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SUSPENSION TRAINING AS AN EXERCISE METHOD

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The aim of this thesis was to create a knowledge clip about suspension training as an exercise method. The information presented in this report is evidence-based gathered through literature review. The objective of this thesis was to create an accessible and easy to follow clip no matter what the level of fitness the viewer had.

Suspension Training was invented by Randy Hetrick (Navy SEAL operator). His concept of developing an exercise routine which could be performed anywhere with minimum equipment was a solution for Navy SEAL units as they would find themselves in confined, small and isolated places, e.g. submarines. The easy installation and portability of suspension training straps help to meet those requirements.

Suspension training combines a variety of movements that can help the user to improve health, fitness and/or recovery from surgery or musculoskeletal disorders. It follows the same principles of gymnastics and calisthenics, which use body weight to develop muscle and strength. Though originally suspension training was created to meet the high requirements of military fitness, it has been adopted by the general population. The equipment is the same, but the movements can be easily modified to meet the demands and fitness levels of the user.

Whether the user is a top athlete, an office worker or a patient recovering from surgery, the versatility, adjustability and user-friendliness make suspension training a complete exercise method to reach the user's goals and improve functionality.

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## 1 INTRODUCTION

The rehabilitation world is in constant change, and new and better treatment techniques are being studied continuously. Suspension training is an excellent tool to treat musculoskeletal disorders as well as for helping with post surgery recovery. This exercise method is also excellent in helping people overcome their fear of falling, improve balance and proprioception.

Before understanding suspension training, it is important to know its origins, history and the concepts this exercise method is based on. Suspension training is not a new idea, but a transformation of older exercise methods.

This paper explains the concept and benefits of suspension training. The theory behind this thesis was gathered through literature review concerning how beneficial suspension training as an exercise method is. Examples of these benefits are discussed in greater detail throughout this report.

Suspension training tackles some of the limitations seen in traditional gym equipment. Installation, versatility, adjustments and regulation of intensity during the exercises are also discussed in this report.

The positive impact that this exercise method has on health can be remarkable. It can help the user to carry out his activities of daily living (ADLs) better as well as improve his fitness. It is recommended that individuals incorporate different types of exercises to their workout, as it is important to have a variety for maximum benefit. For example, suspension training allows the user to do aerobic exercises and build muscle, all the while exercising on an unstable surface which forces the user to engage the core muscles with every movement.

Suspension training offers many benefits. However, if the individuals are not willing to take the first step and apply themselves, none of these benefits will be acquired. The significance of motivation and what motivates people to make positive changes in their health is imperative and necessary, not only concerning physical activity, but in people's life in general.

## 2 AIM AND OBJECTIVES

The aim of this thesis is to create a knowledge clip about suspension training as an exercise method. The information for this knowledge clip will be gathered from evidence based literature.

The objective is to create a concise and accessible knowledge clip for people regardless of their level of knowledge in this topic, help introduce a new way for patients and professionals to take care of themselves and improve fitness and function ability.

## 3 WHAT IS SUSPENSION TRAINING?

Suspension training combines a variety of movements through which the user can improve coordination, power, strength, core stability, endurance and flexibility in a single exercise routine. Suspension training is characterized as cardio and resistance training combined, which is often seen in circuit training. A usual circuit training is divided by stations; in every station the person has to perform a different exercise. The resting period between station is minimum (a few seconds). The idea of suspension training is very simple, exercises are carried out using body weight and two straps. While performing exercises with a suspension training, many exercises can be done, allowing the user to work in his/her flexibility, balance, strength and mobility without risking an injury. By using progressive overload, suspension training allows the improvement of proprioception and strength. (Dolati et al. 2017, 151-158; Gidu et al. 2017, 442-449.)

The idea of suspension training is not new, it has been around for a while; military personnel and rock climbers started using this type of training over a century ago to prepare themselves for the challenges that their lifestyle required. Suspension training is the results of what people have learned from the lived experiences from people before our time. If we think about it, people who practice discipline such as gymnastics, they use their own body weight as the resistance by hanging from loops, bars or ropes. (Dubina 2016.)

Total Resistance Exercise (TRX®), which today is the symbol for suspension training, was born in the 1990's when a Navy SEAL called Randy Hetrick started looking for ideas to stay in optimal physical condition while deployed and executing a mission. The conditions in which he found himself during these missions were not often most optimal to perform the usual exercise routine. The missions took him and his team to far-away places where there was no gym equipment, or to very small places such as submarines or boats where the availability of free space was limited. Training in these types of environments helped them to create the foundation of a new style of functional training. Once Randy finished serving as a Navy SEAL he went to Stanford University Graduate School of Business. While studying he kept training and improving TRX®. The positive assimilation and feedback from military service men and top athletes helped to develop TRX® to what we see today. Due to its popularity, suspension training has become the foundation for exercise programs for many top performing athletes in different disciplines such as football, basketball, martial arts, boxing. (Dubina 2016.)

#### 4 HOW SUSPENSION TRAINING WORKS

Suspension training follows the same philosophies as gymnastics and calisthenics, which is to work with the body weight for the development of functional muscles. Training only with our bodies has its limitations. If we intend to imitate the exercises we do at the gym with specific equipment most likely we will not succeed. Suspension training offers a solution to this dilemma, incorporating and giving the user the ability of working in different planes due to its versatility, easy adjustability and resistance level. Suspension exercises are not a new thing, but the concept is. A difference from other suspension equipment such as gymnastic rings, bars or single ropes, the “new” suspension equipment, such as TRX®, only need one anchor point which splits in two handles in which hands or feet are placed. (Cryne, 2018.)

The single point of attachment (Figure 1), makes the suspension training equipment easy to install and adjust. For installation one only needs a steady strong object such

a door frame, tree branch etc. also, the single point of attachment allows easy adjustability. Having a single point of attachment allows the user to perform exercises with a ROM and with more control over the movements. (Bettendorf 2010, 15.)



Figure 1. Single point of attachment. (Monje Morales 2018.)

Suspension Training allows the user to load or unload the difficulty of the movement to reach the desired goals. Suspension training stands out from other more traditional training methods because the hands or feet are usually supported by a single point of attachment and the other end of the body is in contact with the floor or ground. A suspension training device is very easy to carry and not only can be used to improve fitness but also to improve functionality. Suspension training is very versatile since it allows the user to work in a multi-planar way and it is because of its versatility that it is being used for injury prevention, patients with disabilities and fitness. (Bettendorf 2010, 15.)

All in all, suspension training exercises can be easy or very complex and dynamic. Even a person without experience can get familiar with the equipment and create an exercise routine according to his/her level and make progress easily. The exercises can be arranged so that resistance and/or stability can be adjusted easily and when it comes down to rehabilitation this is very important because those small increases are essential for the positive outcome of the therapy. (Royle 2011.)

Every type of training has risks that must be taken into consideration while performing suspension training. People who are not used to work with the body movement performed with this equipment can be in trouble, also people who do not possess the core strength and/or joint stability are not going to be able to perform the exercises in a correct and/or safe manner. As mentioned before, there are risks in every type of training, that being said studies showed that the safest way of training is body weight related. (Royle, 2011.)

The level of intensity can be adjusted according to the preferences of the user; Table 1 explains these three principles (stability [Figure 2], vector resistance [Figure 3] and pendulum [Figure 4]) in which the intensity of suspension training is based on. (Bettendorf 2010.)

Table 1. Principles of intensity of suspension training (Bettendorf 2010.)

Principle	Definition
Stability	“The size and position of the base of support (BOS) relative to the center of gravity (COG) determines the stability of the exercise.” (Bettendorf 2010, 5).
Vector Resistance	“The angle of the body relative to the ground determines the resistance/load of the exercise.” (Bettendorf 2010, 6).
Pendulum	“The horizontal position of the COG relative to the anchor point determines the resistance/load of the exercise.” (Bettendorf 2010, 6).





Figure 2. Stability Principle (Monje Morales 2018.)

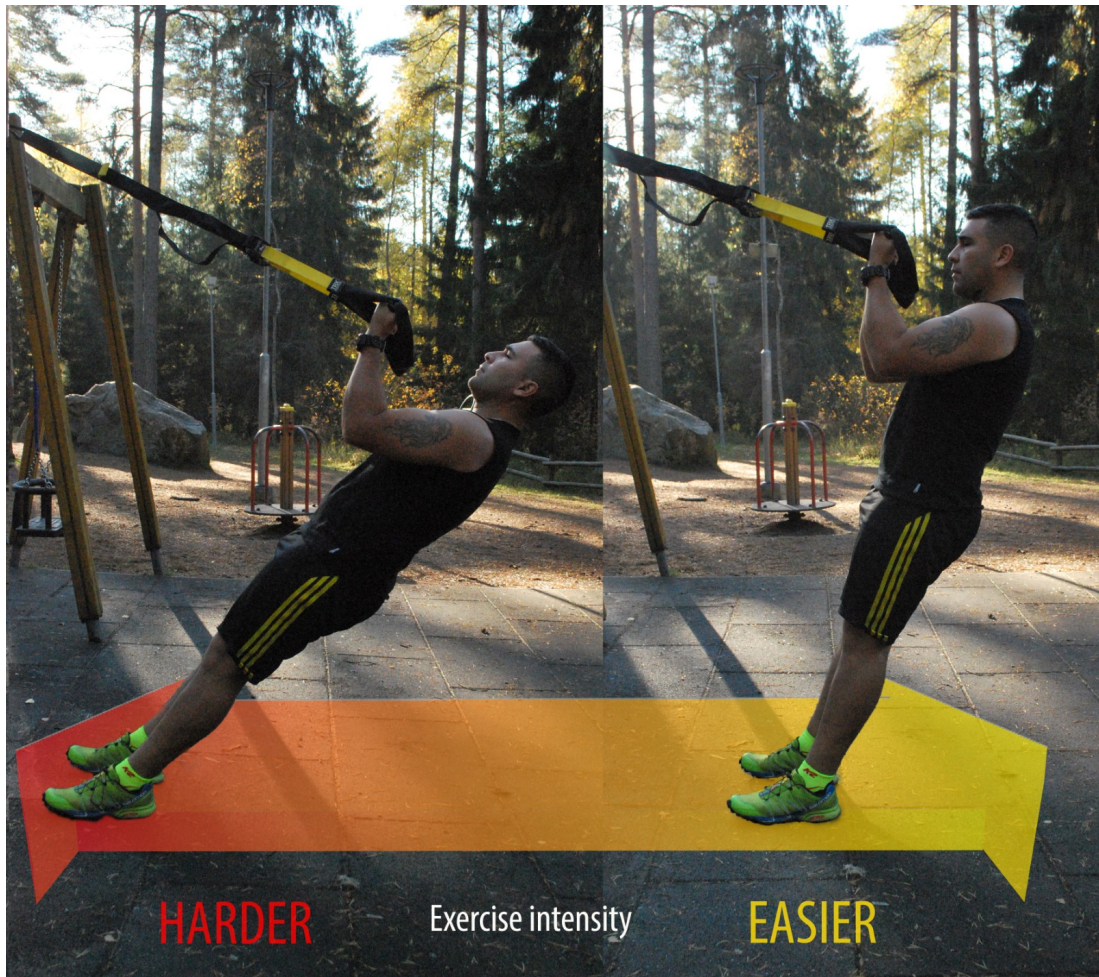


Figure 3. Vector Resistance Principle (Monje Morales 2018.)

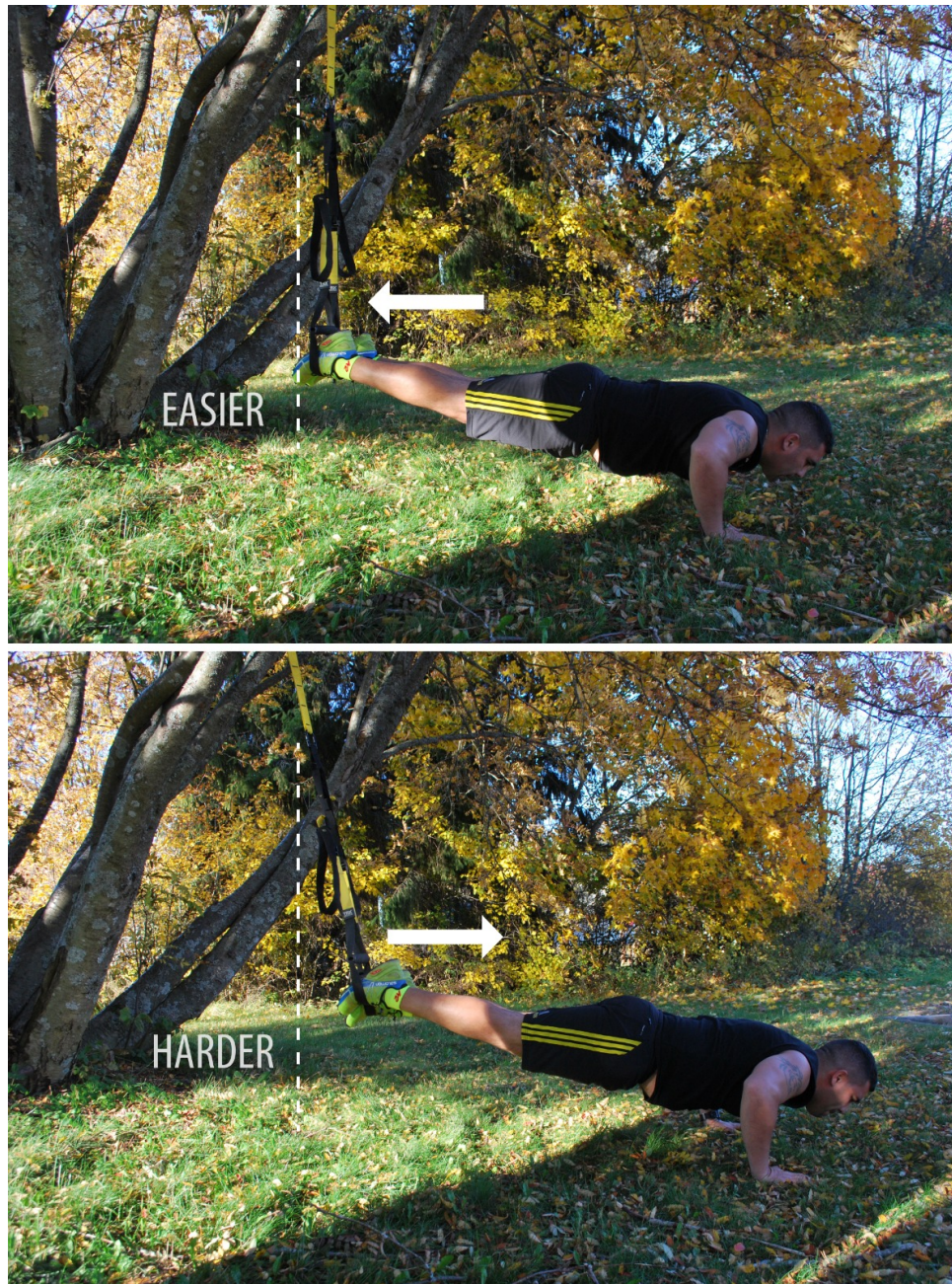


Figure 4. Pendulum Principle (Monje Morales 2018.)

#### 4.1 Changeability of suspension training

Many people do not like to exercise in gyms. These are some of the shared reasons in forums covering this topic: costs and fees, too many people, time consuming, being intimidated, too loud, too crowded. One of the big reasons is that people feel like they are judged, either for their appearance, strength or simply because they do not know how to use a machine. Another reason is lack of time, a lot of people are always on the go, traveling, business meetings etc. (Website of IDEA, 2018.)

Suspension training is not subjected only for the improving of fitness levels. In the report TRX® Suspension Training® Bodyweight Exercise: Scientific Foundation and Practical Application it is stated: TRX® can be used to: “unload for stretching and mobility exercises, unload to perform partial weight-bearing exercises and provide external support for postural control to assist in learning a movement or minimized the fear of falling.” (Bettendorf, 2010, 5.)

#### 4.2 Unload for stretching and mobility exercises

Stretching and mobility exercises are an important part of physiotherapy, either to prevent or treat musculoskeletal pain. The goal of stretching is to bring back the normal range of motion (ROM) of the joints and also increase the flexibility of the soft tissue around the joints. If a person has a higher level of flexibility in his/her joints, the joints can travel through more space, which results in better performance. Tight soft tissue can also produce a misalignment of structures in the body and as consequence can affect posture. Stretching can help as well prevent soft tissue injuries due to the fact that it diminishes the tension in the muscles, therefore the chances of overextending the tissue decreases. (Tortora & Dirrickson 2014, 333.)

Magnusson et al. (1996) reached the conclusion that the improvement in functionality after stretching is due to the elongation of the muscle tendon unit, reduction of pick force, decrease in rate of force production and tensile resulting in less tight tissue (Magnusson et al. 1996, 622 – 628.)

Furthermore, Lee et al. (2014) performed a study to see the effects of self stretching on pain and musculoskeletal symptom of bus drivers. They reached the conclusion that performing stretching exercises had a positive outcome due to that the exercises helped to reduce symptoms and pain (Lee et al. 2014, 1911–1914.)

Bolarinde et al. (2017), performed a single-blind control trial to see the effects of stretching exercises on pain and functional disability in quarry workers with work-related low back pain. They compared the evaluation results between weeks 0 - 4, 4 -

8 and 0 -8. The results showed that the stretching exercises affected pain reduction and functional disability positively. (Bolarinde et al. 2017, 3–11.)

#### 4.3 Unload to perform partial weight-bearing exercises

Pierson et al. (2002) defines partial weight-bearing exercises as the slight quantity of weight that the affected limb can take. The amount of weight allowed to be supported by the affected limb can be boosted progressively up to half of the person's body weight, thus the person would be able to stand on both feet supporting his/her both weight, however walking is not permitted. (Pierson et al. 2002, 208.)

Kamel et al. (2003) said in their study that partial weight bearing exercises are prescribed for patients who suffered from pelvic fracture, to assure bone healing and/or surgical constructs and to contribute with the stimulation of bone growth. (Kamel et al., 2003, 1042–1045.)

Zaky et al. (2013) performed a study with 30 male patients suffering of hemophilic knee arthritis. Patients were divided into two groups of 15. One group received an exercise program consisting of isometric quadriceps contractions. The other group received the same type of exercises plus partial weight-bearing exercises. After reviewing the results, they concluded that there was a remarkable improvement in the group who did quadriceps strength (exercises) by incorporating partial weight-bearing exercises. This shows the importance of partial weight-bearing exercises in the improvement of muscle strength. (Zaky et al. 2013, 413-418.)

#### 4.4 Provide external support for postural control to assist in learning a movement or minimized the fear of falling

Kisner et al. (2012) states that the terms postural control, postural stability and equilibrium are exchangeable terms when in relation to static or dynamic balance. (Kisner et al. 2012, 2). Pollock et al. (2000) defines postural control as the process of keeping, accomplishing or bringing back any posture or action (Pollock et al. 2000, 402-406.)

It is necessary to define balance. In some literature balance = postural control = postural stability = equilibrium. Balance is understood as the capability of a person to keep his/her line of gravity within his/her base of support (BOS). Similarly, balance can be described as an individual's ability to control his/her equilibrium. Equilibrium can be understood as any situation in which the total number of acting forces cancel out one another creating a stable system which is in balance. (Website of Physiopedia, 2018.)

It is very common that as people age, their fear of falling increases and can produce stress in their lives. Fear of falling can become worrisome, because the thought of the consequences after the fall is always in the persons' minds even if they have never fallen before. If people are afraid of falling even before this has actually never happened, things can get complicated. People may become more careful, which can result in a complete lack of participation in activities. This might mean a sedentary life, loss of skills and deterioration in motor functioning. (Scottish Government 2018.)

Painter et al (2012) found remarkable connection between fear of falling, activity levels, depression and anxiety. There was a negative correlation between activity levels, fear of falling, anxiety, depression and activity restrictions. Anxiety can lead to fear of falling and reduction in the activity levels. Also, anxiety and depression can lead to activity restriction due to the fear of falling and other reasons. (Painter et al. 2012, 169-76.)

Many agree that core muscles play an important role in fall prevention, Crews L. spokesperson for the American Council on Exercises stated "Balance not only requires equilibrium, but also good stability of the core muscles and the joints, particularly the hip, knee and ankle" (Sorgen 2003.)

## 5 HEALTH, PHYSICAL ACTIVITY AND FITNESS

The Constitution of the World Health Organization, the WHO, was accepted on April 7, 1948. It described health as the condition of full social, physical and mental wellbeing. People in charge of writing the Constitution recognized the thinking of viewing health as a condition built upon the nonappearance or existence of any illnesses. Therefore, they decided to add to the earlier definition that for a person to be considered a healthy individual he/she should not be affected by any illnesses. (Sartorius 2006, 662-664.)

Nowadays, health is defined mainly in three different ways. These definitions can be used according to the context in which they are included in. The first definition is that health is the nonappearance of any impairment or disease. The second definition is that health is the condition that grants the person to handle all the requirements of daily living appropriately (it also has to be in absence of impairment and disease). The third definition says that health is a state of harmony and stability that a person has created within him/herself and between him/herself and the physical and social surroundings. (Sartorius 2006, 662-664.)

If health is described as the absence of illnesses, doctors are the only ones who can call a person healthy. Today's medicine is very advanced and a person who is healthy today can be found to be ill tomorrow, because more sophisticated methods of examination could find other signs and symptoms of a disease that were not found before. How a person feels about his/her condition is not important in this model of health. How other individuals perceive his/her behavior and capability to negotiate his/her ADLs is only important if the observations carried out by other individuals match with the criteria of abnormalities that doctors have found. (Sartorius 2006, 662-664.)

Counting the number of healthy people within a population would be simple; people who present signs and symptoms after examination will be counted and compared with the ones who do not present any symptoms. There are people who can present signs and symptoms of a disease but do not feel sick and others whose bodies do not present any signs and symptoms but feel sick. The problem with the third definition

is that a person with an illness or impairment will be considered healthy as long as that person has found a way to create a balance that permits him/her to get the most of his/her life even in the presence of illness. Societies that have health improvement of their citizens as a goal are now facing tremendous challenges. Those challenges will not be answered unless the paradigms of illness and health are looked at. It is also necessary to design ideas for work utilizing these new paradigms in the future. The acceptance and formulation of these paradigms is everyone's responsibility, and very important. (Sartorius 2006, 662-664.)

Health is always changing; therefore, it is dynamic process. Through someone's lifespan, health can have ups and downs. An individual can have days of good health, sickness or even days of serious illness. Any changes in lifestyle will affect health. People who are involved in regular physical activity often do it to improve their future health. When bad habits are given up and people make better lifestyle choices, health also improves and fewer periods of sickness and disease are experienced. Most people understand that being healthy means to have good levels of flexibility, cardiorespiratory capability, good muscle tone and good body composition. These factors are important when defining health, but there are also other factors to take into account to describe what being healthy means. Physical health is only one facet of someone's total health. Table 2 shows other components of health that need to be considered. (Human Kinetics 2018.)

Table 2. Other components of health. (Human Kinetics 2018.)

Component	Definition
Social Health	Capability of an individual to engage with his/her environment and people from it and to accomplish fulfilling personal relationships.
Mental Health	Capability of an individual of learning and growing intellectually. Knowledge acquired through lived experiences and formal institutions such as schools, help to increase mental health.
Emotional health	Capability of keeping emotions under control so the individual feels confident communicating these emotions and demonstrating them in an appropriate manner.
Spiritual Health	Belief in a consolidating force, higher power. It changes from individual to individual but in all cases is based on the concept of faith.

If people assume responsibility for their own wellbeing and health, they will be able to increase life quality, personal development and abilities through positive habits and attitudes on daily basis. Other factors affect wellness, including healthy relationships, nutrition, professional success, physical activity and mechanisms to deal with stress. People make daily efforts for maintaining good health and wellness to enjoy long and healthy lives. Personal development and life quality are founded on living in balance. To accomplish balance, the individual needs to take care of his/her body, mind and spirit. (Human Kinetics 2018.)

Physical activity (PA) has sometimes been used as a synonym with exercise. This is an understandable confusion, but those terms have completely different meanings. To explain it in a simple way, exercise is a kind of PA. PA is defined as any bodily movement produced by the contraction of skeletal muscles that results in a substantial increase in caloric requirements over resting energy expenditure. PA carried out in ADLs can be grouped into sports, household, occupational, conditioning or other activities. Exercise, however, is defined as a planned, structured, repetitive and intentional movement intended to improve or maintain physical fitness. Exercise is a subcategory of physical activity. The term physical fitness is something that is used rather carelessly with no clear understanding of what it really means. Physical fitness has been given many definitions, but the preferred one goes as follows: physical fitness is the capability of a person to perform ADLs with agility and dynamism, without excessive fatigue. In doing so he/she will have enough energy to appreciate leisure activities and to be able to deal with sudden emergencies. Physical fitness can be broken down into two components: health and skill related. Those components are explained in detail in Table 3 and 4. Everybody performs PA in order to stay alive. The amount of PA performed depends of the preferences of every person and changes from individual to individual, as well as the type and the amount of PA that a person executes during a timeframe. (American College of Sports Medicine [ACSM] 2018, 49-50; Gummelt 2015; Caspersen et al. 1985, 126-131.)



Table 3 Health-related physical fitness components (American College of Sports Medicine [ACSM] 2018, 50).

Component	Definition
Cardiorespiratory endurance	Capacity of the heart and lungs to provide oxygen to the working muscles for an extended period of time. (American College of Sports Medicine [ACSM], 2018, 50).
Muscular strength	Capacity of the muscles to produce force. (American College of Sports Medicine [ACSM], 2018, 50).
Muscular endurance	Capacity of the muscle to keep performing without suffering fatigue. (American College of Sports Medicine [ACSM], 2018, 50).
Flexibility	Capacity of a joint and attached muscles to move through an explicit range of motion in an easy and painless manner. (American College of Sports Medicine [ACSM], 2018, 50).
Body composition	Way to explain what a person's body consists of (minerals, body water, fat, protein). Even more precise than Body Mass Index (BMI). (American College of Sports Medicine [ACSM], 2018, 50).

Table 4. Skill-related physical fitness components (American College of Sports Medicine [ACSM] 2018, 50).

Component	Definition
Coordination	The right muscles working at the right time with correct intensity. Coordination is the basis of smooth and efficient movement, which often occurs automatically (Kisner & Colby, 2012, 984)
Power	Someone's level or capacity to perform physical work. (American College of Sports Medicine [ACSM], 2018, 50).
Balance	The ability of maintain stability during motion or stillness. (American College of Sports Medicine [ACSM], 2018, 50).
Reaction time	Someone's delay between the stimulus

	occurring and the response to it. (American College of Sports Medicine [ACSM], 2018, 50).
Agility	Someone's capacity to switch from one position of the body to another in a fast and precise manner. (American College of Sports Medicine [ACSM], 2018, 50).
Speed	Someone's capacity to complete a movement in a short interval. (American College of Sports Medicine [ACSM], 2018, 50).

According to the (WHO) adults from 18 to 64 years of age need to do a minimum of 150 minutes of moderate-intensity aerobic physical activity and a minimum of 75 minutes of vigorous-intensity activity weekly. Aerobic physical activity needs to be done in periods of at least 10 minutes. Muscle-strengthening exercises must be carried out including major muscles groups on two or more days a week. (Website of World Health Organization, 2018.)

WHO claims that people who perform sufficient physical activity will have a chance to have lower rates of mortality caused by type 2 diabetes, stroke, metabolic syndrome, breast and colon cancer, depression, high blood pressure and coronary heart disease; be less susceptible to suffer a vertebral or hip fracture; will have a better chance to maintain a healthy weight; their muscular and cardiorespiratory level of fitness will be higher; their body mass index will be better. (World Health Organization website, 2018.)

Smith et al. (2016) carried out a project to see the "Acute and Chronic Health Benefits of TRX® in Healthy Adults". Sixteen women and men were subjected to an eight-week suspension training program to see if their "muscular, neuro motor, cardiorespiratory, and flexibility fitness" would show any improvement. Both groups participated in a 60-minute suspension training exercise routine three times a week for the duration of eight weeks. Metabolic and cardiovascular information was gathered with the help of a portable caloric consumption electronic device. Before and after the study, the fitness level of every individual was measured. Posterior the eight weeks of training a significant improvement in muscular fitness and cardio metabolic risk factors parameters was observed: systolic and diastolic blood pressure,

circumference of the waist, level of adipose tissue, one-repetition max for leg and bench press, push ups and curl ups. Upon the revision of these results it was concluded that suspension training is a viable alternative for traditional exercises that produces positive metabolic responses when executed in a range of moderate intensity. Also, suspension training improves muscle performance and reduces the risk factors of cardiovascular diseases such big waist circumference, high levels of body fat and high blood pressure. (Smith et al. 2016, 1-15.)

### 5.1 Aerobic exercise

Aerobic exercising is widely known as “cardio”. This type of exercise needs the delivery of oxygenated blood from the heart to be sent to working muscles. Aerobic exercises trigger an increase in heart and breathing rate so they can be maintained during the exercise. On the other hand, anaerobic (without oxygen) exercising is the type of exercise that gets the person out of breath very quickly e.g. lifting heavy weights. If the person is performing an aerobic exercise at a level that it is too high, it can become anaerobic. Aerobics exercise is not only good to enhance fitness, but it also supports the improvement of physical and mental health. Aerobic exercising can help in the prevention of diseases such as diabetes, osteoporosis, cancer and cardiovascular diseases. (Weil, 2017.)

Dimeo et al. (1998) carried out a study in which aerobic exercise as therapy for cancer fatigue was prescribed. There were five participants, four females and one male who were subjected to the training program. The fatigue in these patients had been affecting them from about five weeks and eighteen months and had been stopping them from performing ADLs. The training program consisted of daily treadmill walking “with an intensity corresponding to a lactate concentration of 3 +/- 0.5 mmol.L-1” and it was performed for six weeks. They concluded that “an aerobic exercise program of a precisely defined intensity, duration and frequency can be prescribed as therapy for primary fatigue in cancer patients.” (Dimeo et al. 1998, 475-8.)

Aerobic exercises have many benefits. When the heart gets stronger, it can pump more blood with every beat; this is known as the stroke volume. A well-conditioned heart has a bigger diameter and mass (the heart is a muscle as well, and as every other muscle in the body, it gets bigger when well trained), which means that the heart can pump in a more efficient manner to permit a higher filling time. This has a positive outcome, because when more blood is filled into the heart's chamber, more blood can be delivered with every pump. Also, when the heart has a higher stroke volume it indicates that the heart does not have to pump as fast to meet the requirements of the exercise. Next are the muscles, which become more competent in oxygen consumption when aerobic exercise is performed regularly. (Weil, 2017.)

Dunn et al. (2005) carried out a study controlled between 1998 and 2001 which was analyzed in 2003. The idea of the study was to test if exercise is an effective way to treat "mild to moderate major depressive disorder and the dose-response relation of exercise and reduction in depressive symptoms." Eighty participants between the ages 20 to 45 with a diagnosis of mild to moderate depressive disorder were selected for the study. The exercises were performed under supervision and in a controlled environment. "Participants were randomized to one of four aerobic exercise treatment groups that varied total energy expenditure (7.0 kcal/kg/week or 17.5 kcal/kg/week) and frequency (3 days/week or 5 days/week) or to exercise placebo control (3 days/week flexibility exercise). The 17.5-kcal/kg/week dose is consistent with public health recommendations for physical activity and was termed "public health dose" (PHD). The 7.0-kcal/kg/week dose was termed "low dose" (LD)." After reviewing the results, they concluded that a consistent recommended dose of exercises according to what public health officials recommend "is an effective treatment for major depressive disorder of mild to moderate severity." (Dunn et al. 2005, 1-8.)

Dolati et al. (2017) conducted a study to see the effects of suspension training on overweight women; body composition and lipid profile of the participants were analyzed before and after the study and results were compared to see whether there were improvements. Participants were 24 women between 29 and 49 y/o, all overweight. They were in two groups, a control group and an experimental group (12 and 12 respectively). The length of training was eight weeks and the exercise routine

was performed three times per week. During the first week training was done for 12 minutes and it was increased periodically up to 30 minutes during the last week. The intensity went from 50 bpm to 80 bpm. After reviewing the results, they came to the conclusion that body composition and performance indicators are affected positively by the use of TRX®. (Dolati et al. 2017, 151-158.)

## 5.2 Muscle strength

Muscles become stronger when trained close to their present maximal force-producing capability. Common equipment found in households and health clubs such as dumbbells, pulleys or resistant bands help to create an effective muscle overload. Strength improvement is controlled by the intensity of the overload and not by the type of equipment in use. Isokinetic, isometric and progressive-resistant training are the best known system to train muscles and develop strength. The best known type of resistance training is to lift and lower an external weight which stays constant during the entire movement. Isometric training is performed when the muscle tries to shorten but cannot handle the resistance delivered by the external weight. Concentric training is performed when the muscle shortens, the joint is mobilized as tension is produced. Eccentric training is performed when the muscle lengthens while in tension. (McArdle et al. 2015, 509 – 511.). Building muscle helps to lose weight and control it. When talking about metabolism, muscle is the main instrument. As people perform strength training, their muscle mass is going to increase, therefore metabolism becomes more efficient and burns more calories which allows the person to lose weight easier. For every 0,453592 kg of muscle that is gained, 50 calories are burned. It is known that as a person ages his/her muscle mass decreases and so does strength, by the age of 50, ten percent of muscle has been lost and by the age of 60 and 70, muscle strength has gone down approximately 15 percent every ten years. Therefore, it is important for older adults to keep training to maintain their muscle tone and strength to help them to have a more active lifestyle and quality of living. (Stellner, A. 2017.)

The more muscle surrounds the joint the more protected it will be. With age, balance can become an issue and falls can produce fractures and other injuries related to falls

such as contusions, concussions etc. If the muscles are strong, the joint will be better supported and the person can have a more independent life as he/she ages. Also, more muscle mass means more strength. The stronger the person is the more stamina he/she will have at the time of performing physical activity. Strong muscles help preventing the side effects of weak muscles which can produce structural pain and instability. With a good muscle tone, person's appearance improves which leads to higher self-esteem and makes him/her feel better. Also, more muscle mass means more strength. The stronger the person is the most stamina they will have when doing physical activity. (Stellner 2017.)

Arazi et al. carried out a study to compare the effects of suspension training and traditional resistance training on physical fitness factors and extremities perimeter. According to the results, as an alternative for traditional resistance training, suspension training could benefit underweight non-athlete girls and it also offers feasible advantages compared to traditional resistance training. (Arazi et al. 2018, 73-80.)

People prefer to do some type of exercises for different reasons. They may be good at it, they feel comfortable, it is easy, challenging; you name it. Some may stick to one type of exercise whether it is strength, cardio or flexibility training only. The National Institute of Health states that exercise and physical activity can be divided in four categories: strength, balance, endurance and flexibility. If we compare diet and exercising, the same principle is applied. People cannot just eat one type of food group only, they need a variety of foods and it is the same with exercises, it has to have variety in order to be more beneficial. (Fitness Anywhere, LLC 2018).

### 5.3 Importance of core muscle engagement

Core exercises should be included in every fitness program. Core exercises make the muscles in the trunk, pelvis, lower back, hips and abdomen to work in synchronized manner. This gives the person a better balance and more stability. Most sports require stable core muscles. If a person wants to start to perform any physical activity, it would make it easier if he/she has strong core muscles. Athletes are

required to have strong core, otherwise performance level goes down, fatigue sets in faster and risk of injury is higher. (Mayo Clinic Staff, 2017).

Chang et al. (2015) conducted a study to see the relationship between core strength training and lower back pain. Four types of training were evaluated and compared: motor control exercises, stabilization, segmental stabilization and trunk balance. After reviewing the results, it was concluded that typical resistance training is less effective in relieving chronic low back pain than core strength training. All these exercises help to alleviate low back pain and it is recommended to place emphasis on deep trunk muscles training to alleviate chronic low back pain. Many people are more concerned about their abdominal muscles looking good and they forget about the rest of the core muscles. The center of gravity of the body resides in the core and movements that the body performs start in it. (Chang et al. 2015, 619-622.)

Sharrock et al. (2011) evaluated the relationship between core stability and athletic performance. There were 35 participants, all of them student athletes. The following tests were performed in the study: “double leg lowering (core stability test), the forty-yard dash, the T-test, vertical jump, and a medicine ball throw.” Participants could perform three attempts of each test in a random manner. After reviewing the results of this study, it was stated that there was a correlation between core stability test and athletic performance test, but more research is needed to assure that there is direct relationship. (Sharrock et al. 2011, 63-74.)

McGill et al. (2014), study the difference in muscle activation between conventional pushing exercises and pushing exercises performed with the TRX® suspension training. It was concluded that in every exercise performed with the TRX® suspension training the level of activation within the core muscles was superior to the levels recorded during conventional pushing exercises. Cugliari et al. (2017) evaluated the level of activation of core muscles during suspension training exercises. After conducting this study, it was concluded that suspension training could be an effective way to achieve a high to very high level of activation in abdominal muscles such as external oblique and rectus abdominis. (McGill et al. 2014, 105-116; Cugliari et al. 2017, 61-71.)

Kang (2015) studied the “Effects of core muscle stability training on the weight distribution and stability of the elderly”. Thirteen participants were selected to carry out this study and were divided in two groups, experimental and control group. The experimental group executed core strengthening exercises while the control group executed regular strengthening exercises. The length of both training programs was eight weeks. After reviewing and comparing results it was seen that the experimental group improved significantly in terms of weight distribution index (WDI) and the stability index (SI). Nevertheless, the control group presented no improvements significantly in either. It was concluded that the elderly benefit from core training exercises due to their improved WDI and SI. Those exercises can be the tool of choice for fall prevention programs. (Kang 2015, 3163-3165.)

Mok et al. (2015) analyzed the core muscle activity during suspension training. Suspension training has been labeled as an excellent way to improve core stability in healthy people and those with musculoskeletal disorders. The methods of this study were the following “Surface electromyographic (sEMG) activity of core muscles (rectus abdominis, external oblique, internal oblique/transversus abdominis, and superficial lumbar multifidus) during four suspension workouts (hip abduction in plank, hamstring curl, chest press, and 45° row) was investigated. Muscle activity during a 5-s hold period of the workouts was measured by sEMG and normalized to the individual's maximal voluntary isometric contraction (MVIC)”. The level of activation differed during chest press, hip abduction in plank and hamstrings curl. 45-degree row delivered the lowest level of muscle activation. After reviewing the results, it was determined that the highest level of activation in the core muscles was produced by the hip abduction in plank with coaching. In general, suspension training produces high levels of core muscle activation when compared with other studies carried out to see the level of muscle core activation during the performance of exercises on stable and unstable studies. (Mok et al. 2015, 189-914.)

#### 5.4 Exercising on steady vs. unsteady surfaces

There is a lot of controversy within the training world between what is more effective: training on a steady surface or on an unsteady one. If a person intends to



lift a weight standing on an unstable surface it would affect the amount of strength used and therefore would not be beneficial. The question is if there is a difference if one end of the body is on a stable surface and the other end is not (feet vs. hands and vice versa). Due to its similarity with gymnastic rings, researchers thought that the results would be similar when comparing an exercise performed with suspension training vs. performing the exercise in a more traditional way (on a stable surface). Most believe that performing an exercise with suspension training would produce more activation within the muscles than performing the same exercise on a stable surface. (Dupont 2014.)

McGill et al. (2014) carried out a study to analyze pushing exercises on a stable surface vs. suspension training. In this study the researchers were not only focusing on muscle activation level, but also how each method affected the load on the spine and how coaching improved the performance of the exercises. Close attention was paid to the activation of the serratus anterior muscles whose primary function is shoulder protraction. The exercises performed on a stable surface were bench press, shoulder protraction and push-ups. On the other hand, the exercises performed on the unstable surface were TRX® push up, TRX® scapular push and TRX® push. While performing the exercises on a stable surface, a major level of activation was observed in the serratus anterior muscle. The normal push up and shoulder protraction (which is also known as scapular push up) caused a higher activation in the serratus anterior muscle as well in comparison to the TRX® version of the exercise. TRX® exercises had a higher level of activation in core muscles in general. The bench press exercises were performed with with 50% of 1RM (Repetition Max). The bench press exercise showed a higher activation of all the muscle groups over the stable and unstable exercises (only internal oblique and quads were considered). Spinal load did not show any significance changes in any of the exercises. When it came down to coaching, it was observed that coaching helped keep the spine in a safe position during TRX® exercises, but no difference was found during the stable exercises performance. After these results, it was concluded that TRX® was more effective in activating core muscles than any of the other exercises, but had no remarkable difference to regular push-ups in other muscle groups. Also, a push up performed on a stable surface required less coaching to make it effective. Neither TRX® or a stable push up had a major impact on the spine. (McGill et al. 2014, 105-116.)

Harris et al. (2017) performed a cross-sectional study to see if suspension training boosts the muscle activation to a higher level in comparison to exercises performed on a stable surface. The participants were twenty-five healthy adults, 16 males and 9 females. All participants had a wireless electromyography (EMG) electrodes placed on bilaterally: “pectoralis major (PM), middle deltoid (MD), serratus anterior (SA), obliques (OB), rectus abdominis (RA), gluteus maximus (GM), erector spinae (ES), and middle trapezius/rhomboids (MT). Each participant performed reference isometric exercises (Sorensen test, push-up, sit-up, and inverted row) to establish a baseline muscle contraction. Muscle activation was assessed during the following exercises: ST bridge, ST push-up, ST inverted row, ST plank, floor bridge, floor push-up, floor row, and floor plank.” The results of this study showed that there is a “statistically significant greater muscle activation in at least one muscle group during suspension training condition”. It was found out that suspension training increases muscle activation in some muscles in comparison to exercises performed on a stable surface. (Harris et al. 2017, 42-52.)

## 6 SUSPENSION TRAINING AND REHABILITATION

People take the capacity to move without pain as a given. While moving, a person does not realize the small adjustment that our mind and body have to do to keep the movement functional. When the ability of moving without pain is lost, the person accepts how complex and precise the human body is. Patterns in movement are affected by behavioral changes that our body needs to execute to deal with the painful dysfunction. The nervous system creates stiffness and/or tightness to provide continuous movement. The problem is that stiffness and/or tightness affects the biomechanical communication that mobility and stability factors possess. Human movement is an acquired behavior and it must be thought of as such (as an arrangement of behaviors) when treated for disturbances. To improve these arrangements, the therapist must use rehabilitation techniques adopting body-weight exercises directed to the improvement of joint mobility in a more demanding force vectors. Most musculoskeletal pain syndromes are the result of dysfunctional

movements performed for a period of time. To fix this, therapists need to re-educate the person in how to move in a correct and more efficient manner. Suspension training is an excellent tool to re-educate the person's movements because it allows working in different planes, angles and forces in a more dynamic way. (Nickelston 2018.)

## 6.1 Functional Training

Every person should train according to what he/she wants to achieve. Not all exercise routines benefit everyone the same way. Carrying out an aimless group of exercises at the gym has some benefits but it will not help the person to achieve his/her goals and needs. Gym machines have a narrow functional approach and the movements performed using them are hard to transfer to real life situations. Machines are helpful when used properly and in an integrated manner. However, when misused, they can create a dysfunctional movement behavior. Functional training is described as the exercises or movements that help toward the improvement of an individual's capability to reach a specific goal or complete his/her ADLs. All exercises possess a certain degree of functionality when carried out correctly. This degree is measured by seeing how the exercise can be used outside the gym. (DeFrancesco 2012.)

When looking from a functional point of view, the most common problem with gym routines are the following: people work muscle groups instead of movement behaviors e.g. quads, biceps, triceps instead of pushing, stepping, jumping, squatting. Also, commonly these exercises are performed in the sagittal plane which only requires forward and backward action. The reality is that human movement patterns do not focus on one muscle group only and movements are performed in all planes of motion, not just one. Functional training also calls for unilateral movement (performing the exercise with one limb at the time e.g. Bulgarian split squat). The positive point of unilateral training is that it not only helps to improve muscle imbalance but also incorporate instability which can be transferred to the balance needed when performing activities in the real world. (Roberts 2017.)

Gaedtke et al. (2015) explain that functional training has become very important within the elderly population because of its close relation to ADLs. At the beginning, sling training was meant to be used for therapy and rehabilitation. It helps to improve balance, strength and its high engagement of core muscle makes it a good tool to be used with the elderly. A study was carried out with the intention of creating a TRX Suspension Training exercise program for healthy adults and evaluate the usefulness of this program. Eleven participants finished the twelve-week program. All the participants performed seven exercises divided in stages. The intensity of every exercise could be changed by adjusting the body position. Training program acceptance was evaluated through a self-developed questionnaire. Training acceptance was between 85 and 91%. Most of the participants felt motivated to keep going with the program. All participants claimed positive outcomes after the study being stated that the most common was strength gain. The program can be adapted for the person's condition, preferences, and goals. (Gaedtke 2015, 224-233.)

Pacheco et al. (2013) performed a study to compare functional vs. strength training in adults. The purpose of the study was to compare traditional training to functional training for healthy independent middle-aged adults and elderly subjects. The results showed that no differences were noticed between the two training methods, but when the explicit groups were analyzed, the results showed that functional training was less compelling for women when compared to the men in the same group and compared to the women from the strength training group. It was apparent that no differences were observed in the improvement of functional capacity in either group, but it is necessary to take into account the individual's condition before the intervention because it was believed that women should have improved their basic abilities before participating in this study. (Pacheco et al. 2013, 34-43.)

## 6.2 Injury prevention

Injury is a dominant cause of disability and death for people under the age of 60. Relative to other common causes of the death around the world, road traffic injuries themselves are the 2<sup>nd</sup> or 3<sup>rd</sup> more common causes from ages 5 to 44. It's estimated that by 2020 the level of disability due to injuries will pass those from the heart,

respiratory disease or cerebrovascular problems. Before, injury was largely ignored and was not getting the necessary attention from professionals. Some people use the words accident and injury as synonyms, but in reality, they mean different things. An accident is an unpredictable casual event, and because of its randomness it cannot be avoided. On the other hand, research has shown that injuries can be anticipated, and therefore, avoided. Injury is defined as “the transfer of one of the forms of physical energy (mechanical, chemical, thermal etc.) in amounts or at rates that exceed the threshold of human tolerance. It may also result from lack of essential energy such as oxygen (for example, drowning) or heat (for example, hypothermia).” (Pless et al. 2005, 182-185.)

The American Academy of Pediatrics (2007) issued a document that gives tips to help reduce the risk of injuries while performing sports. It was mentioned that in the U.S., children are practicing sports more than ever before. Sports help children to create healthy habits, stay in shape and feel good about themselves. However, there is some guidance that parents and coaches need to adopt to promote excellent, safe and injury-free sport practices. (American Academy of Pediatrics 2007.)

In the practice of any sport there is a risk of injury. As a general rule, the more contact present in a sport the higher the risk of getting an injury. The majority of injuries occur in tendons, muscles and ligaments. Only 5% of sport related injuries involve bones (fractures). However, the areas where bones grow during childhood (physis) have a higher chance of injury during the fast growing stages of the child. When children complain about a specific painful spot on a bone, it must be evaluated by a physician, even if edema and movement limitation is minimal. The most common injuries during sports practices are sprains (stretching or tearing of a ligament) and strains (tearing or stretching of a muscle, tendon or both) which happen when an abnormal tension is applied on tendons, joints, bones or muscles. Table 5 shows recommended guidance to prevent injuries during sports. (American Academy of Pediatrics 2007; Mayo Clinic Staff 2018.)

Table 5. Recommendations for the avoidance of injuries in sport (American Academy of Pediatrics 2007).

Recommendation	Explanation
Right equipment	Protective equipment is a must when a contact sport is being practiced
Increase of flexibility	Stretching exercises before and after help to improve flexibility
Muscle strengthening	Conditioning exercises during training help to get strong muscles necessary to practice the sport.
Right form/technique	Must be re-enforced during game season.
Breaks	Rest period must be established during training and games. It is very easy to be injured when there is muscle fatigue.
Safety Rules	Must be respected. A wrong tackle and/or illegal hit can cause a serious injury or even death.
Time off	The person must take time off if there is pain or discomfort
Hydration	The person must hydrate properly before, during and after training especially in periods when temperature and humidity levels are high.

Winning can place a lot of pressure on a child and can cause a significant amount of emotional stress. Sadly, many coaches and parents consider that winning is the most important part of practicing sports. Young athletes must be judged for their effort, sport spirit and hard work. They must be recognized for their effort and skill improvement instead of being punished or criticized for losing a game or competition. (American Academy of Pediatrics 2007.)

The coach should establish a sense of trust with the athlete so that the athlete feels confident on approaching the coach without fear to let him/her know that there is pain or discomfort. Some young athletes are tough and do not mind dealing with pain, but they need to understand that pain can lead to a more complicated long-lasting injury if not treated. Table 6 shows and explains other precautions that must be taken to avoid injuries during the practice of sports. (John Hopkins Medicine website 2016.)

Table 6. Recommendations for injury prevention. (John Hopkins Medicine website 2016.)

Recommendation	Explanation
Talk to the Athlete	The coach should establish a sense of trust with the athlete, thus the athlete feels confident on approaching the coach without fear. to let him/her know that there is pain or discomfort. Some young athletes are tough and do not mind dealing with pain, they need to understand that pain can lead to a more complicated long-lasting injury if not treated.
Preseason check-up	A pre-season physical examination is a great way to find out if the athlete is fit to start participating in sports again.
Cross-training	Some young athletes play in more than one team (same sport). When this happens, they are placing the same stress in the same joints and muscles. This is why it is recommended that young athletes try different sport to prevent stress injuries. Parents should also be vigilant and limit the number of teams their children are playing in.
Warm up	Athletes should never skip a warm up. A mix of static and dynamic stretches must be a mandatory part of every training session, prior to and after a game.
Rest	Athletes, no matter what age, must be well rested. Sufficient hours of sleep and rest between practices and games must never be underestimated. Lack of rest and overuse of a joint, muscle e.g. may cause a considerable amount of injuries during sport practices.
Healthy, well balanced diet	A regular diet schedule should be followed. The diet must include fruits, vegetables and lean proteins. Parents and coaches must reinforce healthy eating habits.
Notice an injury and look for help promptly	Many athletes have injuries and do not do anything about it until the damage has got worse. If a dysfunctional movement in the athlete is observed or if he/she is rubbing a leg or arm too often during a game or training, he or she must be pulled aside and asked question and allow him/her to return to the activity. If the problem persists, medical attention must be sought.

Sadek (2016) conducted a study to see if TRX® suspension training is a feasible solution to prevent shoulder pain in young swimmers. Ten swimmers participated in this study. The participant performed a TRX® suspension training exercise routine three times a week for eight weeks. The subjects did not present any previous shoulder injury. Static strength test, passive chest flexibility, active chest flexibility,

shoulder mobility and seated medicine ball throw were measured pre-post study. Significant improvement was observed when the results of the previous and post study evaluation were compared. It was concluded that swimmer's shoulder is a condition that can be prevented with the help of TRX® suspension training and a meticulous screening to identify training mistakes, impairments to any pathology that needs further evaluation from a higher level of care. (Sadek 2016, 222-227.)

## 7 MOTIVATION

Motivation is defined as the incentive or incentives that make someone to act or behave in a certain way. Motivation is also understood as the real strength that pushes a person or a group of people to make extraordinary efforts to accomplish an objective. That strength is used by leaders to obtain special results or to create a favorable environment to pursue big efforts. The importance of motivation settles in the mind. The thinking process plus the desire or will to think positively will determine how the person perceives and reacts to everything around him/her. There are two types of motivation, internal and external. Motivation caused by incentive or fear are very effective, but they have a common weakness, they are not permanent and they are commanded by external agents (teacher, boss, parents). That is why this motivation does not come from within the person, it is not authentic because it answers to the particular interest(s) of the external agent. On the other hand, internal motivation is the one that people should be more interested in because it is much superior to external motivation; it is harder to acquire, but it can be developed, stimulated and maintained to the point it becomes part of the person's behavior. (Oxford University Press 2018; LinkedIn Corporation 2012.)

Pillay (2016) explains that it is complicated to preserve the lifestyle changes people want to do. No matter what the goal is, just being aware of what the benefits are of the lifestyle changes, is not enough to help people maintain them. Due to the huge amount of available information about of the benefits of exercising or the amount of calories in a glass of wine or the dangerous consequences of stress (only a few people are ignorant in these areas), but even though known, lifestyle changes are



hard to keep because bad habits are hard to get rid of. It is easier and cozier to sleep in another hour during a cold winter morning instead of going to the gym before going to work. After a long tiring day, it may seem that those extra calories in that cold, relaxing beer are meaningless. So how can people motivate themselves better? Pillay states that “There are two kinds of rewards: hedonia and eudaimonia. Hedonia (H-rewards) includes superficial pleasures such as weight loss, looking good, and acceptance by others. These rewards are more concrete and often short-lived. Eudaimonia (E-rewards), on the other hand, refers to a sense of meaning and purpose that contributes to overall well-being. Connecting your lifestyle goals to E-rewards may help motivate you even more.” For people to stay motivated, they need to think how they can boost their sense of meaning and purpose because these can be important movers to achieve the set goals. (Pillay 2016.)

Roizman (2018) explains that good or bad habits have a purpose in someone’s life and that is why it is easy to be emotionally attached to them. Despite everyone having a different reason for getting rid of a bad habit, there are some motivators that are common across the board. According to “Arlene Mathews Uhl, author of "The Complete Idiot's Guide to the Psychology of Happiness,"” for a person to get rid of a bad habit and turn it into one that will improve wellbeing and exercising, will take between 21 to 30 days. A person can help him/herself to choose healthy habits through education. Education can help a person to make good healthy decisions, exercise judgment and confidence. Education takes time, perseverance and discipline. The same factors are necessary to improve the level of exercising, eating habits, or anything that needs to be improved. People perform exercises to maintain a good level of health, to feel strong and in good shape, to feel that they have accomplished something and to get out of the house. Mental alertness is another reason why people exercise. Some issues have been found concerning self evaluation because it’s been observed that some people rate their level of physical activity lower whereas others rate it higher than what it is. A comfortable place is necessary for the person to stay motivated. If a person signs up for a gym, the chances are higher that he/she is going to stick to the healthy habit of exercising because gyms offer that extra motivating factor and friendly atmosphere where having a positive attitude and sense of achievement is obtained while the person thrives toward his/her objective. Also, having someone who can be some source of role model is an important factor

that can help a person to stay focused, motivated and also can help the person to get back on track when lost. (Roizman 2018.)

Zhang et al. (2016) conducted a randomized control trial to see what motivates people to exercise more (support or competition). For this study, they recruited 790 university students 25 y/o in average to participate in a 11-week exercise program. The exercises varied from jogging, spin classes, weightlifting and yoga. The participation of every student was checked through an interactive website especially built for the purpose of this research. The students were divided into four groups to control how different types of social networks and origins of motivation affected their exercise attitude. The groups were: team support, team competition, individual competition, and control group that had neither support nor competition. Unexpectedly, the analysts discovered that too much support given through social media can negatively affect the interest and conviction to be more active. Compellingly, competition was the factor that motivated the students most to exercise every week by creating a goal to strive for. The attendance rate was 90% higher in the competitive groups than in the control group. The data showed that team and individual competition pushed the participants to exercise roughly at the same rate. The attendance rate in the support group were even lower than the control group. Therefore, the conclusion was that competition perhaps is the most effective motivator to exercise more and spend less time on the couch. (Zheng et al. 2016, 453-458.)

Teixeira et al. (2012) performed a systematic review to see if there was a relationship between exercise, physical activity and the self-determination theory (SDT). It is explained that motivation plays an important role in the person's willingness to maintain an exercise habit, which will have a healthy outcome in the person's life. There is a growing amount of research from the point of view SDT related to motivation. There is a constant relationship between a more independent forms of motivations and exercising. It was also observed that identified regulation supports initial short-term attachment more than intrinsic motivation and that intrinsic motivation will support a long-term exercise attachment. The literature offers evidence for the importance of SDT and the comprehension of exercise behavior,

establishing that the importance of the existence of independent (identified and intrinsic) guidance in encouraging physical activity. (Teixeira et al. 2012, 78.)

## 8 KNOWLEDGE CLIP

Nowadays, teaching through video is an important part of education. Studies has shown that video can increase learning and also can be used as an efficient educational tool. For a video to be effective as a useful tool in the learning process cognitive load, non-cognitive elements that impact engagement and features that promote active learning must be considered. (Brame 2015.)

Cognitive load theory states that an idea must be presented at the same speed and level of difficulty that the brain processes the information given. John Sweller, had the idea that the working memory can only process a defined number of things at the same time. Sweller recognized three types of cognitive load that interfere working memory: intrinsic load, which are the ideas that need to be processed at the same time; extraneous load, ideas that need further mental processing but do not help to the process of learning and germane load, which are the components that help to carry information from short to long-term memory and form long to short-term memory. (Rouse 2018.)

It is important to include elements in the videos that promote engagement. This will ensure that they will be watched and learning takes place. The video must be kept short; making videos longer than six to nine minutes is a waste of time. The use of conversational language instead of formal language is a must at the moment of giving instructions. The tone of voice must be quick and energetic because the student will pay more attention as the tone of voice gets more energized. The material in the video must be oriented for the audience who are going to watch it, as the target audience will define the requirements of the learning that will take place. The content of the video determines who should watch it. Giving additional visual material will help students to engage better in the lesson. (Brame 2015.)

For the student to get the best out of an educational video, it is necessary to assist them with the processing of the information. This can be done by using modeling questions, using interactive components that give the student the possibility to participate with the video, adding quizzes to the video and make the video as part of a bigger project. (Brame 2015.)

## 9 DISCUSSION

When I ask, “Have you heard about suspension training?” many times people answered no or yes, I have seen it, I heard about it or is that done with a pole? The truth is that several of these people have seen the device, but they have no idea what it is, or perhaps they know what it’s for, but they do not know how to use it. Often people think that because they are not lifting a couple of heavy iron plates attached to a barbell they are not getting a good workout and that their muscles are not working hard enough. This is why I decided to start working on this research project to introduce suspension training and its benefits not only to gym fans but also to health providers.

Previously suspension training was oriented toward military personnel, but during the last few decades, it went from being an underground exercise approach to a mainstream style that can be found in almost every gym. The idea of this thesis was to collect information about the benefits of suspension training so people can be informed about the possibilities of exercising with this system.

Due to its dynamics, when a person uses suspension training, he/she has the possibility of improving core stability, endurance, coordination, flexibility, strength and power in just one workout. The motto of suspension training has always been “all core, all the time” and it has been proved by studies that this slogan matches reality, because exercises performed with this system have a higher level of activation in core muscles than other exercise systems. Despite these results, there is some controversy, because other studies have shown that more classic exercises such as bench press, produce a higher level of muscle activation than suspension training and other exercises performed on a stable surface.

The simple installation, adjustment and use, make it easy for people of all ages and level of fitness to perform exercises with suspension training. Even though it is straightforward to use, it was shown that performing the exercises with a coach is more effective and safe.

People exercise for different reasons – whether it is to stay in shape, feel better or build muscle. With suspension training, all these goals can be achieved in the comfort of the one's home or anywhere else. Something people need to understand is that physical activity and exercising will not only help them to get that sexy ripped bulky body that makes everyone to turn around at the beach to appreciate such a stunning silhouette, but there are other health benefits that are also worth considering.

Suspension training is also used in therapeutic settings whether treating musculoskeletal disorders, preventing injuries or improving functionality. Rehabilitation with suspension training works, and it should be used more often, especially because it is backed up by scientific studies with positive results and also because it allows the patient to train at his/her own pace. Also due to its portability, therapy with suspension training can be done on the go, same as exercising, thus limiting the number of potential excuses.

The elderly can also benefit from exercising with suspension training, because exercises performed with this system are easy to transfer to the real world and especially because it allows the use of multiple joints and force vectors in one movement.

As it is seen, fear of falling can produce many other issues other than just a bruise or a hole in a favorite pair of pants. Being scared of falling can affect the person physically, socially and psychologically. It is in this area where suspension training can be an indispensable tool to improve balance because stability during the exercise can be changed with one step, allowing the person to work and improve their balance. This will help them to carry out ADLs with confidence and without fear of falling. Part of people's ADLs, is to carry heavy bags full of groceries. Imagine a

person who is coming from the store with a several heavy of bags. To get up the stairs this person is going to grab those bags and bring them as close as he/she can to his/her body to perform the climb. If the ascend is recorded, it will be seen that the posture and balance of this person will be affected by the weight of the bags. The question is, how can this person be helped to improve the posture during this task? Would it be helpful to give the person lighter bags to improve posture and facilitate the movement? The answer is “yes”. This is a clear example of how suspension training works as external support to improve balance and posture.

Some challenges were faced during the research period. It was hard to find specific studies concerning the main benefits of suspension training, because most of the studies found were related to comparing performance of traditional exercises vs. exercises executed with suspension training. It is hoped that this paper will not only help people who are physically very active to try a different exercise method, but also help to open new doors for health professionals and patients, so they can incorporate exercises with this method to their rehabilitation routines.

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## APPENDIX 1

Contreras (2010) explains: What is the purpose of using load vector terminology?

The purpose of load vector terminology is to explain what planar terminology cannot due that is insufficient and not that specific. E.g. “in planar terminology, jumping, running, and backpedaling are all sagittal plane movements even though they are quite different as one action has you moving upward, one has you moving forward, and one has you moving backward.” Vector terminology fixes these insufficiencies and permit us explain movement better. (Contreras 2010).

Load vector terminology allows the categorization of exercises, description of movements, evaluation of weakness and strength and the selection of sport specific exercises. “Load vector training takes into account the “line of pull” or direction of the resistance, as well as the position of the exerciser’s body in space when they are directly opposing the resistance or line of pull. The easiest way to determine a directional load vector is by using images to show a graphical representation of the direction of resistance (via an arrow) in relation to the human body.” (Contreras 2010).

Table 7. Basic load vector terminology. (Contreras 2010).

Basic load vector terminology
Anterior – toward the front (sometimes synonymous with ventral)
Posterior – toward the back (sometimes synonymous with dorsal)
Lateral – toward the side (away from the midline)
Medial – toward the middle or midline
Superior – upper or above
Inferior – lower or below
Axial – top to bottom
Torsion – twisting or rotating force
Anteroposterior – front to back
Posteroanterior – back to front
Lateromedial – outside to inside

Table 8. The six primary load vectors in strength training and sport. (Contreras 2010).

The six primary load vectors in strength training and sport
Axial
Anteroposterior
Lateromedial
Posteroanterior
Torsional
Axial/Anteroposterior Blend

Table 9. Other terms used in this thesis. (Biel 2015; Website of Oxford Dictionaries 2018).

Term	Definition
Skeletal Muscle	Contractile tissue that moves the skeleton, bones. (Biel, 11, 2015).
Stamina	“The ability to sustain prolonged physical or mental effort”. (Website of Oxford Dictionaries, 2018).