fractures. (Han et al., 2018, pp. 532-537.)

Retrospective chart review conducted between the years of 2003 and 2017 concluded that majority of figure skating injuries were overuse injuries. 68,9 percent of reported injuries were overuse injuries. In females the most commonly injured areas were foot/ankle, knee, back, hip, shoulder, and wrist/hand. Foot and ankle being the most commonly injured area and wrist and hand the least. In males, foot/ankle was the most commonly injured area followed by hip, knee, back, pelvis, lower leg, and shoulder. Tendinopathy and ligamentous injuries were the most common injury categories at the ankle and foot. Ankle sprain was the most common diagnosis of all ankle and foot injuries. Extensor mechanism injuries was the most common injury category in the knee area, including both acute and overuse injuries. Extensor mechanism injuries include all injuries to the anterior knee including injuries to the patellofemoral joint, patellar and quadriceps tendons, apophyses and remaining adjacent soft tissues. Quadricep muscle injuries and bone contusions at the knee area were excluded from extensor mechanism injury category. Most common diagnosis at the knee area were patellofemoral pain syndrome, patellar tendinopathy, knee contusion, and Osgood-Schlatter disease. 31,9 percent of all back injuries were diagnosed to be posterior column bone stress injury. Another 23,7 percent of back injuries were classified as back pain not otherwise specified and did not have a specific diagnosis. Majority of bone stress fractures occurred in the back. (Kowalczyk et al., 2019, pp. 296-298, 302.)

Due to weakness in core muscles or improper positioning during jumps and spins, injuries to intervertebral discs and facet joints result from rotational forces transmitting through these structures. Figure skaters are likely at a risk of sacroiliac joint dysfunction and pain due to asymmetric loading in single leg landings and falls on the ice. (Kowalczyk et al., 2019, p. 301.)

Overuse injuries are often caused by homogenous training, excessive use, or microdamage caused by repetitions. Other reasons for overuse injuries might be issues in technique and misfitting skates. (Aalto, 2017, pp. 33-34.) A more accurate terminology for overuse injuries is repetitive stress injury, due to the injuries occurring as a result of repetitive loading of the musculoskeletal system with deficient rest and recovery time needed for structural repair and adaptation (Stracciolini et al., 2017, p. e99).

Research shows that 50-78 percent of ankle and foot injuries could be prevented with off-ice training (Aalto, 2017, pp. 32-33). Specific strengthening exercises for trunk, hip, and lower extremity could benefit figure skaters to prevent injuries and enhance performance. Focus should be placed on strengthening the transverse abdominis, multifidus, and gluteal muscles followed by balance and power training. (Mohney et al., 2017, p. 58.)

5 GLUTEAL REGION

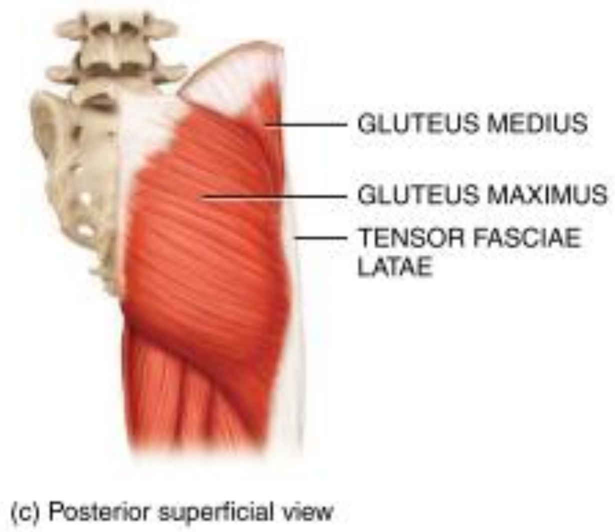
Gluteal region consists of muscles on the posterior/back side of pelvis. These muscles stabilize and assist posture control and move the hip joint. There are many muscles in this region: gluteal muscles, superior and inferior gemellus, internal and external obturators, quadratus femoris, tensor fascia lata and piriformis. There are three gluteal muscles: gluteus maximus, gluteus medius and gluteus minimus. (Tortora & Derrickson, 2014, pp. 380-381.) This thesis is focusing on these three gluteal muscles.

5.1 Gluteal muscles

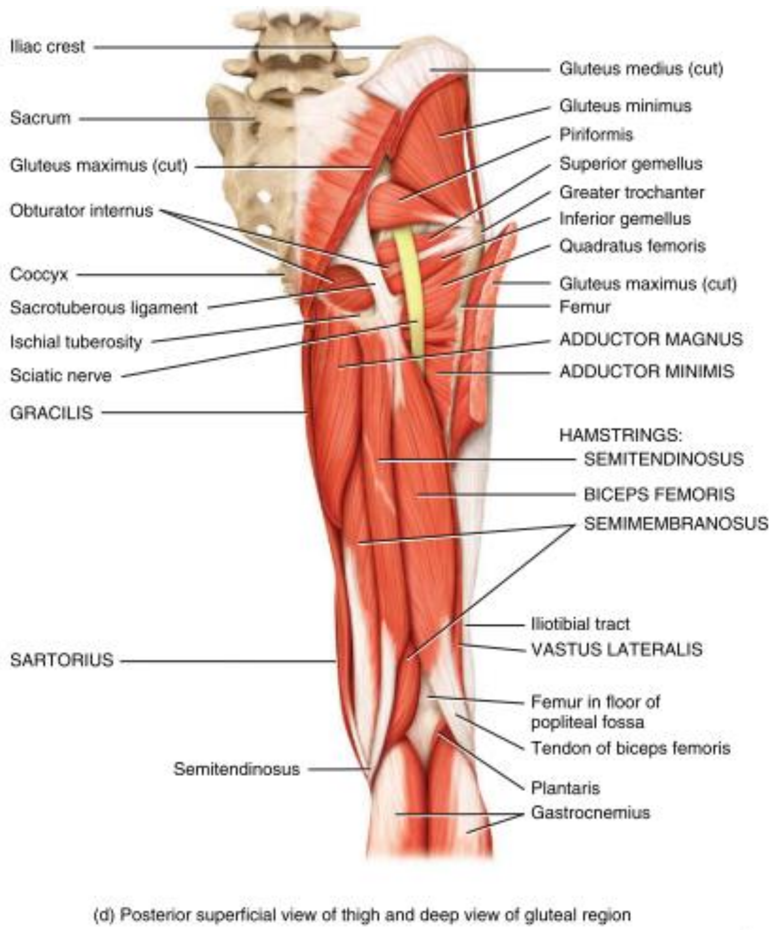
Gluteus maximus (GMax) is one of the largest muscles in human body (Tortora & Derrickson, 2014, p. 380). It is the most superficial of the three gluteal muscles. Proximally it attaches from posterior ilium to posterior gluteal line, dorsal surface of sacrum and coccyx and sacrotuberal ligament. Distally it attaches to iliotibial tract, which inserts into lateral condyle of tibia/shin bone, lower deep fibers attach to gluteal tuberosity. GMax is innervated by inferior gluteal nerve. The main actions of GMax are hip extension and assistance in lateral rotation, it also steadies thigh and assists in raising trunk from flexed position. (Agur & Dalley, 2017, p. 502.) In pictures 1 and 2, GMax is shown from posterior/looking from the back view.

Gluteus medius (GMed) is located profound to gluteus maximus. Proximally it attaches to external surface of ilium, between anterior and posterior gluteal lines, and gluteal fascia. Distally it attaches to lateral surface of greater trochanter of femur/thigh bone. GMed is innervated by superior gluteal nerve. The main actions of GMed are abduction and medial rotation of hip joint, it also keeps pelvis leveled when the opposite leg is off the ground, and it advances pelvis during swing phase of gate. (Agur & Dalley, 2017, p. 502.) In pictures 1 and 2, GMed is shown from the posterior view.

Gluteus minimus (GMin) is located profound to GMed. Proximally it attaches to external surface of ilium between anterior and inferior gluteal lines. Distally it attaches to anterior surface of greater trochanter of femur. GMin is innervated by the same nerve as GMed and their main actions are the same. (Agur & Dalley, 2017, p. 502.) In picture 2, GMin is shown from posterior view.



Picture 1. Gluteus medius and gluteus maximus from posterior view (Tortora & Derrickson, 2014, p. 383).



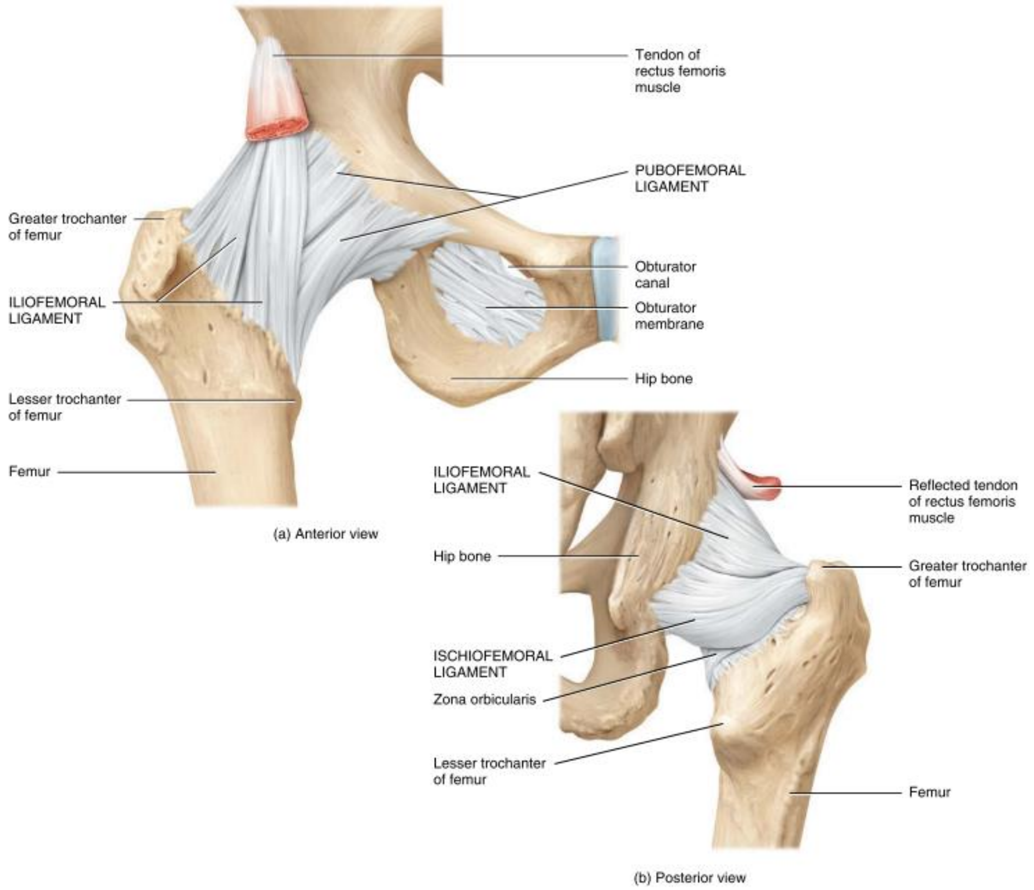
Picture 2. Posterior view of muscles of lower limb. Placements of gluteus maximus, gluteus medius and gluteus minimus can be seen. (Tortora & Derrickson, 2014, p. 383.)

5.2 Hip joint

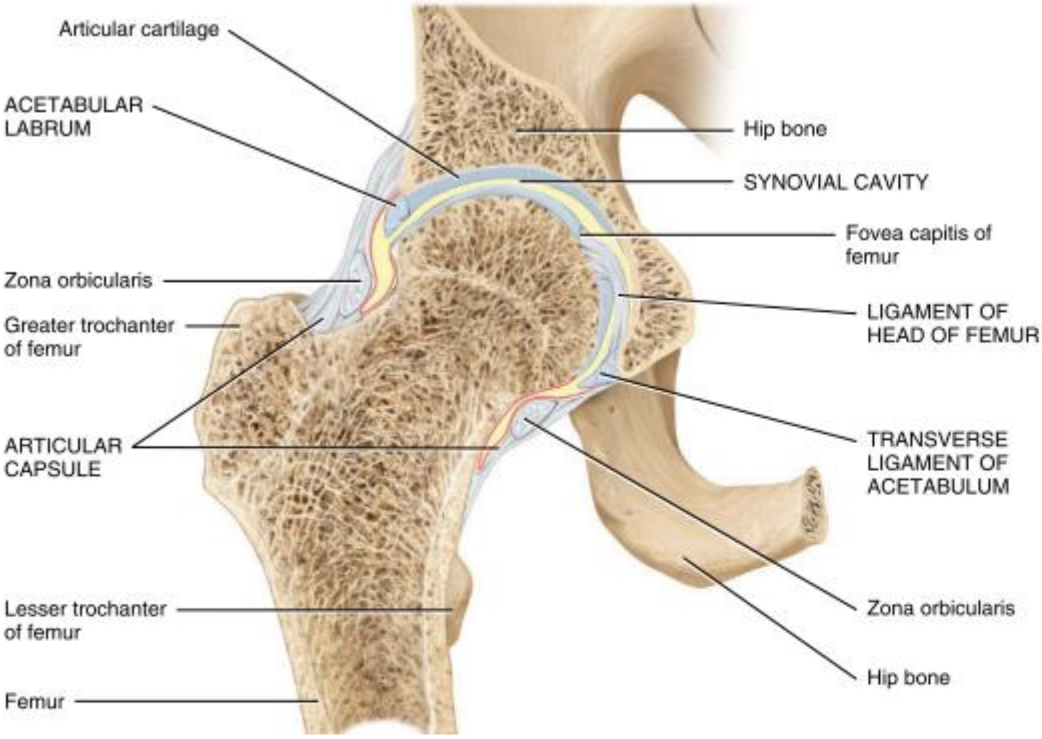
The hip joint is ball-and-socket joint between the head of the femur, thigh bone, and the acetabulum of the hip bone. The joint can be moved in flexion, extension, adduction, abduction, internal and external rotations, and circumduction of the thigh. The joint is extremely stable due to a strong articular capsule, its accessory ligaments, the structure of the joint and the muscles around it. (Tortora & Derrickson, 2014, p. 280.)

Articular capsule extends from the rim of the acetabulum to the neck of the femur. It consists of two types of fibers: circular/zona orbicularis, which form a collar around the neck of the femur; and longitudinal. Ligaments surrounding the joint reinforce longitudinal fibers. Thanks to this structure, the capsule is one of the strongest structures of the human body. (Tortora & Derrickson, 2014, pp. 280-281.)

There are 5 ligaments in the hip joint: Iliofemoral ligament (picture 3), pubofemoral ligament (picture 3), ischiofemoral ligament (picture 3), ligament of the head of the femur (picture 4) and transverse ligament of the acetabulum (picture 4). These ligaments limit range of motion of the joint and together with acetabular labrum, fibrocartilage rim that enhances the depth of the acetabulum, increase stability, and prevent dislocation of the joint. (Tortora & Derrickson, 2014, p. 281.)



Picture 3. Picture of the right hip joint. In picture (a) iliofemoral and pubofemoral ligaments can be seen from anterior view. In picture (b) Iliofemoral and ischiofemoral ligaments can be seen from posterior view. (Tortora & Derrickson, 2014, p. 280.)



Picture 4. Frontal section of the right hip. In the picture ligament of head of femur and transverse ligament of acetabulum can be seen. (Tortora & Derrickson, 2014, p. 281.)

5.3 Other relevant muscles affecting on the hip joint

Joined, the psoas major and the iliacus are known as the iliopsoas. Iliopsoas locates in the inner hip area. Iliopsoas flexes thigh at hip joint, rotates thigh laterally, and flexes trunk at hip joint when sitting up from back lying. (Tortora & Derrickson, 2014, p. 380.) Psoas major proximally attaches to lateral aspects of T12-L5 vertebras and intervertebral discs, and transverse processes of all lumbar vertebras. Distally it attaches to lesser trochanter of femur. Psoas major is innervated by anterior rami of lumbar nerves. Iliacus attaches proximally to iliac crest, iliac fossa, ala of sacrum and anterior sacro-iliac ligaments. Distally it attaches to tendon of psoas major, lesser trochanter, and femur distal to it. Iliacus is innervated by femoral nerve. (Agur & Dalley, 2017, p. 493.)

On the lateral surface of the thigh locates the tensor fascia lata muscle. Fascia lata is laterally well-developed layer of deep fascia that surrounds the whole thigh and is composed of dense connective tissue. It forms a structure called the iliotibial tract together with tendons of tensor fascia lata and gluteus maximus muscles. (Tortora & Derrickson, 2014, p. 380.) Tensor fascia lata's main actions are to abduct, medially rotate, and flex hip joint, and help to keep the knee extended. It also steadies trunk on thigh. (Agur & Dalley, 2017, p. 493.) Tensor fascia lata attaches proximally to iliac crest. Laterally it attaches to tibia through iliotibial tract. Tensor fascia lata muscle is innervated by superior gluteal nerve. (Tortora & Derrickson, 2014, p. 380.)

There are four muscles in the anterolateral abdominal wall. These are transversus abdominis, internal oblique, external oblique, and rectus abdominis. The transversus abdominis is the most profound of these four. Most of its fascicles direct transversely around the abdominal wall. Its origin is at iliac crest, inguinal ligament, lumbar fascia, and cartilages of ribs 5-10. Its insertion is at xiphoid process, linea alba, and pubis. It is innervated by thoracic spinal nerves T8-T12, iliohypogastric nerve, and ilioinguinal nerve. The internal oblique is the intermediate flat muscle locating externally from transversus abdominis. Its fascicles extend inferiorly and laterally. Its origin is at iliac crest, inguinal ligament, and thoracolumbar fascia. Its insertion is at cartilage of ribs 7-10 and linea alba. Internal oblique is innervated by thoracic spinal nerves T8-T12, the iliohypogastric nerve, and ilioinguinal nerve. The external oblique is the superficial muscle locating externally from internal oblique. Its fascicles extend inferiorly and medially. Its origin is at ribs 5-12 and insertion at iliac crest and linea alba. The external oblique is innervated by thoracic spinal nerves T7-T12 and the iliohypogastric nerve. Transversus abdominis, internal oblique, and external oblique, together, form three layers of muscle around abdomen. The muscle fascicles extend in a different direction in each layer. (Tortora & Derrickson, 2014, p. 350.) The main action of these three muscles is to compress and support abdominal viscera. Internal oblique and internal oblique also flex and rotate trunk. (Agur & Dalley, 2017, p. 298.) Rectus abdominis is the so called "six-pack" muscle. It extends the entire length of the anterior abdominal wall. Its origin is at pubic crest and pubic symphysis. Its insertion is at cartilage of ribs 5-7 and xiphoid process. It is innervated by thoracic spinal nerves T7-T12. (Tortora & Derrickson, 2014, p. 350.) Its main actions are to flex trunk, compress abdominal viscera, and stabilize and control tilt of pelvis (Agur & Dalley, 2017, p. 298).

The largest muscle mass of the back is the erector spinae. It forms a prominent bulge on both sides of the vertebral column. It is the main extensor of the vertebral column.

It is also essential in controlling flexion, lateral flexion, and rotation of the vertebral column, and maintaining the natural curve of lumbar spine. Erector spinae consists of three groups: iliocostalis, longissimus, and spinalis, which consist of a series of overlapping muscles. (Tortora & Derrickson, 2014, p. 378.) Inferiorly erector spinae arise by a board tendon from posterior part of iliac crest, posterior surface of sacrum, sacral and inferior lumbar spinous processes, and supraspinous ligament. Superiorly the groups attach separately. Iliocostalis fibers run superiorly to angles of lower ribs and cervical transverse processes. Longissimus fibers run superiorly to ribs between tubercles and angles to transverse processes in thoracic and cervical regions, and to mastoid process of temporal bone. Spinalis fibers run superiorly to spinous processes in the upper thoracic region and to skull. Erector spinae is innervated by posterior rami of spinal nerves. (Agur & Dalley, 2017, p. 38.)

5.4 Core

In aesthetic athlete, core and lower extremity strength and flexibility are essential to avert spinal stress injuries (d'Hemecourt & Luke, 2012, p. 397). The lumbopelvic-hip complex is also referred to as the core. This three-dimensional space is bounded from the superior prospect by diaphragm, anterior-lateral prospect by abdominal and oblique muscles, posterior prospect by paraspinal and gluteal muscles, and inferior prospect by pelvic floor and hip girdle. These muscles together stabilize the trunk and spine. Injury prevention programs, which include core stability exercises, have been shown to be effective at reducing injury rates of lower extremity injuries. Alterations in recruitment of core muscle and injury risk are associated with moderate evidence. (Huxel Bliven & Anderson, 2013.)

Mechanisms of core stability include three subsystems; passive, active, and neural control, these subsystems are interdependent. Passive system includes vertebrae, intervertebral discs, ligaments, joint capsules, and passive properties of muscles. Primary function of passive system is stabilizing at the end ranges of motion and transmitting position and load information to the neural control. Core musculature forms the active subsystem, and dynamically stabilizes the spine and proximal appendicular skeleton, also providing information to the neural control about movement. Neural control produces and maintains core stability by managing incoming and outgoing signals. (Huxel Bliven & Anderson, 2013.)

Many classification systems dividing core muscles into groups exist. Initially muscles were categorized under local stabilizers and global mobilizers. Local stabilizers are deep muscles that only cross one joint and attach on or near the vertebrae. These local stabilizers primarily function eccentrically, and they control movement and maintain static stabilization. Global mobilizers are usually large, superficial muscles, crossing multiple joints, and connecting trunk to the extremities. They function concentrically and produce movement and power with large torque. In some classification systems these local mobilizers are rather divided into stabilizers, such as internal and external obliques; and mobilizers, such as rectus abdominis and iliocostalis; or stabilizers and transfer load categories. Muscles in the transfer load category transfer force and momentum between the extremities and core. Gluteus maximus and medius, hip adductors, and rectus femoris are examples of muscles in load transfer category. (Huxel Bliven & Anderson, 2013.)

Relationship between core muscle recruitment alterations and low back pain has substantial evidence. Deficiencies in core stabilization and load transfer muscles may be related to lower extremity function and injury. A study concluded that out of core muscles the strength of hip external rotators was the strongest predictor of injury. Through proper training, weaknesses in the load transfer muscles may be an injury risk that could be prevented. (Huxel Bliven & Anderson, 2013.)

The core is often synonymous with the abdominals but in figure skating, and other similar activities, the muscles around the hips and pelvis are very important. To provide stability to the hip joint and pelvis, GMed is working along with the abdominals and local muscles. Proper alignment of the hip over the knee and ankle achieved by GMed keeping the pelvis leveled, is essential for maintaining edges, taking off and landing jumps. (Snelling, n.d.) Inhibition of the gluteus and the abdominal muscles together with overactivation of the erector spinae and iliopsoas muscles can often be associated with mechanical low back pain (d'Hemecourt & Luke, 2012, p. 403).

To make movements efficient, strong, and coordinated, a strong core to stabilize spine is required. Core stability allows to generate maximum power and transfer loads. In figure skating core stability is needed to maintain balance, control the blade on the ice, achieve tightness in the air and to keep the body upright while jumping. (Snelling, n.d.)

5.5 Weakness in gluteal muscles

In aesthetic athletes a common cause of hip pain and lower extremity dysfunction is a consequence of hip abductor weakness. The GMed abducts and pulls the ilium away from sacrum to support the hip from dropping during gait. In case of weakness, the lower extremity adducts and internally rotates, which increases stress on the tensor fascia lata. Weakness in GMed has been associated with patellofemoral pain, more commonly known as pain at the front of the knee; iliotibial pain, pain on the outer thigh and knee caused by an overuse injury of the connective tissues; and medial tibial stress syndrome, more commonly known as “shin splints”, a condition that causes pain on the inside of the shin. (d'Hemecourt & Luke, 2012, p. 403.)

GMax acts as local and global stabilizer, and it exerts force as a global mobilizer. As a local stabilizer GMax is involved in stabilizing lower back, sacroiliac joint, lumbo-sacral region, and the femoral head in the acetabulum. It may also play a role in stabilizing the knee joint in extension due to its attachment into the iliotibial band. As a global stabilizer, through eccentric and isometric actions, GMax controls range of motion across three planes of motion. GMax prevents trunk forward lean and trunk rotation, it stabilizes the pelvis in single leg stance preventing adduction and internal rotation of the femur. Together with other gluteal muscles, GMax stabilizes the hip by eccentrically controlling adduction and internal rotation of the thigh and therefore maintaining proper leg alignment, while counteracting gravity’s hip adduction torque. As a global mobilizer GMax contributes to hip extension and external rotation of the femur, action of superior fibers produces hip abduction torque, and the action of inferior fibers produces hip adduction torque. Due to compensations, occurring due to weakness or a dysfunction in GMax, chronic ‘biomechanical overload’ type injuries or acute injuries may occur, due to excessive force acting upon a compromised neuromuscular system. Weakness or dysfunction of GMax may be a contributing risk factor or the result of injury. Injuries like anterior knee pain, anterior cruciate ligament injuries, low back pain, ankle sprains, hamstring strains, and femoral acetabular impingement syndrome have been associated with weakness of GMax. (Buckthorpe et al., 2019.)

6 METHODS

Action research cycle can be explained as simply as plan, do, study, and act. Action research cycles consist of phases, after one cycle has finished the same cycle starts again with the knowledge gained from the previous cycle. (Lawson et al., 2015, pp. 13-14.) Action research is started with reviewing the current practice, after which the aspect, wished to investigate, is identified. After identifying the aspect, question is, how to investigate it and what is the goal. Once the solutions for the aspect are clear, the solutions are taken into action and the actions are evaluated. Plan is modified based on what has been found out in action and the modified action is continued. The cycle goes on until a satisfactory goal is achieved. (McNiff, 2013, p. 90.) This thesis has similar approach as action research. It started with the club identifying their problem of inactive or weak gluteal muscles in their single skaters. After knowing the problem, author started researching the issue.

Literature search was done using two data bases, PubMed and Samk Finna. Many different search terms and combinations of them were used. Some of the search terms were figure skating, glutes, gluteal muscles, injury prevention, risk factors (combined with the most common figure skating injuries), and gluteal strength, also all three gluteal muscles in combination with injury prevention and risk factors. A librarian’s help was used in forming the search terms. Relevant studies were selected from the searches.

After literature search the author of this thesis found out a possible solution for the club’s problem. The possible solution was tested at the club, but due to time management only the usability of the guidebook and exercise program could be evaluated by a questionnaire. The effectiveness of the exercise program could be evaluated after a reasonable amount of time. Based on feedback, the guidebook was modified to suit the clubs needs and sent for the club to be used. From here another cycle could be started by evaluating the effectiveness of the exercise program and modifying it if needed.

Reason for choosing this thesis method was to find up-to-date literature, to gather information about injury prevention, exercises, and the exercising methods to strengthen gluteal muscles in figure skaters. As written by Lawson (2013, p. 24), action research is “a form of words that refers to people becoming aware of and making public their process of learning with others”. The guidebook provides information to the coaches about injuries, injury prevention and exercises. The exercise program focuses on strengthening gluteal muscles of 10-12-year-old figure skaters of KooKoo Jäätaiturt, figure skating club in Kouvola, as these muscles have been repeatedly found to be weak or inactive during screenings done by physiotherapists.

7 GUIDEBOOK

A guide made by Finnis Centre for Health Promotion was used when planning the guidebook. A guidebook should have a concrete aim, it should include risk factors, and it should provide methods that can be implemented to achieve change in the issue. A guidebook should be motivating and empowering and serve the user's needs. It should bring out curiosity of the user towards the topic and create thrust between the user and the author. The aim of the guidebook should be promoted by the outlook. (Rouviainen-Wilenius, n.d., pp. 11-12.)

The guidebook is focusing on bringing new perspectives for the coaches to promote healthy habits and longer careers for their skaters. The guidebook provides the coaches with information regarding figure skating, injuries, injury prevention including risk factors, a small portion of anatomy, current guidelines for resistance training in youth and an exercise program. The exercises are divided into four parts, all of which contain three similar exercises. One exercise from each section is selected and a four-exercise program is formed. Providing the club with more exercises allows them to follow the program for longer. Following a program with only four exercises allows the skaters to perform the exercises a couple of times per week within the training hours. By performing the exercises during off-ice training, the coaches can ensure proper technique of the skaters. Guidebook can be found from Appendix I.

8 INJURY PREVENTION

The leading cause of injury in youth is sport. Sport related injury affects negatively on future participation in physical activity adversely affecting future health. Eliminating all injuries in youth sport is impossible. However, the number or seriousness of injuries can be positively affected by injury prevention strategies. The focus of injury prevention in youth is on reducing the risk of lower extremity injuries. (Emery et al., 2015, p. 865; Emery & Pasanen, 2019, p. 6.) When the focus is on affecting on the risk factors before a condition has occurred, the prevention is called primary prevention (Rouviainen-Wilenius, n.d., p. 6). Research shows that one of the most important issue for development of a figure skater is staying injury free. If a skater often suffers from injuries, development is likely to plateau due to irregular practices and other limiting factors during training. (Aalto, 2017, pp. 32-33.)

A model for injury prevention in sports was developed by Van Mechelen and is used as a foundation for the development and evaluation of injury prevention programs. The model has four steps. The first step is to, through surveillance system, establish the extent of injury in a specific population. The second step is to identify the risk factors for injury in a specific population. The third step is development and validation of injury prevention strategies. The fourth and last step is evaluation of these injury prevention strategies by measuring the impact of the prevention strategy on the incidence of injuries using appropriate surveillance systems. An extension to this model has two additional steps, which allows the transition of the effectiveness of injury prevention strategies into practice in real life. These two additional steps are understanding of the real world to which the specific intervention is being developed and a real-world setting evaluation of this intervention. (Emery & Pasanen, 2019, pp. 4-5.)

Research on injury prevention in sports is focusing on three areas: training strategies, modification of sport rules and changes in policies, and equipment recommendations. Through neuromuscular exercise interventions, modifiable athlete related risk factors are the focus of training strategy research. Strength, endurance, and balance are examples of modifiable intrinsic, athlete related, risk factors. Various studies show neuromuscular injury prevention programs to reduce the risk of injury. Studies evaluating neuromuscular training interventions in youth sport show an estimate of 35 percent reduction in lower limb injury risk and 26 percent reduction in knee injury risk. Reported effect was even greater if the focus of the neuromuscular prevention programs was proprioception, balance, and strength. (Emery & Pasanen, 2019, p. 7.)

Little research has been done on figure skating injury prevention strategies in youth skaters. A systematic review and meta-analysis evaluating neuromuscular training injury prevention strategies in youth sports was focusing on team sports. The review found that multifaceted neuromuscular training programs executed as preseason, or warm-up training strategies show reduction in injury incidence rate in team sports by 28 to 80 percent depending on the sport. The evidence also suggested the efficacy of such training programs to reduce knee injuries by 45 to 83 percent and a trend towards a preventative effect in reduction of ankle injuries by 44 to 86 percent, depending on the sport. Majority of neuromuscular training strategies used in research and included in this meta-analysis included components of balance, agility, and strength. Research shows preventative benefits of interventions focusing on strength and proprioception/balance, interventions focusing on stretching have failed to show preventative benefits. (Emery et al., 2015, pp. 865-869.)

9 RISK FACTORS FOR INJURY IN YOUTH ATHLETES

The first step of injury prevention in youth is understanding and identifying modifiable risk factors, such as muscle strength and movement patterns. Factors placing young athletes at risk of injury are still not fully understood. Same goes with the best strategies for injury prevention. Age, sex, sport selection, maturation phase, pattern of previous injuries, biomechanics, degree of sport specialization, and sleep patterns are the most commonly researched risk factors. Effectiveness of different prevention programs, such as neuromuscular training to improve muscle strength and teach movement patters, have been researched. Risk factors vary based on gender, which might be due to different movement patterns between genders. (Krabak et al., 2019; Stracciolini et al., 2017, p. e99.)

9.1 Previous injury

Understanding athlete's history in injuries may help reduce future injuries (Krabak et al., 2019). Consistent evidence shows the strongest predictor of a future injury to be a previous injury. Identifying previous injuries that might be incompletely healed or rehabilitated is important before clearing an athlete for full participation. Prior injuries that are pain free might leave an athlete with weaknesses in muscles, which might predispose to another injury. (Stracciolini et al., 2017, p. e100.)

9.2 Growth

Understanding the difference in progression of biologic and chronologic age is required to reduce injuries in skeletally immature athletes. Comparing to adults, children may be more sustainable to repetitive stress injury due to the susceptibility of growth cartilage and growing soft tissue as well as growth process itself. This happens due to the long bones growing in length more rapidly than the muscle-tendon complex, which creates tension to the tendon apophysis and can possibly create traction injuries to the growth plates. Rapid growth typically occurs in girls at the age of 12 years, and in boys at the age of 14 years. The most susceptible time period for musculoskeletal injury in young girl athletes may be the period of rapid growth or peak high velocity just before the onset of menarche. (Krabak et al., 2019; Stracciolini et al., 2017, p. e100.)

9.3 Biomechanics

Joint movement patterns are influenced by athlete’s way of using their muscles during athletic maneuvers. These patterns can affect on the risk of injury. Relatively rapid increase in body mass and height is experienced by both genders during puberty as well as elevation in their center of mass. During this time boys have a surge of testosterone which results in an increase in muscle mass and strength. Girls do not have this testosterone surge, and therefore do not experience muscle growth on the same level as boys. Due to this, pubertal girls tend to have decreased muscle control of their joints and core stability during athletic maneuvers. The absence of increase in strength and muscle recruitment at the hip and trunk are the reason for the decreased core stability. (Stracciolini et al., 2017, p. e100.)

Dynamic knee valgus, which is an inward rotation of the knee due to a combination of hip internal rotation and adduction during athletic maneuvers, is a contributing risk factor for anterior cruciate ligament injuries and patellofemoral pain syndrome. Girls going through pubertal maturation tend to perform athletic movements, such as jumping, with increasing amounts of dynamic knee valgus. This might be due to relative weakness in the hip and trunk muscles. (Stracciolini et al., 2017, p. e100-e101.) In patients with patellofemoral pain, association between dynamic knee valgus and gluteal muscle strength is shown in numerous studies. However, studies show that strengthening gluteal muscles shows improvement in symptoms but does not change the kinematics in patients with patellofemoral pain. (Rabelo, Nayra Deise dos Anjos & Lucareli, 2018.) Multiple studies concluded that reduced ankle dorsiflexion is correlated with dynamic knee valgus (Fong et al., 2011; Lima et al., 2018; Rabin et al., 2016). A literature review conducted in 2020 concluded that in reducing dynamic knee valgus during single leg squat, gluteal muscle strength and activation, strength of trunk lateral flexion, ankle dorsiflexion range of motion, and midfoot mobility should be taken into consideration. During single leg landing knee valgus may occur due to higher midfoot mobility and decreased strength of hip abductors, extensors, and external rotators. (Wilczyński et al., 2020.) A recent literature review found conflicting relationship between hip muscle strength, and dynamic knee valgus. Out of seven studies, the relationship between dynamic knee valgus and hip abductor strength was negatively and positively correlated in two studies each, and not correlated in three studies. Reduced strength in hip extensor muscle was associated with dynamic knee valgus in two studies, while no correlation was found in three studies. Reduced strength in hip external rotator muscle was associated with dynamic knee valgus in two studies, while no correlation was found in five studies. (Alzahrani et al., 2021.)

9.4 Early sports specialization

The frequency of early sport specialization is increasing as youth is striving to achieve the elite level. Significant evidence supports the association in youth athletes between sport specialization and increased risk of overuse injury. Motor skill development may be reduced due to early sport specialization. Sports specialization is defined as intensive training in a single sport, lasting year-long, at the exclusion of other sports. When compared to multisport athletes, adolescent girls who specialize in one sport had increased risk of anterior knee pain disorders. Sport specialization has been shown to be a risk factor for overuse injuries in youth athletes, no matter the training volume. (Fabricant et al., 2016; Jayanthi et al., 2019; Myer et al., 2016; Post et al., 2020; Stracciolini et al., 2017, p. e101-e102.)

9.5 Sleep

An apparent association between sleep duration and sport-related injury risk has been reported. Study found that in young athletes' fatigue-related injuries were related to sleeping less than six hours the night before the injury. Adolescent elite athletes who report more than eight hours of sleep per night on typical weekdays have significantly reduced risk of sustaining an injury. A significantly positive effect has been found in adjusting training schedule to improve sleep duration to impact on several aspects of athletic performance. (Copenhaver & Diamond, 2017; Stracciolini et al., 2017, p. e102.)

10 EXERCISE PROGRAM

Based on majority of recent literature, resistance training is effective and safe in all phases of maturity when qualified supervision, age-appropriate program design, and gradual progression are used. Beginning a resistance-training program does not have a minimum age requirement, as long as the subject is mentally and physically able to understand the instructions of a trainer. (Behringer et al., 2010, p. e1200, e1205.)

10.1 Neuromuscular training

Neuromuscular training is defined as a program that consists of general and sports-specific strength and conditioning activities. Activities like this include resistance, dynamic stability, balance, core strength, plyometric, and agility exercises. The goal of neuromuscular training is to enhance health- and skill-related physical fitness components and reduce the risk of injury. (Grancher et al., 2018.) Three main components of an effective program are strengthening exercises of hip and core; plyometrics, such as repetitive jumping exercises; and feedback about proper form. (Stracciolini et al., 2017, p. e101.)

10.2 Resistance training

Resistance training, sometimes used synonymously with strength training when talking about youth, is a type of training used to enhance muscular strength, muscular power, and local muscular endurance for general exercise or competitive sports. Resistance training uses various loads, from body weight and elastic tubing to free weights and barbells. Resistance training in youth can lead to improvement in motor skill performance, gains in speed and power, reduction in the risk of injury, and injury rehabilitation. (Stricker et al., 2020.) In youth, resistance training is an important factor for promotion of athletic development and increasing the tolerance to the demands of long-term training and competition (Granacher et al., 2016). In children, strength can improve by 30 to 50 percent after just 8 to 12 weeks of strength training, using a well-planned program. (Dahab & McCambridge, 2009.)

Nervous system can be divided into central nervous system and peripheral nervous system. One function of the nervous system is transmitting contraction messages to muscles. Eccentric, isometric, and concentric contractions are different types of muscle contractions. During eccentric contraction muscle elongates, during concentric contraction muscle shortens, and during isometric contraction the length of the muscle stays the same. By training, adaptation between muscle and nervous system is achieved. (Aalto, 2017, p. 16.) Resistance training provides enhanced stimulation to the central nervous system which would not occur with normal growth and maturation (Gallahue et al., 2012, p. 257). Gains in strength during childhood are primarily attributed to the increases in motor neuron recruitment, allowing increase in strength without resulting in muscle hypertrophy (Stricker et al., 2020). Neuromuscular adaptation is a term used for changes that result from training. A natural reaction for the body is to adapt to the new conditions when the body is subjected to significant amount of anatomical or physiological stress over time. (Gallahue et al., 2012, p. 257.)

When resistance training is well planned and supervised, children and adolescent can increase strength with relatively low injury rates. An emphasis should be put on correct technique. Variables affecting on youth resistance program include quality of instruction, training environment, training frequency, training age, type of resistance used, effort intensity, number of sets and repetitions, rest interval between sets and exercises, and duration of training. (Stricker et al., 2020.)

Studies suggest that the most effective resistance-training programs in attaining maximal strength gains last 23 weeks and more. Strength is increased with various types of resistance training for a minimum duration of 8 weeks with a frequency of 2 to 3 times per week. (Stricker et al., 2020.) A positive and significant correlation was found in a meta-analysis, between the number of sessions performed per week and the effects of training. This correlation is compatible with guidelines for childhood and youth resistance training recommendations of 2 to 3 sessions per week. (Behringer et al., 2010, p. e1207.) 1 minute rest between sets for beginners and 2 to 3 minutes rest when the intensity increases, is recommended when working with youth. Starting with 1 to 2 sets of 8 to 12 repetitions, with low resistance training intensity of less than 60 percent of 1 repetition maximum, which allows completion of a variety of exercises without undue fatigue. As resistance training skill competency improves, increasing weight in 5 to 10 percent increments and reducing number of repetitions is reasonable. Training program can be progressed to low and moderate resistance training intensity with 2 to 4 sets of 6 to 12 repetitions with the load of less than 80 percent of 1 repetition maximum. (Stricker et al., 2020.) Even though volume and intensity are important factors when designing a resistance-training program, no correlation between these and gained strength has been found (Behringer et al., 2010, p. e1207). Exercises involving the core, including abdominals, low back, and gluteal muscles, can be beneficial for sport-specific skill acquisition and postural control. Resistance training can be included into training year-round. Plan should vary in volume and intensity depending on the timing during the season, such as preseason, in season and off season. (Stricker et al., 2020.)

Resistance training can be combined with plyometric training, which has shown positive findings in reduction of injuries. Plyometric training enhances muscle strength and power by involving rapid concentric and eccentric muscle actions in a relatively short amount of time, such as in squat jump. When combined with proprioceptive training, such as balance exercises, programs have been shown to benefit in rehabilitation and reduction of some injuries, such as ankle sprains. (Stricker et al., 2020.)

10.3 Exercises

Research evaluating muscle contraction during various exercises is often done using electromyography (EMG), which measures muscle's electrical activity, meaning the physiological signal of depolarization of sarcolemma, which is the membrane of a muscle. EMG does not measure the actual muscle activation, but the preface of muscle activation. There are many challenges in repeatability with EMG, some of the challenges are the specific placements of electrodes, changes between participants, and the differences in execution of an exercise between measurement times. (Tapio & Vilén, 2020, pp. 183-187.)

Between large degree of muscle activation and subsequent increase in strength, a relationship exists. Due to this, designing a resistance training program should initiate from selecting exercises that encourage large amount of EMG activity. Differences in strength ratio between muscle groups can influence muscle activity during an exercise, therefore simply measuring muscle activation is not sufficient to prescribe exercises. An evidence-based training program can be based on exercises with large degrees of muscle activity, but muscle activity across exercises is not consistent between athletes. When selecting exercises EMG can be used as a starting point, due to individual differences in strength and muscle activation there is a need for individual training programs. (Stastny et al., 2016.)

Single leg squat exercise has been shown to cause high to very high level of activation in GMed when performed using body weight. Skater squat showed high level of activation in GMed when preformed using body weight. (Stastny et al., 2016.) Monopodal squat showed high activation level in GMed and GMax (Muyor et al., 2020). Even though the GMed functions as a pelvis and knee stabilizer, performing exercises on an unstable surface does not result in additional activation of the GMed during squatting (Stastny et al., 2016). In single leg squatting the movement patterns are similar to those of figure skating. Various variations of single leg squats exist. Skater squat, monopodal squat and single limb squat are similar exercises with changes in the placement of the unloaded leg.

Step-up variations showed highest activation of GMax, compared to other common strength and hypertrophy exercises based on a systematic review. Step-up variations included lateral, diagonal, and cross-over step-ups. Activation level in GMax was very high in all of the variations. (Neto et al., 2020.)

Single leg deadlift showed high muscle activation in both GMax and GMed (Boren et al., 2011). During single leg deadlift, hip hinge movement and the position of the leg is similar to a skater gliding on ice. Balance and strength are the main focus of single leg deadlifts, which helps with jumps and landings. (SkatePerfect, n.d.)

As mentioned before, figure skating jumps are landed on one leg (Lipetz & Kruse, 2000). Single-leg landings have been studied to measure lower limb biomechanics.

Study testing three different landing directions; forward, lateral, and rotational, found that an advantageous active whole-body configuration resulted in forward landing. The joints of the lower limbs adopted different and specific energy absorption strategies depending on the landing direction. (Dello Iacono et al., 2019.) Another study investigated knee joint coordination during multidirectional single-leg landings. The study used four directions in landing: forward, diagonal in both 30- and 60-degree angles, and lateral. The study observed poorer knee coordination during landing to the lateral direction. Also, better coordination seemed to be in the non-dominant limb compared to the dominant limb. This leads to the dominant limb to be at a greater risk for injury. (Sinsurin et al., 2020.)

11 ETHICAL CONSIDERATIONS

As this thesis is focusing on youth skaters, some ethical considerations were necessary in the process of this thesis. Main ethical issues were concerning the piloting of the guidebook. As research shows that proper supervision is important when working with youth athletes, especially during resistance training, a decision was made for the coaches to instruct the exercise program to the skaters, while the author is observing the session. This allows the author to see the work of the coaches and provide tips, so that the exercise program can be safely executed under the supervision of the coaches throughout the season. Information letter about the piloting, a research consent, and the information about the use of private data in the thesis, was sent to the coaches. Information letter can be found from appendix II, the research consent form appendix III, and the information about the use of private data from appendix IV.

12 THESIS PROCESS

Thesis process started in the Spring of 2020, when a couple of topics were considered. In the Autumn of 2020, a decision to focus on figure skating was made. After a meeting with KooKoo Jäätaiturit in December of 2020 the topic got specified, as the club wanted an exercise program. To make the topic more specific and physiotherapy related, the topic got specified to focus on gluteal muscles and injury prevention. The thesis plan was presented in December of 2020.

Theory was mostly written during the spring and summer of 2021. As the topic of this thesis is quite narrow the main research question of the thesis was "How to implement gluteal exercises to reduce the risk of injury in youth figure skaters?". Literature search was performed in the Autumn of 2021.

After the literature search the exercises were selected out of electromyographic research. In the chosen exercises, the movement patterns resemble those of figure skating. After finalizing the exercise choices, the guidebook was put together.

Guidebook was piloted with the skaters and coaches of the KooKoo Jäätaiturit in November of 2021. Feedback for the guidebook was asked from the coaches using an e-form questionnaire. Questionnaire used, can be found from appendices (Appendix V). A feedback questionnaire was filled by the coaches of the club after they got familiar with the guidebook and went through the piloting. Some of the coaches were more interested in the topic and would have wanted more specific information to be included in the guidebook. The exercise program would be used weekly and with some modifications also with other age groups. Modifications to the guidebook were made based on the coaches' requests and sent back to the club. Thesis was finalized and presented in November of 2021.

13 DISCUSSION

The aim of this thesis was to develop an exercise program which would strengthen gluteal muscles and reduce the risk of future injuries in figure skaters aged 10-12. The exercise program is included in a guidebook. The topic was requested by KooKoo Jäätaiturit, a figure skating club of Kouvola, Finland, after noticing weak gluteal muscles to be a recurring issue with their skaters. The guidebook is based on the current literature and guidelines and provides the club with needed information about injuries, injury prevention, risk factors, and exercises to strengthen gluteal muscles.

Figure skating was selected to be the topic of the thesis because of the author's interest and previous knowledge in the sport. After considering different topics relating to the sport, author of this thesis started contacting figure skating clubs to find a more specific topic and need for the thesis. KooKoo Jäätaiturit needed an exercise program for their youth skaters. To make the topic even more specific and physiotherapy related, the topic got specified to focus on injury prevention by strengthening the gluteal muscles.

Finding research that would match the topic was challenging. Research about figure skating injuries exists but due to the evolution of the sport within the past 10 to 15 years, older research shows very different injury mechanisms in figure skaters. Now overuse injuries cover majority of injuries. Different studies define injury differently. Some studies report only injuries that cause skaters to miss trainings or cause impaired performance to the skaters. Overuse injuries are likely underestimated in this type of data collection methods. (Han et al., 2018; Kowalczyk et al., 2019.) Minimal research was found concerning exercises, figure skating and injury prevention. Author did not find research concerning intrinsic injury risk factors in figure skaters even after contacting a librarian to help with the search terms, which could indicate that the topic is not widely researched. Due to this the guidebook had to be based on a wider search. Due to the lack of research found about figure skating, research about other sports were included. No conclusions can be made based on this thesis work as it is an operational thesis. If someone else performed the same search they would most likely end up with similar results, but the end product could be totally different. Also, if the topic was wider at the beginning, the exercise program could focus on totally different muscle groups. As the guidebook is based on evidence, it may reduce the risk of injury in figure skaters, but also other exercise programs could have similar results. In the future, further research about risk factors and figure skating would be needed to provide health care professionals and the coaches with more accurate data, and to allow professionals to plan their implementations based on evidence.

Literature does show that injury prevention strategies are beneficial, and neuromuscular training can reduce injury risk (Emery et al., 2015; Emery & Pasanen, 2019; Grancher et al., 2018; Mohney et al., 2017). The challenge of planning the exercise program came when trying to decide the exercises as most of the injury prevention research do not specify what exercises they were performing during the studies, but only specify what muscle groups they were strengthening. The exercises for the injury prevention program were selected out of EMG research. Exercises chosen had similar movement patterns to figure skating. A lot of research can be found on muscle activation based on EMG, the problem comes with the reliability of the research, as the repeatability of EMG research is low, due to the challenges of the measurements. EMG also only measures the pre-activation phase of muscle activation; therefore, actual muscle activation remains unknown. Load used for the exercise, the way of performing the exercise and the person performing the exercise all affect on muscle activation. Due to these challenges a more individual program could be more beneficial for the skaters, but this would require a lot of resources from the club. (Stastny et al., 2016; Tapio & Vilén, 2020.)

Studies show that longer resistance training program have greater effect in gained strength. A program should last a minimum of 8 weeks and the training frequency should be 2 to 3 times per week. (Behringer et al., 2010; Stricker et al., 2020.) The exercise program included in the guidebook has four parts, each part containing three similar exercises. One exercise from each part is selected and a four-exercise program is formed. Providing the club with more exercises allows them to follow the program for longer. Following a program with only four exercises allows the skaters to perform the exercises a couple of times per week within the training hours. By performing the exercises during off-ice training, the coaches can ensure proper technique of the skaters, which is one of the main points of a beneficial injury prevention program (Behringer et al., 2010).

As this thesis only focused on developing the exercise program, effectiveness of the program is unknown. Effectiveness could be tested in the future by testing skater before starting the program and after using the program for at least 8 weeks, as research shows this to be the minimal intervention time for results to occur. Exercises could be tested by measuring muscle strength and evaluating the control during the exercises. By a longer follow up or a questionnaire, guidebook's effect on injury prevention could be evaluated. While using the program, skaters are most likely also performing other exercises, due to this, evaluating the exact effect of the exercises in the program is difficult. But as research shows, coordination and balance training are an important part of neuromuscular training, together with resistance and plyometric training (Grancher et al., 2018; Stracciolini et al., 2017; Stricker et al., 2020). As this program only includes resistance training, with a small portion of plyometrics, it would be beneficial for the skaters to perform coordination and balance drills together with this program.

In the feedback of the guidebook, the coaches were interested in more information. This would mean that either author managed to bring out their curiosity about the topic, or the first version of the guidebook had too limited information. In the feedback coaches mentioned some parts of the guidebook that were not clear enough and would have needed charts, for example in the exercise program. Charts were added for clarity. The exercise program will be used by the coaches weekly, and with some modifications also with other groups.

During the process of this thesis, the author learned about the world of research. As the author had no prior experience in thesis writing or research, the beginning was difficult, and with the current knowledge the process would most likely be much smoother. As the thesis is operational and the literature of the thesis was gathered through literature searches, the research included in the thesis were not evaluated using a specific tool. No structured inclusion or exclusion process was involved. In the future this experience of research will be beneficial in the physiotherapy work when researching evidence-based methods. During the thesis process author learned about injuries in figure skating, and injury prevention. In the future this will be beneficial, as these strategies can be used with both athletic and unathletic population. Author also learned about resistance training in youth, as the author is interested in working with paediatric population in the future, this was a great learning experience for the author.

REFERENCES

Aalto, A. (2017). Taitoluistelun lajianalyysi ha valmennuksen ohjelmointi. Valmennusseminaarityö. Jyväskylä: University of Jyväskylä. http://urn.fi/URN:NBN:fi:jyu-201711104218

Agur, A. M. R. & Dalley, A. F., II. (2017). Grant's atlas of anatomy (Fourteenth edition. International edition). Wolters Kluwer.

Alzahrani, A. M., Alzhrani, M., Alshahrani, S. N., Alghamdi, W., Alqahtani, M., & Alzahrani, H. (2021). Is Hip Muscle Strength Associated with Dynamic Knee Valgus in a Healthy Adult Population? A Systematic Review. International Journal of Environmental Research and Public Health, 18(14), 7669. https://doi.org/10.3390/ijerph18147669

Behringer, M., Vom Heede, A., Yue, Z. & Mester, J. (2010). Effects of resistance training in children and adolescents: a meta-analysis. Pediatrics (Evanston), 126(5), e1199-e1210. https://doi.org/10.1542/peds.2010-0445

Boren, K., Conrey, C., Le Coguic, J., Paprocki, L., Voight, M. & Robinson, T. K. (2011). Electromyographic analysis of gluteus medius and gluteus maximus during rehabilitation exercises. International Journal of Sports Physical Therapy, 6(3), 206-223.

Buckthorpe, M., Stride, M. & Villa, F. D. (2019). Assessing and treating gluteus maximus weakness - a clinical commentary. International Journal of Sports Physical Therapy, 14(4), 655-669. https://doi.org/10.26603/ijspt20190655

Contreras, B. & Cordoza, G. (2019). Glute Lab: The Art and Science of Strength and Physique Training. Victory Belt Publishing Inc.

Copenhaver, E. A., & Diamond, A. B. (2017). The Value of Sleep on Athletic Performance, Injury, and Recovery in the Young Athlete. Pediatric Annals, 46(3), e106-e111. https://doi.org/10.3928/19382359-20170221-01

Dahab, K. S. & McCambridge, T. M. (2009). Strength Training in Children and Adolescents: Raising the Bar for Young Athletes? Sports Health, 1(3), 223-226. https://doi.org/10.1177/1941738109334215

Dello Iacono, A., Ayalon, M. & Wang, W. (2019). The influence of single-leg landing direction on lower limbs biomechanics. The Journal of Sports Medicine and Physical Fitness, 59(2), 195-203. https://doi.org/10.23736/S0022-4707.18.08358-5

d'Hemecourt, P. A. & Luke, A. (2012). Sport-Specific Biomechanics of Spinal Injuries in Aesthetic Athletes (Dancers, Gymnasts, and Figure Skaters). Clinics in Sports Medicine, 31(3), 397-408. http://dx.doi.org/10.1016/j.csm.2012.03.010

Emery, C. A., Roy, T., Whittaker, J. L., Nettel-Aguirre, A. & van Mechelen, W. (2015). Neuromuscular training injury prevention strategies in youth sport: a systematic review and meta-analysis. British Journal of Sports Medicine, 49(13), 865-870. https://doi.org/10.1136/bjsports-2015-094639

Emery, C. A., & Pasanen, K. (2019). Current trends in sport injury prevention. Best Practice & Research. Clinical Rheumatology, 33(1), 3-15. https://doi.org/10.1016/j.berh.2019.02.009

Fabricant, P. D., Lakomkin, N., Sugimoto, D., Tepolt, F. A., Stracciolini, A., & Kocher, M. S. (2016). Youth sports specialization and musculoskeletal injury: a systematic review of the literature. The Physician and Sportsmedicine, 44(3), 257-262. https://doi.org/10.1080/00913847.2016.1177476

Fong, C., Blackburn, J. T., Norcross, M. F., McGrath, M., & Padua, D. A. (2011). Ankle-dorsiflexion range of motion and landing biomechanics. Journal of Athletic Training, 46(1), 5-10. https://doi.org/10.4085/1062-6050-46.1.5

Gallahue, D. L., Ozmun, J. C. & Goodway, J. D. (2012). Understanding motor development: infants, children, adolescents, adults (7th ed. International ed). McGraw-Hill Education.

Granacher, U., Lesinski, M., Büsch, D., Muehlbauer, T., Prieske, O., Puta, C., Gollhofer, A., & Behm, D. G. (2016). Effects of Resistance Training in Youth Athletes on Muscular Fitness and Athletic Performance: A Conceptual Model for Long-Term Athlete Development. Frontiers in Physiology, 7, 164. https://doi.org/10.3389/fphys.2016.00164

Han, J., Geminiani, E. & Micheli, L. (2018). Epidemiology of Figure Skating Injuries: A Review of the Literature. Sports Health, 10(6), 532-537. https://doi.org/10.1177/1941738118774769

Huxel Bliven, K. C., & Anderson, B. E. (2013). Core Stability Training for Injury Prevention. Sports Health, 5(6), 514-522. https://doi.org/10.1177/1941738113481200

KooKoo Jäätaiturit. (2020). Kilpa 2: Ryhmä. Retrieved April 6, 2021, from https://www.kookoojaataiturit.fi/yksinluistelu/joukkueet/8895

Kowalczyk, A., Geminiani, E., Dahlberg, B., Micheli, L. & Sugimoto, D. (2019). Pediatric and adolescent figure skating injuries: a 15-year retrospective review. Clinical Journal of Sport Medicine, 31(3), 295-303. https://doi.org/10.1097/JSM.0000000000000743

Krabak, B. J., Tenforde, A. S., Davis, I. S., Fredericson, M., Harrast, M. A., d'Hemecourt, P., Luke, A. C., & Roberts, W. O. (2019). Youth Distance Running: Strategies for Training and Injury Reduction. Current Sports Medicine Reports, 18(2), 53-59. https://doi.org/10.1249/JSR.0000000000000564

Lawson, H. A., Caringi, J., Pyles, L., Jurkowski, J., & Bozlak, C. (2015). Participatory action research (First edition ed.). Oxford University Press.

Lima, Y. L., Ferreira, Victor Matheus Leite Mascarenhas, de Paula Lima, Pedro Olavo, Bezerra, M. A., de Oliveira, R. R., & Almeida, G. P. L. (2018). The association of ankle dorsiflexion and dynamic knee valgus: A systematic review and meta-analysis. Physical Therapy in Sport, 29, 61-69. https://doi.org/10.1016/j.ptsp.2017.07.003

Lipetz, J. & Kruse, R. J. (2000). Injuries and special concerns of female figure skaters. Clinics in Sports Medicine, 19(2), 369-380. https://doi.org/10.1016/S0278-5919(05)70209-X

McNiff, J. (2013). Action research: principles and practice (3rd ed ed.). Routledge.

Mohney, G., Miller, M. G. & Hanson, N. (2017). Strengthening the Figure Skater: Considerations for Injury Prevention and Performance. Strength and Conditioning Journal, 39(3), 58-65. https://doi.org/10.1519/SSC.0000000000000220

Muyor, J. M., Martin-Fuentes, I., Rodriguez-Ridao, D. & Antequera-Vique, J. A. (2020). Electromyographic activity in the gluteus medius, gluteus maximus, biceps femoris, vastus lateralis, vastus medialis and rectus femoris during the Monopodal Squat, Forward Lunge and Lateral Step-Up exercises. PloS One, 15(4), e0230841. https://doi.org/10.1371/journal.pone.0230841

Myer, G. D., Jayanthi, N., DiFiori, J. P., Faigenbaum, A. D., Kiefer, A. W., Logerstedt, D., & Micheli, L. J. (2016). Sports Specialization, Part II. Sports Health, 8(1), 65-73. https://doi.org/10.1177/1941738115614811

Neto, W. K., Soares, E. G., Vieira, T. L., Aguiar, R., Chola, T. A., Sampaio, V. d. L. & Gama, E. F. (2020). Gluteus Maximus Activation during Common Strength and Hypertrophy Exercises: A Systematic Review. Journal of Sports Science & Medicine, 19(1), 195-203. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7039033/

Rabelo, Nayra Deise dos Anjos, & Lucareli, P. R. G. (2018). Do hip muscle weakness and dynamic knee valgus matter for the clinical evaluation and decision-making process in patients with patellofemoral pain? Revista Brasileira De Fisioterapia (São Carlos (São Paulo, Brazil)), 22(2), 105-109. https://doi.org/10.1016/j.bjpt.2017.10.002

Rabin, A., Portnoy, S., & Kozol, Z. (2016). The association of ankle dorsiflexion range of motion with hip and knee kinematics during the lateral step-down test. The Journal of Orthopaedic and Sports Physical Therapy, 46(11), 1002-1009. https://doi.org/10.2519/jospt.2016.6621

Rouviainen-Wilenius, P. (n.d.). Tavoitteena hyvä ja hyödyllinen terveysaineisto: Kriteeristö aineiston tuotannon ja arvioinnin tueksi. Finnish Centre for Health Promotion.

Sinsurin, K., Vachalathiti, R., Srisangboriboon, S. & Richards, J. (2020). Knee joint coordination during single-leg landing in different directions. Sports Biomechanics, 19(5), 652-664. https://doi.org/10.1080/14763141.2018.1510024

SkatePerfect. (n.d.). 5 BEST EXERCISES FOR ICE SKATING AND WHY. https://skateperfect.com/5-best-exercises-for-ice-skating-and-why/

Snelling, D. (n.d.). Grand River Sports Medicine Centre: What Skaters Need to Know About Core Stability…. Retrieved July 26, 2021, from https://www.grsm.ca/wp-content/uploads/GOALPost-V1-7-SKATING-Dana.pdf

Stastny, P., Tufano, J. J., Golas, A. & Petr, M. (2016). Strengthening the Gluteus Medius Using Various Bodyweight and Resistance Exercises. Strength and Conditioning Journal, 38(3), 91-101. https://doi.org/10.1519/SSC.0000000000000221

Stracciolini, A., Sugimoto, D. & Howell, D. R. (2017). Injury Prevention in Youth Sports. Pediatric Annals, 46(3), e99-e105. https://doi.org/10.3928/19382359-20170223-01

Stricker, P. R., Faigenbaum, A. D. & McCambridge, T. M. (2020). Resistance Training for Children and Adolescents. Pediatrics (Evanston), 145(6), e20201011. https://doi.org/10.1542/peds.2020-1011

Suomen Taitoluisteluliitto. (2021). Luistelukoulu. Retrieved November 10, 2021, from https://www.stll.fi/tule-mukaan/luistelukoulu/

Suomen Taitoluisteluliitto. (2021). Yksinluistelun elementtivaatimukset kaudella 2021-2022. Retrieved August 17, 2021, from https://www.stll.fi/wp-content/uploads/sites/4/2021/07/YL-kilpailuvaatimukset-2021-2022.pdf

Tapio, J. & Vilén, V. (2020). Fysioterapia 2.0 (1st). VK-Kustannus.

Terveystalo. (2013). Yleisimmät vammat: Taitoluistelu. Retrieved November 16, 2020, from https://www.terveystalo.com/fi/Palvelut/Urheilijat-ja-aktiiviliikkujat-Sport/Tietoa-urheiluterveydesta/Yleisimmat-vammat-Taitoluistelu/

Tortora, G. J. & Derrickson, B. (2014). Principles of anatomy & physiology (14th edition). Wiley.

Wilczyński, B., Zorena, K., & Ślęzak, D. (2020). Dynamic Knee Valgus in Single-Leg Movement Tasks. Potentially Modifiable Factors and Exercise Training Options. A Literature Review. International Journal of Environmental Research and Public Health, 17(21), 8208. https://doi.org/10.3390/ijerph17218208

APPENDIX I

Guidebook

Sisällys

JOHDANTO

Tämä harjoitusohjelma on kehitetty opinnäytetyönä Satakunnan ammattikorkeakoulussa. Harjoitusohjelma on tarkoitettu 10–12-vuotiaille taitoluistelijoille pakaralihaksen vahvistamiseen ja vammojen ennaltaehkäisyyn.

Kirjallisuus haulla on koottu tietoa taitoluistelusta, taitoluistelu vammoista ja vammojen ennaltaehkäisystä. Harjoitteet on valikoitu elektromyografia tutkimuksista taitoluistelijoille sopiviksi.

Harjoitusohjelman intensiteettiä on hyvä mukauttaa kauden mittaan kauteen sopeutuvaksi, vähentämällä tai lisäämällä sarjoja, toistomääriä ja lisäpainoja.

TAITOLUISTELU

Taitoluistelu vaatii jatkuvaa tasapainon hallintaa. Yksinluistelijalta vaaditaan räjähtävyyttä, voimaa ja kestävyyttä. Yksinluistelu sisältää hyppyjä, piruetteja, ja perusluistelua. Liikkeiden jatkuva toistaminen voi aiheuttaa rasitusvammoja.

Monet ulkoiset voimat vaikuttavat luistelijaan hyppyjen lähdöissä ja alastuloissa, sekä pirueteissa. Piikkihyppyjen aikana luistelijaan kohdistuvat voimat ovat kaarihyppyjä suuremmat. Alastulon aikana nilkkaan, polveen, ja alaselkään kohdistuvat suuret voimat. Alaraajojen luihin kohdistuva voima on 8–10 kertaa suurempi kävelyssä kohdistuvaan voimaan verrattuna. Piruettien aikana luistelijalta vaaditaan enemmän energiaa hyppyihin verrattuna. Ylä-, ala-, ja keskivartalon voimaa vaaditaan jalkojen ja käsien hallintaan piruetin aikana, jotta pyörimisvoimaa pystyy vastustamaan. Pyörimisvoima on 90–135 kg luistelijan pyöriessä kuusi kierrosta sekunnissa.

Taitoluistelijat pyörivät aina samaan suuntaan sekä hypyissä että pirueteissa ja hyppyjen alastulo jalkana toimii aina sama jalka. Taitoluistelijan voimantuotto polven ojennuksessa ja koukistuksessa, lantion ojennuksessa ja koukistuksessa, olkapäiden loitonnuksessa ja lähennyksessä on verrannollinen yksöis- ja kaksoisakselin korkeuteen.

ANATOMIA

Pakaran alueella on monia lihaksia. Pakaralihaksiksi nimettyjä lihaksia on kolme paria. Isot pakaralihakset eli gluteus maximus, keskimmäiset pakaralihakset eli gluteus medius ja pienet pakaralihakset eli gluteus minimus.

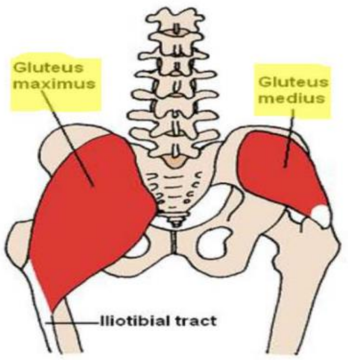
Iso pakaralihas on pakaralihaksista pinnallisin. Ison pakaralihaksen päätehtäviin kuuluu lonkan ojennus ja ulkokierron avustaminen. Iso pakaralihas myös stabiloi reittä ja avustaa vartalon nostoa eteen taivutuksesta.

Ison pakaralihaksen heikkoudet voivat olla vaikuttava riskitekijä tai seuraus vammasta. Vammat kuten polven etuosan kipu, eturistisiteen vammat, alaselän kipu, nilkan nyrjähdykset, takareiden venähdykset, ja ahdas lonkka -oireyhtymä, on yhdistetty ison pakaran heikkouksiin.

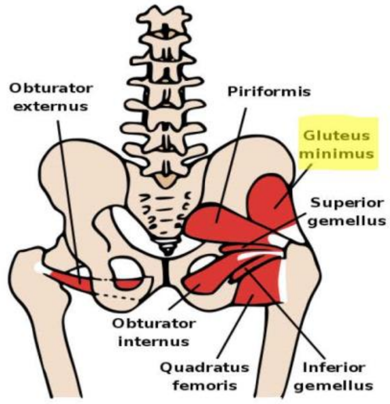
Keskimmäinen pakaralihas sijoittuu ison pakaralihaksen alle. Keskimmäisen pakaralihaksen päätehtäviin kuuluu lonkan loitonnus ja sisäkiero. Keskimmäinen pakaralihas pitää lantion tasoissa toisen jalan ollessa irti maasta.

Keskimmäisen pakaralihaksen heikkouksilla on yhteys polven etuosan kiputiloihin (patellofemoraalinen kipu syndrooma), iliotibiaali kipuihin (sidekudosten liikarasituksesta aiheutuva kipu reiden ja polven ulkosyrjällä), ja medialis tibialis syndroomaan, useammin tunnettu penikkatautina (syndrooma aiheuttaa kipua säären sisäpuolelle).

Pieni pakaralihas on pakaralihaksista syvin. Pienen pakaralihaksen päätehtävät ovat samat kuin keskimmäisen pakaralihaksen.



Iso pakaralihas vasemmalla ja keskimmäinen pakaralihas oikealla (Tuntematon tekijä).



Pieni pakaralihas (Tuntematon tekijä).

On tärkeää muistaa, että tietyn lihaksen heikkouden ja vamman yhteys ei suoranaisesti tarkoita syyseuraus suhdetta.

VAMMAT

Yksinluistelussa rasitusvammat ovat akuuttivammoja yleisempiä ja alaraajavammat ovat yläraajavammoja yleisempiä. Nilkan nyrjähdykset ja venähdykset ovat yleisimpiä vammoja ja patellaajänteen tendinopatia on yleisin rasitusvamma. Tyttöjen yleisimpiä vammoja ovat rasitusmurtumat.

Nilkan nyrjähdykset ja venähdykset ovat jalkaterän ja nilkan alueen vammoista yleisimpiä. 50–78 prosenttia nilkan ja jalkaterän vammoista voidaan ehkäistä oheisharjoittelulla.

Polven ojentaja mekanismin vammat ovat yleisimpiä polvialueen vammoja. Ojentaja mekanismin vammat sisältävät kaikki polven etuosan vammat, kuten patellofemoraalinivelen sekä patella- ja etureisilihaksen jänteen vammat. Yleisimmät diagnosoidut vammat polven alueella ovat patellofemoraalinen kipu syndrooma, patellajänteen tendinopatia, polven kontuusio vammat, ja Osgood-Schlatterin tauti.

31,9 prosenttia selän vammoista diagnosoitiin selkärangan rasitusmurtumiksi. 23,7 prosenttia merkattiin luokittelemattomiksi selän vaivoiksi.

Taitoluistelijoilla on riski IS-nivelen vammoihin, epätasaisen kuormituksen ja kaatumisten seurauksena.

VAMMOJEN ENNALTAEHKÄISY

Kaikkien vammojen poistaminen on mahdotonta, mutta vammojen määrään ja vakavuuteen voidaan vaikuttaa ehkäisevillä menetelmillä. Taitoluistelijan on tärkeää pysyä terveenä kehittyäkseen.

Urheilussa vammojen ennaltaehkäisy keskittyy kolmeen osa-alueeseen. Ensimmäinen osa-alue on harjoittelustrategia. Toinen osa-alue on sääntöjen ja toimintatapojen muokkaaminen. Kolmas osa-alue on varustesuositukset.

Harjoittelustrategioiden tavoitteena on harjoitusohjelmien avulla vaikuttaa urheilijan sisäisiin, muokattavissa oleviin vammojen riskitekijöihin. Näitä ovat lihasvoima, kestävyys ja tasapaino. Näitä kehittämällä urheilijan riski vammoille vähenee.

Muita vammojen riski tekijöitä nuorilla ovat edelliset vammat, kasvu, biomekaniikka, uni ja aikainen lajiin erikoistuminen.

Vammojen riskin vähentämiseksi, keskivartaloa, lantiota, ja alaraajoja vahvistavat harjoitteet voivat olla taitoluistelijoille hyödyllisiä. Pakaralihakset ovat ihmisen vahvin lihasryhmä. Pakaralihasten vahvistamisesta voi olla hyötyä polven, lonkan ja alaselän vammojen ennaltaehkäisyssä. Vahvat pakaralihakset auttavat ponnistamaan korkeammalle ja juoksemaan lujempaa.

10–12-VUOTIAIDEN HARJOITTELU

Vastusharjoittelu kehittää lihasvoimaa ja lihaskestävyyttä. Vastusharjoittelussa käytetään erilaisia vastuksia kehonpainosta, vastuskuminauhoihin ja ulkoisiin painoihin. Nuorissa vastusharjoittelu voi kehittää motorisia taitoja, parantaa nopeutta ja voimaa, ja vähentää vammoja tai kuntouttaa niitä. Vastusharjoitteluun ei ole ikärajaa. Voimaharjoittelu on turvallista ja tehokasta kaikissa kehittymisen ikävaiheissa, kun tasokas valvonta, ikään sopiva ohjelma rakenne ja asteittainen eteneminen ovat käytössä.

Harjoitusohjelman kesto on oltava vähintään 8 viikkoa ja harjoituskertoja tulisi olla 2–3 kertaa viikossa lihasvoiman kehittymiseksi. Aloittelijoilla sarjojen välissä tulisi olla 1 min tauko, intensiteetin lisääntyessä 2–3 min palautukset sarjojen välissä ovat suositeltavia. Aloittaessa 1–2 sarjaa 8–12 toistolla kevyellä vastuksella (alle 60 % maksimaalisen toiston painosta) antaa mahdollisuuden oikeiden liikemallien oppimiseen ilman liiallista lihasväsymystä. Vastusharjoittelun taitojen ja kapasiteetin kehittyessä vastusta voidaan lisätä 5–10 % kerrallaan, jolloin toistomääriä vähennetään. Harjoitusohjelmaa voidaan edetä kohtalaiseen intensiteettiin, jolloin tehdään 2–4 sarjaa 6–12 toistolla, vastuksena tällöin alle 80 % maksimaalisesta toistosta.

Vastusharjoittelua voidaan jatkaa koko kauden mittaa. Intensiteetti ja toistojen kokonaismäärä vaihtelevat kauden edetessä, ottaen huomioon kilpailukauden.

Vammoja ennalta ehkäisevässä ohjelmassa on kolme tärkeää komponenttia; lonkkaa ja keskivartaloa vahvistavat harjoitteet, plyometria harjoitteet kuten toistuvat hypyt, ja palaute oikeanlaisista liikemalleista. Ohjelman sisältäessä tasapaino ja ketteryys harjoitteita (joita tämä ohjelma ei sisällä), vamman riskin on huomattu pienenevän entisestään.

Harjoitusohjelman kesto vähintään 8 viikkoa

Harjoituskertoja per viikko 2–3

	Toistot	Sarjat	Palautus	Intensiteetti
Aloittelija	8–12	1–2	1 min	Alle 60 % 1 RM
Kehittyneempi harjoittelija	6–12	2–4	2–3 min	Alle 80 % 1 RM

Esimerkki: kehittyneemmän harjoittelijan ohjelman mukauttaminen kauteen

	Volyymit/toistot viikon aikana /liike	Toistot	Sarja	Palautus	Intensiteetti	Harjoituskertoja per viikko
Harjoittelukausi	70–100	6–8	4	3 min	Alle 80% 1 RM	3
Kilpailukausi	50–90	8–10	3	2–3 min	Alle 80% 1 RM	2–3
Kilpailuviikko	40–50	10–12	2	2 min	Alle 60% 1 RM	2

HARJOITTEET

Harjoitteet on jaettu neljään osaan; yhden jalan kyykyt, portaalle nousut, yhden jalan romanialaiset maastavedot ja pudottautumiset. Jokaisessa osassa on kolme saman tyyppistä liikettä. Tarkoitus on valita jokaisesta kohdasta yksi liike, näin saadaan neljän harjoitteen ohjelma. Kun näitä valittuja liikkeitä on toistettu noin neljän viikon ajan, valitaan uudet liikkeet. Näin saadaan noin 12 viikon ohjelma. Kun kaikki liikkeet on käyty läpi, niitä voi yhdistellä erilaisiksi harjoitus ohjelmiksi.

Liikkeen käydessä liian helpoksi, voi niihin lisätä vastusta (esim. vastusnauhalla tai lisäpainolla) tai muuttaa toistojen nopeutta (esim. hidastaa jarrutusvaihetta ja nopeuttaa työvaihetta). Kyykkyihin voi myös ottaa tasapainolaudan mukaan, tämä ei lisää pakaran aktivaatiota, mutta sillä haastetaan tasapainoa, mikä saattaa vaikuttaa positiivisesti vammojen ennaltaehkäisyyn.

Yhden jalan kyykyt

Kahdessa ensimmäisessä kyykyssä, tuoli on käytössä kyykyn hidastamiseksi, tuolille ei tule missään vaiheessa istua.

Yhden jalan kyykky jalka edessä:

Seiso yhdellä jalalla, vapaa jalka ojennettuna edessä. Rauhallisesti kyykisty, työntäen peppua taakse päin, kunnes pakarasi osuu takanasi olevaan tuoliin tai korokkeeseen. Nouse takaisin ylös yhden jalan seisontaan.

- Kiinnitä kyykyissä huomiota lantio-polvi-varvas linjaan.
- Keskity keskivartalon hallintaan, ja lantion asentoon (etuvalot).

Yhden jalan kyykky jalka vieressä:

Seiso yhdellä jalalla puoliksi tuolin tai korokkeen edessä. Vapaajalka on ilmassa tuolin tai korokkeen vieressä. Kyykisty kunnes pakarasi osuu tuoliin ja nouse takaisin pystyyn.

- Kiinnitä kyykyissä huomiota lantio-polvi-varvas linjaan.
- Keskity keskivartalon hallintaan, ja lantion asentoon (etuvalot).

Luistelukyykky:

Seiso yhdellä jalalla. Kallista vartaloa eteenpäin, ja ojenna vapaajalka taakse, polvi saa olla koukussa. Kyykisty hallitusti, samalla ylävartaloa kiertäen tukijalan puolelle. Nouse takaisin suoralle polvelle.

- Kiinnitä huomiota lantioon, jotta ylävartaloa kiertäessä lantio ei lähde kiertämään.

Portaalle nousu

Kiinnitä näissä huomiota lantio-polvi-varvas linjaan. Jännitä pakaraa portaalle noustessa, ja ojenna lantio loppuun asti portaalla.

Sivulle nousu:

Seiso sivuttain portaan vieressä. Nouse portaalle porrasta lähempänä olevalla jalalla. Laskeudu takaisin alas hallitusti jarruttaen.

- Keskity lantion asentoon ja lantion loppuun asti ojentamiseen.

Sivulle ristiin nousu:

Seiso sivuttain portaan vieressä. Nouse portaalle portaasta kauempana olevalla jalalla. Laskeudu takaisin alas hallitusti jarruttaen.

- Keskity lantion asentoon ja lantion loppuun asti ojentamiseen.

Nousu kiertäen:

Seiso sivuttain portaan vieressä. Nouse portaalle porrasta lähempänä olevalla jalalla, samalla kääntyen 90 astetta. Laskeudu takaisin alas hallitusti jarruttaen.

- Keskity lantion asentoon ja lantion loppuun asti ojentamiseen.
- Laskeutuessa tarkista, että lantio kääntyy takaisin lähtöasentoon.

Yhden jalan romanialainen maastaveto

Tarkoitus on lantiota koukistaen kurottaa painolla maata kohti, pitäen samalla selkää mahdollisimman suorana. Tukijalka koukistuu lievästi liikkeen aikana. Vapaajalka tasapainottaa takana, jalkaa ei ole tarkoitus nostaa korkealle. Nouse takaisin pystyyn pakaraa ja takareittä käyttäen.

Vastus tukijalan puoleisessa kädessä:

Vastus vapaajalan puoleisessa kädessä:

Vastus molemmissa käsissä:

Pudottautuminen yhdelle jalalle

Kiinnitä näissä huomiota pudottautumisen jälkeiseen lantio-polvi-varvas linjaan ja lantion asentoon. Muista joustaa polvesta. Pidä alastulo muutaman sekunnin ajan.

Pudottautuminen eteen:

Seiso portaalla yhdellä jalalla. Pudottaudu eteenpäin portaalta alas yhdeltä jalalta toiselle jalalle.

Pudottautuminen sivulle:

Seiso sivuttain portaalla yhdellä jalalla. Pudottaudu sivulle portaalta alas yhdeltä jalalta toiselle jalalle.

Pudottautuminen kiertäen:

Seiso portaalla yhdellä jalalla. Pudottaudu portaalta yhdeltä jalalta toiselle, samalla kiertäen ½ kierrosta.

Lähdeluettelo

Behringer, M., Vom Heede, A., Yue, Z. & Mester, J. (2010). Effects of resistance training in children and adolescents: a meta-analysis. Pediatrics (Evanston), 126(5), e1199-e1210. https://doi.org/10.1542/peds.2010-0445

Boren, K., Conrey, C., Le Coguic, J., Paprocki, L., Voight, M. & Robinson, T. K. (2011). Electromyographic analysis of gluteus medius and gluteus maximus during rehabilitation exercises. International Journal of Sports Physical Therapy, 6(3), 206-223.

Buckthorpe, M., Stride, M. & Villa, F. D. (2019). Assessing and treating gluteus maximus weakness - a clinical commentary. International Journal of Sports Physical Therapy, 14(4), 655-669. https://doi.org/10.26603/ijspt20190655

Dello Iacono, A., Ayalon, M. & Wang, W. (2019). The influence of single-leg landing direction on lower limbs biomechanics. The Journal of Sports Medicine and Physical Fitness, 59(2), 195-203. https://doi.org/10.23736/S0022-4707.18.08358-5

d'Hemecourt, P. A. & Luke, A. (2012). Sport-Specific Biomechanics of Spinal Injuries in Aesthetic Athletes (Dancers, Gymnasts, and Figure Skaters). Clinics in Sports Medicine, 31(3), 397-408. http://dx.doi.org/10.1016/j.csm.2012.03.010

Emery, C. A., Roy, T., Whittaker, J. L., Nettel-Aguirre, A. & van Mechelen, W. (2015). Neuromuscular training injury prevention strategies in youth sport: a systematic review and meta-analysis. British Journal of Sports Medicine, 49(13), 865-870. https://doi.org/10.1136/bjsports-2015-094639

Han, J., Geminiani, E. & Micheli, L. (2018). Epidemiology of Figure Skating Injuries: A Review of the Literature. Sports Health, 10(6), 532-537. https://doi.org/10.1177/1941738118774769

Mohney, G., Miller, M. G. & Hanson, N. (2017). Strengthening the Figure Skater: Considerations for Injury Prevention and Performance. Strength and Conditioning Journal, 39(3), 58-65. https://doi.org/10.1519/SSC.0000000000000220

Muyor, J. M., Martin-Fuentes, I., Rodríguez-Ridao, D. & Antequera-Vique, J. A. (2020). Electromyographic activity in the gluteus medius, gluteus maximus, biceps femoris, vastus lateralis, vastus medialis and rectus femoris during the Monopodal Squat, Forward Lunge and Lateral Step-Up exercises. PloS One, 15(4), e0230841. https://doi.org/10.1371/journal.pone.0230841

Neto, W. K., Soares, E. G., Vieira, T. L., Aguiar, R., Chola, T. A., Sampaio, V. d. L. & Gama, E. F. (2020). Gluteus Maximus Activation during Common Strength and Hypertrophy Exercises: A Systematic Review. Journal of Sports Science & Medicine, 19(1), 195-203. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7039033/

Stastny, P., Tufano, J. J., Golas, A. & Petr, M. (2016). Strengthening the Gluteus Medius Using Various Bodyweight and Resistance Exercises. Strength and Conditioning Journal, 38(3), 91-101. https://doi.org/10.1519/SSC.0000000000000221

Stracciolini, A., Sugimoto, D. & Howell, D. R. (2017). Injury Prevention in Youth Sports. Pediatric Annals, 46(3), e99-e105. https://doi.org/10.3928/19382359-20170223-01

Stricker, P. R., Faigenbaum, A. D. & McCambridge, T. M. (2020). Resistance Training for Children and Adolescents. Pediatrics (Evanston), 145(6), e20201011. https://doi.org/10.1542/peds.2020-1011

APPENDIX II

Information letter

Tutkimustiedote valmentajille

Tutkimustiedote - Injury prevention program to strengthen gluteal muscles in 10-12-year-old figure skaters: Operational thesis

Pyydämme Sinua osallistumaan tähän Satakunnan ammattikorkeakoulussa tehtävään opinnäytetyöhön liittyvään näyttötuntiin. Näyttötunnin tarkoitus on esitellä opinnäytetyön tuote. Perehdyttyäsi tähän tiedotteeseen Sinulla on mahdollisuus esittää kysymyksiä näyttötunnista.

Näyttötunnin tarkoitus

Opinnäytetyön tarkoituksena on kehittää pakaroita vahvistava harjoitusohjelma vammojen ennaltaehkäisyyn 10–12-vuotiaille taitoluistelijoille. Näyttötunnin tavoitteena on esitellä kyseinen harjoitusohjelma taitoluistelijoille Sinun toimestasi.

Tutkimukseen osallistumisesta ei makseta palkkiota.

Tutkimuksen kulku

Harjoitusohjelma on kehitetty opinnäytetyönä. Kyseinen harjoitusohjelma toimitetaan Sinulle viikkoa ennen näyttötuntia, jolloin Sinulla on aikaa tutustua ohjelmaan. Näyttötunnin aikana paikalla on Sinun lisäksesi taitoluistelijat, ja kyseistä opinnäytetyötä tekevä fysioterapeuttiopiskelija Elmira Sakhina. Näyttötunnin jälkeen Sinulta pyydetään palautetta harjoitusohjelmasta ja sen käytettävyydestä verkossa täytettävänä kyselynä. Palautteesi avulla harjoitusohjelma viimeistellään käyttövalmiiksi.

Tutkimuksen hyödyt ja riskit

Opinnäytetyössä kehitetty harjoitusohjelma jää käyttöösi.

Tutkimukseen ei sisälly terveydellisiä riskejä.

Luottamuksellisuus, tietojen käsittely ja säilyttäminen

Sinusta kerättyjä tietoja käsitellään luottamuksellisesti tietosuojalain edellyttämällä tavalla. Tietojen käsittelystä on kerrottu tarkemmin tietosuojaselosteessa. Palautekyselyn vastaukset ovat vain opinnäytetyötä tekevän käytössä. Tutkimustietoja käsitellään tutkimuksessa ilman tietoja, joista Sinut voitaisiin tunnistaa.

Vapaaehtoisuus

Tutkimukseen osallistuminen on vapaaehtoista. Jos koet jonkin kysymyksen liian arkaluonteiseksi voit jättää vastaamatta siihen.

Vastaamalla annat suostumuksen tietojesi käyttämiseen tässä tiedotteessa kuvatun mukaisesti. Voit keskeyttää osallistumisen syytä ilmoittamatta, sekä peruuttaa suostumuksesi ottamalla yhteyttä kyseistä opinnäytetyötä tekevään opiskelijaan Elmira Sakhinaan. Suostumuksen peruuttaminen tarkoittaa, että tietosi poistetaan tutkimuksesta. Tietojasi ei kuitenkaan poisteta julkaisuista ja muista raportoiduista tuloksista, jotka on tehty ennen suostumuksesi peruuttamista. Päätös kieltäytyä tutkimukseen osallistumisesta ei aiheuta Sinulle mitään kielteisiä seuraamuksia.

Yksityisyys opinnäytetyön julkaisussa

Tutkimuksen tulokset esitetään tavalla, joista Sinua tai tutkimuksen aikana mainitsemiasi henkilöitä ei voida tunnistaa.

Opinnäytetyö julkaistaan Theseuksessa, jossa se on kaikkien luettavissa.

Lisätiedot

Jos sinulla on kysyttävää tutkimuksesta, ota yhteyttä fysioterapeuttiopiskelija Elmira Sakhinaan: puh. 0404115075, elmira.sakhina@student.samk.fi

APPENDIX III

Research consent

SUOSTUMUS TUTKIMUKSEEN VALMENTAJILLE

(Injury prevention program to strengthen gluteal muscles in 10-12-year-old figure skaters: Operational thesis (Pakaroita vahvistava harjoitusohjelma 10-12-vuotiaille taitoluistelijoille vammojen ennaltaehkäisyyn))
(Kouvola, Elmira Sakhina)

Minua **(tutkittavan nimi)** on pyydetty osallistumaan yllä mainittuun tutkimukseen, jonka tarkoituksena on kehittää pakaroita vahvistava harjoitusohjelma 10–12-vuotiaille taitoluistelijoille vammojen ennaltaehkäisyyn. Olen lukenut ja ymmärtänyt saamani kirjallisen tutkimustiedotteen. Tiedotteesta olen saanut riittävän selvityksen tutkimuksesta ja sen yhteydessä suoritettavasta tietojen keräämisestä, käsittelystä ja luovuttamisesta. Tiedotteen sisältö on kerrottu minulle myös suullisesti, minulla on ollut mahdollisuus esittää kysymyksiä ja olen saanut riittävän vastauksen kaikkiin tutkimusta koskeviin kysymyksiini.
Tiedot antoi Elmira Sakhina __ / __/ 20 ___. Minulla on ollut riittävästi aikaa harkita osallistumistani tutkimukseen. Olen saanut riittävät tiedot oikeuksistani, tutkimuksen tarkoituksesta ja sen toteutuksesta sekä tutkimuksen hyödyistä ja riskeistä. Minua ei ole painostettu eikä houkuteltu osallistumaan tutkimukseen.
Ymmärrän, että osallistumiseni on vapaaehtoista. Olen selvillä siitä, että voin peruuttaa tämän suostumukseni koska tahansa syytä ilmoittamatta eikä peruutukseni vaikuta kohteluuni millään tavalla. Tiedän, että tietojani käsitellään luottamuksellisesti eikä niitä luovuteta sivullisille. Olen tietoinen siitä, että mikäli keskeytän tutkimuksen tai peruutan suostumuksen, minusta keskeyttämiseen ja suostumuksen peruuttamiseen mennessä kerättyjä tietoja ja näytteitä voidaan käyttää osana tutkimusaineistoa.

Allekirjoituksellani vahvistan osallistumiseni tähän tutkimukseen ja suostun vapaaehtoisesti tutkimushenkilöksi.

____
Tutkittavan nimi

_____________ ______________________
Päivämäärä Allekirjoitus

Suostumus vastaanotettu

____________________ _____________ _____________
Fysioterapeuttiopiskelija Päivämäärä Allekirjoitus

Alkuperäinen allekirjoitettu tutkittavan suostumus sekä kopio tutkimustiedotteesta jäävät opinnäytetyötä tekevälle opiskelijalle arkistoon. Tutkimustiedote ja kopio allekirjoitetusta suostumuksesta annetaan tutkittavalle.

APPENDIX IV

Information about the use of private data

Tietoa tutkimukseen osallistuvalle

Olet osallistumassa Satakunnan ammattikorkeakoulun opintoihin kuuluvan opinnäytetyöhön liittyvään tutkimukseen/selvitykseen tms.

Tämä seloste kuvaa, miten henkilötietojasi käsitellään tutkimuksessa.

Tähän tutkimukseen osallistuminen on vapaaehtoista. Voit myös halutessasi keskeyttää osallistumisesi tutkimukseen. Jos keskeytät osallistumisesi, ennen keskeytystä kerättyä aineistoa voidaan kuitenkin käyttää tutkimuksessa. Tässä tietosuojaselosteessa kerrotaan tarkemmin, mitä oikeuksia sinulla on ja miten voit vaikuttaa tietojesi käsittelyyn.

1. Tutkimuksen, kehittämistoiminnan tai opinnäytetyön rekisterinpitäjä

Opiskelija: Elmira Sakhina

Osoite: Antinkatu 19 A 15, 28100 Pori

Yhteyshenkilö tutkimusta koskevissa asioissa:

Nimi: Elmira Sakhina

Osoite: Antinkatu 19 A 15, 28100 Pori

Puhelinnumero: 0404115075

Sähköpostiosoite: elmira.sakhina@student.samk.fi

2. Kuvaus tutkimuksesta tai muusta selvityksestä ja henkilötietojen käsittelyn tarkoitus

Henkilötietoja käytetään yhteydenpitoa varten

3. Tutkimuksen tai kehittämistoiminnan vastuullinen tutkija tai vastaava ryhmä tai opinnäytetyön tekijä

Nimi: Elmira Sakhina

Osoite: Antinkatu 19 A 15, 28100 Pori

Puhelinnumero: 0404115075

Sähköpostiosoite: elmira.sakhina@student.samk.fi

4. Tietosuojavastaavan yhteystiedot

Satakunnan ammattikorkeakoulun tietosuojavastaava on Osmo Santavirta. Häneen saa yhteyden sähköpostiosoitteesta tietosuojavastaava@samk.fi

5. Tutkimuksen tai kehittämistyön suorittajat

Opinnäytetyön tekijä

6. Opinnäytetyön aihe ja kesto

Opinnäytetyön nimi: Injury prevention program to strengthen gluteal muscles in 10-12-year-old figure skaters: Operational thesis

X Kertatutkimus

Henkilötietojen käsittelyn kesto: Opinnäytetyön tekemiseen menevä aika.

7. Henkilötietojen käsittelyn oikeusperuste

Henkilötietoja käsitellään seuraavalla yleisen tietosuoja-asetuksen 6 artiklan 1 kohdan mukaisella perusteella:

X tutkittavan suostumus

8. Mitä tietoja keräämme ja tallennamme

Valmentajien yhteystiedot ovat opinnäytetyötä tekevän käytössä. Yhteystietoihin kuuluvat nimi, puhelinnumero ja sähköposti.

A. Arkaluonteiset henkilötiedot

Tutkimuksessa/kehittämistoiminnassa tai opinnäytetyössä ei käsitellä arkaluonteisia henkilötietoja.

9. Mistä henkilötietoja kerätään

Sähköposti

10. Tietojen siirto tai luovuttaminen muille

Ei siirretä.

11. Tietojen siirto tai luovuttaminen EU:n tai Euroopan talousalueen ulkopuolelle

Ei siirretä.

12. Automatisoitu päätöksenteko

Automaattisia päätöksiä ei tehdä.

13. Henkilötietojen suojauksen periaatteet

X Tiedot ovat salassa pidettäviä.

Tietojärjestelmissä käsiteltävät tiedot:

X salasana

Suorien tunnistetietojen käsittely:

X Suorat tunnistetiedot poistetaan analysointivaiheessa

14. Henkilötietojen käsittely tutkimuksen tai kehittämistyön päättymisen jälkeen

X Tutkimusrekisteri tai muu rekisteri hävitetään

15. Mitä oikeuksia sinulla rekisteröitynä/tutkittavana on ja oikeuksista poikkeaminen

Yhteyshenkilö tutkittavan oikeuksiin liittyvissä asioissa, johon voi ottaa yhteyttä on Elmira Sakhina.

Suostumuksen peruuttaminen (tietosuoja-asetuksen 7 artikla)
Sinulla on oikeus peruuttaa antamasi suostumus, mikäli henkilötietojen käsittely perustuu suostumukseen. Suostumuksen peruuttaminen ei vaikuta suostumuksen perusteella ennen sen peruuttamista suoritetun käsittelyn lainmukaisuuteen.

Oikeus saada pääsy tietoihin (tietosuoja-asetuksen 15 artikla)
Sinulla on oikeus saada tieto siitä, käsitelläänkö henkilötietojasi hankkeessa ja mitä henkilötietojasi hankkeessa käsitellään. Voit myös halutessasi pyytää jäljennöksen käsiteltävistä henkilötiedoista.

Oikeus tietojen oikaisemiseen (tietosuoja-asetuksen 16 artikla)
Jos käsiteltävissä henkilötiedoissasi on epätarkkuuksia tai virheitä, sinulla on oikeus pyytää niiden oikaisua tai täydennystä.

Oikeus tietojen poistamiseen (tietosuoja-asetuksen 17 artikla)
Sinulla on oikeus vaatia henkilötietojesi poistamista seuraavissa tapauksissa:
a) henkilötietoja ei enää tarvita niihin tarkoituksiin, joita varten ne kerättiin tai joita varten niitä muutoin käsiteltiin
b) peruutat suostumuksen, johon käsittely on perustunut, eikä käsittelyyn ole muuta laillista perustetta
c) vastustat käsittelyä (kuvaus vastustamisoikeudesta on alempana) eikä käsittelyyn ole olemassa perusteltua syytä
d) henkilötietoja on käsitelty lainvastaisesti; tai
e) henkilötiedot on poistettava unionin oikeuteen tai jäsenvaltion lainsäädäntöön perustuvan rekisterinpitäjään sovellettavan lakisääteisen velvoitteen noudattamiseksi.

Oikeutta tietojen poistamiseen ei kuitenkaan ole, jos tietojen poistaminen estää tai vaikeuttaa suuresti käsittelyn tarkoituksen toteutumista tieteellisessä tutkimuksessa.

Oikeus käsittelyn rajoittamiseen (tietosuoja-asetuksen 18 artikla)
Sinulla on oikeus henkilötietojesi käsittelyn rajoittamiseen, jos kyseessä on jokin seuraavista olosuhteista:
a) kiistät henkilötietojen paikkansapitävyyden, jolloin käsittelyä rajoitetaan ajaksi, jonka kuluessa yliopisto voi varmistaa niiden paikkansapitävyyden
b) käsittely on lainvastaista ja vastustat henkilötietojen poistamista ja vaadit sen sijaan niiden käytön rajoittamista
c) yliopisto ei enää tarvitse kyseisiä henkilötietoja käsittelyn tarkoituksiin, mutta sinä tarvitset niitä oikeudellisen vaateen laatimiseksi, esittämiseksi tai puolustamiseksi
d) olet vastustanut henkilötietojen käsittelyä (ks. tarkemmin alla) odotettaessa sen todentamista, syrjäyttävätkö rekisterinpitäjän oikeutetut perusteet rekisteröidyn perusteet.

Oikeus siirtää tiedot järjestelmästä toiseen (tietosuoja-asetuksen 20 artikla)
Sinulla on oikeus saada yliopistolle toimittamasi henkilötiedot jäsennellyssä, yleisesti käytetyssä ja koneellisesti luettavassa muodossa, ja oikeus siirtää kyseiset tiedot toiselle rekisterinpitäjälle yliopiston estämättä, jos käsittelyn oikeusperuste on suostumus tai sopimus, ja käsittely suoritetaan automaattisesti.
Kun käytät oikeuttasi siirtää tiedot järjestelmästä toiseen, sinulla on oikeus saada henkilötiedot siirrettyä suoraan rekisterinpitäjältä toiselle, jos se on teknisesti mahdollista.

Vastustamisoikeus (tietosuoja-asetuksen 21 artikla)
Sinulla on oikeus vastustaa henkilötietojesi käsittelyä, jos käsittely perustuu yleiseen etuun tai oikeutettuun etuun. Tällöin yliopisto ei voi käsitellä henkilötietojasi, paitsi jos se voi osoittaa, että käsittelyyn on olemassa huomattavan tärkeä ja perusteltu syy, joka syrjäyttää rekisteröidyn edut, oikeudet ja vapaudet tai jos se on tarpeen oikeusvaateen laatimiseksi, esittämiseksi tai puolustamiseksi. Yliopisto voi jatkaa henkilötietojesi käsittelyä myös silloin, kun sen on tarpeellista yleistä etua koskevan tehtävän suorittamiseksi.

Oikeuksista poikkeaminen
Tässä kohdassa kuvatuista oikeuksista saatetaan tietyissä yksittäistapauksissa poiketa tietosuoja-asetuksessa ja Suomen tietosuojalaissa säädetyillä perusteilla siltä osin, kuin oikeudet estävät tieteellisen tai historiallisen tutkimustarkoituksen tai tilastollisen tarkoituksen saavuttamisen tai vaikeuttavat sitä suuresti. Tarvetta poiketa oikeuksista arvioidaan aina tapauskohtaisesti.

Valitusoikeus
Sinulla on oikeus tehdä valitus tietosuojavaltuutetun toimistoon, mikäli katsot, että henkilötietojesi käsittelyssä on rikottu voimassa olevaa tietosuojalainsäädäntöä.

Yhteystiedot:

Tietosuojavaltuutetun toimisto
Käyntiosoite: Ratapihantie 9, 6. krs, 00520 Helsinki
Postiosoite: PL 800, 00521 Helsinki
Vaihde: 029 56 66700
Faksi: 029 56 66735
Sähköposti: tietosuoja@om.fi

APPENDIX V

Feedback questionnaire

Palautekysely

Tämä on palautekysely opinnäytetyönä kehitetystä pakaralihaksia vahvistavasta harjoitusohjelmasta.
Palautteen pohjalta harjoitusohjelmaa kehitetään ja viimeistellään käyttövalmiiksi.
Kiitos vastauksistasi.

Pakaralihaksia vahvistava harjoitusohjelma 10–12-vuotiaille taitoluistelijoille

Vastasiko harjoitusohjelma tarpeitasi?

Kyllä ○ Ei ○

Oliko oppaassa tarpeeksi tietoa?

Oliko opas kirjoitettu selkeällä ja ymmärrettävällä kielellä?

Ovatko oppaan kuvat selkeät?

Olivatko valitut harjoitteet sopivia kyseiselle ikäryhmälle?

Puuttuiko mielestäsi oppaasta jotain?

Voidaanko opasta hyödyntää harjoituksissa?

Vapaa sana oppaasta