

Jasmin Kruus  
Jenni Tuomola

CORE STABILITY FOR DANCERS - TESTING THE EFFECT OF  
AN EXERCISE PROGRAM

Degree Programme in Physiotherapy  
2014



## CORE STABILITY FOR DANCERS – TESTING THE EFFECT OF AN EXERCISE PROGRAM

Kruus, Jasmin

Tuomola, Jenni

Satakunnan Ammattikorkeakoulu, Satakunta University of Applied Sciences

Degree Programme in Physiotherapy

November 2014

Supervisor: Törne, Mari

Number of pages: 45

Appendices: 2

Keywords: Exercise program, dance, core stability, testing, questionnaire

---

The purpose of this thesis was to create a targeted tool, a three-month exercise program, for an advanced group of dancers to improve their core stability. The second purpose was to increase awareness of the importance of deep abdominal activation among dancers. The thesis was implemented in cooperation with a local dance school in Pori, Tanssikoulu Tiina ja heimo, which provided the target group of research: an advanced group of dancers, called LeikistiVakavasti. The research methods of this thesis were both qualitative and quantitative.

Through dancing it is possible to take care of one's physics as well as the health of your muscular-skeletal system. In addition, dancing has been compared to athletic performance. However, physical indicators show that dancing is often more strenuous than many sports. Therefore, proper stability of the supporting muscles is vital in order to avoid injuries.

The intervention of the exercise program lasted for three months and consisted of two six week intervals. Testing of core stability with a blood pressure cuff was implemented before and after the program in order to discover whether the exercises were effective by comparing the initial and final level of the test group. Furthermore, the target group was requested to respond to a questionnaire which provided additional information.

The hypothesis of our research was that the target group would improve their core stability and they would become more aware of their deep abdominal activation with the aid of the exercise program. In addition, the exercise program was assumed to support their training; the subjects would be able to link the core stability to the demands of dance. This was partially accomplished; according to the questionnaire, majority of the subjects informed increased awareness of core stability and that the exercise program supported their dancing. However, we did not receive reliable results to support our main purpose: all the subjects did not perform the exercise program as instructed and only four subjects out of eight were able to participate in the final testing.

## CONTENTS

1	INTRODUCTION .....	4
2	PURPOSE OF THE THESIS .....	5
3	TARGET GROUP .....	6
4	ANATOMY AND CORE STABILITY .....	7
4.1	The core .....	7
4.2	Central stabilizers.....	8
4.3	Global stabilizers .....	11
4.4	Core stability .....	14
4.5	Breathing and M. diaphragm .....	16
5	DANCE EXPLAINED .....	17
5.1	What is dance? .....	17
5.2	The importance of core stability in dance.....	19
	EXERCISE PROGRAM FOR CORE STABILITY .....	21
5.3	Stabilization training .....	21
5.4	Dosage.....	23
5.5	Mode .....	26
6	INTERVENTION .....	26
6.1	Exercise program .....	27
6.2	Testing.....	29
7	RESEARCH METHODS.....	31
7.1	Approach.....	31
7.2	Sampling .....	32
7.3	Collection of data.....	32
7.4	Measurement tools .....	33
8	RESULTS.....	36
8.1	Objective .....	36
8.2	Subjective.....	36
9	CONCLUSION .....	40
10	DISCUSSION .....	41
	REFERENCES.....	43
	APPENDICES	

## 1 INTRODUCTION

Dance is considered as a diverse form of physical activity through which it is possible to enhance the body profoundly; balance, coordination, agility and body awareness are needed among various other components. However, the physical demands of dancing are causing significant load for the structures of the muscular-skeletal system. Physical indicators show that dancing is often more strenuous than many sports. Therefore proper stability of the supporting muscles is vital in order to avoid injuries. (Ahonen 1995, 5.)

This thesis was conducted as co-operation with a local dance school Tanssikoulu Tiina ja heimo. Tiina Santavuo who is the artistic director of Tiina ja heimo has operated the dance school since the year 2011. The target group was an advanced group of dancers called LeikistiVakavasti. Core stability as a term was already familiar to all subjects and had been highlighted throughout their three-year curricula. However, caused by the limited amount of hours the lessons would concentrate mainly on dance technique and choreography, leaving body care primarily for the dancers own responsibility. In addition, Pilates lessons were available for the dancers but only few participated regularly. Based on recent research evidence regular body control training should be included in the exercise program of an athlete throughout the year (Ahonen & Parkkari 2011, 20-21). Needless to say there was a demand for additional exercising targeted for this specific area.

“Dancing requires skill and body control.” (Parviainen 1994, 54). This thesis is focusing on the improvement of core stability among dancers. It is providing information of the methods through which it is possible to enhance the stability as additional exercising to support training. The exercise program was designed to act as a targeted tool for dancers to enhance and maintain their core stability with movements that could be performed at home without any equipment. Furthermore, the exercise program was measured in order to research the effectiveness of the three-month intervention. Both qualitative and quantitative methods of research were carried out in this thesis; we received subjective as well as objective results. Measurement tools were blood pressure cuff and questionnaire.

Taking into consideration our own background as dancers of LeikistiVakavasti, we are viewing the concept of dance from a specific angle. The personality of the teacher impacts vitally on the implementation of dance education and they all have their individual methods (Anttila 1994, 71). Therefore, in this thesis we are highlighting the education received by our target group. The references used in this thesis discuss mainly the work of professional dancers. However, those considered as amateur dancers can phase as heavy physical and mental loading as professionals and therefore we saw it justified applying these propositions for our target group as well.

## 2 PURPOSE OF THE THESIS

The main purpose of this thesis was to create a targeted tool for an advanced group of dancers and to discover whether they would be able to improve their core stability. The exercise program would act as a channel through which they would be able to link the enhanced core stability to the demands of dancing. The second purpose was to research if the target group would become more aware of the importance of deep abdominal activation among dancers. As a result, they would be able to prevent possible injuries and support their dancing.

The target group acted as a pilot for this exercise program with the intention of providing a tool for the dance school. The effectiveness of the exercise program was measured in order to discover whether the movements had an impact in the ability to activate the muscles of the core. In addition to discovering the effectiveness, the measurement would act as a motivator for the subjects.

### 3 TARGET GROUP

*”Ryhmä on tarkoitettu tanssijoille, jotka ottavat tanssin leikisti vakavasti ja haluavat tähdätä kohti omaa huippuansa. Tunnit koostuvat tanssitekniikasta, nykytanssista, tanssiteatterista, improvisaatiosta, kehonhuollosta ja läsnäolon harjoittelemisesta.” (Santavuo, personal communication on 07.10.2014.)*

Translation by Jenni Tuomola:

*“This group is designed for dancers who take dance seriously for fun and wish to aim towards their own ultimate peak. Lessons consist of dance technique, contemporary dance, dance theatre, improvisation, body care and exercising presence.” (Santavuo, personal communication on 07.10.2014.)*

The target group of this thesis was an advanced group of dancers who have been working together since 2011. When the group began to function the age range varied between 15 and 22-years of age. The majority of the dancers aimed for professional career; this group was created to provide the skills needed with the intention of applying for professional education. Training frequency has varied between 2-5 times a week.

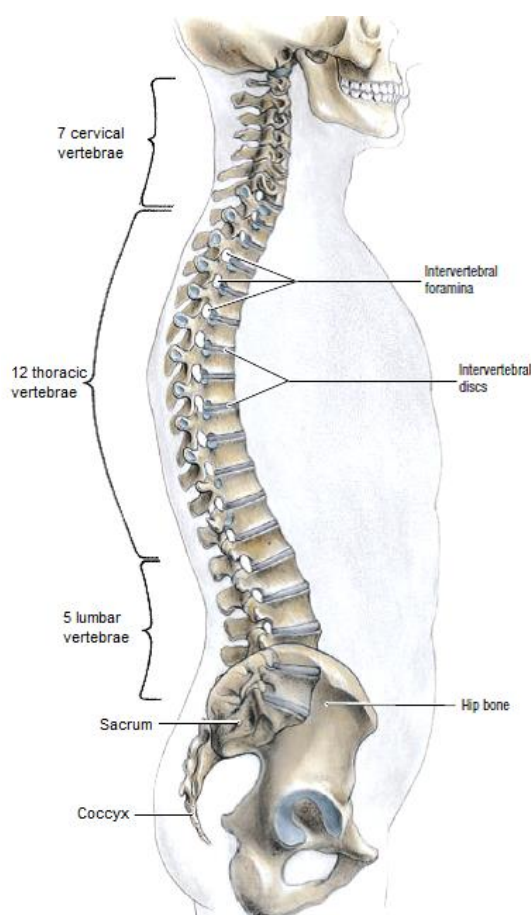


©Tanssikoulu Tiina ja heimo

## 4 ANATOMY AND CORE STABILITY

### 4.1 The core

“The musculoskeletal core of the body includes the spine, hips and pelvis, proximal lower limb and abdominal structures.” (Kibler, Press & Sciascia 2006, 189). Spine consists of total 24 vertebrae: 7 cervical, 12 thoracic and 5 lumbar vertebrae. In addition, there are 5 fused vertebrae in sacrum and 4 vertebrae in coccyx, which varies to be fused or separate (Picture 1). (Agur & Dalley 2009, 286.)



Picture 1. Structure of the spine (Agur & Dalley 2013, 290)

The core muscles have a great role in movements. The musculature of the core includes the muscles of the trunk and pelvis. These muscles are responsible for maintaining the stability of the spine and pelvis. The core muscles provide local strength and balance

to the body. (Kibler, Press & Sciascia 2006, 189-190.) Furthermore, the spine is rather unstable and requires a proper muscle stability in order to function and prevent it from collapsing (Sandström & Ahonen 2011, 219). Since the core is central to almost all kinetic chains of physical activities, a good control of the core is vital. It also enables maximum kinetic chains in upper and lower extremity functions. (Kibler, Press & Sciascia 2006, 190). The trunk muscles are involved in multiple homeostatic functions in addition to controlling the trunk and movements. Unlike the muscles of the limbs, trunk muscles take part in respiration and continence. (Richardson, Hodges & Hides 2004, 20-21.)

The core muscles can be divided to central stabilizers and global stabilizers. These muscles form a multi-layer capsule around the waistline. All of the muscles are contributing in core stabilising. The essential factor is that the central muscles should activate first, before the global stabilizers. The global stabilizers are stronger, which cause the strong and powerful movements. The strong contraction of the global stabilizers may cause damage to the joint structure and discus if there is no support of the spine in segmental level, as between the vertebrae. (Sandström & Ahonen 2011, 225.)

#### 4.2 Central stabilizers

The central stabilizers are also called the deep stabilizers of the core. These deep stabilizers take part in supporting the lumbar spine. The insertion is directly on the vertebrae or through the membrane structure. The deep stabilizer muscles are: transversus abdominis, multifidus, quadratus lumborum, psoas major and minor, rotatores, diaphragma pelvis (pelvic floor muscles) and diaphragm. (Sandström & Ahonen 2011, 226.)

*Transversus abdominis (Tra)* is a local stabilizer which contributes to rotations of the trunk and covers the area between thoracic and pelvis partly as a muscle and partly as fascia (Picture 2.). Tra's insertions are posteriorly in lumbar vertebrae' processus transversus' via fascia transversus, superiorly the underside of the lowest ribs and inferiorly the crest of the iliac. On the back, the fascia of this muscle forms the deepest part of



three-layered thoracolumbar fascia. When contracting, the Tra applies tension via thoracolumbar fascia and therefore increases the tension in the muscles of the lower back; multifidus and erector spinae. In addition, it increases the intra-abdominal pressure as well. (Sandström & Ahonen 2011, 237.)



Picture 2. M. transversus abdominis (Agur & Dalley 2013, 108)

The segmental stability is increased by drawing-in maneuver (Kisner & Colby 2012, 418,420). The drawing-in maneuver will be discussed more in detail in chapter 4.4. Nowadays, the early activation of the Tra is understood; the Tra should activate before the other abdominal muscles (Sandström & Ahonen 2011, 226). The rapid movements of upper and lower limbs and anticipatory activity cause the response from the Tra, which is cooperating with respiration during these activities (Kisner & Colby 2012, 420).

*Multifidus* is activated during all movements, which are implemented in upright position (Picture 8.). When contracting, the multifidus bulges against the fascia of Tra muscle, which provides a larger stabilizing effect than working without the tension of the surrounding fascia. (Sandström & Ahonen 2011, 226.) Multifidus' prime action is spinal extension and contralateral rotation. It stabilizes the spine against flexion, rotational and contralateral side flexion movements. The segmental stability to lumbar vertebrae is provided by the deep muscle fibers. "Its segmental attachments are able to control movement of the spinal segments as well as increased spinal stiffness." (Kisner & Colby 2012, 418, 420). The deep muscle fibers should maintain so called slightly

tonic condition, which provides the constant support to spine (Sandström & Ahonen 2011, 231).

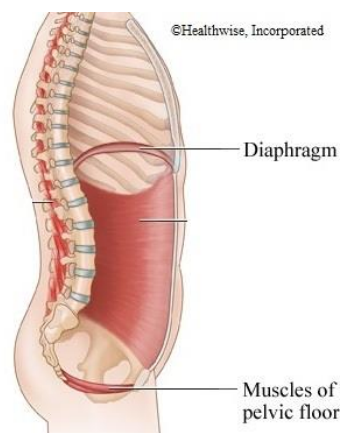
*Quadratus lumborum*'s main actions are pelvic hiking and side bending of the spine. It provides segmental stability to lumbar vertebrae through the deep muscle fibers. *Quadratus lumborum* also acts as a stabilizer for ribs, against the pull of the diaphragm, which is occurred during inspiration. (Kisner & Colby 2012 418.)

*Psoas major* is a strong muscle in the posterior abdominal cavity (Picture 3.). It is divided into deeper and more superficial parts. There are two psoas major muscles, and they are located in both sides of the spine. The contraction of this muscle refers to strong compression of the lumbar vertebrae. *Psoas major* is a stabilizer, but also a hip flexor muscle. The cooperation of psoas major and abdominal muscles is vital, and they are preferred to practice simultaneously. *Psoas minor* (Picture 3.) has a smaller role than psoas major, and it may not be even found from everyone. However, psoas minor has a role as stabilizing the pelvis in relation to lumbar spine. (Sandström & Ahonen 2011, 231.)



Picture 3. Psoas major and psoas minor (Website of The Free Dictionary 2014)

*Diaphragma pelvis*, or pelvis floor muscles, forms the base of the pelvis. The pelvic floor muscles cover the area in the pelvic opening from pubic bone to coccyx and laterally from ischium to another (Picture 4.). It is essential to include practicing the pelvic floor muscles as a part of exercising the back muscles, since continence is a part of the stabilizing mechanism of the back. (Sandström & Ahonen 2011, 231-232.)

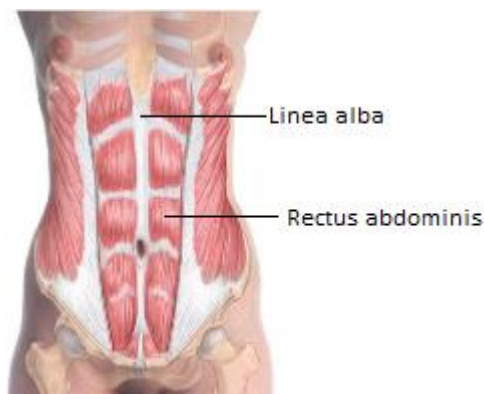


Picture 4. Pelvic floor muscles (Website of David Lasnier 2010)

#### 4.3 Global stabilizers

The global stabilizers which are also known as the superficial stabilizer muscles are the ones which do not have origin or insertion directly on the vertebrae. Thus, they are affecting on the lumbar spine through the movements of the pelvis and thoracic spine. These muscles are: rectus abdominis, oblique externus and internus, erector spinae (spinalis, longissimus and iliocostalis), iliocostalis lumborum and latissimus dorsi. (Sandström & Ahonen 2011, 226.)

*Rectus abdominis* (Picture 5.) is responsible for trunk flexion. It stabilizes the pelvis against anterior rotation movements and provides stability for extension direction movements. (Kisner & Colby 2012, 416.) Even though the muscle is structurally composed of two muscles separated by the linea alba, it functions as one muscle. Rectus abdominis has a vital role as a stabilizer when it comes to vast load of the back and a strong support and stability is required. (Sandström & Ahonen 2011, 232-233.)



Picture 5. Rectus abdominis (Agur & Dalley 2013, 108)

*Oblique externus* (Picture 6.) and *internus* (Picture 7.) function as trunk flexors, diagonal trunk rotators and lateral flexors of the trunk. Obliques are stabilizing the spine by preventing the extension and lateral flexion movements of the spine. (Kisner & Colby 2012, 418.) The rotations of the spine require cooperation of the obliques (Sandström & Ahonen 2011, 234). Obliques stabilize the pelvis in collaboration with rectus abdominis. In addition, these muscles participate in intra-abdominal pressure by contracting simultaneously with transversus abdominis. (Kisner & Colby 2012, 418.)

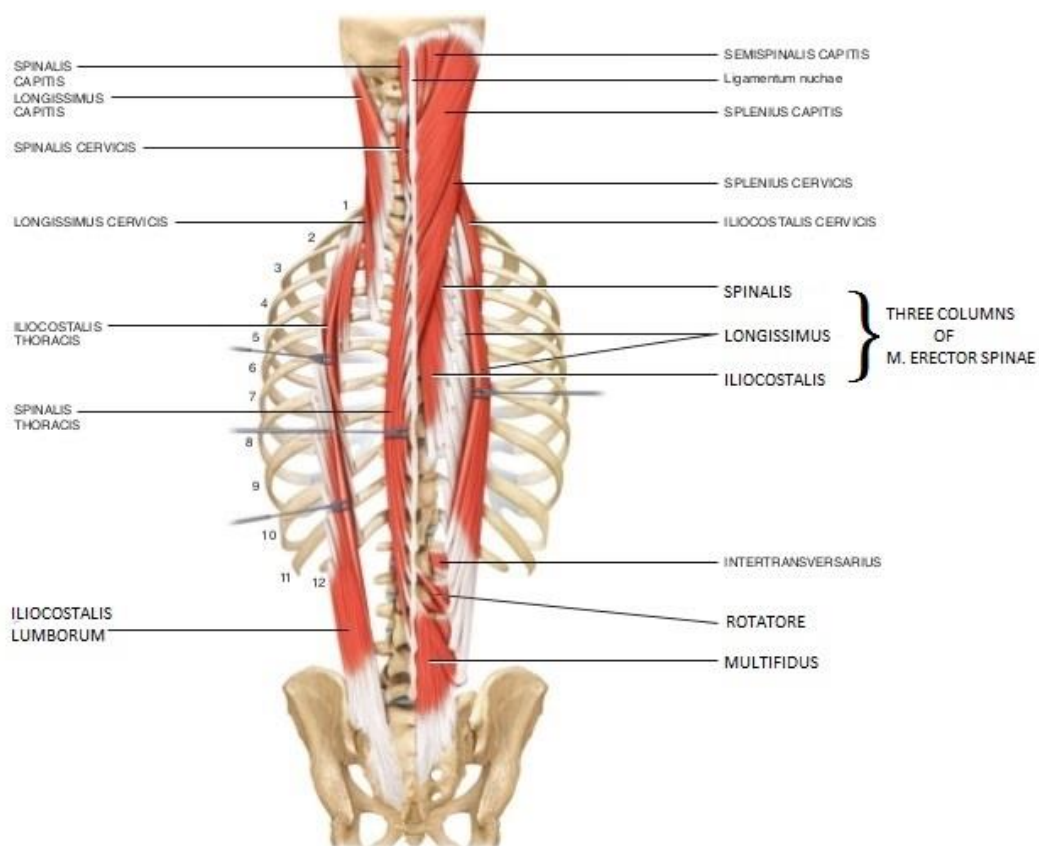


Picture 6. Oblique externus (Agur & Dalley 2013, 108)



Picture 7. Oblique internus (Agur & Dalley 2013, 108)

*Extensors of the back* (Picture 8.) are participating in extension direction movements of the back. They also function as spine rotators along with the abdominal muscles. The extensor muscles of the back have a remarkable role in supporting the movements and controlling posture. Majority of these muscles are postural muscles, in other words, muscles that maintain the posture. (Sandström & Ahonen 2011, 235.)



Picture 8. Core muscles of the back (Tortora & Derrickson 2011, 421)

#### 4.4 Core stability

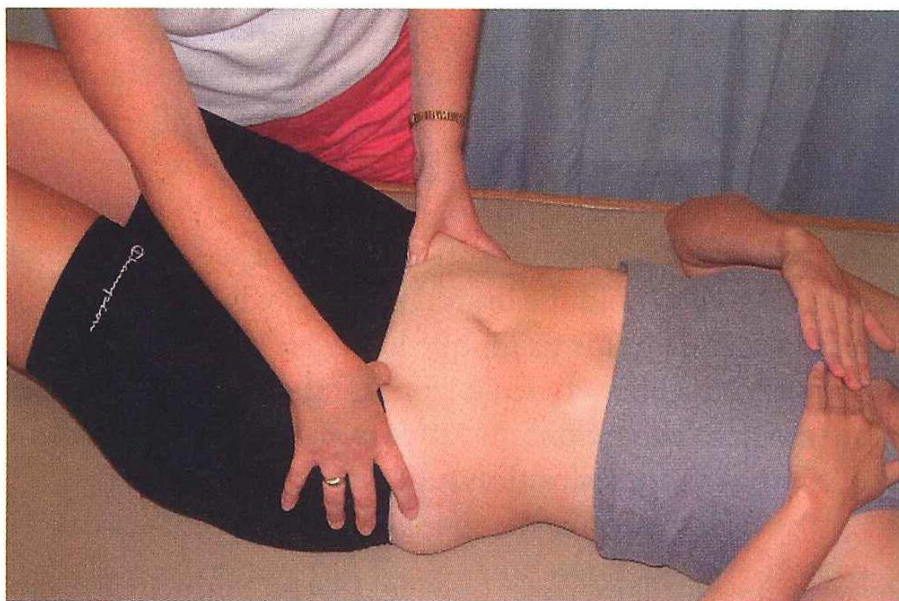
“Stability and control should be thought of as a dynamic process of controlling static position when appropriate in the functional context, but allowing the trunk to move with control in other situations.” (Richardson, Hodges & Hides 2004, 13-14). The core muscles function as stabilizers during various movements. The corner stone in core stability is that the vertebrae would be in ergonomic position in standing and in any movement. It is challenging to function this way, since the back is loaded in multiple postures and movements while working and implementing leisure time activities. The co-contraction of the muscles in the back and in the abdomen improves considerably the stability. The co-contraction occurs during implementing various daily living activities. It signifies to the balanced functioning of the agonist and antagonist muscle; the active and the reversal muscle's relation. (Sandström & Ahonen 2011, 219, 341.)

Intra-abdominal pressure is one of the significant systems that support the lumbar spine. It is formed by the cooperation of the trunk muscles and it is applied during lifting, take-off and landing from a jump. In these situations a momentary catching of breath and Valsalva maneuver (closing the epiglottis) is required with the intention of the exhaled air would not extract the internal pressure. During inhaling the diaphragm contracts and descends down, and simultaneously the pelvic floor muscles contract causing them to arch slightly upwards. These opposite movements produce pressure anteriorly, posteriorly and laterally. (Sandström & Ahonen 2011, 237.)

The first step in developing a habitual activation for spinal stability, is to learn the conscious activation of the deep segmental muscles without contracting the global trunk musculature. The drawing-in maneuver is taught to the subject by palpating the muscle and giving verbal clues (Kisner & Colby 2012, 508, 511.) “The “drawing-in” maneuver is used to activate Tra voluntarily and, with training, produces the most independent activity of this muscle.” (Kisner & Colby 2012, 420). Drawing-in maneuver, in other words abdominal hollowing, requires isolation of the deep abdominals from the superficial abdominals. Pulling the abdomen towards the spine without allowing movement of the rib cage, pelvis and spine performs hollowing action. (Kisner & Colby 2012, 511; Norris 2008, 132-133.)

“With the patient prone, the Stabilizer (or blood pressure cuff) is placed horizontally under the abdomen (centered under the navel).” (Kisner & Colby 2012, 511). A comfortable position to practice the transversus abdominis (Tra) activation is on supine with knees flexed from 70° up to 90°. As a procedure, the patient is taught with visual and verbal methods the anatomy of the Tra; the muscle is like a capsule surrounding the trunk and when it is activated, the waistline draws inward. (Kisner & Colby 2012, 511.)

As the anatomy is clear for the patient, the tester palpates the Tra (Picture 9.) muscle distally to the anterior superior iliac spine (ASIS) (Kisner & Colby 2012, 511). The subject is told to “breathe in, breath out, and then gently draw the belly button in toward the spine to hollow out the abdominal region.” (Kisner & Colby 2012, 511). The activation of the Tra is a gentle contraction during which a flat tension is felt. When the activation is performed correctly, there are no compensational patterns, for instance large movement of pelvis, widening or depression of the lower ribs, lifting of the rib cage, bulging of the muscle or increased pressure through the feet. (Kisner & Colby 2012, 511.)



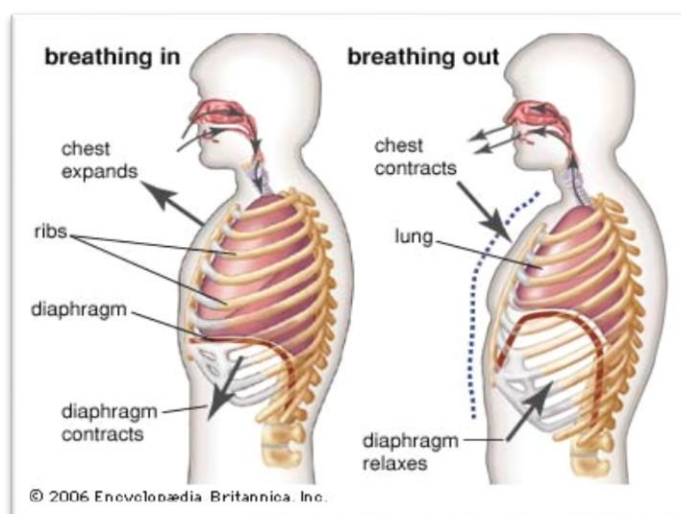
Picture 9. Palpating the transversus abdominis muscle while performing the drawing-in maneuver (Kisner & Colby 2012, 511)



#### 4.5 Breathing and M. diaphragm

M. diaphragm is the most important muscle participating in inhaling (Picture 10.) (Sandström & Ahonen 2011). This dome-shaped muscle distributes the thorax from the abdomen (Richardson, Hodges & Hides 2004, 36). Furthermore, it is one of the core stabilizer muscles, and it has an important role when it comes to core stability and breathing. The best support of the diaphragm comes via ligamentum diaphragmae, which is attaching the diaphragm to thoracic vertebrae 10-12 and lumbar vertebrae 1-2. The support is directed to lower part of the thoracic spine and the upper part of the lumbar spine. (Sandström & Ahonen 2011, 230.)

Even though breathing is mainly controlled automatically, it can be controlled voluntarily. By connecting the diaphragm into movements through breathing, the activation of the abdominal muscles is enhanced. The researches have proved that it is profitable to connect breathing to core exercises. (Sandström & Ahonen 2011, 227,230.)



Picture 10. Demonstration of the diaphragm movement during respiration (Garrigues 2011)

In a situation where the demand for breathing is increased and therefore the frequency and depth of expiration is increased as well, the activation of the abdominal muscles takes place (Richardson, Hodges & Hides 2004, 54). By a synchronized contraction of the transversus abdominis, diaphragm and pelvic floor muscles, the intra-abdominal



pressure is increased. This action takes load off from the spine and produces stability. (Kisner & Colby 2012, 423.)

## 5 DANCE EXPLAINED

*“In many connections I have confronted the allegation that spontaneous self-expression and natural movement are not seen as dancing or art. Even the children have asked: when are we going to dance? I respond by revealing that all movements can be considered as dancing.” (Anttila 1994, 24).*

### 5.1 What is dance?

The concept of dance is wide-ranging; ‘dance’ is a general term for several forms of movement that can vary in quality. From a dancer’s perspective dancing is defined as human behavior, which is composed of purposeful, intentionally rhythmical and culturally patterned sequences of nonverbal body movements other than ordinary motor activities. (Parviainen 1994, 10-11.) However, dancing is not necessarily bound to specific steps or patterns, it is rather freely adaptable. Therefore the question, what is dance, cannot be answered completely; it is forever changing. (Parviainen 1994, 53.)

Movements are considered as basic units in dancing (Parviainen 1994, 36). According to Anttila (1994, 25) movement can be considered either functional or expressional. Functional movement requires motor skills and has an external purpose, whereas expressional movement reflects inner emotions. Functional movement can be considered intentional, and this exercises largely body control. Experiencing sensations, thoughts and the environment through your body produces expressional movement; the latter trigger nerve impulses that are transferred through neural pathways into the muscles causing instant reactions and unplanned movements. Both functional and expressional movements are required in dancing. Body control is a necessity when it comes to expressing your inner life through the language of movement. (Anttila 1994, 25-26.)



©Tanssikoulu Tiina ja heimo

The first stage in changing movement into dancing is to pay attention to it. The motion itself might seem ordinary, such as walking or elevating your arm, but kinesthetic awareness and acknowledgement transforms it into dancing. Thus, the inner experience of the person performing the motion determines whether it is dancing or not. (Anttila 1994, 24-25.)

It has been discovered that trained dancers have enhanced body awareness, in other words, kinesthesia; dancers practice complex multijoint activities and free exercise where body weight is used as a resistance (Norris 2008, 193). Body awareness refers to the ability to consciously examine your body and the changes occurring. When listening to the body it is possible to receive information through the proprioceptive system; pain, tension, postural positions, emotions and conceptions. (Anttila 2009, 1.) Proprioception refers to a specialized sensation, perceiving, of joint movement and joint position (Norris 2008, 131; Kisner & Colby 2012, 190; Sandström & Ahonen 2011, 34).

Dance technique can be consisted of various elements from many genres of dance, such as ballet, modern and jazz. The techniques of these genres are merged together in order to reflect the components of body control valued by the teacher. Dance technique aims for finding proper alignments of the body in order to support all movements. In

addition, these exercises enhance several body segments. (Santavuo, personal communication on 07.10.2014.) Dancers are required to practice their body profoundly without limitations; thus, muscle balance is essential (Sandtröm & Ahonen 2011, 341). Furthermore, practicing your body profoundly through dancing develops elasticity, coordination and motor skills (Anttila 1994, 15).

Contemporary dance examines various methods and qualities of moving. It is relevant to discover one's own most suitable and natural form of producing movement. Moreover, strong presence and experiencing the movement is highlighted. (Santavuo, personal communication on 07.10.2014.)

*"Tanssi on minulle: Maailman maalaamista liikkein, kehollista älykkyyttä, elämäntilanteiden kohtaamista ja käsittelemistä, irtaantumista, hetkessä olemista, itsensä hyväksymistä, unohtamista, muistamista, kanavointia, rakastamista, vihaamista, nauttimista, itsekkyyttä ja jakamista. Pidän itsestäni, kun tanssin. Kun tanssin, olen elävä ja ehjä hetken."* (Santavuo, personal communication on 07.10.2014.)

Translation by Jenni Tuomola:

*"I experience dance as: Painting the world with movement, intelligence of the body, confronting and processing the circumstances of life, unchaining, living in the moment, self-acceptance, forgetting, remembering, channeling, loving, hating, enjoying, selfishness and sharing. I like myself while I am dancing. While dancing, I am alive and whole for a moment."* (Santavuo, personal communication on 07.10.2014.)

## 5.2 The importance of core stability in dance

*"The body is a tool for the dancer as well as the choreographer."* (Parviainen 1994, 35).

Dance is not only about controlling specific skills and movement patterns; it also requires the ability to practice your body as a whole. Therefore dancing focuses on body control profoundly. (Anttila 1994, 15.) "In modern dance the body is known as an

instrument, which is the dancer's tool. Martha Graham says: I am a dancer. My experience has been with dance as an art. Each art has an instrument and a medium. The instrument of dance is the human body; the medium is movement. ” (Parviainen 1994, 41).

Through dancing it is possible to take care of one's physics as well as the health of your muscular-skeletal system. In addition, dancing has been compared to athletic performance. However, physical indicators show that dancing is often more strenuous than many sports. The difference between these two is the implementation of the laws in exercise physiology; gaining adequate recovery and balancing between work and rest can be challenging in dancer's work. It can be quite common that the dancer does not have an impact on the exercise rhythm. Therefore it is crucial to find enough time for recovery as well as additional exercising. Lack of proper balance can often cause over training which results to injuries. (Ahonen 1995, 5.)



©Tanssikoulu Tiina ja heimo

Norris (2008, 193) is also describing dancers as athletes among gymnasts. A dancer requires all the same physical aspects as an athlete; there needs to be a balanced amount

of endurance, strength, speed, elasticity, agility, tissue flexibility and good coordination- and learning skills. In addition, the ability to express a variety of emotions and possession of musical and rhythmical skills are required. (Ahonen 1995, 5.)

Based on recent research evidence regular body control training should be included in the exercise program of an athlete throughout the year. In order to avoid injuries in sharp change of directions and sudden full stops good core stability is essential. It is a key factor especially when the latter are repeated continuously and quick recovery is needed. According to research adequate core stability is required in order to perform controlled movement of the extremities. If trunk control fails during movement the torque focused on the joint of the extremity is multiplied. (Ahonen & Parkkari 2011, 20-21.)

## EXERCISE PROGRAM FOR CORE STABILITY

The base for exercising the stabilizing muscles of the trunk is endurance, which is followed by strength and lastly by speed (Sandström & Ahonen 2011, 222). Stabilization exercises are a form of isometric training, which is practiced in order to develop a sustained level of contraction to improve postural stability. These exercises can be performed by static contractions against a resistance, typically body weight, in anti-gravity positions. Stabilization exercises that aim to increase stability of trunk are referred as core stabilization exercises. (Kisner & Colby 2012, 180.)

### 5.3 Stabilization training

While exercising stability it is important to consider the basic principles of motor control. Performing automatic control and maintenance of the stabilizing muscles is not as simple as it may sound: awareness of muscle contractions and spinal positions is required in order to control the spine while performing even simple exercises. The first step includes learning to consciously contract your deep segmental muscles before the global trunk muscles. Afterwards it is possible to transfer into even more complex

exercises, however it is crucial that control of the spine and stability is adequate enough. (Kisner & Colby 2012, 507-508.)

Sufficient sensorimotor control is essential with the intention of gaining the required results (Sandström & Ahonen 2011, 222). The drawing-in maneuver is recommended to perform in stabilization training; it increases the abdominal pressure by inwardly displacing the abdominal wall. Furthermore, it trains in coordination with the global muscles the holding capacity of the deep abdominal and multifidus muscles. (Kisner & Colby 2012, 511, 516.) Neutral spine position and abdominal hollowing must be maintained throughout the exercises (Norris 2008, 166). In case the stable spine position is not maintained adequately, the deep abdominals are no longer able to stabilize. Thus, superficial muscle activation overrides the deep muscles. (Kisner & Colby 2012, 516.) However, though activation and early use of the deep muscles is essential in body control, the superficial muscles are also allowed to participate (Sandström & Ahonen 2011, 234).

Good core stability in its own is not enough; it is essential to be able to channel your core stability into movement. It has been said that static muscle work combined with movement is the tool to exercise your core stability while linking the exercise to the demands of your own sport. (Ahonen & Parkkari 2011, 20-21.) Once the subject is able to recognize the activation of the deep segmental muscles in the lumbar region and discover the neutral spine position, the drawing-in maneuver is performed while maintaining control during extremity motions (Kisner & Colby 2011, 516). Furthermore, use of limb loading facilitates the automatic response of the stabilization muscles (Norris 2008, 165).

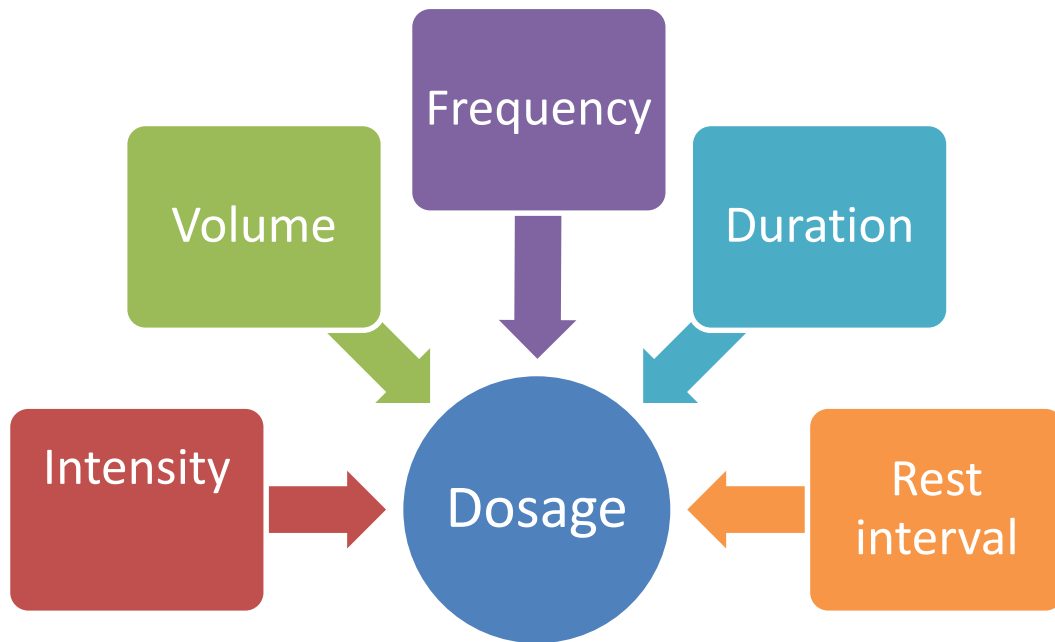
Co-contraction of muscles is commonly used while exercising stability of the core; muscles of the back are supporting the work performed by the abdominal muscles in order to maintain a balanced amount of pressure in the spine. On the contrary, while performing the regular sit-ups, in other words crunches, the pressure against the posterior walls of the discs expands. This results in extensive loading of the lumbar spine. Stability of the back is adequate enough when the body is balanced to its prime. The term 'kehon kannatus' (translation: body support) is commonly used in dance. This describes the longest position of the body where potential energy is at its minimum;

the body is a complex structure that can transfer heavy loads without collapsing. The latter can be achieved only when the postural muscles of the back are functioning properly. (Sandström & Ahonen 2011, 223.)

Pilates is a form of exercise through which it is possible to exercise the stability of the core. The base for Pilates exercises is to begin each movement by deep abdominal activation and produce controlled breathing during the exercise. This method strengthens the deep abdominals that support the posture and produce economic use of the muscular skeletal system. (Website of the Finnish Association of Pilates 2014.) Based on research, breathing during core exercises is considered valuable and engaging your diaphragm through breathing intensifies abdominal activation (Sandström & Ahonen 2011, 227-230). Furthermore, the lowest tendons of insertion of the diaphragm are attached to the highest vertebrae of the lumbar spine. Thus, recent research indicates the diaphragm to support the lumbar spine during inspiration. (Sandström & Ahonen 2011, 238.)

#### 5.4 Dosage

There are many elements that determine the effectiveness of an exercise program; these elements, in other words variables, can be applied to a rehabilitation program as well as a general conditioning program to improve the level of fitness of healthy individuals. When considering all the variables a desired outcome is more likely to occur. (Kisner & Colby 2012, 170.) The variables discussed in this chapter are intensity, volume, frequency, and duration of exercise and rest interval, which are summarized in Picture 11. The latter are reflected as the dosage of an exercise program (Kisner & Colby 2012, 170; Sandström & Ahonen 2011, 74).



Picture 11. Variables that determine the effectiveness of an exercise program, in other words dosage

*Intensity* of exercise refers to the amount of resistance forced on the contracting muscle. Usually this is described as to which extent the muscle is loaded or how much weight is lifted, lowered or held. (Kisner & Colby 2012, 171.) In addition, weight or partial body weight is measured as one source of resistance while performing the exercise in an antigravity position (Kisner & Colby 2012, 175).

*Volume* of exercise is considered as the summation of repetitions and sets performed during one exercise session times the intensity of the exercise. The amount of times a movement is repeated is measured as the number of repetitions. The exact amount of repetitions used is depended on whether the goal of the exercise is to increase muscle strength or endurance. The amount of specified repetitions performed consecutively is known as a set of exercise, which is followed by a brief interval of rest. (Kisner & Colby 2012, 173.)

With both repetitions and sets, there is no optimal number defined to increase strength or endurance. However, there are common recommendations, for instance 2-4 sets are known to have positive training effects among adults. While training to improve endurance performing many repetitions against a submaximal load is included. Although it is mentioned that in order to improve endurance there is a need for performing as



many repetitions as 50, endurance training can also be accomplished by maintaining an isometric, in other words static, muscle contraction for an extended period of time. (Kisner & Colby 2012, 173.)

While Norris (2008, 203, 233) is describing the stability concepts in abdominal training and forms of stability exercises he mentions guidelines of performing each exercise in range of 8-15 repetitions. In addition, endurance stability exercises with limb loading can be performed by maintaining an isometric contraction for an extended period of time, where 10 seconds is the most challenging, with 10 repetitions (Norris 2008, 165). However, quality of exercise is overriding the quantity in abdominal exercises: performance needs to be stopped as soon as the quality is decreased (Norris 2008, 233).

*Frequency* refers to the weekly amount of performed exercise sessions. There are some generalizations when considering the optimal frequency while intensity and volume of the exercises are increased; two to three times per week, every other day, or up to five exercise sessions per week is common. (Kisner & Colby 2012, 174.) Training should always be progressive while considering the frequency and volume of exercise; too demanding muscle contraction can lead to collapsing of the supportive systems (Sandström & Ahonen 2011, 222).

*Duration* of exercise is the time period during which an exercise program is carried out. For significant changes to occur in muscle, at least six to twelve weeks of resistance training is needed. (Kisner & Colby 2012, 174.) However, having a variation of results between individuals of the same exercise program is common; some respond to identical training stimulus more willingly than others (Katch, McArdle & Katch 2011, 412).

*Rest interval* is designed to act as tool for the muscles to recover from the demands of the exercise. An adequate balance between loading and rest can only improve muscle performance. This has to be implemented to the rest interval between the sets as well as the rest interval between exercise sessions. The duration of rest is depended on the intensity of the exercise, where a lower intensity exercise requires a shorter rest interval compared to a high intensity exercise. (Kisner & Colby 2012, 174.)

## 5.5 Mode

The mode of the exercise is referring to the type of muscle contraction occurring and the method in which the exercise is carried out. Furthermore, the form of resistance, in other words load, applied to the exercise is included. An exercise can be performed dynamically or statically and they are two broad categories of exercise. (Kisner & Colby 2012, 175.) Though this thesis focuses on isometric exercising, it is reasonable to mention dynamic exercising as well in order to compare the two.

*Isometric exercise* is conducted by static muscle work where muscles contract and produce force without a considerable change in muscle length or joint motion (Kisner & Colby 2012, 179; Tortora & Derrickson 2009, 324). Although there is no movement included, isometric contraction expends energy and is crucial for postural maintenance (Tortora & Derrickson 2009, 324). Maintaining a position against the resistance of body weight is considered as one source of resistance in isometric exercise (Kisner & Colby 2012, 179).

*Dynamic exercise* causes joint movement and is divided into concentric and eccentric muscle work. Concentric muscle work is produced by muscle contraction and shortening, whereas eccentric muscle work is performed by muscle lengthening under tension. Source of resistance in dynamic exercise can be applied in several ways, such as free weights or weight machines that provide a variety of resistance. (Kisner & Colby 2012, 180.)

## 6 INTERVENTION

Planning the exercise program began in September 2013, when the original idea for a thesis topic was decided. The official and final program was initiated at the beginning of March 2014 and continued till the end of May. The schedule for the exercise program was implemented during the spring 2014 as a consequence of one of the authors

performing her three-month clinical practice abroad. This particular factor made division of the thesis work rather clear; the author who was staying in Finland was in charge of the exercise program and the other was in charge of performing the needed testing before and after the three-month implementation.

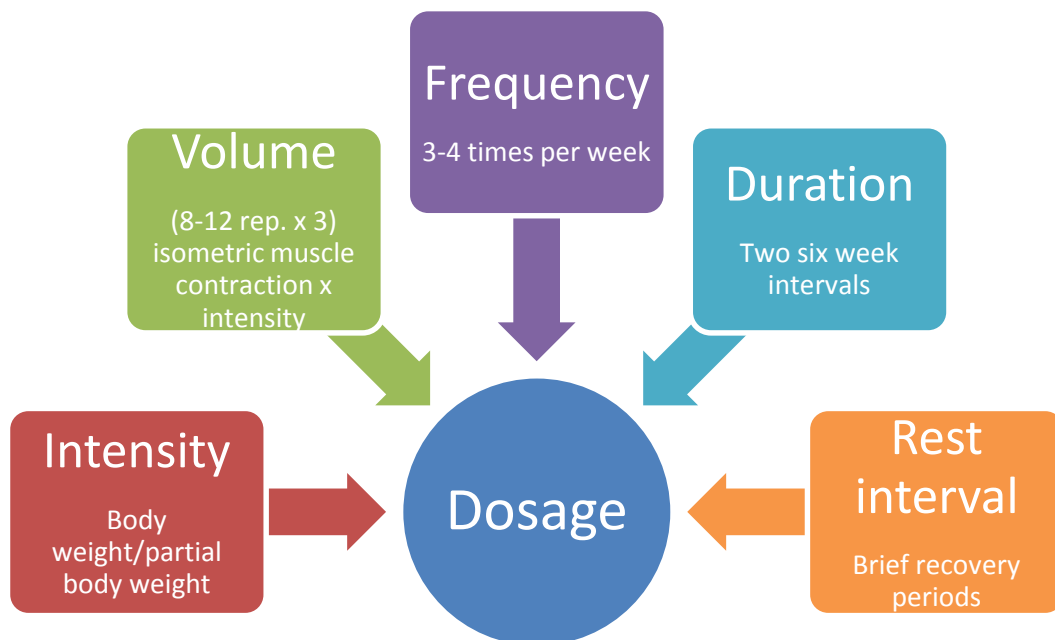
Testing of core stability with a blood pressure cuff was implemented before and after the program in order to discover whether the exercises were effective by comparing the initial and final level of the test group. In addition, Hoover testing was performed to act as a motivational factor for the subjects. A more detailed description of the blood pressure cuff and performed testing are described later in the following chapters.

## 6.1 Exercise program

The program contained two six-week intervals. Both intervals consisted of three movements and their alternative options in order to either facilitate the exercise or make it increasingly challenging. The subjects received written instructions with pictures of the movements for both intervals (appendix 2). The pictures were taken in the dance school to serve as a natural surrounding and hence increase the motivation. In addition, one of the authors performed as a model for the pictures, providing a familiar face for the test group.

The movements of the exercise program were designed as isometric contractions of the muscles of the core combined with movements of the extremities. Co-contraction, activation of both abdominal muscles and supportive muscles of the back, was involved in each exercise. Movements of the extremities were included with the intention of challenging the stability of the core by combining limb loading. The movements were inspired by Pilates form of exercises, however there was only one movement that was considered directly from Pilates, Pilates hundred (P100). Hence, subjects were instructed to add breathing to the exercise performance in order to increase deep abdominal activation. Preceding each movement the subjects were instructed to activate their deep abdominals by the drawing-in maneuver and maintain the activation throughout the exercise.

Positioning of the exercises were the following; crook-lying (lying on supine, knees bent), plank (forward lean position, arms straight) and dolphin plank (hoover). As mentioned earlier, each exercise had alternative options of positioning in order to modify the demand level. The dosage was created in order to increase muscle endurance of the core. Load of exercise was body weight due to limb loading in antigravity positions. All the movements except Pilates hundred were in sets of three. Repetitions were mainly 8-12, where one repetition distributed one movement of one extremity. One exercise had timing instead of repetitions. The subjects were instructed to implement short recovery periods between each set of exercise. The dosage of the exercise program is summarized in Picture 12.



Picture 12. Dosage of the exercise program

Taking into consideration the starting level of the test group, the exercises were designed to be quite challenging already in the beginning; the ability to consciously perform abdominal hollowing was seen as adequate enough. Therefore the exercises were not focusing on the recognition of deep abdominal activation, but rather to the improvement of muscular performance. In addition, the subjects were instructed not to perform bad quality repetitions where the deep abdominal activation would collapse.

The exercises were instructed first together as a group where the subjects would have a chance to practice the movements and the author had the opportunity to give corrections. Exercises were kept rather simple to ensure proper performance and avoid mistakes; due to lack of resources and hectic time-period there was no possibility in arranging weekly sessions for the group. Hence, the subjects were instructed to consult the author whenever they had difficulties in regards to performing the movements.

To act as a motivational tool the target group received an exercise diary where they would mark the performed exercises and possible notifications, such as having the flue or matricular examinations and so on. As a result of one of the authors had the opportunity to meet the subjects weekly during the dance lessons, she was able to receive brief interviews of performing the movements and give instructions and corrections. As additional motivational factor, hoover testing was implemented for the target group to receive a concrete feeling of improvement.

After the first six-week interval the target group was given new movements. The movements were directly linked to the first interval, only this time slightly more challenging. The group also performed a special test for core stability strength for athletes. However, the results of this test were not analyzed due to the unreliability of the source used. Furthermore, this test was designed again for a motivational factor.

## 6.2 Testing

The testing was implemented at the Satakunta University of Applied sciences. The subjects implemented the test one by one. During the test there were not any bystanders in the room.

Before the test, the subject received a short introduction of the transversus abdominis anatomy. A skeleton was applied as a visual model. In addition, the subject was taught the correct transversus abdominis activation, drawing-in maneuver, technique. Methods used for teaching included verbal instruction and palpation of the transversus abdominis muscle.

The test included three different stages:

1. Lying on supine, knees flexed
2. Sitting on a plinth (Picture 13.)
3. Sitting on plinth plus lifting lower extremities in turns

The pressure cell was placed between the lower back and a firm surface (plinth). For the resting pressure, the air was pumped into the pressure cell until the monitor showed 40mmHg. During the test, the subject was instructed to contract the Tra muscle and lift the pressure in the pressure cell up to 48mmHg. The contraction was held 10 seconds, followed by a five second break. The contraction was repeated two more times. Both stage 1 and 2 were testing the ability to contract the transversus abdominis, and they were partly implemented as a practice for the third stage of the test.



Picture 13. The position during the second and third stage of testing © Jasmin Kruus & Jenni Tuomola

In the third stage of the test, the subjects were instructed to first activate the Tra muscle, and then slowly lift the right lower extremity up a few centimeters. After that the subject was instructed to slowly return the lower extremity to the starting position and repeat the movement with the left lower extremity. This was also implemented three times. The variation of the pressure was told to be kept in the 48 mmHg during the whole test. The classroom where the test was carried out and other settings were implemented similarly in both initial and final testing situations to increase the reliability and also to have a standard test situation.

## 7 RESEARCH METHODS

Asking questions and finding answers to those questions in a reasonable and well-organized manner conduct research. The different methodologies in research are established by various methods of asking and answering questions. (Hicks 2004, 5.) The need for health care professionals to comprehend research methods is vital: in order to implement high-quality treatment clinicians are increasingly required to practice and consult evidence-based research as a basis of their work. Furthermore, critical evaluation and judgment of the performed researches by other professionals is essential to guarantee the desired outcome. (Hicks 2004, 4.)

### 7.1 Approach

“All research involves the collection of facts about an individual or a group of people.” (Hicks 2004, 6). When the information received is considered numerical, or in other words measurable, the approach of research is characterized as *quantitative*. In quantitative approach objective events are measured numerically. The information received is for instance range of motion, distance walked or blood pressure. (Hicks 2004, 6-7.) Quantitative research aims for discovering results that are generalizable to other subjects, times and settings (Carter, Lubinsky & Domholt 2011, 57). Conversely, when the research is aiming to discover subjective events, such as person’s feelings, opinions and thoughts in their natural setting, the research is characterized as *qualitative* (Hicks 2004, 6-7). Unlike quantitative approach, qualitative approach aims to discover results that offer a deep understanding of a particular case in a particular time and context (Carter, Lubinsky & Domholt 2011, 60-61).

Qualitative and quantitative research should be seen as two corresponding techniques where both are offering their own insights (Hicks 2004, 7). As a result, this thesis was conducted by both qualitative and quantitative approaches. The effectiveness of the exercise program was measured objectively, in other words numerically, with the blood pressure cuff and subjective feelings of the test group were evaluated by gaining information with the aid of a questionnaire.

## 7.2 Sampling

An essential segment of all decent research is to discover the appropriate number and type of people to participate in the study. This segment is defined as sampling of research. (Hicks 2004, 24.) For qualitative research, purposive sampling is commonly used. Sampling can be described as purposive when the researcher chooses particular individuals for the study for a specific reason. Thus, the specially selected subjects meet the needs of the researcher and offer in-depth information for the study. (Carter, Lubinsky & Domholt 2011, 99.)

From the qualitative perspective of this thesis purposive sampling was used; we wished to offer an exercise program for this specific group of advanced dancers who were lacking additional training for core stability. As a result, this specific group met our demands for the study to discover whether the exercise program would be effective; the exercise program could be implemented later with future advanced groups.

## 7.3 Collection of data

Questionnaires are widely used as a tool to gather data about a group of people due to their efficiency and ease. However, there are many areas to consider while coming up with a targeted questionnaire: the questions are required to be structured in a matter, which will reflect the objectives of the researcher. In addition, piloting of the questionnaire is recommended in order to recognize possible errors or clarifications before conducting the official questionnaire. (Hicks 2004, 19-23.) One person outside of the thesis process who was able to recognize few spelling mistakes performed piloting of the questionnaire (appendix 1).

The format of questionnaires is wide-ranging. However, there are some standard guidelines; the questions can be in open- or closed format. The closed format of questions includes both Likert-type and multiple-choice items. (Domholt 2005, 227.)

Open-format questions allow the subject to give flexible responses, which results in greater depth of answering. This is dependent on the respondent's willingness and



ability to communicate with the absence of an interviewer. The biggest challenge in open-format questions is the analysis performance; the researcher has to categorize the responses to manageable categories. (Domholt 2005, 227.)

Closed-format questions limit the range of responses. Multiple-choice questions can be used to measure for instance opinions and behavior. There is a possibility in allowing flexibility of response in closed-format questions by adding a response category 'other'; this allows the subject to give a response they chose outside the given options. The Likert-type of questions measures the strength of response and varies from a negative response to positive response. Likert-type is typically characterized as 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree'. (Domholt 2005, 227.)

There is a recommendation in setting the order of questions with the intention of maintaining the respondents' interest; it is beneficial to begin the questionnaire with easier questions which are followed by more demanding questions (Domholt 2005, 232). The questionnaire of this thesis began with questions considering basic information, such as age and profession. These can be perceived easy to answer, which increased the motivation to complete the questionnaire. Following questions were in both open- and closed format, including Likert-type and multiple-choice items.

#### 7.4 Measurement tools

The functioning of the deep and superficial abdominal muscles can be examined specifically with the dynamic ultra sound analysis. In addition, the cooperation of the deep and superficial muscles can be researched by using the surface-ENMG to synchronize information. However, these methods cannot be recommended in routine examinations due to the expensive equipment and problematic availability. (Sandtröm & Ahonen 2011, 342.) Thus, Kisner and Colby (2012, 511) are describing that the use of a stabilizer or a blood pressure cuff can be implemented as well. In the circumstances of the stabilizer provided by the school was broken, measurement tool used in this thesis was blood pressure cuff. Furthermore, the questionnaire served as additional measurement tool. Blood pressure cuff (Picture 14.) offered information of the objective level of

deep abdominal activation whereas the questionnaire gave evidence of the subjective experience of core stability.



Picture 14. Blood pressure cuff © Jasmin Kruus & Jenni Tuomola

Instrument reliability needs to be assessed before conducting research with the aid of an instrument, or in other words, device. Biophysiological measurements require a use of a mechanical tool, which obliges calibration before conducting measuring. In addition to calibration, taking repeated measurements across the range of results expected to occur assesses the reliability of the device. (Carter, Lubinsky & Domholt, 238.) “Assessment of scores on two or more administrations of a test is called test-retest reliability.” (Carter, Lubinsky & Domholt, 238). Test-retest reliability of the blood pressure cuff was evaluated before the initial testing by the authors of this thesis. Furthermore, the same device was used later in the final testing in order to receive reliable results.

In addition, there is a difference in whether the output of the device is digital or in analog format; digital format leaves little space in the understanding of the examiner. However, in analog format it is impossible to distinguish the difference between the reliability of the device from the ability of the examiner to read the scale accurately.

(Carter, Lubinsky & Domholt, 238.) The blood pressure cuff used in thesis had a mercury monitor where the output is in analog format.

Intrarater reliability is referred as “the consistency with which one rater assigns scores to single set of responses on two occasions.” Moreover, the examiner is able to view one performance identically on several occasions for instance via video clip. (Carter, Lubinsky & Domholt 2011, 239.) Videotaping was consumed during the testing in order to increase the reliability of the performed analysis: this enabled the possibility to view the results from the monitor of the blood pressure cuff as many times as possible at different times. This was seen as necessary taking into consideration the analog monitor affecting on the reliability of result interpretation.

“Measurement validity is the appropriateness, meaningfulness and usefulness of the specific conclusions made from test scores.” (Carter, Lubinsky & Domholt, 241). A reliable measure is valid only if it is repeatable and provides significant information (Carter, Lubinsky & Domholt, 241). Furthermore, reliability of measures is necessary to create valid results. However, a reliable measure does not validate the meaning behind the measure. (Carter, Lubinsky & Domholt, 249.)

Construct validity of measurements refers among other things to the ability of the researcher to defend the appropriateness of the measurements used: “a researcher who wishes to assess strength gains following a particular program of exercise must be prepared to defend the appropriateness of the measurements he or she used for the type of exercise program studied.” (Carter, Lubinsky & Domholt 2011, 249). Constructs, such as strength and pain, are not directly observable and therefore there is no standard to which they could be compared. Therefore, the validity of constructs can be established by persuasive argument. (Carter, Lubinsky & Domholt 2011, 249.)

The testing performed and exercise program of this thesis are in relation: The movements of the exercise program were isometric contractions of the core combined with movements of the extremities. The testing was performed by isometric contractions of the deep abdominals combined to the movement of lower extremities. Therefore, the validity of measurements can be seen as adequate.

## 8 RESULTS

### 8.1 Objective

In the chart 1, the blue column is describing the initial test result, as in how many units (in mmHg) was the variation during the contraction. The orange column is describing the final test result. The chart 1 is reporting the results from the third stage of the test: sitting on plinth in addition to lifting lower extremities in turns.

As the chart shows, there was a slight improvement in the test results. During the test the subjective aimed to stabilize the cuff in 48mmHg, which states that the less there is variation in the mmHg, the better the result. The results were improved in all four subjects who were able to implement the test after the exercise program period.

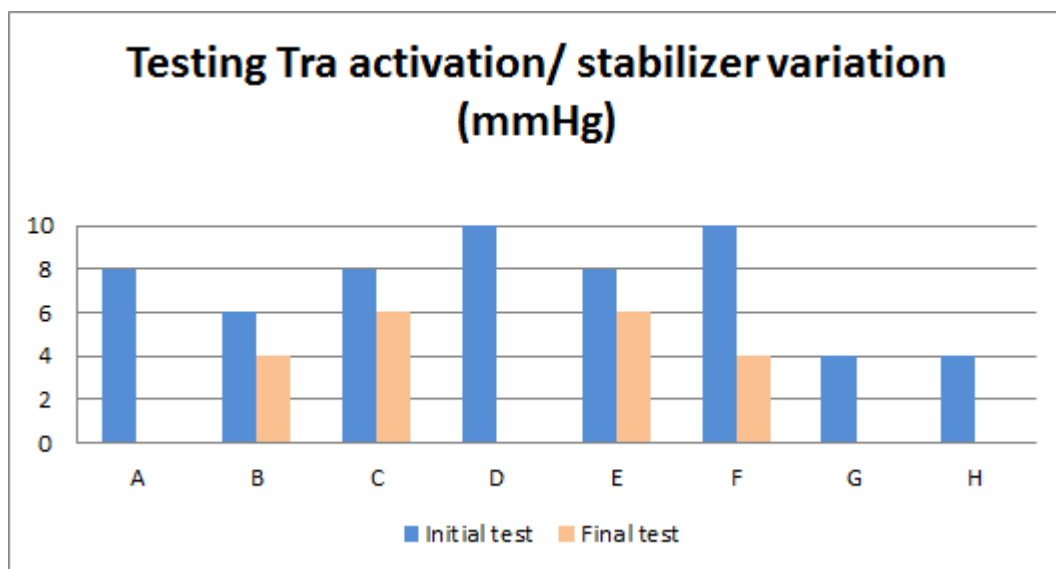


Chart 1. The results of the blood pressure cuff testing (n=4).

### 8.2 Subjective

After the three-month intervention the test group received a questionnaire (appendix 1), which contained questions considering for instance, basic information, the performed frequency, received instructions, the subjective feeling of their development,

motivational concerns and possible improvements. The results received from the questionnaire can be perceived as reliable: seven out of eight subjects responded, with one drop out, leaving the total percentage of participation 87.5%.

When inquiring the performed frequency of the exercises, four subjects out of seven responded that they executed the exercises 1-2 times per week and three subjects performed less than once a week. The most common reason for not executing the exercises as instructed was stated as lack of managing. When determining the reason for the latter the majority responded that the time period was impacting; school, work, dance practices and other aspects of life were too loading in order to perform the exercises. Two subjects stated also that the exercises were unpleasant, which led to avoiding the exercises.

The Likert-scale, in other words 5 point disagree-agree scale, was perceived more challenging to answer and therefore it followed the more simple questions. The 5 point disagree-agree scale gave the subjects the option to choose from the following:

1. Strongly disagree
2. Disagree
3. Undecided
4. Agree
5. Strongly agree

Questions and their results are described in Table 1 and Chart 2. The subjects are listed in Chart 2 by letters from A-H, where D is missing, as the subject presenting that letter was the one drop-out. The questions are highlighted by different colors, each of the color categorizing one question; for instance the question 'I am now more aware of my core stability' is seen as purple in Table 1 and Chart 2. Above each letter, that presents one respondent, are seen all the answers that one respondent gave.

Questions of the 5 point disagree-agree scale
I was given enough alternative movements
I received enough instructions concerning the movements
The movements gave a subjective feeling of deep abdominal activation
I am now more aware of my core stability
My core stability has improved during the three months
The exercise program supported my dancing

Table 1. Questions of the 5-point disagree-agree scale

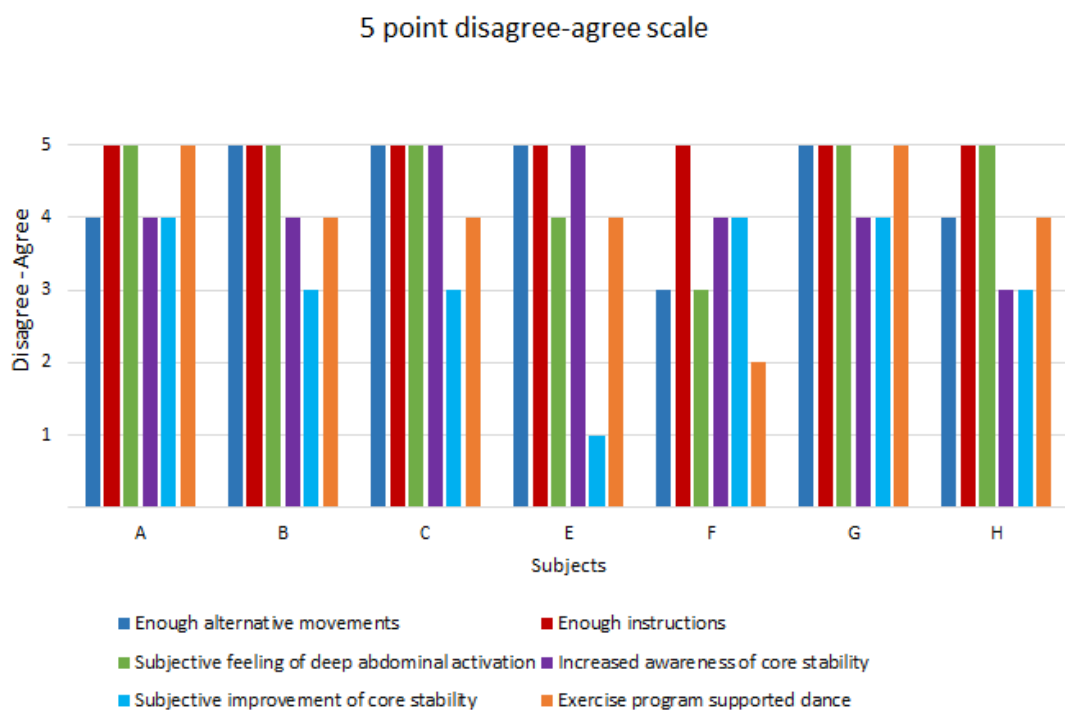


Chart 2. Results of the 5-point disagree-agree scale (n=7)

As the chart shows, all the subjects strongly agreed on receiving enough instructions considering the performance of the movements and majority of the respondents felt that they received enough alternative movements. Furthermore, the same pattern is seen on subjective feeling of deep abdominal activation during the movements and increased awareness of core stability. Although subjective improvement of core stability gave the most scattered answers of the questionnaire, the majority of the respondents perceived that the exercise program supported their dancing.

Following the 5 point disagree-agree scale were open questions, which are listed in Table 2 according to the order in the questionnaire. The open questions gave the possibility for the respondents to describe their answers freely. In addition, the questions were set up so that the subjects would have to answer with more words than ‘yes’ or ‘no’. This would give the authors more to analyze, however the answers would be more in-depth.

Open questions
10. Describe how the exercise program has effected on your dancing and overall presence?
12. What factors could have motivated you to perform the movements more often?
13. How do you think the exercise program could have been developed?

Table 2. Open questions

Positive findings occurred in question 10, where majority of the respondents were more aware of their posture and their core stability:

‘Mietin nyt todella usein ryhtiäni ja vatsan kannatusta. Kävellessänikin käytän ydintukea.’

Translation by Jenni Tuomola: ‘nowadays I often think about my posture and abdominal support. Even as I am walking I am able to implemented core stability.’

There were also negative findings, where one respondent felt the program had really no impact on dancing and another stated that her core stability had by the contrary diminished during the three months. However, these were a minority of the respondents. The most motivational factor (question 12) according to the group would have been mutual exercise sessions. Performing the movements alone was seen as a challenge. Question 13 indicated that time period could have been different according to the majority of the respondents.

‘En ole hyvä tekemään itsenäisiä harjoitteita ainakaan näin pitkällä väliajalla. Tarvitsen muiden kannustusta ja ryhmäpainetta, ohjaajan jatkuvaa motivointia ja reaaliaikaisempaa raportointia tehdyistä suoritteista.’

Translation by Jenni Tuomola: 'it is not easy for me to perform long-term exercises independently. I require encouragement from others and peer pressure, constant motivation from the instructor and reporting of the performed exercises.'

## 9 CONCLUSION

The hypothesis of our research was that the target group would improve their core stability and they would become more aware of their deep abdominal activation with the aid of the exercise program. In addition, the exercise program was assumed to support their training; the subjects would be able to link the core stability to the demands of dance. All the subjects who were able to participate in both initial and final testing of the deep abdominal activation were able to improve their results. However, it has to be considered that only two of those four subjects who participated in the testing did perform the exercises during the three months; the other two did not and still were able to improve the final test results. There are various other factors that could have had an impact on the results.

The results from the questionnaire indicated that the majority of the subjects were more aware of their core stability. Furthermore, the majority of the subjects perceived that the exercise program supported their dance. However, only three subjects stated subjective improvement in core stability. In conclusion, the hypothesis was partially accomplished; through intervention of the exercise program we were able to increase awareness of core stability among the test group and offer a tool that supported their dancing.



## 10 DISCUSSION

Taking into consideration our own background as dancers, the topic of our thesis was highly motivational and therefore made the process interesting. We have received valuable information about the importance of core stability in dance. Furthermore, the information collected for our research has supported our own dance enthusiasm. The time management of this thesis was rather successful from the beginning. We were able to organize our schedule efficiently and the process was initiated early enough. The cooperation between the two authors was beneficial; we were able to take in use each other's strengths. In addition, the cooperation with the third party was fluent. Both the dance school and the target group were willing to cooperate throughout the process.

The reliability of results is questionable; although there was improvement seen there are many other factors that could have had an impact. LeikistiVakavasti had a heavy practice season during the spring 2014, which possibly had both negative and positive effects on the results; lack of motivation for additional exercising and improvement of overall level of physical capacity. Furthermore, when research includes a small amount of participants, the risk of drop-outs has a greater impact on the reliability of results. Taking into consideration of the hectic time period of the subjects, the exercise program could have been conducted during the summer time; all the subjects were occupied simultaneously with dance, school and work. Furthermore, the target group could have been the younger LeikistiVakavasti, who would have had less demanding schedule due to their younger age. This would have possibly resulted in higher motivation to perform the exercises.

Collection of data was rather vast; the questionnaire concluded too many questions to analyze and they were not all necessarily relevant. Therefore the authors decided to analyze only those questions that had most value and were related to the research questions. As the questionnaire indicated the target group would have preferred weekly sessions to perform the exercises. This would have enabled the possibility to gradually increase the level of demand of the exercises, which were in the beginning already rather challenging. This possibly impacted on the motivation to perform the exercises.

This process has been highly educational and has improved our professional competences as future physiotherapists. We have deepened our knowledge of core stability and stabilization training; how to implement a targeted exercise program and perform testing and analysis. Methods of research have also become more familiar to us. In addition, we have been able to critically evaluate our own research process and recognize factors in our own work that would have required improvement. In order to further develop our topic, an exercise program for core stability could be implemented outside the practice season, for instance during the summer time. Exercise sessions could be implemented weekly including several areas of stabilization training. This would serve as maintaining and preparing exercising to support the following season. Furthermore, motivation for performing the exercises was not adequate enough; there would be a need for further research in this specific field in order to discover more in depth what factors would increase the motivation.



©Tanssikoulu Tiina ja heimo

## REFERENCES

Agur, A.M.R. & Dalley, A.F. 2009. Grant's atlas of anatomy. 12<sup>th</sup> ed. Philadelphia: Lippincott Williams & Wilkins.

Agur, A.M.R. & Dalley, A.F. 2013. Grant's atlas of anatomy. 13<sup>th</sup> ed. Philadelphia: Lippincott Williams & Wilkins. Referred 19.09.2014. <https://key-chests.com/item.php?v=mdlggrfkfim>

Ahonen, J. 1995. Tanssityö koettelee kuntoa. Fysioterapia 3, 4-7.

Ahonen, J. & Parkkari, J. 2011. Kokonaisvaltainen harjoittelu parantaa urheilusuoritusta. Liikunta & Tiede 5, 18-22. Referred 14.09.2014. <http://www.terveurheilija.fi>

Anttila, E. 2009. Mitä tanssija tietää? Kehollinen tieto oppimisen ja ajattelun perustana. Aikuiskasvatus 2, 1. Referred 24.10.2014. <http://www.aikuiskasvatus.fi>

Anttila, E. 1994. Tanssin aika: opas koulujen tanssikasvatukseen. Tampere: Tammer-Paino Oy.

Carter, R., Lubinsky, J. & Domholt, E. 2011. Rehabilitation research: principles and applications. 4<sup>th</sup> ed. St. Louis: Elsevier Saunders.

David Garrigues. The diaphragm is the key!! Don't forget it. Observe it. Ashtanga kiji! with David Garrigues. 21.08.2011. Referred 14.09.2014. <http://davidgarrigues.com/blog/?p=1514>

Domholt, E. 2005. Rehabilitation research: principles and applications. 3<sup>rd</sup> ed. St. Louis: Elsevier Saunders.

Hicks, C. 2004. Research methods for clinical therapists: applied project design and analysis. 4<sup>th</sup> ed. Edinburgh: Churchill Livingstone.

Katch, V., McArdle, W. & Katch, F. 2011. Essentials of exercise physiology. 4<sup>th</sup> ed. Philadelphia: Lippincott Williams & Wilkins.

Kibler, W.B., Press, J. & Sciascia, A. 2006. The role of core stability in athletic function. Sports Med 36, 189-198. Referred 16.09.2014. <http://www.researchgate.net/publication/7251191>

Kisner, C. & Colby, L.A. 2012. Therapeutic exercise: foundations and techniques. 6<sup>th</sup> ed. Philadelphia: F.A. Davis Company.

Norris, C.M. 2008. Back stability: integrating science and therapy. 2<sup>nd</sup> ed. Champaign: Human Kinetics.

Parviainen, J. 1994. Tanssi ihmisen eksistenssissä: filosofinen tutkielma tanssista. Dissertation. Tampere: University of Tampere.

Richardson C., Hodges, P.W. & Hides, J. 2004. Therapeutic exercise for lumbopelvic stabilization: a motor control approach for the treatment and prevention of low back pain. 2<sup>nd</sup> ed. Edinburgh: Churchill Livingstone.

Sandström, M. & Ahonen, J. 2011. Liikkuva ihminen: aivot, liikuntafysiologia ja sovellettu biomekaniikka. Keuruu: Otavan Kirjapaino Oy.

Santavuo, T. 2014. Artistic director, Tanssikoulu Tiina ja heimo. Pori. Personal communication 07.10.2014.

Tortora, G.J & Derrickson, B. 2009. Principles of anatomy and physiology. 12<sup>th</sup> ed. Hoboken (NJ): John Wiley & Sons, Inc.

Tortora, G.J. & Derrickson, B. 2011. Principles of anatomy and physiology: organization, support and movement, and control systems of the human body. 13<sup>th</sup> ed. Hoboken (NJ): John Wiley & Sons, Inc.

Website of the Finnish Association of Pilates. Referred 27.10.2014. [www.suomenpilatesyhdistys.fi](http://www.suomenpilatesyhdistys.fi)

Website of David Lasnier. Referred 14.09.2014. <http://davidlasnier.com/2010/the-inner-core-the-forgotten-part-of-core-training>

Website of the Free Dictionary. Referred 14.09.2014. <http://medical-dictionary.thefreedictionary.com/psoas+major>

Pictures by Teresia Lohiranta, Tiina Santavuo and Jani Vanhatalo © Tanssikoulu Tiina ja heimo, models LeikistiVakavasti dance group

## THE QUESTIONNAIRE

Pvm:

## KYSELY HARJOITUSOHJELMASTA

**Perustiedot**

Nimi: .....

Ikä: .....

Ammatti: .....

Tanssikokemus vuosina: .....

Tanssituntien määrä viikossa: .....

Muu liikunta:

.....

.....

.....

**Harjoitusohjelman teko**

(Voit tarvittaessa ympyröidä useamman vaihtoehdon)

## 1. Tein annettuja liikkeitä

- a. useammin kuin 4 kertaa viikossa
- b. 3-4 kertaa viikossa
- c. 1-2 kertaa viikossa
- d. harvemmin kuin kerran viikossa

*Jos vastasit yllä olevaan kysymykseen a-c, voit siirtyä suoraan kysymykseen 2. Jos vastasit d, tarkenna vastaustasi:*

## 1.1 Tein annettuja liikkeitä

- a. kerran kahdessa viikossa
- b. kerran kuukaudessa
- c. harvemmin kuin kerran kuukaudessa
- d. en lainkaan

1.2 En tehnyt liikkeitä ohjeistettua määrää, koska

- a. en muistanut (tarkenna mikä tähän vaikutti)
- b. en jaksanut (tarkenna millaisissa tilanteissa)
- c. en kokenut liikkeitä mielisiksi (tarkenna miksi)
- d. joku muu syy, mikä?

.....  
.....  
.....  
.....

2. Harjoitusohjelman liikkeiden suorittamista motivoi

- a. kirjalliset ohjeet kuvineen
- b. halu parantaa hoover-testin alkutuloksia
- c. väli-intervalli
- d. liikkeiden teko yhdessä kaverin kanssa
- e. joku muu, mikä?

.....  
.....  
.....

3. Liikkeiden tehokkuus

Numeroi alla olevat liikkeet järjestyksessä 1-6, jossa 1 on omasta mielestäsi tehokkain liike ja 6 tehottomin liike

- Selinmakuulla jalkojen lasku 90° kulmassa
- Lankussa käsien kohottaminen
- Hooverissa jalkojen kohottaminen
- Pilates-100

Lankussa käsien ja jalkojen kohottaminen samanaikaisesti

Hooverissa jalkojen ”tamppaus”

Halutessasi voit tarkentaa vastaustasi:

.....

.....

.....

#### 4. Liikkeiden miellyttävyys

Numeroi alla olevat liikkeet järjestyksessä 1-6, jossa 1 on omasta mielestäsi miellyttävin liike ja 6 epämiellyttävin liike

Selinmakuulla jalkojen lasku 90° kulmassa

Lankussa käsien kohottaminen

Hooverissa jalkojen kohottaminen

Pilates-100

Lankussa käsien ja jalkojen kohottaminen saman aikaisesti

Hooverissa jalkojen ”tamppaus”

Halutessasi voit tarkentaa vastaustasi:

.....

.....

.....



## Vaihtoehtokysymykset

Arviointiasteikko: 1. Täysin eri mieltä 2. Jokseenkin eri mieltä 3. En osaa sanoa  
4. Jokseenkin samaa mieltä 5. Täysin samaa mieltä

(Voit halutessasi tarkentaa vastaustasi kysymysten alapuolelle)

### 5. Ohjeistus ja motivointi

a. Annetut kirjalliset ohjeet kuvineen olivat selkeät ja helppolukuiset.....1 2 3 4 5

.....

b. Koin, että minulle annettiin tarpeeksi vaihtoehtoisia liikkeitä.....1 2 3 4 5

.....

c. Sain tarpeeksi ohjeistusta liikkeiden suorittamiseen.....1 2 3 4 5

.....

d. Olisin kaivannut enemmän motivointia harjoitusohjelman laatijalta.....1 2 3 4 5

.....

### 6. Liikkeiden suorittaminen

a. Koin liikkeet vaatimustasoltaan sopiviksi.....1 2 3 4 5

.....

b. Harjoitusohjelman liikkeet tuntuivat syvissä vatsalihaksissa.....1 2 3 4 5

.....

c. Koin hengityksen tehostavan poikittaisen vatsalihaksen aktivaatiota.....1 2 3 4 5

.....

d. Koin hengityksen liittämisen liikkeisiin turhan haastavaksi.....1 2 3 4 5

.....

e. Jaksoin aina suorittaa annetut toistomäärät ja sarjat loppuun asti.....1 2 3 4 5

.....

7. Kehitys kolmen kuukauden aikana

a. Olen nyt tietoisempi omasta ydintuestani..... 1 2 3 4 5

.....

b. Koen ydintukeni vahvistuneen kolmen kuukauden aikana.....1 2 3 4 5

.....

c. Koen harjoitusohjelman tukeneen tanssiharrastustani.....1 2 3 4 5

.....

d. En koe, että harjoitusohjelmasta olisi ollut minulle hyötyä.....1 2 3 4 5

.....

**Avoimet kysymykset**

8. Kerro yleisesti harjoitusohjelman teon vaiheista kolmen kuukauden aikana?

.....  
.....  
.....  
.....

9. Millaisina koit liikkeet (esim. toistomäärät, sarjat, hengitys)?

.....  
.....  
.....  
.....

10. Kuvaile, miten harjoitusohjelman teko on vaikuttanut tanssiharrastukseesi ja yleiseen olemukseesi?

.....  
.....  
.....  
.....

11. Oliko sinulla viikkoja, jolloin liikkeet jäivät täysin tekemättä? Jos vastasit kyllä, kerro mikä oli yleisin syy tähän?

.....  
.....  
.....  
.....

12. Kerro omin sanoin mikä olisi motivoinut sinua suorittamaan liikkeitä useammin?

.....  
.....  
.....  
.....

13. Miten harjoitusohjelmaa olisi voinut sinun mielestäsi parantaa?

.....  
.....  
.....  
.....

**Kiitos vastauksestasi!**

Henkilöllisyytesi tullaan salaamaan tulosten julkaisun yhteydessä eikä antamiasi tietoja luovuteta ulkopuolisten käsiin.

## HARJOITUSOHJELMA 1



Asetu selinmakuulle, koukista polvet. Aktivoi poikittainen vatsalihas ja ylläpidä sitä koko harjoituksen ajan.

Hengitä sisään. Uloshengityksellä nosta polvet n. 90 asteen kulmaan. Hengitä sisään. Uloshengityksellä laske hitaasti toinen jalka samassa kulmassa kohti maata ja tuo takaisin sisäänhengityksellä. Tee sama toiselle puolelle. **8-12 toistoa X 3**

***Liian vaativa?** Voit tarvittaessa lisätä polvien kulmaa ja tuoda jalkoja lähemmäs keskivartaloa*

***Turhan helppo?** Mitä alempana jalat ovat, sen haastavampi harjoitus on. Tämän lisäksi voit myöhemmin halutessasi lisätä toistomääriä ja lopuksi esim. nilkkapainot.*

Lankku



Variaatio



Asetu käsien ja päkiöiden varaan lattialle. Aktivoi poikittainen vatsalihas ja ylläpidä sitä koko harjoituksen ajan. Pidä niska pitkänä, lapatuki vahvana ja lantio suorassa linjassa muun vartalon kanssa. Vältä kyynärpäiden yliojentumista lukittuneeseen asentoon.

Hengitä sisään. Uloshengityksellä lähde varovasti nostamaan toista kättä eteesi, hallitse asentoa poikittaisen vatsalihaksen aktivoinnin avulla. Sisäänhengityksellä tuo käsi takaisin lähtöasentoon. Tee sama toiselle puolelle. **8-12 toistoa X 3**

**Liian vaativa?** Voit tarvittaessa tehdä saman liikkeen polvet maassa. Vaihtoehtoisesti tee niin monta variaatiota kuin kykenet ja pysy loput hengitykset lankussa.

**Turhan helppo?** Voit halutessasi pysyä useamman hengityksen ajan variaatiossa käsi ojennettuna. Tämän lisäksi voit myöhemmin halutessasi lisätä toistomääriä ja lopuksi esim. Nilkkapainot ranteisiin.



Asetu lattialle kyynärvarsien ja päkiöiden varaan. Aktivoi poikittainen vatsalihas ja ylläpidä sitä koko harjoituksen ajan. Pidä niska pitkänä, lapatuki vahvana ja lantio suorassa linjassa muun vartalon kanssa.

Hengitä sisään. Uloshengityksellä kohota toista jalkaa hitaasti, säilytä lantion asento suorana ja vältä kallistumista toiselle puolelle. Sisäänhengityksellä palauta jalka lähtöasentoon. Tee sama toiselle puolelle. **8-12 toistoa X 3**

***Liian vaativa?** Voit tarvittaessa tehdä saman liikkeen polvet maassa. Vaihtoehtoisesti tee niin monta variaatiota kuin kykenet ja pysy loput hengitykset hooverissa.*

***Turhan helppo?** Voit halutessasi pysyä useamman hengityksen ajan variaatiossa jalka koholla. Tämän lisäksi voit myöhemmin halutessasi lisätä toistomääriä ja lopuksi esim. Nilkkapainot.*

## HARJOITUSOHJELMA 2



Asetu selinmakuulle polvet koukussa vatsan päällä. Aktivoi poikittainen vatsalihas ja ylläpidä sitä koko harjoituksen ajan. Käännä lantiota niin, että alaselkä painuu alustaan mutta pakarat eivät jännity. Tämän jälkeen aseta polvet 90° kulmaan.

**Hengitä sisään:** Pysy tässä asennossa.

**Hengitä ulos:** Pidä niska pitkänä ja rullaa pää ja hartiat irti alustasta. Nosta kädet lattiasta ja suorista jalat yläviistoon, ojenna myös nilkat. Muista säilyttää lantion asento.

**Sisäänhengityksellä:** Pumppaa käsiä ylös-alas viisi kertaa.

**Uloshengityksellä:** Pumppaa käsiä ylös-alas viisi kertaa.

Toista käsien 5+5 pumppausliike 10 kertaa niin, että teet liikettä yhteensä sata kertaa.

*Helpottaaksesi harjoitusta voit halutessasi tehdä liikkeen jalat 90° kulmassa.*



Lankku



Variaatio



Asetu käsien ja päkiöiden varaan lattialle. Aktivoi poikittainen vatsalihas ja ylläpidä sitä koko harjoituksen ajan. Pidä niska pitkänä, lapatuki vahvana ja lantio suorassa linjassa muun vartalon kanssa. Vältä kyynärpäiden yliojentumista lukittuneeseen asentoon.

Hengitä sisään. Uloshengityksellä lähde varovasti nostamaan toista kättä eteesi ja samanaikaisesti kohottamaan vastakkaista jalkaa. Hallitse asentoa poikittaisen vatsalihaksen aktivoinnin avulla. Sisäänhengityksellä tuo käsi ja jalka takaisin lähtöasentoon. Tee sama toiselle puolelle. **8-12 toistoa X 3**

***Liian vaativa?** Voit tarvittaessa tehdä saman liikkeen polvet maassa. Vaihtoehtoisesti tee niin monta variaatiota kuin kykenet ja pysy loput hengitykset lankussa.*

***Turhan helppo?** Voit halutessasi pysyä useamman hengityksen ajan variaatiossa. Tämän lisäksi voit myöhemmin halutessasi lisätä toistomääriä ja lopuksi esim. Nilkkapainot*



Hoover



Variaatio



Asetu lattialle kyynärvarsien ja päkiöiden varaan. Aktivoi poikittainen vatsalihas ja ylläpidä sitä koko harjoituksen ajan. Pidä niska pitkänä, lapatuki vahvana ja lantio suorassa linjassa muun vartalon kanssa.

Lähde nostelemaan jalkoja 15-20 sekunnin ajan vuorotellen reippaaseen tahtiin niin että varpaat irtoavat maasta. Muista hengittää harjoituksen aikana nenän kautta sisään ja suun kautta ulos. Keskity tämän liikkeen aikana erityisesti siihen, että lantio ei heilu puolelta toiselle vaan pysyy suorassa linjassa. Toista liike 3-4 kertaa.

*Voit halutessasi helpottaa/vaikeuttaa liikettä vähentämällä/lisäämällä suoritusaikaa.*