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Editorial

This special issue, which you now hold, is comprised of 3 research and 13 review articles related to sport nutrition, physiology of sport and exercise and sport nutrition for health and performance

The editors would like to thank the contributors who gave so generously their time and experience and who made this publication a valuable tool for scientists in the field of sport nutrition for health and performance. All authors participated at the Post Graduate University Course NK_Move: Dietetics and Nutrition for Wellness, Sport and Physical performance at Dipartimento di Farmacia, University of Salerno.

Thanks are also due to the referees for their valuable comments and for the very detailed and accurate review of manuscripts; their comments certainly helped to improve the papers.

The editors are also very grateful to the Editorial Board of Pharmacologyonline for embracing this project with interest and enthusiasm, and for the opportunity to publish this first NK_Move Special Issue in this attractive and interesting journal.

Luca Rastrelli and Giuseppe Castaldo
Guest Editors

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SPORTS INJURY PREVENTION: A CONCISE REVIEW

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Abstract

Introduction: It is widely recognised that physically active lifestyle and sport participation have the potential to improve health. However, involvement in sports can increase the risk of sustaining an injury. Recently, a growing interest in the issue of sports injury prevention has been registered. Despite the variety of preventive intervention proposed, the translation of this evidence into real-word sport settings is still poor.

Methods: Review of the available literature.

Results: Pre-participation screening is used to identify conditions that might adversely affect sport participation and identify injury risk, need for pre-habilitation or rehabilitation, as well as establish baselines of athlete health, from an orthopedic /musculoskeletal and general medical perspective. Medical assessment must include respiratory disease, neurological and general health screening. Cardiac screening is aimed at identifying those athletes who may have underlying conditions that may lead to sudden cardiac arrest or death. Musculoskeletal screening includes a variety of tests and intervention aimed at the detection and correction of any potential problems with athlete's musculoskeletal composition. Physical and fitness assessment is used to evaluate athletic qualities and to identify the strengths and weaknesses of an athlete. Kinesio taping and physcology can be used as adjuncts for sports injury prevention.

Discussion: Injury prevention should be a primary goal for team-sport athletes of all ages and participation. Further researches are required to improve the translation of sports injury prevention protocols into the real-world sport settings.

Keywords: *Sports injury, injury prevention, injury screening*

Introduction

It is widely recognised that physically active lifestyle and sport participation have the potential to improve health (1–3). In the USA, from 2003 to 2015, average daily participation rates in sports and exercise increased by 3.6% and, in 2015, the 19.5% of those aged 15 and older participated in some form of exercise (4). In 2014, in Europe, some 44 % of the EU population aged 15 or over reported that they practised sport at least once a week (5).

However, involvement in sports can increase the risk of sustaining an injury. About 8.6 million sports-related injuries were documented per year between 2011 and 2014 in the USA (with an incidence rate of 34 injuries per 1000 persons) (6). The majority of these injuries were lower extremity strains and sprains sustained during basketball, American football and soccer (42%) (6). A similar rate of 26 injuries per 1000 persons was registered for the European Union, with a peak occurring in the 15–19 years age group (7).

The most common traumatic injuries in team ball sports, such as basketball, volleyball, soccer and field hockey, are ligament injuries of the ankle (15% of all reported sports injuries), followed by the knee (3%) (8,9), whereas overuse injuries mostly affect the groin area and represent 5%–10% of all sports-related injuries (10,11).

Injury risk factors may have intrinsic (age, sex, general health, physical fitness, genetics) and extrinsic (sports venue, equipment and environmental) origins (12,13). The risk for injuries associated with these intrinsic and extrinsic risk factors can be reduced if athletes complete specific exercise programmes (14–16).

For all the above-mentioned reasons, the prevention of sport injuries is important to maintain and increase a physically active lifestyle and sports participation, and to maximise the related health and societal benefits (17).

Recently, a growing interest in the issue of sports injury prevention has been registered, and numerous studies and systematic reviews have been performed to evaluate the efficacy of preventive intervention on the risk of sport injuries and even to reduce the risk of recurrent injury (18–20). Despite the variety of preventive interventations proposed, the translation of this evidence in real-word sport settings is lagging (21,22). So, the difficulty to implement the prevention protocols, together with some levels of risks that are intrinsic to sport practice, injuries continue to occur (23,24).

Given the heterogeneity of sports injuries and proposed strategies for their prevention, the aim of this study is to give a general overview about the most used protocols and screening tools for sports injuries prevention.

Methods

For the purpose of this review, the studies selected from the available literature and later examined were mainly reviews and books that proposed programmes and screening tools for sports injury prevention.

Results

Pre-participation screening

Pre-participation screening (PPS) has become a routine tool in the assessment of players at the beginning of a new season, or when a new player joins a new training group (25).

Not all pre-participation medicals should follow the same format, but should be tailored to the needs of the medical team, the organisation and the athlete.

The main reasons for performing a PPS in sport are to identify conditions that might adversely affect the sport's participation and identify injury risk, need for pre-habilitation or rehabilitation, as well as establish baselines of athlete health, from an orthopaedic/musculoskeletal and general medical (including cardiovascular) perspective (25).

It is also important to allow the medical team to uncover and discuss high-risk behaviours, such as infections, alcohol use, smoking and drug use (25).

For example, it is well recognized that the use of fluoroquinolones (i.e. a kind of antibiotic drug) can induce tendinopathy (26). Tendinopathies, regarded as a mix of pain, swelling (diffuse or localized) and impaired performance (27), are common in elite and recreational athletes and are traditionally considered overuse injuries, involving excessive tensile loading and subsequent breakdown of the loaded tendon (28–30).

In the PPS process, it is important to collect data from the athlete, such as: personal life, medical and social history (birth defects, childhood illness, genetic trait, eating disorders, etc), athlete's family history (cardiovascular, respiratory, inflammatory diseases, etc), musculoskeletal history (previous trauma and management), sport-specific history (athlete's background within the sport), previous strength training programmes as do pre-habilitation or rehabilitation regimes (25).

Often missed, but vitally important, is the need to know what nutritional input that they get in terms of supplementation, allergy medication or any special diet (25). Consistent consumption of a diet that is well-designed for the athlete in terms of calories, protein, carbohydrates, and fluids will support training and promote optimal performance. The well-nourished athlete should have reduced risk for injury and possess a solid foundation to support recovery from injury and skeletal trauma. Athletic trainers and therapists should encourage good eating behaviors in their athletes: in this way they can promote practices that will reduce the risk of injury in their athlete (31).

Medical assessment

Most examination processes are tailored to the needs of the athlete and the medical team, but it is important to use this to obtain baseline readings on the general medical status of your athlete. Height, weight, BMI and other anthropometric measures such as skinfold thickness can be recorded (25).

In adolescents, being overweight/obese increases the risk of time loss injury and knee injury: for this reason, sport injury prevention training programs should include strategies that target all known risk factors for injury (32).

The medical examination must include: respiratory disease screening (such as exercise-induced asthma, which is highly prevalent in elite athletes) (33), neurological screening (in particular in sports where concussion usually occurs), and general health screening (such as blood tests and hormonal status).

A recent review (34) reported that different biomarkers in the blood, such as hematological, biochemical, hormonal, and serological biomarkers, can be used to monitor performance, overtraining, and overall health in competitive athletes.

Cardiac screening

Cardiac screening is aimed at identifying those athletes, between the ages of 14 and 35 years old, who may have underlying conditions that may lead to sudden cardiac arrest (SCA) or death. Sudden cardiac death (SCD) is defined as an "unexpected death occurring as a result of natural causes in which loss of all functions occurred instantaneously or within 6 hours of onset of symptoms" (35).

The prevalence of cardiovascular disorders known to cause SCD in young athletes is approximately 3 on 1.000 persons (36,37). It is estimated that the 80% of all non-traumatic deaths in young competitive athletes are due to inherited congenital structural or functional abnormalities, most of which can be identified during life (35,38). Male athletes appear to be at a greater risk of exercise-related SCA, and a particularly vulnerable cohort is adolescent males <18 years of age (39). Race is also an influencing risk factor, with black athletes being at higher risk than white athletes, particularly concerning hypertrophic cardiomyopathy (40).

In 2005, European recommendations were established endorsing a screening protocol that prior to participation in organised sport any fit and healthy young person should have cardiac screening that includes a resting 12-lead heart rate monitoring (ECG) (41). This recommendation was informed by the Italian experience of mandatory cardiac screening and has since been supported by such bodies as the International Olympic Committee (IOC), International Federation of Football Association (FIFA) and an institutional review board (IRB) (36,42).

The knowledge that 70–80% of all young athletes with congenital abnormalities, whether structural or electrical in origin, are asymptomatic prior to the event (35) provides the stimulus to do everything possible to uncover underlying cardiac abnormalities. This is why a structured screening process of all athletes, not just the symptomatic ones, is critical.

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The medical history and physical examination for the cardiac screening should be collected as follows: establish the family history (i.e. cases of SCD in the family), ask the athlete if he experienced episodes of syncope, or palpitations, or shortness of breath, or if the athlete was diagnosed a cardiac murmur (25).

Anyway, a negative history or physical examination is not enough to clear an athlete, so further screening is still required to ensure a full cardiac screen. This screen should be performed with: 12-led echocardiogram (to classify the heart as either 'normal', requiring no further testing, or 'abnormal', requiring further evaluation), echocardiogram, exercise stress test/ECG test, 24-hour Holter test, and cardiac magnetic resonance imaging (25).

Musculoskeletal screening

Musculoskeletal (MSK) injury prevention is a process whereby the athlete is screened through a variety of tests to identify any potential problems with their MSK composition. These problems can then be identified and training practices put in place to either eradicate these problems or reduce their possible impact. Several procedures are used by sports practitioners with varying degrees of success as the need for one common procedure for MSK screening becomes apparent (43).

Injury prevention exercise programmes (IPEPs), such as the FIFA 11 (44) + and the Knaekontroll (45), consist of a combination of balance, plyometric, stability and sport-specific exercises targeting established lower limb injury risk factors (46,47).
IPEPs contribute to a reduction of the risk of sustaining sports injuries in athletes. The current evidence indicates that general or mixed IPEPs tend to be more efficacious in preventing sport injuries in athletes, than sports-specific programs (48).

The back and knee are two of the major areas that the screening process needs to assess, due to their importance to locomotion and therefore the resultant sporting performance (43).

An injury to the ACL is one of the most serious problems that can happen to an athlete and have a serious effect on their career (49). The major risk factors associated with ACL injuries include lower extremity malalignments, ligamentous laxity, lower extremity muscular strength considerations, neuromuscular control, hormonal influences, intercondylar notch width and the biomechanics of the athletes' sporting techniques (49).

ACL sprains occur as a consequence of the magnitude and rate of knee valgus whilst landing or turning. In order to reduce the risk of ACL injuries, an athlet who practices a high-risk ACL injury sport (such as soccer or basketball) should also practise exercises that reduce frontal or transverse plane forces through the knee joint (50).

The strength of the muscles around the knee has an important role to play in stabilising the joint and therefore reducing the chances of injury.

A reduction in hamstring to quadriceps strength ratio has been shown to be predictive of ACL injury in female athletes (51). Aagaard (52) suggested that an eccentric hamstring to concentric quadriceps ratio (during isokinetic knee flexion and extension) <0.9 places an athlete at a high risk of ACL injury.

Reduced strength of the hamstrings relative to the quadriceps has also been proposed as a risk factor for hamstring tears (53). Since hamstring strain injuries are endemic in running-based sports, elite sporting clubs invest significant efforts in eccentric hamstring and lumbo-pelvic conditioning programmes for the prevention of primary and recurrent hamstring injuries.

Increasing strain tolerance by increasing hamstring strength may reduce hamstring injury risk in sprinters (50). Anyway, while eccentric training has proven effective in the prevention of primary and recurrent hamstring strains, there is only modest scientific evidence that confirms that lumbo-pelvic stability is an important and modifiable risk factor for hamstring injury (54).

The rehabilitator can only improve and modify the strength and neuromuscular control risk factors, which is why these are key areas of a screening process (49).

Neuromuscular control tests for the lower limb often involve a variety of movements but with common goals: to obtain an objective assessment of function and to challenge dynamic knee stability during landing and deceleration (49).

A range of tests can be used to achieve these goals, such as the single-leg hop, one-leg vertical jump, timed hop, figure of eight running, side stepping and stair running. These tests can also be combined with isokinetic testing to give a full picture of the knee (55).

Muscle imbalances between limbs as well as within are important in assessing the potential for injury in the knee, particularly in females where such imbalances are found in 20–30% of athletes (49,56).

Anyway, if the implication of soft tissue imbalances and asymmetries on athletic performance and injury remains unclear, certain imbalances and asymmetries, may result in abnormal biomechanics or kinetic chain disruptions, with the athlete placed at a high risk of injury (53).

In sport, the kinetic chain concept is often used when describing athletic movements, such as throwing, running and jumping. The term "kinetic chain" describes how components of a system that are interlinked by pin joints can be affected by movement of just one component (53).

Top-level athletes provide the best examples of the human kinetic chain working effectively. The ability to produce repetitive, powerful and energy-efficient movement is almost a prerequisite for success at the highest level in sport. While movement technique is key to kinetic chain performance, equally important is the need for well-developed basic physical attributes, such as balance, stability and strength.

Isokinetic testing can be used, through the study of biomechanics, in a variety of ways to profile an athlete to identify potential areas of injury concern (43). Inefficient movement mechanics lead to injury accelerating muscle fatigue and putting excessive stress on joints (53).

Once deficiencies in the kinetic chain are identified, the next step is to design interventions to correct the faulty mechanics. For example, an improvement of the power output has been found to offer about a 10% reduction in injuries (57).

The interventions selected will depend on the sport, the individual athlete needs and the situation (i.e. competition, training or rehabilitation phase). The coach, strength and conditioning coach and physiotherapist should all contribute during this stage (53).

The use of core (regarded as the muscles around the trunk and pelvis) stability training is often used to help improve the weak mechanics. Anyway, even if core implementation components represent the most crucial and indispensable aspects of an implementation program (given its vital role in the generation and transfer of energy in the kinetic chain) (53), the current reporting of core implementation components in team ball sport IPEPs trials is inadequate (58).

The flexibility of the muscles in the lower limbs plays an important role in the prevention of injuries to the area and should be incorporated in muscle development programs (43). Muscle stretching training is commonly used by athletes. Anyway, a meta-analysis performed by Lauersen et. al (19) showed that stretching added no beneficial effect in decreasing sports injuries. Several other studies found limited evidence to support the benefits of stretching before or after training for injury prevention (59,60).

Physical and fitness assessment

The assessment of athletic qualities is one of the most important aspects of a comprehensive athletic development model (61).

The maximal strenght, force development, maximal power, muscular endurance, jump (vertical and horizontal) and hop assessment, sprinting speed, agility, balance tests, and isotonic/isometric/isokinetic measurements, should all be assessed through different kind of specific tests (61,62).

While the strength, power and movement qualities discussed underpin an athlete's potential, the ability to endure and express repeated performance within and across a sport match is critical, since the majority of injuries occur toward the second half of a sport match, with endurance likely being a contributing factor (61,63).

Fatigue can reduce muscles capacity to create large, rapid forces and reduce reaction times, concentration and joint proprioception. For these reasons, managing fatigue is a vital component of reducing injury risk (50). Planned variation of training volume on a daily, weekly and monthly basis reduces the monotony of training, which reduces the risk of injury and illness in athletes (64).

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Fitness testing allows coaches and rehabilitators to identify an athlete's strengths and weaknesses, enabling them to tailor and adjust training and rehabilitation according to the athlete's greatest needs (62).

Kinesio taping in injury prevention

The introduction of the kinesio taping (KT, i.e the application of elastic and adhesive tape) is increasing in clinical practice due to its use by athletes at major sporting events (65,66).

Theorised mechanisms of action are different, including reduction of pain through stimulation of sensory afferents, increased range of motion due to enhanced local circulation, increased proprioception, reduced amount of inflammatory substances and increased lymphatic drenage (67–69). However, even if the use of KT was found to be somehow useful in injury prevention in some sports (70,71), its clinical benefits remain unclear, and there is little quality evidence to support the use of KT over other types of elastic taping in the management or prevention of sports injuries (65,66).

Psychology in injury prevention

Educating and assisting athletes to control and regulate their own physiological response to stress is useful in the prevention of injury (72). Teaching deep relaxation techniques to all athletes to enable their bodies to naturally produce a state conducive to healing can prevent minor injuries from becoming more serious and make them less susceptible to injury. One role of the sport psychologist is to help their athletes to become psychologically robust to prevent injury. Research has demonstrated that athletes high in hardiness (i.e. athlete's ability to withstand difficulties and adversity) are less prone to injury, and that hardiness can facilitate the rate and quality of their recovery from injury (73). What athletes experience prior to injury is important, and there is a good level of evidence to support the argument that an athlete can have a psychological vulnerability to injury (74).

Discussion

In modern competitive sport, injured athletes are under pressure to return to competition as early as possible, and they are also afraid of losing their place in the team due to the highly competitive scenario and naturally come under higher pressures to return to play (75).

For this reason, injury prevention should be a primary goal for team-sport athletes of all ages and participation levels (eg, recreational, semiprofessional, professional) since an injury results in performance disability, loss of playing time, high financial burden for the athlete's employer as well as the healthcare system and an increased risk of reinjury and chronicity (11).

Compliance and adherence are important in sport injury prevention research and practice (76,77). For example, identifying the salient psychological factors that relate to individuals' compliance with prevention and rehabilitation for ACL injuries, will provide important knowledge of manipulable factors that could be targeted in injury management interventions (78).

Despite the growing interest in the field of sports injury prevention, the transfer from theoretical knowledge to practical routine is overall incomplete (79).

Sports injury prevention is still an area of public health practice that is often unaddressed at a population level, so a gap remains in the use or application of this information from those in public health. This gap may be due to the lack of time and/or capacity to interpret this literature to support injury prevention practice (80).

For all the above-mentioned reasons, further researches are required to improve the translation of protocols for sports injury prevention into the real-world sport settings.

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WEIGHT LOSS IN COMBAT SPORTS: ANALYSIS OF PHYSIOLOGICAL, PSYCHOLOGICAL AND PERFORMANCE ASPECTS

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Abstract

Weight regulation has become a key component of the culture of combat sports. Athletes practice weight regulation not only to gain a physical advantage over opponents but also for purposes of identity, mental diversion, and mental advantage. Health care professionals working with weight-category athletes should be familiar with both the negative and perceived positive aspects of weight regulation. Psychological counseling may aid athletes in learning how to gain mental advantages in ways that do not require a focus on weight. Instead, from a physiological point of view , various studies have been conducted to investigate the effects of the weight loss on performance-related physical fitness and inflammatory cytokines in athletes who practise combat sport. It was reported that KD diet can be helpful for weight category athletes, such as Taekwondo athletes, by improving aerobic capacity and fatigue resistance capacity, and also by exerting positive effect on inflammatory response. Others studies have shown the effect of ketogenic diet on oxidative stress and antioxidative capacity markers in athlete, the result suggests that weight loss by 3 weeks of calorie restriction and exercise can cause oxidative stress, and that ketogenic diet can be effective for preventing it. It could also be inferred that ketogenic diet can be effective for increasing blood antioxidative capacity.

Keywords: *sport identity, combat sports, ketogenic diet, taekwondo, weight loss*

Introduction

In almost all combat sports, athletes are categorized according to their body weight so the matches are more equitable for body size, strength and agility [1,2].

Since muscle strength and power of an athlete with heavier weight are stronger when compared with the abilities of an athlete with a lower weight, it is common practice in heavier weight athletes to cut the weight aggressively close to the contest, in order to compete in the lower weight category and confront less strong athletes than their normal weight classes.

Despite many adverse effects of rapid weight loss (RWL) on health status, the use of very injurious and aggressive procedures for rapid weight loss is very high in most combat sports, such as wrestling, judo, taekwondo and boxing.

To achieve such a rapid weight reduction, athletes use a variety of methods such as: reduced liquid ingestion; use of saunas, blouses and plastic suits; reduced energy intake; fasting one day prior to the weigh-in; reduced carbohydrate and fat intake. Other more aggressive methods are also used, such as vomiting, laxatives and diuretics. the use of diuretics are prohibited by the World Antidoping Agency [3] and are the reason of doping cases in combat sports [4]. Those methods might increase reactive oxygen species (ROS) production.

ROS, produced by physiological metabolism or external stimuli, are today known as a major factor that induces oxidative stress and accelerate aging and various diseases (including cardiovascular diseases, cancers, Alzheimer's disease and Parkinson's disease) [5]

For this reason, a way to induce rapid weight loss has always been demanded for athletes who have to face a race and require this result, without having all these side effects and deteriorate the performance [6].

An other study [7] reported that 14 days of ketogenic diet with dietary restriction resulted in weight loss and significant improvement in total antioxidative status, without causing blood oxidative stress.

Methods

A review of the most relevant studies was carried out, to systematically evaluate physiological, psychological and performance aspects of weight loss in combats sports.

Results

Several investigations have reported that RWL in athletes gave decreased short-term memory, vigor, concentration and self-esteem as well as increased confusion, rage, fatigue, depression and isolation [3 4 8 9 10], all of which may ruin competitive performance. Infact, decreased short-term memory can impact the ability of an athlete to follow the coach's instructions before a match. In addition to these problems, a high percentage of wrestlers are quite concerned about their body mass and food intake and 10–20% of them feel unable to control themselves while eating, this means eating disorder. This number increases to 30–40% after the competition [8]. Few studies investigated the association between rapid weight loss and competitive success in real tournaments [11, 12]. In a regional-level wrestling competition, it was observed that athletes who lost a higher amount of weight achieved better classification than the athletes who lost less weight [13]. When all weight categories were grouped, a higher percentage of medalists (58%) had not followed the minimum wrestling weight recommendations compared to those who had followed such recommendations (33%).

Therefore, athletes who had practiced more aggressive weight-cutting procedures had more competitive results than those who were more aware of their health. The constant attention directed to body mass control increases the probability of eating disorders such as binge eating, anorexia and bulimia, with higher risk among female athletes [14].

Such weight loss methods also may result in the deterioration of athletes' health, such as decrease in immune function or in resistance to infection, by causing problems with respiration, circulatory, thermoregulatory and renal function [15].

Accordingly, the necessity of a more effective weight control method is being suggested that can eliminate the damage of athletes' performance and health, while recently there has been an increasing

interest in ketogenic diet, which has been known to be a possible method for loosing weight without negative effects on muscle strength and muscle size [6].

Ketogenic diet, a kind of low carbohydrate high fat diet, is a method of reducing carbohydrates intake while allowing a large amount of lipids intake and a proper amount of proteins intake, to reach a physiological state called ketosis, a medical term. Ketosis means the state of using lipids instead of carbohydrates as a fuel for the body [16]. Carbohydrate combustion is fast and drastic compared to lipids and proteins, whose combustion is slow and constant without acceleration. Therefore replacement of carbohydrates with lipids as an energy source of the body results in less variations in physiological condition and in desire for food intake, consequently effectively leading to decrease in weight and body fat mass [17].

In several studies athletes have been subjected to RWL with KD or NKD, and results were compared in terms of weight loss, body composition and variation of blood parameters.

The participants were randomly assigned to 2 groups, the ketogenic diet (KD) group, and the non ketogenic diet (NDK) group. The participants were subjected to blood analysis of lactatedehydrogenase (LDH), malondialdehyde (MDA), ROS, superoxide dismutase (SOD) , high density lipoprotein (HDL). The participants selected for the second research were 20 Taekwondo athletes of the high schools located in the C area who participated in a summer camp training program without a physical or mental disease. They were randomly assigned to 2 groups, 10 participants to each group: the ketogenic diet (KD) group, and the non-ketogenic diet (NKD) group. Performance-related physical strength was evaluated by measuring the items related to aerobic capacity, anaerobic capacity, muscle strength, muscle endurance, instantaneous reactionary force, and balance.

The participants were subjected to blood analysis of interleukin (IL)-6, tumor necrosis factor (TNF)-α, and interferon (IFN)-γ

In the first research, compared to before the diet period, there was significant decrease in weight after the period, as well as in % body fat, fat free mass and BMI (P<0.05). However, no difference was found between the KD and NKD groups, and there was also no effect of interaction between the independent variables. No difference were found in oxidative stress and antioxidative capacity markers after diet during 3 week.

In the cases of ROS and SOD, no significant difference was found between the independent variables. In contrast, in the case of LDH, MDA and HDL interaction effect was found when comparison was made between before and after diet and between diet groups (P<0.05). According to result of the main effect analysis, the KD group showed an elevated HDL level and NKD group showed an elevated both LDH and MDA level after diet compared to before diet (P<0.05).

In the second research,; compared to before the weight loss period, there was significant decrease in weight after the period, as well as in %body fat, fat free mass and BMI (P<0.05). However, no difference was found between the 2 groups, and there was also no effect of interaction between the independent variables. In the cases of IL-6 and IFN-γ, no significant difference was found between the independent variables. In contrast, in the case of TNF-α, interaction effect was found when comparison was made between before and after weight loss and between the 2 diet control groups (P<0.05). According to result of the main effect analysis, both the KD and NKD groups showed an elevated TNF-α level after weight loss compared to before weight loss (P<0.05).

Discussion

During the last several year, there have been many research reports that proved the effects of ketogenic diet on short-term weight loss, as well as on metabolic profile with regard to insulin sensitivity, glycemic control and serum lipid values [18]. In addition, Paoli et al. (2012) reported that 30 days of ketogenic diet could decrease the weight and body fat mass of elite artistic gymnasts without affecting their performance. Such research results show that ketogenic diet can be very effective for weight class contestants who need rapid short-term weight loss without negative effect on performance. However, in spite of many reports on the effect of ketogenic diet, there have been rare

researches that involved athletic contestants to investigate the effect of short-term ketogenic diet on body mass and body composition. The result showed that 3 weeks of ketogenic diet and Non ketogenic diet both caused decreases of weight, body fat mass and BMI, and that there was no difference between the 2 groups in the extent of such decreases.

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A NUTRITION INTERVENTION FOR BODYBUILDING COMPETITION PREPARATION: CASE STUDY

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Abstract

Bodybuilding is the sport par excellence focused on changing body composition, through the increase in muscle mass and reduction of body fat; the aesthetic aims are therefore subject to intense training and nutrition schemes.

Along with endurance and aerobic exercise, targeted energy and macronutrient traps are followed to accumulate muscle mass in the low season (offseason) and reduce fat mass during the preparation season (1).

This work aims to examine how the dietary strategy adopted on a typical bodybuilder, and specifically the counting of carbohydrates in the week before the competition, is useful to promote the athlete's muscular definition. The progressive reduction of carbohydrate and fat intake has been used to create an energy deficit with consequent fat loss; protein intake remained low similar to the off-season period to prevent loss of lean mass.

The adopted food strategy was divided into two phases: the first phase covers the two months prior to the first competition of the season based on the maintenance of the daily glucose quota (refeed days), with a progressive decrease up to the week preceding the competition, second phase (peak week), with carbohydrate reloading in order to increase glycogen and muscle volume.

Keywords: *Bodybuilders, competition, contest preparation, energy restriction, supplementation,*

Introduction

In competitive bodybuilding, athletes are judged based on their muscularity (muscle size), conditioning (absence of body fat) and symmetry (muscle proportion). In order to obtain the required physical qualities, the athletes take a regimen of fat loss without affecting the lean body mass (LBM) accumulated during the mass period; this practice is recognized as "hardcore" (1).

The setting of a diet during the definition phase is based on two important parameters: protein intake and caloric intake.

The total caloric intake should be about 15% -20% lower than the normal calorie diet, taking into account the metabolic adaptation that intervenes in this condition.

The few studies in this regard, show that in trained subjects, being able to count on a better metabolic efficiency and an always present physical exercise, they suffer little from a real metabolic adaptation, thus avoiding a reduction of their basal caloric consumption. What you may be subjected to is body weight loss (including muscle mass); this is why it is necessary to intervene in such a way as to limit the weight reduction between 0.5% and 1% per week. Moreover it must be considered that the lower the fat mass reached, the greater the lean mass that will be compromised (2).

This paper aims to examine how the food strategy, specifically the CHO counting, is useful to promote muscular definition in pre competition.

The study involves a single bodybuilder in preparation for the IFBB (International Federation of Body Building) competitive on the Italian national circuit.

The nutritional strategy adopted by its trainer refers to a period of about 3 months, 90 days.

Methods

As this is an observational study, all data was provided by the individual participant and his trainer before and after the competition. It was requested to describe in detail all their practices (training, diet, food supplements)

Participant characteristics

Athlete A. A., 32, tricopigmentist tattoo artist

Ginoid conformation

Height 178.0 cm

Refeed days training: 6 days a week, with 4 series scheme for 8/8/6/6 high load repetitions and 60 seconds recovery

Peak week training: 7/7 days with 4 series scheme for 12 repetitions each and 40 seconds of recovery.

Initial body composition

On 10 April 2019 a 7-fold computerized body analysis was performed. The main data of the test show a body weight of 91 kg, with a body fat percentage of 6.1% compared to the normal values of equal sex and age ranging from 14 to 17%.

The basal metabolism was calculated according to the Grande and Keys formula and is equivalent to 2666 kcal.

Results

On 25/06/2019 the athlete underwent a body analysis for bioimpedance analysis after his three competitions; The final data reveal a current body weight of 95.0 kg. TBW = 96.9%, ICW = 68.1, ECW = 31.9.

Discussion

The variables on which to act when it comes to building muscle or losing fat are the caloric surplus to allow the construction of new muscle tissue or energy deficit when you want the body to gain from only the energy from fat (3).

The typical carb up charge regimes involve a two-step process. The first step is to reduce the intake of carbohydrates as much as possible. This lowering of carbohydrates depletes the muscles of glycogen, which is the form of storage of carbohydrates in the body (stored in the liver and muscles). Since muscle glycogen is stored with 2.7 grams of water, when the glycogen muscles are depleted, a considerable amount of stored body water is also lost. This first step of reducing carbohydrate intake usually occurs

for three days. For the next three days, carbohydrates are added to the diet. Since the glycogen muscles are depleted in the first phase of loading carbo, the idea is that increasing the carbohydrates in the diet will not only reconstitute lost muscle glycogen, but also achieve a super compensation effect where the muscles now memorize more glycogen than before loading carbo. The goal is a more complete muscular aspect (4-5).

The strategy put into practice in our study was based on the carbohydrate count which becomes particularly important during the peak week.

Glucid aid

Carbohydrate manipulation strategies followed a pattern similar to classic CHOL, with three days of restriction, followed by three days of recharging that declined in recent preparations with a single day of pre-charge recharge.

For an athlete who has a calorie expenditure up to 4000kcal, we recommend about 600g of CHO to reconstitute glycogen deposits. This contribution was introduced during the low season to then reduce the carbohydrate load in peak week. In the three days of discharge, the CHO% was reduced from 20% in the first day to 10% in the third day, to then raise the glucose quota in the two days prior to the race.

The result is that our athlete manages to maintain muscle mass despite the caloric deficit that would normally lead to a reduction in muscle mass. Anthropometric measurements in fact show for example the same circumference of the biceps before and after reloading equal to 43 cm.

Water and electrolytes

The handling of liquids was necessary in favoring the drainage of extracellular liquids. During the peak week it is possible to consume 10 L of water a day to reach only 2 L in the day before the race. Simultaneously with the reduction of water the contribution of sodium has been considerably reduced until a complete restriction in the day before the race two weeks before the race in order to avoid water retention on the stage and be able to assess, with due advance, the actual weight achieved by the athlete.

Beta-alanine. The benefits are also known of this. In this case the chronic up to even the immediate pre-race can help in terms of performance and indirectly on body composition.

Supplementation

Creatine. Even in the pre-race period, creatine intake is useful and essential. The benefits are known, the difficulty lies rather in considering the increase in weight and a slight effect of prerogative that is consequent to it. That's why the assumption has been eliminated

Conclusion

The strategies reported in the present investigation may not even reflect the most effective strategies to improve a competitor's aesthetics. This manuscript should not be considered a guide to the peak; it simply attempts to describe the current practices and plausible mechanisms of action used on a typical bodybuilder. Future work should focus on the bodybuilding metabolic requirements of competition day to better prepare athletes for their time on stage. Finally, more qualitative research is needed to better understand the role of peaking in bodybuilding culture.

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Table 1. Early season food plan (REEFED DAYS)

	BREAKFAST	SNACK	LUNCH	SNACK	DINNER
MONDAY TUESDAY WEDNESDAY	300 ML WHITE EGG 1 WHOLE EGG 80 GR BASMATI RICE	150 GR TURKEY 100 GR RYE BREAD	225 CHICKEN BREAST 80 GR BASMATI RICE 1 EVO SPOON 1 DISH OF ZUCCHINI	130 GR OF NATURAL TUNA 50 GR KAMUT TUNNELS 1 EVO SPOON	300 GR COD 80 GR QUINOA 1 CUCUMBER PLATE 1 EVO SPOON
THURSDAY	250 ML WHITE EGG 1 WHOLE EGG 100GR BASMATI RICE	130 GR TURKEY 120 GR RYE BREAD	200 CHICKEN BREAST 80 GR BASMATI RICE 1 EVO SPOON 1 DISK OF ZUCCHINE	110 GR OF NATURAL TUNA 70 GR KAMUT TUNNELS 1 EVO SPOON	200 GR SALMON 100 GR QUINOA 1 DISH OF ZUCCHINI 1 SPOON OF EVO
FRIDAY SATURDAY SUNDAY	320 ML WHITE EGG 1 WHOLE EGG 60 GR BASMATI RICE	150 GR TURKEY 80 GR RYE BREAD	250 GR CHICKEN BREAST 60 GR BASMATI RICE 1 EVO SPOON 1 DISK OF ZUCCHINE	150 GR OF NATURAL TUNA 30 GR KAMUT TUNNELS 1 EVO SPOON	275 GR GRAY SKIN 60 GR DI QUINOA 1 CUCUMBER PLATE 1 SPOON OF EVO

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Table 2. Pre-race food plan (PEAK WEEK)

	BREAKFAST	SNACK	LUNCH	SNACK	DINNER
MONDAY TUESDAY WEDNESDAY THURSDAY	300 ML WHITE EGG 2 SPOONS OF CLARIFIED BUTTER	150 GR CHICKEN BREAST 1 EVO SPOON	300 GR OF COD 1 EVO SPOON	200 COD 1 EVO SPOON	300 GR CALF 1 BUTTERIFIED BUTTER SPOON
FRIDAY	300 ML WHITE EGG 2 SPOONS OF CLARIFIED BUTTER	150 GR CHICKEN BREAST 1 EVO SPOON	300 GR OF COD 1 EVO SPOON	200 COD 1 EVO SPOON	PIZZA ICE CREAM 500GR
SATURDAY DAY OF COMPETITION					

Figure 1. image of the start of the season - before the competition

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POSTURAL REBALANCE IN PREVENTION AND CARE OF PEFS PROBLEMS

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Abstract

Some authors mention the osteoarticular alterations among the possible causes of edematous sclerotic fibrous panniculopathy (PEFS), but the role of posture in the etiopathogenesis of PEFS and an aspect, to date, still little investigated.

Posture derives from the latin positure o position, thus indicating the position of the body, its shape, the spatial organization of individual parts of the body and how they relate to each other.

The system is managed by the postural tonic system, composed of a series of structures that reside in the SNC and pheripheral and designed to react to stimuli by adapting the posture to allow the body to continue to function without pain.

The objective of this study is to demonstrate how rebalancing a postural alteration, specifically a rigid diaphragm, can improve a picture of PEFS and/or reduce its symptoms.

For this purpose an eight-week program applied to a patient with PEFS was used.

The first four- weeks were planned only postural rebalancing, in the next four weeks the work in posture were accompanied by a series of strategies aimed at resolving the specific picture of the patient's PEFS.

The degree of cellulite was clinically evaluated with the PAFEG PROTOCOL. The oedema was evaluated by examination with BIA and digital photos were taken for later comparison.

The respiratory pattern and the overall posture of the patient were clinically evaluated using for metric spinometry and a baropodometric examination.

The PH of the urine and the basal metabolism were also evaluated.

The result of the first four weeks showed an improvement in the respiratory pattern, plantar support and posture overall as well as the disappearance of the symptom of heavy legs. No significant changes in the cellulite texture were detected.

Instead of significant than that produced by programs that do not involve postural rebalancing.

The analysis suggests that diaphragmatic stiffness is correlated with a picture of PEFS and that if flanked by more specific strategies can enhance/amplify the effects

Keywords: *Gynoid lipodystropy, posture, alkaline diet, radiofrequency*

Introduction

PEFS (Edematous Sclerotic Fibrous Panniculopathy) is a multifactorial degenerative disease that affects the adipose layer close to the dermis, completely altering the connective tissue, with possible involvement of the deeper adipose layer (1).

Correlates positively with:

-the gynoid byotipe: Women who have more estrogen and progesterone than android hormones and have a large reserve of fat in the lower limbs.

-with excess fat or high bmi values

Is characterized at the level:

-histological from exudation, lipodystrophy and fibrosis.

-clinic from non-inflammatory thickening of the subepidermal layers, sometimes painful manifested in the form of nodules or plaques of different sizes and positions.

-Aetiopathological by reactive process of SFA (amorphous fundamental substance) associated with microcirculatory deficit, accumulation of hyaluronic acid.

The causes of PEFS are different and not yet fully investigated. Among these:

-The constitutional biological factor

-Estrogens that cause an increase in capillary permeability and a decrease in venolymphatic tone

-Interference in the mechanism of contraction of the first limph

-High protein concentration
-alteration in the anchorage fibers
-Nutrition
-sedentary lifestyle
-The use of hormones
-Tobacco and alchool
-Stress
-Oxidative stress (cascades of response to oxidative stress)
-osteoarticular alterations

The stages of cellulite are (according to Guirro,2001):

-Stage 1 oedema
-Stage 2 edema gel
-Stage 3 fibrosis
-Stage 4 and 5 advanced fibrosis and sclerosis

Pefs is characterized by the suffering of one or both systems that take on the task of absorbing the excess liquid present in the interstitial level: the venous and lymphatic systems.

The malfunction of the former produces a venous oedema with a low protein content, the malfunction of the latter produces a lymphatic oedema with a high protein content.

Factors that can favour/obstacle the functioning of the microcirculation are:

-The muscular contraction, because the muscular pump of the lower limbs determines the displacement of the liquids in a centripetal sense.

-physical exercise, because it induces a sympathetic stimulation that produces a vasoconstriction that at the venous level decreases the volume by increasing venous pressure.

-The decrease in vassal oncotic pressure, due to a lowering of the concentration of proteins in the blood, often linked to diets with very low protein content.

-The increase in interstitial osmotic pressure, due to an excess of proteins or solutes at the interstitial level.

-A correct footplate support, because in this way the pressing of the footplate pump is correctly activated

-The variation of abdominal pressure: a functional diaphragm that maintains an optimal excursion of movement creates, during the expiratory phase, a negative abdominal pressure that favours the venous return.

In recent years some authors have begun to mention osteoarticular alterations among the possible causes of PEFS (2).

Others have gone a little further by stating that the localization of cellulite in some areas (e.g. medial knees) is not random but is related to the presence of an alteration in the postural trim of that joint.

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Methods

Clinical case: 41 year old woman with grade 3 PEFS and recurrent symptoms of heavy and swollen legs.

A clinical evaluation of PEFS with PAFEG PROTOCOL (validated) was made, which also includes an evaluation of oedema with BIA AKERN and digital photos using GLCM MATRICES (software image j1.45 for subsequent comparison.

The posture was evaluated as a whole and specifically the respiratory pattern. The morphology of the trunk was detected using a formetric spinometry and the plantar support in statics and dynamics was evaluated with a baropodometric examination.

The PH of the urine with EDGE (multiparameter of the Hanna instruments) and the basal metabolism with calorimeter fit mate by cosmed were also evaluated.

In addition, an evaluation of the localisation of subcutaneous fat with plicometry was made.

The patient followed the following program:

1) For the first four weeks a program lasting one hour twice a week:

-myofascial diaphragm treatment

-diaphragmatic respiration in decompensated global elongation

2) For the next four weeks a program of this kind:

-Treatment with Radiofrequency (tecar Indiba) once a week to approach signs of ptosis present more clearly on the area of the right buttock subplate.

-Physical exercise appropriate to the degree and the type of PEFS of the patient.

-The training session opened with fifteen minutes of postural rebalancing, to continue with the prescribed exercise and end with 20-30' of self-induced lymph drainage.

The total duration of the exercise is one hour and thirty/one hour and forty, three times a week.

-Diet slightly low-calorie at the level of its basal metabolism (the patient was sedentary), alkaline (previously followed an acid diet: the pH of urine was 5) and with a protein quota redesigned more appropriately (1,2 grams per kg of ideal body weight. The diet that followed before was hyper-protein: about 3 grams of protein per kg of body weight).

The subdivision of macronutrients was: 45% carbohydrates, 25% protides, 30% lipids.

She assumed 2,5 kcal per kg of ideal body weight.

No kind of supplements was used.

Results

The check after the first four weeks showed up:

-Insignificant changes in cellulite texture to clinical evaluation

-Improved, instead, the respiratory pattern, the plantar support and the morphology of the trunk

-Almost disappeared the symptom of swollen and heavy legs.

The check after the next four weeks has, instead, highlighted:

-Cellulitic texture significantly changed as well as the aesthetic profile and the ptosis

-Discrete decrease in subcutaneous fat in the pertrochanteric (meno 2 cm) and suprapatellar (meno 1 cm) area

-Due kg body weight loss

Discussion

The objective of the study is to demonstrate how rebalancing a postural alteration, specifically a rigid diaphragm, can improve a picture of PEFS and/or reduce its symptoms.

Case analysis suggest that it's plausible to think:

-That an alteration of the respiratory pattern (in the guise of a diaphragmatic rigidity) may aggravate a picture of PEFS

-And that not including the treatment of the diaphragm (where necessary) would reduce the benefits of others strategies more specific to PEFS.

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SUPPLEMENTATION OF COLLAGEN HYDROLYSATES IN SPORT: AN UPDATE

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Abstract

The intent of this work is to examine the beneficial effects of collagen hydrosylates supplementation in athletes.
Collagen is the most abundant protein in the human body, it acts as a structure for our body, protecting and supporting the softer tissues and connecting them to the skeleton.
Family of fibrous glycoproteins, characterized by their high tensile strength (resistance to stretching forces), which perform their function exclusively in the extracellular matrix. Collagen is secreted mainly by fibroblasts, but also by smooth and epithelial muscle cells.
The relative composition and amount of different collagens influences the matrix organization of connective tissues. The undirected thin fibrils are composed of collagens II /XI and IX. The tendons contain large bundles of parallel fibrils, which are essentially made from collagen I with small amount of collagen III and IV.
Type II collagen proves to be a valuable ally in protecting articular cartilage from joint wear and tear caused by articular stress.

The administration of new, safer formulations of type II collagen can minimize the risk of allergies and infections, as compared to the previous formulations.

Keywords: *collagen hydrolysates, cartilage, articular stress*

Introduction

Collagen is the most represented protein in the human body (30% of the protein concentration). It is distinguished both by its abundance in the organism and for the variety of conformations it assumes and the functions it performs (1). There are different types of collagen in the literature, whose structure changes depending on where it is located. *Type I* collagen is more expressed in the skin, tendons and bones; the cartilage is rich in *type II* (2). What changes is only the three-dimensional organization that collagen takes up in space, influenced by the "cross-linking" induced by a specific amino acid: hydroxyproline (3-5).

It is consistent in the nails and bones, flexible in the hair, elastic in the skin, fluid in the secretions that lubricate the joints. In the bone it acts as an organic matrix, which catalyzes the deposit of mineral salts (6). On the mucous membranes it spreads a protective veil, which turns this function apart and dissolves, feeding the underlying tissues. In particular it is an important element of the *extracellular matrix* (ECM) of skeletal muscle and tendons and is mainly responsible for their functionality in terms of force transmission, flexibility, and adaptation (7). Thus, to ensure muscle fiber strength transmission, the ECM structures need to adapt in response to resistance training (8).

Collagen is also the protein most subject to continuous loss through skin peeling, hair, beard, nails, secretions and in other ways.

Collagen also has its own biological cycle, which leads to an incessant degradation. It has been calculated that in the adult the overall share of collagen lost daily is around 20 g per day. About half is produced by the same organism, which synthesizes it starting from other molecules or recycling the amino acids released by the collagen that has reached the end of its biological cycle. The other half comes from dietary proteins, which in order not to trigger fearsome toxic reactions, even of an immune type, must be previously digested and broken down into amino acids or tiny peptides. Unfortunately, the digestive capacity decreases not only with age, but also in various physiological, para-physiological and pathological conditions, which in addition lead to an increased need for collagen: pregnancy, breastfeeding, strenuous work, sport and some illnesses. The requirement increases, during a sports competition or training. The increase in the general protein intake helps, but alone is not enough and beyond certain limits it can be counterproductive, favoring the absorption of undigested, potentially toxic proteins. Nor is native collagen, which is resistant to enzymatic digestion, sufficient. Given the extremely important role of collagen in maintaining adequate joint health, collagen-based supplements have been commercially available for several years (3-5).

Initially extracted from the Achilles tendon of cattle, the use of Bovine glue-gene, due to the increased risk of infectious diseases such as bovine spongiform encephalopathy, has been gradually replaced with that of an equine nature. Currently there are procedures able to extract collagen also from fish and vegetable products, thus minimizing the risk of potential infectious diseases, as well as possible allergic manifestations related to the high antigenicity of this protein. Most producers (food supplements and cosmetic products) prefer to include marine collagen (fish-derived collagen) or vegetable collagen (natto gum) in their formulations. The study of the pharmacokinetic properties and the enormous progress made by pharmaceutical technology have facilitated over time the development of techniques of chemical manipulation of collagen. From these developments, hydrolyzed collagen was born, obtained by controlled hydrolysis of native collagen, which is more effective than the latter. Hydrolyzed collagen, in fact, has an optimal intestinal absorption profile; better gastrointestinal tolerability, lower allergenicity; and increased bioavailability (9,10).

Although the scientific literature does not yet show completely agreed results, the use of collagen, especially in some pathological joint conditions, would have been effective in preventing joint complications, while improving the clinical picture. The use of collagen prevents and improves the onset of joint pain in athletes subjected to intense training, thus having direct repercussions on the state of sports practice. It also contributes, also in association with drug therapy, to improving joint mobility and the rate of physical activity in patients

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suffering from osteoarthritis, improving their health and quality of life. It helps reduce the amount of joint pain present in the spine. It allows to register an improvement in pain in the temporomandibular joint in patients with fibromyalgia (11).

Each joint has a specific range of motion (ROM) that differs by age and gender.

The ROM is determined by:
-articular cartilage quality/quantity
- ligaments, muscles and tendons strength
- bone structure
- synovial fluid
- joint pain
- joint wear and tear.

Dysfunctions alter the ROM; this is evident in the objective examination and in rehabilitation. For example, in knee instability.

Knee is one of the most complex joints, with a complex ellipsoid that allows flexion, externalization and a small rotation of the leg.

This is one of the most affected joint by sports injuries, due to the fact that it supports the weight of the body and its stability depends on the muscles and ligaments attached to it.

The most involved ligaments in a sports trauma of the knee are ACL (anterior ligament cruciate), PCL (posterior ligament cruciate), and MCL (medial collateral ligament).

In the physical examination of MCL, a test is provided in which a gentle pressure is applied to the limb, to assess laxity, instability and the degree of medial joint opening

(< 5mm, I grade lesion; 6-10 mm, II grade lesion; > 10 mm; III grade lesion).

MCL can be damaged, for example, during a clumsy landing after a jump or with a contrast during a match.

Articular cartilage injuries can occur as a result of either traumatic or progressive degeneration (wear and tear).

The wear and tear of a joint causes the cartilage to become thinner, as it no longer performs its protective function properly and therefore contributes to osteoarthritis, loss of joint motion, joint instability and pain. The mechanism is also sneaky: cartilage lacks blood vessels, so there will not be inflammation in case of chondral fractures. The exclusive damage to the cartilage causes a reaction around the lesion which, however, does not prove to be reparative. Instead, subchondral bone damage will give start to inflammation and reparation, producing new tissue (11,12).

The frictional forces between two areas could be reduced by joint lubrication. We can define "fatigue wear" the damage caused by joint overwork.

When load is proportionate and articulation is not constantly under stress, it can even gain benefits like improving its resistance. When a certain threshold is exceeded, damage occurs, often caused by continuous exposure to a joint stressor.

With aging o because of joint wear, the cartilage covering the joints tends to thin out. Joint surfaces no longer have the same sliding quality as before, resulting more susceptible to injury.

Osteoarthritis is the most common form of joint disease, and the knee is one of the most commonly affected joints (13, 14).

Is characterized by degenerative alteration that proceeds by stages; at the beginning it is asymptomatic, but then ends with joint deformity, swelling, reduction of ROM and limb stiffness.

Joint damage in this condition can be greater and affect various structures, from the synovial capsule, which is lubricated by a less viscous and more abundant fluid, to the meniscus, which is more prone to breakage. Tendons and ligaments become more easily inflamed. Muscular hypotonia also follows.

Attempted tissue repair may result in new growth of cartilage, bone and other tissues. The bone can present an excessive growth on the edges of the joint, with osteophytes.

Who is affected perceives pain and swelling arise during and after sports activity.
It may derives from mechanical trauma or metabolic disorders, from an infection or from a congenital defect of the joint.

Who has osteoarthritis can be predisposed to another condition: *chondromalacia patellae*, also called "runner's knee". It is very common among young athletes, especially female ones.

It is a condition in which the cartilage on the lower part of the patella become thinner and softens with active deterioration of the tissue and progressive bone exposure.

Pain is felt in the anterior side of the knee, especially during and after physical activity. There is

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a feeling of "joint blockage". Among the causes, in addition to the patellar misalignment, or muscle dysfunction, there is joint stress (13,14).

Some types of injury were found in female athletes more frequently than in male colleagues: injury of the ankle and knee joints, shin splints.

Musculoskeletal injuries are more common in amenorrheic athletes and every female althlete should be monitored to prevent them: bone mineral density assessment, hormonal and blood checks. Athletic amenorrhoeais thought to be linked to intensive endurance exercise and poor dietary intake.

When agonism began after the menarche, a menstrual interruption for at least 3 months is called "secondary amenorrhea". A frequency reduction or irregularity is called instead "oligomenorrhea".

Conventional swimmers are the least affected by condition (15).

In a study (16) was investigated the prevalence of the so-called "female athlete triad": eating disorders, menstrual irregularity, low bone mass among young athletes. This could lead to juvenile osteoporosis.

Girls with disordered eating results to have lower bone mass density compared with healthy colleagues. Losing bone mass increases the risk of stress fractures.

NSAIDs are widely used in the treatment of inflammatory diseases associated with pain in sports (17).

According to a study by Carroll & Chad, analgesics alter the structure of the connective tissue (18).

Several studies on animal and human models have revealed that common analgesics would alter the structure of the extracellular matrix of tendons and muscles, preventing remodeling and causing damage such as loss of tendon stiffness. This would highly influence athletic performance, because it would result in a higher joint load and thus a higher risk of injury.

Corticosteroids have been used extensively in management of sports injuries to promote rapid return to the athlete's activities.

The consequences of prolonged use of corticosteroids are widely known, including tendinopathies or the rupture of the Achilles tendon and of the patellar tendon. The clinician will choose an appropriate drug therapy for the kind of injury, assessing risks and benefits of the therapy.

A clinical study studied the efficacy of hydrolyzed collagen used as a food supplement for 24 weeks in athletes with joint pain related to the type of sporting activity performed. The objective of the study was to examine the effect of hydrolyzed collagen on joint pain related to sports activity in physically active athletes and without any evidence of joint pathologies. The randomized, double-blind, placebo-controlled study was conducted at Penn State University in University Park (Pennsylvania) (19).

Parameters including joint pain, mobility, and inflammation were assessed with the use of a visual analogue scale during a 24-week study phase.

The study participants, in total 147 (72 males, 75 females) were randomized into two groups: one group (n = 73) receiving 25 mL of a liquid formulation containing 10 g of hydrolyzed collagen (CH-alpha) ***** and a group (n = 74) receiving a placebo, which consisted of 25 mL of liquid containing xanthan.

The primary efficacy parameter was the change in visual analogue scales from baseline during the study phase in relation to the parameters concerning pain, mobility, and inflammation.

Results: When data from all subjects (n = 97) were evaluated, six parameters showed statistically significant changes with the hydrolyzed dietary supplement (CH) compared to placebo: resting joint pain assessed by the physician (CH compared with placebo (- 1.37 ± 1.78 vs. -0.90 ± 1.74 (p = 0.025)) and five parameters evaluated by study participants: joint pain when walking (-1.11 ± 1.98 vs -0 , 46 ± 1.63, p = 0.007), joint pain in standing position (- 0.97 ± 1.92 vs -0.43 ± 1.74, p = 0.011), joint pain at rest (-0.81 ± 1.77 vs -0.39 ± 1.56, p = 0.039), joint pain when storing objects (-1.45 ± 2.11 vs -0.83 ± 1.71, p = 0.014) and joint pain during lifting (-1.79 ± 2.11 vs -1.26 ± 2.09, p = 0.018.) When a subgroup of subjects with knee arthralgia (n was performed = 63), the difference between the collagen effect hydrolyzes compared to placebo was more pronounced. The pain at rest parameter, assessed by the physician, had a statistical significance level of p = 0.001 (-1.67 ± 1.89 vs -0.86 ± 1.77), while the other five parameters

based on the evaluations of the participants they were also statistically significant: joint pain when walking (p = 0.003 (- 1.38 ± 2.12 vs - 0.54 ± 1.65)), joint pain when standing (p = 0.015 (-1.17 ± 2.06 vs - 0.50 ± 1.68)), joint pain at rest with (p = 0.021 (-1.01 ± 1.92 vs -0.47 ± 1.63)), joint pain during the execution of a straight line (p = 0.027 (-1.50 ± 1.97 vs -0.80 ± 1.66)) and joint pains in direction changes (p = 0.026 (-1.87 ± 2.18 vs -1.20 ± 2.10))

Conclusion: This was the first clinical trial of 24-weeks duration to show improvement of joint pain in athletes who were treated with the dietary supplement collagen hydrolyzed. The results of this study have implications for the use of collagen hydrolyzed to support joint health and possibly reduce the risk of joint deterioration in a high-risk group. Despite the study's size and limitations, the results suggest that athletes consuming collagen hydrolyzed can reduce parameters (such as pain) that have a negative impact on athletic performance. Future studies are needed to support these findings.

Another study analyzed the effect of collagen hydrolyzed in joint pain.

The randomized, double-blind, placebo-controlled trial lasted 6 months. The objective was to evaluate the efficacy and safety of a dietary supplement based on collagen hydrolyzed 1200 mg / day versus placebo during 6 months, in subjects with joint pain in the lower or upper limbs or in the lumbar spine. 200 patients of both sexes of at least 50 years with joint pain rated ≥ 30 mm on visual analogue scale (VAS) were enrolled. The result was based on comparing the percentage of clinical responders between the active collagen hydrolyzed group and the placebo group after 6 months of study. A responder subject was defined as a subject with a clinically significant improvement (20% or more) in the most painful joint using the VAS score. All analyzes were performed using an intent-to-treat procedure.

At 6 months, the percentage of clinical respondents to treatment, according to the VAS scores, was significantly higher in the hydrolyzed collagen group (CH) of 51.6%, compared to the placebo group of 36.5% (p <0.05). However, there was no significant difference between the 3-month groups (44.1% vs 39.6%, p = 0.53). No significant difference in terms of safety and tolerability was observed between the two groups. Conclusion: this study suggests that collagen hydrolyzed 1200 mg / day could increase the number of clinical responders (an improvement of at least 20% of the VAS) compared to placebo. Further studies are needed to confirm the clinical interest of this food supplement.

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MENSTRUAL CYCLE AND NUTRITION IN WOMEN ATHLETES

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Abstract

The menstrual cycle is one of the most important biological rhythm. It is the result of hormonal variations and involves different organs: hypothalamus, the pituitary gland and the ovary. A normal menstrual cycle needs a healthy physical condition and a correct lifestyle: a crucial aspect influencing the menstrual cycle is the food intake. Recent studies suggest that a 17% minimum of fat mass is necessary for menarche and 22% for regular menstruation. These conditions are often missing in the athletes and sportswomen that are pushed to decrease their body weight to improve the training performance, with negative impact on menstrual cycle. Hormone changes and menstrual cycle disorders like dysmenorrhoea and amenorrhea, negatively impact sports performance and training in most athletes. The eating habits of active women are often wrong because they use to eat less to maintain an ideal body weight with a low body fat mass. Low energy intakes increase the risk of fatigue, injuries and illness and menstrual dysfunction, besides lack of improvement in performance and difficulty training at high intensities. A balanced macronutrients intake, as well as the correct hydration, provide the proper amount of macro and micronutrients, as these deficiencies are more and more spread among female athletes.

Keywords: *menstrual cycle, metabolism, macronutrients, micronutrients, supplementation*

Introduction

The link between menstrual cycle in women and their athletic performance has been widely studied in the last years. Do the female steroid hormone fluctuations affect exercise performance? If so, how? Many women believe that their menstrual cycle has a negative impact on exercise training, both psychologically and physically. Nevertheless, the impact of menstrual cycle on sporting performance depends on several factors, such as the type, the duration and the intensity of the exercise. After the circadian rhythm, the menstrual cycle is the most important biological rhythm. Occurring in the female reproductive system, it makes pregnancy possible. Menstrual cycle is the result of hormonal variations and involves the hypothalamus, the pituitary gland and the ovary (1,2). The hypothalamus causes the nearby pituitary gland to produce some chemicals, which prompt the ovaries to release the sex hormones oestrogen and progesterone. An entire menstrual cycle usually lasts between 24 and 38 days, but the duration may vary from cycle to cycle, woman and woman and may also change over the years. The first period occurs during the puberty and it is named menarche, whereas the permanently stop is named menopause. The menstrual cycle is divided in 4 different phases: follicular, ovulatory, luteal, menstrual (Fig. 1). The follicular phase lasts approximately 9 days; it starts on the first day of menstruation and ends with ovulation, under control of the follicle stimulating hormone (FSH) produced by the pituitary gland. This hormone stimulates the ovary to produce around five to 20 follicles; each follicle houses an immature egg. Usually, only one follicle will mature into an egg, while the others die (1,2). The growth of the follicles stimulates the lining of the uterus to thicken in preparation for possible pregnancy. The ovulatory phase occurs mid-cycle and it lasts about 5 days. This phase is the release of the mature egg from the surface of the ovary, and it is characterized by a peak of oestrogen levels which stimulate the egg growth, the endometrial tissue increases to receive the embryo and the production of another hormone, the luteinizing hormone (LH) by the pituitary gland. The luteal phase lasts normally 14 days, from the ovulatory phase until the beginning of the next period. Once ovulation occurs, the follicle that contained the egg transforms into something called a corpus luteum and begins to produce progesterone as well as estrogen. Progesterone levels peak about halfway through this phase. The hormonal changes of the luteal phase are associated with common premenstrual symptoms that many people experience, such as mood changes, headaches, acne, bloating, and breast tenderness. If an egg is fertilized, progesterone from the corpus luteum supports the early pregnancy. If no fertilization occurs, the corpus luteum will start to break down between 9 and 11 days after ovulation. This results in a drop in estrogen and progesterone levels, which causes menstruation. The last phase of the cycle is the menstruation lasting between 3 and 7 days, when the endometrial tissue is discarded from the body through the vagina. Besides the menstruation, the entire premenstrual period has a great impact on women status. In fact, during the premenstrual phase some changes occur in female physiology: weight gain, water retention, breast tenderness, depression, irritability, uterine volume gain, abdominal swelling and intraocular pressure increase, which can seriously affect the daily routine of a woman, included the training performance. Actually, these symptoms of the premenstrual cycle are part of the premenstrual syndrome (PMS) which affects approximately 3%-8% of women of reproductive age. The PMS is not the only disorder associated with the menstrual cycle. All the disorders can be grouped in different classes: oligomenorrhoea (>35 days) and eumonerrhoea (26-32 days) are disorders of cycle length; anovulation is the absence of the ovulation; defects of luteal phase, such as lower levels of oestradiol, LH and progesterone hormones. Besides these defects, the menstrual cycle cannot occur at all. This condition is defined amenorrhoea and it is highly common in younger athletes and sportswomen, in addition to ovulatory and luteal phases deficiencies. A normal menstrual cycle needs a healthy physical condition and a correct lifestyle: one of the most important aspects influencing the menstrual cycle is the food intake. Recent studies suggest that a 17% minimum of fat mass is necessary for menarche and 22% for regular menstruation. These conditions are often missing in the athletes and sportswomen because

they are pushed to decrease their body weight in order to improve the training performance (1,2).

Athletes' energy balance and metabolism

Active females and female athletes have a unique energy demand different from the sedentary women and their male counterparts. Energy intake needs to match energy expenditure to maintain a high level of training, building and repair of body tissues, cover the energy costs of daily living, prevent illness and maintain reproductive function. Eating habits of athletes are often wrong because they use to eat less in order to maintain an ideal body weight with a low body fat mass. Low energy intakes increase the risk of fatigue, injuries and illness and menstrual dysfunction, besides lack of improvement in performance and difficulty training at high intensities. The World Health Organization introduced an index to estimate the energy needs for each type of person, the TEE (total daily energy expenditure), based on gender, age, weight, height, activity and body fat percentage. In particular, the most common method to evaluate TEE in healthy non-athletic people consist in multiply the resting energy expenditure (REE) by physical activity level (PAL) (TEE=REE×PAL). Instead, for athletes the thermal effect of activity (TEA), based on time, intensity and duration of the exercise, need to be added in the equation, so that TEE= REE×PAL + TEA). The TEE equation can be influenced by some aspects, like the menstrual cycle in women (3). A well-planned diet provides not only the appropriate number of calories, but also the correct type. High carbohydrate diets are generally recommended for female athletes because they assure adequate glycogen replacement and the potential for high-level performance and prolonged fatigue resistance. Women burn more fat, less carbohydrate and less protein than men at the same exercise intensity. Female athletes consume 30% less carbohydrate per kilogram of body weight than their male counterparts in the same sports. For this reason, it is recommended that women provide >8 g/Kg bodyweight/day carbohydrate (4) (Fig. 3). Since they rely less on carbohydrate as fuel, they also don't store as much glycogen during carb refeeds. Both differences in the nervous system and the hormonal system, including estrogens, are responsible for women's lesser reliance on glycogen. A more obvious explanation is that women normally have a considerably higher fat percentage than men of the same weight, not only on their body but also within their muscles, so it makes sense to use this as the primary energy source. As far as concern the proteins, they are necessary to maintain and repair muscle and bone. Protein need can range from 1.4-1.8 g/Kg (10-35% of total energy intake according to the Institute of Medicine) bodyweight for strength and power athletes, both women and men (3,4). The sticking point of the deal athletes-diet is the fat intake, as female athletes limit fat consumption and usually follow an extremely low-fat diet (< 10-15% energy as fat). Instead, the recommended fat intake for athletes range from 20-30% of total daily energy. Obviously, a healthy fat consumption is necessary to increase use of lipid sources, hormonal balance and optimal health (4).

Athletes, menstrual cycle and metabolism

Many studies demonstrate that female reproductive system is highly sensitive not only to intrinsic factors, but also to extrinsic factors, like intensive training and dietary restraints of athletes. For this reason, female athletes are prone to develop reproductive dysfunction. The most common dysfunction among females of all ages engaged in highly competitive sport are range from primary amenorrhea or delayed menarche to luteal phase deficiency, oligomenorrhea, anovulation and secondary amenorrhea (5). However, recent studies suggest that the absence of menstruation on athletes depends upon a critical body weight and low-fat percentage. It should be not forgotten that adipose tissue is an active endocrine organ, whose adipocytes secrete factors (known as adipokines) which are involved in signalling, energy balance, insulin action, reproductive function and inflammation processes. Leptin has an important role in reproductive function (6). Athletes have different opinions regarding the effect of menstrual cycle on their performance: some women refer no changes in training during their period, whereas many other are affected from pain and hormonal variations. It has been demonstrated that dysmenorrhea effects on performance are greater

than amenorrhea effects. In general, food and menstrual cycle have a complementary relationship. The diet can affect the reproductive system functions, while menstruation affects the need and use of micronutrients (i.e. vitamins and minerals). Across the menstrual cycle, women experiment changes in body weight and water retention. Food intake and energy consumption vary during the phases of menstrual cycle, especially in women with symptoms compared to women without (7). The food intake is characterized by an increased consumption of fat and carbohydrates, also based on psychological female conditions, especially during the PMS (premenstrual syndrome). Different studies show that glucose tolerance and the insulin responsiveness are modified in this period. At the same time, the estrogens promotes glycogen uptake and storage in liver and muscle, so that the energy reserves are rapidly restored also during exercise.

Supplementation for athletes across menstrual cycle

Besides the importance of balanced macronutrients intake for athletes in general, female athletes sometimes have low levels of certain essential minerals and nutrients, in particular during the menstrual cycle (10). For this reason, supplementation is crucial during the menstrual cycle, when most women feel the changes of their mood and body. Some women find that changing the diet during their period makes pain less severe. It has been shown that following some simple rules helps women in general to feel good and do their best both physically and psychologically during the menstrual cycle. It is recommended to eat food rich in calcium and high in antioxidants; avoid refined food and prefer healthy cooking oil; avoid caffeine and alcohol and eliminate trans-fatty acids. As far as concerns supplementation, different studies show that vitamin E and Magnesium may help reduce menstrual pain, whereas vitamin D and omega-3 fatty acids supplementation may reduce inflammation (11). However, the most frequent deficiency in women during their period is associated to the iron. Iron is essential to deliver oxygen throughout the body and it intake varies during the lifetime, depending on age and physical conditions (Fig. 2). Iron is of particular concern for menstruating people as approximately 30% of premenopausal women are iron deficient (8), and the levels of iron deficiency are much higher in young females as compared to young males (9), also affecting performance because it may lead to fatigue. At last but not least, hydration is important for all women during menstruation. Dehydration contributes to increase the weakness and digestive problems that are a common period side-off effect (12). For constipated women and for those who suffer of diarrhoea, water and its electrolytes help to relieve the situation and maintain the physiological hydration. Also, when the levels of estrogen and progesterone are low, as they are at the start of a period, then the body is more likely to try to retain water, making women feel bloated and uncomfortable. As counter-intuitive as it might sound, drinking more water helps to flush out the system (12).

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Fig.1: the hormonal mechanism in menstrual cycle (1)

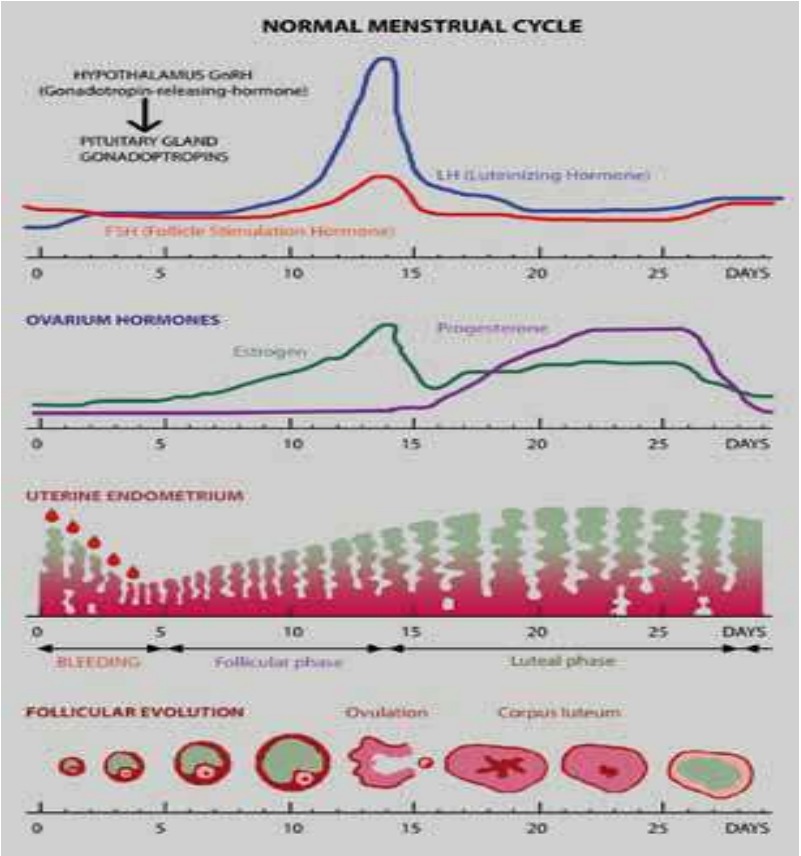

Figure 2. Balance of carbohydrate (glycogen) and fat stores at four phases of the menstrual cycle for 24 h periods in the calorimeter. The follicular (F) and luteal (L) phases were divided into early (E) and late (L) parts. ANOVA shows that the differences between phases were not significant. Values are means, with their standard errors represented by vertical bars, for eight subjects (six subjects for the LL phase) (13)

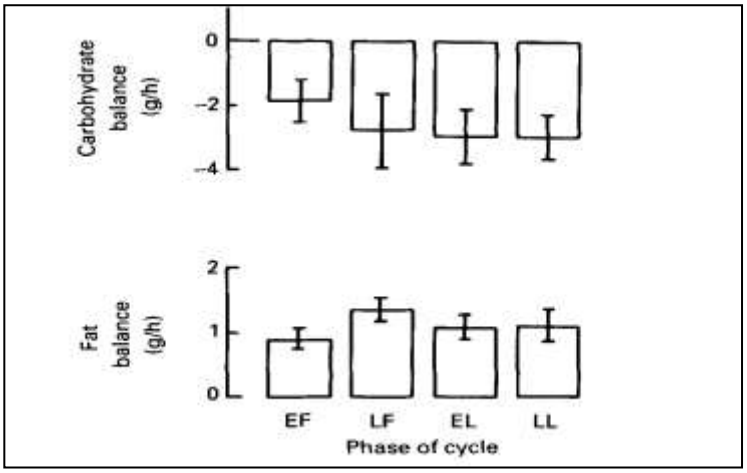

Figure 3: Recommended amount of iron in female diet (4).

Table 3
Recommended dietary allowance for iron: females

Years of Age	mg/d
19–50	18
≥51	8
Pregnant	27
Lactating	9

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KINESIOLOGY OF THE HIP: A FOCUS ON MUSCULAR ACTIONS

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Abstract

In this paper it is analysed the kinesiology of the hip and, in particular, all the muscles synergies during the six main movements (flexion-extension, abduction-adduction, external-internal rotation) and their influence on the coxo-femoral stability and on both sagittal and frontal plan pelvic tilt.
Therefore, it is highlighted the crucial role of the hip joint on the main motor patterns during the biomechanics of gait concerning the triple flexion and extension of the whole lower limb.

Keywords: *hip, pelvis, gait, acetabulum, extracapsular ligaments, intracapsular ligaments femoral head, cotyloid eyelash, glutes, hamstrings, iliopsoas, TFL, stance*

Introduction: anatomical notes

The hip joint is a ball and socket synovial joint made of the pelvic acetabulum and the head of the femur. This joint enables three degrees of freedom.
Cranially, the acetabulum is formed by the ilium, ventrally from the pubis and caudally from the ischium.

The outer edge of the bone is called cotyloid eyelash and it presents a 40 degrees angle on the frontal plane and a 10-15 degrees angle on the transverse one which establishes the femoral neck upward rotation.

The acetabular labrum is a triangular fibrocartilaginous collar which is cranium-caudally wider and cranium-ventrally tighter with the function that allows to enlarge the acetabular cavity.

The femoral head is 2/3 made up by a 40-50 mm sphere diameter and it is attached to the mid-shaft femur through the neck.

The passive hip stability is ensured by a unique intracapsular ligament (Fig.1) called "ligament of head of femur (which starts from the acetabular fossa and ends to the fovea of the femur) and by three different extracapsular ligaments. (Fig.1)

The three extracapsular ligaments are (Fig.2):

- Iliofemoral ligament – is the strongest of the three ones and, at the same time, limits hip hyperextension ("Y" shaped).
- Pubofemoral ligament – which avoids excessive abduction and hyperextension (triangular shape).
- Ischiofemoral ligament – which enables the coaptation between the femoral head and the acetabulum; simultaneously, it prevents hyperextension (spiral orientation).

Muscle action and hip articular physiology

The hip movements on the sagittal plan are the flexion and extension.
Flexion (Fig.3) can be done in three different ways: the first one is an active contraction with flexed knee of about 130°; the second one in an active contraction with extended knee of about 80-90°; the last one consists in a passive action with flexed knee of approximately 145°.

The main muscles in charge of the flexion are the iliopsoas (psoas major, psoas minor, iliacus -Fig.5-) sartorius, rectus femoris and tensor fasciae latae; additionally it follows with pectineus, gracilis, adductor brevis, adductor longus, adductor magnus (except for its posterior fibers) and front portions of gluteus medius and minimus. (Fig.5)

Extension (Fig.4) is more limited than flexion and can be still done in three different modalities: an active contraction with flexed knee of about 10° (as a result of rectus femoris' tension); an active contraction with extended knee of about 20°; a passive action with flexed knee of approximately 30°. (Fig.4)

The extension movement is performed by the gluteus maximus, hamstrings (Fig.6- semimembranosus, semitendinosus and biceps femoris-) and adductor magnus.

On the frontal plan the hip motion breaks down into abduction and adduction.
Abduction (Fig.7), usually, happens with a range from 40° to 60° but there are some cases like gymnasts who reach ranges wider than 70° until 90°(" frontal split "). (Fig.7)

The abductors muscles (Fig.8) are the gluteus medius, gluteus minimus, and the gluteus maximus (in particular its upper fibers); tensor fasciae latae (TFL), piriformis. The TFL and medius and minimus gluteus have an essential role on normal deambulation due to the fact that they guarantee hip stabilization. (Fig.8)

Adduction (Fig. 9) is pretty limited than the opposite motion and takes place at 30°.

The adductors muscles (Fig.10) involves the whole adductors (adductor magnus, brevis and longus, pectineus and gracilis); quadratus femoris, obturator internus, obturator externus and gluteus maximus' lower fibers).

On the transverse plan the hip can perform two movements: external rotation (ER) and internal rotation (IR)(Fig.11).

The range of motion of the external rotation (60°) is double compared to the internal rotation (30°) because of the hip structure and the prevalence of the external rotator muscles.

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As regards the external rotator muscles, there are the gluteus maximus, gluteus minimus and medius' posterior portions; the entire hip rotators external rotators - (obturator externus and internus, piriformis, quadratus femoris, inferior and superior gemellus, (Fig.12).

Last but not least, the internal rotator muscles are the anterior fibers of the gluteus minimus and medius; tensor fasciae latae and the adductor magnus and longus.

Hip muscolar actions during gait

The intervention of the gluteus maximus comes when the hip starts its extension motion a few moment before the first ground contact, as soon as the swing ends up. At the very beginning of the monopodalic stance, the gluteus maximus twitches concentrically giving, at first, a stable position to the hip (when the lower limb is loaded) and, then, enabling its extension in order to raise the center of gravity. The engagement of the gluteus maximus finishes when the center of gravity matches the stance foot's vertical (1).

Subsequently, the hip extension movement is slowed down by an eccentric contraction of the iliopsoas as the stance finishes. Afterwards, the whole swing phase is characterized by the concentric twitch of the iliopsoas which ends with the following ground contact.

The gluteus medius is responsible for the regulation of the pelvic tilt, through the alternation of a concentric twitch and an eccentric one, on the side of the swinging leg before the initial contact happens. As soon as the stance comes, gluteus medius' task ends up.

The adductor magnus has two duble crucial functions: the first one consists in cooperating with the gluteus medius for an optimal pelvic stabilization on the frontal plan; the second function takes place assisting femoral flexion in synergy with the iliopsoas, sartorius and the rectus femoris(2-8).

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Fig.1. (By TeachMe Anatomy)

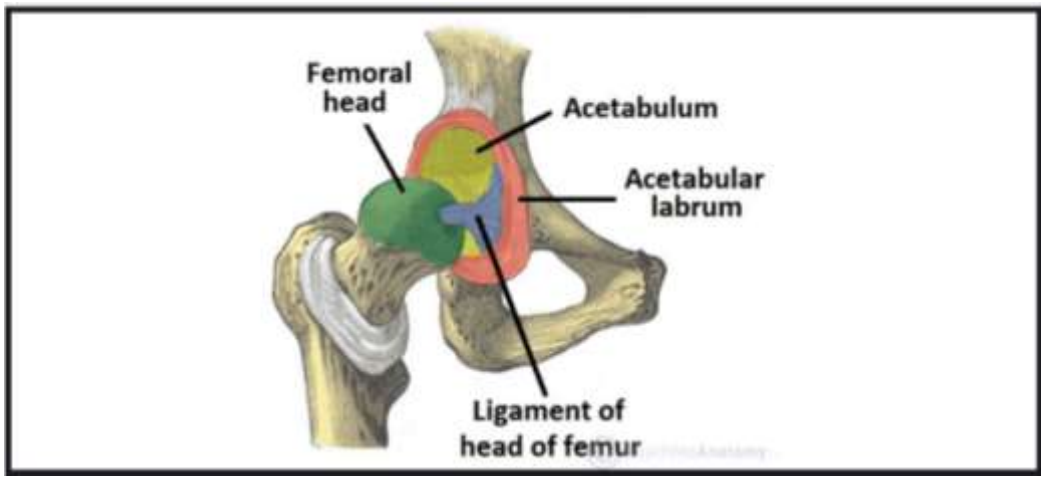


Fig.2. (By TeachMe Anatomy)

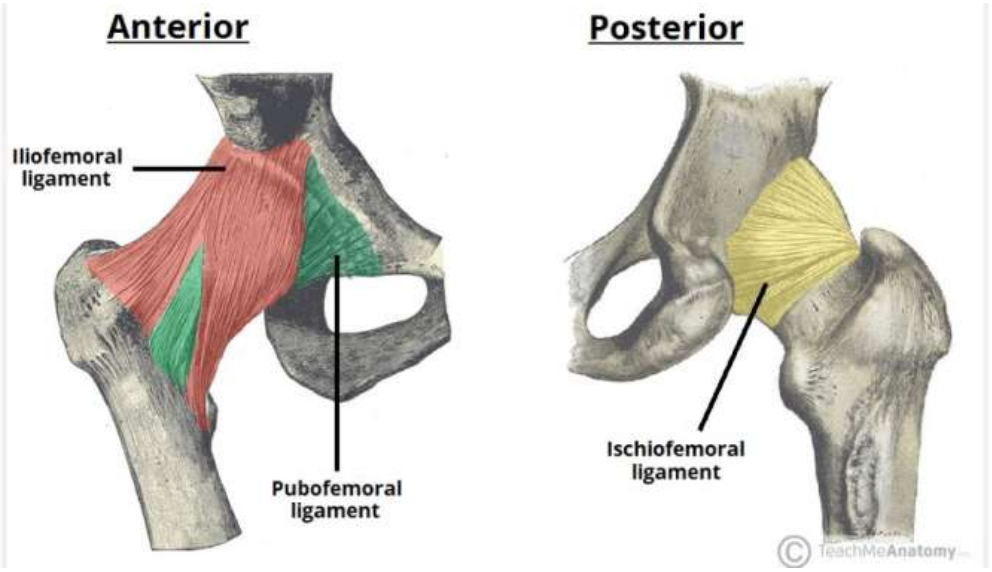


Fig. 3. (*By "Anatomia e meccanica dell'apparato motorio" – Fucci et al*).

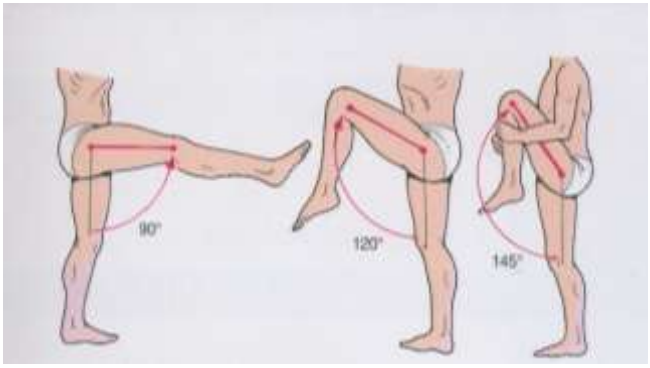


Fig. 4. (By "Anatomia e meccanica dell'apparato motorio" – Fucci et al.)

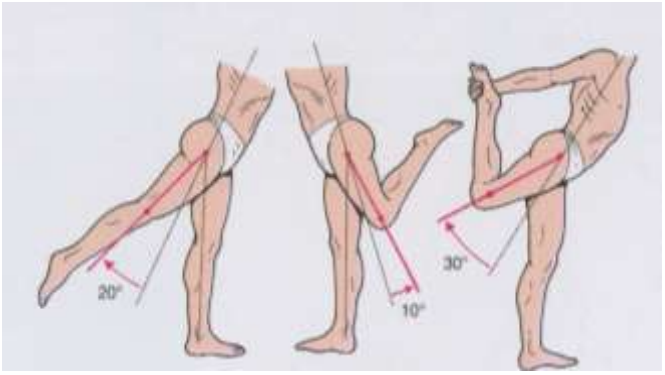


Fig. 5. (By Muscle and Motion)

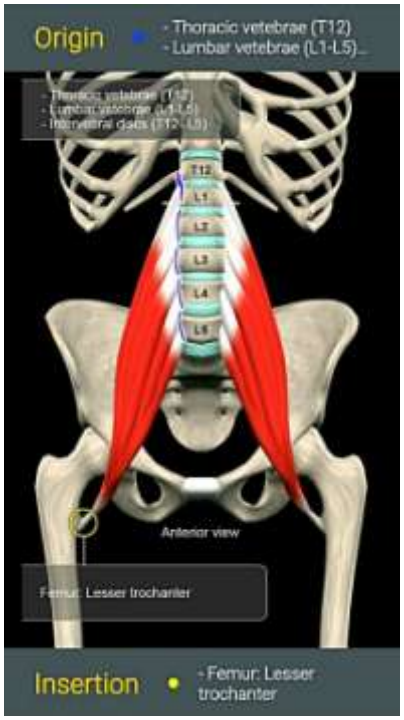


Fig.6. (By Muscle and Motion,)

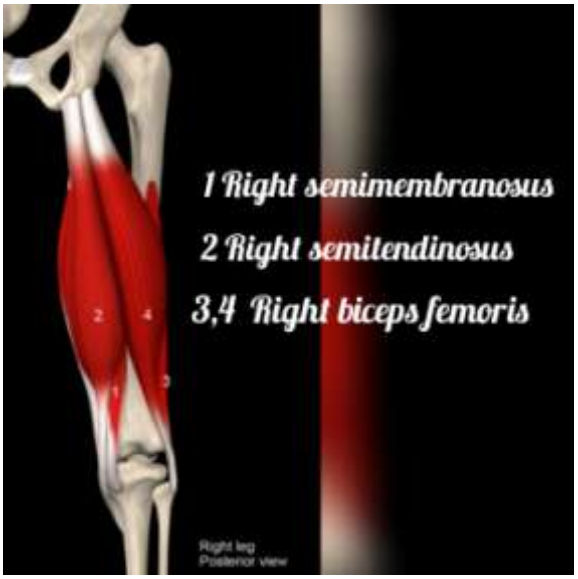
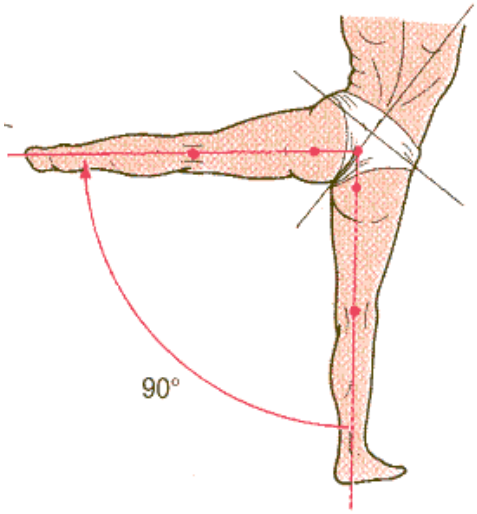
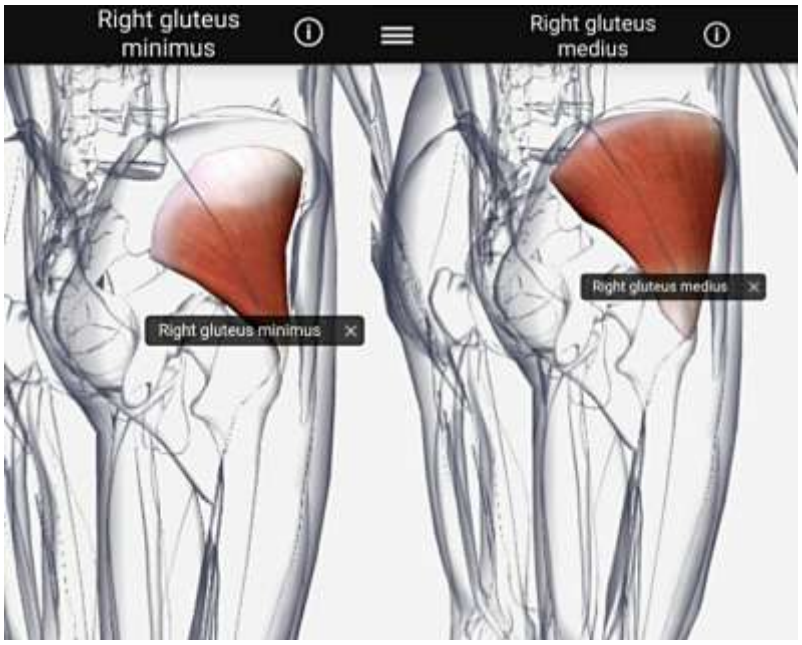


Fig.7. (By "Anatomia e meccanica dell'apparato motorio – Fucci et al)



Abduction

Fig.8. (by Human)



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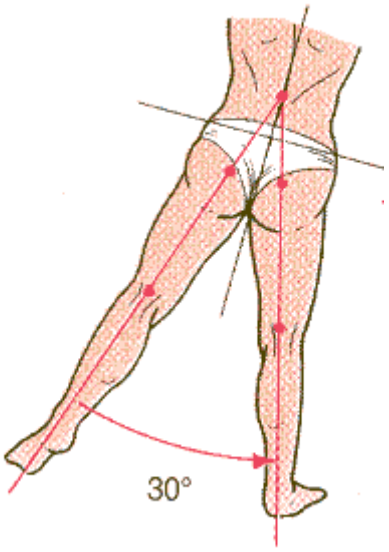


Adduction

Fig.10. (By Muscle and Motion)

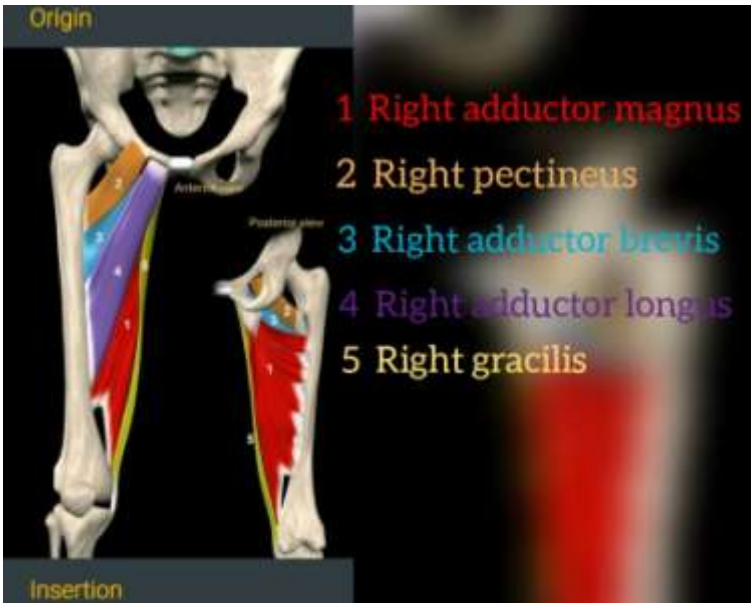


Fig.11. (Hip Rotation external- internal

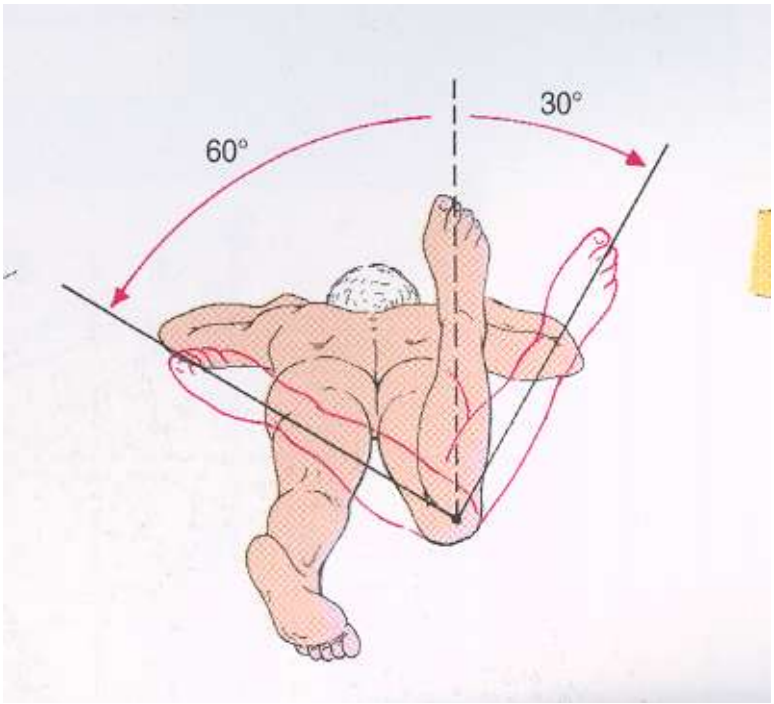
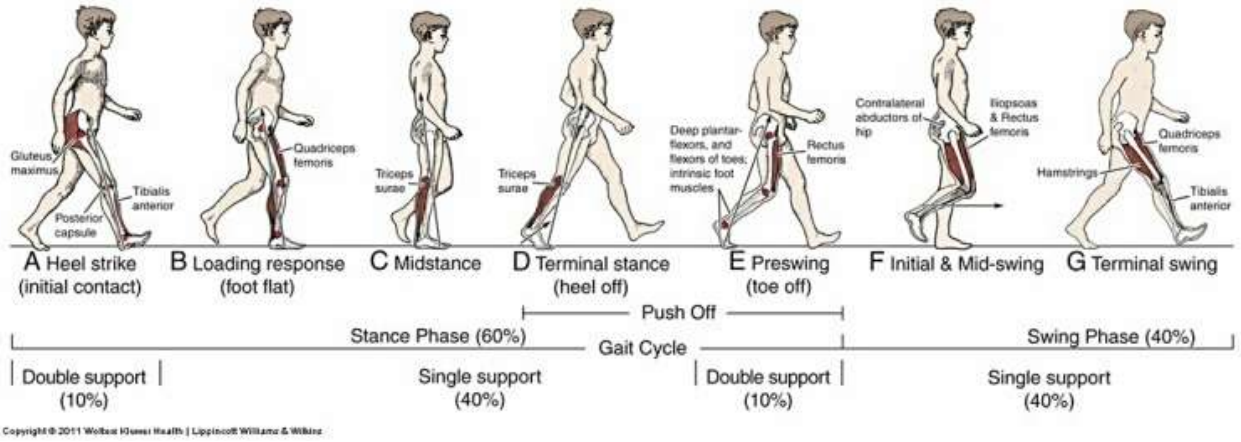


Fig.12. (By Muscle and Motion)

Fig.13. (By Wolters Kluwer Health – Lippincott Williams & Wilkins)



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BCAA AND ESSENTIAL AMINOACIDS. AMINO ACID SUPPLEMENTES TO IMPROVE ATHELTIC PERFORMANCE

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Abstract

The athletic performance is always associated with BCAA/EAA and protein utilization.

Mechanisms. During exercise, BCAAs are catabolized into succinyl-CoA and acetyl-CoA, both of which can enter the citric acid cycle to support ATP resynthesis (2). This pathway has a critical role in exercise tolerance and is likely fed by muscle protein breakdown, which can be reduced with BCAA supplementation. Therefore, BCAAs can preserve muscle protein by acting as an energy substrate. Furthermore, BCAAs may enhance exercise performance by reducing central fatigue (3-4), and enhancing fat oxidation.

The source of EAAs for muscle protein synthesis seems to be very useful. EAAs could derive by muscle protein breakdown, but not always are sufficient. The 70% of EAAs derived by muscle protein breakdown are incorporated into new muscle protein.

For this reason, a only supplement of BCAAs cannot support an increased of muscle protein synthesis. The supplementation of all EAAs (already inclused BCAA) will accelerated protein synthesis. More studies, with the only supplementation of BCAA show a not improvement of muscle anabolism, specially compared with EAA supplementation (23).

Keywords: *BCAA, EAA, Muscle improvement, leucine, mTOR*

Introduction

The athletic performance is always associated with BCAA/EAA and protein utilization.

There are 20 amino acids that make muscle protein; 9 are considered essential amino acids (EAAs), meaning they cannot be produced by the body and are introduced by a balanced diet.

Muscle protein is in a constant turnover, and all amino acids must be present in adequate amounts.

Branched -Chain Amino Acids

The branched-chain amino acids are: leucine, isoleucine and valine.

Leucine is not only a precursor for muscle protein synthesis, but also may play a role as a regulator of intracellular signaling pathways that are involved in the process of protein synthesis.

It is known that the intake of amino acids increases and stimulates muscle growth, specifically the synthesis of muscle human proteins (MPS)(1).

The branched-chain amino acids (BCAAs), which include leucine, isoleucine, and valine, are essential nutrients involved in muscle protein synthesis and energy metabolism. Leucine is particularly important for stimulating muscle protein synthesis, but BCAAs can be used collectively to enhance endurance, reduce muscle breakdown, and stimulate recovery after exercise.

Mechanisms. During exercise, BCAAs are catabolized into succinyl-CoA and acetyl-CoA, both of which can enter the citric acid cycle to support ATP resynthesis (2). This pathway has a critical role in exercise tolerance and is likely fed by muscle protein breakdown, which can be reduced with BCAA supplementation. Therefore, BCAAs can preserve muscle protein by acting as an energy substrate. Furthermore, BCAAs may enhance exercise performance by reducing central fatigue (3-4), and enhancing fat oxidation.

Protein synthesis is the most well-known and arguably the most important mechanism through which BCAAs enhance performance. Although all three of the BCAAs contribute to protein synthesis, leucine is particularly important. This is because leucine activates translation initiation factors and the mammalian target of rapamycin (mTOR), which are influential in the regulation of protein synthesis .

Evidence. Some trials have shown BCAAs to enhance exercise capacity (5), while others have not. In a recent trial including 19 untrained males and 8 weeks of resistance training, 9 g·d−1 of BCAAs failed to change body composition or improve strength or muscular endurance to a greater extent than the placebo (6). However, in a similar trial including 26 untrained men and 12 weeks of resistance training, 4 g·d−1 of leucine led to greater strength gains .These contrasting results suggest that either leucine alone is more effective, or that 8 weeks is too short of a training period.

Practical Use

As little as 77 mg·kg−1 of BCAAs has been shown to reduce muscle protein breakdown during exercise (7).For EAAs, although 6 g has been shown to enhance protein synthesis (8), 10 g appears to be the optimal dose .

An interesting study shows that an amino acid supplement high in BCAA is capable of significantly decreasing the elevated cortisol response of overreaching resistance training; testosterone levels may be significantly increased during overreaching training if accompanied by BCAA supplementation; and markers of skeletal muscle damage (CK) in response to chronic high-intensity resistance training can be significantly decreased with concomitant BCAA ingestion in previously resistance trained men. Effective and efficient recovery protocols are critical for optimal training-induced adaptations and subsequently achieving enhanced performance-related goals. This is particularly true of athletes who utilize the rebound enhanced performance effect of overreaching, which occurs only with adequate recovery.

The results of different study indicate that an amino acid supplement high in BCAA exerts an anticatabolic hormonal effect by significantly decreasing serum cortisol levels in response to resistance training overreaching. Bird et al. previously reported in untrained males that essential amino acid ingestion during an acute bout of resistance exercise resulted in no significant increase in cortisol compared to baseline. Results

support earlier findings, which indicate that amino acid supplementation may enhance recovery from overreaching by reducing skeletal muscle breakdown, indicated by significant decreases in serum CK levels following exercise. (9)

The purpose of this study was to investigate whether short-term amino acid supplementation could maintain a short-term net anabolic hormonal profile and decrease muscle cell damage during a period of high-intensity resistance training (overreaching), thereby enhancing recovery and decreasing the risk of injury and illness.

While it is generally ideal to consume protein from whole-food sources, EAA supplementation has been suggested as an efficient method of promoting muscle growth while limiting caloric intake. This is particularly relevant to athletes who need to lose or maintain weight. Furthermore, because exercising with a full stomach is generally not desirable, supplementation may be more appropriate for preexercise consumption.

A single acute serving of high-quality protein containing the optimal 10 g dose of EAAs contains approximately 1.8 g of leucine (10). Relative to common protein sources, the leucine content of a 100 g (3.5 oz.) serving of beef, pork, chicken, turkey, salmon, cod, or tuna ranges from approximately 1.3 to 2.3 g. Two eggs or a 100 g serving of haddock, shrimp, or scallops contains slightly less leucine, but still more than 1 g (11).

Finally, liquid sources of protein are known to elevate BCAA, EAA, and leucine concentrations more rapidly], which can result in greater protein synthesis. Whey and milk (12), if well tolerated, are particularly effective.

Timed-Daily Protein -pacing Intake

Protein is arguably the most crucial nutrient for general health and athletic performance because of its role in protein synthesis, energy metabolism, body composition (optimal lean muscle mass and fat mass), immune support, and satiation. Further, research supports timed-daily protein feedings throughout the day to maximize protein synthesis and thus lean muscle mass accretion (13).Dietary guidelines have consistently encouraged a higher carbohydrate (CHO) intake (up to 65% of total kcals), moderate fat (20–35% of total kcals), and 10–35% of intake as protein (PRO) for proper weight control (11). However, recent data suggests that consuming protein at the higher acceptable range (~25–35%) enhances energy expenditure] and body composition and may do so independent of inducing weight loss. This is important because it will have important implications for athletes attempting to improve health and performance outcomes without undergoing caloric restriction and weight reduction. Recent data also shows that the combined effects of increased dietary PRO and reduced glycemic index (GI) diets enhances weight loss maintenance and improves body composition.

Meal frequency (number of meals eaten) is another important factor for optimization of body composition and athletic performance. Several studies have suggested meal frequency is inversely related to body weight (14).

Recent studies confirm the hypothesis that to stimulate the production of MPS does not need all the amino pull of EAA, but only of determinate amino acids. The Branched-aminoacids (BCAAs), especially leucine, stimulates and serves as a substrate for the synthesis of new muscle proteins.(15)

The BCAA are specifically
* oxidized for energy purposes
* for protein synthesis as mentioned above
* synthesis of alanine
* not metabolised, and used directly by the brain (16)

Effects of BCAA supplementation on muscle protein metabolism in relation to exercise

The effects of BCAA supplementation before and after exercise on muscle-protein metabolism and exercise-induced muscle damage were examined in humans. It was reported that an oral supplement of BCAAs (77 mg/kg body wt) before exercise increased intracellular and arterial BCAA levels during exercise and resulted in suppression of endogenous muscle-protein breakdown. It was also reported that oral BCAA administration (12 g/d for 2 wk and an additional 20 g each before and after the

exercise test) suppressed the rise in serum creatine kinase activity for several days after exercise. Similar effects were also observed in a study in which subjects ingested an amino acid mixture (that contained 3.6 g of amino acids with 37% BCAAs) before and after the exercise test and 2 doses/d of the amino acid mixture for 4 d after the exercise test. The amino acid supplement also diminished muscle soreness that usually follows exercise. Although the mechanism responsible for the protective effects of BCAA supplementation against exercise-induced muscle damage and soreness have not been elucidated, it is presumed that stimulation of protein synthesis by leucine and suppression of exercise-induced protein breakdown by BCAAs may be involved. Furthermore, the most effective ratio of the three BCAAs for the beneficial effects is not known. Clearly these interesting observations should be followed up with studies designed to elucidate the mechanisms responsible for the phenomena and to clarify the most effective composition of BCAAs.(17)

Results

Garlick and Grant showed supplement of BCAAs into rats increased the rate of muscle protein synthesis in response to insulin (18) , but they did not measure the effects of BCAAs alone. Other studies show that the only leucine can induce an anabolic response (19).

Always about leucine, another interesting study shows that the leucine stimulates mTOR, and the intake of branched-chain or essential amino acids attenuates the elevation in muscle levels of PGC-14 mRNA caused by resistance exercise (20).

The transcriptional coactivator peroxisome proliferator-activated receptor- coactivator (PGC)-1 is the first regulator of mitochondrial biogenesis. Recent studies find a new isoform, PGC-14, that regulates muscle hypertrophy. Because the complex mTORC1 is closely associated to hypertrophy, its hypothesized that PGC-14 could be associated in some ways to mTOR too.

The authors demonstrate that the type of exercise involved could have different results. Sports of endurance give an increase in mitochondrial biogenesis, while sports of resistance enhances the content of MPS.

In recent studies instead, was showed that high concentration of leucine activates the metabolic pathway that oxidizes all of the BCAAs, but ingestion of leucine alone results in a decrease in the plasma concentrations of the others BCAA. The availability of isoleucine and valine could become rate limiting for muscle protein synthesis when only leucine is metabolized. This could be why studies with dietary leucine supplementation have failed to give positive results (21).

Conclusion

Advances in athletic performance training and nutrition have prompted a reevaluation of our current practices in order for both (training and nutrition) to work synergistically with each other instead of in isolation to one another. The current review, albeit novel, bridges the gap between athletic performance training and sports nutrition by linking the scientifically validated multicomponent training model (timed-protein feedings; resistance training; interval sprint training; stretching/recovery training; and endurance training; PRISE) employed by most, if not all, athletes with specific performance enhancing diets (PEDs) to foster optimal athletic performance. The goal of this innovative review is to provide a new paradigm of sports nutrition that allows performance training (PRISE) and sports nutrition (PEDs) to complement each other instead of working apart from one another.

Results of this study indicate that protein supplementation is effective at promoting increases in fat-free mass and muscle endurance during the initial stages of a resistance training program and a combination of whey protein and casein protein appears to be more effective at promoting gains in fat-free mass.

Alongside this, however, it has been shown that BCAA but EAA too, have the same transport system, and therefore there is competition. This lets us imagine that leucine could stimulate protein synthesis less in presence of other amino acid because would not always find transporters available to enter cells (22).

In the same time, a significant increase of muscle protein synthesis requires adequate availability of all amino acid precursors.

The source of EAAs for muscle protein synthesis seems to be very useful. EAAs could derive by muscle protein breakdown, but not always are sufficient. The 70% of EAAs derived by muscle protein breakdown are incorporated into new muscle protein.

For this reason, a only supplement of BCAAs cannot support an increased of muscle protein synthesis. The supplementation of all EAAs (already inclused BCAA) will accelerated protein synthesis. More studies, with the only supplementation of BCAA show a not improvement of muscle anabolism, specially compared with EAA supplementation (23).

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ANTI-AGING THERAPY TROUGH FITNESS ENHANCEMENT

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Abstract

Regular physical activity, the practice of relaxing techniques and proper nutrition entail considerable health benefits in all age groups. On the other hand, a sedentary lifestyle, stress, incorrect nutrition contribute, together with other risk factors, to the development of numerous chronic-degenerative diseases and in particular to those of the cardiovascular, metabolic and osteoarticular apparatus. Exercise is indicated as a highly effective means of treating and preventing the main causes of morbidity and mortality, most of which are linked to aging, especially in industrialized countries. Poor physical activity is an important risk factor for cardiovascular morbidity and mortality and in this case it is even a predictor of these problems.

The Anti-Aging Fitness for longevity introduces the concept of well-being to 360 ° and through professional technicians proposes Global, Holistic and Functional programs seeing as protagonists the following activities: exercise, mental / cognitive exercise, healthy eating, detoxification and purify the organism , take care of the psychological aspect, practice meditation and relaxation techniques, undergo manipulation and bio-energy techniques, take micronutrients and antioxidants.

Keywords: *fitness, anti-Age Therapy, Physical exercise, health*

Introduction

Regular physical activity, the practice of relaxing techniques and proper nutrition entail considerable health benefits in all age groups. On the other hand, a sedentary lifestyle, stress, incorrect nutrition contribute, together with other risk factors, to the development of numerous chronic-degenerative diseases and in particular to those of the cardiovascular, metabolic and osteoarticular apparatus. Exercise is indicated as a highly effective means of treating and preventing the main causes of morbidity and mortality, most of which are linked to aging, especially in industrialized countries. Poor physical activity is an important risk factor for cardiovascular morbidity and mortality and in this case it is even a predictor of these problems.

Although longevity has been associated with some specific genotypes, the interaction between individual and environment remains of primary importance and there is much evidence to show an inverse relationship between aging and a set of beneficial activities. It is important that research is aimed at promoting a healthier aging than researching better ways to treat aging-related diseases. A highly effective form to promote well-being and longevity is the practice of physical exercise, associated with proper nutrition. The latter has always been one of the most valuable allies of man in prevention and in the treatment of different morbid states, as well as in the maintenance of physiological organic functions. Even in the broad scenario of anti-aging medicine and healthy aging, that is healthy aging, nutrition is certainly the first step from which to start. So many diets, different foods and more or less miraculous foods have alternated on the media stage, sometimes offering interesting ideas for reflection and more often only simple commercial repercussions. However, clinical research in this area has never stopped, in fact in recent years has experienced a strong boost, offering nutritionists and scientists from around the world new statistical and clinical material to consider. It has therefore passed over time to research the miraculous molecule Anti-aging to study a complex dietetic system able to offer protection to the organism in its entirety both aesthetic and functional. As with any nutritional protocol, even for the Anti-aging diet there are certainties on which to set the entire system, derived from years and years of research, both experimental and clinical. The key points of an Anti-aging diet will be summarized below, in line with the most recent scientific evidence.

- Decreased caloric intake
- Balancing of lipid levels in the diet
- Quality of the sugars used
- Alternation of protein sources used
- Constant use of fruit and vegetables
- Correct state of hydration
- Elimination of Junk food
- Break up food into small meals: given the physiological reduction of intestinal eubiosis over the years, in addition to the advantage over glycemic homeostasis, a better absorption of micronutrients is also obtained
- Prevent protein intake to that of carbohydrates, so as to maximize the action of glucagon.
- Control the intake of alcoholic beverages, containing it in a glass of wine per meal, favoring the red one, which sees a greater presence of tannins, catechins and antioxidants.

Methods

This work aims to hypothesize how a wellness program that includes personalized exercise, meditation and healthy eating can slow down the cellular aging process, slow down the progression of pathologies that may already be present, and prevent cardiovascular diseases, related morbidity and disability to the advancement of age

Results

The Anti-Aging Fitness for longevity introduces the concept of well-being to 360 ° and through professional technicians proposes Global, Holistic and Functional programs seeing as protagonists the following activities: exercise, mental / cognitive exercise, healthy eating, detoxification and purify the organism , take care of the psychological aspect, practice meditation and relaxation techniques, undergo manipulation and bio-energy techniques, take micronutrients and antioxidants. The lifestyle coach or personal trainer through the application of

these activities and considering individuality, optimizes the well-being of the body so that the subject is comfortable with himself and with others. At the base of an Anti-Aging Fitness process it is necessary to develop a correct motivation. In these new proposals, physical exercise must absolutely not produce joint damage, oxidative stress, muscle injuries, traumas, hormonal imbalances and alterations in the hormone production curve. On the contrary, it must generate improvements in the muscle / tendon and ligament apparatus, in the cardiovascular and respiratory system, in flexibility, in strength and resistance, in muscle, in coordinative, conditional components of body composition. Therefore, in general, physical exercise is able to improve muscle tone and movement capacity, to induce an increased release of neuro hormonal mediators such as endorphins and serotonin, which give a feeling of general well-being. The positive aspects of a regular physical activity are multiple and reported below:

- reducing the risk of sudden death, heart attack or heart disease in general;
- risk reduction, up to 50%, of colon cancer development;
- risk reduction, up to 50%, of the development of type 2 diabetes;
- prevention or reduction of hypertension;
- prevention or reduction of osteoporosis, with a decrease of up to 50% in the risk of hip fracture in women;
- reducing the risk of developing osteoarticular pathologies;
- reducing the risk of developing cognitive impairment and dementia;
- reduction of symptoms of anxiety, stress, depression, loneliness;
- the decrease in weight and the reduction in the risk of obesity, with benefits of 50% compared to those with a sedentary lifestyle.

In fact over the past 15 years numerous epidemiological and prospective studies have reported a strong association between a correct physical form and morbidity-mortality index of the population (Balady 2002, Carnethon et al 2003), even in overweight and obese people (Blair and Brodney 1999). Being physically fit dramatically reduces mortality from all causes (Myers 2003). Improving one's fitness can reduce the risk of death by 44% (Blair et al 1995). Furthermore, several studies have shown that improving physical fitness has a favorable influence on self-image, self-esteem and depression, as well as anxiety and panic syndromes (Kirkcaldy et al 2002; Strawbridge et al 2002; Goodwin 2003). The professional technician must be scrupulous in planning the best frequency, intensity, time and type of physical activity, taking into account the individual's individuality. The prescription of physical exercise with the aim of attenuating the physiological consequences of aging should, in fact, be oriented towards increasing daily physical activity without overstimulating one's body and improving physical fitness. In terms of exercise physiology, the goal is to train at maximum but not at maximum tension. Therefore, it is very important to correctly identify the exercise and monitor the functional adaptation; this will allow adjustments to be made based on the subject's medical and physiological conditions at all times. In general terms, the exercise prescription is based on the frequency, intensity and duration of the training, on the type of activity and on the initial level of suitability (the main determinant). The anti-aging fitness for longevity provides besides the physical exercise the purification and detoxification of the organism through appropriate techniques. It is also essential to lower the stress level through meditation, the correct use of breathing, the cultivation of positive emotions, practicing everything that creates mental and psychological well-being.

An integral part of an anti-aging program is the practice of healthy eating / nutrition through:

The consumption of fresh, organic, seasonal food, at zero km.

The use of micronutrients and antioxidants.

Metabolic and hormonal regulation of insulin.

The use of natural supplements, spices and phyto elements.

Having said that, it is necessary to clarify that an anti-aging diet is completely different from a weight-loss diet: the element common to the two diets is the calorie restriction, aimed at reducing or controlling body weight, which is an important factor in the direction of anti-aging.

More specifically, it is necessary to modify the individual body composition, rebalancing the ratio between fat mass and lean mass, in favor of the latter: a result that is obtained by combining proper nutrition with physical exercise, indispensable for the development of lean mass (mass muscle). An increase in lean mass increases the body's ability to consume calories, as happens in young people; but not only, the increase in lean mass and a parallel reduction in fat mass, maintains or optimally increases the production and levels of key hormones and biohumoral substances of aging (GH, IGF-1, insulin, glucagon, cortisol , Dhea).

Incorrect eating habits, in fact, limit the normal expression of their genetic potential and activate the genes involved in the aging process.

In short, the first step to take is to better activate your genetic potential by eating properly and exercising regularly.

The International Anti-Aging Commission, based on the scientific knowledge of the aging process, has defined the AADN (Anti-Aging Dietary Norms), indicating the essential nutrients for the prevention of human aging and the related necessary intake levels.

This panel of experts states that low calorie diets based on correct values of the necessary nutrients are able to significantly improve different biomarkers of human aging. The anti-aging diet is based on a ratio between carbohydrates / proteins / fats, to the extent of: 40/30/30 or 45/25/30, while the ratio between omega-6 and omega-3 requires a rebalancing in favor of these last, passing from the old ratio of 5: 1 to the current one, which is placed in a range between 2: 1 and 4: 1.

The intake of carbohydrates should see privileged those rich in fiber, low in starch, low in simple sugars and low glycemic index.

The protid intake should preferably be guaranteed by white meats and fishery products, as well as by vegetable proteins, precisely to reduce the protein intake derived from red meat, which could otherwise play an acidifying role, with an acceleration of the aging process instead of its physiological deceleration.

From this point of view it becomes extremely important to increase the intake of alkalizing foods, setting one's diet so that they represent about 70-75 percent of daily consumption. Many foods, although acidifying, are indispensable for other reasons and therefore must absolutely not be eliminated, therefore their acidifying contribution must be inescapably compensated with an increased intake of foods with alkalizing content.

As far as lipid supply is concerned, it is important to take mainly unsaturated fatty acids, balancing the mono and polyunsaturated ones, so that the omega-3 and omega-6 ratio is kept correct. Otherwise, an excessive imbalance in favor of the omega-6 fatty acids, would favor the activation of the "bad" eicosanoids, increasing those factors of inflammation attributed to the aging process of the organism.

Another current of thought instead, which belongs to Dr. Valter Longo, defined as the "Guru" of anti-aging is provided to us through the Mima fasting diet that follows the following decalogue:

Adopt a vegan diet + fish paying attention to fish with high mercury content. Limit fish to 2-3 meals a week.

Minimize fats and sugars.

Consume beans, chickpeas, peas, and other legumes as the main source of protein.

Up to 65-70 years keep protein consumption low (0.7- 0.8 grams per Kg of weight, ie 35-40 grams of protein per day for a person of 50 kilos and 60 grams of protein per day for a person of 100 Kg if about a third of the weight is fat). After 65-70 years increase slightly so as not to lose muscle mass.

Consume high levels of complex carbohydrates (tomatoes, broccoli, carrots, legumes, etc.). See the recipes section.

Consume relatively high quantities of olive oil (50-100 ml per day) and a handful of walnuts, almonds or hazelnuts.

Eat fish with a high content of omega 3/6 and / or vitamin B12 (salmon, anchovies, sardines, cod, sea bream, trout, clams, prawns) at least twice a week.

Observe a diet rich in vitamins and minerals but supplement it twice a week with a high quality multi-vitamin / mineral.

Eat within 12 hours a day (for example if you have breakfast at 8 o'clock try to finish dinner at 8pm, or if you know that you will have dinner at 9pm, have breakfast at 9).

Do not eat for at least 3-4 hours before going to bed.

Make periods of 5 days of diet fasting every 1-6 months, depending on the need and advice of the doctor or nutritionist (see chapter 6 of the book The diet of longevity).

For people who are overweight or who tend to gain weight it is advisable to have breakfast plus lunch or dinner plus two 100 kilocalorie snacks with low sugar (less than 3-5 grams) one of which replaces the meal. Consult a nutritionist to prevent malnutrition.

Monitor body weight and abdominal circumference to decide how to proceed (2 or three meals a day etc.).

For people who have a normal weight and tend to lose weight it is advisable to make the three normal meals plus a 100 kilocalorie snack with low sugar (less than 3-5 grams)

Eat by selecting the right ingredients from those who ate their ancestors.

Walk at a fast pace 1 hour a day.

Avoid escalators and elevators even if the stairs plans are many.

During the weekend try to walk to distant places (avoiding polluted areas).

Do moderate exercise for 150-300 minutes a week, with a bit of intense exercise.

Do exercises, with or without weights, to strengthen your muscles (combining them with meals that contain 30 grams of protein after weight training).

Last but not least important for longevity are all the holistic techniques for wellbeing and global health: massage, acupuncture, osteopathy, bioenergetics, respiratory gymnastics, hydrotherapy, heliotherapy, shiatsu, Tai chi and Qi Cong, aromatherapy, Bach flowers , thermal medicine, etc.

Discussion

Performing a global, holistic and functional wellness program has beneficial effects on most (if not all) organs and systems and is therefore essential for the primary prevention of a large number of diseases. Exercise, weight loss, reduced stress levels produce three main benefits:

- improvement of functional capacity both in the healthy subject and in the patient with illness;
- support in the management of widespread diseases such as arterial hypertension, diabetes, obesity and dyslipidemia;
- reduction of the risk of developing disabling chronic diseases.

The greatest benefits come from moderate physical activity, thus modulating the frequency and intensity.

In conclusion we can affirm that an adequate Anti-aging program must:

- be adequate to the subject's abilities (organic, psychic, functional, etc.);
- be prescribed after having correctly established the intensity, duration and rhythm of repetition of the exercises and after careful assessment of the environmental conditions in which it must take place;
- be a global stimulus for the whole organism and not sectorally only for some systems and apparatuses;
- be congenial and suitable to the subject's cultural, ideational and affective possibilities.

In light of what has emerged aging is a physiological process that can be influenced for better then delaying it or worse for accelerating it. The latest scientific evidence shows that to delay or prevent the consequences of aging, it is necessary to adopt a healthy lifestyle that includes physical exercise, associated with proper nutrition. The exercise always brings benefits, regardless of age, sex, health or physical condition of the person undertaking it. Instead, a lack of exercise clearly accelerates aging and its consequences, first and foremost changes in physical appearance; Maintaining one's own body weight, which is not always easy to adopt, is able to prevent, by itself, a very long list of pathologies. Furthermore, according to studies conducted successfully on many laboratory animals, an overall reduction in caloric intake would seem to be one of the best ways to continue in the state of psychophysical efficiency that characterizes youth.

Without getting to malnutrition, an aggravation of aging processes, it is important to cover the need for all the indispensable nutrients (proteins, fats and

carbohydrates but also, and above all, vitamins and minerals) without exaggerating with calories.

In conclusion, the strengthening of the physical form and the maintenance of the body weight norm, undoubtedly represent the best medicine available today to fight the inexorable aging process.

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CREATINE SUPPLEMENTATION WITH FOCUS ON EXERCISE PERFORMANCE: AN UPDATE

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Abstract

Creatine is one of the most popular and widely sought-after natural supplements. It is mainly used by professional athletes with the aim of improving their physical abilities and performances during training. However, it is important to know the method by which the molecule acts within the organism, the intake protocol and any risks that may arise following its intake. Our studies have focused particularly on creatine monohydrate and its effects on performance and health, although there are widespread formulations on the market, creatine monohydrate remains the best selling.
The main effect due to the intake of creatine is the increase in strength, lean mass and muscular morphology when associated with heavy resistance training.

Keywords: *Creatine, Supplement, Training, Strength*

Introduction

Creatine (methyl-guanidin-acetic acid) is a non-protein amino acid derivative normally present in the human body. It is synthesized by the liver, kidneys and pancreas from three amino acids arginine, glycine and methionine and three enzymes SAM (S-adenosyl methionine), amidinotransferase-glycine and guanidinoacetate N-methyltransferase. Almost all the creatine in the human body is located in skeletal muscle (95%) where it has a main role in cellular bioenergetics, present as free creatine for about 40% and stored as creatine phosphate for the remaining 60%. It is mainly involved in the synthesis of ribonucleatide adenosine triphosphate (ATP), in the regulation of glycolysis, it has a buffering effect on the pH in muscle tissues (buffering acidosis) and stimulates mitochondrial respiration. As a molecule normally present in our body, it is excreted daily (2g) for this reason it is important to have adequate supplementation, especially in situations of poor diet intake. In fact, it is not uncommon to find this compound in food, it is present in meat and fish. Creatine is also used in the diagnostic field in the search for various pathologies or disorders, such as myopathies, and is also used as an ergogenic contribution as it improves athletes' sports performances and their health. However, the mechanisms by which creatine improves cognitive and physical performance is still not clear. Creatine needs to be deactivated before being taken out of the body. Actually, an intramolecular reaction occurs between the carboxyl of the acetic group and the amino group of phosphatocreatine, thus converted into creatinine. All creatinine is filtered through the renal glomeruli and eliminated in the urine as there is no type of tubular reabsorption. The concentration of creatinine eliminated is directly proportional to the muscle mass of the individual. On a diagnostic level, the control of creatinine eliminated is used to assess possible kidney damage detectable with the increase in blood creatinine concentration.

The synthesis of ATP from ADP occurs within the mitochondria during oxidative phosphorylation, also called cellular respiration. When ATP comes out of the inner membrane of the mitochondria, through special membrane transporters such as ADP/ATP translocases located in the intermembrane space, it becomes a substrate of creatine kinase which converts it into CP releasing ADP. The phosphatocreatine will be transported to the cytosol, passing through specific channels of the mitochondrial membrane and reaching the myofibrils of the muscle where it will release ATP, reforming creatine, for which the re-synthesis of ATP will occur.

The human muscle puts aside only small concentrations of ATP, in fact these are exhausted very quickly during the exercise, so the body must constantly regenerate it. In conditions of maximum energy demand, ie during a muscular effort, the concentration of ATP is further reduced, although its concentration at rest would provide energy only for 1.5 seconds. For this reason, ATP synthesis mechanisms are rapidly activated. These processes lead to an increase in ATP muscle concentration and are divided into three main classes: anaerobic alattacic mechanisms, anaerobic lactic acid mechanisms and aerobic mechanisms. In the anaerobic alattacid mechanism, also called phosphocreatine via, energy is produced without producing oxygen and lactic acid. This mechanism is able to work only for a few seconds and is a typical metabolic system of short-term efforts that do not lead to the discarding of acid molecules.

ADP + CP = ATP + C (Lohmann reaction)

However the stocks of phosphocreatine are not infinite, in fact they are sufficient only for a hundred of muscular contractions, or 8-10 seconds. Therefore, intense physical activity cannot take place unless one or both of the other metabolisms are activated.

Methods & Results

Because of its strong use in sports, different types of creatine have been synthesized that could meet the needs of athletes, optimizing their performances, without causing possible damage to the body. Since the late 1990s, various creatine-based products have been introduced to the market, most likely to try to differentiate the large quantity that was available on the market and perhaps try to improve some aspects of it.

- Creatine monohydrate
- Ethyl-ester creatine
- Buffered creatine

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- Creatine serum
- Effervescent creatine
- Creatine magnesium chelate
- Creatine citrate
- Creatine sick
- Creatine pyruvate
- Creatine taurinate
- Creatine gluconate

Although you can buy creatine as a single product, there are different combinations with other nutrients on the market. For example, there are various combinations of creatine, or other proteins, associated with carbohydrates so as to increase absorption following the release of insulin from the pancreas. In one study it was observed that the retention of creatine in the body, after the integration of 5g of CM, was increased by about 25% thanks to the addition of 50g of protein and 47g of carbohydrates, or 96gr of carbohydrates, if compared to placebo. The addition of 10g of creatine to 75g of dextrose, 2g of taurine, vitamins and minerals, has led to a change in cellular osmolarity which, in addition to increasing muscle mass as expected, would also produce a large-scale upregulation of genes, including genes involved in DNA synthesis and repair, in the control of RNA transcription, regulation of glycogen and protein synthesis, cellular and other survival. Similar effects have been observed with the integration of the single CM in combination with resistance training.

A commercial formula of pre-workout supplement currently available is composed of 2.05gr of caffeine, taurine and glucuronolactone, 7.9gr of L-leucine, L-valine, L-arginine and L-glutamine, 5gr of di-creatine citrate and 2.5gr of beta-alanine together with 500ml of water, taken 10 minutes before training, showed an increase in time as a result of which fatigue was felt during the exercise of moderate intensity resistance. They have also shown to increase the feeling of concentration and energy, before and during endurance exercise, due to the synergistic effects of the ingredients.

The effects of creatine supplementation

Most of the studies carried out on creatine supplementation have shown an increase in its total concentration within the organism, therefore there is a correlation between exercise performance and creatine uptake in the muscle. Through the studies it was possible to determine that there was a significant increase in strength after 12 weeks of integration in conjunction with a periodic training protocol consisting of heavy resistance exercises. The positive effects of the integration were attributed to the increase in the total creatine concentration which led to a more rapid regeneration of ATP between the resistance training sessions, thus allowing the athletes to maintain high levels of intensity and to improve the quality of the exercises throughout the training period.

Creatine intake should cause increased resistance to training, reduced fat mass and increased lean mass, but the opposite was observed in one study, revealing no effect on strength performances. Furthermore, on a short-term creatine loading protocol, no effect was identified with respect to the isometric bending force (determined by isometric exercises of muscle toning and resistance development), muscle activation, and much less about the recovery process. However, it had never been clearly stated whether the creatine supplementation had been carried out in conjunction with resistance training or not.

In another study, consisting of creatine supplementation in association with whey protein (whey protein) to improve muscle strength and mass, after a progressive training program consisting of 14 weeks (3 days a week) in older men, it showed no further benefit again due to creatine supplementation. These conflicting data may be justified by the possibility that the creatine intake group consisted mainly of non-responders, or because creatine was only integrated on the days of physical exercise, ie 3 days a week. The same type of study never gave the same results in middle-aged men and older men in the maintenance phase of high creatine concentrations.

According to more recent research, which provided more information regarding the mechanism of improvement of anabolic performances due to creatine supplementation, the effects would be due to cell proliferation, myogenic transcription factors and the insulin-dependent muscle growth factor IGF-1 . A change in myogenic transcription factor was detected when integration and resistance training were combined in healthy

young men. Furthermore, serum levels of myostatin, an inhibitor of muscle growth, had decreased in those taking creatine supplementation. Therefore in general, despite few controversial results, it would seem that the creatine supplementation associated with resistance training, would lead to improving the performances of maximum strength and resistance, as well as muscle hypertrophy.

In a study consisting of creatine supplementation of 25 grams per day for 5 days followed by a maintenance dose of 5 grams per day for 3 days in young men, it showed a negative influence in the active dorsiflexion of the ankle, abduction of the shoulder and in the interval of extension of the movement. Scholars have suggested two possible theories that justify these effects:

- Creatine supplementation increases the concentration of intracellular water causing a decrease in muscle stiffness and resistance to stretching.
- The neuronal outflow from muscle bundles is damaged due to the increased volume of muscle cells

They also pointed out that the interval of extension of the measured movement was taken immediately after the loading phase, and its reduction could not be observed after several weeks of maintenance phase. Furthermore, there may also be a decrease in the pressure of the anterior compartment of the lower leg, which could be responsible for the reduced range of extension of the active movement.

Glycogen and creatine

Creatine is known to increase the volume of skeletal muscle cells along with increasing its volume in water. Since glycogen itself increases the osmolytic balance of a cell (ie the absorption of water), it is thought that creatine is also related to an increase in cell volume, which is known to promote glycogen synthesis. Both creatine and glycogen seem to be positively correlated with each other in muscle cells, and when one increases the other also tends to increase. Because of this, creatine supplementation is believed to play a role in the accumulation and supply of glycogen.

Creatine is used as energy during high intensity exercise, because of this, the amount of glucose required by glycogen is slightly reduced, this preserves glycogen concentrations in skeletal muscle and reduces lactate production, which is produced when glucose is oxidized to produce energy.

When resistance training is associated with a multi-nutrient integration consisting of 0.1gr / kg / day of creatine and 1.5gr / kg / de carbohydrates, great improvements have been observed in the mass and cross-section of muscle fibers in young men, compared to a diet consisting only of proteins or integration of proteins and carbohydrates, without the intake of creatine. At first, these findings turned out to be new because no other research had shown improvements in body composition at the cellular and sub-cellular level in participants trained through resistance training that integrated with creatine.

Oral creatine supplementation leads to increased levels of creatine within the body. The best method to take creatine and maintain high concentrations of it as a muscle reserve is to start with a 5-day loading period, followed by a maintenance period. During the loading phase it should be taken around 5g of creatine four times a day (so as to reach 20-25gr), with an intake 30-60 minutes before training and one immediately afterwards. Afterwards the standard doses are 2g a day for 3 months. If there are any problems following the intake, it is suggested to take, for the loading phase, 3gr a day for 30 days. After the loading dose, the muscles will be saturated with creatine, making further increases impossible, so it is important to maintain the same concentration in the muscles. For the maintenance dose, 2gr per day is sufficient to preserve the reserves, even if this dosage is slightly modified when it comes to athletes, in fact in this case the recommended supplement is 3-5gr of creatine, depending on the type of sport and the weight of the sportsman. One month of abstinence from the substance is a standard practice after each cycle.

Conclusion

We can summarize the information gathered about creatine by enclosing them in key points:

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- Amplifies the effects of resistance training with consequent improvement in strength and muscular hypertrophy,
- Improves the quality and benefits of intermittent high-speed training
- Improves aerobic endurance performance in tests lasting more than 150s
- You seem to produce positive effects on strength, power, lean mass, performance of daily life and neurological function in young and old
- Increases power and maximum strength by over 10%
- Delays the appearance of fatigue and muscle and increases critical power, ie the maximum power developed before fatigue occurs
- Research on the mechanisms of the creatine supplementation effect has progressed since 2007, showing an increase in gene expression regulation when creatine is administered along with resistance training exercises.
- As for the performance mainly of aerobic duration, the increase of creatine reserves in the body seem to amplify the favorable physiological adaptations such as: increase in plasma volume, glycogen conservation, improvement of the ventilatory threshold and a possible reduction in oxygen consumption in the maximum ceiling exercise.
- A typical creatine supplementation protocol of a loading phase from 20 to 25 grams of CM / day, 0.3 grams of CM / kg / day divided into 4 to 5 daily intakes of 5 grams each

It is important to remain impartial when evaluating the safety of creatine ingested as a natural supplement. The available evidence indicates that creatine consumption is safe. This perception of safety cannot be guaranteed, in particular that of long-term safety and the various forms of creatine that are administered to different populations (athletes, sedentary, patients, active, young or elderly) all over the world.

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Figure 1. Creatine

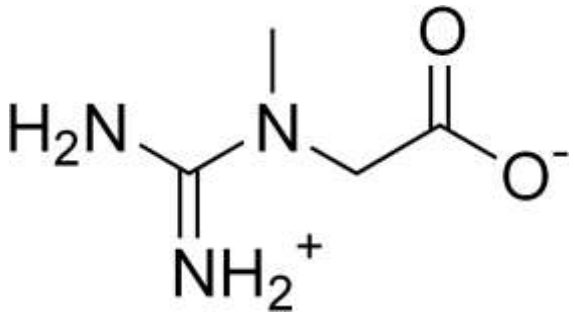
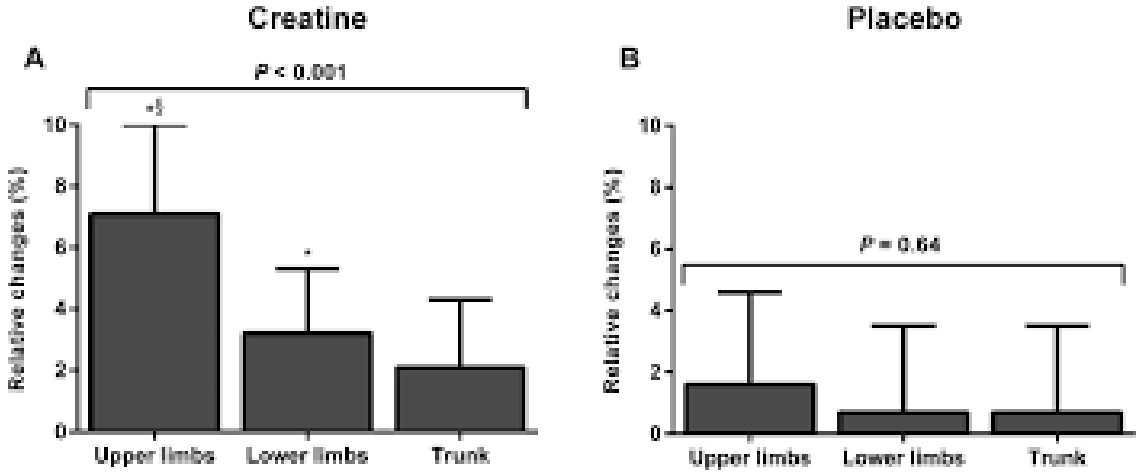


Figure 2. Creatine supplementation



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EFFECTS OF THE PHYSICAL EXERCISE ON THE COGNITIVE FUNCTION AND ON THE MOOD

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Abstract

In our overview of systematic reviews (SRs) we explored the effects of the physical exercise (PE) on both together the cognitive function (CF) and the mood by SRs of randomized and controlled trials (RCTs). We found SRs exploring different conditions: obesity and overweight in children and adolescents, stroke adult survivors, elderly mild cognitive impairment (MCI) and dementia. In practice, we selected in PubMed 4 SRs of RCTs with an intervention time median range of 2-24 months. We assessed the risk of bias in the SRs with the Assessment of Multiple Systematic Reviews (AMSTAR) tool. As concerns the results, about dementia and MCI in elderly patients one SR observed a positive effect of PE and cognitive intervention only on the global cognitive function (GCF). Another SR on elderly people in nursing homes found a significant effect only by the multimodal type of PE. A secondary concomitant effect has been observed also on the mood in both the SRs. A SR on overweight or obese children and adolescents registered a good effect of only PE (without concomitant diet or lifestyle education) on the cognitive executive functions. As concerns adult stroke survivors, where mood and CF were considered both as secondary outcomes in a very few primary studies, a moderate effect of strength exercises was registered on mood, while cardiorespiratory exercises resulted effective in physical fitness present as primary outcome in a very larger number of studies. The overall risk of bias in the SRs here examined was low or moderate. All the primary researches in every SR were affected by a high degree of heterogeneity between studies, due to a large variety of measurement tools, of duration and frequency of the sessions, of treatment and follow-up duration. In the future, larger trials with higher number of covariates and more homogeneous measurement tools with their relative outcomes are needed in order to obtain a more detailed information and results.

Keywords: *physical exercise, cognitive function, mood, randomized controlled trials, systematic reviews, heterogeneity, and risk of bias*

Introduction

Physical exercise (PE) is recommended to the general population by many medical entities – including the Centers for Disease Control and Prevention and the American College of Sports Medicine – because it is considered an important tool for the improvement of public health. As is the case for non-psychiatric diseases, physical activity might be an effective measure for the treatment and even for the prevention of psychiatric diseases such as depressive and anxiety disorders. In addition, PE has increasingly been recommended to individuals with or without disease in order to improve their quality of life. On the other hand, PE can compromise mental health, especially when performed in a more intense manner (1). Furthermore, chronic diseases are long-term conditions with slow disease progression and without an effective cure, and, e.g., from China death registers (2) it results that 38 million people die there from chronic diseases each year. In addition, 16 million of these deaths occur before the age of 70 years. Chronic diseases may lead to alteration in brain structure and function and are associated with cognitive change. Some of these changes may be related to neurodegenerative diseases (such as Alzheimer's disease and other types of dementia), increased dementia incidence, and cognitive decline. Strategies are needed to reduce disease-related cognitive impairment in chronic disease patients. Exercise, the aim of which is to improve or maintain physical fitness, is a subset of physical activity that is planned, structured, and flexible, in addition to promoting aerobic endurance. Exercise is essential in maintaining physical function and physiological health. The results of animal studies have identified that engagement in physical activity may enhance neurotrophic factor levels, neurogenesis and vascularization, and may even reduce aggregation of pathogenic proteins, mediate neuroinflammation, and inhibit neuronal dysfunction. Exercise also appears to be associated with the maintenance of brain health and cognitive performance in cognitively normal older adults. Most experimental studies have identified increased lifetime physical activity to be associated with reduced risk of suffering from dementia in cognitively normal older persons (2). Moreover, also the prevalence of overweight and obesity in children in the United States is currently 31%. Specifically, the prevalence of obesity has increased from 13.7% of children and 11.5% of adolescents in the 1988–1994 period to 17.1% of children and adolescents by the year 2010. Moreover, research shows that overweight children are more likely to remain overweight as adults. These alarming statistics support the necessity for effective interventions to target obesity in children, and to look beyond basic nutrition and physical activity recommendations. Neurocognitive functioning, which influences cognitions, emotions, and behaviors linked to obesity, may be an important, yet under-emphasized factor, in informing existing and future weight-loss interventions. Limited research has emerged examining differences in neurocognitive functioning between obese versus non-obese youth; only a few studies have explored how neurocognitive factors relate to behaviors that promote weight gain. Obesity-related behaviors, such as food intake and physical activity, may play a role in the relationship between neurocognitive functioning and weight (3).

In this overview of systematic reviews (SRs) relative to the effect of PE on cognitive function (CF) and mood, our objective has been to assess the actual degree of evidence of this relationship in every pathological or pre-pathological conditions described by randomized and controlled trials (RCTs) in the literature. This, in order to evaluate the different impact of PE on cognitive function (CF) and mood in settings differing each other by age, pathology and intervention type. Being very high the number of the published primary studies, we have considered less time-consuming and more exhaustive to take into consideration and to select and evaluate only the SRs of primary studies relative to our objective of research.

Methods

Search strategy

In May 2019 systematic search was conducted in the database PubMed. We used the terms "physical exercise AND cognitive function AND

mood" using the following filters: article types: reviews; publication dates: 5 years before 2019; species: humans. To identify eventual additional potentially relevant articles, the reference lists of the selected articles were screened.

Eligibility criteria and study selection

Studies were eligible if they met the following inclusion criteria: 1) only SRs (qualitative or quantitative); 2) SRs considering as primary studies only randomized and controlled clinical trials (RCTs) or cluster RCTs (cRCTs); 3) only SRs including primary studies relative to the effect of PE on both CF and mood. The reviews were excluded if they were reviews of: 1) prospective or retrospective cohort studies; 2) cross-sectional studies; 3) case-control studies. If different reviews would include the same primary study, a sensitivity analysis - testing the kind of results obtained including and excluding this duplicated study in the whole context of the reviews – was done. Two reviewers screened the title/abstracts and subsequently full text articles separately. Eventual disagreements were planned to be discussed with a third researcher and subsequently adjusted after reaching consensus.

Interventions and outcome measures

Only RCTs with PE intervention group, that also included an active or passive control group, were included. Global and specific cognitive and mood functions, evaluated with validated screening tools, were used as the outcome measures. Other outcome measures were performance on the domains of memory, attention and activities of daily living (ADL). All outcome measures had to be determined at baseline and directly after the intervention period.

Risk of bias assessment

The measurement tool for the "assessment of multiple systematic reviews" (AMSTAR) - developed by Shea et al. and successively validated (4) – for assessing risk of bias in SRs, was used as a measure of quality assessment (Table 1). Each bias domain was rated as low (yes) or high or unclear (no) (Table 2). The final judgment for each SR was of low risk of bias if the affirmative answers to the 11 items in Table 1 were at least 9/11; moderate if they were 5-8/11; high if there were less than 5/11 affirmative answers. Two researchers independently performed the risk of bias assessment. Eventual differences that we found in outcome were planned to be discussed with a third researcher until consensus was reached. A total risk of bias judgment was based on the assessment of all domains.

Analysis

The SRs we have recruited were one qualitative SR and three quantitative SRs. Because of the high degree of heterogeneity between primary studies registered in the SRs (5-8), a subgroup analysis – to assess eventual differences between subgroups by the available covariates - was not successful also for the quantitative SRs (6-8).

Results

Identification of studies and risk of bias assessment

The Figure shows the flow diagram of the SRs selection in our overview. The initial search yielded 91 reviews (published between January 2014 and December 2018). Based on titles and abstracts 81 papers were excluded. The remaining 10 articles were screened full text, leading to exclusion of six articles.

Table 2 shows the risk-of-bias profile for the four included SRs. The final judgment was of low risk in (6), (7) and (8); it was of moderate risk of bias in (5). There was an inclusion bias in SRs (5) and (8) (they considered only primary studies published in English; also, (8) has excluded conference abstracts). The publication bias was not assessed in (5) (6) (7) relative to the mood and cognitive

function outcomes. Finally, the conflict of interest was not declared from (5) and (8).

Participants and study characteristics

Table 3 summarizes the characteristics and the outcomes of the included RCTs and cluster RCTs (cRCTs), review by review. They are all open and pertain to different pre-pathologic or pathologic conditions. Two of the four SRs were relative to primary studies on dementia and MCI in elderly people (5) (8) (number of primary studies, respectively: 12 and 10; global sample sizes: 901 and 742). One SR was on stroke survivors (7) (number of primary studies: 58; global sample size: 2707), and one on obese children and adolescents (number of primary studies: 18; global sample size: 2384). Three SRs collected elderly or middle-aged people (5) (7) (8) .Two SRs (5) (8) were relative to a disabling pathology (dementia or MCI) and one SR to a reversible pathologic condition (stroke survivors followed in an ambulatory setting) (7)). Another SR (6) collected primary studies on children and adolescents subjected to a pre-pathological condition (obesity). All reviews consisted of a PE intervention in various forms, alone (Brett (5), Saunders (7) or combined with cognitive (Karssemeijer (8)) or lifestyle educational or diet (Martin (6)) interventions. The combination PE-cognitive intervention in (8) was unique for all patients, while different types of physical interventions in (5-7) (Table 3) were assigned to groups of patients independent from each other. The training frequency varied from 1 to 6 sessions per week and the duration per session varied from 15 to 300 min. The different types of exercise interventions are indicated in the Table 3. The used outcome measurement tools in the different studies varied widely between studies not only in dependence of the specific disease, but likewise inside each specific pathology. The more diffused measurement tools in the geriatric context were the Mini-Mental State examination (MMSE), the Alzheimer Disease Assessment Scale- Cognitive subscale (ADAS-Cog), the Nurse Observation Scale for Geriatric patients (NOSGER) and the Geriatric Depression Scale (GDS). For the academic children and adolescent's achievement, the more diffused scales were the Grade Point Average (GPA) or the Canadian Achievement Test (CAT)-3.

Primary and secondary analysis

The outcome analysis was quantitative in tree of the four reviews included (6) (7) (8). Nevertheless, in two of them (6) (7) the high degree of the outcome heterogeneity prevented a synthetic plausible quantitative answer and likewise the subgroup analysis was ineffective. Therefore, we have often knowledge of the positive and negative results but it was not possible to determine precisely the effect degree (low, moderate or strong). Obviously, particularly in the qualitative SR (5), the heterogeneity is heavier and the precision is weaker. The Brett (5) and the Martin (6) SRs included both RCTs and cluster RCTs. In every RCT, the randomization was open.

In their SR on dementia and MCI in elderly subjects (mean age 71 years), Karssemeijer et al. (8) found a low risk of bias in 6/10 studies. Concerning the *primary outcomes*, they found small-to-medium effect of the combined PE-cognitive intervention only on the *global* cognitive function (GCF) (10 primary studies, 742 subjects), here finding also no heterogeneity between studies and no publication bias using the funnel plot graph analysis. Furthermore, they found not significant the intervention on specific skills (memory, verbal, spatial orientation, etc.). As concerns the *secondary effects,* they only found: 1) a medium-large effect of the intervention on the activities of daily living (ADL) (but here they found 80% of heterogeneity between studies), 2) a small-medium effect on the mood (no heterogeneity between primary studies, no evidence of publication bias).

In their SR on very elderly subjects with dementia assisted in nursing homes (mean age 83 years), Brett et al. (5) sub-grouped the patients in the primary studies by different PE types of *primary intervention* (multimodal, music and movement, hand exercises) and they found significance only in the multimodal group. The *secondary intervention* was on the mood, and here too only the multimodal subgroup intervention resulted significant. Risk of bias in the primary studies resulted low in nine studies, medium in three studies. The patient's attendance in the primary studies presented a very wide range (33-100%).

In their SR on stroke elderly-middle aged survivors, Saunders et al. (7) also sub-grouped the subjects in the primary studies by type of PE (cardiorespiratory, strength and mixed), but both mood and CF were only considered as secondary outcomes. Mood improvement resulted significant only in the strength subgroup; CF resulted not significant. However, these secondary outcomes were assessed in a few number of studies (respectively, two and three trials). The mean age of the subjects was 62 years. The overall risk of bias in the primary studies resulted moderate. The patient's attendance in the primary studies presented a wide range (65-100%).

In their SR on obese and overweight children and adolescents (3-18 years of age, 10 different countries), Martin et al. sub-grouped the subjects in the primary studies by treatment as follows: PE alone, PE + lifestyle education, PE + diet administered. The overall risk of bias in the primary studies resulted moderate. The primary outcomes were the following: school achievement, cognitive function, adverse events in PE. Only in the subgroup with only PE there was an improvement, specifically in cognitive executive functions (that are, mental control and self-regulation). The subject's attendance in the primary studies presented an acceptable range (71-100%).

Discussion and Conclusions

Interpretation of results

Our overview examined the most recent synthetic findings of SRs – relative to RCTs and cRCTs as primary studies - on the role of PE on the CF and mood in a wide range of pre-pathological and pathological conditions. The interventions considered were of primary prevention (in overweight and obesity of scholar children and adolescents), secondary prevention (in ambulatory adults stroke survivors), and rehabilitation (in elderly subjects with MCI or dementia). Four SRs published between 2016 and 2018 were included in our overview.

Only in the primary prevention setting of overweight or obese young people in scholar age, the PE is not supporting a medical therapy and is the only determinant of the effect measurement. Here resulted a good effect of PE alone only on cognitive executive functions, while PE + (lifestyle education *or* diet) resulted here not significant. Despite the high primary studies heterogeneity that prevented a definition of the effects more complete and detailed, it appears evident that in younger subjects PE promotes the self-control that is an important achievement at school attendance. In this setting, depression is included in the context of the adverse events that were globally not significant. Probably, in obese and overweight children and adolescents, obesity has not considered a consequence or a cause of a depressed mood but rather of a wrong parental lifestyle or education. Therefore, the depressive mood was not considered important. This dependence from their parents in the children lifestyles could be also the reason of the ineffective lifestyle education and diet associated to the PE. In fact, here the parents were not involved.

In the rehabilitation setting of MCI or dementia in elderly people, as in the primary prevention setting above described, the CF was considered a primary outcome. Differently from the primary prevention setting (6), here PE integrates the medical therapy. Karssemeijer et al. (8) found a small-medium effect of PE and cognitive intervention only on the global cognitive function (GCF) and Brett et al. found a significant effect (not quantified) of PE only on the multimodal type of PE group. Probably, the efficacy on the GCF and of the multimodal PE intervention were successful mainly because they were various as are the usual activities in the everyday life. The mood here was registered as a secondary outcome. This, probably because the SRs authors considered a mood improvement as natural effect of the intervention on the primary outcomes. This hypothesis appears to be likely in both cases: the mood registers – like GCF - a small to medium effect in (8) and is significant – like PE - only in the multimodal group in (5).

In the secondary prevention setting of ambulatory stroke survivors (7), the primary studies focus is on the physical outcomes. Not only mood and CF are registered in the Saunders et al. SR as secondary outcomes, but they are considered, respectively, in only two and three primary studies. Nevertheless, mood has resulted moderately

significant in the strength group of PE. It resulted not significant in the cardiorespiratory and mixed (cardiorespiratory-strength) groups. The lower consideration of CF and mood is likely related to the normal or quite-normal gait of these subjects referring to an ambulatory set, that emphasizes in the caregivers the need of preventing future cerebrovascular obstructions and physical disabilities, given that the stroke in those subjects with transitory ischemic attack generally did not yet seriously compromise the neurological functions.

Strenght and limitations of this overview

A strength of this overview is that only SRs on RCT or cRCT primary studies were included. cRCT design randomization is a little more prone to bias than an RCT design, but only a few cRCT groups were included in some of the SRs here considered. It is sufficiently clear that an educational lifestyle program should be addressed also to the parents of the children and adolescents to be practically effected, and that PE in the youngest people is effective in promoting characteristics of self-control and task-concentration (executive cognitive functions). Furthermore, it appears clear that diversified PEs that had better promoted the different activities of the everyday life is more interesting – and therefore successful – than more specialized and monotonous exercises for the ancient people in conditions of MCI or dementia (Table 3). There are also limitations that need to be addressed when interpreting the results. First, there is considerable heterogeneity in the primary studies regarding the intervention characteristics (e.g., type of training, separate or multiple-tasks, intervention period, frequency, duration) and the measurement tools used (MMSE, ADAS-cog, AMS, NOSGER, GPA, CAT-3, etc.). Therefore, the optimal PEs intervention design, for eliciting beneficial effects, remains in all the SRs unclear. Due to the high methodological heterogeneity it was no possible to analyze the impact of different intervention components or to calculate the efficacy for different conditions of disease severity using a subgroup (subgrouping by 'moderator' covariates) analysis. However, subgroup quantitative meta-analyses are very useful in developing preventive strategies and designing appropriate interventions. Second, the adherence of the enrolled subjects to the interventions and the intensity of the PE program was not reported in detail in several primary studies, which could have influenced also the SRs results. In addition, data about adherence and intensity of intervention programs are essential to gain insight in dose-response ratios. Finally, in two SRs of four, only studies reported in English were included and, furthermore, the conflict of interest was not stated.

Implications for future research

To investigate the different intervention combinations, we need future research. For adult or elderly people with MCI, dementia or cardiovascular diseases we suggest a multi-arm design, including a cognitive, nutritional (9) and physical training, single physical training, single cognitive training, single nutritional training and a control group to distinguish the contribution of different components of the intervention. Furthermore, additional studies should explore the most effective training characteristics in combined interventions specifically aiming at duration, frequency, intervention type and mode of combination. Moreover, in secondary and tertiary prevention studies future research should focus on investigating physiologic mechanisms that underlie the positive effect by including neuroimaging measures and molecular markers as an outcome. In addition, long-term effects of combined interventions could in future gain insight into possible maintenance effects. Finally, the identification of individual predictors for a beneficial outcome (i.e., using individual patient data meta-analyses) is also important to personalize multi-modal interventions. Conversely, in young people the interventions focusing on one target behavior, i.e. PE, our findings suggest that they yield beneficial effects on cognitive executive functions and, consequently, also on memory and general intelligence compared to standard practice. In childhood and adolescence, it might be that the positive effect of the PE program on the cognitive functions is diluted with the increasing complexity of the interventions. The intensity of the PE component at this early age might be reduced when additional intervention activities, such healthy lifestyle education sessions, are implemented. Moreover, healthy lifestyle and diet education is here probably a parental issue. To conclude,

selecting with standardized univocal methods appropriate outcome measurements in larger studies is essential in future research.

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Table 1. AMSTAR measurement tool assessing the methodological quality of systematic reviews.

1. **Was an 'a priori' design provided?**

The research question and inclusion criteria should be established before the conduct of the review.

2. **Was there duplicate study selection and data extraction?**

There should be at least two independent data extractors and a consensus procedure for disagreements should be in place.

3. **Was a comprehensive literature search performed?**

At least two electronic sources should be searched. Fhe report must include years and databases used (e.g. Central, Embase, and MEDLINE). Key words and/or MESH terms should be stated and where feasible the search strategy should be provided. All searches should be supplemented by consulting current contents,reviews, textbooks, specialized registers, or experts in the particular field of study, and bt)

4. **Was the status of publication (i.e. grey literature) used as an inclusion criterion?**

The authors should state that they searched for reports regardless of their publication type. The authors should state whether or not they excluded any reports (from the systematic review), based on their publication status, language etc.

5. **Was a list of studies (included and excluded) provided?**

A list of included and excluded studies should be provided.

6. **Were the characteristics of the included studies provided?**

In an aggregated form such as a table, data from the original studies should be provided on the participants, interventions and outcomes. The ranges of characteristics in all the studies analyzed e.g. age,race, sex, relevant socioeconomic data, disease status, duration, severity, or other diseases should be reported.

7. **Was the scientific quality of the included studies assessed and documented?**

'A priori' methods of assessment should be provided (e.g. for effectiveness studies if the authors chose to include only randomized, double-blind, placebo controlled studies, or allocation concealment as inclusion criteria); for other types of studies alternative items will be relevant.

8. **Was the scientific quality of the included studies used appropriately in formulating conclusions?**

The results of the methodologic rigor and scientific quality should be considered in the analysis and the conclusions of the review, and explicitly stated in formulating recommendations.

9. **Were the methods used to combine the findings of studies appropriate?**

For the pooled results, a test should be done to ensure the studies were combinable , to assess their homogeneity (i.e. Chi-squared test for homogeneity, I^2). If heterogeneity exists a random effects model should be used and/or the clinical appropriateness of combining should be taken into consideration (i.e. Is it sensible to combine?).

10. **Was the likelihood of publication bias assessed?**

An assessment of publication bias should include a combination of graphical aids (e.g., funnel plot, oter available tests) and/or statistical tests (e.g., Egger regression test).

11. **Was the conflict of interest stated?**

Potential sources of support should be clearly acknowledged in both the systematic review and the included studies.

Table 2. Risk of bias assessment per AMSTAR domain across studies.

Author	Karssmeijer	Brett	Saunders	Martin
1-design	yes	yes	yes	yes
2-selection	yes	yes	yes	yes
3-search	yes	yes	yes	yes
4-inclusion	no	no	yes	yes
5-checklist	yes	yes	yes	yes
6-characteristics	yes	yes	yes	yes
7-quality	yes	yes	yes	yes
8-conclusions	yes	yes	yes	yes
9-methods	yes	yes	yes	yes
10-publication	yes	no	no	no
11-conflict	no	no	yes	yes

Table 3. SRs characteristics.

First author	Karssemeijer	Brett	Saunders	Martin
Type of SR	Quantitative	Qualitative	Quantitative	Quantitative
N. (studies/subjects)	10/742	12/901	58/2707	18/2324
Study design	RCTs open	RCTs, cRCTs open	RCTs open	RCTs, cRCTs open
Disease	dementia, MCI	dementia	stroke survivors	obesity, overweight
Setting	nr	nursing homes	ambulatory	schools in 10 countries
Mean age	71years	82.6years	62years	3-18years
Male gender	41%	nr	nr	nr
Intervention	PE, cognitive	PE (multimodal, hand, walk, music)	PE (aerobic, anaerobic, mixed)	PE, PE+ education, PE+ diet
Control treatment	usual therapy	usual therapy	usual therapy	usual
Intervention tools	MMSE, ADAS-cog et al.	MMSE, AMS, NOSGER et al.	various rating scales	GPA, CAT-3 et al.
RoB in primary studies	low(6),unclear(4)	low(9)medium(3)	moderate	moderate
Treatm. Duration	8-52	4-52	8-16	24-76

(range of weeks)				
Session duration/ /frequency(range)	30-300min/ /1-5 x week	15-120/ /2-6 x week	20-180 min/ /2-5 x week	15-60 min/ /2-5 x week
Primary outcomes	verbal, memory, spatial orientation, GCF	Multimodal, music, walk	ADL, disability, death, mobility, phys. Fitness	school achievement, cognitive function, adverse events
Secondary outcomes	ADL, mood	mood	mood, CF	future success, obesity
Primary effects/ /heterogeneity	GCF: small-medium/ 0%; others: ns	signif. in multimodal /0%; others: ns		good of PE on cognitive executive functions/high
Second. effects/ /heterogeneity	ADL: medium-large/ /80%; mood: small-medium/0%	signif.in multimodal and walking group/ nr	mood moderately signif.in anaerobic groups/nr	discordant/high
Attendance	nr	33-100% (5 of 12 studies)	65-100%	71-100%
Publication bias	absent	nr	nr	nr

Legend: ADAS-Cog=Alzheimer Disease Assessment Scale-Cognitive subscale; ADL=Activities of Daily Living; AMS=Alzheimer Mood Scale; CAT-3=Canadian Achievement Test (third version); GCF=Global Cognitive Function; GPA=Grade Point Average; MMSE=Mini-Mental State Examination; NOSGER=Nurse Observation Scale for Geriatric patients; nr=not reported; PE=physical exercises; RoB=Risk of Bias.

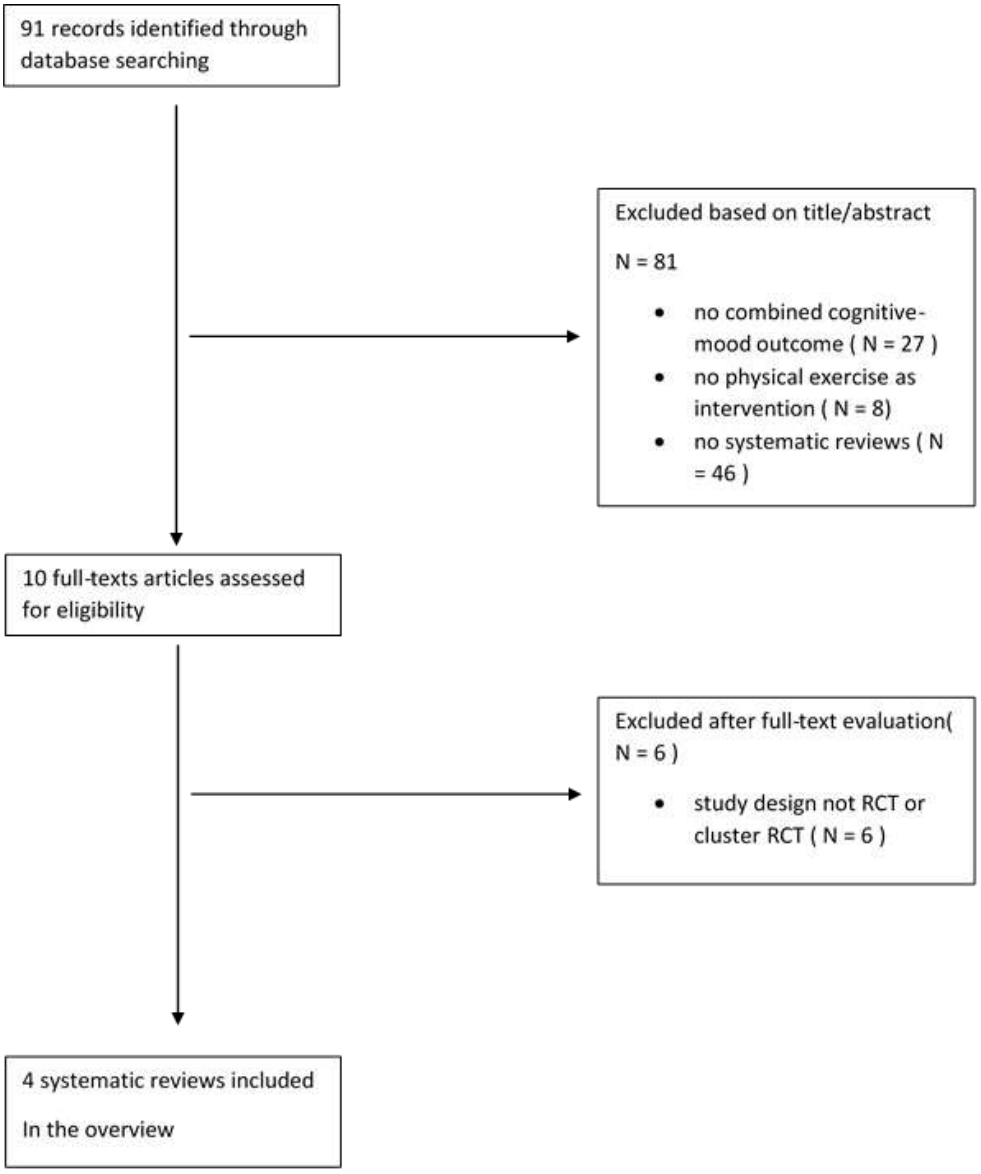

Figure 1. Flow diagram of systematic reviews selection process

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WHEY PROTEIN AND MUSCLE HYPERTROPHY

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Abstract

Muscle hypertrophy is largely induced by strength training to become stronger, while resistance training causes our muscles to produce more mitochondria in order to improve our aerobic performance.
Basically, the initial stimulus for growing muscles is to stress the muscle to a level that it is not used to. While resistance training represents a reduced load performed for an extended period of time, strength training consists of a high load performed for a short period of time.
Leucine acts as a trigger to instruct our muscles to actually start the anabolic process. We therefore need the additional essential amino acids to subsequently provide the building blocks of the new muscle proteins to be produced

Keywords: *proteins, whey, supplements, sport*

Mechanism of muscle growth

Muscle hypertrophy is largely induced by strength training to become stronger, while resistance training causes our muscles to produce more mitochondria in order to improve our aerobic performance.

The size of our muscles is under the control of two competing processes: muscle protein synthesis (SPM) against muscle protein rupture (RPM). Over a 24-hour period, SPM is usually equal to RPM such that our muscle mass remains constant. However, for hypertrophy, the SPM must pass the RPM during a training program. On the contrary, for muscles to shrink, the RPM must overcome SPM.

The strength training plan

Basically, the initial stimulus for growing muscles is to stress the muscle to a level that it is not used to. While resistance training represents a reduced load performed for an extended period of time, strength training consists of a high load performed for a short period of time. Recent studies have suggested that multiple sets of resistance exercises performed to the point of exhaustion provide sufficient stimulus for muscle growth (1,2).

Furthermore, each repetition is best performed with a slower and more controlled approach than a fast explosive movement (3). In this way, the "time in tension" increases, all the muscle fibers are recruited and the stress of training causes our muscles to adapt in the recovery period so that over time they can become bigger and stronger. Strength training can cause muscle damage and soreness in the hours and days after each session (4), it is essential that the muscles receive the correct nutrients and rest to recover.

The recovery period

During the actual training session, the RPM increases and subsequent muscle damage occurs. If we did not consume any nutrients (especially proteins) in the recovery period, the net muscle protein balance would become negative. This is often referred to as a "catabolic state". To induce a net positive protein balance and provide the conditions to grow muscles, it is essential to take proteins within 30 minutes of the end of the workout. In this way, the amino acids are delivered to the muscle, thus providing the bricks to help our muscles to rebuild, grow and recover. At this time, the muscle is said to be in an "anabolic state".

With the right training and nutrition plan, the SPM will exceed the RPM and therefore the muscles accumulate proteins so that they become stronger and stronger. In terms of protein feeding, (5. Leucine acts as a trigger to instruct our muscles to actually start the anabolic process. We therefore need the additional essential amino acids to subsequently provide the building blocks of the new muscle proteins to be produced (6).

Considerations on the assumption of proteins

To maintain muscle protein synthesis you need to follow these guidelines:

Choose a protein source with a high content of branched chain amino acids (BCAA) and whey proteins such as leucine (5, 7)

Consume 20-30 g of protein every 3-4 hours during the day to help maintain muscle protein synthesis (8)

Try to take between 1.4 and 1.8 grams of protein per pound of body mass per day (7)

Immediately after exercise (within 30 minutes), the muscle is more reactive to the intake of nutrients. Immediately consume 0.3 grams of protein per pound of body mass (9). This is usually equivalent to 20-40 g of protein (10).

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INFERIOR LIMBS DRAINING SYSTEM AND THE ROLE OF MUSCULAR PUMPS TO PREVENT DISFUNCTIONS OF THE CIRCULATORY SYSTEM

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Abstract

People working in standing up position are predisposed at lower limbs circulatory dysfunctions, because the force of gravity makes it more difficult for the blood to travel back from the periphery to the heart. Malfunctions in the draining system can causeseveral diseases, such as Chronic Venus Insufficiency (CVI).

Within the inferior limb are present the muscular pump that carry out the fundamental role of blood pumping and they allowing the correct venous return (VR). Muscular action is very importantin CVI patients, some studies have shown the role of physical exercise and its positive effectsto avoid disease progression. However, more studies are needed.

Keywords: *venous return, muscular pumps, physical exercise, CVI*

Introduction

Deambulation is not simply the motor strategy utilised by human beings to move within space, but a fundamental activity, pivotal to prevent dysfunctions of the circulatory system. Muscular contraction allows the venous return of blood from the periphery of the body to its centre, the heart.

"Venous return" (VR) is defined as the amount of blood that returns to the heart in a minute, and equals the one that comes back again to the right atrium. This means that, quantitatively speaking, VR corresponds to the cardiac output.

It is not rare to encounter lower limbs circulatory dysfunctions in subjects routinely working in orthostatism. When standing up, the force of gravity makes it more difficult for the blood to travel back upwards. Within vessels, the force of gravity acts as hydrostatic pressure. In a still, standing subject, hydrostatic pressure at the ankle level equals the weight of the blood mass found within the vessels travelling from the heart to the ankle. In a subject of average height and in normal physiological conditions, it amounts to 90mmHg.

Hydrostatic pressure strongly influences the pressure of blood flowing within limbs and this effect impacts the vessels that contain it. Veins, generally thin and not much elastic, are dilated by hydrostatic pressure. This effect is limited by specific valves that look like a swallow's nest, and after which they are named, and serve to reduce pressure against vein walls. Their malfunctioning can depend on the veins' weakness or deformity, such in the case of varicose veins.

Discussion

Inferior limb draining system

The venous system of the inferior limb is controlled by three districts, each one taking care of a specific phase of the VR: the foot, the leg and the groin (1).

The foot is also defined as "propulsion pump", as its function is to pump blood upwards. Such function is carried out thanks to three systems: plantar and dorsal venous arches and interconnections. The plantar venous arch functions as collector of blood, which is then directed towards the deep veins of the leg, that is the anterior and posterior tibial veins and the fibular vein; the dorsal venous arch collects blood from the foot dorsal surface and from the digital veins; the interconnections between the two arches allow the passage from the surface veins to the deep ones through the system of perforating veins. They represent a transfascialvalvular communication system, whose function is to make blood flow thanks to the opening and closing of the valves, thus avoiding gravity reflux.

The principal veins are the small saphenous vein, which climbs up the calf laterally and along the back; the great saphenous vein, body's longest ones, climbs up the medial margin of the leg and of the thigh where it flows into the femoral vein.

Thanks to the described plantar systems, during walking blood is pumped again back into the heart. In the heel strike, the systole occurs through the compression of the veins situated in the calcaneal region; successively, the diastole takes place in the pushoff phase and allows its emptying and the discharge of blood.

In order for this physiological function to be respected, placing the foot in the correct position, hence, performing the step in the right way, is fundamental. Therefore, postural alterations can negatively impact on the VR.

The thigh acts as a pump as well, allowing the progression (progression pump) of the blood to the abdomen. The popliteal pump, situated in the popliteal fossa, the posterior area of the knee, is made up of anterior and posterior tibial veins and of the fibular vein. It climbs up the thigh and flows into the femoral vein, which travels along the thigh within the femoral artery. Before reaching the abdomen, it merges with the great saphenous and the deep and circumflex femoral vein.

Finally, the inside of the groin, known as the "hemodynamic borderline", contains the external and internal iliac veins, whose function is to drain the inferior limbs, the pelvis and the inferior portion of the abdomen. The two form the communal iliac vein and, when they merge at the level of L5, form the inferior vena cava. Together with the superior vena cava, it allows blood to reach the right atrium

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of the heart, the beginning of the cardio circulatory system.

Muscular pumps

Within the inferior limb are present a series of mechanisms that carry out the fundamental role of blood pumping, allowing the VR from the periphery to the heart. Such mechanisms are defined venous pumps and are categorised as: plantar pump, calf pump, popliteal pump and quadriceps pump (2).

The plantar pump is constituted of the Sole of Lejars, a venous structure places between the skin and the foot osteoarticular arch. It comprises the principal plantar, medial and lateral veins and the posterior tibial vein. During the gait cycle, the bodyweight systematically shifts from the back to the front of the foot. The compression of the heel to the ground involved the sole of Lejars and the squeeze of its veins, allowing the blood outflow in a centripetal direction. During the distension of plantar muscles, the foot blood reserves fill up; then, the contraction of the plantar muscles causes the emptying of the foot towards the superficial and deep thigh collectors (2). The muscular activity involves the opening and closing of the vascular structured with the following increase or reduction of blood and lymph supply to the heart.

The calf pump is the most important muscular pump for the VR system. The calf is defined as "the peripheral heart", as every contraction corresponds to the push of the blood upwards. It performs the action of aspirant and pressing pump. The aspiration phase occurs with muscle distension, that is with the dorsal flexion of the ankle during which the venous axes get filled through the perforating veins (2); the pressing phase occurs, instead, with muscle contraction, thanks to which the thigh is emptied. Anatomical-functional dysfunctions of the muscles or the pumps can contribute to the appearance of pathological conditions that affect the venous system. Alterations of the mechanisms appointed to VR can be: alterations of the plantar loading, as in the case of flat foot or cavus foot; inadequate orthopaedic-physiotherapy correction; reduction of muscular activation (sedentary lifestyle, work in a seated position); post-thrombotic syndrome; valve damage.

The popliteal pump allows the blood flowing from the foot to the leg, towards the thigh thanks to the action of the knee articulation. During walking, in the flexo-extension phase, it compresses the popliteal vein which is, at the same time, pushed by the gastrocnemius and soleus band against the popliteal muscle found just below it. The band constitutes the most important drainage canal for the deep venous system of the thigh.

Finally, the quadriceps pump completes the blood pumping system guaranteeing the blood flux from the inferior limbs to the abdomen.

To ensure a correct VR, all pumps act in synchrony and both muscular and venous action of specific body districts comply to a phasic coordination. This stems reflections upon the use of bad exercises, which often do not respect physiological mechanisms and are, instead, detrimental (2).

Physical exercise and circulatory system

Cardiocirculatory systems alterations include chronic venous diseases, a morphological or functional dysfunction of the venous system. This condition can manifest with telangiectasia (dilation of small vessels), which can progress to the formation of varicose veins and ulcerations, causing Chronic Venous Insufficiency (CVI).

It not only represents an aesthetic discomfort due to a more enhanced appearance of the veins, but it also involves several symptoms, such as: leg tingling, inferior limb swelling, muscular cramps. It is a pathology that mainly affects women and the elderly. Principal risk factors are familiarity, number of pregnancies, age, lifestyle and work type.

A mainly orthostatic work can be a predisponing factor for CVI appearance. Several studies have shown that it tends to progress in subjects that keep an erect position for prolonged times (3). The standing position, due to gravity, causes the accumulation of blood in inferior limbs veins which, in turn, leads to a reduction in central venous pressure with difficulties in VR.

Thanks to the activation of the baroreceptor reflex, a small portion of blood manages to travel up. However, because it is a short-term regulation mechanism, this reflex is not sufficient, especially for those who stay in orthostatism for long. Hence,

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muscular action is essential to ensure an adequate VR, and is fundamental in CVI patients to avoid disease progression. Several studies have highlighted that a calf pump dysfunction is directly related to the worsening of CVI pathology (4-5).

Despite scientific literature still lacks evidence on the importance of physical activity in CVI, numerous studies, although not statistically significant, showed its positive effects. In particular, the study by Frank T. et al demonstrates that, following a 6-month programme of structured exercise, both pump function and muscular strength of the calf improved.

Moreover, a meta-analysis conducted in 2016 on 14 studies highlighted the beneficial effects that simple exercises bring to CVI patients with or without venous ulcers. Specifically, it was observed that exercises aimed at improving mobility and ankle strength led to optimal results for the calf haemodynamics, restoring its pump activity (6).

Treatments aimed at CVI patients are limited, and surgical intervention is performed in the most severe cases, however in the majority of them patients still suffer from the effects of the disease. To find out if physical activity can complement medical therapy in CVI and contribute to the improvement of the pathology, it would be interesting to investigate what type of exercise is the best for these patients and in what way the movement specialists can operate.

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NUTRITION AND NUTRITIONAL ISSUES FOR DANCERS

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Abstract

Nutritional assessment for vocational dance student in ballet school with special needs for evolutive development, for growth, for physical performance, for slim body physique. In professional performers it is important the management of nutritional intake and energetic expenditure, for prevention injuries in training and in elite competitions. The dancers are the perfectionist athletes and the balanced diet with medical personalized approach, based also on gender differences and level of competition, prevents many problems: RED (relative energy deficiency), triad female athletes, osteoporosis, amenorrhea, bone low density, eating disorders, fractures and joints injuries. In this paper, the focus is on nutritional requirements of dancers, from young and elite dance school students to professional performers, and on injuries due to malnutrition and unbalanced lifestyle. The new paradigm of dance medicine and nutrition must be educate the dancers to healthy lifestyle, to an adequate nutrition, to a positive attitude and motivation and on prevention of injuries and related pathologies.

Keywords: *dancers, injuries prevention, performance, low bone density, thinness, eating disorders, supplementation*

Nutritional recommendations

Little scientific research exists concerning nutrition in dance to propose nutritional guidelines for this field. Proper nutrition, not simply adequate energetic intake, is needed to achieve optimal dance performance. To diminish the risk of energy imbalance and associated disorders, dancers must consume at least 30 kcal/kg fat-free mass/day, plus the training energy expenditure. For macronutrients, a daily intake of 3 to 5 g carbohydrates/kg, 1.2 to 1.7 g protein/kg, and 20 to 35% of energy intake from fat can be recommended. Dancers may be at increased risk of poor micronutrient status due to their restricted energy intake; micronutrients that deserve concern are iron, calcium, and vitamin D. During training, dancers should give special attention to fluid and carbohydrate intake in order to maintain optimal cognition, motivation, and motor skill performance. For competition/stage performance preparation, it is also important to ensure that an adequate dietary intake is being achieved. Nutritional supplements that may help in achieving specific nutritional goals when dietary intake is inadequate include multivitamins and mineral, iron, calcium, and vitamin D supplements, sports drinks, sports bars, and liquid meal supplements. Caffeine can also be used as an ergogenic aid. It is important that dancers seek dietary advice from qualified specialists, since the pressure to maintain a low body weight and low body fat levels is high, especially in styles as ballet, and this can lead to an unbalanced diet and health problems if not correctly supervised.

The aim of this review is to underline the most relevant nutritional issues among adult dancers, establish some general nutritional recommendations, focus on nutrition during training and nutrition for competition/ stage performance, and point out some dietary supplements that might have a justified role in dance.

Therefore, dance classes can be categorized as intermittent bursts of moderate-to-intense activity, with the predominate solicitation of the anaerobic system. Some choreographies may require a dancer to dance for over 5 min, but these may not be performed frequently enough to induce a training effect at the aerobic system.

Given the fact that increasing energy expenditure through extra hours of exercise is normally difficult due to dancers' busy schedules, food restriction is usually the method used by dancers to maintain a low weight and low percentage of body fat (%BF). The female athlete triad is well recognized and is seen just as commonly in dancers. The triad refers to the interrelation among energy availability, menstrual function, and bone mineral density. Some of the clinical manifestations may include eating disorders, functional hypothalamic amenorrhea, and osteoporosis. The triad is especially relevant in activities and sports in which leanness and/or a low body weight are considered important, such as dance.

The nutritionist should explain that an effective nutrition program can be personalized to each dancer in order to meet their goals. Weight management interventions should be thoughtfully designed to avoid detrimental outcomes with specific regard for performance and health.

Other physiological parameters, body composition in dance has been viewed primarily in the context of ballet, where typical BF values for female dancers range from 16 to 18%. The equivalent values in male ballet dancers range from 5 to 15%. The International Society for the Advancement of Kinanthropometry (ISAK) sum of seven skinfolds indicates that the range of values for the athletic population is 40 to 90 mm for females and 30 to 60 mm for males.12 Therefore, dancers should at least achieve the minimum recommended values cited above, i.e., 40 mm for females and 30 mm for males.

The dancer must understand that proper nutrition (Table 1), not simply adequate caloric intake, is needed to maximize dance performance, to recover properly from training and rehearsal, and also to maintain body composition within healthy and adequate values. In addition, long-term low energy intake may lead to poor nutrient intake, particularly of the micronutrients, which could result in metabolic dysfunctions associated with nutrient deficiencies as well as lowered resting metabolic rate.

With reference to the table 1, many researchers have suggested that 30 kcal/kg FFM/day might be the lower threshold of energy availability for

females below which some reproductive disorders occur. Typically, energy balance in healthy adults is achieved at an energy availability of ~45 kcal/kg FFM/day. It is important to highlight that a chronically energy-deficient athlete is at a great risk of impaired performance, compromised growth, and disease. Actually, even if this recommendations, dancers are known to typically have low energy intake. Female dance students and professional ballerinas reported to consume below 70 and 80%, respectively.

For what concern macronutrients, there are no studies on the specific fuel requirements of dancers training, although moderate intensity activities within each session are characterized as being carbohydrate-dependent. Since dancers struggle almost every day for weight maintenance, recommendations of at least 3 to 5 g/kg/day for carbohydrate intake have been suggested. Protein is an important nutrient for the growth of the muscle and repair, important processes for the intensive training programs undertaken by dancers. Therefore, dancers should meet the general guidelines for protein intake for the athletic population of 1.2 to 1.7 g/kg/day. Fat is a necessary component of a normal diet, that provide energy, essential elements, and fat-soluble vitamins (A, D, K, and E). The acceptable macronutrient distribution range for fat is 20 to 35% of total energy intake, and intakes below 20% can impair dance performance.

Since most of the dancers tend to have a lower energetic intake and eliminate one or more of the food groups from their diet, so that the use of multivitamin-and-mineral supplement in necessary. The micronutrients that should receive more concern in dancer's diet are iron and calcium. Regarding iron, dancers and other athletes engaged in impact sports must compensate for the high rate of hemolysis. On the other hand, due to restriction of dietary intake, dancers may be at risk of iron deficiency. Adequate intake of vitamin C should be reinforced due to its ability to improve iron absorption. Concerning calcium, its adequate intake is essential for a strong skeleton not predisposed to injury. Adequate calcium intake (and absorption) reduces the risk of developing osteoporosis, which is alarmingly common in dancers and can hinder a promising career. Another micronutrient that may need special concern is vitamin D. It is now recognized that vitamin D is of extreme importance for bone health, immune function, and inflammatory modulation, and it may be necessary for optimal muscle function and performance. It has also been reported that many athletes are at risk of vitamin D deficiency, and its prevalence seems to be higher among those participating in indoor sports, such as a dancer. Therefore, it might be useful for dancers to monitor their serum concentrations of iron, calcium, and vitamin D and consult with their health care professional and/or nutritionist to determine if there is a need for special dietary interventions or/and for any specific supplementation.

During the performance is necessary to take care to the dehydration because the exercise becomes harder, performance levels become sluggish, and dancers may experience symptoms such as general tiredness, sluggishness, headaches, and light-headedness or nausea. Poor muscle one, joint and muscle soreness, and cramps are also associated with poor fluid intake and dehydration. While The average adult requires around 2 L of fluid intake per day. Dancers, due to their fluid losses during exercise, require more than this. During a hard training session or long rehearsal, fluid losses can reach 2 L/hr.

Ballet school dancers

Ballet school dancers, from classical to modern and in many different styles, have an aesthetic model that plays an important role, in their nutritional and training planning. The children and adolescent dancers are the elite athletes but the difference with professional and adult performers is that there are many factors to consider: growth, musco-skeletal development, menarche for female, puberty, malnutrition, inadequate sleep.

For evaluation of children and adolescent under the age of 18, the BMI is scaled according to so-called growth scales (Table 2).

These curves are different for boys and girls and very little data are available on the growth and development of young dancers. The existent studies, based on observation of small group of schools and collegiate dancers, 8-16 +/- 1 aged, in

different countries as United States, Brasil, Sweden, and in Korea considered nutritional intake with dietary record, body composition, bone mineral density, isokinetic muscular function measurement. The interesting data was concerned the adipose tissue distribution in female dancers, aged 8-16, from non dancers girls. At the age 8, both groups show similar weight while at age 13 non dancers are heavier than dancers 48.5 +/- 9.6 kg for non dancers and 40.6 +/-8.5 kg for dancers. The hormonal factors and menarche influence the adipose tissue distribution, and reduce the difference between two groups of 2 kg. Female ballet dancers frequently experience late menarche, and these delays may be due to the disruption in fat accumulation, which results from excessive exercise, (13.9 +/-2 age)

Gender differences during the puberty

The gender differences are also important into elite dance in growth:

-Girls mature, on average, around 2 years in advance of boys.

-Sex differences are notable in both strength and motor performance

In the girls, strength and motor performance have been shown to peak, during adolescence, and even to decline, while in the males tend to increase. Sex differences in relation to physical performance can be attribuited to greater relative fatness in girls and greater leanness in boys. The flexibility is a particularly important component in dance, while the average flexibility is reported to increase in girls age 11-14, before reaching a plateau. It's clear that growth can influence the flexibility for young dancers and it's important, in the same time, an healthy nutritional balance with a variation of personalized training planning.

Nutritional intake in ballet school dancers

Although it's necessary for dancers to obtain sufficient nutrition to ensure their best training and performance, dancers experience limited nutritional intake to maintain their body and shape because the aesthetic slim models influence the dance and concept of graceful movements. The low caloric intake and the deficiency of micronutrients such as iron, calcium, and vitamin D, was observed in group of 8-16 aged school dancers. The total energy intake in similar age group of non dancers was 1,780.2 - 2,150 Kcal, for ballet dancers was 1,310 +/- 390,32 kcal. and for contemporary dance group was 1,454+/-478.59 kcal. These results indicated that total nutritional intake expenditure is insufficient for dancers elite student. Next nine months of nutritional adequate intake, with dietary record, was improved the nutritional intake from 1,640 +/-412 to 2,368 +/-182 kcal. Eat sufficient food daily to meet the body's energy requirements for growth, tissue repair, and physical activity. The body needs approximately 15 Kcal/lb/kg to function under normal circumstances, plus an extra 200-300 kcal/day to meet the physical demands of ballet class, rehearsal and performance. The treatment consist in a good nutritional planning for investing in health and prevention of dancer's injuries: foods are relatively low in calories and high in nutritional density.

Complex carbohydrates

The complex carbohydrates should form the energy base of a dancer's diet as they are reduced to glucose slowly and provide a sustained energy release over a greater period of time. They are also an excellent sources of vitamins, minerals, and fiber that are frequently lacking in the dancer's diet. These complex carbohydrates are found in dried beans and peas, seeds and nuts, whole-grain, rice, pasta, cereal, breads, and as starches and fiber in vegetables and fruits.

Supplement of vitamins and minerals

A well-balanced and energetic diet for dancer in growth incorporates an adequate vitamin and mineral supplement to provide nutritional insurance. The supplement that supplies 100-150% of RDA for the basic vitamins and mineral, vit. A, vitamin C, folic acid, thiamine, riboflavin, niacin, zinc, magnesium, iodine, vitamin D and calcium. In particular, during the growth it is important the vitamin D and calcium supplementation with food intake and with supplement, for prevent several bone injuries such as fracture, bone fragility and low density, skeletal abnormalities. The iron for help to prevent the fatigue. The vitamin C is important and with protein stimulate the collagen matrix formation. It is well known the importance of minerals and vitamins, for growth and tissues

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development, and the reduction of deficiency before and after supplementation. The evident reduction of deficiency is for vitamin D, vitamin C, and vitamin B group, after supplementation.

Proteins

During the growth, the muscular structure is in the development and part of nutritional requirements, based on protein. For elite athletes as the ballet school dancers it is recommended that 12-15% of calories come from proteins. In a healthy nutritional planning, approximately 2000 kcal. in a day, a school dancers need about 60-70 gr. of proteins in their diet. In a recent study, the proteins from planted-based food are considered more healthy, for prevent risk of pathologies and improve the longevity of performer's career. The main sources of animal protein are meat, fish, cheese, eggs, milk and vegetal proteins indicated from beans, peas, lentils, seeds, grains.

The body doesn't like to use protein as fuel or energy. The body, in adolescent age, wants to spare valuable proteins for muscle building, making hormones, controlling fluid balance. High protein diets can lead to more calcium being lost from bones, and for dancers in training and growth it's a big problem, because increase the risk for fractures and low bone density.

Fats

Dancers needed the essential fatty acids, for carry vitamins around the body, protect the essential organs and lubricate joints, that are at risk of injuries. The fats are also essentials for the brain and nervous tissue. The essential fatty acid in the diet can be found in oily fish like mackerel, sardines, herring and salmon, as in nuts and seeds.

Hydratation

For dancer in growth staying hydrated is extremely important because poor balance and fatigue are the first sign of inadequate hydratation. Every dancer is a little different but pre-professional and training elite dancers should aim for about 2800-3300 ml. of fluids every day. About 20-25 % came from foods like fruits and vegetables, but about 80% comes from drinks, as juices, sport beverages and water. Some ballet school dancers prefer an mix of 50% water and 50% sport beverage.

Nutrition for training in professional dancers

The nutritional goals regarding meals/snacks before, after, and during training are similar to those for other sports (see the position of the American Dietetic Association, Dieticians of Canada, and the American College of Sports Medicine for additional information). (Table 3)

According to table 3, before exercise, a meal or snack should provide sufficient fluid to maintain hydration and be relatively low in fat and fiber to facilitate gastric emptying and minimize gastrointestinal distress. It also should be relatively high in carbohydrate, preferentially of low to moderate glycemic index, to maximize maintenance of blood glucose, be moderate in protein, and be well tolerated by the dancer. The pre-event meal should contain between 1 and 4 g carbohydrates/kg when eaten 1 to 4 h before exercise, to increase carbohydrate availability before a prolonged exercise session. At least 4 h before exercise, dancers should slowly drink about 5 to 7 mL/kg. These recommendations can be achieved by ingesting a sports drink with carbohydrates or by combining water with food. If the dancer does not produce urine, or urine is dark or highly concentrated, she/he should drink another 3 to 5 mL/kg about 2 h before the event. It is recommended that drinks have between 20 and 50 mEq/L of sodium. During exercise, especially if it lasts more than 1 h, primary goals for nutrient consumption are to replace fluid losses and provide carbohydrates (approximately 30 to 60 g/h) for maintenance of blood glucose levels. The use of carbohydrates during training has been shown to delay fatigue, potentially by reducing muscle glycogen depletion, maintaining blood glucose as an important energy source for both muscle and brain, and/or by altering neurotransmitter activity that could influence cognition, mood, motivation, and motor skill performance, factors that are essential for a dancer. Dancers should drink sufficient fluid during exercise to limit dehydration to less than about 2% of body mass, and sodium should be included when sweat losses are high, especially when exercise lasts more than about 2 h. The

recommendations are 150 to 350 mL every 20 min, depending on how intense the training is. Body weight measurement before and after training is one practical method to ensure that the amount of fluids ingested during training was adequate. Ideally, dancers should neither over-hydrate, which leads to a transient weight gain, nor dehydrate by keeping the weight loss per session below 2%. It is recommended that fluid replacement beverages might contain 20 to 30 mEq/L of sodium and 2 to 5 mEq/L of potassium. After exercise, dietary goals are to provide adequate fluids, electrolytes, carbohydrates, and proteins to replace muscle glycogen and ensure rapid recovery. To achieve a proper recovery process, it has been recommended an ingestion of 0.8 g carbohydrates/kg/h and 0.2 to 0.4 g protein/kg/h at frequent intervals in the early recovery period. The first meal should be taken during the first 30 min and again every 2 h for 4 to 6 h. Protein consumed after exercise will provide amino acids for building and repair of muscle tissue. During recovery from exercise, rehydration should include replacement of both water and salt loss in sweat.22 Since fluid losses will continue during the recovery period via urinary losses and ongoing sweating, the dancer will need to consume additional fluid to counter this. Typically, a volume equal to ~150% of the post-exercise fluid deficit should be consumed over the subsequent 2 to 4 h to fully restore fluid balance.

Nutrition for competition/stage performance

Although competition/stage performance may not threaten fluid or fuel stores, since routines are typically brief and moderate- to-low intensity, in the days before it, dancers may encounter absolute exhaustion due to long hours of rehearsals. When dancers are required to attend long rehearsals for several days, their muscles may be in a near glycogen- depleted state for performance, especially if dancers are restricting their dietary intake.

On the performance day, the dancer needs to find a plan that fits comfortably both in her/his nutritional needs and with her/his confidence. As costumes are normally tight and choreographies are physically demanding, dancers usually do not like to have a full gut/stomach prior to and during competition or stage performance. One possible strategy is to consider switching to a low residue-diet over the final 24 h before the event to reduce the stomach and intestinal contents. On the event day, the last meal should be taken 4 h before the performance in the case of a large meal, or 1 to 2 h in the case of a snack. Dancers should be encouraged to take their own food and drinks with them to ensure suitable fuel and to avoid gastrointestinal problems. Additionally, dancers may suffer from anxiety and stress, which may decrease appetite and, consequently, compromise the amount of energy intake. It is important to work with a plan that considers fuel needs and practical opportunities to consume food and drink during the event, especially on long events. But if the dancer feels that food and fluid intake impair performance and/or aesthetics, she/he may choose to not drink or eat during the event and start the recovery strategies as soon as possible after the performance. This quickness is even more important if the event lasts for several days. Given that performances sometimes finish late at night, restaurants and bars serving food may already be closed. Therefore, dancers should carry with them snacks (Table 2) to eat as soon as possible after the end of performance to ensure proper recovery nutrition.

Dietary supplements and ergogenic aids

Products that have a justified role in dance are sport foods and supplements that can be used to achieve a nutritional goal, including the prevention or treatment of a nutritional deficiency: i.e., multivitamins and mineral, iron, calcium, and vitamin D supplements. Caffeine can also be considered as an ergogenic aid. One of its potential beneficial effects is the altered perception of fatigue and effort, allowing the dancer to undertake better and more consistent training/performance. Caffeine can also beneficially influence reaction time, alertness, and visual information processing. There is evidence that beneficial effects from caffeine intake may occur at modest levels of intake (1 to 3 mg/kg body mass). Caffeine overdosing has been associated with decreased reaction time and alertness and with impaired visual information processing, which might counterbalance its stimulatory effect.

Malnutrition and injuries

Low bone density and fracture

For ballet school dancers and for pre- and professional performers, the intense exercises, low BMI and low BMC, in association with nutritional factors involve into many different injuries. In puberty, this situation involves into a low bone mineral content (BMC), with elevated fracture risk. The dancers of 16.5-17 age, started dancing at 5.8 years, and danced 22 hours/week. BMI for age group was found to be a normal in only 42.5% of dancers while in the 15.7% of dancers had more or less severe thinness. Assessment was made for BMI, BMC and BMAD (bone mineral apparent density). For female adolescent elite dancers there is a positive correlation between BMAD and years since menarche, because the estrogens have a protective effects. The balanced diet is necessary for a correct skeletal develop and for prevention of fracture risk. The aesthetic criteria for ballet's art encourage low BMI, and many young dancers often limit their energy intake, for maintain a thin body. The energy restriction accompanied by a decreased protein and fat intake, many dancers are vegetarian and presented very deficient protein intakes. Mineral and vitamins are also deficient, specially, calcium and vitamin D, which are indispensable for bone health. The caffeine and smoking reduce the assumptions of calcium from bone tissue. The low energy intake and malnutrition retard the menarche (13.9 aged +/-2) and the low estrogens influence the bone density. The bone mineral content was measured with DXA: dual energy x-ray absorptiometry, in particular of left femoral neck (FN) and lumbar spine (L1-L4), for evaluation of mineralization independent of bone size. In female dancers population, 41.2 % have a BMI low (thinness GRADE 1) and this inadequate nutritional intake involves into fractures, joint's injuries, osteoporosis, postural problems and skeletal abnormalities.

The female athlete triad

For female dancers school and professional performers when the energy intake is inadequate, and the osteoporosis is accompanied with amenorrhea (Table 4), is known as " Female Athlete Triad". This concept, was described officially in 1997, as a syndrome often observed in physically active girls and women and in 2007, was remodeled by American College of Sports Medicine (ACMS) to provide a framework for discuss of issues of bone health in dancers, three corners of interrelated issues of (1) energy availability, (2) menstrual function, and (3) bone health, and each of these issues is a continuum ranging from optimal health to a diagnosed problem. ACMS defines " energy availability" as amount of energy left over and available for normal body functions after the energy expended for training is subtracted from the energy taken in from food. The multidisciplinary approach is recommended for treatment of Female Athlete Triad, dietetic, medical, and psychological specialists, for best support the dancer. The most important aspect is informer dancers of relationship between energy intake and energy avalaibility, promoting the healty attitudes towards body physique and supporting medical check – up to track hormone functions and the menstrual cycle.

Relative energy deficiency in dance (RED)

In 2014, the International Olympic Committee (IOC) was coined the phrase Relative Energy Deficiency (RED), for describe the syndrome effects not only in female.

The energy availability (EA) has been defined as Energy intake (EI in Kcal), minus exercise energy expenditure (EEE), divided by fat-free mass (FFM in Kg). The functions, energy regulated, include cell manteinance, thermoregulation, growth and reproduction. A low EA (<30 kcal/kg FFM/day), due to food reduction and extraordinary energy expenditure for training and performance. A professional female dancer needs around 2,000-2,100 kcal and a professional male dancer around 2,650-2,700 kcal. and it can be more of course if physical demands are high. When an individual's dietary energy intake is insufficient respect expenditure request for dance training and performance, manifests RED. The related energy deficiency can affect metabolic rate, bone health, menstrual function, immunity, and cardiovascular health. In addition, RED may lead to a gradual reduction in the athletes' performance by a number of factors, decreased endurance, coordination, concentration, irritability, depression, decreased muscle strength. (Table 4)

Injuries in young dancers

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The physical changes, during adolescence for females and males, addition a risk for injuries increase. This period of rapid growth, susceptibility to injuries is increased. The skeletal mass increases in the mass but not in volume et in density. There is a temporary state of low bone mass, for asynchrony between rate of growth in stature and accumulation of bone mass. This condition reduces the resistance to mechanical stress and increases risk of injuries such as stress fracture. For prevent the injuries, in young elite dancer, it is important that they understand these changes are temporary and inevitably. The adaptation depends on positive motivation, gradual training planning with personalized nutritional, postural and technical approach. The high pressure for a rapid and successful adaptation is counterproductive and there is a risk to develop negative mood, with more injuries, for example foot fractures and selective and repetitive movements.

The obsession for thinness and eating disorders

Thinness is perfection? The obsession, in today's society, for ideal thinness has reached epidemic proportion. In United States and Sweden, a collaborative study reveals that in dance the demand of thinness is increased, and it is associated to more graceful in the movement and to perfect body. The aesthetic model of elite dance, the society, the media and the impact of social media, consider beautiful and perfect the slim body, and for dancers this imagine represents the grace and the most important objective. Many dancers become a compulsive dieters, with reduction of energy nutritional intake, particularly for young dancers in high school, with differences about level of competition of their ballet school. Young dancers from more competitive schools have a increased chance of developing the anorexia nervosa in comparison with their high school colleagues. In the national ballet school and in competitive international companies, the higher pressure and the greater performance expectations involve into eating disorders. The professional dancers are at a much higher risk for eating disorders than are adolescent dance students, for elevated competitiveness and psychological stress. Many companies select their dancers from large general auditions open to all students with different physical characteristics but others companies select the dancers solely from schools where extremely rigid standards for weight, shape and training with attention to puberal development. The school dancers who are not naturally thin would be those who are most vulnerable to the development of serious eating disorders. The genetic predisposition and nutritional education, adapted to dance, play an important role to develop an eating disorder. The obsession of thinness is pathologic but the thinness in a balanced and healthy body, it is necessary for training and for become an professional dancers in good health.

Nutrition and prevention in post-injuries

In ballet school dancers and in professional performers injuries can result from overuse or trauma to a body part, as foot, ankle, low back, hip or joints. The nutritional therapy is fundamental part of rehabilitation process and in prevention of the others injuries. Energy needs increase during acute injury repair. In fact, basal metabolic rate (BMR) may increase by 15-50% based on the severity of the trauma. For example, athletic injury and minor surgery may increase BMR, by 15-20%, while major surgery may lead to a 50% increase in BMR. The dance nutritionist must balance the increased energy and nutrient needs of injured and recovering dancers with the reality of less activity. A young school dancer, 14 years old, with BMR of 1,611 Kcal/day, energy need when sedentary of 1,933 Kcal/day, energy needs during recovery of 2,319 kcal/day. During the injuries repair, energy intake should decrease relative to training and competition. During the injuries the dancers should eat less, but they are still athletes. For injury repair requires more protein, injured dancers should aim for 1.5-2.0 g/kg, up from usual 0.8 g/kg. the fat, particularly omega -3s and cut down omega-6s, preferably to 3:1, avocados, olive oil, mixed nuts, and fish as salmon, are indicated for nutritional rehabilitation. For injury period, no specific carbohydrate recommendations but it is important to stable insulin concentrations (which, as an anabolic hormone, may affect wound healing). The meals must be frequency, every 3-4 hours, and each meal should contain 1-2 servings of veggies and

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fruits. The nutritional support is necessary for prevent future injuries and improve the quality of body's resistance of young and professional dancers.

Conclusion

The dancer's health requires a multidisciplinary approach, with nutritional, postural, clinical and psychological support and gender medicine specific approach. There are different styles of dance and different types of dancer's body, it's important the role of dance medicine for find a balance and healthy lifestyle. Many factors influence the dancer's health, thinness, inadequate energy intake, intensive training, and their consequences such as hormonal imbalance, low bone density, fractures, eating disorders, and with difference from gender. The aesthetic model is important part of dancer's imagine and for graceful performance, but this model can become an obsession until to wrong behaviors that involve into medical problems and injuries. The dance medicine and dance nutrition are very elite fields of specialization, the dancers are athletes but they are different from sport's athletes and it is important to found the key for a new approach. The nutritional and medical counseling for children and young dancers in elite school and for professional performers is only possibility to prevent many physical and psychological problems, during the career. The dance is an art but his instruments are body, soul and mind of dancers, with physical, emotional, technical, motivational and energetic implications. The healthy body and mind must be the first objective for a dancer and for his/her career. The movement is harmony when the body is in harmony

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Table 1. Daily Nutritional Guidelines for Dancers

Energy	≥30 kcal/kg fat-free mass + training energy expenditure
Carbohydrates	3–5 g/kg
Protein	1.2–1.7 g/kg
Fat	20–35% of energy intake

Table 2. growth curves for children and adolescents

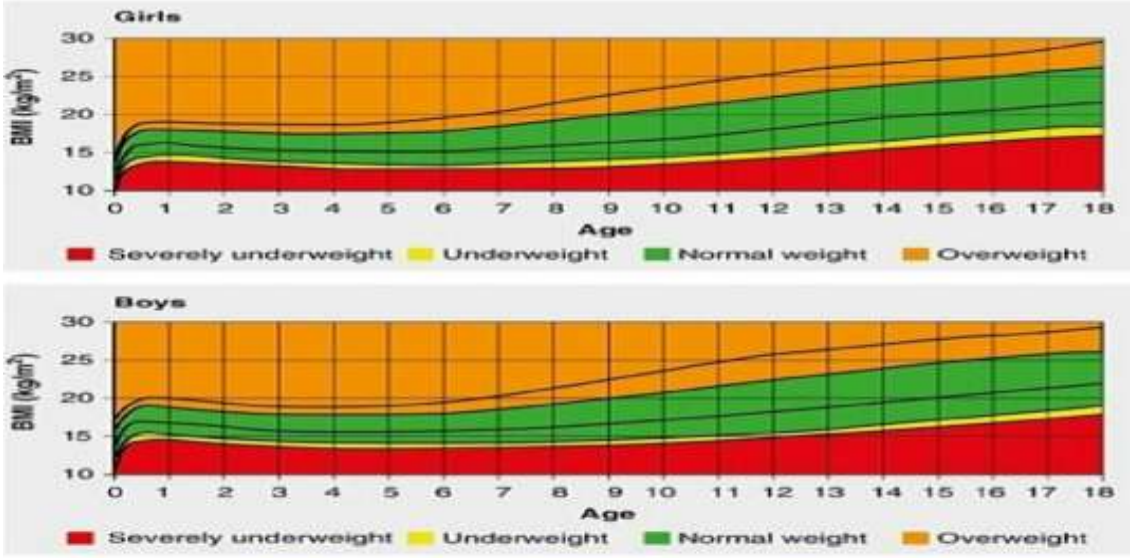

Diagram 6.1a and 6.1b: BMI growth curves for children and adolescents up to the age of 18 with regard to age and sex. Modified according to Kromeyer-Hauschild, 2001 and Kromeyer-Hauschild, 2015.

Table 3. Nutritional recommendations for dance training and practical tips

Before exercise	1–4 g CHO/kg eaten 1–4 h before exercise 5–7 mL/kg of fluid 4 h before exercise If under-hydrated: additional 3-5 mL/kg 2 h before exercise	Snacks providing 50 g of CHO: • 600 mL of sports drink with 6% CHO • 2-3 cereal/muesli bar • 2 medium bananas or 3 pieces of other fruit • 80 g of dried fruit • 2 slices of bread with jam
During exercise (>1 h)	30-60 g CHO/h 150-350 mL of fluid every 20 min	Dancers should weigh themselves before and after training to adjust the amount of fluid intake. The weight difference must not be >2%.
After exercise	0.8 g CHO/kg/h 0.2-0.4 g protein/kg/h (The first meal should be taken during the first 30 min and again every 2 h for 4–6 h)	Snacks providing 50 g of CHO and 10 g of protein: • 500 mL of flavoured low-fat milk • 2 cups of low-fat breakfast cereal with 1 cup of low-fat milk • 2 slices of bread with cheese/ham/meat/chicken and 1 large piece of fruit • 250–350 mL of milk-shake or fruit smoothie

CHO, carbohydrates. Adapted from Rodriguez et al. Burke, Mastin, Sawka et al., Beelen et al., and Burke and Deakin.

Table 4. Study of dancers, with different age and ethnicity

Study	*Population*	*N*	*Ht*	*Wt*	*Leanness*	*% Ideal Wt*	*Menarche*	*Secondary Amenorrhea*
Brooks-Gunn et al., 1987	Adults	55	65"	110	1.70	−12%	14.29	19%
Hamilton et al., 1985	Black adults*	11	66"	110	1.67	−15%	—	—
Garner and Garfinkel, 1980	Adolescents	183	64"	109	1.70	−13%	—	—
Frisch et al., 1980	Adolescents	89	64"	100	1.57	−18%	13.70	15%

*The only study to include black dancers.

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CONDITIONING STRATEGIES FOR COMPETITIVE KICKBOXING

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Abstract

It is not easy at all to study and develop a specific workout to improve the kick boxer.

The vast majority of people still believe that, in order to make as many shots as possible, it is fundamental just to have “breath”: run for one or two hours does not mean to be able to complete any fight.

However, in reality, not everyone knows that combat sports, such as boxing or kick boxing, are mixed - or acyclic sport.

The right combination of Micro and Macro nutrients is crucial and essential for the success of a food plan! In our opinion the feeding must turn around the proteins without neglecting carbohydrates and fats that will be the "protein carers". One time that you have set your meals with proteins to add fat and carbohydrates, it will be not so difficult.

We had the chance to deepen our knowledge with the Nutriketo course, which was very interesting with a high and professional profile.

Keywords: *Kickboxing, health, nutrition, sport*

Introduction

In dealing with such an important and essential topic, one cannot help but consider our technical knowledge on:
-Aerobic resistance
-Anaerobic resistance
-Specific resistance
-General technical training
-Specific technical training
-Compensation
-Supercompensation
-Overtraining
-Nutrition

It is not easy at all to study and develop a specific workout to improve the kick boxer.

The vast majority of people still believe that, in order to make as many shots as possible, it is fundamental just to have "breath": run for one or two hours does not mean to be able to complete any fight.

However, in reality, not everyone knows that combat sports, such as boxing or kick boxing, are mixed - or acyclic sports: athletes need a good balance between aerobic - and anaerobic resistance and in order to interact successfully with each other, they bear in mind:
-heart rate;
-work intensity;
-duration of work;
-rest.

In a match, it is impossible to believe that you can keep a bland and constant pace, with heart rate between 120 and 140 beats per minute (typical of aerobic work). Actually, during a match there are different stages of fights, which alternate together: from very intense combat, where the heart rate exceeds 200 beats per minute, to very mild recovery phase.

Let's start by clarifying the reason why there is a relationship between aerobic - and anaerobic resistance.

Aerobic resistance and anaerobic resistance

Aerobic endurance is the organic quality that allows to produce works of moderate intensity for some time.

The factors that establish the performance value of the endurance tests can be of two different entities: the physical and the psychic nature. To the first belong the efficiency of the cardiovascular – and respiratory system, the high degree of progress of oxidative processes, the high degree of perfection of the technical gesture; to the second belong the willpower and the concentration skills of an athlete.

Aerobic resistance is a basic resistance, on which to build and plan future training, in order to reach later the specific strenght. The development of the basic resistance is determined by the continuous execution in the time of an exercise, according to oxygen balance (without lactic acid formation) with the frequency heart rate between 120 140 pulses / min. For this reason, the exercise should not be so quick to get breathless, forcing us to stop after burning all the energy; it must have a balanced rhythm, able to encourage the athlet to improve the efficiency of the cardiovascular system. In fact, aerobic work pushes the heart to pump at an higher frequency than the state of rest, and in the attempt to reduce frequency, it will tend to increase its range.

Common thought is that the energy source depends on the work times: within 20 minutes most of the energy comes from sugars; from 20 to 30 minutes the energy is a mix of sugars and fats; over 30 minutes, energy comes from fat oxidation.

We know that these times and percentages are subjective.

Anaerobic resistance develops in the absence of oxygen (anaerobiosis) with lactic acid formation, the heart rate should not be lower than 180 pulses / min. When the body requires an amount of power higher than usual, it creates an oxygen debt and through many different chemical reactions, the body starts forming lactic acid as a residue. This resistance is just the body's ability to train, contract and endure a large debt of oxygen in a given minimum period of time. The most stressed energetic mechanisms are those of ATP (adenosine triphosphate) of CP (phosphocreatine) and glycolytic.

The best and the simplest ways to increase it are: the shots and the repeated blows to the bag, ai

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paou, sparring work with remarkable strength, due to the number of shots of a match.

Now let's start analyzing the reason why these two resistances are closely linked to each other.

We know that, the more anaerobic resistance is, the more it increases tolerability of lactic acid in muscles, but without the same developed aerobic resistance, that allows to dispose of the lactic acid and to restore the oxygen level in the blood, through the apparatus organic, including the cardio circulatory - and respiratory system, we are not able to achieve good results (1, 2).

The specific resistance

Before starting to work on the specific resistance, maybe, we need to keep in mind some factors to better monitor the work and the efforts of the athlete. In order to assess if the athlete gave his best and to find improvements, stops or regressions, which are always at the basis of training, we should calculate the maximum heart rate, through the Karvonen formula.

The Karvonen Formula is a mathematical formula that helps us to determine the target heart rate (HR) training zone. The formula uses maximum and resting heart rate with the desired training intensity to get a target heart rate.

Target Heart Rate = [(max HR – resting HR) × %Intensity] + resting HR example

Ideally, you should measure your resting and maximum heart rate for more accurate results. If the maximum heart rate cannot be measured directly, it can be roughly estimated using the traditional formula 220 minus the age of the athlet. For example, for a 25 year old boy who has a resting heart rate of 65, wanting to know his training heart rate for the intensity level 60% - 70%.

His Minimum Training Heart Rate:

220 - 25 (Age) = 195

195 - 65 (Rest. HR) = 130

130 x .60 (Min. Intensity) + 65 (Rest. HR) = 143 Beats/Minute

His Maximum Training Heart Rate:

220 - 25 (Age) = 195

195 - 65 (Rest. HR) = 130

130 x .70 (Max. Intensity) + 65 (Rest. HR) = 156 Beats/Minute

His straining heart rate zone will therefore be 143-156 beats per minute.

Technical training: generic and specific

Also technical training differs into generic - and specific part.

The generic part is usually combined with the basic work, where athlets learn new techniques such as to work in the mirror, in pairs or by doing sparring tests; all that at low intensity, in order to make the exercise the most technical and accurately as they can.

We must necessarily combine the specific part with the anaerobic work because the rhythms are equal and higher to the rhythms of the competition.

The specific training leads to the repetition of a number of exercises of techniques at ever-increasing intensity (both in speed and in potency) in front of a mirror, in paou, with the box bag, and even better, through fighting on specific race rhythms.

Compensation and compensation adjustments

Once we have examined these points, we would like to point out the relationship between workload and compensation.

Common thinking is: the more we train hard, the more results we get. This is absolutely not true!

The organism is a complex machine, able to adapt to the environment and to any other alarm stimulus. For example, when we start running, for the first time or after a period of inactivity, typical muscle pains appear (calves, quadriceps, hamstrings, buttocks) that vanish afterwards a few days. This is an alarm phase of the body, that proceeds until the next day to restore everything. In the rest period between a training session and the other, the

musculature "regenerates" and "rebuilds" stronger than before, from the same stimulus that destroyed it.

If we want to increase our performance, we will must increase our workload, allowing the compensation and the supercompensation. The physiological adaptation processes stop if the work is done without the right rest but also if the rest break is too long. The right adaptation processes are created in the correct way only if the stimulus has a certain intensity and only if there is a correct alternation between loading and rest.

Usually people think that it is enough one night of rest to recover (compensation) everything that we lost in a workout; actually it is optimal a rest time of 24-48 hours for enhance the phenomenon of supercompensation.

To sum up: the compensation occurs when the body restores physiological balance (ie it restores energy supplies, it disposes of lactic acid in the muscles, it reconstructs the worn muscle fibers); when the body passes the initial qualitative level, then starts the supercompensation.

Super training

The organism, however complex and perfect in its own natural imperfection, drawes up an answer, it gives us " an alarm bells". It is not difficult to hear them, but to know how to decipher them!

If a person feels a general sense of fatigue, loss of appetite, difficulty in falling sleeping, increase in frequency cardiac at rest, consequent lowering of the performance, this can be a consequence of too much training and the need of a break, in order to not have physical problems.

As we have seen, the training processes are not neither as simple nor straightforward as we think. It does not exist a standard traning for everyone, but there are different training. In the training planning phase, we should consider factors such as: age, sex, weight, height, type of life, etc.

Training is important but equally important and basic are the nutrition and the integration.

Nowadays a physical preparation of an athlet, of an amateur or of a simple person cannot ignore the nutrition. All athletes and also the Kickboxing athlete should eat properly in order to have excellent training and competition results.

A kickboxer has nutritional guidelines which are similar to that of a Greek fighter wrestler, judo, or a muay thay or boxing fighter. They must have a food protocol to reach the right weight before the competition, in a healthy and natural way.

Often it is not the workouts that scare the athletes, the workouts are pure fun for them; what scares are the food restrictions.

The right combination of Micro and Macro nutrients is crucial and essential for the success of a food plan! In our opinion the feeding must turn around the proteins without neglecting carbohydrates and fats that will be the "protein carers". One time that you have set your meals with proteins to add fat and carbohydrates, it will be not so difficult.

We had the chance to deepen our knowledge with the Nutriketo course, which was very interesting with a high and professional profile.

We would like to take the opportunity to thank Prof. Luca Rastrelli because he gave us the opportunity to take his class. We also thank our mentor Dott. Massimo Spattini.

We are waiting for attend other interesting events.

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PILATES TRAINING ON PEOPLE WITH FIBROMYALGIA

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Abstract

Pilates is a particular exercise approach that was founded on the teachings of Joseph Pilates and was initially practiced almost exclusively by athletes and dancers. Pilates has become a fast-growing, popular trend in rehabilitation and fitness programs in recent years[1, 2]. Pilates can be described as a method combining Oriental and Western philosophies including yoga, dance, durability-strength training, and gymnastics.

The goal of Pilates training is improvement of general body flexibility and health, emphasizing core (truncal) strength, posture, and coordination of breathing with movement. Although Pilates exercise is generally adopted in training programs for healthy people as part of general fitness programs, it has been suggested as a therapeutic modality for several musculoskeletal disorders. Fibromyalgia syndrome, a chronic condition typically characterized by widespread pain, nonrestorative sleep, fatigue, cognitive dysfunction, and other somatic symptoms, negatively impacts physical and emotional function and reduces quality of life. Exercise is commonly recommended in the management of people with fibromyalgia, and interest in examining exercise benefits for those with the syndrome has grown substantially over the past 25 years. Treatment of FMS is usually symptomatic because of the lack of understanding of its etiology and pathophysiology, and several treatment modalities ranging from antidepressant therapy to biofeedback and electroacupuncture have been suggested [3-5]. A range of pharmacologic and nonpharmacologic management options have also been examined in evidence-based guidelines and reviews[6]. A stepwise program emphasizing education, certain medications, exercise, cognitive therapy, or a combination of all these modalities has been recommended in the light of current evidence[5] .Exercise programs were reported to be helpful in FMS patients in several studies, and the programs including stretching, strength maintenance, and aerobic conditioning were accepted as a standard treatment protocol[7-12] A recent study has suggested the beneficial effect of supervised aerobic exercise training and strength training on physical capacity and clinical symptoms in FMS patients[13]. In this mini-review we reported some scientific evidences oh the effects of Pilates on pain, functional status, and quality of life in fibromyalgia, which is known to be a chronic musculoskeletal disorder

Keywords: *Pilates, training, fibromyalgia, health*

Introduction

Fibromyalgia syndrome is a common rheumatological condition characterized by chronic widespread pain and a reduced pain threshold as well as hyperalgesia. The cause of Fibromyalgia is associated with genetic, environmental and neuromodulatory factors. Associated features are fatigue, depression, anxiety, sleep disturbance, headache, migraine, variable bowel habits, diffuse abdominal pain and altered urination frequency. This features leads to a great decrease in quality of life and often prevents the performance of activities of daily living, thereby reducing productivity in the work environment. There are several approaches to the diagnosis and classification of fibromyalgia, patient must have symptoms for at least three months and presence of pain in 11 of 18 specific points (tender points) (14). The prevalence is approximatively 3%, with women more likely to get this disease and the association with body was mentioned in several studies. The importance of physical exercise among patients with fibromyalgia is already well described in the literature, in addition it is a low-cost practice, and a safe and efficient treatment intervention. The Pilates method of exercising has been gaining popularity, developed by Joseph H Pilates, includes stretching and strengthening exercises with controlled and precise movements where special equipment can be used or which can be performed even on the ground. However, few studies have evaluated the effects of this method on the treatment of patients with fibromyalgia. The main objective of this mini-review is focused on recent advances on the effectiveness of Pilates methods in improving pain in patients with fibromyalgia.

Nutritional approach

Recent studies support the recommendation of a multimodal approach to treatment involving individualized, evidence-based pharmacotherapy and self-management, ranging from synthomatic drug therapy to strategies for stress control and relaxation, nutritional approach and physical exercise. At NutriKeto_Lab (AORN MOSCATI UNISA) we have formulated a specific ketogenic protocol for fibromyalgia with very interesting results from the beginning of our nutritional therapy: - 2 days promptly reducing the symptom of headache and insomnia; 7-10 days clear improvement of tiredness and of the feeling of fatigue and of the colitis-like inflammatory symptomatology (15). The aglucidical nutritional therapy (TNA-FIBROMYALGIA) is the therapeutic protocol developed by us for the treatment of fibromyalgia and consists of an aglucidic and normoproteic nutritional therapy, supplemented by alkalizing, vitamins, FOS, micronutrients and various specific nutraceuticals, administered enteral with nasogastric tube or oral tube; this therapy is able to drastically reduce the thickness of visceral fat and insulin resistance with a consequent decrease in the production of inflammatory substances (15).

Physical activity and fibromyalgia

The relationship between physical activity and central nervous system mechanisms of pain in fibromyalgia was reported (16). Exercise programs were reported to be helpful in fibromyalgic patients in several studies, and the programs including stretching, strength maintenance, and aerobic conditioning were accepted as a standard treatment protocol. Moreover is well known that people with fibromyalgia are less active and have lower physical capacity. Have worse balance and risk of falling and the lack of balance is one of the 10 most debilitating symptoms and affects 45% of patients. However, exercise may report many benefits but not all physical activity is positive. Physically active patients appear to maintain their ability to modulate pain while those who are less active do not. Benefits of exercise program was reported in another study where was summarized the physiologic obstacles to exercise and reviewed exercise interventions in fibromyalgia. Authors described the top 10 principles for successfully prescribing exercise in the comprehensive treatment of fibromyalgia and provided a practical exercise resource table to share with patients. Pain reduction, reducing fatigue and increasing energy, reducing depression and improves mood, Improved sleep, Improved quality of life, improved fitness, decreased medication, improved balance are the main benefits. Any type of exercise can be beneficial if it fits the needs and

tastes of the person, pilates and aquatic exercises seems to be especially recommended.

Pilates

Pilates was created in New York, USA and matured from the 1920s to 1960s as an adjunct for the training and rehabilitation for dancers in the performing arts. Pilates exercise has a holistic approach where a correct execution of the six fundamental principles (concentration, control, centering, flowing movement, precision and breathing) increases body awareness with less ground impact and joint-stress. It can also be performed at various intensity levels whereby the participant or patient may adjust the difficulty to their own level of conditioning.

The 6 Principles of the Integrative Mind-Body-Spirit Approach of Pilates are:

Centering: This concept is defined as physically bringing the focus to the center of the body, the powerhousearea between the lower ribs and pubic bone. Energetically, Pilates exercises are sourced from the center.

Concentration: If you bring full attention to the exercise and do it with full commitment, you will obtain maximum value from each movement.

Control: Every Pilates exercise is done with complete muscular control. No body part is left to its own devices. It is all a conscious, deliberate movement that the mind is controlling.

Precision: In Pilates, awareness is sustained throughout each movement. There is an appropriate placement, alignment relative to other body parts, and trajectory for each part of the body.

Breath: Joseph Pilates emphasized using a very full breath in his exercises. Most Pilates exercises coordinate with the breath, and using the breath properly is an integral part of Pilates exercise.

Flow: Pilates exercise is done in a flowing manner. Fluidity, grace, and ease are goals applied to all exercises.

Pilates training is a form of structured physical activity, which has been shown to improve muscle endurance, flexibility, and dynamic balance in young and middle aged population. This method is different when compared to traditional exercises, which, in turn, tend to isolate the working muscles and have specific training approaches using repetitive motions. Cruz-Ferreira in a systematic review evaluated evidence for the effectiveness of the Pilates method of exercise in healthy people. Authors reportred sixteen studies that met the inclusion criteria. The outcomes studied most often were flexibility, muscular endurance, strength, and postural alignment. The Pilates method appears to be effective in improving flexibility (strong evidence), dynamic balance (strong evidence), and muscular endurance (moderate evidence) in healthy people (18).

Recent reviews

Pilates is a system of exercise focusing upon controlled movement, stretching and breathing. Pilates is popular today not only for physical fitness but also for rehabilitation programs.

There have been several recent reviews that focused on the benefits of pilates on postural control, rehabilitation programs, neck and back pain, fibromyalgia. Korkmaz et al. investigated (twenty-five female patients with an age range of 33 to 63 years) the effect of Pilates exercises on the social physical concern (SPC) and on strength, body mass index (BMI), pain, and depression. Patients underwent a Pilates exercise program consisting of one hour of exercise performed three times per week for 12 weeks. Pilates exercises significatively improved the weight, BMI, body fat ratio and SPC and pain level of the patients. A statistically significant correlation was found between SPC scores and the body fat ratio, weight, BMI, and pain and depression scores of patients before and after the exercise program. The study concluded that a 12-week Pilates program had positive effects on anthropometric parameters, SPC, and pain and depression levels of FMS patients. Patients with FMS can safely perform Pilates exercises to control weight, improve physical appearance, and reduce SPC and pain and depression levels, and no adverse side effects were observed.

Several studies showed that physical practice, such as that produced by pilates, therefore moderate, is

not only functional on symptoms but can even increase the perception of the pain threshold and improve the quality of life. Of course, on the contrary, motor / physical inactivity creates functional limitations for a long time, facilitating the unearthing of a disharmonic condition, this reason explains why physical practice combined with postural, respiratory and movement principles such as Pilates have more effects compared to drug therapy.

In Brazil, the effectiveness of this type of gymnastics is being tested on improving the symptoms of this disease. Researchers at the Universitdade Cidade De Sao Paulo, in Brazil, have as their objective to seek to understand not only which type of exercise can be most effective, but to try to understand whether Pilates can really be effective on fibromyagic patients.The researchers indicated that, most likely, this study will demonstrate how Pilates could be a solution for these people. The study participants are 98 and are between 20 and 75 years old. These already had a full-blown diagnosis of fibromyalgia and quite significant pain. People was involved in a differentiated exercise regime, with different duration depending on the people. Some will follow 8-week protocols, others for 12 months.

This study concluded that the Pilates method can be incorporated into the clinical practice of physical therapists treating patients with fibromyalgia. The study l also provided information on which exercise will be most cost-effective, information that can be used by insurers and public health systems (20).

In another study sixty women aged 18–60 years with a diagnosis of fibromyalgia, with a score of between 3 and 8 points on the Visual Analogue Scale for pain, were submitted to an exercise programme based on mat Pilates and aquatic aerobic exercise. The protocol will correspond to 12 weeks of treatment, with both groups performing the exercises with supervision twice a week..

The primary outcome will be pain (Visual Analogue Scale for pain). The secondary outcomes are to include impact related to the disease, functional capacity, sleep quality and overall quality of life. The evaluations will be performed at three points: at baseline and after 6 weeks and 12 weeks of treatment.

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