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EDITORIAL MISSION STATEMENT

The editorial mission of the EWF – Scientific Magazine is to advance the knowledge of human movement based on the assumption that it is firstly, by any standard, the expression of muscular strength and secondly, a way of life and an ethical approach entrusted to professionals who not only are highly qualified, but also have full knowledge of the scientific facts, as well as being specifically competent. From its first issue, EWF – Scientific Magazine, has set itself the ambitious goal of bridging the gaps between the scientific laboratory and the operator on the field, enhancing both the practical experience of the coaches and the results of applied research. Consequently, the editorial rule will be a constant reference to practice and the publication of recommendations on how to apply the results of research to the practice of movement and sport.

SUMMARY

"Research has shown that the longer the athlete's feet are in the non-support position the faster the trunk descends."

Druzhinin, 1974

28

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Women are clearly well acquainted with the menstrual cycle, and the age at which they make this acquaintance is getting increasingly lower (even if, in some cases, menstruation is actually absent).
Nowadays, the menstrual cycle arrives much earlier than in the past, and specialists consider this fosters a greater predisposition to develop pathologies affecting the reproductive organs.

The official journal of the European Weightlifting Federation

EDITORIAL

Woman and sport (or Woman is sport?)

Every year has been important for the EWF Scientific Magazine, but 2019 is set to be an exceptionally important one, as we will try to draw attention, with an approach that we hope will appeal to many willing readers and interested experts, to a theme that "is not new but it is always new "and that is personally very close to my heart. Close to my heart for several reasons, which I will try to explain here. The main theme will be: women and sport. One of the major reasons is that my first federal position, at the beginning of the '90s, was training the women's national team - an experience which truly gave me an insight into the female sports world and that allowed me to open important windows on many personal and group dynamics, and most certainly also on "something" about the way to approach female training. I emphasise "something", because if I think back on those times, in light of the experience accumulated in the years that have followed, I must admit (with no ifs and buts) that I wouldn't have made some of the choices I made back then and, other choices which I should have made, I would have carried through with determination.

In those years, in that cultural climate, we had practically no experience of how to train strength in women, since the methods used were often those implemented with men, even with the same volume and intensity. The belief and experience at the time was that training like men was the best way for a woman to train.

The experience that circulated often originated (and was more or less imported) from the world of track and field, where women had been practising resistance training for some time to improve performance in their throws. The first women's European Championships held in San Marino in 1988, where Italy took its first gold thanks to Roberta Sforza in the women's 48 kg category, had as protagonists athletes from throwing sports, in particular from the former USSR, where female resistance training was already part of their workouts. Obviously - and how could one deny it? - the problems at the time were not only of a methodological nature, they were also cultural. You had to overcome the resistance, not only of the general public, but sometimes also of people involved, so that women could safely and freely do weightlifting, using heavy loads to develop their skills and be truly competitive. They were indeed difficult times, and they prevented the growth (in cultural terms, as previously mentioned) of people in the weightlifting world and those in general, concerning the subject of women in society and, therefore, also in sport. In Italy, we all know very well that new approaches are treated with diffidence, as are sudden or rapid changes.

Today, women's weightlifting is - fortunately - a well-established, legitimated, recognised reality, appreciated as much as men's, in fact, highly appreciated: which is a very good thing, but let's not forget that it was not easy to get to this situation. Far from it!

In truth, all female sport has had to suffer and sweat to establish itself and demonstrate that the old and unproven conjectures on gender difference (and on everything that this meant and incorporated in cultural terms) had little to do with practice and results. Women have actually given sport more than sport has given them.

Mass sport, as we know, is a fairly recent phenomenon. It was born with

the social reorganisation that followed the industrial revolution at the end of the 19th century in England. The industrial revolution, which inevitably became a cultural revolution, of customs and of an overall vision of reality, sparked intense migration from the countryside to industrial cities and, with the start of shift work for the masses (almost all male), free time became available during the day, a concept that was inconceivable to farmers, who worked from dawn to dusk. For this precise reason, sport, previously only a privilege of the well-off who had the free time to practice it, now became a hobby of other social categories and over time, a practice recognised by many. Women's sport, however, was still unheard of!

Women do not even figure when the Olympics came into being. It was the same Pierre de Coubertin (1863-1937) who affirmed that the women should be spectators, appreciating the men's sporting feats (spectators not participants); he also added, "Female participation would be impractical, uninteresting, anti-aesthetic and improper" (1912). The idea of women's sport was inconceivable, even in the Olympics of the early 1900s. We had to wait until the Antwerp Olympics in 1920 to witness the official entrance on the international scene female athletes and the admission of the same into Olympic sport. Although already in Paris (home to the second edition of the modern Olympic Games in 1900), in addition to six hundred male athletes, two female tennis players had performed. The true consecration of women in sport, however, took place in the 1936 Olympic Games in Berlin (XI Olympics, from 1 to 16 August). Forty-nine countries participated with a total of 3,834 athletes, of which only 328 women, about 10%. Italy's Ondina Valla won the first gold medal in the 80-metre hurdles.

With every Olympics that passed, every four years, female sport established itself more and more, distorting rigid beliefs, anachronistic dying traditions and even granite bureaucracies. I remember the 2010 Winter Olympic Games in Vancouver, when the President at the time, Jacques Rogge, together with his executive board, decided (a decision made in 2006) that female ski jumpers would not be competing in that edition of the Games, based on technical merit. The Canadian athletes turned to the Canadian Human Rights Board, accusing the IOC of (clearly, quite evident) discrimination. Despite the factual data, the determination of the petitioners and various uncertainties, the situation has still not been clarified. In 2000, women's weightlifting was already part of the Games in Seoul, as it was in 2012; in Salt Lake City (USA) in 2002, female athletes took part in the first bobsleigh competition, and yet another wall officially fell in 2012 when female boxing made its official entrance in the London Olympic Games. What was the main resistance in the social sphere that contrasted the development of women's sport? Why is there still male predominance today? The first negative approaches, which greatly hindered and undermined the sport of women, underlined the (very obvious) differences between the two sexes: men are muscular and competitive, women weaker and more submissive. And that was it, end of story, without any in-depth analysis and with a certain peremptory tone to it. Obviously a line of thought, not only wrong, but extremely wrong and unfortunately in vogue until the world of feminism as a whole did not begin to structure new concepts and a new paradigm regarding the female body. The relationship between sexes and gender began to be treated differently, and finally, in the 1980s gender was defined not as a cultural aspect of a biological representation, but as the experience of a body that can express two sexes. According to Julia Epstein & Kristina Straub (1991), with this line of thought the biological foundation is only apparently obvious and well defined: the gender of bodies is an unstable cultural construction, whose purpose is to limit and contain the menacing absence of confines between the bodies and the practices of the body that would otherwise explode the institutional and organizational structures of social ideologies. This obviously calls into question the clear distinction between two sexes as differentiated units. The passage is subtle but decisive.

This approach changed the vision of the woman and her body within the sports system. We have come a long way from those years, even if men are more culturally facilitated when it comes to accessing sport, through authentic rites of passage, in some cases obliged, while this is not the case - generally and in our culture at least - for the female universe. But is this only the reason why female numbers are lower in terms of participation in sport? This is certainly one reason. The other may lie in the fact that the percentage of women who abandon sport is very high. Numerous authoritative studies have shown that about 40% of women interrupt competitive activity prematurely and abruptly. The age group most at risk is between 15 and 17 years. Having said that, further investigation should be made into these figures in order to discern the various sectors and the different reasons:

- for motivational aspects;
- coaches are not skilled in training female athletes;
- an obsolete sports organisation;
- bringing forward competitive objectives.

The list could be much much longer! Hence the choice to dedicate our magazine this year to women, to try to provide as many explanations as possible to these and other aspects of women's sport and training, because "female sport" with a greater number of participants and the right visions, broadens the cultural landscape of a nation and brings joy and passion (which would do us all some good) to the entire sports movement.

Antonio Urso
EWF President

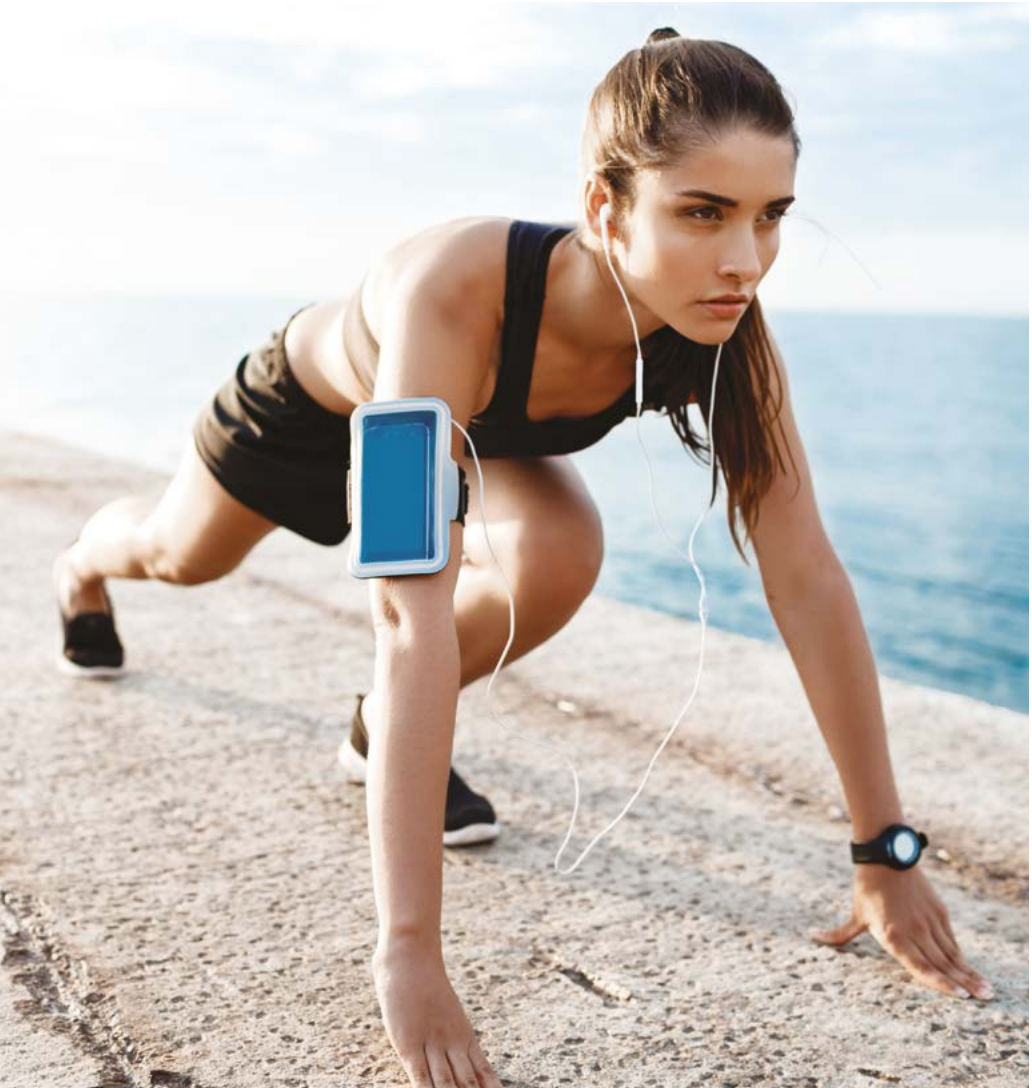
The official journal of the European Weightlifting Federation

PNEI AND YOUTH SPORTS ACTIVITIES

HOW FOOD STRESS SHAPES THE ATHLETE'S BODY

BY N. BARSOTTI, M. BRUSCOLOTTI, M. CHIERA

Tackling a complex and complicated problem such as managing an athlete's diet and its many variations requires reflection from an epistemological point of view on the logical structures and the methodology that one intends to adopt. Up until at least the 1950s, the Western scientific standard was characterised by a reductionist approach. This occurred in the various areas of human science and disciplines such as economics have not been exempt from this vision, with the formulation of the theory of rational decision (Von Neumann, Friedman), with the idea of an economy based on a rational model rational that obeyed mathematical laws, psychology, with the success of Behaviourism and Cognitivism and the affirmation of the idea of mind as a black box (Barrhus F. Skinner 1904-1990) or as a computer (Janos von Neumann 1903- 1957). In the field of biology and genetics we witnessed the affirmation of the mathematisation of evolutionism and molecular reductionism, the idea of a genome as a fundamental invariant part. Over the decades, this process has been more evident in the medical field, but not only in the radicalisation of the diagnosis process and in the choice of increasingly hyperspecialistic therapies. Unfortunately, paradoxically, this has led to (1) a crisis in international healthcare systems both in reference to the enormous increase in costs, and in relation to the low degree of satisfaction expressed by patients and professionals, to the increase in frequency of "medical" errors, and the increase in disparities in treatment and an overall loss of quality of clinical outcome.



INTRODUCTION TO PNEI

In actual fact, not all the scientific research of the previous century followed the paradigm. On the contrary, the biopsychosocial research (2) born in 1977 with Engel contrasted dominant reductionist thinking, approaching the idea of "health" no longer only from a biological point of view, but also from a psychological and social point of view. Today, the biopsychosocial approach is taking giant steps, so much so that Goldstein himself (3) has felt the need to qualify the so-called "integrative scientific medicine" as a new intellectual standard. A standard that, by applying the systems theory for the understanding of normal physiology and clinical disorders, constitutes an essential basis for understanding the dynamic complexity typical of everything that threatens the integrity of our organism, with major consequences in the development and choice of treatments to be adopted in function of the same complexity and dynamism. The athlete, first and foremost and consequently Sports Medicine and the training methodology are not exempt from these considerations. Referring to the biopsychosocial model (2) proposed by Engel in Italy, by its founder F. Bottaccioli, the PNEI paradigm was born, acronym of the term Psycho-NeuroEndocrinoImmunology, a discipline that studies the bi-directional relationships between the psyche and biological systems, describing how the psyche is able to modulate the functioning of our body up to the

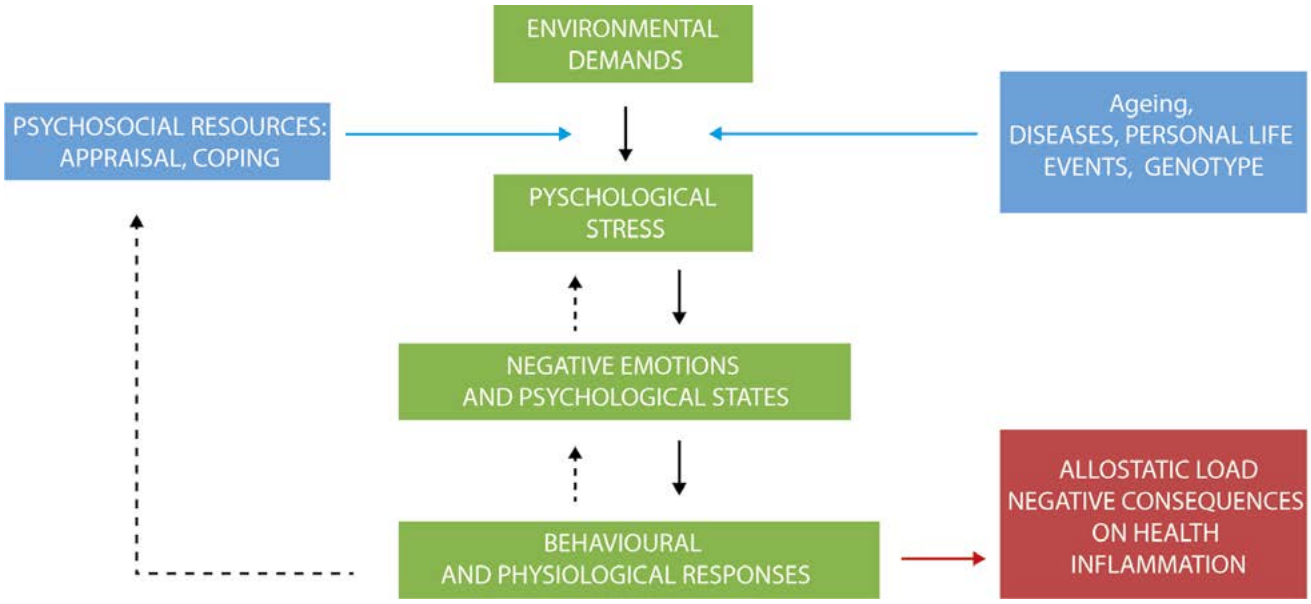


FIGURE NO. 1

THE ALLOSTATIC LOAD AS A RESULT OF AN EXCESS OF PSYCHOLOGICAL, SOCIAL AND PHYSICAL STRESS, IN WHICH THE DEMAND EXCEED THE APPRAISAL AND COPING RESOURCES AND SKILLS, WITH NEGATIVE CONSEQUENCES ON THE HEALTH AND COPING SKILLS THEMSELVES. REPRODUCED WITH PERMISSION FROM (4).

point of gene expression (epigenetic effect) and explaining, on the other hand, how the various biological systems modify thought itself. All this allows people to respond in the best possible way to environmental stressors, be they psychological or antigenic (4). In fact, from a chronological point of view, the first elaborations in this field were made by the American, Walter Cannon (5) in 1914 and then by Italy's, Carlo Ceni (6), who had already introduced the concept of "psycho-neuro-endocrine" activity in 1925, clearly still not fully declined in any way in reference to the athlete, nor to modern day food strategies. The literature of the time considered stress response systems as a kind of instrument that allowed the organism to produce systemic modifications functional to fight and/or flight, and which allowed the same organism to restore homeostasis after an emergency.

The years of war and devastation in European territory produced definitive research on "Stress" in America, in particular by Selye (7), who in 1936 first described the General Adaptation Syndrome, qualifying stress as "essence of life", therefore no longer a phenomenon linked to emergencies. It took Selye approximately 40 years of research to identify and describe the so-called "adaptability", the physiological or pathological changes underlying it, and to lay the foundations of the so called "diseases of maladaptation" until his elaboration of the dynamic definition of "heterostasis" (8). Nowadays we use the term "allostasis", the body's ability to implement multisystem, coordinated, physiological and behavioural strategies to achieve stability (9.10).

The basic requirements, which the athlete knows very well, to obtain a certain degree of stability through change are substantially of three types: a. predictive ability, b. ability of the brain to coordinate physiological and psychological adaptations, c. ability to adapt their homeostatic set points. We only need to think of how the HRV of a marathon runner varies in comparison to a sprinter, sensitive to change even before the start of physical activity, to the blood pressure, to the variable weight, etc. On the contrary, very few homeostatic variables (osmolarity, pH of body fluids, blood O2) are susceptible to less extensive adjustments. With reference to these variables, the concept of "allostatic load" (11), (Figure 1) becomes fundamental, in other words, the state the organism enters into as a result of all the events (from environmental and performance requirements to psychological stresses, from the training overloads to an irregular diet, etc.) that, when they exce-

ed the organism's appraisal and coping threshold, determine physiological and/or psychological responses that can negatively affect health.

To correctly approach such a complex and complicated problem as nutrition, whether it is an experienced athlete or a young beginner, it is necessary to take note that inadequate food strategies, not customised to the real needs of the athlete or, worse, following the "DIY" principle, can constitute a high risk of allostatic load. Not to mention that this "DIY" approach often does not focus on diet, on which every athlete should work with their trainers, but on the reckless use of ergogenic supplements, which are often useless and even harmful (although some substances may have a theoretical basis of effectiveness, their actual practical effects depend on the sport and the level of competitions) (12) if not really harmful (13).

This is especially true for young athletes who may be particularly affected by media pressure and be pushed in the direction of unsafe, illegal substances (13) or perhaps eating in the wrong way (e.g. the consumption of only egg white as opposed to the entire egg, which in addition to reducing the assimilation of certain vitamins, can favour the production of inflammatory cytokines such as IL-1a and TNF-a.) (14). Young people are in fact those who present many side effects such as headaches, gastralgia, sleep problems, hyperactivity and risk of trauma. Not to mention the possible behavioural consequences such as little sleep and a lower perception of fatigue which, although useful during a performance, is detrimental when it does not allow adequate rest (15).

COMPLEXITY OF THE PNEI NETWORK

Given the difficulties of explaining in just a few lines the complexity of the mechanisms that underlie the regulation of the stress response, we can at least underline that a central role is played by the hypothalamus. Respiratory difficulties, energetic imbalances, dehydration, visceral or somatic pain, as well as prolonged fasting or diets and/or highly inflammatory eating behaviours, basically any condition capable of producing a homeostatic disturbance, weighs on this area of just over 4ml, compared to an average brain volume for the human species of 1350ml, which in

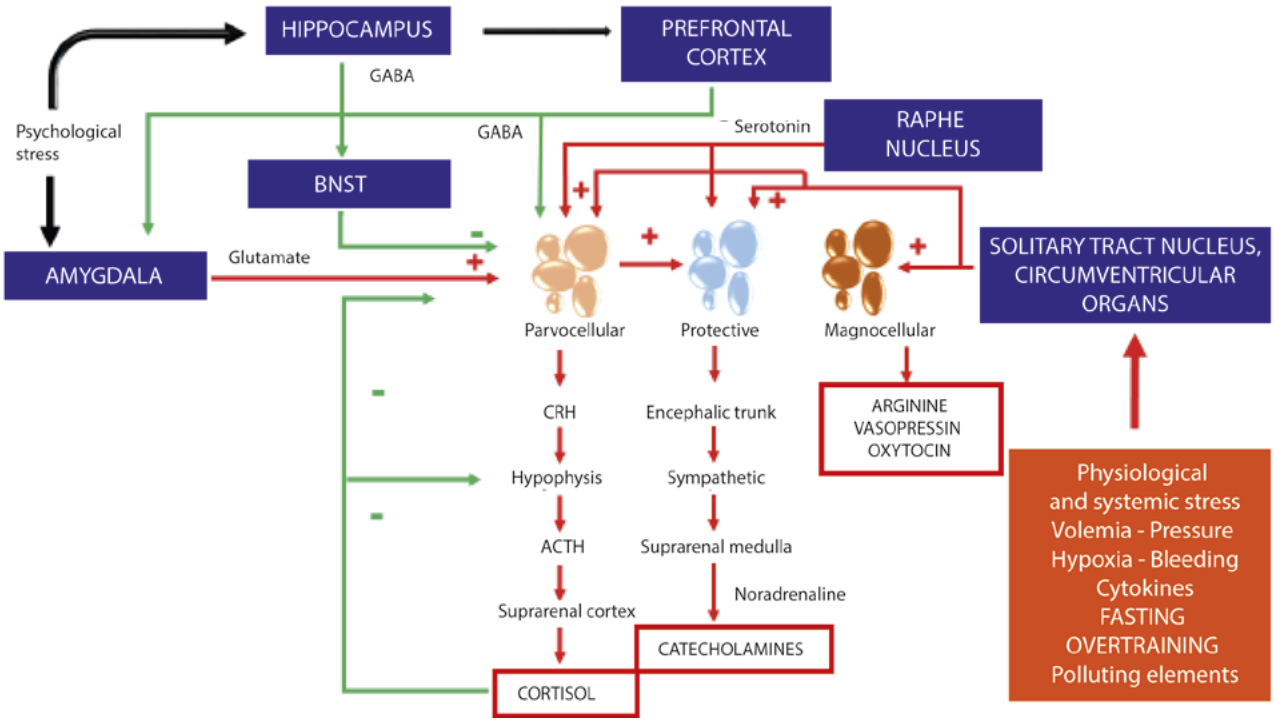


FIGURE NO. 2

HYPOTHALAMIC PARAVENTRICULAR NUCLEUS (PVN) AND STRESS RESPONSE. WHEN FACED WITH CONSIDERABLE INFORMATION COMING FROM, FOR EXAMPLE, THE MEMORY (HIPPOCAMPUS, AMYGDALA) AND COGNITIVE-EMOTIONAL PROCESSING (PREFRONTAL CORTEX), THE PVN IS CAPABLE OF ACTIVATING THE ENDOCRINE AND NERVOUS AXES OF THE STRESS RESPONSE. REPRODUCED WITH PERMISSION FROM (4).

turn is able to activate the so-called hypothalamic-hypophysis-adrenal endocrine axis and the orthosympathetic nerve axis. The hypothalamus, divided into nuclei and areas, is responsible for the regulation of multiple functions, such as sleep, hunger, thermoregulation, memory, behaviour, water balance, etc., and is capable of activating the two axes described above, at the same time determining the production and release of cortisol from the cortical and catecholamine area from the medullary area of the adrenal gland (Figure 2). Through a negative feedback mechanism, such molecules will in turn stimulate the immune system. It is at this point that in reference to the athlete we must introduce the concept of ''myofascial'' tissue, crucial for any technical movement and unfortunately sometimes having a significant impact on the competitive career of a professional athlete.

MYOFASCIAL TISSUE

The connective tissue (CT) (16) is subdivided into the "pannicular" fascia (subcutaneous adipose), "axial" fascia (trunk and limb muscle), "visceral" fascia (internal organs) and "meningeal fascia" (meninges). Today, the CT itself is no longer considered merely a support/adaptation tissue to the mechanical stimuli of the muscular component with which it is in contact, but rather, due to its actual role as an extracellular environment, an authentic field of action of the immune system and inflammation site. In fact, today "mechanobiology" provides us with further insights into the mutual relations between merely mechanical effects and biochemical effects in the context of myofascia.

Today we know that, in particular, the an excessive activation of the humoral immunity Th2 (17) (18) under the action of cortisol, stimulates:

- macrophages to produce IL-6, IL-1β and TNF-α, with the aim of cleaning the tissue from microbes and toxins;
- the degranulation of mast cells with the consequent production of IL-6, metalloproteinases or MMP (inflammatory enzymes degrading the CT) and TNF-α;
- triptases and kinases, also sensitive to increases in body temperature, to break down and remodel CT.

Similarly, the production of cortisol increases:

- the activity of osteoclasts of bone remodelling (19)
- the activity of re-positioning of the muscular tissue.

Substantially, therefore, the body responds by implementing its own "ability to adapt". Unfortunately, the stimulation produced by cortisol and the activation of the humoral immunity Th2, processes useful to the athlete in the short term, become deleterious over a long time, especially if due to wrong eating habits and/or excessive training, determining:

- excessive muscle myostatin response, from which an excessive protein degradation and an atrophy of the IIx fibres linked to power (17);
- excessive bone reshaping, a parameter already associated by the scientific literature with an increased risk of fracture in osteoporotic patients (19);
- implementation of FGF23 fibroblast growth factor, with the consequent variation of phosphorus blood levels, associated with asthenia, renal and cardiovascular problems;
- reduction of the activity of the osteocalcin, fundamental for the functioning of testosterone and insulin.

In the long term, the same degranulation of mast cells with early MMP production, associated in the literature with obesity and periodontal and oncological diseases (20), hyperstimulates even more the remodelling of CT, thus determining the general histopathological picture of common tendinopathies (21), and inhibits the activity of neurotrophic growth factors (NGF) at the central hypothalamic level (22), thus paradoxically determining an overall loss of adaptive capacity.

It is important to bear this mind for young athletes as:

- until the age of 8-10, the immune system tends to react predominantly with a Th2 action, then finds a balance between Th2 and Th1 during puberty (23). The Th2 response is inadequate to fight viral, intracellular and tumour infections and an excess can induce immune allergies and hypersensitivity. It is no coincidence that athletes infections are common in athletes, especially in the respiratory tract (24). These infections are favoured by the systemic immune-suppressor effect that physical activity normally has (24,25), which can be balanced by a wise use of nutrients such as carbohydrates, glutamine and vitamin C, which support the Th1 immunity (26.27);
- during intense and prolonged physical activity, there may be a tissue infiltration of neutrophils due to the DNA leaked into the blood due to microfractures of the muscle fibres. This infiltration can foster inflammation (and therefore injuries) and self-immunity (25, 28). The same nutrients mentioned above (but also others such as vitamins A, E, zinc and N-acetylcysteine), in the context of adequate nutrition, can reduce the

oxidising and inflammatory effect of neutrophils, although more precise studies are required (25, 29).
The immune system, just as the endocrine axis of the stress response, is then also influenced by the sex hormones, androgens and estrogens, which during adolescence particularly affect organic development and metabolism. Testosterone, whose production is increased by anaerobic power activity (30), tends to regulate the production of cortisol (31) and to stimulate the consumption of carbohydrates (32), but, since it increases the production of sebum in the sebaceous glands, it can foster the growth of Propionibacterium acnes (33.34). This microbe is not only responsible for acne but, although we still need to understand the actual causal nexus, it has been found in degenerated intervertebral discs, in hernias, in the uro-genital apparatus in the case of prostatitis and tumours, and even in the substantia nigra in the case of Parkinson's disease (35). An inflammatory diet, rich in foods with a high glycemic index and fat, which promote the production of hormones stimulating androgen production, such as IGF-1, can therefore favour the results outlined above (34).
Regarding estrogen, however, two aspects must be considered: estrogens stimulate cortisol secretion, favouring Th2 immunity (31), increasing the production of elastin and reducing that of collagen in the CT, thus making the fascia more elastic, but also therefore more prone to injuries (36). For this reason, a diet that ensures good doses of vitamin B6 and favouring vegetarianism can be useful to support the liver in its function of metabolising and expelling excess estrogen (37,38), given that the same excess of estrogen, imitated also by the use of contraceptives, induces the deficiency of vitamin B6 (39). On the other hand, estrogen metabolism is influenced by energy balance and body weight: a negative energy balance due to excessive physical activity can, through weight loss, reduce estrogen production with repercussions not only on the reproductive metabolism (e.g. amenorrhea), but also on sports performance itself (40). For this reason, a diet that combines a correct caloric intake, paying particular attention to the breakdown of macronutrients (estrogens seem to favour the consumption of fats as opposed to carbohydrates (32)), anti-inflammatory foods and regulators of metabolism (e.g.: whole grains containing fibre, as we shall see later) is extremely important.

THE "SECOND BRAIN" AND THE PNEI NETWORK

In the specific case of the athlete, in addition to this general context of response to long-term homeostatic perturbation, whether induced or attributable to continuous requests for performance, inadequate administration of workloads and overtraining syndrome (41), the specificity of the response from the gastrointestinal tract to a highly inflammatory diet or to some extremely incorrect dietary management practices of the athlete's weight. The last twenty years of research agree in attributing the role of "second brain" to the gastrointestinal tract (42). The gastrointestinal tract of the athlete (Figure 3) subjected to a high intensity exercise load is damaged by intestinal permeability: this occurs based on the exposure time, for activities that are already carried out at 50-60% of the VO2Max. In particular, researchers observed, in relation to the increase in body temperature resulting from exercise and a different distribution of the volemia, an increase in intestinal permeability, a transfer of lipopolysaccharide (LPS) within the gastrointestinal segment, an increase in blood flow of stress hormones, an increase in inflammatory cytokines and also in this case, a strengthening of the immune response (43).
The increase in intestinal permeability induced by incorrect eating habits and aggravated by workloads and environmental requirements, leads the body to increase the production of reactive oxygen species (ROS) and to alter the composition and behaviour of the intestinal microbiota itself, the so-called "dysbiosis" with consequent alterations in the release of hormones and neurotransmitters, for example -aminobutyric acid (GABA), neuropeptide Y (NPY) and dopamine, related to gastrointestinal disorders, but also to anxiety, depression, loss of appetite and the ability to cope with stress. On the contrary, we know that an adequate function of the intestinal microbiota, in particular with an adequate production of butyrate and propionate, involves a greater transepithelial resistance of the gastrointestinal tract, a greater resistance of the intestinal barrier and a consequent reduction of the parameters of inflammation (43) .

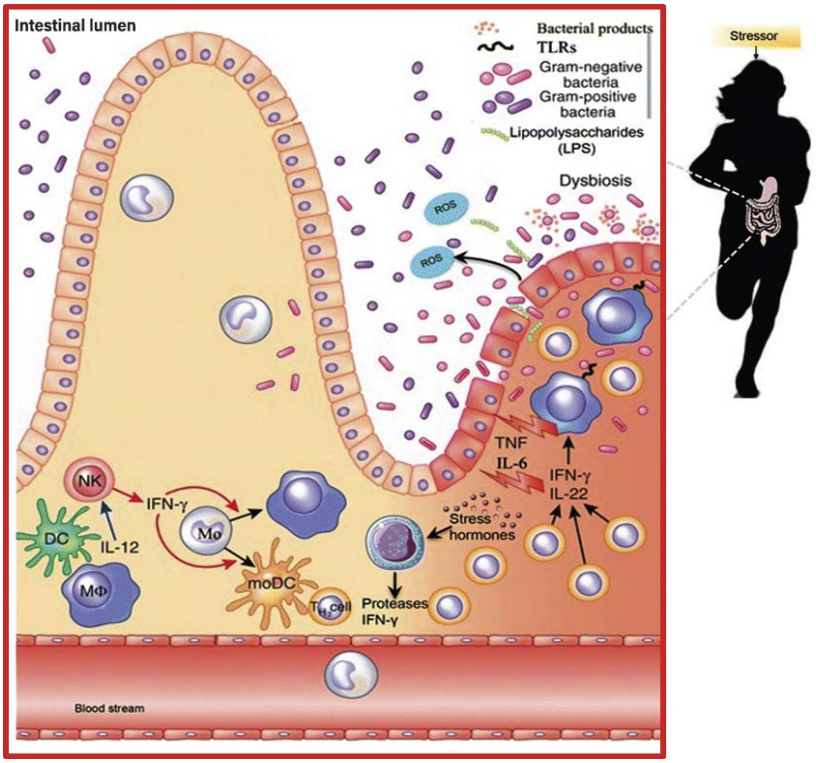


FIGURE NO. 3
DIAGRAM OF DAMAGE TO THE GASTRO-INTESTINAL TRACT IN THE ATHLETE UNDERGOING HIGH-INTENSITY PHYSICAL EXERCISE. EXCESS STRESS INDUCES AN IMMUNE RESPONSE WITH THE RELEASE OF INFLAMMATORY CYTOKINES (TNF-γ, IL-6, IFN-α, IL-12 AND IL-22) AND ROS, WHICH PROMOTE AN INCREASE IN INTESTINAL PERMEABILITY. THE CONSEQUENCES ARE A GREATER ABSORPTION OF TOXIC SUBSTANCES (E.G. LIPOPOLYSACCHARIDES OR LPS), WHICH IN TURN STIMULATE AN INFLAMMATORY RESPONSE, AND A DYSBIOSIS THAT FAVOURS THE PRODUCTION OF THESE TOXIC SUBSTANCES. REPRODUCED FROM (43).

In this regard, the changes mentioned above regarding the immune system (e.g. neutrophilic infiltration) as a result of excessive physical activity, favour intestinal permeability and any autoimmune diseases that may result (28), which is paradoxical since good physical activity favours gastro-intestinal health (lower risk of constipation, diverticulitis, gallstones, inflammatory bowel diseases and tumours) (44). These effects occur especially when eating patterns are irregular, and in young athletes there are often nutritional deficiencies: many young people are deficient in micronutrients such as vitamins A, D and E, zinc, magnesium and calcium (45,46). Besides their classic "enzymatic" role, these are fundamental factors for regulating the immune system: vitamin A supports the production of mucosal secretory immunoglobulins; vitamin D regulates immune responses; vitamin E protects epithelial cells from oxidation; zinc is one of the main stimulators of immunity; magnesium and calcium act as anti-inflammatories, as well as regulators of neuro-muscular metabolism (47,48). And as far as the intestine is concerned, several young athletes are also lacking in fibre (46), fundamental substances in protecting the intestinal barrier, regulating the intestinal neuroendocrine production (including the production of TRH) and promoting the health of the intestinal microbiota, the importance of which is becoming increasingly acknowledged in sport: not surprisingly, the integration of probiotics (Lactobacilli and Bifidobacteria) is beginning to be recommended (43), which can, however, also be implemented through the intake of fermented foods (49). Although not strictly linked to the intestine, to close the circle we should not forget the importance of drinking water, which is often not taken or deliberately expelled by diuretics in order to lose weight, which can, however, lead to serious problems of dehydration, thermal shock, metabolic regulation and cognitive impairment (50). In the context of the systemic and local responses described above, another element very well known to the athlete plays a central role in the response to stress: catecholamines. Released by the medullary portion of the adrenal gland, this is also in response to a stress stimulus of a psychic nature, of an organic or environmental nature, where the athlete is exposed to chronic stimuli, the effect of catecholamines is added to the effects described above. In fact (Figure 4), on one hand in association with an excess of cortisol there is a further activation of MMP with consequent release of TGF- 1, and on the other in association with the increase in intestinal permeability, there is a further increase in ROS: the result, which is harmful for the athlete, consists in a transformation of myofascial tissue.

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THE RESPONSE OF THE "CONNECTING TISSUE"

In acute circumstances, if subjected to the stimuli just described, myofascial tissue actually benefits: in fact, the response translates into a transformation of fibroblasts into myofibroblasts, through the activation of connective cells endowed with α-SMA strands, a protein similar to actin. The fibroblast, key to the organisation of the CT, activates its slow and low consumption contractile capacity and is in a position to produce inflammatory cytokines. This mechanism, from a phylogenetic point of view, allows the organism to provide an accurate response, for example to events that determine a solution of continuity of the tissues, thus allowing the repair of wounds. However, if this system is hyperstimulated, as often happens in the athlete, we begin to witness the establishment of fibrosis, of slow, long-lasting slow contractures that inform cell membrane integrins around the extra-cellular environment. At this point (Figure 5), the organism will transfer the information related to the tissue modifications to the central level:

A) via the interstitial receptors linked to the slow Ad fibres and above all C fibres, through the lamina 1 of the spinal cord to the hypothalamic paraventricular nucleus (PVN).

B) to the posterior lobe of the insula, fundamental in body awareness, in the integration of sensory, emotional and environmental signals, in consciousness and pain.

The activation of macrophages, on the other hand, and the consequent production of IL-6, IL-1β and TNF- , will reach some cerebral targets by means of body fluid via the circumventricular areas, through the production of prostaglandins (PGE2) and Nitric Oxide (NO), via the nerve, through the vagus nerve up to the visceral-sensory nucleus of the solitary tract in the encephalic trunk, a nucleus that receives the sensitive information of all the viscera innervated by the vagus, the glossopharyngeal, the facial nerve and the afferent fibres coming from the kidneys, heart, large vessels, in particular the baroceptors and chemoceptors with respect to the aortic arch and carotid vessels. The transfer of this information leads to a deterioration in the athlete's interception, resulting in a change in behavioural strategies. In support of these considerations, since 1989 scientific literature has been associating chronic pain (51) with an alteration of the perceptive mechanisms, just as the same are correlated to post-traumatic stress disorders (52), affective disorders (53), addictions (54), ea-

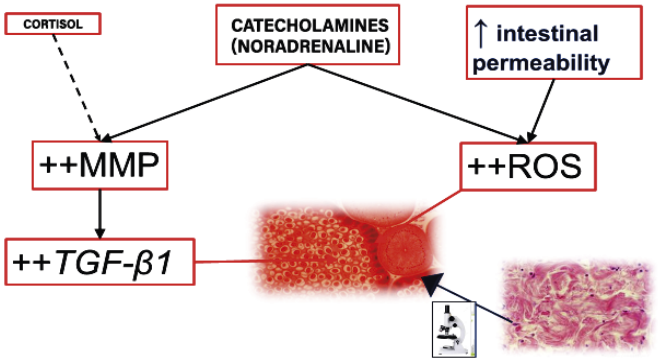

FIGURE NO. 4
DIAGRAM ILLUSTRATING THE INTERACTION OF CATECHOLAMINES AND CORTISOL ON CONNECTIVE TISSUE. AN EXCESS OF THESE SUBSTANCES FAVOURS THE PRODUCTION OF METALLOPROTEINASES (MMP), FREE RADICALS (ROS) AND INFLAMMATORY CYTOKINES SUCH AS TGF-α 1, WHICH INDUCE BOTH A FIBROTICIZATION OF THE TISSUE AND ITS CONSEQUENT DEGRADATION.

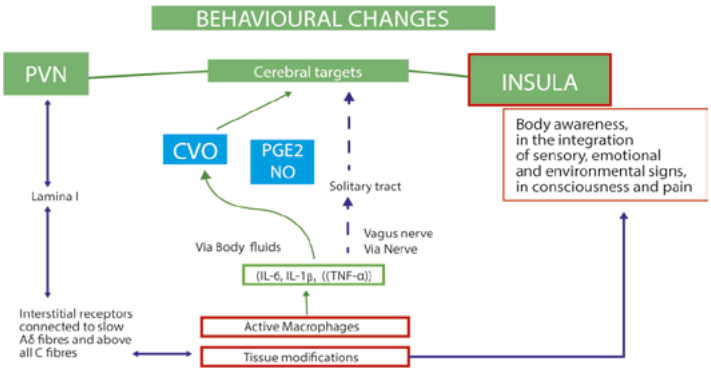

FIGURE NO. 5
PERIPHERAL CHANGES, IN PARTICULAR THOSE RELATED TO INFLAMMATION AND ACTIVATION OF THE IMMUNE SYSTEM, ARE TRANSFERRED TO THE BRAIN THROUGH DIFFERENT PATHWAYS, NERVES (VAGUS NERVE AND INTERSTITIAL RECEPTORS PRESENT IN THE FASCIA) AND BODY FLUIDS (CIRCUMVENTRICULAR ORGANS, CVO). AT THIS POINT, THEY REFLECT ON DIFFERENT CEREBRAL TARGETS, INDUCING BEHAVIOURAL RESPONSES THAT IN THE LONG RUN CAN BECOME COUNTERPRODUCTIVE. PVN, HYPOTHALAMIC PARAVENTRICULAR NUCLEUS; NO, NITRIC OXIDE; PGE2, PROSTAGLANDIN E2.

ting disorders (55), somatoform disorders (56), etc.

CONCLUSIONS

Therefore, according to what has been explained, the management of an athlete's diet, if ill-advised, can represent an excessive allostatic load and, if protracted over time, may determine a series of physical and psychological adaptations that can reduce the overall capacity of performance within the specific sport and on an even more serious note, affect the state of psycho-physical health of the athlete.

This can lead to a deterioration in the ability to make technical-tactical choices, of the ability to adapt to the workload, exposing the athlete to a greater risk of injury. Precisely in consideration of the complexity of the PNEI network, it is advisable not to approach the phenomenon of an athlete's nutrition in a reductionist way, also considering that due to the numerous interrelations between the variables involved (Figure 6), it is very difficult to identify specific allostatic load indices on which to intervene quickly and effectively for the resolution of the problems we have seen can arise.

For these reasons, it is essential to educate young athletes and their trainers on the basics of proper nutrition, including brief information programmes (57) that fill the often highlighted gaps (58) and to stress the importance of a diet based on foods capable of regulating the metabolism, the immune system and the intestine (43.59), and not on supplements often useless for the purpose of performance. especially in adolescent athletes (60).

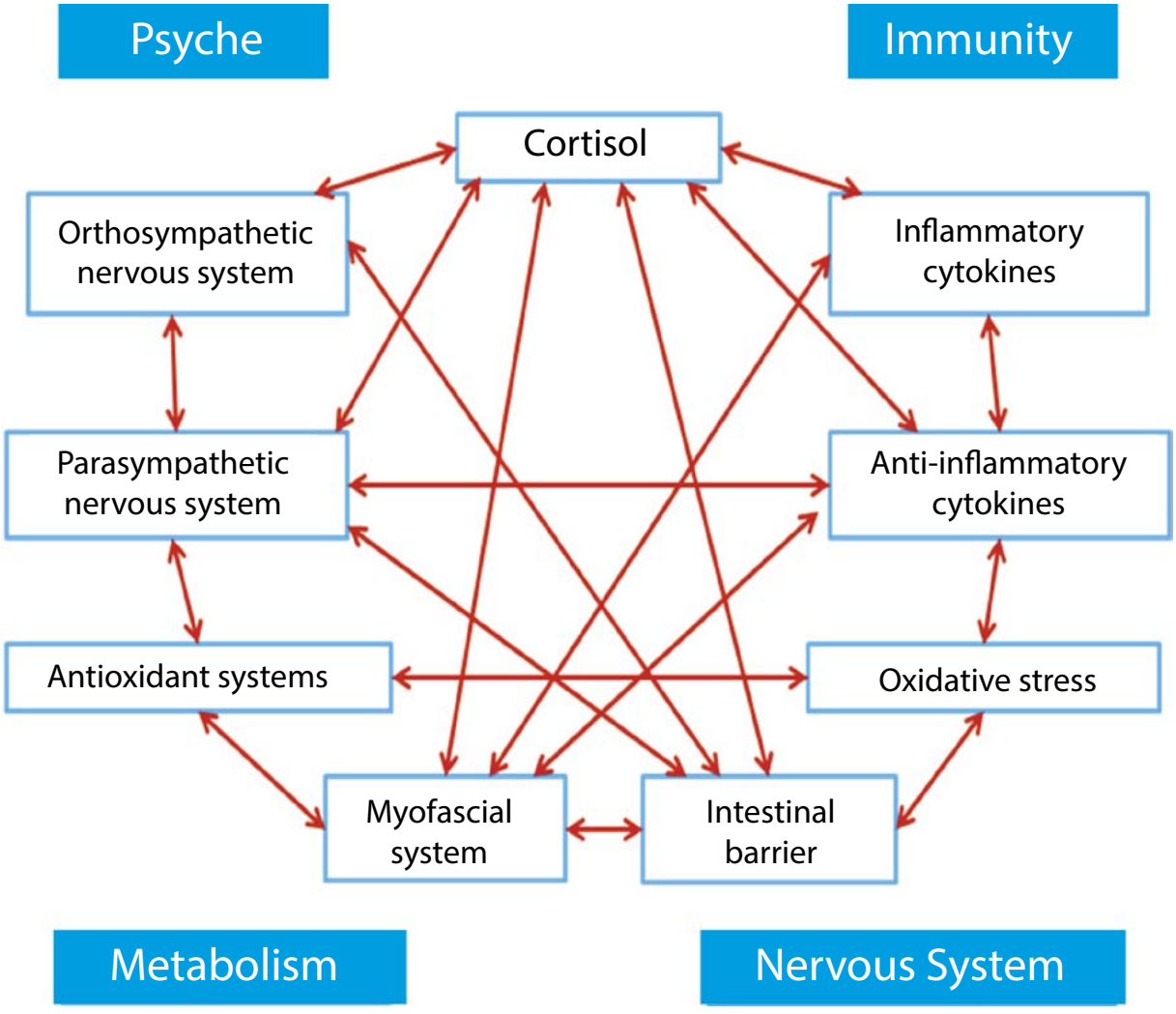

FIGURE NO. 6
COMPLEXITY OF THE RELATIONSHIPS BETWEEN THE POSSIBLE PNEI INDICATORS OF THE ALLOSTATIC LOAD.

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The official journal of the European Weightlifting Federation

THE BIO-MECHANICS OF THE SARCOMERE, THE ORIGIN OF MUSCULAR FORCE

PART THREE

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THE ARCHITECTURE OF THE SARCOMERE

The architecture of the sarcomere is mainly composed of two structures - support and function. The supporting structure is represented by the cytoskeleton, the complex molecular matrix that allows the sarcomere to maintain a mechanical and biological interdependence with the entire surrounding myofascial tissue, while ensuring complete vital autonomy. Depending on where the elements composing it are located in the sarcomere, the cytoskeleton is anatomically divided into two sections - exosarcomeric and endosarcomeric[1]. The function structure is, on the other hand, is designed for contraction and is made up of four main complexes, two permanent and two temporary. Myosin-titin and actin-nebulin are the two permanent complexes that preserve the typical columns of the sarcomere's protein strands and passively participate in the restitution of force during contraction. Whereas troponin-titin and actin-myosin are the two temporary complexes that occur during contraction only in the presence of calcium ions (Figure 1).

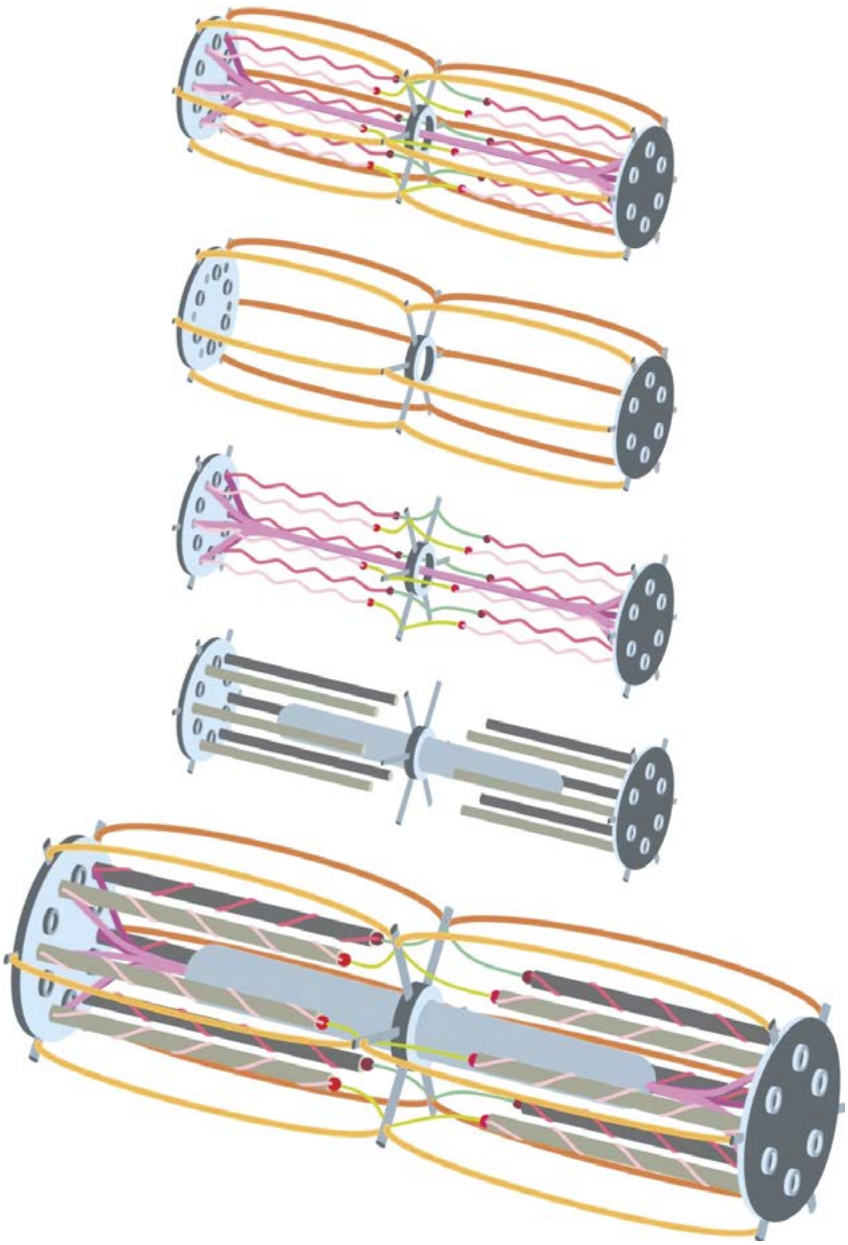

FIGURE NO. 1

STRUCTURAL AND FUNCTIONAL COMPONENTS OF A SARCOMERE. THE SARCOMERIC CYTOSKELETON (A) IS PERIPHERALLY CIRCUMSCRIBED BY THE TWO Z DISCS (DARK GREY) AND CENTRALLY BY THE M BAND (GREY CROWN IN THE CENTRE). ON THE Z DISCS THERE ARE THE ADHESION PLATES (LIGHT GREY RINGS) AND THE STRANDS OF THE COSTAMERE (LIGHT GREY) RADIATE FROM THE M BAND. THE ENDOSARCOMERIC COMPONENTS OF THE CYTOSKELETON (B) ARE MAINLY REPRESENTED BY THE INTERMEDIATE FILAMENTS (LIGHT AND DARK YELLOW), WHILE THE ENDOSARCOMERIC (C) COMPONENTS ARE REPRESENTED BY THE FILAMENTS OF TITIN (LIGHT AND DARK VIOLET) AND NEBULIN (LIGHT AND DARK PINK). THE CONTRACTILE COMPONENTS OF THE SARCOMERE (D), CONSISTING OF ACTIN FILAMENTS (DARK GREY) AND THE CENTRAL MYOSIN STYRENE (LIGHT GREY), ARE COMPLETELY ENVELOPED BY THE CYTOSKELETON (E) TO ENSURE MAXIMUM STRUCTURAL STABILITY DURING OPERATION.

From a biomechanical point of view, the sarcomere generates force by means of the supercomplex actin-myosin-titin-nebulin, which superimposes the effects of the flow of the sensitive filaments to the sarcoplasmatic ionic forces with the effects of the stretching of the filaments which are sensitive to the cytoskeletal inertial forces. The classical principle expressed in physiology, which defines the sarcomere as capable of generating muscle strength through the acto-myosin complex only, excludes the dependence that the production of force has with the previous electro-ionic activities of the sarcoplasm (which is an integral part of the cytoskeleton) and with the state of stretching, winding or degradation of the protein strands [2].

In this article, we will describe the main elements of the cytoskeleton that belong to both the operating structure and the support structure, and which participate significantly in the production of sarcomeral force. According to the latest scientific updates in the field of microbiology, the cytoskeleton is not only the site of storage of the elastic potential of the sarcomere, but also plays a major role on cellular responses to training stimuli. For the realisation of muscle contraction, cytoskeletal activity is as important as that of the acto-myosin bridge and, knowing this allows us to rationally choose the exercises that best meet the demands of specific training programmes for the development of muscle strength.

THE EXOSARCOMERIC CYTOSKELETON

The exosarcomeric elements of the cytoskeleton consisting of the intermediate filaments, the costamere and the adhesion plaques, radiate from the centre of the sarcoplasm up to the outermost part of the sarcolemma, the thin cell membrane that connects the sarcomere to the extracellular environment.

Intermediate filaments are protein formations that lead to the creation of long bridges capable of anchoring the M band, the central part of thick myosin filaments, to the Z discs, the extremities of the sarcomere[3]. The protofilaments of schelemin and vimentin in the periphery of the Z discs, allow desmin to become encapsulated along the whole of the hemi-sarcomere before binding itself to the obscurin and myomesin of the M bands. These proteins respectively constitute the constraint and bending points of the intermediate filaments. We can use a nautical analogy to understand how the intermediate filaments, leaving the myosinic axostyle free to float at the centre of the sarcomere, solving the problem of the sarcomere's structural collapse. Just as the mooring lines tie the cleats of the Venetian gondolas to the bitts, preventing them from banging against the quay and ruining the very thin prows, the desmin filaments bind to the Z disks and the M band to allow the myosin heads to float in the sarcoplasm. The thick filament of myosin is thus able to support the fluid dynamics of the dense sarcoplasmic gel and to protect itself from possible molecular disruptions and deviations from the contraction axis that the strong convective motions of this chiral liquid (in perpetual movement) can cause. Viewed as a whole, the compact imbrication of the intermediate filaments cushions the longitudinal excess tension produced by excessive cell stretching and, during the cellular repair and replication phases, preserves the alignment axes on which the molecules of the contractile proteins are assembled[4]. The results of some biopsies, performed on the exact point of the leg muscles in which ten subjects felt pain, two days after quickly descending ten flights of stairs fifteen times (the subjects took a lift to return to the top floor), have observed how desmin and other intermediate filament proteins are actively involved in the generation of new sarcomeres in series[5].

Three proteins - vinculin, talin and integrin - together with dystrophin and a supernumerary complex of glycoproteins, are part of the costamere, the other network of molecular exosarcomeric tensors that crowns the edges of the Z disks and of the M line, with the purpose of joining every single element of the sarcomere to the sarcolemma[6]. The costamere, besides reinforcing both lipid layers of the sarcolemma, protects the sarcomere from the lateral sagging produced by the excessive contraction forces, disperses the excess structural tension in the extracellular

matrix, favours the adhesions between adjacent sarcomeres and channels the calcium ions inside the sarcomere[7]. The joint protein system vinculin-talin-integrin combines the sarcolemma with the filaments of actin filaments in the vicinity of the Z disks. The complex of glycoproteins, combined with dystrophin, puts the internal part in communication of the sarcolemma with the extracell matrix ulcers and deep interdigitations of myotendinous junctions. The glucidic terminal of glycoproteins, free to move outside the sarcolemma, allows to capture amino acids, electrolytes, enzymes and various other molecules dispersed in the extracellular matrix that are necessary for the maintenance of sarcomeral functions[8].
Knowing the biology of the costamere is of considerable importance in the clinical field, suffice it to say that many congenital diseases of the muscular apparatus carrying hypotonia, weakness, absence or reduction of contractile capacities of sarcomeres, such as Erb, Duchenne and Beckers dystrophies, are caused precisely by genetic mutations that alter the glycoprotein framework based on dystrophin[9], a protein that possesses the joint role of supporting and nourishing sarcomeres.

The adhesion plates (or focal adhesions) are the most peripheral components of the costamere and, together, they mechanically transmit adjacent sarcomeres both to ensure that the muscle fibre contracts with the force contributions produced by all the sarcomeres that compose it, and to dissipate the forces of expansion (or compression) that stretch (or compress) the sarcolemma during the phases of sarcomeral shortening (or elongation). The adhesion plaques of the terminal sarcomeres of a muscle fibre give rise to the muscle-tendon junction. The interlaced disks, the polarisation channels and the desmosomes belong to the adhesion plaques, three intersarcomeric junctions whose behaviour is similar to the collectors that in construction work serve to assemble the arches of prefabricated bridges and to lighten the support loads (it is no coincidence that the adhesion plaques, in the treatises of microbiology, are called molecular collectors)[10]. The polarisation channels release the sarcomeres from the accumulations of ions and other molecules in the same way as a bridge drains rainwater and the stagnant debris from its surface. Desmosomes allow the cohesion between adjacent sarcomeres in the same way that the clamps join the arches of a bridge. Interlaced disks ensure total freedom of movement and deformation of the sarcomere series during contractions, just as the wooden morals of a scaffolding flex to dissipate the wavering forces. The adhesion plaques are also home to countless immunoglobulins and other cell mediators capable of controlling the sarcomere functions and the health of the entire muscle cell[11]. If a strong stress generates an operating anomaly in the sarcomere, the mediators between the plaques of adhesion would be able to initiate all restoration processes, from the simplest ones such as the reconstruction of disrupted protein strands, to the most important ones such as cell death and replication.
The latest research on glomerular proteins present in the adhesion plaques, such as Focal Adhesion Kinase (FAK)[12], Mitogen-Activated Protein Kinase (MAPK) and other proteins activating cell proliferation[13], have allowed us to see how the way these enzyme mediators are degraded influences the process by which the muscle cell replicates its sarcomeres. If these molecules receive a longitudinal mechanical stress strong enough to detach a terminal, then the muscle cell will be stimulated to create new sarcomeres in series. If, on the other hand, the mechanical stress is transverse to the protein glomerulus and breaks a curvature, then the cell will create new sarcomeres in parallel[12,13]. These observations are perfectly in line with muscle strength production comparisons between cyclists and runners reported by the International Olympic Committee Medical Committee[14]. To push harder on the pedals, cyclists contract the rectus femoris muscle when the legs are closer to the pelvis compared to runners who want to push harder on the ground[15]. The biarticular extender of the cyclists' knee has therefore a number of sarcomeres in series less than that of the runners, because it

produces force when it is not yet fully lengthened[16]. Therefore, by cross-checking the observations on the cellular stimuli that induce the formation of new sarcomeres, and the analysis on the way in which muscular strength is produced in the different articular angles of the two types of long-distance athletes, it is possible to hypothesise two situations:

1) a fibre muscle will be stimulated to form new sarcomeres in series if subjected to strong eccentric stresses:

2) a muscle fibre will be stimulated to generate new sarcomeres in parallel if subjected to strong concentric stresses (Figure 2).

The way in which the muscles are trained can therefore lead to a spatial redistribution of the sarcomeres within the muscle fibres[17]. Maximal strength workouts, performed with controlled movements and producing contraction peaks with the fibres in maximum shortening, produce an increase of sarcomeres in parallel. Explosive strength workouts performed with rapid movements and contraction peaks that develop when the fibres are maximally elongated, increase the number of sarcomeres in series[18].

The electrostimulation programmes that improve post-workout muscle recovery, base their functioning principle on the ability that the electric fields have to circulate the ionic currents of sarcoplasma[19], also exploiting the drainage pathways of the intersarcomeric molecular collectors[20].

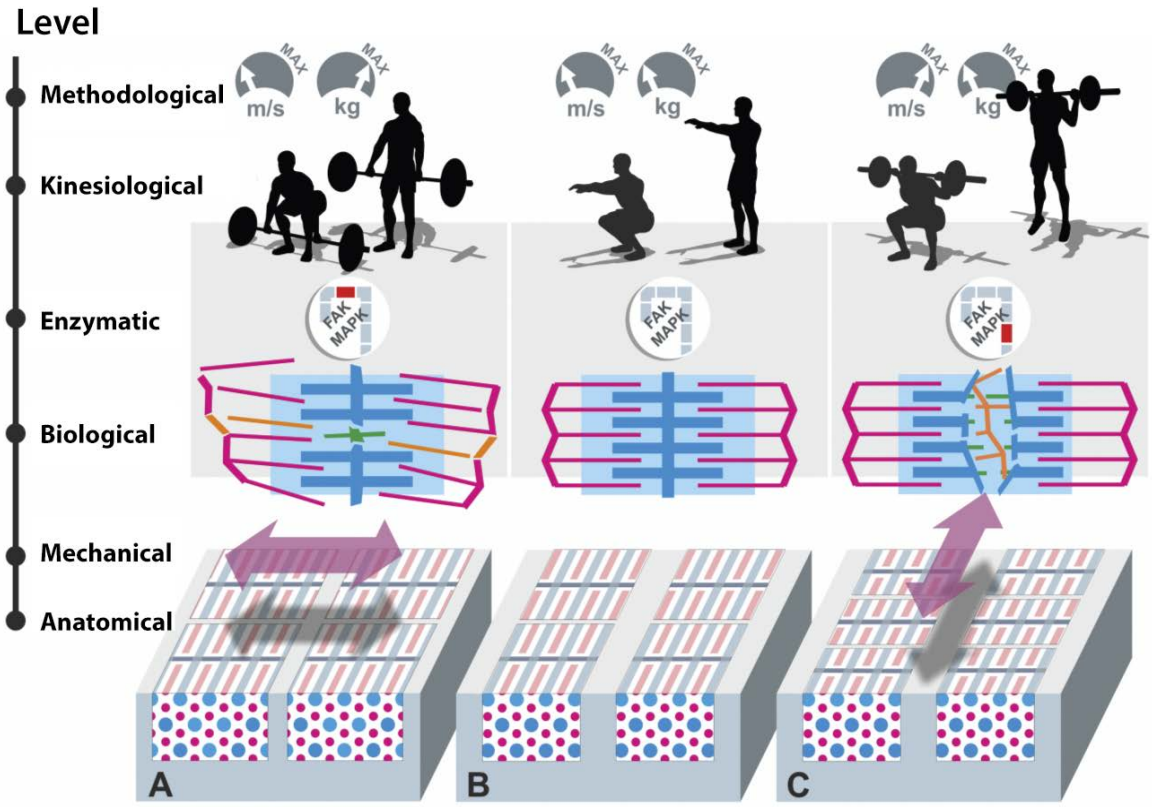

FIGURE NO. 2

CELLULAR EFFECTS OF TRAINING FOR THREE COMPARED EXERCISES. A) LIFTING THE BARBELL FROM THE GROUND, WHERE MAXIMUM MUSCULAR CONTRACTIONS ARE REQUIRED FOR HEAVY LOADS, NEGLECTING THE ELONGATION PHASES.
B) NON-TIRING SQUAT EXERCISES, WITH REDUCED LOAD AND SPEED.
C) EXPLOSIVE EXERCISES OF REPEATED JUMPS AT MAXIMUM SPEED AND REDUCED WEIGHT ON SHOULDERS, WHICH EXPLOIT MUSCULAR TENSIONS PRODUCED BY ELONGATION. THE MECHANICAL STRESS OF THE FIRST METHOD PRODUCES AN ENZYMATIC EFFECT THAT LEADS TO A TRANSVERSAL DEFORMATION (PROTOFILAMENTS IN YELLOW AND GREEN ON THE LONGITUDINAL AXIS) OF THE SARCOMERES AND AN INCREASE IN THE CONTRACTILE UNITS IN PARALLEL OF THE MUSCLE CELLS. THE MINIMUM MECHANICAL STRESS OF THE SECOND METHOD GENERATES AN INSUFFICIENT ENZYME STIMULUS TO OBTAIN A BIOLOGICAL RESPONSE AND A SIGNIFICANT MUSCULAR ANATOMICAL ADAPTATION. THE MECHANICAL STRESS OF THE THIRD METHOD, ON THE OTHER HAND, HAS AN ENZYMATIC EFFECT THAT STIMULATES A LONGITUDINAL DEFORMATION (PROTOFILAMENTS IN YELLOW AND GREEN ON THE TRANSVERSE AXIS) OF THE SARCOMERES WITH AN INCREASE IN THE CONTRACTILE UNITS IN SERIES PRESENT IN THE MUSCLE CELLS.

The muscular contraction, induced by the external electrical impulse, appears to increase the contractile strength levels of the muscle cells precisely via the strong mechanical stresses to which the whole tubular structure of the exosarcomeric cytoskeleton is subjected to in the presence of the exogenous pulsatile electric field[21]. If subjected to intense electrostimulation programmes, sarcomeres will begin to produce greater force peaks because the cytoskeleton will become more rigid[22] while the sarcoplasmic gel will be more dense and more sensitive to ionic flows[23]. Finally, recent revisions of the scientific literature on muscle recovery through pulsatile electric waves, have shown that some appropriate programmes of electrostimulation help the formation in series of sarcomeres in maximally stretched muscle fibres, precisely through the tension of the cytoskeletal termini[21,2].
The endosacromeric elements are mainly represented by nebulin and by titin, whose filaments run longitudinally from one extreme of the sarcomere to the other and, crossing it internally, carry out four main tasks:

1) ensure the permanent positions and flow of contractile filaments,

2) predispose the passive components of the contraction forces for an elastic reuse in the shortening phase,

3) externally discharge the tensions produced in the sarcoplasm,

4) guarantee the return to the original length of the sarcomere as soon as it is deactivated and passes to a state of rest.

In the infinitesimally small space of a sarcomere, the nebulin molecule is classified as a giant, inextensible filament, which originates at the base of the Z disk to form the supporting axis of the double helix of actin filaments[25]. Although nebulin is not essential for the formation of the actin filament, and its molecular conformation may be shorter than that of the double actinic helix, in the stretch in which it is present, it generates greater structural strength[26]. Nebulin inhibits both the disintegration of actin filaments, when the sarcomere contracts while it is elongating, and the uncontrolled addition of new free actin molecules (called G-actins) to the already established filaments. A single actin filament (F-actin) helix has an average of 360 G-actins and may extend into multiples of six[27]. This rule is established by the ability that the actin filament possesses to perform a sixth of a complete rotation (corresponding to 30°, for each helix) whenever the acto-myosin bridge produces two power strokes (one for each helix)[28].
A single troponin molecule is bound to a tract of tropomyosin which controls the phosphorus sites of seven G-actins. Once this septet is discovered, in the presence of calcium, the discharge of power of six myosin heads brings the actinic filament to complete a sixth of a rotation, before the action of the last myosin head predisposes it for a new twist. This configuration prevents the acto-myosin shift from being stalled due to the rotational arrest of the actinic helixes. An additional prolongation of the actin filaments, induced by a protein synthesis stimulus, begins with the nebulin extending to the length necessary to add a new troponin molecule to the tropomyosin filaments[29].
In this regard, in the continuous search for new biomarkers to evaluate the effects of strength training, it has been observed that the reduction of troponin blood levels is linked to the synthesis of new muscle contractile proteins[30]. The nebulin supports and orients the tropomyosin filaments that travel in parallel to the actins and closes the terminal part of their double helixes. There are about 35 molecules of nebulin that, with their weak and localised electrostatic charge, assist the delicate repositioning of tropomyosin on each G-actin[31]. Actin filament length is a fundamental parameter of sarcomeral contraction, as it determines the overlap degree of acto-myosin bridges. The shorter the actin filament, the less force a sarcomere can develop. In the absence of nebulin, the actin filaments surrounding the myosin styrene have an uneven length (Figure 3) and the excursion for the sarcomere to produce force is drastically reduced[32].
The degradation of the nebulin filaments is associated with the lowering of maximum force peaks that occurs in the two days fol-

lowing a session of high intensity eccentric exercises[33]. Approximately eight days after maximal eccentric training, the nebulin sarcomeral resources are enhanced5. A lack of nebulin can lead to sarcomeral popping, a condition in which muscle contraction occurs abnormally. If the loss of nebulin delays the reaching of the peak of the sarcomere's strength, and the reintegration anticipates and increases it, then the undulatory effects that sporting performance undergoes during the training cycles are also linked to the metabolism of nebulin.

Titin is a large protein strand that starts from the M band and, just outside the tubular cavity of myosin, it unfolds six branches that join the disc Z in proximity of all the filaments of actin that surround the myosin[34]. The six titin branches are like springs which, during contraction in both the conditions of maximum elongation and minimum shortening, convert more than 90% of the passive tensile and compressive forces into elastic potential energy[35].

The elastic function of titin is passive in the section associated with myosin and active in the section associated with actin filaments. The N2A terminal is a receptor which, placed at the beginning of each branch of titin, is capable of binding to the calcium that is placed on the active troponin site arranged sequentially along the entire actin filament. During contraction, the myosin heads pull the double actinic helixes that wind on their main axis, twisting the tropomyosin and nebulin spirals that are associated with it and moving the troponinic terminals to which the calcium ions are bound. These are joined by the N2A receptors that rotate together with the actinic filament structure and stretch the springs of the titin filaments (Figure 4). The latest discoveries in the field of microbiology define titin a "whirlwind filament" precisely because of this characteristic[36].

As a result, when the sarcomere is activated, actin filaments produce two strengths, one in association with the titin and the other in association with myosin. The former behaves like a hoist pulling the myosin axostyle towards the periphery, the second like a tractor pushing it. At the end of the contraction, and in the absence of extrasarcomeral tensions, titin is able to return the accumulated elastic force with its elongation to

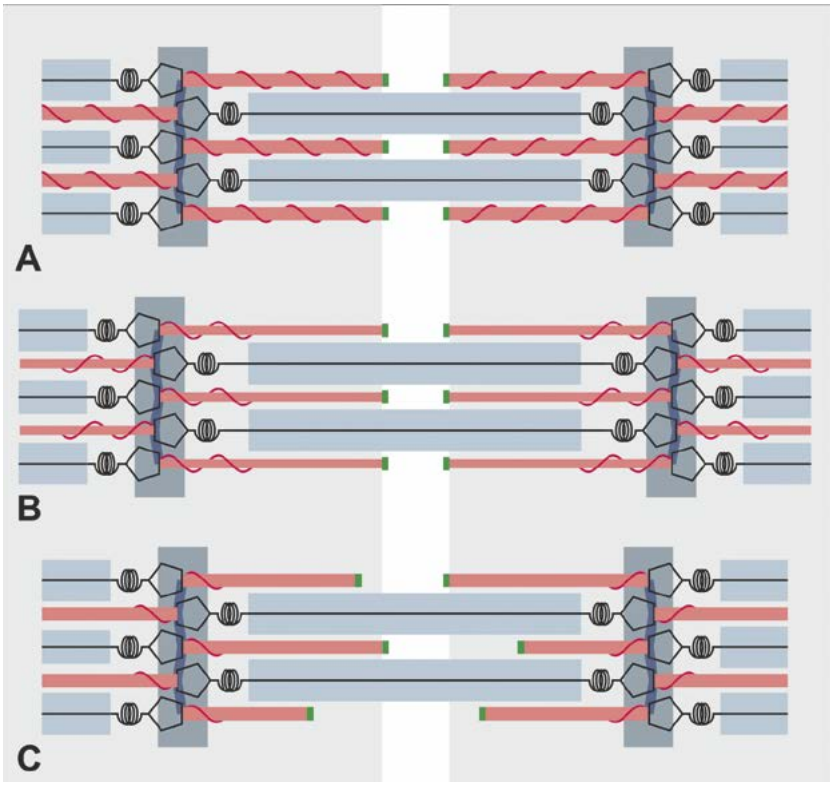

FIGURE NO. 3

ACTIVITY OF THE NEBULIN FILAMENT. DURING SARCOMERAL CONTRACTION, THE PRESENCE OF NEBULIN (FILAMENT IN RED) ALONG THE ACTIN FILAMENT (MAIN AXIS IN PINK WITH TERMINAL IN GREEN) GUARANTEES ITS INTEGRITY AND TENSILE STRENGTH (A). IN THE ABSENCE OF NEBULIN, A PART OF THE CONTRACTILE FORCE WOULD BE USED TO STRETCH THE ACTIN FILAMENTS (PINK SEGMENT OF REDUCED SECTION) BY PREVENTING THE Z DISCS (VERTICAL AREAS IN DARK GREY) FROM APPROACHING AND THE SARCOMERE BECOMING COMPLETELY SHORTENED (B). MOREOVER, THE ABSENCE OF NEBULIN WOULD LEAD THE ACTINIC FILAMENTS TO DISPOSE OF NON-UNIFORM LENGTHS, REDUCING THE STRETCH IN WHICH THEY OVERLAP WITH THE MYOSIN FILAMENTS (MAIN AXIS IN LIGHT GREY). THIS MISALIGNMENT WOULD CAUSE, IN THE PRESENCE OF CALCIUM IONS, AN ANOMALOUS TENSION ON THE TITIN FILAMENTS (BLACK LINES IN THE MIDDLE OF THE MYOSIN) AND AN ALTERATION OF THE ELASTIC POTENTIAL OF THE ENTIRE SARCOMERE (BLACK SPIRALS CLOSE TO THE Z DISCS).

quickly bring back the sarcomere, and all its filaments, to the initial position. The storage of elastic potential energy, through the extension of titin springs, occurs only in the presence of calcium ions, in other words, under active muscle contraction conditions. The active participation of titin during muscle contraction is able to amplify more than three to four times the production of the sarcomere's shortening force, when contraction and maximum stretching start.

Titin manifests its function as an accumulator of elastic potential energy in the performance of plyometric actions, and in all athletic movements which involve rapid active muscle stretching[37]. Lastly, during stretching exercises, by voluntarily activating the muscles at different amplitudes of movement, it is possible to act on the instant in which the N2A receptor binds titin to actin and establish at which joint angle it is possible to exploit the elastic potential energy stored in the treadmilling filaments.

Finally, it must be remembered that the titanium terminal N2A is sensitive to troponin-bound calcium but is independent of tropomyosin activity. If to move the tropomyosin coils that open the active actin filament sites, each troponin terminal must have bound with a circulating calcium ion, the elastic springs of the titin begin to stretch even before the sarcomeral contraction is activated, as soon as a minimum calcium ion current begins to show up in the sarcoplasm (Figure 5).

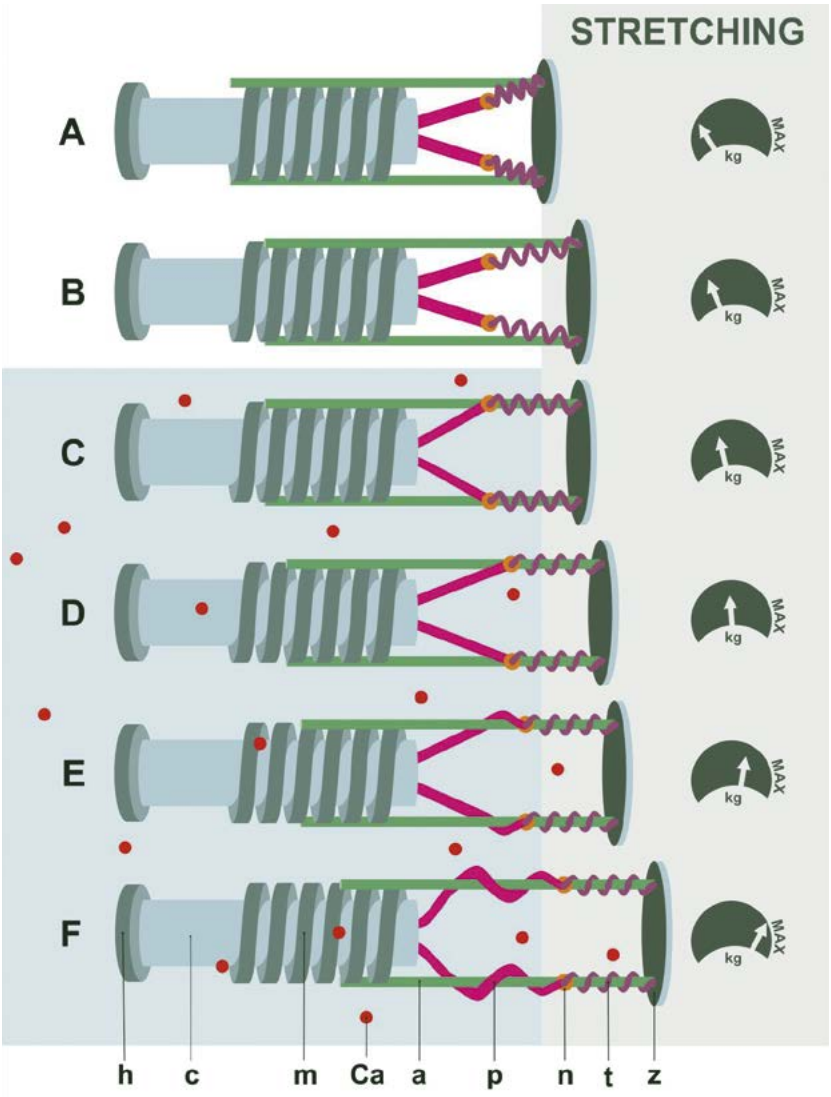

FIGURE NO. 4

TITIN FILAMENT ACTIVITY. THE FILAMENT OF TITIN ORIGINATES FROM THE M BAND (H) AND RUNS INTERNALLY THROUGH THE ENTIRE AXOSTYLE (C) AND PROTRUDES, AT THE END OF THE CROWNS OF MYOSIN HEADS (M). TITIN HAS THE RECEPTOR SITE (N) OF CALCIUM BETWEEN THE MOST PROXIMAL TRACT TO MYOSIN (P) AND THE PERIPHERAL TRACT (T) THAT JOINS THE Z DISK (Z). IN THE ABSENCE OF CALCIUM IONS (CA), THE TITIN FILAMENTS EXTEND FROM THE MYOSIN TERMINAL AT THE BASE OF THE ACTIN FILAMENT (A). THE T SEGMENT IS MORE ELASTIC THAN THE P SEGMENT, THEREFORE, DURING PASSIVE SARCOMERAL ELONGATION (B), THE T SEGMENT IS STRETCHED BEFORE THE P SEGMENT. WITH SARCOMERAL ACTIVATION, THE CALCIUM RECEPTOR N BINDS TO THE TITIN PRESENT ON THE ACTINIC FILAMENT (C). CONTINUING THE ELONGATION PHASE IN THE PRESENCE OF IONIC CURRENTS, THE T SEGMENT WRAPS AROUND THE ACTIN FILAMENT, STRETCHING ITSELF MORE (D). THE ROTATION OF THE ACTINIC FILAMENT, DUE TO THE POWER SHOCKS PRODUCED BY THE INTERACTION WITH THE MYOSIN HEADS, CONTINUES TO STIFFEN THE FILAMENT OF TITIN CAUSING IT TO WRAP ITSELF AROUND THE P SEGMENT (E). THIS TENSILE ACTIVITY LASTS UNTIL CALCIUM IS PRESENT IN THE SARCOPLASM (F). THE DIAL TO THE RIGHT OF THE FIGURE SHOWS, APPROXIMATELY, THE TREND OF THE TENSILE STRENGTH, AT THE ENDS OF THE HEMI-SARCOMERE (FROM THE M BAND TO THE Z DISK), PRODUCED BY THE STRETCHING OF THE TITAN FILAMENT DURING THE VARIOUS STRETCHING PHASES.

Therefore, it is not necessarily essential to reach the shortening of a muscle fibre in order to stretch its parts. The effects of structural stiffening that titin produces in sarcomeres are found in the study of co-activations and temporal synergies between agonist muscles and between antagonist muscles, where it is very easy to incur the error of accidentally pre-stressing some bundles of muscle fibres which are not specific to the required technical movement.

THE ROLE OF THE CYTOSKELETON IN SPORTS PERFORMANCE

For many decades now, athletes in power and speed sports have instinctively adopted the counter-movement technique to generate increasingly explosive muscle contractions. The counter-movement technique involves pre-stretching the muscle fibres with a rapid movement that is opposite to the intended one. However, the difficulty in generating an effective counter-movement is due to three aspects:

1) minimising the time taken to realise it in order to prevent muscle forces dissipating in the connective tissue;

2) contracting the muscles that contribute to the action to be performed throughout the counter-movement;

3) limiting the activity of the opposing muscles to the technical movement in the instant that precedes the inversion of movement, at the end of the counter-movement.

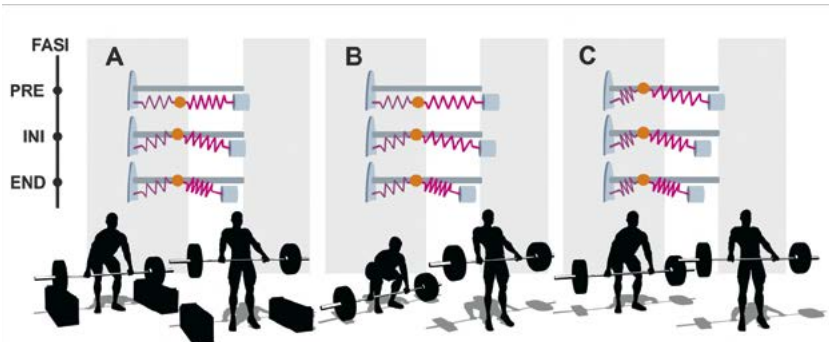

FIGURE NO. 5

EXAMPLES OF TITIN INTERVENTION. THE FIGURE SHOWS THREE VARIATIONS OF THE OLYMPIC WEIGHTLIFTING EXERCISE. IN THE VARIANT THAT STARTS WITH THE BARBELL RESTING ON THE BLOCKS (A), THE TITIN FILAMENTS OF THE QUADRICEPS MUSCLE SARCOMERES ARE LENGTHENED IN THE PERIPHERAL STRETCH (PRE PHASE). DURING CONTRACTION, THE TITIN BINDS TO THE TROPONINIC CALCIUM OF ACTIN FILAMENTS (INI PHASE) AND, AS THE EXERCISE IS PERFORMED, IT RETURNS THE RESIDUAL ELASTIC FORCE OF THE MYOSIN TRACT (END PHASE). IN THE VARIANT THAT SEES THE BALANCE ON THE GROUND AT THE START (B), THE QUADRICEPS MUSCLE SARCOMERES ARE COMPLETELY STRETCHED (PRE-PHASE), BEFORE THE CALCIUM ION CURRENT BINDS THE TITIN TO ACTIN FILAMENTS (PHASE INI). WITH THE ACTIVATION, THE ACCENTUATED SARCOMERAL STRAIN PREVENTS OVERLAPPING THE POTENTIAL STRENGTH OF THE ACTO-MYOSIN COMPLEX WITH THAT OF THE TITAN FILAMENT, REDUCING THE RETURN OF FORCE WITH RESPECT TO THE PREVIOUS EXECUTIVE VARIANT (PHASE END). IN THE VARIANT WHOSE INITIAL PHASE REQUIRES TO HOLD THE BAR ABOVE THE KNEES (C), THE QUADRICEPS MUSCLE SARCOMERES ARE IN A PRE-ACTIVATION STATE, WITH THE TITIN FILAMENTS ALREADY LINKED TO THE ACTINIC CALCIUM SITES (PRE PHASE). BY PERFORMING THE EXERCISE, THE MYOSIN TRACT OF TITIN IS IN STRONG PRE-STRETCH (INI PHASE) AND ITS ELASTIC POTENTIAL IS FULLY USED TO GENERATE A HIGHER LEVEL OF SARCOMERAL FORCE, COMPARED TO THE OTHER TWO MOVEMENTS (END PHASE). NOT ALL WEIGHTLIFTERS TRAIN THE ABOVE THE KNEE SUSPENSION VARIANT WITH LOADS THAT ARE HEAVIER THAN BLOCK SUSPENSION VARIANT. THIS DIFFERENCE, AVOIDING INTERMUSCULAR COORDINATION ASPECTS, IS DUE TO THE SUBJECTIVE ABILITIES OF BEING ABLE TO OPTIMALLY COMBINE THE ACTIVE AND PASSIVE COMPONENTS PRODUCED BY THE EXTENSION OF THE TITIN FILAMENTS.

Learning to use the counter-movement technique to improve performance requires several years of practice, too many for the current request for rapid specialisation that the elite sports world offers to its new generation. In fact, the significant increase in the executive speed of sporting actions, which has led to breaking many sporting records in recent years, has been possible by reducing the intervention of the slow and difficult counter-movement[38]. In tennis, a modern forehand has lost the wide retroposition of the arm. In current football, a powerful blow to the ball no longer requires a long back stretch of the leg involved in the shot. In volleyball, the smashing technique has progressed in speed reducing the time in which the legs bend before jumping. Sprinters ankles are increasingly stiffer so as not to disperse muscle tension during the race. In weightlifting, the age-old technical movement of the second bending of the legs, when the bar

has passed the knees, has been eliminated for a faster overall movement. All of these examples demonstrate that today's top athletes perform counter-movements much shorter than their predecessors[38] and that the current training methodology shifts the focus to passive elastic reuse, obtained with explosive movements, from extrasarcomeral to intrasarcomeral connective tissue structures. The time it takes to over-stress a tendon is longer than for a muscle that is already contracted. For these reasons, strength training, which is linked to the strengthening of inertial responses of muscles and tendons, is increasingly integrated with coordination, training, linked to the improvement of the management of muscle-tendon tensions, in order to shift the effects the improvement of muscle contraction from quantity to quality (in my research on improving sports performance, these are the reflections that led me to resume studies on the sarcomeral contraction and to write the four articles published (and to be published) in Strength & Conditioning: The science of human movement.

The joint excursions that current successful athletes perform in their counter-movements are extremely limited, just enough to allow the muscle springs to load and increase the density of the sarcomeral plasma by neurologically intensifying the pulsations of ionic calcium currents and consequently hardening the exosarcomeral cytoskeleton, to shift the state of the sarcomeral from semi-liquid to semi-rigid, loading it electrically and mechanically in this way, to stretch the adhesion plates, pulling the framework of the costamere and tightening the knots of the intermediate filaments, to rotate the actin helixes even before the sarcomeres and the whole muscular fibre are shortened, to twist and compress the nebulin reinforcement, to load the long titin springs that move the protein traps in the right positions, align the myosin heads with the open cavities of the actin, like the pistons of a bolt that resist a bit in the short instant before settling well between the teeth of the key, before triggering a lock able to produce a muscle contraction of 300% higher than what the simple sliding of the myosin heads on the molecules of actin can generate.

I would like to thank Andrea Tilomelli and all the staff of Evolutionfit srl, an Italian company, part of the TeamSystem srl group that plays a leading role in the national production of software clouds for gyms, fitness centres, coaches and personal trainers, for having provided me with the 3D graphic support necessary to complete the figures that accompany the text of this article.

ABSTRACT

The cytoskeleton is the complex matrix of filamentous and glomerular proteins that make up the framework of the sarcomere. The cytoskeleton is not limited to exercising a structural function, it assists muscular contraction both passively, exploiting its elastic properties, and actively, manifesting sensitivity to the ionic currents of sarcoplasm.

In this article, we will describe the functions that the intrinsic components of the cytoskeleton perform to support sarcomeral contraction, reporting the results of the latest updates in the specific field of experimental microbiology. All the elements that make up the sarcomere participate in the phenomenon of shortening. The lack of only one of these elements drastically reduces the production of force by the single contractile unit of the muscle, as has been verified both by means of simulations with bioinformatics systems, and through direct experiments.

The effects of muscular elastic components on sports performance are well known among training methodology experts. However, in relation to the high demands of competitive results advanced by the current world of sport, coaches, athletic trainers, physical trainers and physiotherapists have to take into account the latest updates on how the cytoskeleton components influence the production of force, to plan more effective intervention protocols on the improvement of athletic and sporting performance.

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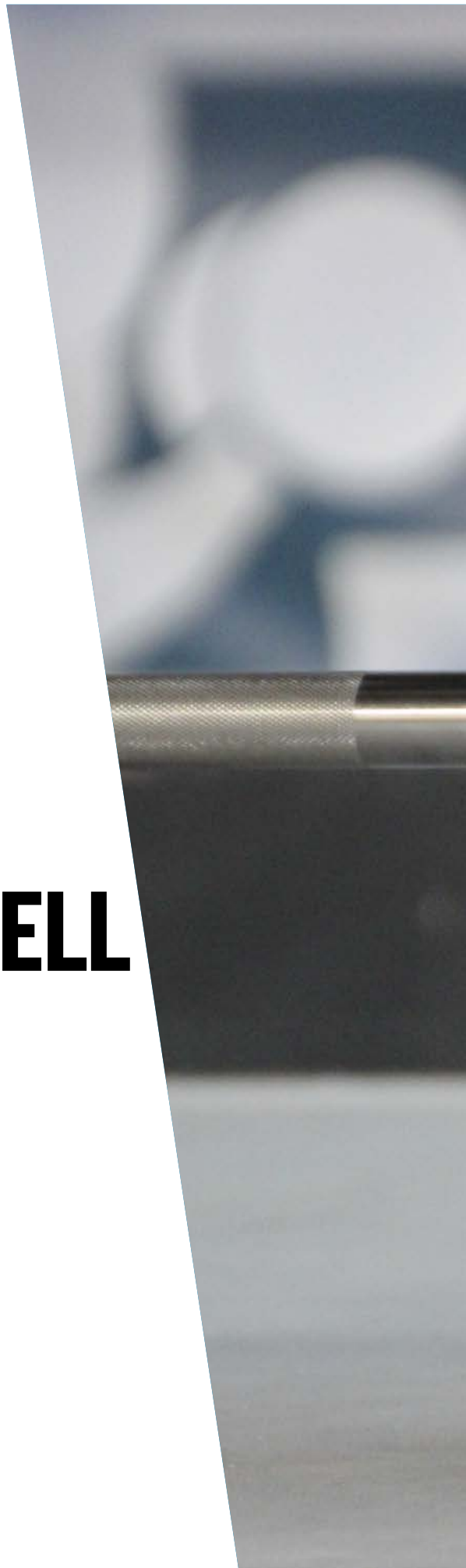


VARIATIONS OF THE JUMP UNDER THE BARBELL IN THE SNATCH AND THE CLEAN

BY ANDREW CHARNIGA


"Research has shown that the longer the athlete's feet are in the non-support position the faster the trunk descends."
Druzhinin, 1974

The official journal of the European Weightlifting Federation

FIGURE NO. 1
VARIANT 1. AN OPTICAL ILLUSION IN WEIGHTLIFTING IS MANIFEST WHEN AN EFFECTIVE 'JUMP DOWN' IN WEIGHTLIFTING IS FREQUENTLY CONFUSED WITH A VERTICAL JUMP. THE ATHLETE'S FEET ARE RISING FROM THE FLOOR – SIGNALLING A JUMP; BUT HIS PELVIS IS DROPPING. SO, INSTEAD OF JUMPING UP AND RAISING BODY CENTER OF MASS THE ATHLETE 'JUMPS' DOWN CREATING ADDITIONAL ACCELERATION TO LOWER IT.
CHARNIGA PHOTOS.

Extensive research of weightlifting technique over a period of many years, confirms the importance of speed of movement. The speed with which the weightlifter drops under the barbell in the snatch, the clean, and the jerk; if timed and performed effectively will contribute to raising the barbell; as the athlete drops under the weight. The heavier the weight one attempts to lift, the lower the height to which it can be raised. Consequently, the heavier the weight, the slower its vertical speed, the faster one has to drop in order to fix the barbell at the chest or overhead in the snatch.

Most weightlifting coaches would agree it is necessary to forcefully switch from lifting up with the arms and shoulder muscles to forcefully pulling the body down under the weight as fast as possible. Indeed, in his analysis of the clean technique of David Rigert, M. Shakirzyanov noted:

"For a period of 0.2 sec the athlete's body could drop by 21 cm, but in actuality it descended 59 cm. All of this was due to the athlete's forceful efforts after the explosion which did not stop in the non – support phase."

Rigert's body could only drop 21 cm in 0.2 seconds under the sole influence of gravity. The fact that he dropped 59 cm means his movement exceeded the 9.8 m/s acceleration of gravity; which is impossible; unless Rigert was holding onto something and forcefully pulling himself down faster than the laws of physics permit. In this case, the slow moving barbell provided the support for the athlete to lower his body faster than a free falling object.

"the skill to execute the squat under in the presence of a slower barbell speed is also indicative of better technique; It is namely this skill that is important for lifting maximum weights."

I.P. Zhekov, 1976

So, pulling oneself down with the muscles of the upper extremities is crucial to an effective descent. However, other elements are important. Namely, the athlete has to switch off the muscles which straighten the legs and switch on the muscles which flex the legs. This involves at least two components: relaxation of extensor muscles and recruitment of muscles to flex the legs and lower the pelvis. Of the various strategies of dropping under the barbell the literature indicates the method; let's call it variant 1; with significant flexing of the hips and raising the feet forcefully from the platform as depicted in figure 1 is the optimum. The forceful hip flexion adds to the athlete's forceful efforts with the arms and shoulders. And, what sounds like a contradiction in terms, the athlete drops faster the longer feet are in the air.

Too numerous to mention sources in the weightlifting literature confirm the weightlifter jumps in the performance of the snatch and the clean. Consequently, many coaches have their lifters jump up to boxes, stacks of discs, perform standing long jumps and so forth to improve explosive strength for this element of weightlifting technique.

That being said, it should be emphasized there is no jumping up in weightlifting. Few stop to think that if a weightlifter endeavors to jump up at the end of the pull before dropping – first you have to come down to where you started before going lower.

FIGURE NO. 2

VARIANT 2. WORLD CHAMPION FEMALE LIFTER SWITCHES FROM STRAIGHTENING LOWER EXTREMITIES TO BENDING AS HER FEET ARE MOVED TO THE SIDE – WITHOUT PULLING (FLEXING) HIPS UP. THE ACTION OF JUMPING DOWN IS CARRIED – OUT WITH A VERY SLIGHT RAISING THE FEET FROM THE PLATFORM; WITH TRUNK TILTING BACKWARD AT A SIGNIFICANT ANGLE FROM THE VERTICAL. CHARNIGA PHOTOS.

A vertical jump preceding the descent under the barbell precludes any semblance of mechanical efficiency to raise a maximum weight. On the other hand if the athlete endeavors to jump down when dropping under the barbell in the snatch, the clean and the jerk; technical proficiency is significantly enhanced.

The photos of the lifter dropping under a heavy snatch in figure 1 illustrate this concept very well. In the photo on the left the athlete's navel is approximately level with the number 26 on the scoreboard in the back round. His legs are already beginning to bend. In the next photo the lifter's feet are some 6 – 8 centimeters from the platform and he is flexing at the hip, the knee and raising his toes (dorsi-flexing), i.e., he is jumping. In point of fact, the athlete is jumping; just not up. He is jumping down. His pelvis has dropped significantly as his feet move up.

An effective jump down with the variant 1 method by forcefully flexing of hips, knees and ankles, imparts additional acceleration to the barbell; facilitating the lifter's efforts to lower his body as he pulls his trunk down with his arms and shoulders. So, an optical illusion of vertical jumping is created. The feet are rising, but the trunk is dropping. Variant 1 illustrates Druzhinin's (1974) obvious counter-intuitivity: the longer the athlete's feet are in the air the faster the body drops. Furthermore, a connection was found between the length of time the feet are in the non – support and the depth of the squat (Druzhinin, 1974).

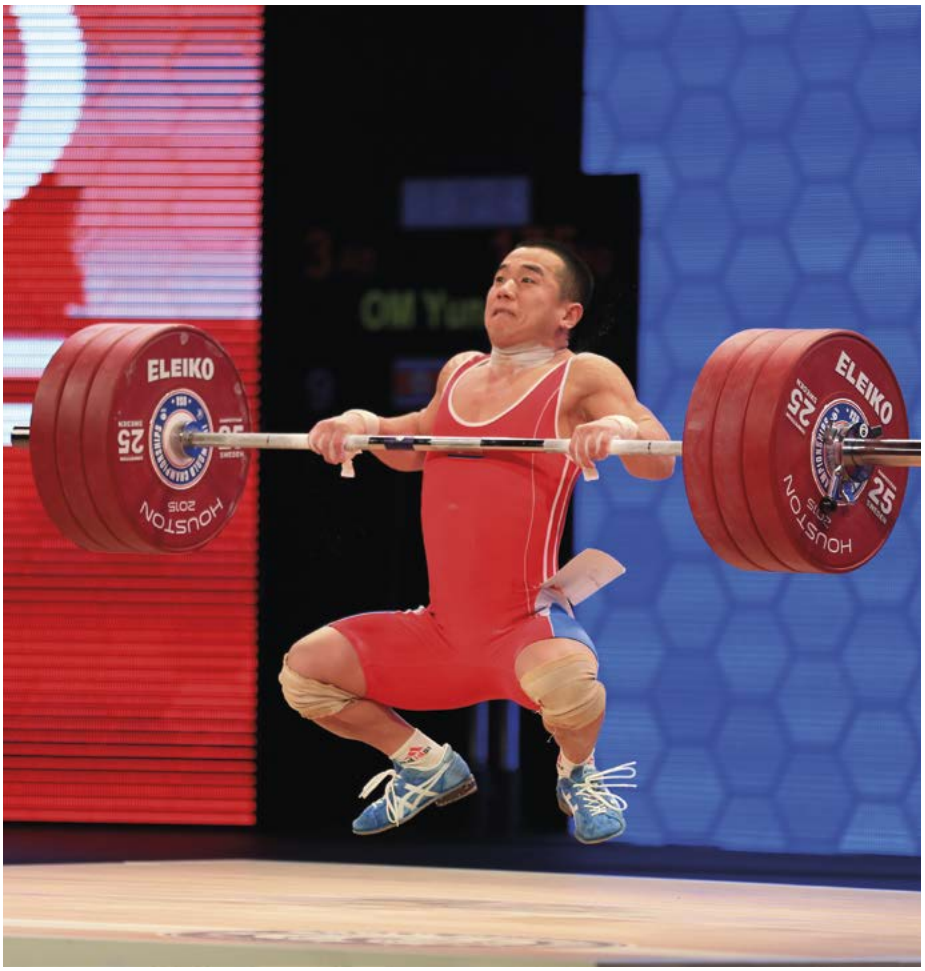
Consequently, all outcomes are positive with variant 1. The hips and knees flex, feet rise, the trunk is pulled down, the barbell goes up, the lifter drops low.

By most any measure the variant 1 technique would appear to be the most effective method for the weightlifter to lower into the squat. However, there is another element to what seems to be a simple action of assisting descent in the snatch by forcefully flexing the hips, knees, raising the feet and pulling the body down.

It cannot be possible to significantly exceed the acceleration of a free falling body as shown by Shakirzyanov's analysis of Rigert's clean; by merely pulling – pushing down and flexing lower extremities. In point of fact, the athlete must posses the ability for high speed switching from contracting muscles to relaxing; so, that unnecessary tension from muscle antagonists do not impede the speed of his movements.

So, a rapid descent under the barbell is not a jump up and and pull down; but, a jump down – pull – down, flexing of lower extremities facilitated by extremely fast relaxation of unnecessary muscle tension. However, variant 1 is not the only strategy of effectively jumping under the barbell in the snatch and the clean.

Another variant of jumping under the barbell, let's call it variant 2;



is to slide the feet to the side while rapidly flexing the lower extremities. One observes this method most often with female lifters. Super elites like DENG Wei in figure 2 and others who employ this method of jumping under the barbell, drop extremely fast and low without noticeably raising the feet from the platform; and, without forcefully flexing the hips.

These athletes are actively pulling the trunk down and flexing the lower extremities just as the lifters who pull the hips up and raise the feet. However, the muscle action of variant 2 is different different from that of variant 1.

Textbooks tell us the main muscles involved in flexing lower extremities are hip flexors such as iliacus, psoas, rectus femoris, sartoris and hamstrings. However, since rectus femoris, sartoris and three fourths of the hamstrings cross – two joints they cannot be classified as either flexor or extensor muscles, i.e, they have multiple functions.

Furthermore, a thigh muscle typically only considered to work at the ankle joint; the gastrocnemeus can flex knee and ankle simultaneously. When this muscle group acts to flex knee and ankle; of course this affects the hip. The muscles in the front of the shin the tibialis anterior pull the feet up which also affect knee and hip. In short, such an action as flexing lower extremities in dropping down under the barbell is far more complex than can be found by merely perusing university textbooks. The main difference between the variants has to be variant 2 involves fast relaxation of muscles, i., e., a faster release from contraction to relaxation. Whereas, the significant effort expended in variant 1 can be considered partly the male athlete's need to forcefully release tension switching from extensor muscles to flexing muscles of the lower extremities to lower the body quickly.

"The two joint muscle gastrocnemius can flex knee and flex ankle simultaneousl"

F.J. Zajac, 1993

FIGURES NO. 3 & 4
THE WORLD'S STRONGEST MAN (RECORD HOLDER IN THE JERK WITH 305% OF BODY WEIGHT) DROPS EXTREMELY FAST UNDER RECORD ATTEMPT WITH FEET RAISED HIGH FROM THE PLATFORM DUE TO SIGNIFICANT FLEXING OF HIPS, KNEES AND ANKLES.
CHARNIGA PHOTOS.

FIGURE NO.5

TTHE EXTRAORDINARY COMPLEXITY OF INSTANTANEOUS SWITCHING DIRECTIONS FROM LIFTING UP TO DROPPING DOWN IN THE SNATCH AND THE CLEAN INVOLVES COORDINATING THE RAPID RELAXATION OF MUSCLES STRAIGHTENING LOWER EXTREMITIES (EXTENSORS) AND LIKEWISE A SEQUENTIAL RAPID CONTRACTION – RELAXATION OF ARM AND SHOULDER MUSCLES WHEN THE LIFTER TURNS THE BAR OVER IN THE SNATCH I.E., SWITCHING THE MUSCLE TENSION OF THE LOWER EXTREMITIES OPPOSITE TO THOSE OF THE UPPER.

CHARNIGA PHOTOS.

More effort is obviously involved in variant 1 because of the muscle actions are greater. Anecdotal evidence indicates males have more muscle tonus than females; but, little exists on gender differences in the ability to release muscle tension.

Anecdotal evidence points to a gender based muscle contraction – relaxation anomaly. Male weightlifters are able to generate higher velocity at barbell separation in the pull than female lifters; an indication of faster and greater recruitment of muscle fibers. Some have attributed the lower speeds achieved by the female lifter at the beginning of the pull to a slower electro – mechanical delay, i.e., the time it takes from a decision to contract muscles to the actual start of contraction.

On the hand, very few males are able to effectively relax muscle tension after a difficult clean in order to re – group and prepare to jerk the barbell. Extremely few male weightlifters succeed in jerking the barbell under these conditions. Conversely, many female lifters are significantly better at releasing tension and re – grouping, before proceeding to jerk the barbell; despite a prolonged and draining struggle to stand from a squat.

Less effort would appear to be involved in performing variant 2 because there is obviously less aggressive muscle action requi-

" ...executing the squat under the barbell after completing the pull in the snatch or the clean involves an instantaneous switching from the extensor muscles from a state of limit tension to a state of complete relaxation".

Y. Verkhoshansky, 1988

red to flex lower extremities and lower the trunk. In all probability the super elite and elite females compensate for lower muscle mass and speed of muscle fiber recruitment with a natural ability to relax muscles to lessen resistance to movement; while, coupling this quality with more mobility in joints. The speed of descent under the barbell for these super elites and elites is the result of muscle effort pitted against less resistance of unnecessary muscle tension.

COMPLICATIONS FOR THE FEMALE WEIGHTLIFTER JUMPING DOWN WITH VARIANT 2 RELATED TO BERNSTEIN'S PROBLEM

Soviet era Biologist, father of motor learning, Nicolai Bernstein proposed one of the fundamental complications of animal and human movement. Stated simply Bernstein's problem raises the question as to how animals and humans manage the large and even redundant degrees of freedom of movement potential of the body to move about efficiently and without injury.

Assume for a moment the observed gender differences in the ability to switch from contracting to rapidly relaxing muscles is in point fact instead of a logical assumption. And, this quality of rapid relaxation of muscles contributes to the ability to drop at high speed under a barbell. Problems establishing balance arise when this quality is coupled with a large amplitude of motion in the lower extremities.

FIGURE NO. 6

SUPER ELITE FEMALE SITTING EXTREMELY LOW IN SQUAT WITH NEAR WORLD RECORD WEIGHT.
CHARNIGA PHOTOS. .

Consider the example of the super elite female sitting in extremely low squat in figure 6. The accompanying video of the same lift illustrates Bernstein's problem of coupling high speed relaxation of muscles with a very large range of motion in the joints.

The lifter drops extremely fast in the video to a very low squat and experiences difficulty establishing balance and controlling the barbell in the subsequent recovery. The extremely fast jump under the barbell resulting from rapid relaxation of the muscles of the lower extremities, the lifter's forceful efforts to pull her trunk down and the very large mobility of her hip, knee and ankle joints create the conditions where it is difficult for her to control all of this motion in joints and establish a stable equilibrium.

And, of course, these factors complicating Bernstein problem are further exacerbated by a too flexible female barbell. The lifter's body weight, the weight of the barbell relative to her mass, her hand spacing (normal for her) her speed of movement, abruptness of hitting the low squat and the dimensions of the barbell cause further complications. Those factors all contribute to excessive oscillation of the barbell which is already visibly bowed in the low squat position of the photo.

Two distinct variants of jumping down under a barbell in the snatch and the clean are both highly effective means of performing this critical phase lifting a maximum weight. One observes variant 1 most often with male weightlifters where the male physiology comes with the advantage to generate large muscle tension faster than the female lifter. However, this advantage comes with the caveat; males are slower to release tension.

The caveat is reversed with variant 2, females experience difficulty rapidly generating significant muscle tension; attributed to a slower electro – mechanical delay. However, the female lifter is able to compensate at critical junctures in the weightlifting exercises with faster (than males) release of muscle tension.

DOES A GENDER DIFFERENCE MATTER?

An interesting aside here is the question as to whether gender distinctions in muscle recruitment patterns of switching from forceful straightening to rapidly flexing of lower extremities would manifest in differences in injury rate between male and female weightlifters. The recruitment of muscles for variants 1 and 2 are obviously different.

There is no evidence to support such a distinction would make the female lifter more susceptible, to knee injury, for instance. On the contrary, evidence from medical commission of the European Weightlifting Federation over a span of seven years showed a low overall injury rate at European championships with no knee injuries recorded for female lifters.

However, in the USA anterior cruciate ligament (ACL) injury is practically the national disease of female athletes in such sports as basketball, volleyball, soccer, lacrosse and others. The literature endeavors to link the injuries to differences in female anatomy and physiology such as lax articulations, estrogen, smaller ligaments and gender differences in muscle activation of hamstring muscles to 'support' the ACL ligament.

The gender (although not all exclusive) distinctions of muscle recruitment of variant 1 and variant 2 presented here contradict the American ideas female differences in anatomical structure and physiology make them more susceptible to knee injury. This is especially telling considering the substantially greater forces inflicted on the joints and soft tissues of weightlifters in comparison with such activities as volleyball, basketball, soccer and so forth.

"Coordination of movement is the process of mastering the redundant degrees of freedom of the moving organism".

Bernstein, 1967

CONCLUSIONS

Two major variants (1 & 2) of jumping under the barbell in the snatch and the clean are similar, but with subtle distinctions.

The 'action – reaction', technique of forcefully pulling hips up and raising feet (variant 1) would appear to be the best strategy of jumping under the barbell in the snatch and the clean. The concerted action of flexing at hip, knee, ankle and pulling feet up, adds acceleration to downward shifting of the pelvis. These actions add vertical acceleration to the barbell. Furthermore, the longer the feet are in the air the faster the descent. So, all outcomes are positive. The feet rise from the platform the trunk drops fast, the barbell goes up.

Variant 2 is likewise and effective method of jumping under the barbell. This variant is most often observed in female lifters. The super elite and elite female deploy the features of female biomechanics and physiology to compensate for less muscle mass and speed of recruitment of muscle fibers, often referred to as electro – mechanical delay; with a faster relaxation of muscles. The outcome can be very fast descent coupled with a very low squat position.

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ATHLETIC TALENT: BIOLOGICAL AND PSYCHOLOGICAL PREREQUISITES

BY VLADIMIR ISSURIN


USA
5KG
TRAINING
IVANKO
TEAMBATH

As it was previously stated, Athletic Talent has a complex, multilateral structure where environmental, biological, and psychological components are of primary importance. The environmental aspects associated with the methodological background are highlighted in the previous chapter while biological and psychological components of talent need thorough consideration. Available information concerning this matter is presented below.

GENETIC DETERMINANTS OF ATHLETIC TALENT

In order to understand the nature of Athletic Talent and the possibilities and limitations for athletic training, the following questions should be answered:

- *Does heredity really contribute to great sport successes?*
- *How does genetics condition the main somatic and functional traits?*
- *To what extent is the response to training stimuli (cumulative training effect) genetically dependent?*

The above questions belong mostly to the area of sports genetics where, in recent decades, a large body of facts and evidence has been accumulated related to the contribution of heredity to athletic performance and exceptional potential of outstanding athletes. The specific genetic investigations are twin studies, family investigations, and experimental studies in the branch of molecular genetics.

Family studies are not frequently used in genetic investigations. Somatic and physiological traits of parents and their offspring have been evaluated (review by Malina and Bouchard, 1986; Bouchard et al.,1997) in different populations of Europe and North America. Their results show great differentiation, both in respect to type of relationship and to the population under study.

Unfortunately, classic quantitative genetic methods have a lot of limitations, especially when analyzing outstanding sports families. Coaches and sport scientists noted however, that parents of top-level athletes are usually developed to a higher degree (both physically and functionally) than the general population and are often experienced in high-performance sport. Some of them achieved outstanding results. The data of several so-called "sports dynasties" are presented in Table 3.1.

Certainly, each outstanding athlete (Olympic, world champion and medal winner) is unique. The occasional occurrence of two outstanding athletes in one family is negligible so that each example of such families can be analyzed as a case study. The collection of these cases is of great interest for understanding the nature of sports talent and the importance of heredity related factors.

It appears that very often, the family education of a great athlete's children is oriented to sport ambitions from early childhood. It is also possible that their training conditions were more favorable than among the average population. The influence of this factor cannot be ignored. However, and there is no doubt about this, the outstanding parents had to be genetically predisposed to a certain sports activity, and heredity related benefits were partly transmitted to the offspring. Hence, the probability to succeed in high-level sport is much higher in children of champions.

Sergijenko (2000) was of the opinion that offspring of an outstanding athlete have a 50% probability to inherit excellent athletic abilities. This probability reaches 75% in offspring of parents consisting of two outstanding athletes (this occurred once in our list – the family of Andrea Gyarmati). Ignoring doubts about the accuracy of this suggestion, the above cases are very impressive.

GENETIC DETERMINATION OF SOMATIC TRAITS, PHYSICAL AND COORDINATION ABILITIES

Quantitative estimation of inheritance, although very sophisticated, makes it possible to consider the first question and to answer the second one (how trainability changes with an increase in athletic level). The most widely used method to assess the inheritance of several traits is the twins' investigation. In general, the idea behind the twins' method is based on the comparison of identical (monozygotic) twins to fraternal (dizygotic) twins. Because the monozygotic twins have identical heredity, all differences in their capabilities are attributed exclusively to the influence of the environment. Dizygotic twins share one-half of their genes, so their heredity is different but environmental conditions are usually identical. In this case, any difference observed between them in a trait must be attributed to heredity.

PARENTS, COUNTRY	SPORT, ACHIEVEMENTS	CHILDREN, COUNTRY	SPORT, ACHIEVEMENTS
Father – Casmir Gustav, Germany	Fencing. Two gold and two silver Olympic medals, 1906	Son – Casmir Erwin, Germany	Fencing. Two silver Olympic medals in 1928; two bronze Olympic medals in 1936
Father – Swahn Oskar Gomer, Sweden	Shooting. Olympic champion in 1908, 1912; Olympic silver medal in 1920	Son – Swahn Alfred, Sweden	Shooting. Olympic champion in 1908, 1912; Olympic silver medals in 1920 and 1924
Father – Gerevich Aladar, Hungary	Fencing. Olympic champion in 1932, 1936, 1948, 1952, 1956 and 1960	Son – Gerevich Pal, Hungary	Fencing. Olympics bronze medal in 1972
Mother – Szekeli Eva, Hungary	Swimming. Olympic champion, 1952; silver Olympic medal, 1956	Daughter – Gyarma-ti Andrea,	Swimming. Silver and bronze Olympic medals in 1972
Father –Gyarmati Dezso, Hungary	Water polo. Olympic champion 1952, 1956, and 1964; silver and bronze Olympic medals in 1948 and 1960	Hungary	European champion and two silver medals in 1970
Father – Tishtenko Anatoli, USSR	Kayaking. World champion in 1970, European Champion in 1971	Son – Tishtenko Anatoli, USSR, Russia	Kayaking. World champion in 1990, 1991 and 1994 (three times). Totally five times
Father – Ali Muhammad, USA	Boxing. Olympic champion in 1960. One of the greatest athletes in professional boxing	Daughter – Ali Laila, USA	Boxing. World champion by International Boxing Association in 2002 and 2005
Father – Hall Gary, USA	Swimming. Silver medal in 1968 and 1972, bronze medal in the 1976 Olympics	Son – Hall Gary, USA	Swimming. Two Gold medals and two silver medals in the 1996 Olympics: three-fold Olympic champion in 2000; Olympic champion in 2004
Father – Stastny Peter, Czechoslovakia, Canada	Ice hockey. World champion in 1976 and 1977; silver medals in WCh of 1978 and 1979	Son – Stastny Paul, Canada, USA	Ice hockey. Silver Olympic medal in 2010; bronze medal in World championship 2013
Father – Anissin Viache-slav, USSR	Ice hockey, European and World Champion in 1973, 1974, and 1975	Daughter – Anissina Marina, France	Figure skating. Olympic champion in 2002, Olympic bronze medal in 1998, World champion in 2000, silver medals: 1998, 1999 and 2001, European champion in 2000 and 2002
Father – Bure Vladimir, USSR	Swimming. Silver and two bronze Olympic medals in 1972, bronze Olympic medal in 1968, European champion in 1970	Son – Bure Pavel, Russia, USA Son – Bure Valery, Russia, USA	Ice hockey. Olympic silver medal in 1998; Olympic bronze medal in 2002; Awards: Maurice Richard goals leader (2), NHL All-star team (6) Ice hockey. Olympic silver medal in 1998;Olympic bronze medal in 2002; NHL All-star team (1)
Father - Montano Mario Aldo, Italy	Fencing - Olympic champion, 1972; silver Olympic medal in 1976 and 1980	Son - Montano Aldo - Italy	Fencing - Olympic champion and silver Olympic medal in 2004
Father - Mustafin Farhat, USSR, Russia	Greco-Roman wrestling. Two-fold World champion in 1974 and 1975; bronze Olympic medal in 1976	Daughter – Mustafi-na Aliya, Russia	Artistic gymnastics. Olympic champion, silver and 2 bronze medals in 2012, three-fold World champion in 2010 and 2013
Father – Janics Milan, Yugoslavia	Kayaking. World champion in 1978, 1979 and 1982; silver Olympic medal in 1984	Daughter – Janics Natasa, Hungary	Kayaking. World champion in 2002-2013 (19 times). Olympic champion in 2004 (two-fold) and in 2008; silver and bronze Olympic medals in 2012

Table 3.1 - Examples of World and Olympic champions and medal winner families
(Sources – Issurin, 2008 and electronic databases).

The quantitative estimate of the effect of heredity is heritability, which characterizes the degree of genetic determination of several traits.

Despite the obvious difficulties, the twins' studies form an extensive and very informative branch of sports science that presents valuable knowledge related to heritability of morphological traits and fitness qualities.

It is well known that different sports have certain specific demands in regard to the body structure of successful athletes. The genetic determination of the most important somatic traits was thoroughly investigated and several findings of these studies are summarized below (Table 3.2.).

Somatotype is understood as the compilation of body length, width and body composition. Each is under different genetic control. In regard to linear body dimensions, there is strong

control over width, medium control over muscle mass and weak control over fat mass. Because of this, their use as indicators of sport predisposition is different. Important meaning is given to body height. Body width can be also important as a factor affecting suitability for certain disciplines despite less inheritance. Total body fat is, to a small degree, genetically controlled. Hence, the athlete's body-build can be successfully corrected in the training processes (excluding linear dimensions).

Total body fat, an extremely important variable in many sports, is to a minor degree, dependent on heredity. Hence, the athlete's body type, with excessive fat mass can be successfully corrected while the major body proportions can be changed very little. At any rate, predisposition to certain sports, which are affected by great demands in regard to body length, is strongly inherited since the linear body dimensions are about 70% inherited. This statement partly answers the question about how heredity contributes to sport successes. Special interest is raised concerning the proportion between fast- and slow-twitch muscle fibers. Data of different studies are equivocal, however the general conclusion concerning this matter presupposes that muscle fiber composition is strongly predetermined by heredity. Similar studies have been conducted with regards to inheritance of several motor fitness characteristics (Table 3.3).

CHARACTERISTIC	GENERAL GENETIC CONTROL	LEVELS OF INHERITANCE
Body lengths-- height, limbs, feet	strong	70%
Body breadths-- shoulders, thighs etc.	medium	50%
Total body fat	low	20 – 30%
Muscle mass	medium	40%
Proportion between fast- and slow-twitch muscle fibers	medium to strong	45-65%

TABLE 3.2 - LEVELS OF INHERITANCE OF THE MAIN SOMATIC TRAITS
(BASED ON KOVA, 1980, SHVARTS, KHRUSHTCHOV, 1984; SZOPA ET AL. 1985 AND 1999; BOUCHARD ET AL. 1997)

CHARACTERISTIC	GENERAL GENETIC CONTROL	LEVELS OF INHERITANCE
Alactic Anaerobic Power	strong	70-80%
Lactacid Anaerobic Power	medium	~50%
Peak blood lactate	strong	~70%
Aerobic Power (VO_2 max)	medium	~50%
Maximum isometric strength	low	20-30%
Strength endurance (resistance to acidity)	medium	40-50%
Frequency of movements	medium	40-50%
Flexibility	medium	~40%

TABLE 3.3 - HEREDITARY CHARACTERISTICS OF SEVERAL MOTOR ABILITIES
(BASED ON MLECZKO, 1992 ; KLISSOURAS, 1997; BOUCHARD ET AL., 1997 ; SZOPA ET AL., 1999)

The most relevant metabolic characteristic was maximum aerobic capacity (VO_2max). Its history can serve as a perfect example of the evolution of particular investigator's views. It ranged from a very high estimation of being a hereditary ability in former studies (over 90%) to a relative lower and trainable ability in other publications (about 50%) (see Bouchard et al. 1997). A particularly high level of genetic determination was found regarding anaerobic (especially alactic) power and peak blood lactate. Consequently, explosive strength, speed abilities, etc. have a strong genetic base.

In the light of the inheritance of various somatic traits, the general situation in each event indicates that specific trainability is more understandable. For instance, athletes who have relatively low inherited levels of anaerobic productivity will be very limited in the sprint disciplines

where these demands are high. A similar situation exists in other sports demanding a high level of maximum speed. The situation in strength and endurance disciplines is much more optimistic. Heredity-related factors in these sports are not so limiting.

Special attention should be given to hereditary aspects of coordination abilities, which contribution to acquisition and perfection of technical motor skills cannot be underestimated. An extensive review of numerous familial and twins studies was fulfilled by Lyakh with coworkers (2007). Despite the fact that several research groups presented contradictory findings, the general tendencies of coordinative inheritance can be specified (Table 3.4).

CHARACTERISTIC	GENERAL GENETIC CONTROL	LEVELS OF INHERITANCE
Space orientation	strong	60-70%
Kinesthetic differentiation	medium	~40%
Eye-hand coordination	moderate	~30%
Movement frequency (speed)	moderate	~30%
Body balance	low	~20%

TABLE 3.4 - HEREDITARY CHARACTERISTICS OF SEVERAL COORDINATION ABILITIES (BASED ON LYAKH ET AL, 2007)

The authors of the mentioned review noted that twin studies reported relatively higher heredity indices compared to familial studies. The general conclusion that can be drawn from Table 3.4 claims that coordination abilities with exception of space orientation have moderate to low genetic control and, therefore, are sufficiently trainable. Nevertheless, data of rare studies have shown a more sophisticated perspective. Namely Ljach (2002) studied the speed of complex motor reaction in children 7-9 years and found that this functional ability is strongly determined by heredity. This fact seems very important with regard to the world-wide practice of coordination training in children ages 5-9 years in such sports as gymnastics, figure skating, etc. High learnability, at this age, is strongly determined by heredity-related factors. This indication can be used as an early predictor of athletic giftedness and talent.

GENETIC DETERMINATION OF THE CUMULATIVE TRAINING EFFECT

It should be emphasized that the role of inheritance is very different in regard to several motor abilities and functions. Moreover, the inheritance of certain motor abilities and the inheritance of the training response to develop this ability can be also different. Relationships between heredity dependent abilities and the training responses can be described by the following three factors:

- *The motor ability is strongly heredity dependent and the effect of training for this ability is strongly heredity dependent as well. In this case, the final condition and performance of an athlete is decisively genetically determined;*
- *The motor ability is strongly heredity dependent, but the effect of training for this ability is slightly heredity dependent. In this case, the final condition and performance of the athlete are moderately genetically determined;*
- *Both the motor ability and the effect of training for this ability are slightly heredity dependent. In this case, the final condition and performance of the athlete show little dependence on heredity. Other factors such as preparation, restoration, etc. are of primary importance.*

There were several studies where inheritance of the training response was investigated. These studies only pertained to relatively long-term training and their results can be considered as cumulative training effects.

Table 3.5 summarizes data from several studies. Interestingly, heredity related responses to training are very event-specific. The training induced responses of maximum strength and maximum speed are independent (or slightly dependent) on heredity. The cumulative effect of training for anaerobic glycolytic endurance, and particularly for maximum aerobic power is largely dependent on genetic factors.

Special remarks should be made regarding the inheritance of motor learning and perfection of technical skills.

MODALITY OF TRAINING	STUDY DESIGN	OUTCOMES	SOURCE
Strength training	10-weeks isokinetic strength training by five pairs of monozygotic twins	The results suggest that the training effect was independent of heredity	Thibault, Simoneau et al, 1986
Aerobic training	20-weeks endurance training by 10 pairs of monozygotic twins	The changes in maximum aerobic power are 75-80% heredity dependent; the anaerobic threshold response is heredity dependent by about 50%.	Prud'homme et al.,1984
Anaerobic training	15-weeks high-intensity intermittent training by 14 pairs of monozygotic twins	The response of alactic capacity assessed by a 10s test is heredity independent. The response of glycolytic endurance, assessed by a 90s test is about 65% heredity dependent	Simoneau et al, 1986

TABLE 3.5 - INHERITANCE OF CUMULATIVE EFFECTS FOLLOWING DIFFERENT MODALITIES OF TRAINING

Extensive studies, which have been conducted in this area, relate to elementary motor tasks and do not address athletic skills (see review of Bouchard et al., 1997). Nevertheless, the results suggest that sensitivity to motor learning is quite variable between age groups, sexes, and among several tasks. In general, the acquisition and perfection of non-athletic and relatively simple motor skills is not dependent or only slightly dependent on heredity. It can therefore be assumed that genetic determination of highly coordinated athletic skills is low to moderate.

Special remarks should be made regarding the inheritance of motor learning and perfection of technical skills. Extensive studies, which have been conducted in this area, relate to elementary motor tasks and do not address athletic skills (see review of Bouchard et al., 1997). Nevertheless, the results suggest that sensitivity to motor learning is quite variable between age groups, sexes, and among several tasks. In general, the acquisition and perfection of non-athletic and relatively simple motor skills is not dependent or only slightly dependent on heredity. It can therefore be assumed that genetic determination of highly coordinated athletic skills is low to moderate.

In conclusion, it should be emphasized that the top level athletes are individuals who inherited several somatic and physiological traits as well as the ability to respond well to training. The combination of these two factors makes it possible to reach a level of sport skill that is the key to sports talent. However, the final result of sports training (technical and motor ability mastery) depends predominantly on long-term preparation. This gives much freedom to the coach's creativity, which allows for partly compensating for the genetic limitations. In addition, life conditions should be mentioned as relevant factors supporting trainability. This includes nutrition, sufficient rest, biological restoration, normal conditions for professional activity, proper psychological climate, and social conditions.

EVIDENCE FROM MOLECULAR SPORT GENETICS

During the recent decades, studies of genes and genetic markers of athletic performance became a popular and informative branch of sport science. Studies of athletes' genome that contains the complete genetic information of an organism allowed researchers to obtain unique information concerning the predisposition of individuals to a certain mode of sport activities. New perspectives in this branch were opened with discovery of genetic markers associated with a strong influence on athletic performance. The most widely used forms of the genome investigation presuppose fulfillment of so-called case-control studies or cross-sectional association studies. In the first case, the researchers reveal whether one allele, i.e. specific form of certain gene, is more prevalent within some sub-population of elite athletes compared to the general population. It is assumed that this allele affects more efficient performance. In the second case, the study design allows for evaluation of the

impact of an allele or a particular genotype on a certain estimate of motor potential such as maximum speed, strength, or VO_2max comparing elite and non-elite performers. Following the review of Ahmetov and Fedotovskaya (2012), the current body of information describes about 79 genetic markers that characterize the status of elite athletes with regards to endurance performance (59) and strength/power disciplines (20). A detailed description of these markers contains characterization of their location, functional properties, and linkage with other genes. Specific genes have been revealed that can boost functional athletic adaptations such as structure, development and contractile abilities of muscles, energy metabolism, synthesis of mitochondrial proteins, immune responses, metabolism of proteins, etc. (Stepto et al., 2009).

As it was previously stated, the vast body of information has been received with regards to endurance and strength/power disciplines. One of the most popular among researchers and a frequently studied gene is angiotensin converting enzyme (ACE) that exists in two separate alleles: ACE-I, which associated with efficient endurance performance, and ACE-D, which affects performance in strength/power disciplines. The prevalence of an ACE-I allele compared to control groups has been found in high-performance distance runners, long distance swimmers, triathletes, and rowers.

The ACE-I genotype has also been shown to be associated with the prevalence of slow twitch fibers in the quadriceps, increased aerobic capacity, faster recovery, and higher fatigue resistance (Ahmetov, 2009). Contrary to this, the allele ACE-D is firmly associated with a predisposition for strength/power activities and appropriate adaptations of athletes to strength exercises. The ACE-D allele has been repeatedly shown to be linked with a pronounced increase in strength abilities and muscular hypertrophy following high resistance training and the prevalence of fast twitch fibers in various muscle groups (Montgomery et al., 1998; Zhang et al., 2003 a.o.).

Another widely investigated gene involved in the regulation of strength/power activities is a-Aktinin (ACTN3).

ACTN3 is considered one of the contributing genes in the heritability of fiber type distribution (Vincent et al., 2007). Importantly, ACTN3 is expressed exclusively in fast-twitch muscle fibers and associated with their forceful contraction. The findings of case-control and cross-sectional association studies demonstrated highly significant associa-

tions between ACTN3 genotype and sprint performance of elite athletes. Apparently, the presence of a-Actinin-3 provides a positive impact on speed-strength activities and is reasonably considered a genetic marker of predisposition for these disciplines (Yang et al., 2003; Vincent et al., 2007).

It is worth noting that the review of a large number of studies of genetic markers reveals many cases with contradictory outcomes and equivocal evidence related to the frequency and prevalence of some genes in various groups of athletes. This inconsistence may be explained by the fact that complex traits such as VO2max or maximum strength are affected by numerous genes and this polygenic effect is not always controlled by researchers. For instance, the proportion of slow-twitch muscle fibers (STF) can be predicted based on the presence of genetic markers of endurance in some individuals. However, the predicted result is strongly dependent on the number of endurance-related alleles in some individuals. In athletes possessing one allele, the predicted estimate of STF was equal to 42.2%; in athletes with three detected alleles, this proportion reached 50.1%; and in individuals possessing six endurance-related alleles, the contribution of STF was equal to 67.8% (Ahmetov, 2009).

Apparently, the analysis of gene polymorphisms allows for the prediction muscles fiber type distribution but this procedure demands appropriate precautions. A similar situation occurs with other functional traits. Correspondingly, the outcomes of many case-control studies need replication of other samples and careful interpretation. Following the review of Ahmetov and Fedotovskaya (2012), the predictive potential of studies where genetic markers explain only a small part of the training effect is very limited and does not allow for evaluation of athletic gifts. Nevertheless, the further progression in genomic studies will enlarge the area of practical application and of their outcomes. From a practical position, it is important to implement genetic tests for examination of risks of deceases in elite athletes. We can expect that future research will find genetic markers associated with exceptional coordination abilities and flexibility. The longer perspective presupposes incorporation of genetic methods in monitoring programs of elite athletes and evaluation of giftedness in young prospects.

PSYCHOLOGICAL BACKGROUND OF ATHLETIC TALENT

For many years and still today, the psychological aspects of Athletic Talent remain in focus of both scientific and practical interests in the world sport community.

DESCRIPTION OF STUDIES	STUDY OUTCOMES	SOURCE
Comparative study of collegiate and Olympic athletes (totally 713 males/females) using Psychological Skills Inventory for Sports	Superiority of Olympians in mental concentration, self-confidence, anxiety management, mental preparation, and self-motivation	Mahoney et al., 1987
Interview and surveys of 235 Canadian Olympians concerned items of physical, technical and mental preparation	Olympic success is associated with commitment and quality training, use of imagery, goal setting and competition focusing; psychological variables have the highest predictive value for Olympic success	Orlick & Partington, 1988
In-depth interview of 10 Olympic and World champions, their coaches and parents	Great athletes manifested love for sports, self-motivation and self-confidence, determination, ability to cope with pressure and distractions, and perseverance	Durand-Bush, 2000
Standardized psychological measures and interview of 10 US Olympic champions and several associated persons	Olympic champions possessed by high confidence, determination, commitment and mental toughness; abilities for concentration and focus, self-regulation, positive imagery, and self-talk.	Gould et al., 2001
A customized survey of 641 Australian high-performance athletes including 51 Olympians	Olympians possessed by significantly higher perseverance and determination, independence, resilience, competitiveness, tolerating to pressure	Gulbin et al., 2010
In-depth interview of 12 Olympic champions from Great Britain, Ireland and New Zealand	Studied champions possessed by positive personality, self-motivation, confidence, focus, and perceived social support	Fletcher & Sarkar, 2012

TABLE 3.6 - SUMMARY OF STUDIES DEVOTED TO DISCOVERY OF TALENT-RELATED PSYCHOLOGICAL PROPERTIES

From the viewpoint of talent identification and development it is worthy to consider psychological prerequisites, separately focusing on particularities of elite, outstanding athletes and young, gifted prospects. In the first case, available evidence will allow us to outline the psychological framework of outstanding performers. In the second case, we will try to highlight the psychological prerequisites of potentially talented youngsters who have a chance to obtain exceptional mastery while their subsequent preparation will be sufficiently efficient.

PSYCHOLOGICAL FRAMEWORK OF EXCEPTIONAL MASTERY OF TALENTED ATHLETES

The psychological characteristics of talented athletes such as personality traits, and mental and behavioral skills eventually raised particular interest in researchers.

Correspondingly, a number of well controlled studies were conducted aiming to discover psychological talent-related properties. The researchers focused on identification and characterization of the psychological attributes that produced the greatest impact on the successfulness of outstanding talented athletes (Table 3.6).

Table 3.6 contains data from six studies with the participation of Olympians, which guarantied representation of the most talented athletes. Considering the outcomes of the fulfilled studies, at least three important particularities can be highlighted, namely: the availability of psychological prerequisites typical for outstanding talented athletes (1), the predictive potential of psychological attributes (2), and the contribution of psychological skills as an indispensable component of exceptional athletic performance (3).

Let's consider the above particularities with regard to their role in discovery and development of Athletic Talent.

In-depth analyses fulfilled by different research groups allowed them to find out the most informative and influencing properties that determine performance potential of world leading athletes. Although different researchers reported on various psychological prerequisites of outstanding athletes, their findings allow one to reconstruct an evidence-based framework of psychological prerequisites of Athletic Talent. Such personality traits as self-motivation, high determination, independence, competitiveness, motivation, and commitment were persuasively reported by the mentioned authors. Importantly, all researchers noted the predictive value of psychological skills, where

the most frequently mentioned were high confidence, self-regulation and mental toughness. These reports were consistent and supported by numerous observations and practical reports (Jones, 2001; Blumenstein and Orbach, 2012 a.o.). Qualitative results of Gould et al. (2001) clearly indicated such psychological attributes as mental toughness, competitiveness, optimism, confidence, and sport intelligence as being very characteristic of great champions. The authors claimed that their availability and high extent of these psychological characteristics persuasively explain the superiority of Olympians compared to less successful athletes.

In studies where various aspects of athletic mastery such as technical and physical components were examined (Orlick & Partington, 1988; Durand-Bush, 2000; Gulbin et al., 2010), the predictive prevalence of psychological attributes has been found. It can be suggested that comparison of experienced high-performance athletes with exceptional performers does not always reveal substantial differences in technical components, or general and sport-specific fitness. Presumably, the superiority of outstanding athletes can be characterized, first of all, in higher realization of their physical and techno-tactical potential in stressful competitive conditions. Such negative factors as fear, anxiety and insufficient self-regulation may strongly debilitate performance of sub-elite athletes. The opposite situation occurs with outstanding athletes, where performance potential can be markedly reinforced thanks to highly efficient stress regulation and beneficial mental preparedness.

VARIOUS SPORTS	PREVALENCE OF PSYCHOLOGICAL SKILLS
Track and Field	Concentration, confidence, self-regulation, imagery, thought control, comfortable pace
Swimming	Self-regulation of arousal, confidence, thought and feeling control, goal setting, imagery, relaxation, concentration
Artistic gymnastics	Focus, concentration via imagery, confidence building, anxiety control, mental relaxation
Rhythmic gymnastics	Goal setting, self-talking, confidence, attention-focusing via imagery, mental relaxation, self-awareness
Tennis	Mental toughness, commitment, self-belief, confidence, attention control
Canoeing/Kayaking	Mental control, mental toughness, self-regulation, mental relaxation, focusing
Judo, Taekewondo	Self-regulation, concentration, anticipation, self-talking
Fencing	Attention, self-control, consistency, will power, decision-making
Wrestling	Narrow focus of attention, positive self-talking, self-confidence
Soccer	Concentration, self-regulation, self-talking, positive thinking
Basketball	Imagery, concentration, self-talking, team cohesion, self-regulation

TABLE 3.7 - PREVALENCE OF VARIOUS PSYCHOLOGICAL SKILLS IN INDIVIDUAL, COMBAT AND TEAM SPORTS
(adopted from Blumenstein and Orbach, 2012)

The third particularity listed in the studies in Table 3.6 is the discovery and reasonable emphasis of the decisive function of psychological skills, which serve as a larger contributor of exceptional performances in studied Olympic champions.

In fact, psychological skills embrace a number of practical tools, which permit athletes to cope with competitive stress distractions, to fulfill various procedures of self-regulation and, finally, completely realize their athletic potential in peak performance. As listed in Table 3.6, researchers specified a number of psychological skills that efficient realization of largely assists in attainment of more favorable performance. They are anxiety management, use of imagery, self-talk and goal setting, ability to cope with pressure and distractions, self-regulation such as relaxation and activation, and competition focusing. Unlike the personality traits, that are partly associated with heredity-transmitted factors, the psychological skills are a pure product of purposeful mental preparation.

The data of studies with Olympians are persuasively supported by findings of numerous investigations of large groups athletes representing various individual, team, and combat sports. Blumenstein and Orbach (2012) summarized evidence from a many recent publications where the prevalence of psychological skills were specified properly for different sports (Table 3.7). Track and Field embraces a large number of disciplines and each of them require a unique combination of psychological skills. Nevertheless, skills such as concentration, confidence, and self-regulation are of primary importance for successful fulfillment of training routines and competition. The utilization of imagery and thought control provides particular benefits in such events as jumping and throwing that are characterized by relatively long breaks. The aquatic specificity of swimming emphasizes the additional importance of thought and feeling control, which facilitate more favorable technique improvement and a specific "feel for water." Similarly, enhanced imagery and relaxation largely contribute to the formation of swimming athletic mastery.

Both artistic and rhythmic gymnastics are characterized by increased demands to mental concentration, focusing, and self-confidence. Such psychological skills like anxiety control, mental relaxation, and self-awareness may largely enhance the quality of preparation and performance in these sports (Lidor et al., 2007).

Tennis is a sport with an unpredictable scenario and psychological skills such as mental toughness, self-belief, and confidence are particularly important for successfully competing.

Canoe-kayak paddling, as a typical endurance sport, requires pronounced demands to mental control and mental toughness. Variable environmental conditions and water resistance components reinforce demands on self-regulation and mental relaxation.

Combat sports are characterized by rapid changes of fighting situations that demand appropriate motor reactions based on highly developed abilities of self-regulation, concentration, and anticipation. Accordingly, such psychological skills as will power, decision-making, and self-talking may play a decisive role in the achievement of excellent performance.

Team sports are specifically characterized by additional demands for application of individual psychological skills during permanent interaction with partners. Correspondingly, the defensive and offensive team strategies should be supported by appropriately developed skills of concentration, self-regulation, and team cohesion. In addition, such productive psychological skills as imagery, self-talking, and positive thinking can substantially assist in the achievement of sport-specific mastery.

In conclusion, acquisition and perfection of rational, psychological skills is an indispensable part of the development of an athlete's talent in any sport. This educational cognitive process is predetermined by highly dedicated, long-term athletic preparation where the creativity of athletes and professional assistance of their coaches play crucial roles. However, purposeful guidance of professional psychology consultants can substantially facilitate and accelerate this process.

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WOMAN AND SPORT

BY FRANCESCO RICCARDO

Despite the passing of time that has brought about important historical, social and cultural changes, women still remain the centre of attention, as if to indicate the interest in a "minority" in need of protection, of respect for their often shattered rights; we continue to talk about gender discrimination, sexism, abuse and violence against women, of femicide, of unequal treatment in various areas of our existence. Attempting to "destroy" the feminine world is a true paradox as it is this very world that gives life to the world, in exactly the same way as "mother nature".

Political and religious institutions in the various geographical areas of our planet have had, and continue to have, great responsibility for the question of female status in the various social areas in which women enter, or try to do so, without being discriminated, without facing gender inequalities.

This has created a particular, dutiful interest on the part of the institutions, in order to guarantee the absence of gender inequalities and therefore create the conditions so that the female sex would not be discriminated with respect to the male gender, especially in the working/professional field. For example, in Italy the Department for Equal Opportunities was set up in 1996, and its main functions were established with a Ministerial Decree on 12 July 1997. With Legislative Decree no. 198 of 11 April 2006, the "Code of Equal Opportunities between Men and Women" was approved, pursuant to Article 6 of the Law no. 246 of 28 November 2005, which entered into force in the same year. Moreover, the political debate about the application of stricter rules, in relation to crimes committed against women, led to a continuous review of the penal code and penal procedure, in a move to inflict tougher sentences; with the passing of a recent bill, the government approved the "red code", a fast track for complaints against violence against women. The objective of the measure is to counteract a chilling phenomenon, as shown by statistics: feminicides have reached 150 cases a year and, according to data from the latest ISTAT report on violence against women, about 21% of Italian women (equal to 4.5 million) were forced to perform sexual acts and 1.5 million suffered the most violent act, rape.

In this panorama, women, with their abilities and professionalism all too often put at a physical level, must elbow their way in to various social, working, cultural, artistic fields; and more often than not fail to reach top positions, often the exclusive prerogative of men.

The body, with its social connotations, is the most obvious symbol of the difference between men and women, differences that can be strengthened or weakened within various social and cultural contexts, thanks to mental representations, expectations, stereotypes, prejudices of the "system" within which it is expressed. Its representation offers important indications regarding the dominant discourses related to feminine and masculine, on the construction of new imaginaries, about the dimension of domination or power, but also concerning conflict.

Through the experience of the body, the individual can internalise socially approved meanings and values, aesthetic canons, ideas on well-being, conceptions on the body as a productive tool or object of personal care. Through the social meanings attributed to one's own body, education, behaviour patterns, the expectations of others and the prerequisites linked to the role of gender, each woman discovers her feminine identity, understood as a cognitive, emotional and behavioural construct in which two processes are interfaced:

- the attribution of characteristics of the gender to which one belongs or is assigned (social aspect);
- the individual elaboration of these characteristics in relation to oneself and to others (personal aspect).

The two processes connected to role attributions and to the representation of self, although not mirrored in the same way, interact through the patterns and rules of behaviour that the individual internalises. Rules of conduct, for example, interfere with identity in two ways: directly, as obligations or prerequisites, establishing how women should behave; indirectly, as expectations, defining the way in which others are forced to act against them (Salvini, 1982).
In short, society establishes the modalities, social situations and stages suitable for its performance (Goffman, 1977, Inghilleri and Ruspini, 2011).
Personal identity is also a system of shared rules and signs, through which the individual builds and gives life to a social identity. Through the ability to use rules and meanings, such as those relating to the image of oneself, the individual performs communicative acts, producing versions of oneself adapted to the context and the different forms of interaction, and generating an actual theory about oneself. Personal identity is, in fact, sustained and achieved through two fundamental processes:

- self-awareness, that is the explicit recognition of one's own existence as an individual separate from other people.
- self-regulation, understood as a reflexive capacity for self-monitoring, corresponding to the perception that a human being has of herself and her actions.

Identity is always looking for mirrors from which it can be confirmed, be they memories or presences (Salvini 1982). The image of ourselves that the mirror of the situations of the world refers to us is sedimented in our memory, retrospectively giving us that thread of memories that weaves the apparent continuity of our identity over time. In fact, the knowledge of a stable and continuous identity is only the reflection of these reconstructed memories in the light of today's meanings. The image of ourselves restructured through the present that attenuates, or even annuls the discontinuities, fickleness and fractures of the past identity with respect to the present one.
In 1949, Jacques Lacan formulates for the first time what he himself will define as "*the mirror stage as formative of the function of the I*". The child, looking in the mirror for the first time, is enchanted and surprised, she tries to recognize herself in that image and begins to gesticulate, to look at herself and to see how the mirror reacts to her gestures.
The first glimpse that the child encounters is that of the mother who will act as a recognition of the other.
The image in the mirror of the subject is an image other than the subject, an image that carries out a constituent action on it, which therefore offers her an image of herself, offers her a habit; the subject comes to exist. At the same time, there is always an image of another that the subject can never match. But the gap produced compared to the image of self given by the mirror generates a fragmentation of the body, the whole body does not take shape through the image of the mirror. This highlights:

1) the power of the Other on the subject;
2) the condemnation of an eternal shortfall, of never being able to coincide with oneself and to be other than oneself;
3) a body residue that is fragmented with respect to the compactness of the image.

In other words, identity risks becoming the prison of the Real Self, of the true expression of the Self, whenever the gaze of the Other imposes social rules that prevent the Person from recognising their needs, their desire, and above all, from not confusing them. Recalcati emphasizes the importance of desire in the constitution of the human being, of her existence in the world. Desire is therefore not a primary need, but concerns the encounter with the Other.

The goal of my desire, in this sense, is the desire of the other, or as Recalcati says "I want to have a place in the desire of the other". Desire is a question of recognition and its symbolic satisfaction is had in obtaining recognition of this question. Desiring means wanting to feel desired, wanting to be recognised by the Other, means wanting to have a value for the Other. Desire as the desire of the Other shows that human desire has a relational structure. It comes from the Other and heads towards the Other. There is no desire without the Other. The circuit of desire necessarily passes from the Other because desire itself cannot be enough (M. Recalcati, 2018).

WHAT HAPPENS IN THE WORLD OF SPORT?

This topic has always generated great interest in the sporting field as it seems the most fertile ground for eliminating these disparities, which persist in various forms of institutions, from politics to religion, from business community to professions, especially when we speak of leading roles. To tell the truth, at managerial level, CONI federations have had 707 presidents, but only of these was a woman: Andreina Prestini was president of the Italian Equestrian Sports Federation (FISE) in 2008-2009. In over a century, the general secretaries at the top of the various Italian federations were 609, 26 of whom were women (P. Coccia, "Woman and Sport" Il Manifesto.it, Ed. 03.03.2018).

It should also be emphasised that women occupy secondary roles in sports organisations and institutions: they are often under-represented in administrative directives; the coaches, even of female athletes, are more frequently men; the leaders of the International Olympic Committee are still predominantly male, deciding which sports and events to include in the Olympic programme, of the National Olympic Committees, which control the Olympic sports in the various nations - such as CONI in Italy -, and of the International Federation of Sport, which puts forward the new Olympic sports (Gender power and culture 2001).

Josefa Idem, in the preface to the book by M. Cinquepalmi, "Dispari. Storie di sport, media e discriminazione di genere" (Unequal. Stories of sport, media and gender discrimination), writes: "*As long as women are kept at the margins of decision-making in politics and sports, it will be impossible to convey a new image in which they are protagonists*".

Therefore, when it comes to sports, one must always bear in mind that it is not a unitary world where the managerial sphere retains its dominance as a masculine entity.

Sport is one of the most important contemporary social contexts in which gender identity is articulated. Ideas and beliefs about gender can affect the organisation and also the way it is practiced. It can be a place of marginalisation of female activity and of affirmation of ideologies of inequality or masculine values. At the same time, however, it can be a place of transformation and conflict (Salvini 1982).

The development of sporting activity among women appears to be undoubtedly an important sign of female emancipation; athletic exertion, traditionally associated with virility, gradually becomes available to women too, and they seem to escape the more traditional femininity, the stereotype of the "weaker sex", passive and sedentary, custodians of the home. Now they have new spaces for experimenting with a different use of the body and the construction of new forms of identity.

Sport thus becomes a privileged and structured field of investigation: inhabited by bodies, conflicts, representations, roles, genres. A field that has expanded in possibilities, in definitions, in meaning, also thanks to an increase in those practising it.

In an ISTAT (Italian National Statistics Institute) survey on "Citizens and leisure time (2016)", it emerged that 34.8% of the population aged 3 years upwards practice one or more sports in their free time; of these, 25.1% do so on a continuous basis, while 9.7% practice it occasionally. 25.7% of people who do not practice a sport claim to perform some physical activity. The share of sedentary people is 39.0%; with more sedentary women than men (F. = 43.4%, M. = 34.0%). The analysis by gender highlights very marked differen-

ces: among men 29.7% practice sport with continuity and 11.1% do so sporadically; among women, the shares fall respectively to 20.8% and 8.0%. The share of those who perform some physical activity is, however, higher among women: 27.0%, against 24.0% of men.

SPORTS PRACTICE IN HISTORY

With the consolidation of modern sport, women began their ascent, first uncertain and then increasingly more present in the sports universe. Although in the nineteenth century the first feminists did not take sport into account in their activities and reflections on behalf of women, some important developments were recorded in the last two decades of the century. Light and contained forms of exercise became more popular, such as the various declinations of Swedish gymnastics, and medicine began to consider that some controlled and moderate forms of physical exercise could have beneficial also and above all for women, even favouring their reproductive capacity. Towards the end of the nineteenth century, for example, England witnessed a real explosion not only of clinics and baths but also of gyms aimed at middle-class women where, alongside massages and diets, some forms of medical gymnastics were available (Duffin 1978). At the same time, croquet began to spread in the same environments, a physical activity that was not very demanding and deeply ceremonial and ceremonious (Jewell 1977).

In general, the forms of gymnastics that developed in the nineteenth century, both in Europe and in the United States, tended to increase the usefulness of the body, to improve its hygiene, in

an attempt to temper public morals and to forge better citizens, also to prepare the less well-off classes to take their place in the social order, as workers, soldiers and finally as mothers (Vigarello 1988; Park 1994). In Italy, between the end of the nineteenth and early twentieth centuries, there was a lot of gymnastic propaganda, but little physical activity was practiced: neither the De Sanctis reform of 1878, which made gymnastic education compulsory in schools, nor the Gentile reform of 1923, which established the National Body for Physical Education to support also the economic aspect of school gymnastics, had concrete effects (Bonetta 1990). As in males, even in the case of the history of female sport, there are marked differences between social classes. True competitive sport spread more quickly among the elite and the more privileged classes: outdoor sports such as croquet, tennis, horse riding and swimming allowed women of good standing not only to exercise, but also, and above all, to show appropriate manners and equipment together with availability of free time. The idea that refined women practice equally refined activities therefore had the effect of protecting the sporting premieres from breaking the symbolic boundaries of femininity and, at the same time, contributed to reproducing the class distinction that underlined the vulgarity of the most popular pastimes (Cahn 1994).

The spread of female sports was marked, especially at the end of the nineteenth century and still in the early decades of the twentieth century, by the biologic reductionism that paints women as physically fragile. The sports that were first practised by women, in England, the cradle of modern sport, were therefore not only those widespread among the aristocracy, but also those that did not come into direct conflict with the Victorian image of femininity: archery, for example, which despite being a competitive activity, was carried out on highly ceremonial occasions, which did not require a conspicuous amount of energy, nor particularly succinct attire. The development of sporting activities among women was, to a large extent, facilitated by the gradual change in fashion, which was in turn influenced by it, for which the shapes of women's clothes began to change. The popularity of the bicycle from the last part of the nineteenth century, for example, was a symbol of women's demands for freedom and as an opportunity to legitimise less formal, less decorative and more functional clothes. The new clothes designed for the bicycle - shorter skirts and skirt pants, the insertion of elastics and ribbons to shorten and fasten the skirts, etc. - they granted women new physical freedom and movement, symbolizing the claims of control over their bodies and their movements and their revolt against social restrictions. At the same time, in this first phase of female sport development, the clothes that gave more freedom to bodily movement had to avoid suggesting images of sexuality that were too aggressive and free: so they proposed functional and modest styles (R. Sassatelli 2003).

In the years between the two world wars, women's sport still had great drive and, among a thousand difficulties, the participation of women in the Olympic Games became more important. When Pierre de Coubertin organised the first modern Olympics, he undoubtedly had in mind a competition between men, where they could show, in front of a female audience, strength, courage and athleticism. Yet despite the opposition of de Coubertin,

women were included, with golf and tennis, already at the 1900 Paris Olympics (Guttmann 1991, Hargreaves 1994). But we had to wait until 1912, to see, among many complaints, a women's swimming event enter the Olympic arena.

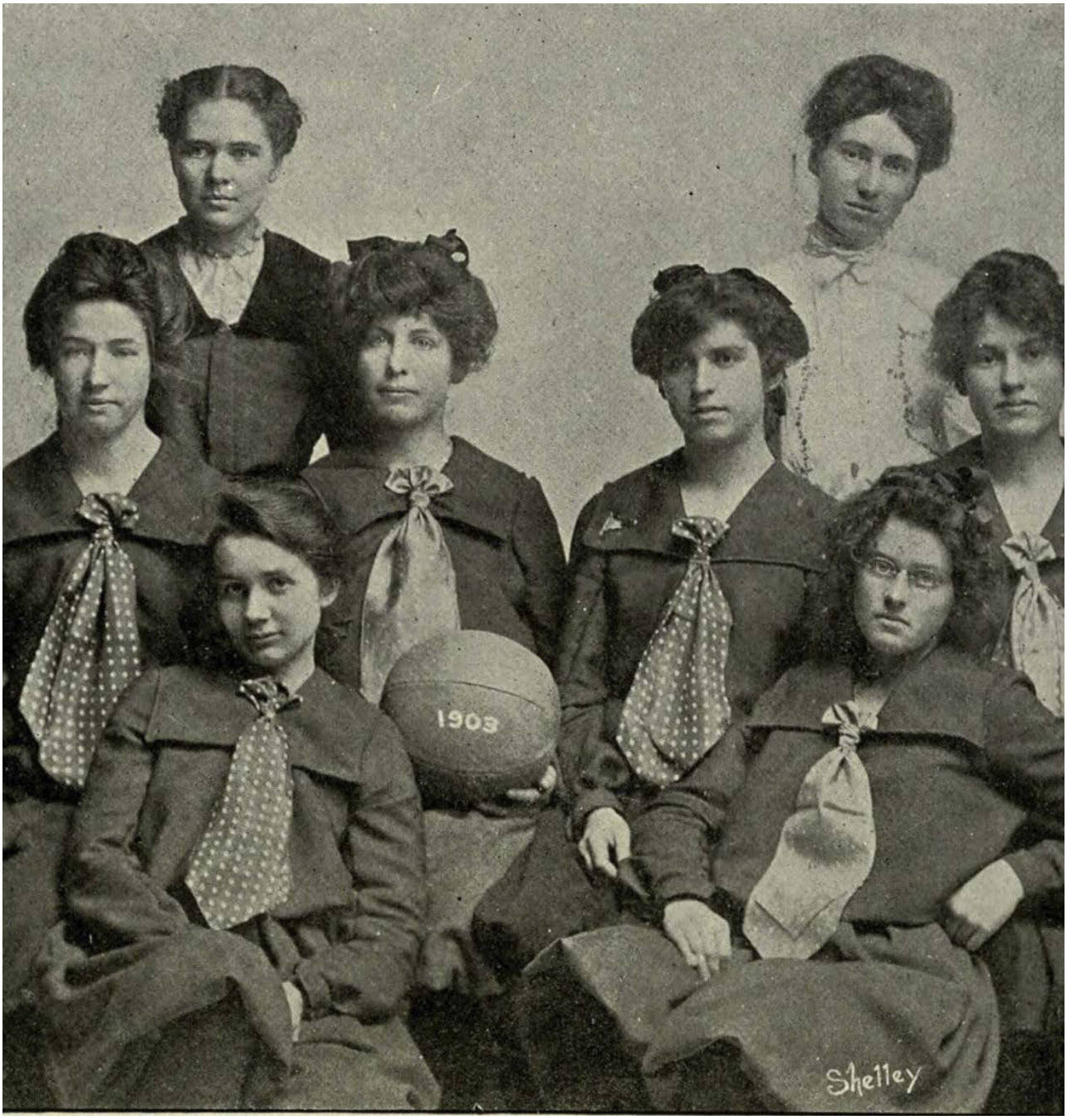
The totalitarian regimes that flourished between the two wars, fascism in Italy and Nazism in Germany in particular, also had an ambivalent attitude towards women's participation in sport. Of course, physical activity in the form of gymnastics was clearly an extra tool for the government to control the population and promote their ideologies. During fascism, for example, the National Balilla Opera was established, which established a true monopoly over gymnastic and sporting activities.

The fascist regime still remained hostile to women's athletic competitions in public, even in keeping with the severe warnings of the Catholic Church: at the 1932 Olympics in Los Angeles, because of opposition also from Pope Pius XI, the Italian national team did not include female members. The Italian women took revenge at the following Olympics in Berlin, where the only gold medal in the whole Italian delegation was won by Ondina Valla in the 80m hurdles. Creating not only a flagship of the regime but also a potential challenge to the male supremacy promoted by it, the success of Ondina Valla sparked reactions far from univocal in the fascist circles (Gori 2003).

In the fifties and sixties, there were still many opponents of women's sport, who used not only aesthetic arguments, but also the classic maternity-sport antinomy. In a short time though - also thanks to the impulse given to women's sport by some athletes, such as for example, the tennis player Billie Jean King, both with her numerous victories and with her initiatives for the development of a female sports conscience and the consolidation of international organisations for the promotion of sport among women (Festle 1996) - there was a rapid change in direction: already in the early seventies, more than a fifth of female American high school students declared that they would like to be remembered for their sporting achievements, and in the same period several studies showed that, not only among boys but also among girls, physical activity and sports fostered popularity and social success (Guttmann 1991). Today many studies confirm that women who perform physical activity, even non-competitive, tend to have greater self-esteem and to look at their bodies with increased satisfaction (Grogan 1999).

From the seventies, the physical appearance of top female athletes in international sport, especially in athletics, began to be considered in positive terms. In addition, the spread of non-competitive physical activities such as aerobics - which, by combining pop music and increasingly energetic movements, revolutionised former healthy female gymnastics and gave it a more playful as opposed to cosmetic slant - began to change the ideal

of the female body: firm muscles and well-defined contours were an increasing sign of beauty, as well as physical shape (Sassatelli, 2000). An event of great symbolic impact occured in 1967 - the participation of Katherine Switzer at the Boston Marathon: until then, women had been excluded from this competition, considered an over-strenuous activity. However, the case of the marathon aptly illustrates the



fact that, when women can regularly engage in sports, they soon reach surprising results.

WOMAN AND SPORT TODAY

After this brief historical exursus on the relationship between women and sport, today, in general, women mainly participate in non-competitive sports, involving , where possible, other family members and they tend to show lesser interest in contact sports. However, there is a certain tendency towards the spread of sports activities that can equally involve both men and women, confusing traditionally male characteristics with more typically feminine characteristics. This is particularly visible in recreational and health sports, from jogging to various forms of fitness in the gym that tend to increasingly mix the two genders, as well as competition, recreational and aesthetic purposes (Sassatelli 2000).

The history of women's sport is characterised by a progressive acceptance of the female athlete, especially where she devotes herself to some specific activities judged compatible with her gender and therefore with the notions of dominant femininity (Sport, men and the gender order. Critical feminist perspective 1990; Hargreaves 1994).

Many of these analyses conducted on the social construction of gender suggest that men and women find themselves undergoing strong social pressure forcing them to maintain an appearance consistent with hegemonic and dominant concepts. Men must therefore appear muscular, strong, cold, emotionless, competitive, rigidly geared towards victory at any cost, etc., while women must appear disinterested in competition and counterbalance sports participation by emphasising their femininity (thus the need to dress in bright colours, wear their hair long, have very long fake nails, etc.).

In this regard, research by D. Eder and S. Parker (1987) shows how these gender differences take place especially during adolescence: by studying the sports activities of young Americans attending high school it is noted that, where for boys dominant positions and most social success derive from athletic performances, for the girls get more satisfaction from supporting or cheerleading the male teams, paying great attention to appearance and aesthetics.

The media heavily contributes to this perpetuation of gender stereotypes in sport. Sports newspapers and sports television programmes have long been packaged for a male target, tending to be saturated with traditionalist notions about what is appropriately masculine and feminine. Therefore, when commenting on a sporting event, the physical aspect of the female athlete was given more importance than her performance. Studying, for example, La Stampa and Tuttosport between 1968 and 1978, A. Salvini (1982) found that although there was a significant change in the image of the sportswoman, the athletes were never looked at regardless of their sex, their sentimental affairs, from their role as wives and mothers: their athletic performance was not, as was the case for male athletes, the only element to be evaluated and judged. Still in the eighties, taking into consideration the articles published in Bild, the most widespread German newspaper, M.L. Klein and G. Pfister (1985) showed that not only over 95% of sports coverage was dedicated to men's sports, football in particular, but that in reference to women athletes they were preferentially mentioned with age and appearance. The photographic images of the athletes showed her smiling and sexually attractive, often emphasising conventionally feminine attributes such as long hair, whereas men were depicted during moments of fatigue or extreme athletic gestures that emphasised their muscles. More recently, especially on major international occasions, women's sport has undoubtedly attracted greater media attention: as early as 1984, during the Los Angeles Olympics, where compared to 168 men's events there were only 73 female and 15 mixed, the The New York Times devoted approximately 40% of the space reserved for sport to the events and victories of female athletes (Guttmann 1991, Hargreaves 1994).

In the construction of genre through sport, the different relationship between men and women that culturally entertain with competitiveness, aggression and violence (Masculinities, gender relations and sport 2000), plays an important role. We have seen how competitiveness, a fundamental attitude in modern society that rewards personal merit and the pursuit of success but is not immune to negative values, such as the production of inequality, exclusion and narcism, is traditionally reserved for men and discouraged among women who, instead, should limit and counterbalance the negative effects of male competition. Women have thus found themselves specularly freed and excluded from the obligation of competition, at least in some spheres of life, including work and sport. Numerous psychology research shows that motivations for success are generally inhibited in women by factors such as the fear of success, conflict

between expectations related to the female role and personal fulfilment, the lack of willingness to face risks, and the lack of esteem; in general, the lack of social incentives. In short, girl are more interested in being accepted, in achieving aesthetically pleasing conditions and in finding their own style, than competing, and therefore have a different vision of performance (Salvini 1982).

Woman, who approached sport as a potential liberating opportunity, compared to the other constraints of pre-established female identity, has ended up by conforming herself to a new system of prescriptions that indicate her way of being and acting. The identity of the sportswoman risks to become a reflected entity, which reflects the attributions of value, the judgments, in other words, the processes of signification, of a totally pervasive and authoritarian context.
In women, for example, there can be many problems and tension related to the conflicts that may arise between their needs, projects, awareness and stereotypes, social roles and expectations. This kind of friction can generate competition and opposition between images of oneself: discomfort which can lead to a drive to change and awareness, rather than the emergence of actual limiting psychological dysfunctionalities.

Therefore, the great swimming champion, or athletic champion, or the "warrior nuns" of boxing, can preserve themselves from the other reality, that of ordinary women, fictitiously resorting to the support of an identity whose referents are outside themselves, in the protective microcosm of sports officials. Also in this case, being a woman obliges her to match her identity with what the important people in her life consider as such. Her husband, her mother, her boyfriend and her friends will be replaced by her coach, the sports journalist, the federal executive, who, unlike the others, will send the athlete a self-image, based only on results, on performance in training, on success.
It is basically what R.W. Connell (2005, pp. 76-78) defines as "hegemonic masculinity", a model that ratifies the subordination of women as a fact, allowing their institutionalisation. An average difference, which concerns the biological dimension - of weight, strength, resistance - is ideally transformed into a universal difference that establishes irrevocable social categories: man is stronger than woman. A concept that does not take into account the enormous variability of these characteristics within each genre, and instead puts a strong emphasis on some bodily differences, omitting the broad spectrum of similarities, even physical, between males and females (Connell, 1987 , pp. 76-82).
We are faced with a paradox: the woman who in sport has found the most fertile ground for

self-assertion, to escape male hegemony, the stereotype of fragile woman, the prejudice that "certain things can only be done by males" risks to remain trapped in the consideration that man has of her as an athlete, sometimes distorted by her femininity, seen as a performance machine, forcibly deprived of its emotional fragility.

In a research ("Effects of the Big Five personality dimensions on appraisal coping and coping effectiveness in sport".) European Journal of Sport Science, January 2012; 12 (1): 62-72) involving 482 athletes (305 males, 177 females) it was found that: high neuroticism is associated with an increase in levels of stress intensity and low level of perceived control, less use of strategies focused on the problem and greater use of those focused on emotions, suppression of competing activities, increased effort. Athletes with high neuroticism seem to use ineffective coping strategies with more difficult results (Vollrath & Togersen, 2000).

In a review (published online: 11 Mar 2013) it was stated that in non-sporting samples it was found that women tend to have high levels of neuroticism, extroversion, pleasantness and conscientiousness (Costa, Terracciano and McCrae 2001; Feingold 1994; Realo, Voracek and Allik 2008). In women athletes it is possible to observe personality characteristics closer to those of men than to women who are not athletes (Fleming 1934; Williams 1980).

Women have higher levels of neuroticism, are more agreeable and conscientiousness (Allen et al 2011).

This has been explained by the authors as the possibility for those who practice a sport to be more involved in relationships with others, to be more open to collaboration and exchanges, inducing the development of desirable personality characteristics such as extroversion and pleasantness.

This in some way supports the idea that the woman/athlete through sport, intended as a means of liberation from the fragile and discriminated female condition, a sort of privileged way of emancipation, has assumed personality characteristics close to those of men, above all if we talk about competitive sport. , in which the goal "victory", in increasingly frequent cases, has pushed the athletes to behaviours that are illicit and harmful to health, such as the use of doping that requires the intake of male hormones, such as testosterone.

But the search for emancipation through sport, the search for social redemption of that weak and fragile figure for years subjected to the hegemony of male power, in some cases, not only produced an homologation to the male dominant model of some psychological characteristics, but also a physical one; it is enough to look at the body of a bodybuilder, tending to be androgynous, who has abdicated female sexual characteristics to make room for the male ones. The CrossFit craze is another recent testimony of this bodily transformation that derails towards a masculine model, powerful and resistant, a model that can deprive itself of the "useless female breast" to give way to a powerful and clearly visible abdominal muscle. This transformation also involves other sports, especially contact sports, and in particular competitive sports subject to weight categories, in which the muscles must replace the ineffective "female fat", to reach very low levels of BMI whose first effect is the arrest of the menstrual cycle. More generally, competitive sport, aiming for performance and suc-

cess, imposes a lifestyle on the female athlete that inevitably leads the female body, biologically predisposed to give life, to the male body, biologically predisposed to hunting and fighting.

In recreational sports, aimed at well-being and fitness, women here strive to improve and develop female body characteristics; the goal is not a medal on a podium, but the achievement of a harmonious, seductive female body, a body that they can "show" with pride and confidence to men and also to other women. Even in this case, there could be psychological traps that push the woman in search of a "perfection" fuelled deeply by a narcissistic fixation, a spasmodic search for an ideal of unreal beauty that cannot be satisfied in any model capable of filling the void or the shortcomings, if not through "delirium" (F. Riccardo 2012).

For the most part of history, sport has been considered synonymous with power, a sanctuary of excellence. To access this, women had to give up something - femininity, or gain masculinity (Adriana Lombardi, 2013).

We can resume the concept deriving from the psychoanalysis of the Diana complex: with this definition we define the tendency to flaunt masculinity. Diana was a Roman goddess who personified the rider, the warrior woman. She was a virgin, opposed to marriage, preferring to go hunting. Psychoanalysis sees in her the symbol of the narcissistic woman who turns her desires into aggression. Sigmund Freud had in his studies catalogued such behaviour as the unconscious desire of "penis envy" or "desire of the penis", in both cases one wants to be able to exercise life choices and prerogatives typical of the male condition, which are symbols of strength and domination. In the complex of Diana or Artemis, there is the fact that the woman assumes certain behaviours and attitudes typical of the male so as to invoke or claim a role that has been precluded since birth. Behind the desire of the penis there is not the desire of the male body, but that of the social role, a condition that has always been excluded from the female. In this sense, competitiveness is synonymous with phallic power, "normal" for males, envied and coveted by females, in sport as well as in other contexts of life, where the "climb to power" dictates the rules that are likely to envelop the woman in those signs and in those prescriptions from which she will be increasingly forced to depend, having renounced any other identity.

Unfortunately, today women suffer from the Diana compley when, for reasons related to a career or a role, they are forced to evaluate the choice to postpone the possibility of being a mother, as the two lifestyles as not easily reconcilable. Until there is real equality between women and men, there will be a desire to have male power and the choices that are reserved for him.

Emancipation through sport could be seen as a neurotic attempt at male compensation. The stereotype, or prejudice, in sport acts in two ways: leads to compliance, so the woman, to be fully "normal", can not be or aspire to fill roles for which you need skills that does not have. Or it leads to deviance, the active, enterprising, muscular, decisive and autonomous woman is no longer desirable, as she is too close to man and is considered "abnormal" (Adriana Lombardi, 2013).

IN CONCLUSION

The woman of the 1800s approached the sports world exclusively as a recreational activity through which she sought physical wellbeing while maintaining her

female characteristics, without posing the dilemma of gender discrimination. The socio-cultural changes then accelerated, shifting the attention of the woman to the competitive sports world, reaching the participation in the Olympic Games of '68 in Mexico City (XIX Olympics) in which the Mexican Norma Enriqueta Basilio was the first woman to light the Olympic flame. The 2012 London Olympics saw for the first time women admitted to all previously totally male-dominated sports, with the addition of female boxing. Paradoxically, there are two female disciplines not present in the male version: rhythmic gymnastics and synchronized swimming.

Sport, however, is not only competitive; indeed, as evidenced by the statistics, the majority of women practice amateur sports, to a greater extent than males, aimed not at competition, but at feeling well and fit, further enhancing their femininity without the fear of falling into the feminist prejudice of being man's "object of desire".

Feminist and post-feminist culture have left us with the idea that the reduction of the woman to an object is a sinister macho manoeuvre, born in the sick brain of stupid and immature people, as spiritually evolved as cavemen. Naturally, it was nonsense. Female objectification has always been indicative of an arrogant and fundamentally insecure mentality on the part of certain males (the normal male does not feel a similar need at all, but rather seeks an equal relationship with the woman), long before the feminists woke up one morning, to proclaim from the roofs the discovery of hot water; nevertheless, the true absurdity of that operation did not reside so much in the things that were proclaimed, but in the perspective from which one started. The majority of women are not indignant at being relegated to the role of pleasure objects available to man or, at least, to his erotic imagery; indeed, we openly support that many women fully recognise themselves in this role, they desire it and feel deeply satisfied with it. Not only that: they despise in their hearts men who do not relate to them according to a scheme of that kind, and are deeply disappointed, not to say wounded and humiliated. So, this is the fact: in the female nature there is a need to perform, to be admired, to focus on the attention of others, not for one's inner gifts, but for one's physical attributes; to arouse the erotic desire of the male and the impotent envy of other women, or potential rivals, mothers, daughters and sisters in the front row, and then all the others. (F. Lamendola, "Reflections without hypocrisy about the "woman-object", Arianna Editrice, 04/11/2011).

On the other hand, the contemporary trend seems to be moving towards a "feminisation" of man: aesthetic care, attention to the physical form, to a healthy diet, interest in "feminine" sports, are all pushing man to "strut" around in the great hedonistic arena.

I believe we must always keep in mind the motivations that drive women to play sports, be it competitive, amateur or just for fun, and the goals that they try to achieve by practising it - success, victory, or general well-being.

Sport, above all, is also fun, or it should be, and everyone is free to choose the direction most suited to their expectations, to satisfy the needs underlying their choices and without necessarily labelling this choice as normal or neurotic, with its sublimating meanings.

It is on the level of competitiveness, in sport as in other professional fields, that we continue to argue about whether there is still discrimination between men and women. In this controversy, woman loses out once again because opposing to the female model which historically, culturally and socially has been supported despite the passing of time, she risks becoming trapped in a male delirium of muscular omnipotence: in counteracting the stereotypes she risks becoming like the dominant male, thus losing the possibility of experimenting and developing her own identity, without falling into a world that is a projection of the male imagination.

PERHAPS WE SHOULD ASK OURSELVES SOME QUESTIONS:

Why do humans, be they male or female, need the approval of others to be happy? Why do they need a stage on which to perform, often behind a mask? Why do they crave success, power?

Why do they need to compete in an event where there is a winner and a loser? Is this the way to achieve the right balance both with themselves and with others, and so live peacefully, or there are other ways?

A child comes into the world with great vital energy and finds in her "good-enough" mother (D. Winnicott, 1974) first, and then in the surrounding environment, the space to grow and develop her personality. This space expands as she grows, offering new models of reference and sport is an exceptional space, if consistent with the principles of fair play. Males and females can happily coexist because sports programmes, and competitions, are differentiated based on gender difference, without creating any conflict with regard to performance and therefore without the concept of inequality disturbing a natural balance, simply based on biological difference of the sexes. In this sense, sport does not have to be gender homologation, rather it must preserve its differentiation to guarantee both females and males the full expression of their identity, without giving birth to the need to oppose on a terrain that, in the end, threatens to make everyone lose.

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THE MENSTRUAL CYCLE AND STRENGTH TRAINING

BY ANTONIO URSO


12.5
KG

INTRODUCTION

Women are clearly well acquainted with the menstrual cycle, and the age at which they make this acquaintance is getting increasingly lower (even if, in some cases, menstruation is actually absent).

Nowadays, the menstrual cycle arrives much earlier than in the past, and specialists consider this fosters a greater predisposition to develop pathologies affecting the reproductive organs.

Many studies have shown a progressive lowering of the age of the menarche, (it normally tends to appear between 10 and 15 years); in some cases, hair appears under the armpits and on the pubis and there is an enlargement of the breasts even before 8 years. In these cases, it may be necessary to resort to pharmacological treatment in order to halt such a precocious developmental process (early menarche).

On the contrary, there is also talk of delayed menarche, arriving between 16 and 18 years. In this case, the following factors are called into question:

- a genetic predisposition;
- practicing intense, competitive sport;
- unbalanced diet;
- a pathological diagnosis (a rare scenario).

More generally, the date of the first menstruation or period, may be related to a genetic predisposition (how old a mother and grandmother was when they got their first period), to excess fat tissue, capable of producing high quantities of leptin, implicated in the maturation of sexual character; lastly, an early menarche can be brought on by obesity, which in this day and age represents one of the most widespread evils, especially among young people.

As far as the sporting aspect is concerned, in particular, with the increase of resistance, alterations of the menstrual cycle of athletes, in particular amenorrhea, increase simultaneously. These aspects can be related to the following factors:

- lower performance capacity of the athlete in endurance activities;
- the anatomical and physiological characteristics of the athlete;
- individual's body composition
- lower oxygen transport capacity.

Changes in the menstrual cycle are closely related to resistance workloads. It is known that over 60% of top athletes in endurance sports have serious alterations to their menstrual cycle. This fact is due, at least in part, to fat reduction. The correlation between **fat percentage reduction and changes in the menstrual cycle** is confirmed by the comparison between different endurance sports: swimmers, in comparison to track & field athletes, report less changes in the menstrual cycle are less frequent, as in the former the percentage of fat amounts on average from 20 to 25%. These aspects are generally reversible, when situations change. The changes in the cycle determined by the physical load are reversible. A high volume of resistance training, typical of elite sport, produces a decrease in the endogenous estrogen rate which, in the long run, increases the risk of **developing osteoporosis**.

The alterations of the menstrual cycle that occur in the presence of a reduction in the percentage of fat must essentially be attributed to an insufficient supply of energy.

THE FEMALE ATHLETE TRIAD

The simultaneous onset of:

- amenorrhea,
- disordered eating,
- osteoporosis.

(cfr. Yeager, Agostini, Nattiv, Drinkwater 1993, 775; Nattiv, Agostini, Drinkwater, Yeager 1994, 405; Lebrun 2000, 772; Nattiv, Louks, Manor 2007, 1867).

The narrow arrows provide an indication of the current position of the athletes regarding the spectrum of the three components of the triad (modified according to Nattiv, Loucks, Manor 2007, 1868).

The condition of an athlete can be developed differently in all three sectors, depending on the relative dieting behaviour, the volume or intensity of training. Energy availability is defined by energy contribution minus energy expenditure due to training.

The availability of energy through the metabolically active hormones affects bone density directly, while it does so indirectly through menstrual function (by means of estrogen).

If the availability of energy is too low, then some physiological mechanisms contribute less to the supply of energy available for cell preservation, thermoregulation, growth and reproduction. These mechanisms allow survival, but the state of health still worsens (see Wade, Schneider, Li 1996, E1, Nattiv, Loucks, Manore et al., 2007, 1868).

PHYSIOLOGICAL ASPECTS OF THE MENSTRUAL CYCLE: THE PHASES

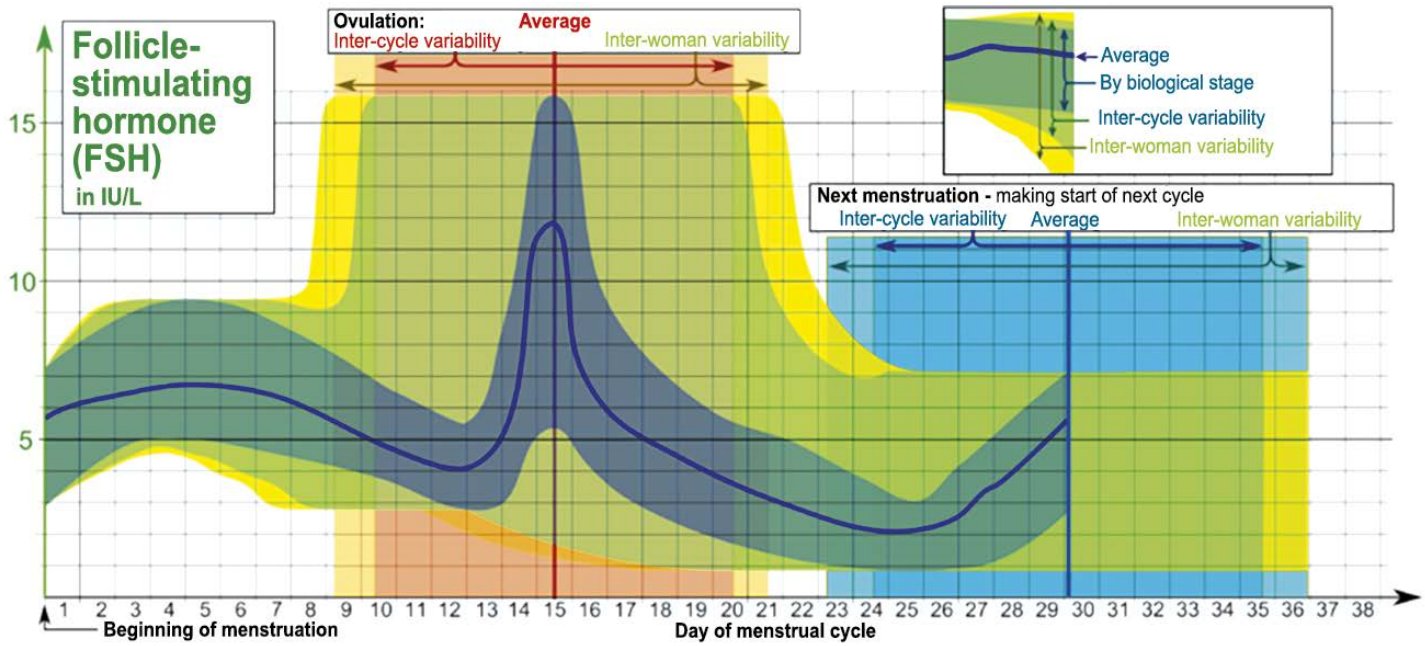
Phase 1: *Follicular phase* - this begins with the first day of bleeding and lasts from 10 to 16 days. In this phase the maturation of the ovarian follicles and their hormone production in the ovaries are stimulated with the help of the FSH, produced by the hypophysis. The FSH also regulates the development of the endometrium and there is pulsative release at about 2 hourly intervals, resulting in consequent pulsations of LH and FSH.

Phase 2: *Ovulation* - this is caused by a peak of luteinizing hormone LH and FSH, with the transformation of the follicle into the corpus luteum. The increase in estrogen in the blood and other hormones produced by granulosa cells stimulates the production of LH. When estrogen levels reach a threshold value, the production of FSH (negative feed-back) is inhibited by acting on two fronts (block of the GnRH factor and blocking of production by the pituitary.

Phase 3: *luteal phase* or also phase of the *corpus luteum*; lasts from 10 to 15 days under the influence of progesterone. In this phase, the degeneration of the uterine mucosa occurs. If the ovule is not fertilised, the production of estrogen and progesterone suddenly drops and the period begins.

Other hormones are particularly implicated for different functions during the menstrual cycle: among these, estradiol (17-beta-estradiol or E2). This is the female hormone par excellence and the main estrogen hormone, a group of substances that also includes estrone (E1) and estriol (E3). The synthesis of estradiol occurs mostly in the ovary by the follicle granulosa cells and also later by the post ovulatory corpus luteum. The main stimulus to the synthesis and secretion of estradiol is the FSH with which the E2 determines a positive feed-back at low doses and a negative one at high doses.

Progesterone, on the other hand, is a steroid hormone that is the precursor of both cortisol and aldosterone and other sex hormones; it is in fact the crossroads of the metabolic pathways that, starting from a molecule originating from cholesterol, reach the synthesis of corticosurrenal, testicular and ovarian steroids. Progesterone has its own endocrine activity as it is produced by the ovary, it is a hormone that is synthesised by all endocrine glands producing steroids, but is only secreted by the corpus luteum. During the ovulatory cycle, the follicle produces mainly estradiol under the influence of FSH, but after the LH peak and the consequent ovulation, luteinisation of the follicle takes place, also called the corpus luteum, which produces mainly progesterone.



WHAT ARE AMENORRHEA AND DYSMENORRHEA?

The term *amenorrhea* defines the absence of the menstrual cycle. Amenorrhea is divided into:

Primary: if at 16 years of age a girl has never had a menstrual cycle; and *Secondary*: when the menstrual cycle, previously present in a more or less regular way, is interrupted.

Dysmenorrhea, on the other hand, is the medical term used to indicate the pain associated with the menstrual cycle. Especially at risk are girls under 20, those who have had the first cycle before 11 years, women with heavy periods or irregular flows, those who have never had children or whose mothers suffer, or suffered, from dysmenorrhea and, in general, smokers.

Fortunately, there are few athletes dedicated to strength training who suffer from amenorrhea in particular.

According to Doldo, Delmonico, Bailey et al. 2006, 415-416, women are inferior to men in all expressions of strength. The greatest disadvantage is shown in maximal strength, while the lesser occurs in sprint strength. For Hollmann, Hettinger, Strüder 2000, 175, if body weight is taken into account, the difference in static maximum strength between men and women is reduced by about 20% on average. So what should women do during the menstrual cycle? We will try to provide some general indications.

IMPORTANT ASPECTS TO BEAR IN MIND

For many women the menstrual cycle is something very intimate and private. Coaches must establish a particularly confidential relationship to exchange information in this regard, bearing in mind the implications that the management of this particular type of situations may involve. Continuous feedback is needed, both during the days of the cycle and during the other days, in particular during the ovulation period. Even a few months before the start of training, the cycle should be noted

In order to take full advantage of the effects of training based on the menstrual cycle, the hormonal system must be mature and in the ovulatory phase.

What has been reported so far is obviously null and void if the athlete uses contraceptives. It is not necessary to follow any cycle as regards strength training.

N° 12 / January-April 2019

MENSTRUAL PHASE

The first day of bleeding is considered a difficult day for many women. Cycle pains can affect performance. The ligamentous system is made more vulnerable by the effects of Rilaxina. We recommend starting with a stabilising unit at a reduced load or at rest if the pain is particularly evident and then continue as follows.

DAYS				
1	2	3	4	5
Stabilization or Rest	Strength+	Strength+	Strength++	Strength++

POST-MENSTRUAL PHASE

Generally from the sixth day of the cycle there is a phase characterised by a higher return. The volume and intensity of training can be significantly increased compared to the hormonal phase.

DAYS						
6	7	8	9	10	11	12
Strength++	Strength+++	Strength+++	Strength+++	Strength+++	Strength+++	Strength+++

OVULATORY PHASE

During the three days of the ovulatory phase, hormonal oscillations appear with particularly individual characteristics. Basal temperature increases from 0.3 to 0.5°C, remaining so until the beginning of the next menstruation. The ovulation period is a major stress for the body. It is necessary to reduce volume and intensity. It is advisable to make this event coincide with a period of cool down.

DAYS		
13	14	15
Light training	Light training	Light training

PRE-MENSTRUAL PHASE

The next nine days of the post-ovulatory phase constitute a period characterised by high performance and specific exercises.

DAYS			
16	17	18	19
Strength++++	Strength++++	Strength++++	Strength++++

PRE-MENSTRUAL PHASE

The next nine days of the post-ovulatory phase constitute a period characterised by high performance and specific exercises.

DAYS								
20	21	22	23	24	25	26	27	28
Strength++++	Strength++++	Strength++++	Strength++++	Strength++++	Strength++++	Strength++++	Strength++	Strength++

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EDITORIAL GUIDELINES

EDITORIAL GUIDELINES FOR AUTHORS OF ORIGINAL RESEARCH WORK TO BE PUBLISHED STRENGTH & CONDITIONING. THE SCIENCE OF HUMAN MOVEMENT (S&C).

EWF Scientific Magazine (hereafter *SM*) is a scientific journal published by the European Weightlifting Federation (EWF). *SM* publishes surveys and research reports, systematic reviews, reviews, collections of studies, research notes and technical and methodological reports - both original and those drawn from the most Authorized international scientific literature available (with particular but not exclusive reference to the three magazines of the Strength and Conditioning Association of the United States of America: *the Journal of Strength and Conditioning Research*, *Strength and Conditioning Journal* and *NSCA's performance training journal*), which contribute to promoting knowledge on physical training as a whole and on strength training in sport and physical activity in particular. All original typescripts, accepted for publication, must present either concrete and practical applications for the professional who works in the strength training sector, or provide the basis for further applied research in the specific field. The original typescripts are subjected to "double blind" *peer-reviews* by at least two reviewers who are experts in that particular field. Editorial decisions are taken based on the quality of the work presented, the clarity, the style and the importance of the presentation regarding the aims and objectives of *SM*. Suggestions for the drafting of a paper to be published on *SM* can be found at *http://www.nsca-li- ft.org/publications/JSCRtips.shtml*. Authors are invited to carefully read this interesting document, which is very useful for the preparation of any manuscript to be published.

EDITORIAL MISSION STATEMENT

The editorial mission of *EWF Scientific Magazine* (*SM*) is to work to advance knowledge of the movement and training of mankind, on the assumption that the first is always, and in any case, the expression of muscle strength and that the second constitutes a lifestyle and ethics entrusted to skilfully and thoroughly trained professionals with vast knowledge of the facts, as well as specific competence. Since its first appearance, *SM* has had the ambitious goal of bridging the gaps and misunderstandings between the scientific laboratory and those working in the field, enhancing both the practical experience of the coaches and the results of research, especially applied research. For this reason, it makes - as an editorial rule - constant reference to the practice and the inclusion of recommendations for the implementation of research results in the practice of movement and sport.

The process of improving the overall psychophysical condition through the implementation of appropriate exercise programmes covers a wide range of people: from children to senior citizens, through all ages, from novices to professional athletes, at all possible levels. For the professional it is important to have an in-depth knowledge of the process of training and to realise how it can be supported by other practices and other areas of knowledge, such as nutrition, rehabilitation and re-education, psychology, technology, special exercise techniques and biomechanics.

Original research

SM publishes studies and research covering both the effects of exercise programmes on performance and on the human body as well as the underlying biological basis. It includes research stemming from the many disciplines whose aim is to increase knowledge about movement in general and sport in particular, their demands, their profiles, workout and exercise, such as biomechanics, exercise physiology, motor learning, nutrition, psychology, rehabilitation and re-education.

One of the primary goals of *SM* is to provide a scientific basis for qualified and updated programmes of physical training and sports training.

Type of articles and their total length

Due to space limitations, *SM* normally publishes articles no longer than ± pages, including bibliography, figures and images (approximately 4 pages of text with line spacing 1 is equivalent to 14,000 characters, including spaces, + 1 page of bibliography + one page of images and figures and graphs). Works of greater length can naturally be accepted for publication, but may be divided into parts or, with particular reference to the bibliography may be suitably posted on the website www.calzetti-mariucci.it .

SM publishes studies and collections of studies and research, systematic reviews, reviews, methodological reports, technical reports and research notes that are associated with and related to the mission of the magazine. A collection of studies is a group of articles by different Authors that address an issue from various perspectives. The reviews should provide a brief critical review of the literature and integrate the results of previous research to inform the reader about the basic aspects and applications of the subject. As noted above, *SM* is mainly concerned with the practical aspects of the literature reviewed and published.

Furthermore, the Author or Authors of the texts submitted for publication must have experience and knowledge in the given area enabling them to declare themselves experts in the field and to ensure credibility to their findings and their recommendations. *SM* strongly recommends the presentation of material that illustrate methodologies to advance the studies on muscle strength and overall training of the same.

GUIDELINES FOR THE PRESENTATION OF ORIGINAL RESEARCH WORK TO BE PUBLISHED

1. A portion of the texts published by *SM*, as a specific editorial choice, are versions in Italian of highly accredited work already published elsewhere, carefully selected among the many papers available in literature. It is also an editorial policy to include research from young up and coming Authors or those in training. Articles may be submitted by e-mail, in the form of files in Microsoft Word format (.doc), to *dir@calzetti-mariucci.it*, following the instructions below. Authors are required to attach the declaration of assignment of copyright for paper and digital publication, which may be downloaded from www.calzetti-mariucci.it.

2. The assignment of copyright is granted free of charge.

3. Articles will be evaluated for publication, provided they have been submitted exclusively to *SM* and, therefore, have not already been published and will not be published elsewhere in whole or in part. Manuscripts containing data that have already been published on the Internet, available for public inspection, cannot - as a rule - be considered for publication.

4. As required by law, articles will be printed in compliance with the original version and with the name of the Author. Any matters not expressly provided for in these editorial notes and by the act of transfer of copyright attached to the article, shall be subject to the laws and customs regulations in force. All disputes arising between the parties regarding the interpretation and application of these editorial notes and/or the act of transfer of copyright, shall be resolved exclusively by the competent Court of Perugia.

5. The material submitted for publication must be accompanied by a brief resume of the Author or Authors.

6. *SM* adopts standards for the protection of living beings, with regard to testing on animals and humans. In this regard, the Authors of the work submitted for publication must have received appropriate approval from their institutional control bodies or if necessary, must demonstrate to have obtained the appropriate consent under the applicable laws. All submissions must include a statement to that effect, in the Methods section of the document presented. Failure to do so will result in the paper not being considered for publication.

7. All texts should be double-spaced, and an extra space between paragraphs. The paper must include margins of at least 2.5 cm and include the page numbers in the upper right corner beside the current title. Authors should use terminology that is based on the International System of Units (SI).

8. The Authors of the texts are invited to use non-sexist language and to show that they are sensitive to the appropriate semantic description of people with chronic illness and disability (as pointed out - for example - in an editorial of Medicine & Science in Sports & Exercise®, 23 (11), 1991). As a general rule, only abbreviations and codified symbols should be used. If unusual abbreviations are used, they must be explained from their first appearance in the text. The names of trademarks must be written with a capital letter and their spelling is to be carefully checked. The names of chemical compounds and generic names must precede the trade name or abbreviation of a drug the first time that it is used in the text.

PREPARATION OF MANUSCRIPTS

1. Title page

The title page should include the title of the paper, the current title in short, the laboratory or laboratories where the research was conducted, the full name of the Author or Authors, the department, the institution, full postal address of the corresponding Author, phone number, fax number and email address; furthermore, a declaration of any funding received for the work carried out must be included.

Title page without the name of the Authors

A second page should be enclosed containing only the title of the paper. This page will be used to send the paper to the Reviewers for the double-blind review process.

3. Summary and Keywords

A separate sheet must contain a summary of the paper in not more than 250 words, followed by a minimum of 3 to a maximum of ± keywords, not used in the title. The summary must be structured in sentences (not titles) related to the purpose of the study, methods, results, conclusions and practical applications arising from the work presented.

4. Text

The text must be composed, as a rule, of the following sections with titles in uppercase and in the following order:

A. Introduction. This section is a careful development of the hypotheses of the study that led to the implementation of the survey. It is advisable not to use subtitles in this section and try to limit it to 4-6 paragraphs, written in a concise manner.

B. Methods. The following subtitles are required in the Methods sections in the following order: "Experimental approach to the problem," where the Author or Authors of the study show that the approach can prove the hypotheses developed in the introduction, and can offer some basic principles for the choices made regarding the independent and dependent variables used in the study; "Subjects", where the Authors insert the approval of their project by the control bodies, if any, and the appropriate informed consent obtained. All the characteristics of the subjects that are not dependent variables of the study are to be included in this section and not in the "Results"; "Procedures" includes the methods used, bearing in mind the concept of the possibility of a "replication of the study"; "Statistical Analysis", is the section that clearly states the statistical approach to the analysis of the series or of the data series. It is important to include the α level of significance (e.g., $P \leq 0.05$). Authors are requested to include in the paper the statistical power for the size and reliability of the measures used with intra-class correlation coefficient (ICC). Additional subtitles may be used, but their number must be as limited as possible.

C. Results. The results of the study are presented in this section. The most important findings must be presented in the form of tables and figures and the less important should be included in the text itself. Do not insert data that are not part of the experimental project or have been already published.

D. Discussion. In this section, the results of the study are elaborated. They must be related to the literature that currently exists; all hypotheses therefore must be covered.

It is recommended that statements such as "further research will be necessary, etc. etc... " be avoided.

Practical applications. In this section, it is essential to indicate to the coach or the sports professional how to apply and use the data contained in the article. It is a distinctive feature of *SM*, also in compliance with the editorial mission (see above), to try to bridge the gaps between the professional laboratory and the professional field.

5. Bibliography

All references must be listed in alphabetical order by last name of the first Author and numbered. References in the text must be made with numbers [e.g. (4, 9)]. All bibliographic entries listed should be cited in the paper and indicated by numbers. Please carefully check the accuracy of the bibliography, mainly to avoid - during the preparation of proofs - changes in bibliographic entries, especially regarding the numerical order in which the citations appear.

6. Acknowledgements

In this section, information may be included regarding identification of funding sources, updated contact information of the Author and acknowledgements to others involved in the execution of the experiment, if it was an experiment. In this part of the document, information must be included relating to conflicts of interest. In particular, the Authors should: 1) declare the professional relationship with other companies or producers who benefit from the findings of the study and 2) cite the specific grant funding in support of the study. Failure to disclose such information could result in the rejection of the article submitted for publication.

7. Figures

The legends of the figures should be submitted on separate pages, and each figure should appear on a separate page. Each work should be accompanied by a set of figures. Electronic photographs copied and pasted in Word and PowerPoint will not be accepted. The images must be scanned at a minimum of 300 *pixels per inch* (ppi). The Line art should be scanned at 1200 ppi. Please specify the file format of the graphs. TIFF or EPS formats will be accepted for both Macintosh and PC platforms. We also accept image files in the following native application file formats:

Adobe Photoshop (.psd)

Illustrator (.ai)

PowerPoint (.ppt)

QuarkXPress (.qxd)

If a digital camera is used to take pictures for printing, maximum resolution with less compression must be set. As digital camera manufacturers use terms and different file formats for capturing high-resolution images, please refer to the manual of the actual camera used for more information.

Layout. Ensure that all figures and tables have been mentioned in the text. Indications must be given as to their position between paragraphs, for example: Figure 1 is to be inserted at this point, or the Table 1 in the latter; etc.

8. Tables

Tables should be typed double-spaced on separate pages and include a short title. Ensure that there is adequate space within the tables and use the least possible number of layout rules of the rows. When tables are necessary, the information must not be a duplicate of data already in the text. All figures and tables must include standard deviations or standard errors.

Costs for Authors

SM does not charge the Authors with any fees for presentation or per page. It is precisely for this reason that it is assumed that once the manuscript has been accepted for publication and sent to the printers, it is in its final form.

Terminology and measurement units

Under the terms of the Scientific Committee of *SM* and in order to promote uniformity and clarity in all scientific journals, the Authors are invited to use the standard generally accepted terms in the field of sports sciences and sports. The Scientific Committee of *SM* accepts the use of the following terms and units. The units used will be those of the International System of Units (SI). Exceptions allowed: heart rate: beats per minute; blood pressure: mm Hg; gas pressure: mm Hg. The Authors may refer to the British Medical Journal (1: 1334-1336, 1978) and the Annals of Internal Medicine (106: 114-129, 1987) to properly express other units or abbreviations. When using units of measurement, please place the multiplication symbol in the middle of the line to avoid confusion with a full stop; e.g. **ml • min-1 • kg-1.**

Among the simple units and those derived most commonly used in research reports of this magazine are:

Mass: gram (g) or kilograms (kg); force: Newton (N); distance: metres (m), kilometre (km); temperature: degree Celsius (° C); energy, heat, work: joule (J) or kilojoules (kJ); power: watt (W); time: Newton per meter (N • m); Frequency: hertz (Hz); pressure: Pascal (Pa); time: second (s), minutes (min), hours (h); volume: litre (l), millilitre (ml); and the quantity of a particular substance: moles (mol), millimoles (mmol).

Conversion factors selected:

• 1 N = 0.102 kg (force);

• 1J = 1 N • m = 0.000239 kcal = 0.102 kg • m;

• 1 kj = 1000 N • m = 0.239 kcal = 102 kg • m;

• 1 W = 1 J • s-1 = 6.118 kg • m • min.

When using the nomenclature for the types of muscle fibres, please use the following terms. The types of muscle fibres can be identified using the methods of histochemical classification or by gel electrophoresis. The histochemical staining of the ATPase is used to separate the fibres in the forms of type I (slow-twitch), type IIa (fast-twitch) and type IIb (fast-twitch). The work of Smerdu et al. (AJP 267: C1723, 1994) indicates that the fibres contain the type IIb myosin heavy chain type IIx (typing fibres by gel electrophoresis). To meet the need for continuity and to reduce confusion on this point, it is recommended that the Authors use IIx to indicate what were called IIb fibres (Smerdu V, Karsch-Mizrachi I, Champion M, Leinwand L, and S. Schiaffino , Type IIx myosin heavy chain transcripts are expressed in type IIb fibers of human skeletal muscle. Am J Physiol 267 (6 Pt 1): C1723-1728, 1994).

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EL TALENTO ATLÉTICO: PRERREQUISITOS BIOLÓGICOS Y PSICOLÓGICOS
Vladimir Issurin
SM (Eng), nº 12, año V, enero-abril de 2019, págs. 38-51
El texto constituye buena parte de un capítulo de un libro del mismo autor, dedicado por completo al talento humano y a las modalidades de descubrimiento y de desarrollo de éste. En él se presentan los componentes biológicos y psicológicos del sujeto poseedor de talento para una determinada actividad deportiva. El libro de Issurin sobre el talento representa la visión actual más exhaustiva sobre toda la problemática del talento deportivo.

LA PNEI Y EL DEPORTE JUVENIL: CÓMO EL ESTRÉS ALIMENTARIO MODELA EL CUERPO DEL ATLETA.
Bruscolotti M., Barsotti N., Chiera M.
SM (Eng), nº 12, año V, enero-abril de 2019, págs. 4-11
Para aproximarse con la debida consideración a una problemática compleja y articulada como la alimentación, independientemente de que se trate de un atleta avanzado o de joven atleta, los autores introducen el concepto de la PNEI y hacen hincapié en la necesidad de tomar nota de que unas estrategias alimenticias inadecuadas, no personalizadas en función de las exigencias reales del atleta, o lo que es peor, articuladas sobre el principio del "hazlo tú mismo", pueden constituir un alto riesgo de carga alostática. Sin olvidar que este "hazlo tú mismo" no se centra generalmente en seguir una dieta, aspecto que cada atleta debería trabajar con sus preparadores técnicos, sino en el uso inconsciente de integradores ergogénicos, generalmente inútiles (aunque diversas sustancias tengan una base teórica de eficacia, la eficacia práctica y real depende del deporte y del nivel de competición), por no decir perjudiciales. Esto vale sobre todo para los jóvenes atletas que puedan sentir en especial la presión mediática y se vean empujados al consumo de sustancias no seguras, ilegales o incluso de forma equivocada (por ejemplo, el consumo exclusivo de la clara del huevo que, además de reducir la asimilación de determinadas vitaminas, puede favorecer la producción de citocinas inflamatorias como la IL-1β y laTNF-α, en lugar del huevo entero). De hecho, es en los jóvenes donde encontramos muchos efectos colaterales como cefaleas, gastralgias, problemas de sueño, hiperactividad y riesgo de traumas. Sin olvidar las posibles consecuencias conductuales como dormir poco y tener una menor percepción de la fatiga, que si bien son útiles durante una competición, resultan deletéreas en el momento en que no permiten un reposo adecuado.

LA BIOMECÁNICA DEL SARCÓMERO COMO ORIGEN DE LA FUERZA MUSCULAR. PARTE III
Donato Formicola
SM (Eng), nº 12, año V, enero-abril 2019, págs. 16-27
El citoesqueleto es la compleja matriz de proteínas filamentosas y glomerulares que compone la estructura del sarcómero. El citoesqueleto no se limita a ejercer una función estructural, sino que participa en la contracción muscular, tanto a nivel pasivo con el disfrute de sus propiedades elásticas, como activamente a través de la manifestación de su sensibilidad ante las corrientes iónicas del sarcoplasma. En este artículo se describirán las funciones que desarrollan los componentes intrínsecos del citoesqueleto para tolerar la contracción sarcomeral, y se indicarán los resultados de las últimas actualizaciones en el campo concreto de la microbiología experimental. Todos los elementos que componen el sarcómero participan en el fenómeno del acortamiento. La ausencia de uno solo de estos elementos reduce considerablemente la producción de fuerza por parte de la única unidad contráctil del músculo, tal como se ha demostrado a través de medios de simulación con sistemas bioinformáticos y con experimentos directos.Los efectos de los componentes elásticos musculares en el rendimiento deportivo son perfectamente conocidos por los expertos de metodología del entrenamiento. Sin embargo, con relación a las elevadas exigencias de resultados agonísticos planteadas por el mundo del deporte actual, los entrenadores, los preparadores deportivos, los preparadores físicos y los fisioterapeutas, deben tener en cuenta las últimas actualizaciones sobre la influencia de los componentes del citoesqueleto en la producción de fuerza con el fin de programar unos protocolos de intervención cada vez más eficaces para la mejora del rendimiento atlético y deportivo.

VARIACIONES DEL SALTO REALIZADO PARA LA COLOCACIÓN BAJO LA BARRA EN LA ARRANCADA Y EL ENVIÓN
Andrew "Bud" Charniga
SM (Eng), nº 12, año V, enero-abril de 2019, págs. 28-37
El autor expone las características de las dos variantes utilizadas actualmente por los/las atletas, del salto bajo la barra en la arrancada y el envión La primera es la llamada acción-reacción, o bien la técnica de estirar las caderas con fuerza hacia arriba y levantar los pies, que parecería ser la mejor estrategia y la más eficaz. La segunda es también un método eficaz de saltar bajo la barra. Esta variante es la más practicada por las levantadoras de pesas. Las mujeres de súper élite y élite hacen uso de las características de la biomecánica y la fisiología femenina para compensar una menor masa muscular y una menor velocidad de reclutamiento de las fibras musculares, generalmente llamado un retraso electromecánico, con una relajación muscular más rápida. El resultado puede ser una bajada muy rápida combinada con una posición de sentadilla muy baja.

LA MUJER Y EL DEPORTE
Francesco Riccardo
SM (Eng), nº 12, año V, enero-abril de 2019, págs. 52-67
El autor argumenta el tema de la progresiva presencia, con el paso del tiempo, de las mujeres en la sociedad, y por ende, en el deporte. En este último ámbito asistimos a un crecimiento del movimiento femenino en términos de practicantes y rendimiento, incluso de excelencia, aunque siguen subsistiendo considerables desigualdades en lo que respecta a su presencia en los órganos directivos y organizativos del deporte. El autor recorre los momentos del crecimiento del movimiento deportivo femenino agonístico y amateur, a lo largo de decenas de años, en especial desde el siglo XIX a nuestros días, y señala los problemas surgidos y las modalidades de superación de estos últimos. De gran interés son las referencias a la cultura feminista y postfeminista.

CICLO MENSTRUAL Y ENTRENAMIENTO DE LA FUERZA
Antonio Urso
SM (Eng), nº 12, año V, enero-abril de 2019, págs. 68-73
El autor se explaya sobre diversas temáticas relacionadas con el ciclo menstrual en las atletas, lo que suscita un evidente interés primario para el entrenador. Aborda los aspectos fisiológicos de las diversas fases del ciclo, el tema de la tríada de la atleta mujer, lo de la amenorrea y la dismenorrea, y por último, de enorme importancia en el entrenamiento, la modulación y la modificación de la carga según cada fase en particular del ciclo. Una hermosa iconografía acompaña y explica el texto.

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СПОРТИВНЫЙ ТАЛАНТ: БИОЛОГИЧЕСКИЕ И ПСИХОЛОГИЧЕСКИЕ ОСНОВЫ
Vladimir Issurin
SM (Eng), nº 12, anno V, gennaio-aprile 2019, pp . 38-51
Статья представляет собой значительную часть книги Автора, полностью посвящённую проблеме таланта и методам его поиска и развития. Автор представляет биологические и психологические составляющие субъекта обладающего талантом для занятия определённой спортивной дисциплиной. Книга Иссурина о таланте представляет собой наиболее полный современный взгляд на всю порблему спортивных талантов.

ПНЕИ (PNEI) И МОЛОДЁЖНАЯ СПОРТИВНАЯ ДЕЯТЕЛЬНОСТЬ: КАК ПИЩЕВОЙ СТРЕСС ФОРМИРУЕТ ТЕЛО СПОРТСМЕНА
Bruscolotti M., Barsotti N., Chiera M.
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Чтобы должным образом рассмотреть такую сложную и комплексную проблему как питание, как спортсменов высокого уровня так и молодых спортсменов, авторы представляют концепцию ПНЕИ (Психо – Невро – Эндокринная Иммунология) и подчеркивают, что необходимо принять к сведению, что неадекватные и не индивидуальные стратегии питания, неучитывающие реальные потребности спортсменов или, хуже того, сформулированные по принципу «сделай сам», сами по себе уже могут представлять высокий риск аллостатической нагрузки.
Не говоря уже о том, что метод «сделай сам» часто концентрируется не на диете, проблематика которую каждый спортсмен должен решать со своими тренерами, а на безрассудном использовании эргогенных добавок, часто бесполезных (хотя разные вещества имеют теоретическую основу эффективности, их реальная практическая эффективность зависит от вида спорта и уровня соревнований) если не очень вредных. Это особенно важно для молодых спортсменов, которые очень подвержены влиянию средств массовой информации и вынуждены использовать опасные и незаконные средства или же использовать средства принятые неправильно (например, потребление исключительно яичного белка, что помимо понижения усваивания определённых витаминов, может провоцировать выработку воспалительных цитокинов таких как IL-1β и TNF-α, в отличиии от цельного яйца). И именно у молодых людей наблюдается множество побочных эффектов, таких как головные боли, проблемы со сном, гастралгия, повышенная активность и повышенный риск травм. Не говоря уже о возможных изменениях в поведении, таких как недосыпание и пониженное восприятие усталости, которые хотя и полезны во время соревнований, однако очень вредны когда не позволяют реализовать адекватный отдых.

БИОМЕХАНИКА САРКОМЕРА, ОСНОВЫ ПРОИСХОЖДЕНИЯ МЫШЕЧНОЙ СИЛЫ. ТРЕТЬЯ ЧАСТЬ
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Цитоскелет представляет собой сложную матрицу нитевидных и клубочных белков, которые составляют каркас саркомера. Цитоскелет не ограничивается выполнением структурной функции, участвует так же и в мышечном сокращении как пассивно, используя упругие свойства, так и активно, будучи чуствительным к ионным потокам саркоплазмы. В данной статье анализируются функции, выполняемые внутренними компонентами цитоскелета для реализации сокращения саркомера, на основе результатов современных исследований конретной области прикладной микобиологии. Все элементы составляющие саркомер участвуют в феномене сокращения. Отсутствие только одного из этих элементов резко понижает производство силы со стороны даже одной мышечной единицы, что было подтверждено как с помощью моделирования системами биоинформатики, так и в результате прямых экспериментов. Влияние мышечно-эластичных компонентов на спортивные результаты хорошо известно специалистам по методике тренировки. Тем не менее, в связи с высокими требованиями к соревновательным результатам, выдвигаемыми современным спортом, тренеры по физической подготовке, спортивные тренеры, физиотерапевты должны учитывать последние достижения науки о том, как компоненты цитоскелета влияют на производство силы, чтобы программировать более эффективные протоколы вмешательства для улучшения производительности и спортивных результатов.

ВАРИАЦИИ ПРЫЖКА ВЫПОЛНЯЕМОГО ДЛЯ ПРИНЯТИЯ ПОЗИЦИИ ПОД ШТАНГОЙ А УПРАЖНЕНИЯХ РЫВОК И ТОЛЧЁК
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Andrew “Bud” Charniga
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Автор анализирует характеристики двух вариантов прыжка под штангой, используемых в настоящее время спортсменами и спортсменками в упражнениях рывок и толчёк. Перый вариант, так называемое «действие-реакция», то есть техника силовой тяги бёдер вверх и подъём ступней, представляет лучшую и более эффективную стратегию. Второй представляет собой тоже эффективный вариант прыжка под штангой. Выполнение этого варианта наблюдается чаще всего у женщин тяжёлоатлеток. Спорсменки высокого и элитного уровня используют функции женской биомеханики и физиологии, для того чтобы компенсировать меньщую мышечную массу и более низкую скорость рекрутирования мышечных волокон, часто определяемые как «электромеханическая задержка» и более высокую скорость расслабления мышц. В результате наблюдается более быстрое снижение в сочетании с очень низким приседанием.

ЖЕНЩИНА И СПОРТ
Francesco Riccardo
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Автор рассматривает тему постепенного прогресса роли женщин в обществе и, следовательно и в спорте. В спортивном мире наблюдается рост женского движения, с точки знения количества женщин занимающихся спортом и уровня спортивных результатов (в том числе очень высоких), хотя в области участия женщин в руководящих и организационных органах существуют ещё значительные различия по сравнению с мужчинами. Автор прослеживает моменты развития женского движения в спорте, как на профессиональном так и на любительском уровне, в течении десятилетий, особенно начиная с девятнадцатого века до наших дней, анализируя возникшие проблемы и пути их преодоления. Очень интересен анализ феминистичекой и постфеминистической культуры.

МЕСТРУАЛЬНЫЙ ЦИКЛ И ТРЕНИРОВКА СИЛЫ
Antonio Urso
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Автор останавливается на различных проблемах связанных с меструальным циклом у спортсменок, представляющих большой интерес для тренеров. Рассматривает физиологические аспекты различных фаз цикла, тему триады женщины спортсменки, аменорею и дисменорею и, наконец, проблему очень важную в тренировке – модуляцию и изменение нгрузки в зависимости от конкретной фазы цикла. Текст сопровождается и объясняется очень интересными иллюстрациями.

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