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"Strength training and Football"

The effect on body composition



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ABSTRACT

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Physical condition as an optimal level is required for any kind of sport regardless of the level or frequency.

In the last decades, Football has become more and more physical, and an adequate preparation during the preseason is essential to reach the "peak" at the right time and maintain an adequate strength and good level of fitness through the entire league.

This thesis responds the necessity of a football team located in Kajaani, Finland (Kajaanin Haka), which just been promoted to the second semi-professional category(Kakkonen), to prepare in the best possible way the players according to their own level.

Theoretical framework cover, exercise physiology, strength training, periodization of training, nutrition with focus of carbohydrate intake.

Skills such: strength, with focus on the lower limbs, speed, aerobic and anaerobic fitness are of primarily importance for achieving good results, avoid injuries and be competitive.

These abilities are achievable also following a healthy lifestyle, recovery and specific diet.

This thesis is based on a research of about thirteen weeks' focus on strength training preparation through which the author collected the data effecting the impact of a strength training program combined with a specific nutrition plan, which emphasize the concept of carbohydrate cycle.

This aimed to maximize the change of body composition in the athlete, with focus on increase the skeletal muscle mass and maintain a low level of body fat. The research has planned to be complete by the end of April 2017 before the beginning of the league, which will start in early May 2017.

ACKNOWLEDGMENT

This thesis has been a great opportunity to enlarge my knowledge in the field of physical activity in the strength training.

I had the opportunity to cooperate with the local football team Kajaanin Haka R.y. and their players, and I had several benefits from this experience.

I would like thank all of the players who participate in this program for the commitment and availability.

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1 INTRODUCTION

Football is one of the most popular and played sports in the world and it has reached almost all the countries on earth. According to the statistic provided by FIFA with the data for "Big Count 2006", 270 million people are active worldwide in football.

Soccer, which is an interchangeable name for this sport, gains its popularity from its features such as the simplicity in terms of rules, and the limited amount of equipment and cost effectiveness, required to play, as demonstrated by several examples of professionals who learned the game in their youth on the street playing barefoot.

On the cultural side, due to the large broadcast of event, including national team or local club, the meaning that each of these games hold, exceeds the mere score line on the pitch, but rather include concept of identification and integration of a certain class or community, with their rivalry. In addition, due to this universality, football can be used as a tool to promote integration and go beyond divisions such as race, languages and even gender.

The Football association of Finland (FAF) has more than 1,000 member clubs and approximately 115,000 registered players. The Finnish Gallup survey has indicated that football is a popular pastime with around 500,000 Finns interested in the sport. The SPL is Finland's largest amateur sports federation.

During the previous season (April 2016-October 2016), the author noticed, according the level of the league and so also of the players, a big difference in the level of physical condition within the team, Kajaanin Haka R.y., which included almost twenty different players in the age between eighteen to over thirty years old.

Throughout the entire previous season, the team faced many different problems with the players, which on several occasions had muscle injuries and sickness. I

also could not avoid noticing, considering my own background in sport in general as passionate first, and then as future potential sport instructor, how most of the players had a “poor level” of strength training, muscle care knowledge and nutrition bad habits. These thoughts have lead me, and the management staff to focus even more on these aspects in the second part of the previous season.

I observed the response of a thirteen week strength training program conducted during the pre-season between the 1st of February 2017 and 30th of April 2017. The subjects were players of local football team Kajaanin Haka R.y. Pre and post training assessments included among the others, Body mass index (BMI), Skeletal muscle mass (SMM) and fitness score, done through “In Body Composition Analyzer 720” Bio-electrical Impedance (BIA).

The training program included one weekly session with machines and weights in the Gym, held on Sunday, which involved all the major muscle groups, plus one brief body weight session held on Wednesday before the practice. A nutrition plan, customize to enhance the result in body composition, had been drawn by the author, according the literature review.

Ten semiprofessional male soccer players, whose average age was $22,5 \pm 8,8$, attended the entire preparation program, customized to maximize the effect of strength training, beside improving the overall body composition, in order to face the upcoming season.

2 PURPOSE OF STUDY

This study investigates, whether a strength preparation program; including resistance training, combined with a diet plan which contains modulation of macronutrient (fat, carbohydrate and protein) during the course of the week; positively affect the body composition of a semi-professional group of football players of a local club.

The local football organization was formed in 1953 in the municipality of Kajaani in Kainuu region, northern Finland, with currently more than 200 registered players including juniors. (www.kajaaninhaka.fi, 2018). The opportunity given to me by my commission party, Kajaanin Haka R.y., matched my request perfectly, to have a real study case scenario where I could have the opportunity to put into practice what I have learned during the study of my degree programme.

I conducted this research due to the fact; in my future career, I will be able to give qualitative consulting to people keen to improve their health/fitness condition through the use of physical activity and a salutary lifestyle. In the future, I would like to use the knowledge and skills acquired through these studies to improve the general level of people's fitness, to become a "wellness advisor".

To do so I will need to have a strong knowledge of all the aspect related to the field; which include not just the pure expertize in training method, but also a strong know-how of the nutrition principles. It was a good opportunity for me, since the good relationship evolved with Kajaanin Haka R.y. through last season, based on my thesis with this organisation and its players.

The first team, which at the time of writing of this paper is playing in the second division, required, among others, to improve the general level of their player's condition, in the period between January and April in sight of the upcoming beginning of the season.

My objectives, which corresponded with Kajaanin Haka R.y. goals, were to improve the fitness level of the whole team, in the field of body composition and enhancing the aerobic performance. This program of development of sport and exercise skills, beside a general health promotion of physical condition, matched with the objective of my curricula competence of Bachelor of Sport Studies, which included also multidisciplinary knowledge, such as instruction, coaching and training.

Due to the low level of the opponent, but also to the good average quality of the team, Kajaanin Haka R.y. have been able to lead the league "Third Division" Northern Finland (SPL Pohjois – Suomi) in 2016 and get promoted in the second division, which will begin in late April 2017. The willing to prepare this season in the better way possible has taken the management staff to focus this year even more on the physical condition of the team.

2.1 Aim of investigation

The commissioning party "Kajaanin Haka R.y." has accepted the opportunity to benefit from my thesis, which investigates the effect of a specific strength training program target on football players, in particular focusing on the following:

Upon a promotion in a higher Finnish soccer division, a new coaching view, oriented to emphasize the physical condition of the players, through a targeted training period of preparation for the season, combined with some general guideline aim to enhance the general level of fitness and their body composition through an assessment done by "In Body Composition Analyzer 720" Bio-electrical Impedance.

The body composition test, of the ten players assessed, were held in January between 16th and 18th, before the strength training program, and again in April between 20th and 28th after the thirteen weeks of workout.

The main objectives of this study were:

1. Assess the effect of a targeted thirteen weeks' strength-training program, with one weekly session held in the university gym with resistance training method, of semiprofessional soccer players.
2. Assess, whether or not, the change in body composition result in an effective increase of skeletal muscle mass.
3. Assess the appropriateness of "In Body Composition Analyzer 720" Bio-electrical Impedance test, as tool to measure and evaluate the body composition and level of fitness of semiprofessional soccer players.

This strength training program is part of the whole annual training program which include mainly a "preseason" and "on season" program with different target and training method beginning already in late December 2016 and will continue until the end of the league in October 2017. These thirteen-weeks of the strength training program will be combined with a nutrition plan, which will follow general guidelines in terms of daily energy intake but will be customized on each player of the team, according his own characteristics to increase the skeletal muscle mass and limit the fat percentage gain at the same time.

The author, after a review on the sources available about the topic decided to follow the guideline from a particular diet called "Dieta Fasica" in Italian "Phasic Diet" or "Shifting Diet" which has taken some aspect from the "Anabolic Diet™" by Mauro G. Di Pasquale. This nutrition approach is a specific diet tailored mainly for bodybuilding, and so not adapted for an entire season for soccer players, but will be used for a part of the pre-season training of about thirteen weeks.

The planning of training program and related nutrition advice are some of the aspects which most likely I will face throughout my future working life in the field of

sport and more in general fitness and wellbeing. I am sure that through the process, I will gain knowledge related to new method of strength training and I will get deeper in some of the aspects of nutrition as well, which I am particularly interested in due to my previous background as a part time fitness instructor in Italy.

The topic chosen is also strictly connected with the field of study I'm following here at Kajaani University of Applied Sciences, in particular with subjects such as coaching, exercise physiology and as said before nutrition. All of these are subjects in which I am really focus to gain a high level of knowledge in.

The Bachelor Degree that I am attending is extremely valuable to have a general overview on the world of sport in general, since it covers many different aspects as for example marketing, tourism and a several varieties of sports. This is of course a plus from one side but on the other, I feel the necessity to get deeper in some topics, which I can't yet claim, that I can master, and in which, I can see myself in the future as a potential employee.

To be able to pursue my goal in this thesis process, I will have first to explain properly the main topics which are involved in my research such as: strength training, nutrition plan including Carbs Cycling, as main, but also relative corresponded features like body mass index, fat percentage, skeletal muscle plan, physical preparation, strength training, periodization of training within the others. The aim of my studies is to show how a scientific approach can have an important impact on the physical condition of a semi-professional athlete, even in quite a short period of time, of thirteen weeks.

I strongly believe that nutrition has a huge impact on the strength training and most of the time the effect of these are neglected at the expense of other aspects.

In particular, I'm willing to show the effect of a specific diet plan, "Dieta Fasica" which uses another carbohydrate cycle, and the effect it has on the body composition, allowing to increase the lean muscle structure limiting at same time the increasing of fat mass at the same time.

The effect of insulin, related to carbohydrate intake, as anabolic hormone is widely known and several studies have been conducted in this field. I wish to adapt this concept also to the field of football, since its most common in my opinion, find this kind of carbohydrate cycle, in activity as bodybuilding rather than aerobic sports.

2.2 Literature review

To further support the aim of this study, which was to assess the effect of strength training combined with certain nutrition guidelines, on the body composition of a local Soccer Team, the following literature review which discusses the mentioned topic is required. Several manuscripts and electronic databases were searched online, inquiring for key words associated, between the others, with: Football, Soccer, Physical Preparation, Strength Training, Preseason, Nutrition Plan, Body Mass Index, Body Fat Mass, Skeletal Muscle Mass.

This review intended to be a based evidence guide for strength training preparation in Soccer. The complexity of physiological demands required in Football is related to the several types of movement necessary during the game, such as sprinting, jumping, high intensity running rather than tackle. Theoretical background required to support my thesis includes Strength Training, Body Composition and Some component of Nutrition.

Football requires training which puts stress on both the anaerobic and aerobic energy systems, beside this "Effective ways to develop both strength and range of movement, especially in the lower limbs, also needs to be systematically planned

and performed in training". (Morgans, Orme, Anderson and Drust, 2014) Many factors such as technical, tactical and physiological areas affect the performance of athletes in soccer, (Stølen, Chamari, Castagna and Wisløff, 2005), and even if not considered a science, but following certain method of training may help to improve performance of players and hence increase the efficiency of the whole team.

3 STRENGTH TRAINING

Strength training can be defined as the stimulus imposed by external resistance, which has the aim to develop the muscle's power; usually using free weight, machines or your own body weight (Mosby's Medical Dictionary, 2009). There are different factors beside the training itself, that affect the outcome of maximal power; between the others: "morphological features including fiber type contribution to whole muscle areas, muscle architectural features and tendon properties as well as neural factors including motor unit recruitment, firing frequency, synchronization and inter-muscular coordination" as stated by Cormie, Mc Guigan, and Newton (2011).

Strength training has shown impact on the factor above in a sensible manner, a good knowledge in the field of training is required to ensure effective maximal power production in the players. Several studies (Football Medicine, 2015) in fact showed correlation between, a better strength and power condition of their players and related results in actions, such as higher jumps or improvement in sprint performance, this is due to the important correlation between these activities and strength of lower limbs, improved through exercises such as Half Squats. (Wisloff, Castagna, Helgerud, Jones and Hoff, 2004)

Other studies reviewed during my research showed that in a Squat protocol training as a strength-power potentiation program, a common rule of 1 RM of a total weight superior at twice the body weight of the subject has been revealed as a significant result in "higher values of power outputs" (Ruben et al., 2010) in particular during horizontal plyometric jumps.

3.1 Body composition

Body composition is one of the most relevant features for success in many sports, the contribution that the physical structure's conformation has on athletic activities, and so, also in football, is widely acknowledged as stated by Nikolaidis and Karydis (2011), where high percentage of lean mass play a significant role for health and performance. The human body, as claimed by Ellis (2000) can be described as a combination made by muscle, bone, skin, fat and organs. An important part which makes up usually 30% to 40% of our body weight, of a healthy individual, is represented by so called skeletal muscle mass according to studies made by Heymsfield et al. (2000)

An accurate way to measure the amount of people's fat mass and lean skeletal mass is through a body composition assessment, which has the benefit, between the others to monitor the overall level of health (University of Utah - Health Care).

The range of approach available to measure the composition of tissue are multiple and any of these have benefits and drawbacks in terms of precision, costs and availability. Several are the methods of body composition measurement available; Air displacement plethysmography (ADP), Dual-Energy X-Ray Absorptiometry (DXA) and Bio Impedance Spectroscopy (BIS) and multi frequency bioelectrical impedance analysis (MF-BIA) (Baracos, Caserotti, Earthman, Fields, Gallagher, Hall and Thomas 2012).

In elite players, strictly correlation between sprint performance and decreasing of fat mass, especially through the "in-season", have been shown main improvements in the sprint times associated with reduction in body fat percentage. As body fat content decreased during the season, players became faster. (Ostojic, 2002)

3.2 Hypertrophy

Skeletal muscle increase in size defined as “Hypertrophy”; progressive overload during a training program combined with an appropriate nutrition intake lead to an adaptation within each muscle fiber in their volume and consequent force production. (Mangine, Hoffman, Gonzalez, Townsend, Wells, Jajtner, and Stout, 2015). This increase in size has remarkable interest to different cluster of population, from recreational gym-goers, bodybuilder and more in general athletes, which plan their training in the most efficacious way to obtain the muscular hypertrophy as stated by Fischer et al. (2013). Several variables such as the immune system, growth factor hormones and their relative muscle fibers types are involved in the process of muscle adaptation in the training period as reviewed by Mangine et al. (2015)

The hypertrophy process happens, as a response of external factors such as strength training, which have caused damage to the muscle fibers. Although the process is the same for everybody the result could vary according to factors such as genetics, and the relative result may take a longer time to be noticed. Variable such as intensity or effort, repetition, volume and contraction types, are modulated to allow a better outcome in enhancing of muscular strength (Mangine et al., 2015).

The analysis from 57 different peers reviewed in the journal made by Fischer et al. (2015) in attempt to provide evidence based recommendation for muscle growth, suggest that single set performed with the higher intensity possible are optimal for athletes wishing to increase their muscular size.

4 NUTRITION

Many aspects contribute to achieve better results in sport, and hence in soccer, nutrition is one of these (Maughan and Shirreffs, 2007). Soccer players face a high calorie expenditure during a ninety-minute game, which can be estimate between 1500 to 2000 calories as stated by Davies, (2005). Several studies show the effect of energy substrate utilization on physical performance of athletes during training and games (Bangsbo, Mohr and Krustrup, 2006). Recommendations aimed to develop physical condition, maintain ideal body weight, to maximize performances and reduce risk of injuries have been improved over the years, these that promote the best performance are entirely consistent with current guidelines for healthy eating. (Maughan and Shirreffs, 2007).

Total energy intake of soccer players, requires an implementation of nutrition program, aimed to share correct eating habits, to ensure an adequate consumption of macronutrient such as carbohydrate, protein and fat rather than micronutrient, and obviously water through the entire season (García-Rovés, García-Zapico, Patterson and Iglesias-Gutiérrez, 2014).

According to MacLaren (2003) advice for an optimal diet should be based on 55-60 % provision from carbohydrate and respectively 25%-30% fat and the remaining 10%-15% by protein. During the pre-season period, these proportions could be modified and customized according to the goal, such as to promote protein synthesis and relative hypertrophy.

4.1 Carbohydrate

Carbohydrate, so called due to the chemical combination of carbon, hydrogen and oxygen, are one of the three principal types of nutrients required for the production of energy in the human body, depending on the complexity can be divided as simple a form of sugar or more complex forms such as starches. (MedicineNet.com. 2018) Carbohydrate (CHO) are highly recommended in order to improve physical efficiency, due the increasing in concentration of glycogen in muscle, it seems to help especially for high – intensity activities (Souglis et al.2013). Although according to the literature available a diminution of CHO intake, seems to optimize the fat loss, it should be noted that, a potential negative impact on performance and further risk of losses of lean body mass could occur (Helms, Aragon, and Fitschen 2014).

A daily intake ranges between 5-7g/kg of Body mass is recognized as appropriate for moderate training according to Burke, Loucks, and Broad (2006). The range of 4-7 g/kg daily amount was also found reasonable for athletes depending on their training phase also by other studies focused on strength sports (Slater and Phillips, 2011).

Evidence present in the scientific literature indicate that during resistance training particularly using large-muscle, glycogen, which derive from CHO, play a role of a fundamental fuel source. The intake of CHO prior to, during, and after the workout appears to give some benefit (Haff, Lehmkuhl, McCoy, and Stone, 2003) such as the increasing of work output, and effect the overall net protein synthesis, which can lead to an enlargement of hypertrophy. High CHO diets are typically tailored for athletic endurance standard, nonetheless like other macronutrient, CHO intake has to be customize to the individual (Helms, Aragon, and Fitschen, 2014).

4.2 Protein

Protein is another of the three macronutrients, essential for the construction of muscle mass, it is highly common in beans, grains or dairy products, but also it can be of animal origin if found in poultry, fish and meat (Livescience, 2018). Proteins, which are the result of agglomerate of amino acid (U.S. National Library of Medicine National Institutes of Health, 2017), are required between the others, for the structure, function and regulation of the human body components such as muscles and organs. From the Greek *protos*, “first”, reflects the primary importance of this essential macronutrient, and the related effect on health it has (Pendick, 2015).

The daily requirement for a healthy adult, is considered to be enough, within the range of 0.8 g/kg of body weight, according World Health Organization (WHO, 2007).

Despite this, few studies have specifically evaluated the protein requirement with focus on soccer (García-Rovés et.al, 2014), recent studies indicate that the current amount of 0.8 g/kg, could be suboptimal for athletes or chronically active individuals. Lemon (1994) stated that an intake of 1.4-1.7 g/kg for day should be appropriate for a soccer player, for enhancing strength and providing stimulus for muscle tissue development.

A higher protein daily intake of 1.2-2.2 g/kg range is sufficient to allow adaptation to training for athletes whom are at or above their energy needs according to a review done by Elm Helms, Aragon, and Fitschen (2014). Due to the limited evidence of harmful effects of high protein intake from the literature available, an ingestion of 2-3 g/kg, within the context of an athlete diet, it appears to maximize the effect of hypertrophy (Tipton, and Wolfe, 2004). Emphasis should not only focus on the amount or protein intake but also on quality, rather than timing, since ingestion in proximity of exercise can promote better adaptation to training due the positive nitrogen balance(García-Rovés, et al., 2014), (Tipton, and Wolfe, 2004).

4.3 Fat

As stated by Helms, et al. (2014) “The importance of carbohydrate and protein in sports nutrition is often emphasized over that of dietary fat”. A lipid from Greek “lipos”, *fat*, has a similarity in molecule structure with carbohydrates but it differs its linkage of atoms, and constitutes the ideal cellular fuel because it carries a larger quantity of energy per unit weight, about 9kCal per gram, more than twice from equal quantity of carbohydrate or protein. Between the others, fat plays a role of protection for vital organs and thermal insulation, any possible protective benefit however, must be weighed against the drawback imposed by “dead weight” to carry (McArdle and Katch, 2007). In this case to generate a diminution of weight, a decrease of calorie intake and concurrent increase of energy expenditure, is generally required.

Although a complete review of metabolic adaptation to dieting in athletes is beyond the scope of this review, one of the most prevalent rules, it claims that generally one pound of body fat yields 3500 kcal if metabolized (Hall, 2008). Lipid oxidation, in highly aerobic sports such as soccer, contribute in a primary role as energy substrate, in rest period after game of high intense training (García-Rovés et al. 2014). Intracellular and extracellular fat, depending on nutritional regimen and exercise intensity can supply between 30% and 80 % of the energy requirement (McArdle, and Katch, 2007). According to the WHO recommendation the total daily energy intake should not derive from fat for over 30%. (WHO Healthy Diet -2015), beside these recommendation, 70 % to 80 % of these should consist of unsaturated fatty acid (McArdle, and Katch, 2007).

5 BODY COMPOSITION ANALYSIS

Players and their trainers need an easily administered, secure and accurate way to estimate their body composition and the relative changes occur during a certain preparation period. The method to assess it, through “In Body Composition Analyzer 720” Bio-electrical Impedance analysis, shows a reliable, safe, noninvasive and easy way to make measurements under homogenized circumstances. In fact, factors such as hydration status, skin temperature and previous meal consumption could affect the result of these tests as claimed by McArdle et al. (2004).

In this test, a small alternating current flowing between two electrodes passes more rapidly through hydrated fat-free body tissue and extracellular water than through fat or bone tissues because of the greater electrolyte content of the fat-free component, then quantify the volume of water in the body and from this the percentage of body fat and fat-free muscles. (www.bodyanalyse.no)

“In Body Composition Analyzer 720” Bio-electrical Impedance measures what the body is made of, scanning the amount of fat from one side, and on the other remaining components which include water, muscle tissue and bone, that are fat-free mass. With the totality of the four-category model it is possible to estimate the distribution of total body weight (www.bodyanalyse.no).

5.1 Muscle fat analysis

The numbers shown in this analysis are representing the values of Weight, Skeletal Muscle Mass (SMM) and Body Fat Mass. The estimation compares also the results with a standardized range according to gender and age, thus a score around 100% shows an ideal value and a balance in the composition of the examined person. Superfluous adipose tissue in excess, effect the locomotor system in situations such as jumping or more in general running during the entire time of physical activity (Reilly, 2007), for this reason, between the others, it is important to optimize the body composition, in particular for athletes or sportsmen.

5.2 Body mass index

Body Mass index (BMI) as an attempt to quantify the amount of tissue mass, is measured as the weight in kilograms divided by the square of the height in meters (kg/m^2), this index is commonly used to distribute obesity, overweight or underweight in adult population (WHO-BMI classification,2004).

In recent years, arguments against the validity of this index, especially in elderly and young people have been raised (Kok, Seidell, and Meinders, 2004). Due to the fact that muscles are denser than fat, athletes and muscular individuals might have a BMI ranked as overweight, without having fat mass. (Harvard, School of Public Health, 2016).

In fact, BMI data collected on athletes, (Ode, et al.,2007) used as surrogate of fat percentage analysis related to obesity, may classify incorrectly, as “overweight” or “obese”, subjects with a high BMI in these populations, compared to “general” or “non-active” with concerning result of misleading interference regarding health problems (Lambert, et. al.,2012).

5.3 Visceral fat area

Also known as organ fat, or intra-abdominal fat, the assessment of body fat distribution can show the presence of adipose tissue within abdominal cavity, stomach, intestines and others vital organs (West,2017).

Unlike subcutaneous fat, which can be measured usually through the skin fold method, with “In Body Composition Analyzer 720” Bioelectrical Impedance assessment is possible to estimate the cross-sectional area of visceral fat in correlation to age (Results Interpretation & Application InBody 720).

Strong correlation between exercise training, especially high intensity, and reduction of abdominal subcutaneous fat have shown (Irving, et al., 2008),(Giannaki, Aphas, Sakkis, and Hadjicharalambous, 2016).

“Visceral adipose tissue is a hormonally active component of total body fat, which possesses unique biochemical characteristics that influence several normal and pathological processes in the human body” as stated by Shuster, Patlas, Pinthus, and Mourtzakis (2012). An elevated level of this adipose tissue can lead to health conditions such as metabolic syndrome, cardiovascular disease and several malignancies including prostate, breast and colorectal cancers. A common threshold of 100cm² of visceral fat span is recognized as abdominal obesity (Results Interpretation & Application InBody 720).

6 STRENGTH TRAINING PROGRAM FOR FOOTBALL PLAYERS

“Skeletal muscles adapt to anaerobic training primarily by increasing in size, facilitating fiber type transitions, and enhancing its biochemical and ultrastructural components. Collectively these changes ultimately result in enhanced muscular strength, power, and muscular endurance, which are critical to athletic success”. (Baechle, and Earle, 2008)

Several variables such as the frequency of training, the amount of repetitions and sets rather than the load, or percentage, of one repetition maximum (1-RM) are affecting the result of strength training.

6.1 Training frequency

Training frequency indicates the total amount of exercise done in a certain amount of time, usually within a week” (Baechle, and Earle, 2008). According to the management staff of Kajaanin Haka R.y, a weekly preparation plan split on four days of practices, plus a potential match held on Sunday, was designed to achieve between the others, improvement in strength and relative increase in skeletal lean mass.

Despite the bibliography examined during this research, suggests a different outcome of study regarding the number of strength training sessions required to be performed during the week such as 3-4 times in the preparation period,(Reilly, 2007), the availability of players, and the number of practice scheduled were not enough to support this number.

During this specific pre-season “mesocycle” of thirteen weeks, focused on strength and endurance conditioning, the number of strength training sessions planned were one on Sunday, with machine exercises in the gym located in the Kajaani University of Applied Sciences, namely “Resistance Training” plus a body weight

session of 30 minute, usually, during the Wednesday practice. The remaining two practices were focused on sprint and speed drills on Tuesday, rather than aerobic capacity enhancing on Thursday. This can be considered similar to what support from other studies reviewed such as Silva, Nassis, and Rebelo (2015) "Strength training in soccer with a specific focus on highly trained players".

6.2 Strength training

The resistance training planned for this weekly session held on Sunday, included eight different exercises, with four focusing on lower limbs and four on upper body. Taking into account the equipment available in the local gym, the following exercises have been chosen after an analysis of the book, "The Science of Training Soccer" by Thomas Reilly, which provided the author with an overall view of scientific principles to training, including the following exercises, focused for enhancing strength and power. (Reilly 2007)

1. Deadlift
2. Leg Curl (seated)
3. Bench Press
4. Leg extension
5. Pulldown Lat Machine Wide grip
6. Squat Multipower/Smith Machine
7. Shoulder Press / Overhead Press
8. Calves Leg press horizontal

For each of these exercises the target was to cover 10 repetitions for every three sets.

6.3 Body weight training

The exercises performed during the Wednesday practice, held in the local football pitch, after the warm up were customized to cover the larger muscle groups possible and hence hit many different joints. The impossibility to train within the local gym facilities combined with the limited amount of equipment available, constrained the author to develop a range of drills based on bodyweight resistance, included isometric training and core stability (Reilly 2007).

The training routine included:

1. Plank, three sets of one minute, with thirty-second rest.
2. One leg Squat/Bulgarian Squat, thirty second for each leg for 3 times with thirty seconds rest between each set.
3. Push Up/ "Modified" push up, thirty-second execution 3 times, with thirty-seconds rest between each set.
4. Isometric Squat on wall, three sets to exhaustion
5. Medicine balls crunches, frontal with partner or twisted, three set of 30 second with thirty seconds rest.
6. Jumping lunge, three sets of thirty seconds rest between each set.

6.4 Loading scheme

One of the three important variables in strength training beside frequency and rest is the load, namely the amount of mass of the weight being lifted; this describes how heavy a load is compared to the personal repetition maximum (1RM) and is defined as Intensity.

The American College of Sport Medicine (ACSM) define load as the percentage of weight lifted in a given set, which is compared to the 1 repetition maximum (Esco, 2013). For an optimal enhancement of hypertrophy and strength a load around 60% to 85% is advised to distribute in 1 to 3 sets of 8 to 12 repetitions. (ACSM, 2013). According to these guidelines the training program set as a target for each of the eight exercises 3 sets of 10 repetitions, with rest period between one to two minute between each set.

6.5 Nutrition plan

An accurate programming of nutrient intake plays an important role in athletes in general. A nutrition plan aimed to maximize the effect of a strength-training program was realized by the author according the knowledge gained during his course of study, combined with the literature analyzed before the planning of the entire training program.

This specific nutrition plan built on dynamic variation of macronutrient intake with the purpose to improve the hormonal anabolic response, in order to maximize muscle growth limiting the fat percentage increase. (Di Pasquale, 2002).

The author decided to customize a weekly diet meal program, which included a dynamic shifting of macro nutrient intake without changing the total amount of calories. This, unlike the traditional diets which consider phases of hyper calories followed by hypo calorie, in aim to “bulk” and “cut” skeletal muscle mass. (Di Pasquale, 2002)

The “shifting” diet has its root in the “Anabolic Diet TM” by Mauro G. Di Pasquale, for recreational and competitive bodybuilders, and the “Phasic Diet” by Enrico dell’Olio.

The diet included weekly phases of low level of carbohydrate, in order to force the metabolism to burning fat as a main fuel, increasing lipolysis and the free fatty acid

oxidation, followed by controlled load of carbohydrate with subsequent increase of anabolic response, without stimulate the lipogenic or “fat-production” drawback (Di Pasquale, 2002).

In particular, the plan contemplated the following four phases of shifting of macro-nutrient intake:

Phase 1; of download: 2 days of Low Carbs (day High Protein and Lipid content): Protein: 3.3 g per Kilo of body weight. Carbohydrates: 30 to 40 g total, all from fruits and vegetables. Fats: are obtained by subtracting from the total calorie difference upstream calories already obtained from carbohydrates and proteins.

Phase 2; 1 Re-Charge day: Day entirely free where it is not necessary to calculate all the nutrients, with the advice to maintain the protein shares at 3.3 g per kilo body, as far as the rest is good to do at least 6 meals throughout the day, introduce more and carbohydrates give a high glycemic load. The risk of gaining weight is very low, as almost all of the carbohydrates restore glycogen consumed for 2 days before, while high levels of insulin and high calorie intake will create a perfect anabolic environment, (This is the day with the highest calorie intake of the week).

Phase 3; Transition: 1 day after charging; Protein: 2.1 g per Kilo of body weight, Carbohydrates 300 Total g (2/3 cereals and 1/3 from fruits and vegetables) while Fats are obtained by subtracting the difference from the mountain calorie calories already obtained from carbohydrates and proteins.

Phase 4; Maintenance: 3 days, after the Phase 3, 1.1 g protein per Kilo of body weight; Carbohydrates 300 Total g (2/3 cereals and 1/3 from fruits and vegetables) while Fats are obtained by subtracting the difference from the mountain calorie calories already obtained from carbohydrates and proteins.

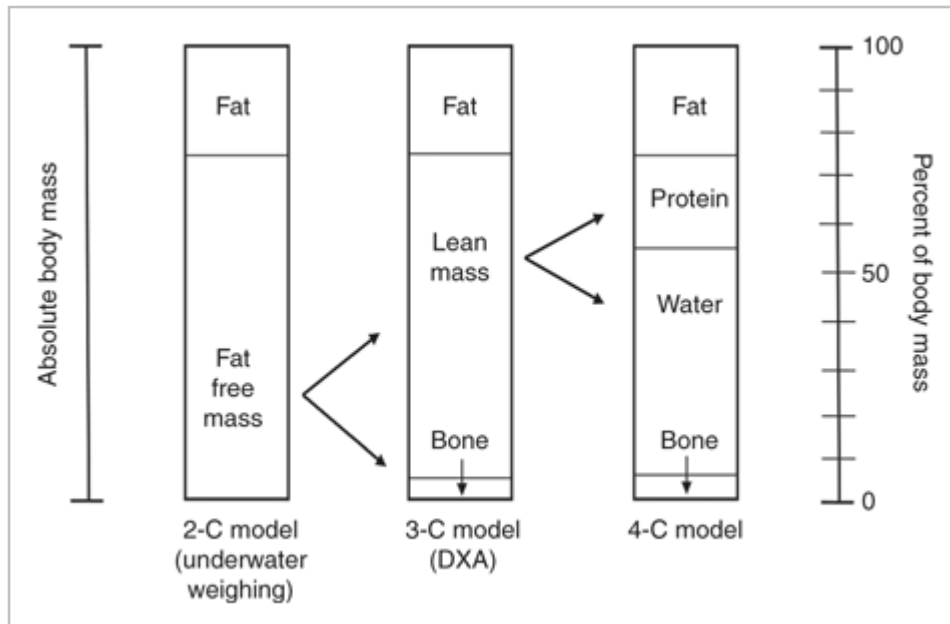
A general overview of the basic fundament of nutrition, plus some instructions aimed to customize as much as possible the individual food intake, and their shifting, during the different days of the week, has been made by the author.

7 ANALYSIS RESULTS

The method used to assess the body composition of the participants of this study has been the “In Body Composition Analyzer 720” Bio-electrical Impedance(BIA). Through this method it is possible to measure between the others, individual features such as total body weight, lean mass, body fat mass and relative percentages. Furthermore, through this model it is possible to estimate the distribution of whole body weight in aggregate body: Water, Protein, Mineral and Body Fat, so called “4-Compartment Model”. Both tests have been conducted and supervised by the “Myötätuuli” staff, to give more impartiality to the result. Here below the most relevant data derivable from the Bioelectrical Impedance Analysis (InBody USA)

7.1 Body composition analysis

From this four categories model, it is possible to estimate the distribution of total body weight subdivided in; body water, namely the quantity of water within cellular membrane rather than blood and bowel fluid. Alongside this, Proteins which compose the soft lean mass are one of the other elements measurable through this multi frequency technique. Mineral, found in the bone and body fat mass, referring to the amount of lipid, are the two remaining compartments evaluated through this bioelectrical impedance analysis.



Picture 1 – Toombs, R. J., Ducher, G., Shepherd, J. A., & De Souza, M. J. (2012)

Models of body composition with two (2-C), three (3-C), or four (4-C) compartments.

Is possible to assume therefore that Total Body Weight is the sum of; Total Body Water + Protein Mass + Mineral Mass + Body Fat Mass.

The following Figure 1 shows the development of body weight of the players among the training period of thirteen weeks. The results gathered showed a general increase of total body weight of the team by 1,76 kg of average, with a maximum of 3,20 kg of increase and a loss of 1kg.

Figure 1 – Body Weight comparison

Name of player	D.O.B.	1st InBody Weight(kg)	2nd InBody Weight(kg)	Difference (Kg)
Player 1	10.12.1992	66,9	69,9	3,00
Player 2	14.10.1996	74,9	77,5	2,60
Player 3	2.10.1995	71,2	74,3	3,10
Player 4	25.9.1997	64,7	64,8	0,10
Player 5	21.4.1997	54,7	56,9	2,20
Player 6	24.10.1997	69,2	72,4	3,20
Player 7	11.7.1991	59,7	62,1	2,40
Player 8	9.10.1985	89,5	88,5	-1,00
Player 9	1.8.1998	67,5	67,5	0,00
Player 10	27.11.1990	76,2	78,2	2,00
Total (Average)		69,45	71,21	1,76

7.2 Muscle – fat analysis

The Muscle-Fat Analysis compare the following three elements; total body weight (Kg.), with the estimation of skeletal muscle mass(Kg.) and body fat mass(Kg.). An overview of the partition between fat free mass, namely the total amount of body weight without the fat; and skeletal muscle mass (SMM) which consist in estimation of the total weight of muscles net the cardiac and smooth ones, allow to identify the types of body composition of examinee if ideal or not, according to his or her standard weight. The estimation compares also the results with a standardized range according to gender and age, thus a score around 100% shows an ideal value and a balance in the composition of the examined person. (“InBody 720 Body Composition Result Sheet”).

All the participants of this test showed an ideal correlation between these three elements before and after the test conducted, due to their particularly active lifestyle. A more in-depth analysis showed an overall increase of the skeletal muscle

mass (SMM) by 0,98 kg for the whole team, with a maximum of 2kg increase and a decrease of 0,1kg in the worst result, as showed in Figure 2.

Figure 2 – Skeletal Muscle Mass comparison

Name of player	D.O.B.	1st InBody SMM(Kg)	2nd InBody SMM(Kg)	Difference (Kg)
Player 1	10.12.1992	34,8	35,8	1,00
Player 2	14.10.1996	38,3	39	0,70
Player 3	2.10.1995	34,5	36	1,50
Player 4	25.9.1997	31,9	33,2	1,30
Player 5	21.4.1997	27,6	29,6	2,00
Player 6	24.10.1997	35,7	36,9	1,20
Player 7	11.7.1991	30,2	30,9	0,70
Player 8	9.10.1985	43,3	43,2	-0,10
Player 9	1.8.1998	34,9	35,3	0,40
Player 10	27.11.1990	38,8	39,9	1,10
Total (Average)		35	35,98	0,98

7.3 Obesity diagnosis

In this section of the “In Body Composition Analyzer 720” is possible, between the others, observe the percentage of body fat mass (PBF), which is so calculated:

$$\text{PBF (\%)} = \text{Body Fat Mass (kg)} / \text{Body Weight (kg)} \times 100$$

Studies aimed to analyze the average PBF in soccer players reveal values around 14%, elite male Brazilian,(Baracos, Caserotti, Earthman, Fields, Gallagher, Hall, Thomas, 2012,), 13,9% for male of National Collegiate Athletic (R.Silvestre et al., 2006) and 13-15% for first Croatian national level players (Matković, Misigoj-Duraković, Matković, Janković, Ruzić, Leko, and Kondric, 2003). Superfluous adipose tissue in excess, effect the locomotor system in situations such as jumping or more in general running during the entire time of physical activity (Reilly, 2007).

No significant variation to the overall percentage of the team related to the PBF are observed, even though the individual results show inhomogeneous outcomes including reduction from 2,5% up to gain of 1,80%, as displayed in Figure 3.

Figure 3 – Percentage Body Fat comparison

Name of player	D.O.B.	1st InBody PBF %	2nd InBody PBF %	Difference %
Player 1	10.12.1992	9,60 %	10,9 %	1,30 %
Player 2	14.10.1996	10,20 %	12,0 %	1,80 %
Player 3	2.10.1995	15,10 %	15,7 %	0,60 %
Player 4	25.9.1997	13,60 %	11,1 %	-2,50 %
Player 5	21.4.1997	10,40 %	8,4 %	-2,00 %
Player 6	24.10.1997	9,90 %	11,3 %	1,40 %
Player 7	11.7.1991	11,10 %	12,3 %	1,20 %
Player 8	9.10.1985	15,80 %	14,7 %	-1,10 %
Player 9	1.8.1998	8,70 %	8,1 %	-0,60 %
Player 10	27.11.1990	10,70 %	10,8 %	0,10 %
Total		11,51 %	11,53 %	0,02 %

7.4 Body mass index

One method aim to classify under or overweight individual according their so called: “Body Mass index” (BMI) which is measured as the weight in kilograms divided by the square of the height in meters (kg/m^2), has been utilized in the last two decades (WHO-BMI classification,2004).

However, the higher density which characterize muscles tissue compared to fat, leads athletes and muscular individuals to show higher BMI results which have relative allocation in overweight categories, although without having Fat Mass

(Harvard, School of Public Health, 2016). In fact, BMI data collected on athletes, (Ode, et al.,2007) used as surrogate of fat percentage analysis related to obesity, may classify incorrectly, as “overweight” or “obese”, subject with high BMI in these populations, compare to “general” or “non-active” with concerning result of misleading interference regarding health problem (Lambert, et. al.,2012)

As indicated in Figure 4, the majority or the examined show an increase of their BMI with an overall growth of 2,53% for the overall average of the team.

Figure 4 – Body Mass Index comparison

Name of player	D.O.B.	1st InBody BMI	2nd InBody BMI	Difference %
Player 1	10.12.1992	21,4	22,3	4,21
Player 2	14.10.1996	22,1	22,9	3,62
Player 3	2.10.1995	24,9	26	4,42
Player 4	25.9.1997	22,9	22,7	-0,87
Player 5	21.4.1997	20,3	21,2	4,43
Player 6	24.10.1997	22,3	23,1	3,59
Player 7	11.7.1991	20,9	22	5,26
Player 8	9.10.1985	25,6	25,3	-1,17
Player 9	1.8.1998	21,5	21,5	0,00
Player 10	27.11.1990	23,5	24,1	2,55
Total (Average)		22,54	23,11	2,53

7.5 Visceral fat area

The assessment of body fat distribution indicate the presence of adipose tissue within abdominal cavity, stomach, intestines and others vital organs, it also called “organ fat”, or “intra-abdominal fat”, (West, 2017).

Through “In Body Composition Analyzer 720” assessment it is possible to estimate the cross-sectional area of visceral fat in correlation to age (Results Interpretation & Application InBody 720). Strong correlation between exercise training, especially high intensity, and reduction of abdominal subcutaneous fat have shown (Irving,

et al 2008), (Giannaki, Aphas, Sakkis, and Hadjicharalambous, 2016). A common threshold of 100cm² of visceral fat span is recognized as abdominal obesity.

A strong correlation with the results of percent of body fat, show in Figure 5, no individual uniform of results, with no significant variation on the overall average of the team.

Figure 5 - Visceral Fat Area comparison

Name of player	D.O.B.	1st InBody Visceral Fat Area	2nd InBody Visceral Fat Area	Difference
Player 1	10.12.1992	15,1	22,4	7,30
Player 2	14.10.1996	29,2	34,7	5,50
Player 3	2.10.1995	40,5	43,8	3,30
Player 4	25.9.1997	29,1	18,9	-10,20
Player 5	21.4.1997	13,3	7,7	-5,60
Player 6	24.10.1997	22,6	27,8	5,20
Player 7	11.7.1991	19,1	27,7	8,60
Player 8	9.10.1985	51,3	47,3	-4,00
Player 9	1.8.1998	19,6	15,8	-3,80
Player 10	27.11.1990	31,7	33	1,30
Total		27,15	27,91	0,76

7.6 Fitness score

The fitness score (FS) is a numerical expression regarding the general level of fitness of the examinee according to his or her body composition. FS is a simple tool, which allows to quickly asses and compare the overall level degree of physical condition of the client according to all the data collected through the "In Body Composition Analyzer 720" Bio-electrical Impedance. The results are on a scale from 1 to 100 where 70 or less indicate a weak or obese type, 90 or over a robust

type with well-developed physical structure and in the remaining range (70-90) normal and healthy type are classified.

The study conducted shows a uniform increase of the FS for the totality of the participants involved in the strength training program with an improvement of overall team fitness score by 2,2 points with a maximum of 5 points and a minimum of no variation, as visible in Figure 6.

Figure 6 – Fitness Score comparison

Name of player	D.O.B.	1st InBody Fitness Score	2nd InBody Fitness Score	Difference
Player 1	10.12.1992	80	84	4
Player 2	14.10.1996	84	85	1
Player 3	2.10.1995	87	89	2
Player 4	25.9.1997	83	84	1
Player 5	21.4.1997	76	80	4
Player 6	24.10.1997	84	86	2
Player 7	11.7.1991	77	82	5
Player 8	9.10.1985	89	90	1
Player 9	1.8.1998	82	82	0
Player 10	27.11.1990	87	89	2
Total		82,9	85,1	2,2

8 RESULT

For Kajaanin Haka R.y. and his Management staff, the whole program was inclusive of competences in physical activity with good variety of training and technique method throughout the entire period represented a good opportunity to lead a realistic and long-term program, that had an overall improvement on the entire group of athletes.

For the writer of the thesis, between the others, competences in wellbeing and health promoting physical activity have been acquired. Besides this, knowledge in pedagogy and leadership in the area of sport management played an important role in the totality of the study research. However, the study presents the following limitation like the limited amount of participants (ten), who completed the strength training program and held both the body composition test, before and after it. The initial number of players involved in the study research was slightly higher as it included 18 players, but due to injuries that occurred during the preparation and the impossibility for some of the players to have the assessment in the testing period, lead to a more limited number of participants.

The impossibility to assess the effective adherence to the guideline given by the nutrition plan, has also be taken under consideration by the author. A general guideline, supporte by an explanatory video available on web (<https://www.youtube.com/watch?v=7YrZgLbc2Og>) has been valued by the author as the most efficient possibilities available.

The author recognizes the impossibility to ensure accurate test results due to the particular condition that could have affected the result of the “In Body Composition Analyzer 720” Bio-electrical Impedance, such as different timing when the first and second test were conducted, due to the impossibility for certain examinee to place the test at the same time such as in the morning on an empty stomach. Impracticality to totally ensure that all the examinees were fasting for at least two hours has been considered also by the author of this study research.

For the author of this research beside the opportunity to realize his thesis, has represented a valuable work and life experience. The choice to base the study on a real scenario allowed also several other beneficial factors like the involvement of third parties such as “Myötätuuli” and hence other students which have the opportunity to practice in the measurement of body composition. The entire project also generated an economical revenue for the University, which rented the local gym to the Kajaanin Haka R.y..

On the other side, the whole group of players which have been involved in this program had the chance to train in better facilities, and had customized coaching during the entire process which increased the sense of awareness of their training knowledge, in specific in the field of strength training.

9 CONCLUSION

The whole program planned and developed by the author of this study research, had as purpose to verify the following:

1. Evaluate the potential impact of a customized strength-training program based on one weekly session including resistance-training method in a gym, on a team of semiprofessional soccer players.
2. Measure, eventual variation in body composition of the players involved in the training program with a particular focus on increase of skeletal muscle mass.
3. Assess the suitability of “In Body Composition Analyzer 720” Bio-electrical Impedance test as device to evaluate the body composition and degree of fitness level of semiprofessional soccer players.

The thirteen weeks' preparation period, included a weekly resistance strength training session with machines, a body weight practice and other two aerobic sessions, it affected the body composition of most of the participants of this study research, due mainly to the variation in total body weight occurred. Observed improvement in the presence of skeletal muscle mass of the examinee have been registered. Besides this, a non-uniform correlation between the growth of fat free mass and relative body weight have been shown, due to the increase in body fat percentage of certain players. Overall according to the individual global fitness score given by the “In Body Composition Analyzer 720” Bio-electrical Impedance, the study suggests that the totality of the participants have displayed a positive alteration. According to the limitation exclaimed, the author considers valid and accurate results given by the test through the “In Body Composition Analyzer 720” Bio-electrical Impedance.

The entire study research, although keeping in mind the relatively small budget available, beside the restricted number of participants; it represented a valid opportunity to combine the thesis process with a real study case within the local community. The material produced during the execution of the project will reinforce the curriculum of the author for future eventual job opportunities in the field of physical conditioning enhancing. The study done by the writer contributed to enlarge his own knowledge in particular in the field of exercise physiology and nutrition.

A more precise delivery of information related to the field of strength training and diet plan to the whole group of participants of the research, could have been done more accurately by the author, to raise the level of awareness of them about these topics. However, the project led Kajaanin Haka R.y. to take more into consideration the importance of strength training programs within their players, implementing this aspect of training focus on physical conditioning even in the current season, including also the athletes belonging to younger categories, with project similar to that one done by the author of this thesis.

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