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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.

The official journal of the European Weightlifting Federation - N° 10 / May - August 2018

SUMMARY

[...] strength training in prepubertal age does not in any way constitute the "drama" that often some insiders want to present.

This type of training aimed at well-being and sporting performance is possible at any age, especially for young people, with immediate and future benefits...

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An expressed aggressiveness, especially a grimace, on the face of someone straining to lift a weight, for instance, is an enduring image; reflecting in psychological terms a masculine exclusivity of human strength.

EDITORIAL

A question I often ask myself: what is sport today?

We cannot rule out that - in times like these in which we live (and that we personally experience) - changes in society, as well as those in sport, do not occur with the same frequency as in the past.

We witness, often as unseen spectators, changes that, until a few years ago, were considered not possible or even impossible. New communication systems, social media that have become another room in our houses, generations that find it more and more difficult to talk to each other, and so great are the cultural and communication distances and the collateral that these social dynamics entail, that they have taken away the comfort of our old certainties, introducing new certainties whose shelf-life is definitely much shorter, random and sometimes gone in a heartbeat.

In all of this, this incessant magma that does not cool down, does not grow, but is constantly changing, unpredictably taking on unthinkable forms and ways of being, sport finds itself encrusted in an organisation whose obsolete dynamics are completely out of step with modern times, ferociously clinging to bureaucratic management that devotes more time to its self-indulgence than it does to sport: monstrous, engulfing bureaucracy.

Sports organisation always brings to light the usual problems, the ones that have never been solved in the past and are never addressed in the present, while asking today's society to be patient with the pace of a pachydermic machine that cannot keep up with the typically rapid progress of this day and age.

To better understand some of sport's unresolved problems, I took to the Internet, where I found an essay[1] by a boy in Middle School, dated March 15, 2011. The essay may be 7 years old, but the topic is still contemporary and still unresolved in the world of sport. Read what is says and you too will be amazed.

"*Sport* – writes the student – *is an educational opportunity because it allows you to grow both physically and psychologically, because playing sports requires attention. Sport teaches you how to play on a team so ... you learn a lot of rules and get to know your body better*". Very true statements (wouldn't you agree?), and yet there is an ongoing battle (and what a battle!) in the world of sport to drive the message home that you can actually be better at maths or Italian by doing more physical activity and organised sport.

"*Unfortunately in sport* - the students continues - *there are some people who, in order to win matches and competitions, decide to use doping and break the rules*". This is a problem that not only have we failed to solve, but it has become even more entrenched and rampant, and the few who tried to put a stop to it in the past and fought like lions on the barricades, but driven back from overwhelming adversaries both in number and in arrogance, well, they have just resigned themselves to this sad reality.

"*I do karate and I play football. In karate I have learned about my body, doing various moves, controlling myself. It has made me grow because it takes courage to perform in front of the public. This sport requires seriousness, sacrifice, willingness and commitment. In my opinion, sport has everything it takes to be an activity that should be practiced by everyone*". Not bad, don't you agree? However, sport cannot be practiced by everybody because many sports have unsustainable costs for families, so the only possibility would be good old physical activity and exercise; but alone?

Taking a step further back, read what the European Parliament deliberated in 2007, precisely in the session on 30.10.2007.[2]

"*School - it states - "is the ideal setting to promote physical activity and positive attitude towards regular physical activities. However, at present, it is often said that school is not delivering on its potentials when it comes to promoting physical activity. Physical education is at risk of increased marginalisation within the school day; over the last years the time allocated to PE across the EU has been gradually eroded: over the last years the time allocated to PE across the EU has been gradually eroded: since 2002 time allocation has been reduced from 121 to 109 minutes per week for primary school, and from 117 to 101 minutes for secondary school; research recommends that children and adolescents perform some form of physical activity for 60 minutes every day.*

There is also inadequate funding for facilities, equipment and their maintenance and teaching material in central, eastern and southern Europe; pupils with disabilities suffer even more the consequences of this lack of financial support. Inclusion: ethnic minorities have especially low rates of participation in sport activities. The problem of participation is arsing already during school time; Muslim girls are an especially sensitive group in this respect. A similar pattern of restricted access is evident among disabled young people. Young people with disability are far less likely to take part in extra-curricular or out-of-school sporting activities.".

And so, back to my initial question "what is sport today?". Now I can answer: "it is a new, full (and overflowing!) bucket of old, unsolved problems.

Antonio Urso
EWF President

1. http://scuola.repubblica.it/piemonte-cuneo-icmuzzonesede/2011/03/15/riflessioni-sullo sport/?refresh_
2. http://www.nonprofitonline.it/detail.asp?c=1&p=0&id=768

The official journal of the European Weightlifting Federation

WHY YOUNG ATHLETES MUST DO WEIGHT TRAINING

BY ANTONIO URSO


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WHY YOUNG ATHLETES MUST DO WEIGHT TRAINING

Up until some time ago, giving an article such an assertive title, stating that young athletes "must" (a strong "must", not a suggesting "can") do weight training, might have put the physical safety of some (many) insiders at risk, so much was the belief that this particular type of training came with a long list of disadvantages, and sometimes even irreparable damage. We need only think that weight training was associated with an interference to growth in height: lifting loads hindered normal growth. Thus far these problems obviously referred to the children, because it was not even conceivable that a child could train with overloads. A cultural drama that still today is heavily paying the price. Yes, unfortunately still today there are categories of professions with no competence in this field (but who are perhaps good in others) who have a strong influence on families and sports clubs, and who engage in open war in discouraging this practice (substantially weightlifting, or equipment with weights) in prepubertal age, but never present any scientific literature to back it up. Evidence proves the result of something, which can also be subsequently criticised but only through a scientific method. Who knows, I wonder, after more than four hundred years, how Galileo Galilei would feel in knowing that his scientific method, then theorised, is still often forgotten and put aside, especially by professionals who, despite their university degree, tend to disagree with this approach. Or who knows how Popper would feel, the scientist who theorised the necessity to disconfirm or falsify the scientific method, in other words: how to criticize a result through the scientific approach. Perhaps still today they would feel completely misunderstood. Despite these illustrious figures, and not only them, still today practices are critisized on the basis of nothing which, obviously when told to people (parents, teachers, doctors, etc. ..) that do not have a scientific basis with which to counteract, a "non-culture" or popular unculture is created that becomes embedded and thus difficult to irradicate, even with scientific evidence in hand.

In my view, the Olympic sport of weightlifting has paid the highest price from this random, rather than scientific approach. Physical fitness certificates were refused not for pathologies, but for the choice made by a boy or a girl, who wanted to approach the world of weightlifting (I have personally witnessed this) and they had to fight, often even with the medical sports specialist (whose medical knowledge we do not intend to discuss), who quite literally discouraged the practice, listing a series of non-existent problems arising from the use of this method of training, which subsequently discouraged families and children, sometimes on a definitive basis. A mother and a father must not necessarily be competent in a sport or physiology, but a professional who qualifies as a doctor must be, no ifs and buts, it is their duty to be informed and educated if their "work" (and mission) is to certify, to assess the eligibility, to advise and to orient. It is not uncommon to find ourselves sometimes as defenceless spectators, observing the extremists of absolute prohibition who oppose other doctors that are inviting boys and girls to approach weightlifting in pre-puberty, without any prescription except that of the methodological approach reserved for those age groups.

Negationism, unfortunately, is not only a prerogative of a part of the medical world, it is also in the sphere of experts: trainers, PE teachers and, in some cases, even teachers in motor sciences faculties. Therefore, the problem is actually right across the boards.

I remember very well how some years ago - but not many I can assure you - several team sports coaches criticized the use of weight training in every age group, because this training method slowed down, made slower. "Slows down what? Makes what slower?" I often asked myself: and the answer was always the same: "movement; the weightlifting makes you slower, it slows down movement ". I had a second question, or rather, I asked myself to explain if they did not practice weight training regardless of everything, because they were sure of their belief, or because they had had bad experiences and negative results in the approach to this method. Well: when I found those few who had had an effective approach to training with weight training, I realised that it was a lack of competence and a distorted vision, which obviously justified the poor results obtained by this form of training. Incredible!

What does science say today about the correlation of prepubertal age and training with weights? It unequivocally explains that such a combination is not impossible: indeed, today it says that it is possible and beneficial; the alliance of the two - it supports - should be compulsory.

From the 1980s, countries that had positively experienced the use of weight training had already disseminated publications about the positive correlation between the two aspects: prepubescent youths and weight training (see Russian and German schools). They had already shown the indisputable advantages that would then have been authentic pillars, on which to erect some substantial aspects of sports performance, or even just of research and maintenance of physical well-being.

One of the obstacles that weight training in young people comes up against, in my opinion, lies precisely in the term that is normally used: weight! On its own, it gives the sensation of an approach to training sessions with tons, exhausting and inappropriate for young athletes. Training with weights is actually the only means of training that can be weighed and measured: it can range from grams to infinity. It is the only form that allows to orient the speed and the angle of execution. It is the only method that allows to develop some characteristics functional to the expression of strength, using also different equipment: elastics, springs, the weight of the body with particular angles of execution and with expedients that engage different muscle districts.

Try asking trainers of other sports if they are able to measure these parameters, as easily as you do in weight training. The question, of course, would cause them some problems, because in reality almost everything could be measured, but at very high costs and with an organisation that very few clubs or federations could afford, and in any case, without absolute precision, perhaps with a high margin of approximation. Let's look at some examples: who measures the strength expressed by a young person blocking under the net in minivolley, every time he/she hits the floor after a jump? Yet, the body falls, impacting with the floor that returns an equal and opposite force that must be combined with a violent contraction of complex kinetic chains that must allow the boy/girl to remain in an optimal condition of balance. How much force has been expressed? In how much time? Always symmetrically? It is not known and can not easily be measured, yet there is no contraindication to this sport which I find to be beautiful and extremely formative, as well as spectacular.

The same is true even if we talked about mini-basketball, rugby, or soccer. Who is able on the spot to measure the strength expressed in a change of direction in football or in a rapid deceleration? Nobody can do it with the same simplicity as done in training with weights. These latter two expressions of force improperly called "natural load", never give the sensation that in between there is the term weight, therefore the exercises and movements involved are all accepted as harmless. The power of words! In reality, they could actually be harmless, if the boys and girls' muscles were appropriately trained for this type of effort. The fact that in these sports there is more harm than in weight training is evidenced by findings obtained from the study called the *High School Sports-Related Injury Surveillance Study*[1], in which high school athletes who participated in 9 different sports in the participating schools suffered 4,350 traumas during the 2005-2006 school year, which corresponds to about

1. *An Epidemiologic Comparison of High School Sports Injuries Sustained in Practice and Competition* - Julie A. Rechel*, Ellen E. Yard, MPH*, and R. Dawn Comstock, PhD*,† *The Research Institute at Nationwide Children's Hospital, Columbus, OH †The Ohio State University, Columbus, OH - http://www.natajournals.org/doi/full/10.4085/1062-6050-43.2.197?code=nata-site

1,442,533 traumas nationwide. The injury rate per 1,000 athletic exposures was higher in competition (4.63) than in training (1.69) (frequency ratio [RR] = 2.73, 95% confidence interval [CI] = 2.58, 2.90). Out of all the sports, football recorded the highest rate in competition (12.09) and in training (2.54) of injured players per 1,000 athletic exposures. Compared to the injuries reported during training, the highest percentages of competition injuries were head - face - neck injuries (proportion [PR] = 1.61, 95% CI = 1.34, 1.94), in particular in boy's football (PR = 7.74, 95% CI = 2.53, 23.65) and girl's basketball (PR = 6.03, 95% CI = 2.39, 15.22). The most common and recurrent lesions were brain concussions (PR = 2.02, 95% CI = 1.56, 2.62), especially in boy's football (PR = 6.94, 95% CI = 2.01, 23.95) and girl's basketball (PR = 5.83, 95 % CI = 2.06, 16.49). Higher percentages of competition injuries caused the athlete to lose more than 3 weeks of play (PR = 1.28, 95% CI = 1.08, 1.52), particularly in baseball (PR = 3.47, 95% CI = 1.48, 8.11) and volleyball (PR = 2.88, 95% CI = 1.01, 8.24). In the aforementioned report, the overall injury rate per 100 hours/participant was 0.8000 for rugby, 0.0120 for resistance training, and 0.0013 for weightlifting, respectively.

This picture all too clearly shows that major precautions must be put into practice in other forms of training, certainly not in weight training, but like all human activities, it requires the presence of experienced, qualified people and, in particular, with a lot of experience in the sector.

One of the most popular accusations attributed to weight training is that it damages the growth cartilages found in three main sites in the body of a growing child: the cartilaginous plates near the ends of the long bones, the cartilage that covers the articular surfaces, and the points at which the main tendons are inserted into the bones (apophysis).

Behm et al. 2008[2] conclude their original research with the following conclusion: fractures of the epiphyseal plate have not been reported in any prospective study on young people engaged in weight training. In actual fact, at a younger age, the lesions of the epiphyseal growth cartilages are less likely to occur during childhood than during adolescence, because children's growth cartilages are actually stronger and more resistant to different forces. compared to those of adolescents (Micheli 1988).[3]

Fractures of the proximal end of the humerus are relatively rare in infancy, making up 0.45% of all fractures in pediatric age, and 4-7% of all traumatic epiphyseal lesions (Sohrab Pahlavan, 2011). The incidence varies from 1.2 to 4.4 cases per 10,000 inhabitants a year. The most frequently occurring fractures are Salter-Harris type II epiphyseal detachments and metaphyseal fractures. The former occur more frequently in adolescents, while the latter are more common in children under the age of 10. The incidence is higher in males than in females, this is probably related to etiological factors; in fact, males practice play-sport contact activities, such as soccer or basketball, more frequently than females (Williams, 1981).

Traction and pressure stimuli promote better bone formation, so it is wrong to say that strength training has negative effects on bones. The idea - often formulated - that increasing the work force also increases the deterioration of bones, ligaments and joints is completely unfounded: the function retains its shape and not the other way around (Klumper, in Umbach C. Fach, 1990)[5].

After having removed this undoubtedly existing but marginal concern, it is necessary to understand the advantages of strength training through the use of weight training in prepubertal age. Since 1987 - 1990 with Sale[6 7], Blimkie 1993[8], Tenebaum 1996[9], Faigenbaum 2000[10], Falk and Eliakim 2004[11], studies have been proposed that have highlighted the positive correlation betwe-

2. Behm D. G., Faigenbaum A. D., Falk B., Klentrou P. (2008). *Canadian society for exercise physiology position paper: resistance training in children and adolescents*. Appl. Physiol. Nutr. Metab. 33, 547–561. 10.1139/H08-020 [PubMed] [Cross Ref].

3. Micheli Lj, Browne Je, Erggelet C, Fu F, Mandelbaum B, Moseley Jb, Zurakowski D. *Autologous chondrocytes implantation of the knee: Multicenter experience and minimum 3-years follow-up*. Clin J Sport Med 2001 Oct; 11 (4): 223-8.

4. Buscema A, Cosentino P, Riccioli M, Testa G, Pavone V. - *Lesioni traumatiche dell'estremità prossimale di omero in età pediatrica in Ortopedia* - Maggio 2013 Dipartimento di Specialità Medico-Chirurgiche Sezione: Ortopedia e Traumatologia Università degli Studi di Catania (*Dir. Prof. G. Sessa*)

5. Sale, D. G. (1988). *Neural adaptation to resistance training*. Medicine and Science in Sports and Exercise 20, S135-S145. [20]

6. Sale DG, MacDougall JD, Jacobs I, Barner S: *Interaction between concurrent strength and endurance traininig*. J. Appl Physiol. (1990)

7. Blimkie CJ, *Resistance training during preadolescence. Issues and controversies*. Sports Med. 1993

8. Tenenbaum G, Falk B, *The effectiveness of resistance training in children. A meta-analysis*. Sports Med. 1996

9. Faigenbaum AD, *Strength training for children and adolescents*. Clin Sports Med 2000

10. Falk B, Eliakim A, *Resistance training, skeletal muscle and growth*, Pediatric endocrinology Reviews: January 2004

en the two aspects: in other words, prepubertal age and use of weight training in general physical preparation. In addition to these researches are important contributions from the following studies carried out by qualified scientific bodies:

The British Association of Sports and Exercise, Science 2004[12] published a study with a 25-year follow-up, studying 520 boys and 605 girls on the correlation of strength training and flexibility. Also this study shows a positive correlation between the two factors, highlighting that the young people who do strength training as adults have consequently less muscle tensions.

The American College of Sport Medicine in 2006[13] produced a study on muscle strength training, presenting the following evidence: a mechanical load acting on the skeleton with the use of weights can effectively stimulate an increase in bone formation in young people, while in adults we witness a slow loss of bone matrix in middle age. Presumably this may result in a lower risk of osteoporosis, osteopenia and bone fracture. Furthermore, recent observational studies have suggested an inverse association between risk of mortality for all causes and various components of muscle strength or endurance. Although the specific mechanisms for these associations are not known, one may consider muscle strengthening to promote the development and maintenance of metabolically active lean muscle mass, which is especially important for enhancing glucose metabolism. A training session with weights at least twice a week provides a safe and effective method of improving muscle strength and endurance from 25% to 100% or more. It is advisable to perform 8 to 10 exercises, to be performed on two or more non-consecutive days, every week, using mainly the major muscles. A weight should be used capable of inducing substantial fatigue after 8-12 repetitions of each exercise. The resulting evidence on musculoskeletal health benefits (30.52) and the potential effects at the population level on the promotion of skeletal health lead to the need for a public health recommendation that includes the inclusion of weight training in physical activity for everybody, especially young people.

Lastly, the American Academy of Pediatrics[14] from 2001 to 2014 proposed a series of reviews entitled "*Strength Training by Children and Adolescents*" which triggered an extremely interesting evolutionary process of thought on the topic of training with weights at an early age. Already in the first publication, the authors had pointed out that there were no particular contraindications regarding the use of weight training in youth physical activity, and in the last review, which dates back to the year 2014, they specify the following: Strength training is a common component of sports and physical efficiency programmes for young people and teenagers. They can use strength training as a means of increasing muscle size and improving their appearance. Strength development programmes may include the use of free weights, weight machines, elastics or body weight. The amount and types of exercises to be used, and the frequency of strength exercises must be determined by specific programme objectives.

11. Mikkelsson LO, Nupponen H, Kaprio J, Kautiainen M, Mikkelsson M, Kujala UM, Adolescent flexibility, endurance *strength, and physical activity as predictors of adult tension neck, low back pain and knee injury: a 25 year follow up study*

12. William L Haskell, I-Min Lee, Russell R Pate, Kenneth E Powell, Steven N Blair, Barry A Franklin, Caroline A Macera, Gregory W Heath, Paul D Thompson, Adrian Bauman, *Physical Activity and Public Health, Updated Recommendation for Adults* - From the American College of Sports Medicine and the American Heart Association.

13. *Pediatrics - Council on Sports Medicine and Fitness 2008;* Academy of Pediatrics. All and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2008 by the American Academy of Pediatrics publication

General indications

training can include the use of free weights, the individual's body weight, machines and/or other weight devices to achieve the goal.

Core Strengthening: implement a muscle strengthening programme that stabilises the body's trunk. The training must be able to emphasise the strengthening of the abdominal, lumbar and buttock muscles, as well as the flexibility of the pelvic muscle insertions, as for quadriceps and thigh muscles. A group of reps alternating with programmed recovery periods (e.g. 3 sets of 20 reps). Finally, the authors explain how the various types of contractions can all be used, including the weightlifting method.

Numerous studies have shown that strength training, with proper technique and careful supervision, can increase strength in preadolescents[15] and adolescents[16]. Frequency, modality (type of weight), intensity and duration must all contribute to an adequately structured programme. Increases in strength are evident with all strength training modalities lasting at least eight weeks and may also occur with training only once a week, even if a minimum strength training programme must have a frequency of at least twice a week in order to be more functional[17]. Properly controlled programmes that emphasise core strengthening (focusing on the muscles of the trunk, e.g. abdominal, lumbar and buttock muscles) are also appropriate for children who, in theory, benefit from the acquisition of specific abilities for sport and postural control. Six weeks after interrupting strength training, strength tends to return to its initial condition[18].

In preadolescents, adequate training with weights can increase strength without concomitant muscle hypertrophy. Such strength increases can be attributed to a neurological mechanism whereby training increases the number of motor neurons that are "recruited" for each muscle contraction[19 20 21]. This mechanism is able to explain very well the increase in strength in populations with low concentrations of androgens, including females and pre-adolescent boys. In contrast, strength training increases the muscle growth that normally occurs with puberty in boys and muscle hypertrophy in girls.[22,23,24,25]

Appropriate strength training programmes apparently have no adverse effects on linear growth, growth cartilages or the cardiovascular system[26 27 28 29 30].

Among the guidelines for strength training, the American Academy of Pediatrics suggests: A child's medical evaluation before starting a formal strength training programme can identify risk factors for injury and offer an opportunity to discuss previous injuries, low-back pain, medical conditions, training goals, motives for wanting to begin physical training, appropriate techniques, and expectations of both the child and the parents. We need to remind young people that strength training is only part of a general fitness or sport programme. Although research supports the safety and effectiveness of strength training for children, such training is not necessary or appropriate for every child. Children, before embarking on a strength training programme, must be able to follow instructions and comply with safety regulations.

Strength increase must be gained through various types of strength training methods and equipment; most of the strength training gym equipment are machines designed for adults, with weight increments that are too big for young children. Free weights that requi-

14. Falk B e Tenenbaum G. *The effectiveness of resistance training in children: a meta-analysis*. Sports Med. 1996

15. Payne VG, Morrow JR Jr, Johnson L, Dalton SL. *Resistance training in children and youth: a meta-analysis*. Res Q Exerc Sport, 1997

16. Blimkie CJ. *Resistance training during preadolescence: issues and controversies*. Sports Med. 1993

17. Webb DR. *Strength training in children and adolescents*. Pediatr Clin North Am. 1990

18. Ramsay JA, Blimkie CJ, Smith K, Garner S, MacDougall J, Sale DG. *Strength training effects in prepubescent boys*. Med Sci Sports Exerc. 1990

19. Kraemer WJ, Fry AC, Frykman PN, Conroy B, Hoffman J. *Resistance training and youth*. Pediatr Exerc Sci. 1989

20. Guy JA, Micheli LJ. *Strength training for children and adolescents*. J Am Acad Orthop Surg. 2001

21. Blimkie CJ. *Resistance training during preadolescence: issues and controversies*. Sports Med. 1993;

22. Kraemer WJ, Fry AC, Frykman PN, Conroy B, Hoffman J. *Resistance training and youth*. Pediatr Exerc Sci. 1989

23. Fleck SJ, Kraemer WJ. *Designing Resistance Training Programs*. 3rd ed. Champaign, IL: Human Kinetics Books; 2004

24. Webb DR. *Strength training in children and adolescents*. Pediatr Clin North Am. 1990;

25. Faigenbaum AD. *Strength training for children and adolescents*. Clin Sports Med. 2000

26. Stricker PR, Van Heest JL. *Strength training and endurance training for the young athlete*. In: Birrer RB, Griesemer BA, Cataletto MB, eds. Pediatric Sports Medicine for Primary Care. Philadelphia, PA: Lippincott Williams & Wilkins; 2002

27. Ramsay JA, Blimkie CJ, Smith K, Garner S, MacDougall JD, Sale DG. *Strength training effects in prepubescent boys*. Med Sci Sports Exerc. 1990;

28. Weltman A, Janney C, Rians CB, et al. *The effects of hydraulic resistance strength training in pre-pubertal males*. Med Sci Sports Exerc. 1986

29. Bailey DA, Martin AD. *Physical activity and skeletal health in adolescents*. Pediatr Exerc Sci. 1994

re better control and balancing technique are preferable and can be used in small increments of weight, which are also useful for strengthening specific movements for the sport.

Exercises with weights performed with very rapid contractions during the routine of strength training are not recommended, because the technique may not maintain an optimum safety standard. This restrictive concept is applied to strength training and not to weightlifting. The sport of weightlifting is different from common strength training, because it implies a specific type of lifting such as "snatch" and "clean & jerk".

When children or adolescents engage in a strength training programme, they should start training sessions with low weight exercises until the correct technique has been achieved, first increasing the number of repetitions (from 8 to 15); it is advisable to add weight increases in the order of 10%.

In order to achieve optimal results in terms of strength, the training sessions must last at least 20-30 minutes, and be 2 or 3 times a week, stimulating adaptations with the addition of either weights or the number of repetitions. Four training sessions per week appear to have no additional benefit and may increase the risk of overuse injuries. Proper technique and close supervision are mandatory for safety reasons and to reduce the risk of injury. Proper supervision is defined as an instructor-pupil ratio of no more than 1:10 and with an instructor specialised in strength training.

Recommendations

- ✓ Appropriate strength training techniques and safety precautions should be followed so that strength training programmes for preadolescents and adolescents are safe and effective. If it appears necessary or opportune, before starting such a programme, evaluate the level of competence that the youth has already achieved in the sport of choice.
- ✓ Preadolescents and adolescents should avoid maximal workouts and exasperated workouts for muscle hypertrophy before reaching physical and skeletal maturity.
- When paediatricians are asked to recommend or evaluate strengthening programmes for children and adolescents, the following aspects should always be considered:
- A medical evaluation should be performed by a pediatrician or family doctor checking for hypertension, convulsive disorders or a history of childhood cancer or chemotherapy; children with congenital heart disease (cardiomyopathy, pulmonary arterial hypertension or Marfan syndrome) should be referred to a pediatric cardiologist before starting a specific strength training programme.
- ✓ Aerobic conditioning must be associated with strength training, if general health benefits are the primary objective.
- ✓ Strength training programmes should always include 15 minutes warm up and cool down.

- ✓ Athletes should ensure adequate fluid intake and a correct and balanced diet, as both are vital for storing muscle energy, recovery and for performance itself.
- ✓ Specifici strength training exercises should be learned initially without weights (in other words, no resistance).
- ✓ Once the exercise technique has been mastered, incremental loads can be added using both barbells and other forms of resistance.
- ✓ Strength training should involve 2 to 3 sets of higher reps (from 8 to 15), 2 or 3 times a week and last for at least 8 weeks.
- ✓ A general strengthening programme should address all major muscle groups, including the core, and involve the full range of motion for each exercise.
- ✓ Specific areas for sport can be taken into consideration at a later point in time.
- ✓ Any sign of illness or injury resulting from strength training should be assessed in depth and thoroughly before continuing with the exercise programme.
- ✓ Instructors or personal trainers should have a specific certification attesting their suitability for the management of strength training in pediatric age.
- ✓ Proper technique and rigorous supervision by a qualified instructor are critical safety components in any strength training programme that involves preadolescents and adolescents.

As can easily be deduced from the indications given by authoritative international organisations and by qualified research, strength training in prepubertal age does not in any way constitute the “drama” that often some insiders want to present. This type of training aimed at well-being and sporting performance is possible at any age, especially for young people, with immediate and future benefits which are far more obvious than the lies often told in this regard. Therefore, returning to title of this report, considering the risks and benefits induced by this practice, we can safely state, in the light of scientific evidence, that young people must indeed use weight lifting to train their strength.

ANTONIO URSO
President of the Italian Weightlifting Federation and of the European Weightlifting Federation. Board member of the International Weightlifting Federation.
Dr. Urso also has a degree in Sports Science, a Master’s degree in Preventive and Adaptive Sports Science; 1st level Master’s degree in Sport Rehabilitation; Weightlifting expert.
He has coached the national male and female weightlifting teams and was an Italian weightlifting champion on several occasions.
He is a Sports Psychologist.

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

PART ONE

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BACKGROUND

The function of the *sarcomere* can be explained by the meanings of the three ancient Greek words that make up the etymology of the term, *sarx, arché* and *méros*, which define the single element (*méros*) of the dense and elastic part of the flesh (*sarx*) capable of generating force (*arché*)[1]. The sarcomere is the part of striated muscle cells in which voluntary contraction occurs. In a striated muscle cell (or fibre), there is the parallel and serial concatenation of myofibrils, thin contractile filaments composed of repeating sections of sarcomeres. In a 10 mm long myofibril there is a serial concatenation of about 4,000 sarcomeres[2]. The electrochemical impulses originating from the nervous system reach the myofibril and cause the sarcomeres to shorten, thus stretching the entire muscle tissue of which the cell is a part.

Muscle contraction is a clear example of how a dense network of intercellular connections can transform cell motility into the mobility of skeletal levers and movement of the entire body[3]. In fact, the muscles - organs that move the body -, report on the macroscopic scale the main properties of which sarcomeres - organs that move muscle tissues -, enjoy on a microscopic scale [2]. Among these, the six most important are: 1) *electromechanical excitability* in response to chemical stimuli; 2) *conductivity* for the propagation of electric impulses; 3) *contractility*, with force production by length reduction; 4) *contraction at constant volume*, in other words, during shortening, the contractile parts change position leaving their structure unchanged; 5) *elastic deformability*, to absorb mechanical stress; 6) *adaptability*, with the regeneration of biological components depending on the stimulations received.

INTRODUCTION

The anatomy and physiology of the sarcomere has been studied for over 60 years [4]. At each new step that technological progress has made in the field of molecular biology, the morphological and functional analyzes of the sarcomere have always revealed new details. Passing from a micrometric to a nanometric scale, it was possible to observe precise molecular interactions[5], to write new bio-informatics algorithms that simulate contraction[6], and complete increasingly realistic 3D reconstructions of the sarcomeric contraction[7].

To have a better understanding of the functionality of the sarcomere, anatomical comparisons were also set up between muscles of different animal species, from which one can deduce that, if considered a single evolutionary axis of conjunction between marine mollusks and all the other animal species, including man, the structure of sarcomeres among the different species is similar[8]. To solve the problem of animal propulsion, it would appear that nature acts on the sarcomeres by changing the molecular makeup without altering its actual architecture[9]. Contraction is an electromagnetic phenomenon: molecules attract and repel each other because they are polarized by the electric charge of their atoms. Since all the filaments of proteins, chosen by nature to generate mechanical propulsion, behave like magnets in mutual attraction, then their infinite combinations can only generate muscular systems of similar structures[10]. There is therefore a typical structural model that nature proposes recursively in order to create, with the molecules, the contractile tissue of the various animal species. In particular, the primitive anatomical structure of the invertebrate *Caenorhabditis Elegans* is the most studied conformation of the somatic muscles, devoid of joints, which shows a strong resemblance to that of vertebrates. This worm nematode (with a circular body) about 1 mm long, has a muscle tissue consisting of only 80 cells, very similar to myofibrils in man (Figure 1) in terms of molecular structure, striated morphology, physiology of contraction, presence of mitochondria, nuclei and other cellular corpuscles[11].

Under further microscopic analysis, it was observed that the spongy consistency of *Caenorhabditis Elegans* muscle tissue derives from a molecular architecture similar to that of latex. In general, the structural model that best explains the visco-elastic properties of sarcomeres is the one obtained from the positions that the molecules assume in the crystals of this colloidal material[9].
Below is a brief presentation of the characteristics of the human soma sarcomere, using the morphological and biomechanical

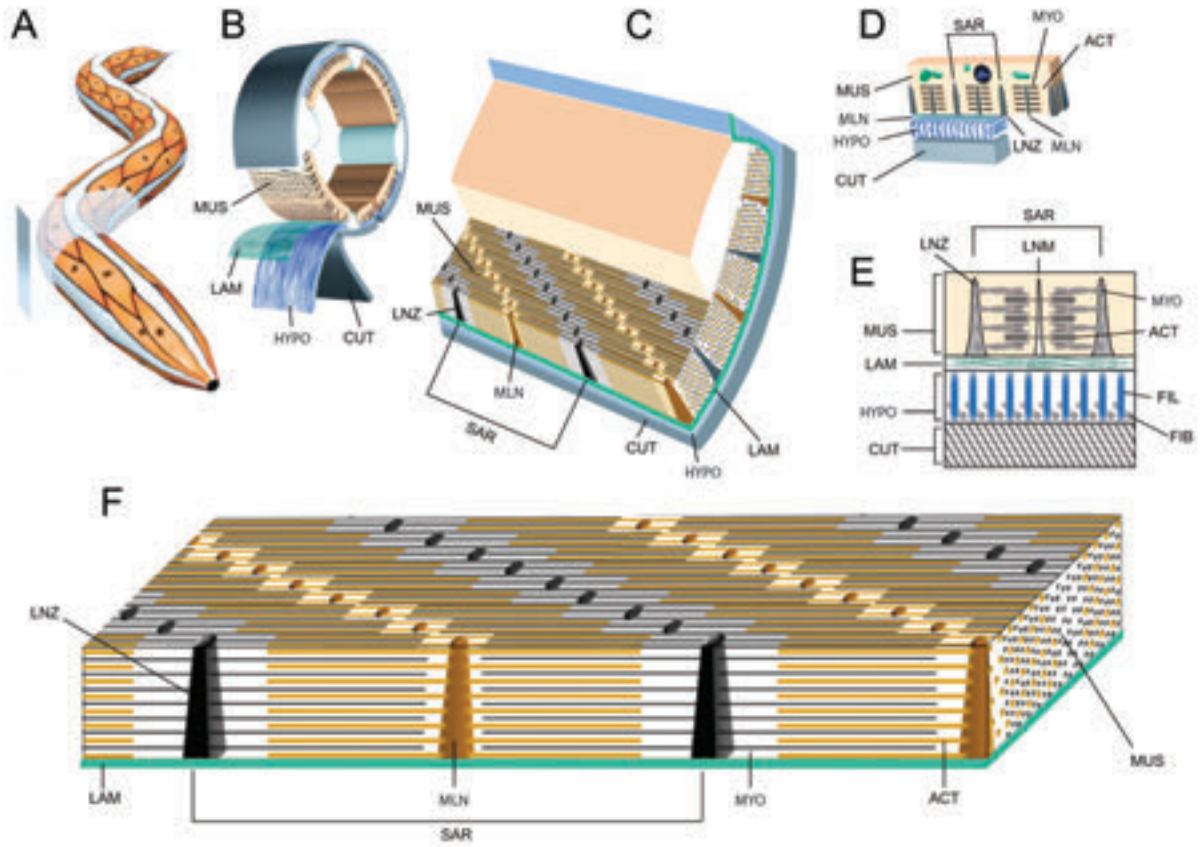

FIGURE NO. 1

MUSCLE TISSUE OF CAENORHABDITIS ELEGANS. (A) BY OBSERVING A PORTION OF THE TUBULAR BODY OF THE NEMATODE, IT IS POSSIBLE TO RECOGNISE (B) THE CONCENTRIC STRUCTURE THAT JOINS THE SUPERFICIAL INTEGUMENTARY LAYERS WITH THE MEMBRANES AND THE DEEP MUSCULAR TISSUES. (C) THE MICROSCOPIC ANALYSIS OF A SECTION OF THE ANIMAL'S BODY SHOWS A CONTRACTILE MUSCLE TISSUE MADE UP OF SARCOMERIC SERIES AND PARALLELS, (D) IN WHICH THE INCONGRUOUS PROTEIN STRANDS ARE PRESENT. (E) EACH SARCOMERE CONTRACTS CONCENTRICALLY ALONG A SINGLE LONGITUDINAL MAIN AXIS. (F) THE STRUCTURE OF THE MUSCLE TISSUE OF THE WORM IS SIMILAR TO THAT OF THE LATEX CRYSTALS.
CUT – CUTICLE. HYPO – HYPODERMA. LAM – BASAL LAMINA. MUS – MUSCULAR TISSUE. SAR – SARCOMERE. LNZ – Z DISC. MLN – M LINE. MYO – MYOSIN FILAMENT. ACT – ACTIN FILAMENT.

components of the ancestral model of the muscular tissue, obtained respectively from the model of the latex crystal and from the electrostatic properties of the sarcoplasm. The purpose of this description is to highlight the electro-mechanical properties of the sarcomere necessary for the generation of force and without which it would not be possible to affirm the physiological, neurological and biochemical concepts that underlie muscular contraction.

THE MORPHOLOGICAL MODEL OF LATEX CRYSTALS

Latex is a natural resinous liquid extracted from the plant sap of plants belonging to the genus of Hevea, the rubber trees. The main component of latex is rubber, a colloidal material with a high degree of elastic deformability which, if subjected to industrial *vulcanization* processes, presents molecules (*polysoprene*) with long filaments of atoms aligned in a symmetrical and regular way. A latex crystal is the smallest portion of resinous material in which the characteristic columns of the molecules can be observed (Figure 2), obtained after vulcanization. The geometric order of the molecules in the latex crystals is such that it can be represented by a mathematical model[12] that can explain, and predict, in detail how the elastic deformations occur. The mathematical model of latex crystal is used in scientific research to emulate the mechanics of biological tissues and to develop synthetic materials that are more resistant

to impact and capable of storing elastic energy. For the molecular similarity between sarcomeres and latex crystals, the properties of consistency, deformability, elasticity, plasticity and stiffness of the former can be obtained by analysing the mechanical responses to the external stresses of the latter.

By comparing a sarcomere and a latex crystal under an electron microscope, it is possible to notice that the filaments of myosin and actin are lined up in the sarcomere[13], in the same way that the polysoprene filaments are arranged in the latex crystal[9]. Both in the compression of a latex crystal, and in the contraction of the sarcomere, the space present between the molecules changes without altering the parallel alignment of the filaments. The sarcomere stretches and contracts on the single main axis that crosses it longitudinally (Figure 3). The more the sarcomere appears elongated, the more the molecules distance each other on the main axis, the more elastic the entire structure becomes, it can flex or twist and become more sensitive to shear forces. The more the sarcomere is shortened, the more the protein strands interpenetrate each other and the whole morphology of the crystal becomes uniform, hardens, becomes compact, non-deformable and resistant.

The model of the interpenetration of the cross sections of the latex crystal demonstrates how it is possible to reduce the length of the sarcomere while keeping the volume constant, without losing and continually replenishing the atomic material. According to biomechanical analyzes obtained from the mathematical model of latex, as crystals tend to change their degree of deformation based on the stretching and compression levels, sarcomeres are also subject to different levels of tension depending on the degree of shortening.

In a sarcomere, during a nerve stimulation, the forces produced by the molecular attraction are added to the static forces that keep the whole cellular structure stable. During contraction, the molecules that align themselves

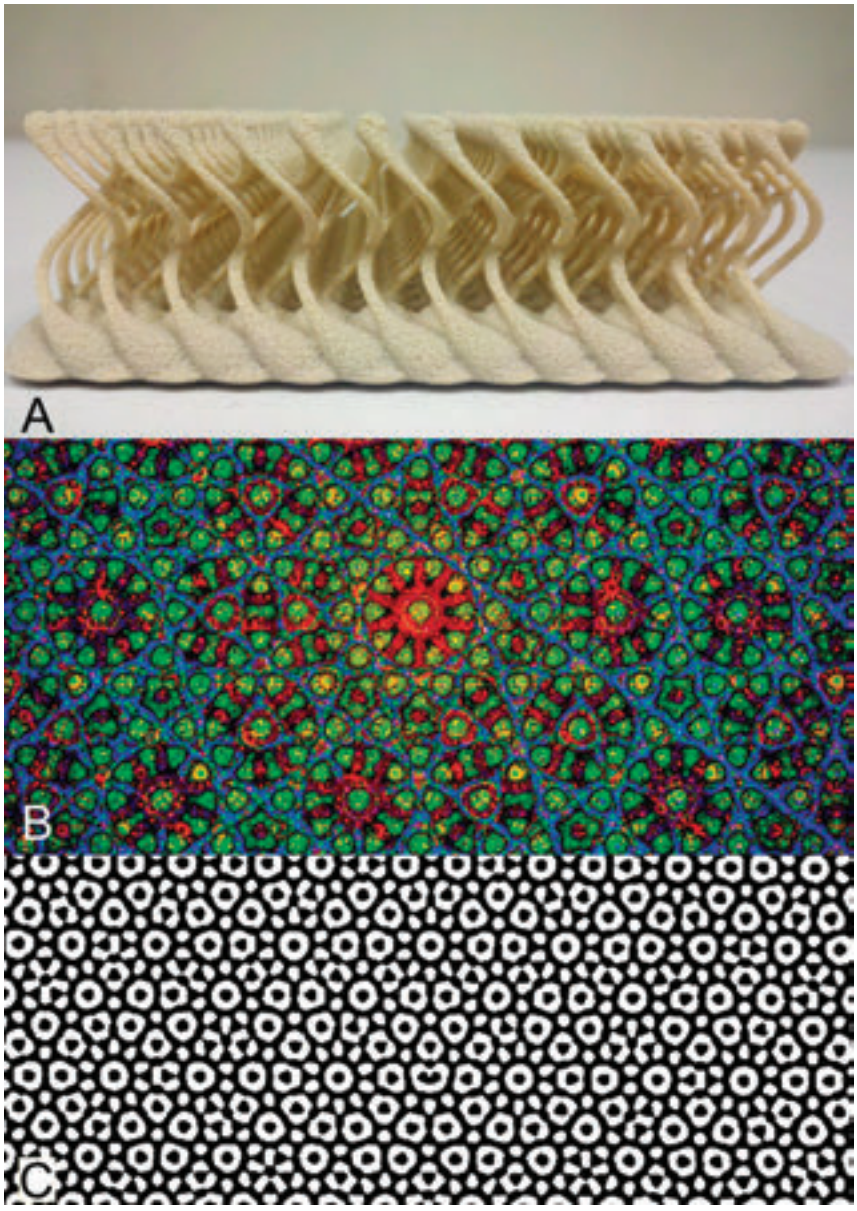

FIGURE NO. 2

CRYSTALLOGRAPHIC REPRESENTATIONS OF THE MOLECULAR MODEL OF LATEX. (A) LONGITUDINAL VIEW OF LATEX FILAMENTS DEFORMED BY ELASTIC COMPRESSION, REPRODUCED IN THE LABORATORIES OF OXFORD PERFORMANCE MATERIALS (SOUTH WINDSOR, CT, USA) FOR AEROSPACE APPLICATIONS OF LATEX CRYSTALS. (B) CROSS SECTION OF THE REAL MODEL OF THE LATEX, RETOUCHED WITH COLOUR FILTERS TO HIGHLIGHT THE REGULAR DISTRIBUTION OF THE MOLECULES AND (C), ITS ALGEBRAIC MODEL.

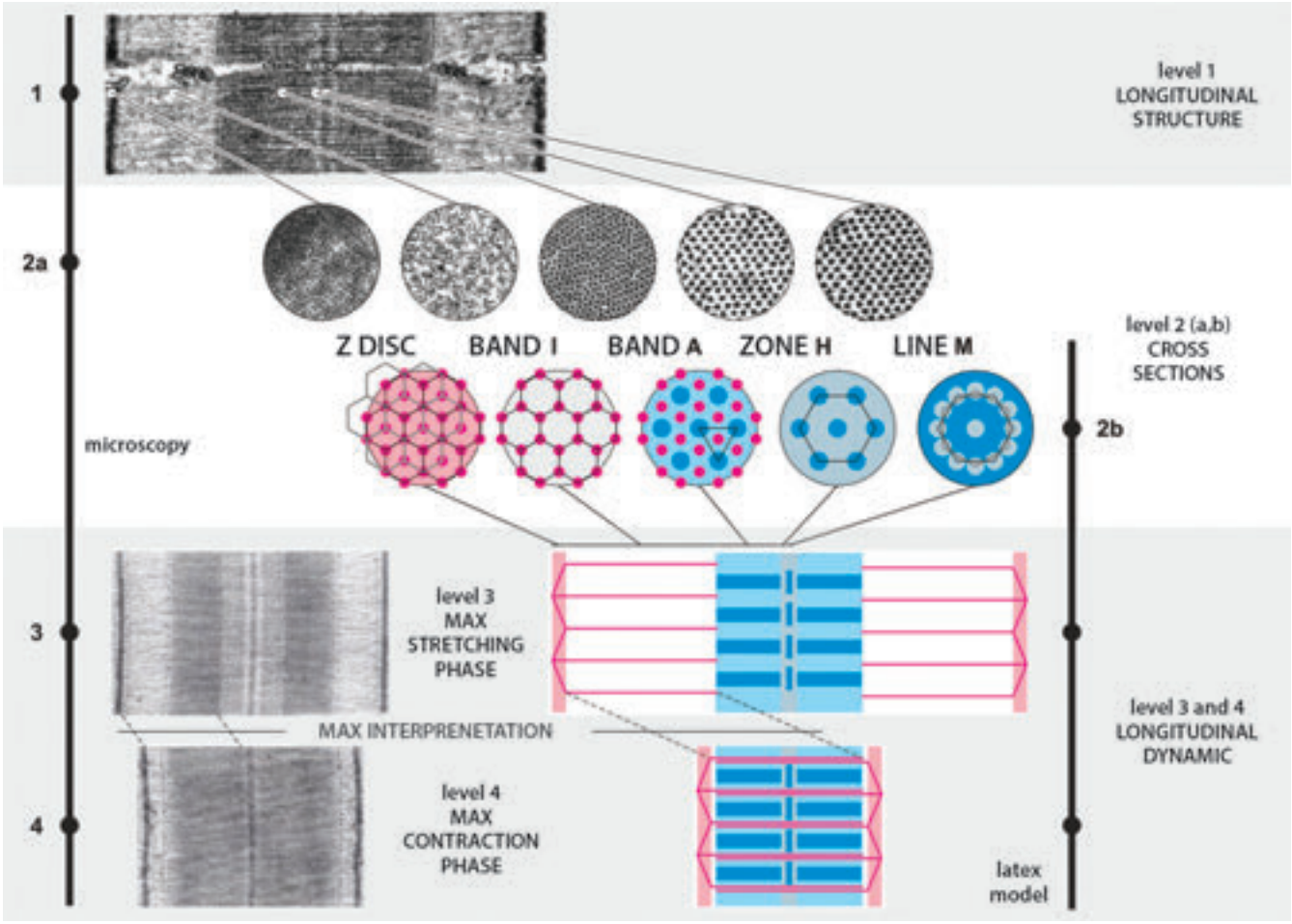

FIGURE NO. 3

REPRESENTATION OF THE MICROSCOPIC STRUCTURE OF THE SAROCOMERE USING THE LATEX FILAMENT MODEL. FROM THE LONGITUDINAL (LEVEL 1) AND TRANSVERSE (LEVEL 2A) SECTIONS OF THE SARCOMERE STRUCTURE (LEFT MICROSCOPY AXIS) IT IS POSSIBLE TO OBTAIN THE CROSS SECTIONS (LEVEL 2B) AND LONGITUDINAL SECTIONS (LEVEL 3 AND 4) OF THE LATEX FILAMENT MODEL (AXIS OF THE LATEX MODEL ON THE RIGHT). IN THE CROSS SECTIONS (2A AND 2B), IN THE Z DISK WE OBSERVE THE COUPLING OF THE HEXAGONAL MATRIX OF THE ACTIN OF TWO ADJACENT SARCOMERES (THE BLACK HEXAGONS BELONG TO A SARCOMERE AND THOSE IN GREY BELONG TO ANOTHER SARCOMERE); THE GROUP OF SIX ACTIN FILAMENTS FOR EACH MYOSIN COMPLEX ALONG BAND I; THE GROUP OF THREE MYOSIN COMPLEXES FOR EACH ACTINIC FILAMENT ALONG BAND A; THE HEXAGONAL CONFORMATION OF THE MYOSIN COMPLEX IN ZONE H; THE COUPLING OF TWO MYOSIN COMPLEXES (THE BASE OF A MYOSIN COMPLEX, REPRESENTED WITH HEXAGON IN BLACK, AND THE BASE OF A SECOND MYOSIN COMPLEX, REPRESENTED WITH A HEXAGON IN GREY) WITH HEXAGONAL MATRIX IN THE M LINE.

in polymer chains in the dense fluid of the sarcoplasm behave as if they were iron bars inserted into column of cement to reinforce it, in other words, elastic and at the same time rigid. The more its length is reduced, the more the structural containment forces of the sarcomere are discharged along the axis of the contraction which, in turn, becomes more intense. Since the central part of the sarcomere is more dense than the extremities, the latter move in a concentric direction. Therefore, the shortening force of the sarcomere initially develops to pull the extremities, until the structural compression overcomes the internal resistances and produces an expansion of the entire cellular body[14]. After this stage, and continuing the contraction, the containment forces weaken and the transverse expansion, which has become necessary to avoid the collapse of the structure, causes a reduction in the contraction force. For these reasons, the highest tensile peak is reached a few moments before maximum length reduction. Sarcomeres produce 25% of the maximum contraction force when they are stretched to the maximum length, generate half their potential strength when

they are activated in the rest position, reach the highest level of force when their length is halved by the contraction, and lose 25% of the peak force in the condition of maximum shortening[14].

By generalising, we can say that sarcomeres are comparable to a specific subcategory of crystals that enjoy four particular properties. Sarcomeres can be identified as *liquid* (1) *leotropic* (2) *nematic* (3) of *biological derivation* (4)[15]. If the liquid crystals can change the aggregative state of their molecules between liquid and solid, sarcomeres are more precisely paracrystals, because on the basis of the ionic currents that pass through them, they can vary their structural consistency without liquefying or completely solidifying[16]. Liotropic liquid paracrystals are particular organic compounds whose molecules have a very precise spatial order of position and orientation that changes in relation to the surrounding electrochemical environment[15]. All the molecules of the sarcomere are aligned on a single main axis and the electromagnetism of the atoms is oriented in a symmetrical and mirror-like manner on both sides of the axis, making the entire paracrystal free of magnetic polarity. This characteristic is typical of *nematic* crystals. Furthermore, the crystalline structure is kept stable by a continuous cellular activity of synthesis, assembly, maintenance and degradation of contractile and support proteins (crystals of *biological derivation*).

However, there is a substantial difference between the latex and the main contractile unit of the muscles: while the latex deforms when subjected to external forces, the sarcomere contracts by means of a flow of ions passing through it and a pulling force obtained by a molecular electromagnetic bridge. For this reason, the latex crystal model is excellent for explaining the mechanical properties of sarcomeres, but not electromagnetic ones. For the latter we must consider the actions of attraction and repulsion exchanged by all the molecules inside the sarcomere, both those rigidly disposed along the molecular lines, and those free to move within the intracellular space. The electro-magneto-mechanical properties of sarcomeres can therefore be obtained from those of liotropic liquid paracrystals and from the electro-active environment surrounding the molecular filaments.

SARCOPLASMIC ELECTRO-ACTIVE GEL

The sarcoplasm interposed between the filaments of myosin and of actin is a constantly electroactive gel [17] which: 1) during contraction is crossed by the ionic current of the atoms of calcium, phosphorus, magnesium and other molecules; 2) during the relaxation phase is home to an electrostatic field; 3) always maintains mutual attraction between the myosin terminals and the actin receptor sites in both contraction and rest conditions. The electrical activity of sarcoplasm participates in increasing the tone of muscles during relaxation, their stiffness during shock absorption, the production of force during contraction, and the ability to become elastic again in a rapid sequence of stretching and shortenings. The electro-active gel of the sarcoplasm directs the flow of positive ions towards the peripheries, and that of the negative ions towards the centre, supporting the electromagnetic orientation of the filaments of the contractile proteins, whose terminals are negatively charged towards the free ends and positively charged towards the anchored ends. By following the polarity of the myosin filaments thus manifested, during contraction, the flow of positive calcium ions moves towards the periphery, and that of the negative ions of the diphosphates goes towards the centre of the sarcomere. Here we find the creatinic enzymes[18] that use their positively charged phosphate ions to neutralise the electrical negativity of the diphosphates coming from the ends and convert them back into tri-phosphates. The sarcoplasmic gel also plays a passive supporting function and can be considered as an integral part of the cytoskeleton. Its high density allows the sarcomeric protein structures to maintain the same longitudinal arrangement regardless of the type of deformation to which they are subjected[17].

The sarcoplasma is a chiral fluid, or rather, the movement of the molecules inside it allows it to mix constantly, creating slow convective currents whose inertia spin all that is immersed in it. At each contraction, the sarcomere produces force thanks to the permanent motion of its internal electro-active plasma[17]. Without it, the protein polymers could not rotate and flow among themselves and the-

refore the energy bonds inherent in the generation of muscle strength, could not be created: *The arrest of the circulatory flow of the sarcoplasmic gel would seriously compromise the total functionality of the sarcomere*. The molecules immersed in the sarcoplasm are arranged in chains of helical or spiral polymers and tend to rotate whenever they move. Instead of vibrating (curving) as if they were immersed in a liquid, they float (twisting) because they float in a gel[19]. As happens in the case of a corkscrew, which in turning easily penetrates the cork, or in the case of the carpenter's drill bit, which, by rotating, slips faster into the wood, the torsion of the molecular polymers reduces the friction that the latter receive from the dense substance that surrounds them, increasing their degree of penetrability.

All the electromagnetic and mechanical forces acting on the sarcomere, both as a result of a contraction, and in conclusion of a deactivation period, come together in the sarcoplasm and condition the efficiency of the subsequent contractions[20]. Although the flexibility of the sarcomere during the state of rest allows to exploit the motility of adjacent cells to keep the sarcoplasm moving, it is possible to find conditions in which the sarcomere is not free to contract integrally. Strong and frequent contractions or stretching can lead the sarcomeres to assume a static condition for such a prolonged time as to slow down the flow of the sarcoplasmic gel to the point of preventing new contractions and creating damage to the entire structure[21]. Indeed, along a chain of sarcomeres stimulated to shorten simultaneously, the greater the number of blocked sarcomeres, the lower the contraction force produced by the whole muscle[22], and the greater the risk of incurring muscle damage[23]. *Popping sarcomere* is the condition that occurs when sarcomeres contract abnormally and asymmetrically (Figure 4) and the myosin heads are forced to overcome a stall force that does not allow them to move freely on the receptor sites of the actin[20]. This degenerative phenomenon is caused by different factors, including structural rigidity acquired

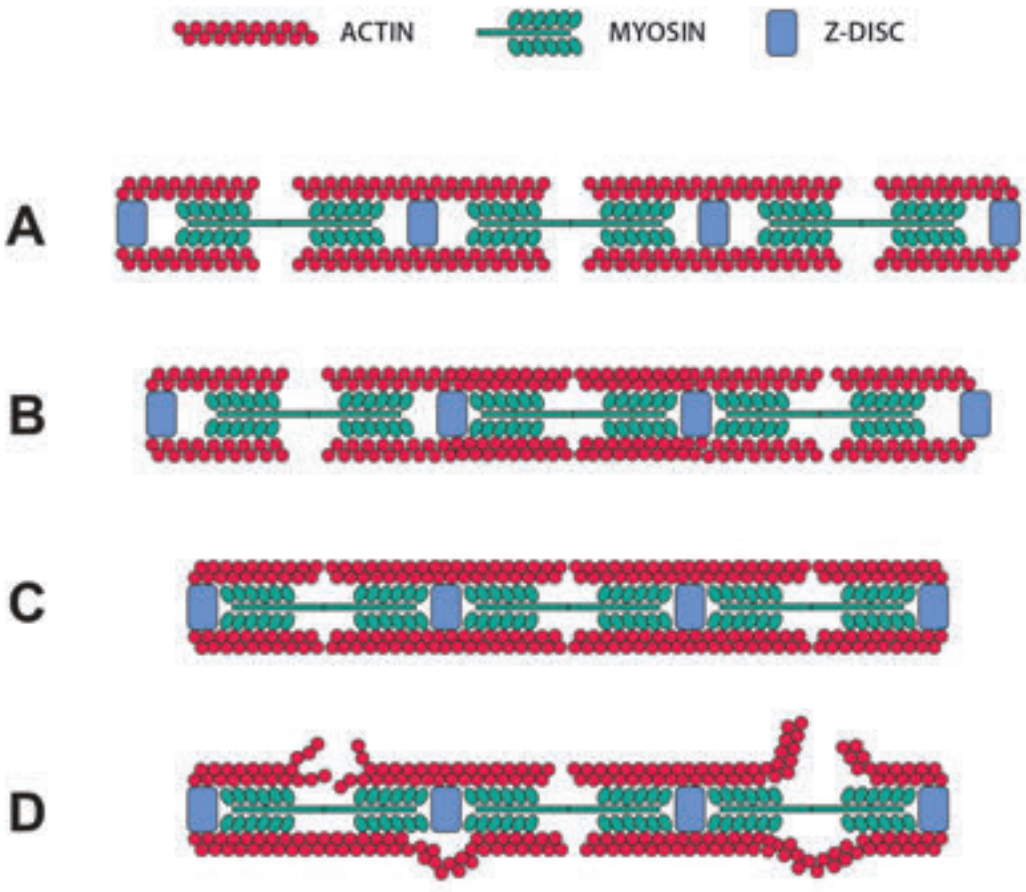

FIGURE NO. 4
EFFECTS OF POPPING SARCOMERE. FREQUENT AND INTENSE STIMULATIONS OF CONTRACTIONS AND STRETCHING, ON THREE SARCOMERES IN A ROW. A) ALL THE SARCOMERES CAN STOP SHORTENING IN AN ELONGATED ISOMETRIC SITUATION. B) SOME SARCOMERES REMAIN STRETCHED, OTHERS REMAIN SHORTENED, OTHERS STILL MOVE ONLY PART OF THEIR CONTRACTILE STRUCTURES. C) ALL SARCOMERES CAN STOP STRETCHING IN A CONTRACTED ISOMETRIC SITUATION. D) STRUCTURAL DAMAGE COMBINED WITH FATIGUE ACCENTUATE THE ABNORMAL BEHAVIOUR OF THE CONTRACTILE TISSUE.

by the reduced internal motility of the muscular cell, by the excessive strain from the surrounding tissue, an increased density of the sarcoplasmic gel and excessive electroactivity induced by calcium, sodium, hydrogen, lactate, phosphate or carbonate ions, which accumulate during muscle work and metabolic stress[20].

SARCOMERES AS MOLECULAR MACHINES

By attributing the same properties of the paracrystals, sarcomeres behave as solids if contracted, or as fluids (gels) if released, respecting their elastic, viscous and thixotropic properties[24]. The elastic properties depend on the degree of deformation of the sarcomere, the greater the lengths to which the sarcomere extends or compresses, the greater the stiffness it manifests. The viscous properties depend on the speed of contraction, the faster the shortening, the stiffer the sarcomere. The thixotropic properties depend on the electro-active state of the sarcomere, the greater its electrical activity, even at rest, the greater the stiffness that it manifests. The sarcomere increases its electrical activity when sarcoplasm fills with ions and some acto-myosin bridges are not released after the last contraction[24].

Sarcomeres are defined as *amphidynamic molecular machines*, in other words, machines capable of accumulating an electromechanical strength potential and at the same time, of producing a certain level of tensile strength based on the thermal and electrochemical equilibrium in which their internal environment is located in a precise instant, and the number and intensity of the previously made contractions[19]. Unlike a motor vehicle, in which the propulsion force is produced by the vector sum of the inertias and frictions of each of its moving parts, in a sarcomere, the force contraction is obtained from the complex interactions of the molecules that move within it. The microscopic forces produced by the "molecular" motors contained in the sarcomere rapidly disperse in the sarcoplasm and overlap less than those produced on a macroscopic scale by the mechanical organs of a "propulsion" engine. Whereas once switched off, a car can start up again without any functional problems, if the slow circulation of the sarcoplasm stops for a brief moment, the molecules would be so immobilised by the inertia of the dense gel that they would no longer be able to produce electro-magneto-mechanical interactions with the intensity needed to restart the circulation of sarcomeric fluid[19]. The contractile and force generating capacity of a sarcomere is therefore linked to the constant and slow motion of sarcoplasm. In the model of the latex paracrystal, the movement of each molecule "*can be compared to that of a man swimming in a sea of molasses or walking through a tornado*"[19].

During contraction, the maximum velocity reached by a myosin head is 1000 nm/s[20]. This velocity index is expressed on a specific dimensional scale to observe cellular behaviours. Alternatively, if we used a dimensional scale capable of measuring the phenomena that are perceptible to humans, the value of this velocity would be converted to about 4 mm per hour. The contraction is a slow phenomenon because the motion of the molecules is hindered by the structural resistances typical of the latex crystal model. Even if the contraction of a sarcomere occurs in very short time, the deformation of the paracrystal takes place in infinitesimal spaces, moving columns of molecules immersed in a very dense fluid, producing every kind of mechanical and electromagnetic resistance. Therefore, the shortening of sarcomeres is a short not a fast phenomenon and must be observed on a time scale and not in relation to speed. On a limb that moves, we see a whole muscle contract maximally in a few tens of milliseconds just because, in the same instant, thousands of sarcomeres reduce their nanometric lengths at the same time.

PRACTICAL APPLICATIONS

In the field of biotechnology, the study of the functionality of sarcomeres using the model of the paracrystal has allowed to overcome the limits of human-machine interfaces for the development of "intelligent" muscular prostheses. The new nickel and titanium spiral-shaped crystal technology[25] has been used to weave synthetic meshes of electro-active yarns capable of shrinking on a micrometric scale and producing a remarkable tractive force, with the aim of designing ever stronger and lighter robotic limbs to help man to overcome his limits of strength[26]. Furthermore, the interpretation of the union of the different cells

that make up biological tissues as a series of electric-powered paracrystals has provided a breakthrough to the study of the connections between electronic microcircuits and a living organism. In the laboratories of the Department of Bioengineering at the University of Los Angeles, a sarcoplasm-like electrodynamic substance has been designed to connect microprocessors and muscle cells[27]. The new interface developed in nanotechnology is capable of controlling growth, proliferation, repair and other intrinsic biological activities of muscle cells, including contraction, as well as the possibility of exchanging signals between the cell and the chip and sending commands to an external bionic organ[28].

In the field of sport and exercise, rapid movements that emphasise the eccentric phase have been associated with the phenomenon of popping sarcomere[23], and the administration of vitamin supplements during exercise has allowed to combat the excess of free radicals that accumulates in sarcomeres, causing an alteration of the electrodynamic equilibrium of muscle cells[29]. Obtaining more intense and prolonged muscle contractions, improving performance levels and reducing the risks of popping sarcomere is therefore also possible by controlling the chiral properties of sarcoplasm, reducing its density and increasing its electrical activity. This would be possible by avoiding training sessions based exclusively on eccentric exercises and keeping the dietary share of electrolytes and antioxidants high.

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EXPRESSION OF STRENGTH IN WEIGHTLIFTING

BY ANDREW CHARNIGA

"The forces produced by muscles in weightlifting does not take into account the sum of the power of the muscular contraction minus the resistance of the antagonist muscles. In theory less resistance of muscle antagonists would mean less force required to perform the exercise."
L.N. Sokolov, 1973

GENDER DIFFERENCES IN 'EXPRESSING' STRENGTH AND A STRONG – WOMAN 'SLEEPING'

Strength for all practical purposes is synonymous with masculinity. Males have the obvious advantages over females of larger muscle mass, larger bones and tendons; ten times serum testosterone levels, and so forth. The facial expression of the strongman in action is most often associated with a three A's of masculinity:

- anger;
- aggressiveness;
- assertiveness.

An expressed aggressiveness, especially a grimace, on the face of someone straining to lift a weight, for instance, is an enduring image; reflecting in psychological terms a masculine exclusivity of human strength.

"Aggression is part and parcel of what distinguishes male from female" (Colette Dowling, 2000).

Consequently, facial expressions most associated with weightlifters in the act of lifting, or other strength athletes for that matter, most often mirror the three A's. However, just how a strong woman could fit into this stereotype; as much a physiological as psychological phenomenon; is an ambiguity of nature. Assertiveness and aggressiveness are qualities not closely connected with femininity. Granted strength has to come from within; but, an angry grimace during muscular effort need not be requisite.

There is little if anything in the special literature about gender differences in facial expressions connected with muscular strain. Research of gender differences in facial expression are usually connected with emotions and/or identifying gender from facial expression (Hess, 2009). However, there is a dearth, if anything on this topic, associated with gender differences in facial expression in a sport of maximum strain like weightlifting.

FIGURE NO. 1

CONTRASTING [MALE/FEMALE/MALE] 'EXPRESSIONS' OF STRENGTH [STRAINING]. *CHARNIGA PHOTOS*

That being said, facial expression can be a window into the physiology of muscular tension. Muscular strain is usually accompanied with a grimace of varying intensity. It is common knowledge mechanical advantage varies throughout the performance of the weightlifting exercises with alterations in inertia and amplitude of movement; likewise the relative contribution of elastic recoil from tendons, fascia and ligaments.

The relaxed expression a world class sprinter straining to run at maximum speed is considered an outward reflection of the athlete's optimization of internal mechanics (Verkhoshansky, 1977). However, given the specifics of sprinting, a relaxed facial expression is in effect an active, not a reactive phenomenon. That is to say, an integral part of the high class sprinter's technique is to relax all unnecessary tension, facial muscles inclusive, to achieve optimum muscular tension and maximize inter-muscular coordination.

Gender differences of facial expression among weightlifters; and, how it might relate to possible differences in the approach to raising heavy barbells does not appear to have received any attention.

A fixed expression spanning exercises of such brevity as the snatch and the clean and the jerk is to be expected. Breath holding and straining go hand in hand. Holding the breath is a reaction to straining. Breath holding increases intra – abdominal pressure which supports the spine. At the same time, a reactive cessation of breathing facilitates the power of muscular contraction through neurological mechanisms (Zatsiorsky, 1995, and others).

So, breath holding as lifting begins up until a point in the exercises where tension can be maintained without this facilitation; would seem inconsistent with multiple alterations in facial expression.

Facial expression during weightlifting exercises, unlike the active effort to relax facial muscles of the sprinter should be considered a reaction to the magnitude of the

muscular strain. That being said, multiple alterations of expression, however subtle, over a fraction of a second as has been observed in super elite and elite female weightlifters; is a rather peculiar phenomenon. This phenomenon is all the more singular when these alterations of expression appear to be a reaction to changes in mechanical advantage, inertia of the barbell, and so forth.

"..women who show angry expressions are identified more slowly as women, and a person who looks angry is more likely considered a man". Hess, 2009

SOME DISCRETE, RAPID ALTERATIONS IN THE FACIAL EXPRESSION OF THE FEMALE WEIGHTLIFTER

Evidence from high speed still photos and observations of female weightlifters in competition and training has shown the facial expression of many elite and super elite female weightlifters can transform in rapid discrete shifts. These alterations of expression just happen to coincide with the variable conditions of mechanical advantage of the weightlifting exercises. The alterations of facial expression can only be reactive; conceivably an individual optimization of the female weightlifter's physiology to lift a maximum weight.

Discrete alterations in facial expression, in all probability, mirror the female lifter's intrinsic abilities to optimize tension of muscles, i.e., to eliminate unnecessary tension for effective rapid switching the disposition of the body during the weightlifting exercises.

FIGURE NO. 2

A COUNTER – INTUITIVE 'EXPRESSION' OF STRAINING ON THE FACE OF A SUPER ELITE FEMALE LIFTING A MAXIMUM WEIGHT. *CHARNIGA PHOTO*

FIGURE NO. 3

ALTERATIONS OF FACIAL EXPRESSION OF WORLD CHAMPION FEMALE LIFTER DURING THE CLEAN AND JERK. FROM LEFT TO RIGHT: RELAXED DURING THE PRELIMINARY ACCELERATION; SWITCHING TO STRAIN IN THE FINAL ACCELERATION; RELAXED/PLACID EXPRESSION DURING THE RECOVERY OF THE CLEAN AND ENHANCED RELAXATION WITH EYES BRIEFLY CLOSING AT THE MOST DIFFICULT PORTION OF THE RECOVERY (A KNEE ANGLE OF 90 – 105°). *CHARNIGA PHOTO*

The following are some of these rapid, discrete alterations in facial expression observed over the course of fractions of a second in the weightlifting exercises:

- *a relaxed expression at instant of barbell separation up to about knee level;*
- *an expression of strain at the beginning of the final acceleration of the pull (barbell above knees);*
- *a relaxed/placid expression as the recovery from the clean begins;*
- *a relaxed expression [as if sleeping], with eyes closing reflexively; as the lifter struggles through the most difficult part of the recovery of the clean (knee angles of 90 – 105°)*

The photos in figure 3 reveal four discrete, but nonetheless distinct alterations in facial expression of

a world champion at four specific junctures of the clean and jerk exercise.

The first part of the pull is arguably the most difficult. The weightlifter has to overcome the barbell's resting inertia and at the same time aggressively accelerate it. The weightlifter generates a force at barbell separation in the range of 140 – 160% of the weight of the barbell. Consequently, the relaxed facial expression of the super elite female pictured belies the magnitude of the requisite exertion.

Various researchers, Garhammer, Oleshko, Gougalis and others, recorded a slower speed of separation and preliminary acceleration of the barbell in both snatch and clean for the female weightlifter; in comparison with male lifters. However, "... in the final acceleration and the maximum speed of lifting, it tended to be larger for females". [Oleshko, 2010). A low tech means of coming to the same conclusion is for the coach to ask a female lifter to go faster at the beginning of the lifting, and, meet this response, "I'm going as fast as I can".

Generally, this gender difference in speed of producing power is thought to indicate females have a slower electro – mechanical delay, i.e., the time span between the decision to contract muscles and onset of tension.

The mechanical advantage of the pulling phases of the snatch and the clean change as the barbell passes the knees. The support reaction drops to 70-90% as the knees stop straightening before re – bending under the bar. As the weightlifter straightens the legs and trunk simultaneously the support reaction rises to 150 – 180% (Zhekov, 1976) of the weight of the barbell. The barbell has inertia and the lifter is able to 're – introduce' the muscles which straighten the lower extremities and take advantage of the fast stretching of tendons (especially the Achilles tendon) as the knees are shifted under the weight, i.e., the conditions are mechanically more favorable.

The facial expression of the super elite and elite female lifters' can transform rapidly from one of relaxation to a strained grimace and vice versa; in response to the change in the biomechanics of the exercises; where conditions for muscular effort are facilitated by storage and release of elastic energy, inertia, and so forth.

So, we have two facial expressions (reactions of focused strain) for the two main phases of the pull which one would expect to be flip flopped. A relaxed face in response to the more difficult conditions of raising the weight from the floor and a grimace in response to the mechanically favorable conditions of the final acceleration.

An efficient, rapid drop under the barbell in the snatch, the clean and the jerk depends to a great extent on the ability to switch from tensing to relaxing muscles. At the instant of switching from pulling to dropping, many super elite and elite female lifters change from an expression of straining to one of relaxation. The switch occurs in a very small fraction of a second; frequently, with eyes closed. In all probability, this a individual technique optimization to release un-

FIGURE NO. 4
SUPER ELITE FEMALE LIFTER DESCENDING UNDER THE BARBELL WITH AN EYES – CLOSED – RELAXED EXPRESSION. *CHARNIGA PHOTO*

necessary muscle tension in order drop fast and to absorb the elastic energy of the descending body and the oscillating barbell.
The ability to instantaneous switch muscular effort from tension to relaxation cannot be underestimated. Even a slow switch to muscle relaxation during these switching phases of the lifts is evidence of poor coordination. (Matveyev, 1977).

A relaxed expression, frequently with eyes closed as the lifter begins to receive the barbell at the chest in the clean.
A relaxed expression with eyes closed as the lifter receives the full weight of the barbell in the deep squat of the clean.

The 'sleeping' female weightlifter receiving the full weight of the barbell in the low squat in figure 5 is a unique 'expression' of muscular strain, i.e., an ambiguity of nature. Conceivably, the lifter reacts to the elastic deformation of the barbell and the stretching of muscles, tendons, ligaments. The relaxation of unnecessary muscle tension probably enhances the absorption of strain energy in tendons and ligaments; the release of this energy when she begins to stand, significantly reduces the requisite effort.
".....elastic energy can be released from a spring like element much more rapidly than a muscle can shorten while it generates significant force". A. Biewener, 2015
/ a relaxed expression at the beginning of the descent under the barbell, frequently with eyes reflexively closed.

FIGURE NO. 5
WORLD CHAMPION FEMALE LIFTER SEEMINGLY ASLEEP AS 148 KG BARBELL RECOILS IN THE LOW SQUAT POSITION OF THE CLEAN. *CHARNIGA PHOTO*

FIGURE NO. 6-7
SUPER ELITE FEMALE LIFTER SWITCHING FROM LIFTING UP TO DESCENDING UNDER WORLD RECORD WEIGHT WITH SUBTLE CHANGES OF EXPRESSION INCLUDING EYES CLOSED. FROM LEFT TO RIGHT (FIGURES 6 &7) THE FRAMES ARE SEPARATED BY 0.083 SECONDS. THE LIFTER'S EXPRESSION TRANSFORMS DISCRETELY FOUR TIMES (EYES OPEN STRAINING, EYES CLOSED LESS STRAIN, EYES BEGINNING TO OPEN A LITTLE LESS STRAIN, EYES OPEN RELAXED) OVER A SPAN OF APPROXIMATELY 0.249 SEC., I.E., FROM TENSION TO RELAXATION. THE FACIAL TRANSFORMATIONS COINCIDE WITH THE SWITCHING OF THE PHASES OF PULLING UP TO DROPPING DOWN. *CHARNIGA PHOTO*

CONCLUSIONS

The rapid transformations of facial expression of the super elite and the elite female weightlifters covered here are by no means comprehensive. However, a unique feature of these transformations of expression is they most frequently coincide with junctures in the exercises when the mechanical advantage changes. The female face expresses the change in mechanics relative to the variations in demand from the body: strain with the need to generate more energy; and, relaxation with the opportunity to absorb elastic energy.

Muscular effort is usually quantified in terms of physics: power, force against the ground. Technical proficiency in weightlifting is likewise expressed in terms of physics: bar trajectory, height of lifting, barbell speed and so forth. In theory, less muscle force is required to perform some exercise if muscles which are not actively contracting to generate power offer minimal resistance to the muscles which are. However, this reflexive ability to switch to an optimum relaxation of muscles to reduce resistance of movements in sport exercises is not readily quantifiable.

The super elite female weightlifter reflexively 'dials down' unnecessary resistance from tension in antagonist muscles; excessive tension in which can impede movement efficiency. This in its turn, enhances the efficacy of the agonists, i.e., the muscles generating the propulsive energy.

The rapid alterations in the facial expression of the super elite and elite female weightlifter; which just so happen to coincide with the changing mechanical advantages of the weightlifting exercises; conceivably manifest a high speed biological switch dialing down muscle tension to an optimum state, and, vice versa. A 'relaxed' strong woman, with facial expression as if 'sleeping' in the process of raising a maximum weight, articulates an individual optimization of the female body's potential.

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The importance of warming up and cooling down in the sports injury prevention

BY MAURA MANNUCCI

The official journal of the European Weightlifting Federation

INTRODUCTION

Warm-up and cool-down activities are often underestimated by athletes, who consider them a waste of time. This non-conscious consideration often leads athletes to either performing the exercises superficially, or to classifying them as recreational or social activities.
In actual fact, warm-up and cool-down activities are not recreational exercises that can be carried out without a real logical sequence. They must be an integral part of the training, and require time and attention.

The purpose of warming up is to activate all the athlete's functional systems in order to create the best psychophysical conditions suitable for training or competition, so the athlete can fully express his/her potential. Cooling down, on the contrary, aims at returning the system to its original condition after the stress of training or competition, in order to optimize and speed up the recovery conditions.
Both contribute to accident prevention.
In other words, warming up and cooling down are essential links in a chain reaction whose final result is maximum performance with no injuries.

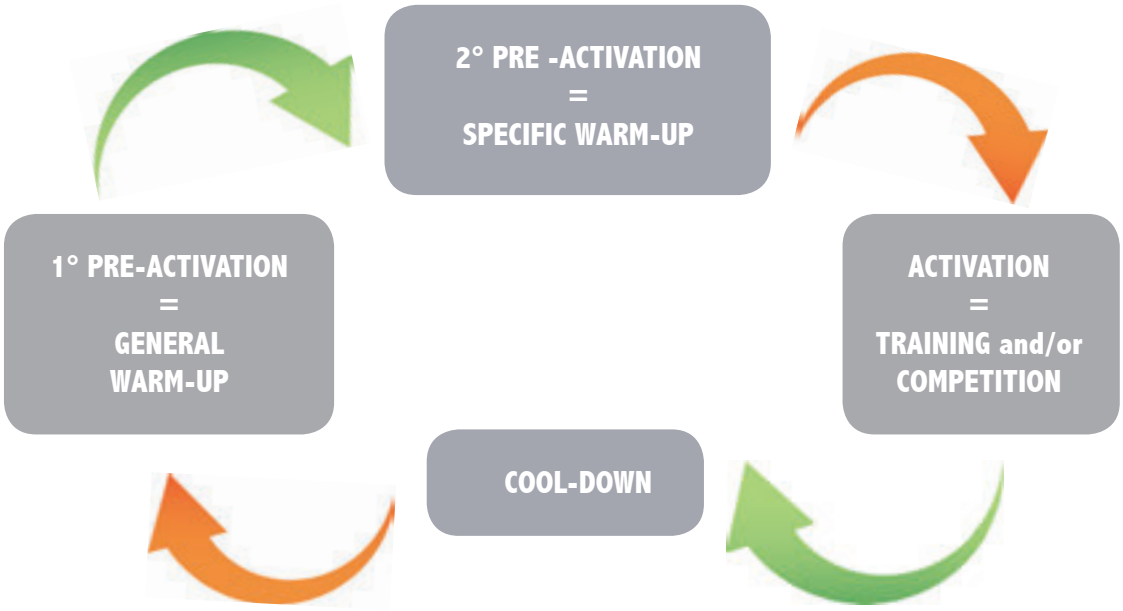
THE IMPORTANCE OF WARMING UP

Warming up [1] [2] is made up of two stages:

- General warm-up
- Specific warm-up

The goal of the **general warm-up** is to create a generalized increase in body temperature in order to reach the optimal temperature (39°C), necessary to accelerate all the physiological reactions indispensable for performance capacity.
The effects induced by this warm-up are:

- **an increase in tissue blood flow**.
- **an increase in the transmission speed of the nervous impulse**. A 2°C increase in body temperature produces a 20% acceleration of the contraction speed.
- **increased sensitivity of sensory receptors**. Especially important for the ability to coordinate performance, since the accuracy of sports movements depends on the information that receptors send to the central nervous system.
- **a reduction of visco-elastic strength**. Muscles, tendons and ligaments become more elastic and extensible, thus lowering the predisposition to tears and, therefore, the danger of injuries in sports movements that stress the active and passive locomotor apparatus to the maximum. Increased tissue elasticity also results in increased joint ROM



and increased muscle efficiency, given that the muscle will be able to contract with more force and relax faster.

- **an increase in the load capacity of the joints**. Warming up increases the production of synovial fluid.
- **an increase in state of awareness**. Increased awareness has a positive effect on the technical learning process and on the ability to coordinate performance, improving the precision of motor actions.

The above effects translate into a general pre-activation state that prepares the athlete for the next specific warm-up phase.
In the **specific warm-up**, the effects induced by the general warm-up are exploited, with the aim of activating and raising the temperature, in particular in the specific muscle masses for the sport practiced, up to an optimal state that will allow:

- the correct coordination of the technical movement;
- specific muscular and articular preparation for subsequent muscle engagement.

For this reason, in the specific warm-up, some of the proposed exercises are very similar, or correspond to the dynamic and kinematic structure of the training and/or competition exercises, enabling interrupted passage from the warm up to the training and/or competition. An example of this is the warm-up in weightlifting competitions where athletes start the specific warm-up with an empty barbell arm and then progressively increase the

loads, depending on the lifts they will have to perform in the competition.

An important aspect to underline is that the warm-up, in addition to being sport-specific, will also have to take into account the characteristics of the athlete, and its effect must be studied over multiple workouts in order to be validated.

It is also essential that the type, volume and intensity of the warm-up methods are never radically changed before a competition, as an increase or decrease in quantity could lead to a decrease in performance or even injury.

That said, the obvious question arises: "Then why not start directly with the specific warm-up? It could save time! "

This is not possible, because saving time would result in:

- **increased risk** of injury, since the entire pre-activation stage of the system would be omitted;

an incorrect execution of the training programme, as starting it without the correct warm-up, whether to avoid

- injury or because the athlete's system is not perfectly activated, would result in part of the programme being performed with less intensity.

The only way to start directly with the specific warm-up, avoiding injuries and performing a workout to its full potential, would be to perform a longer specific warm-up (equal to the sum of the two different warm-up modes) in order to obtain however, both the generalized increase in body temperature (39°C) and the optimal raising of specific muscle masses for the sport practiced.

In this case, the specific warm-up must begin with lower than normal intensity, which will be progressively increased as the warm-up continues.

Having said that, as it does not produce any time benefits, it is advisable, however, for a better activation of all the functional systems of the athlete and therefore, for the purpose of a better performance, to carry out both types of warm-up.

THE DURATION OF THE WARM-UP

The warm-up does not have a fixed duration[1][2] and is influenced by endogenous and exogenous factors.

The endogenous factors include:

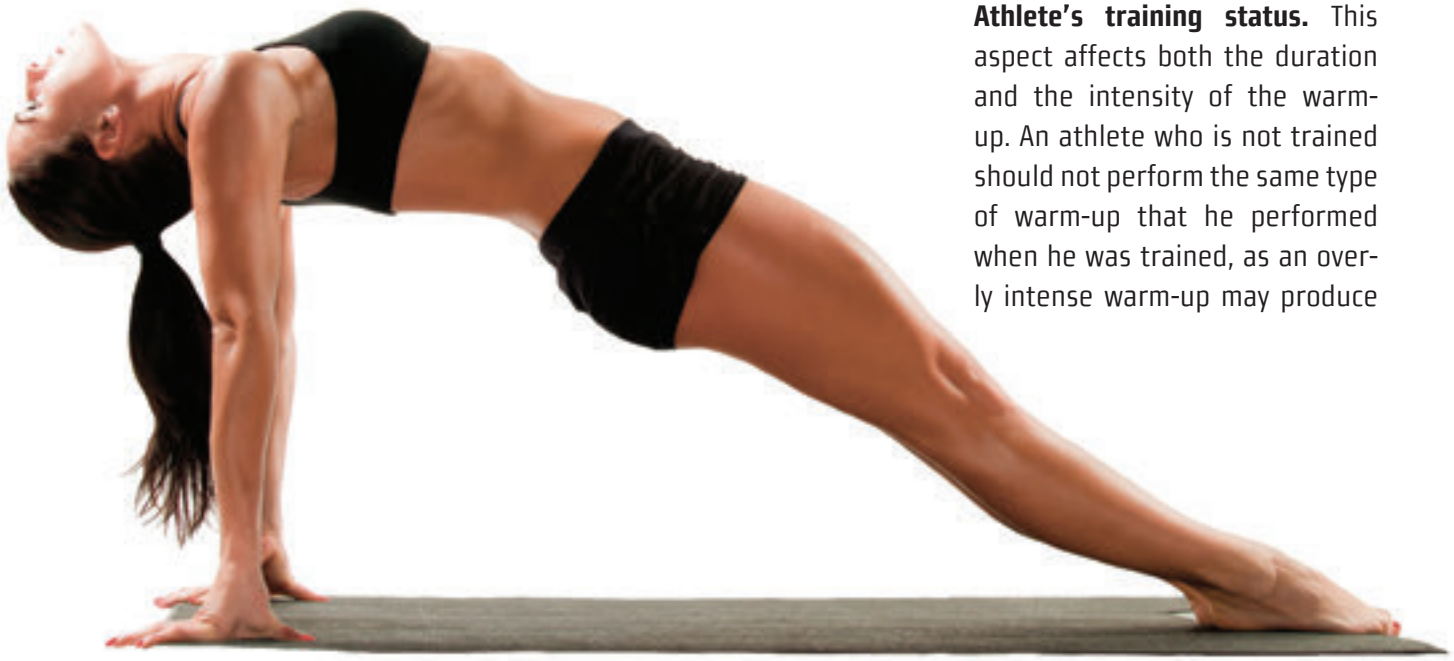
- Age;
- Athlete's training status;
- Indivudual characteristics of the athlete;
- Motivation and psychic attitude.

The exogenous factors include:

- Training and/or competition time;
- Outdoor temperature or weather conditions.

Age. Age does not influence the type of warm-up, but rather its intensity and time of execution. In older athletes, this type of exercises should respect a more careful progression, as the muscle, due to physiological changes related to aging, loses much of its elastic capacity and therefore will be more subject to risk of injury.

Athlete's training status. This aspect affects both the duration and the intensity of the warm-up. An athlete who is not trained should not perform the same type of warm-up that he performed when he was trained, as an overly intense warm-up may produce



muscle fatigue that would generate a deterioration in performance capacity, resulting in greater risk of injury.

The individual characteristics of the athlete. This is another important factor to keep in mind. Some types of athletes need few intense stimuli to get into the right condition, while others need more and different stimuli to reach the same condition.

Motivation and psychic attitude. The motivation and the psychic attitude towards the warm-up activities condition its effectiveness.

In literature, some studies show that a non-acceptance or an underestimation of the same can cause a reduction or even an absence of benefits, whereas the opposite attitude produces an increase in effectiveness.

Training and/or competition time. The times of training and competition consequently change the warm-up times.

Some tests have shown that physical performance increases during the day. In the morning, for example, on waking, the various body functions are slower, because during sleep they are physiologically "deactivated". It will therefore take a certain amount of time to return to their normal functionality. Blood circulation also improves with movement, so in the morning it will certainly be worse than at other times of the day. Lastly, the basal temperature increases during the day; reaching its peak at around 15:00. It follows that in the morning the warm-up should be more gradual and prolonged compared to other times of the day.

External temperature or weather conditions. These factors also greatly affect the warm-up process. In the case of low temperatures, it should be longer. In case of high temperatures, it must obviously be reduced.

WHEN TO DO A WARM-UP

The time between the end of the warm-up and the start of a competition/training must be about five to ten minutes because, in this period of time, the muscle temperature has not yet started to drop and, there is still the full effect of the warm-up on the performance capacity.

SUGGESTED WARM-UP ACTIVITIES

Sports literature proposes the following exercises:

- Moderate cardiorespiratory exercise (about 40% of HR reserve) which involves the movement of the main muscle groups and can be done via running, cycling, jumping rope, rowing machine, etc.;
- Warm-up and muscle activation exercises specific to the sport practiced;
- Stretching (not in all sports);
- Foam rollers and massage bars (only if performed constantly).

Stretching, foam roller and massage bars will be discussed at a later stage.

THE IMPORTANCE OF COOLING DOWN

Cooling down[2][3] involves all activities that, after physical exertion, bring the body back to a state of discharge, relaxation and rest, thus providing an important contribution to recovery, essential for optimal training.

Just as the warm-up is sport-specific and must take into account the exogenous and endogenous variables of the athlete, so too must the cooling down activities. In general, it can be noted that while in the warm-up the initial global stimulus is mild and progressively, it will become more intense and dynamic, in the cool-down the load trend is diametrically opposite.

The duration of the cool-down

In general, the duration of the cool-down varies depending on the athlete's workload and training status. In the case of light work, or in the case of an athlete who is in a poor state of training, the cool-down will be shorter, while in the case of a heavy workload, the cool down will have to be longer.

Suggested cool-down activities

- Light motor activities such as slow running, gentle pedalling, etc
- Stretching
- Postural gymnastics
- Foam rollers and massage bars

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STRETCHING

Stretching is a widely used practice in sports as it leads to an improvement in muscle flexibility, muscle performance and a reduction in the risk of injury. Clinical studies, on the prevention of DOMS, have shown that stretching is also useful in the prevention of such pains, but not in their care.[12][13]
Its effectiveness lies in the fact that - by increasing muscle flexibility - it allows the muscle to better respond to physical exercise, limiting its damage.
In fact, once muscle damage occurs, static stretching and PNF can no longer do anything to improve the situation. Indeed, in the case of PNF, the required muscle contractions could cause an intensified inflammatory response with consequent aggravation of the symptom, since they add a further load on an already damaged muscle.[14]

As there is still much confusion about what is the best time to perform stretching, we would like to underline that as regards the strength sports, scientific literature shows that it should not be carried out neither during the warm-up (since it has in evidence that both static stretching and ballistic stretching produce a decrease of this strength[17] [18] [19]*) not during the cool-down, it should in fact be in a separate session.*
Other important measures to take into consideration are:
that stretching should not be performed on cold muscles, since it increases the risk of damage to the connective tissue. For this reason, it is advisable to carry it out either immediately after warming up (if the type of sport foresees it) or during cool down;
that the intensity of stretching should not be excessive or too prolonged over time, as it could create tissue ischemia with consequent inflammation, especially in the insertion areas.
The right tension on a scale of 0 to 10 (where 0 =no tension and 10 = maximum) should be around 5.

Postural gymnastics

This is a physiotherapeutic method used in order to obtain correct myofascial relaxation. The purpose of postural gymnastics [4] is to position the joints as much as possible towards their anatomical reference axis in order to optimally stretch the fascial muscle system, as opposed to stretching, which can only provide approximate muscle lengthening, because it will stretch the muscle indulging the anatomical variations.
After proper training with their physiotherapist, athletes can perform the postural exercises alone.

Foam rollers and massage bars

Alongside postural gymnastics, foam rollers and massage bars are other types of treatment useful for myofascial relaxation. Foam rollers are rolls of polyurethane available in different sizes and density that are placed under the area to be treated and the self-treatment is performed by rolling on the affected area. The treatment can be more or less intense depending on the amount of body weight that the person decides to load[9].
Massage bars, on the other hand, (also available in different shapes, materials and sizes) are positioned above the area to be treated and self-treatment is carried out by "rolling" the bar. The treatment can be more or less intense depending on how much pressure is exerted by the upper limbs.[9].
Several scientific studies show that these tools, providing a myofascial release, are useful for improving joint (short-term) mobility, facilitating muscle recovery and limiting DOMS[9]. Regarding the increase in flexibility, it has been shown that this equipment is more effective for the femoral quadriceps and biceps than static and dynamic stretching[10].
However, there is no confirmation of their effectiveness on muscle activation.

Some studies report that their use does not impede muscle performance, while others have shown a decrease in muscle activation of the femoral biceps following a treatment on the quadriceps with a foam roller, but not the contrary, assuming that, as the treatment of quadriceps is more painful of that of the femoral biceps, the cause is a mutual inhibition given by the perception of pain on a competitive level[11].
From this it is clear that while the foam roller is certainly useful in the cool-down exercises, as regards the warm-up activities, it can be used only by athletes who use it continuously, so that the massage produced by it is not too painful, thus generating mutual inhibition.

WEIGHTLIFTING: ELEMENTS TO CONSIDER IN ORDER TO LIMIT INJURY

As weightlifting is characterized by the continuous repetition of a high-speed movement with sub-maximal and maximal overloads, the anatomical structures subjected to this mechanical stress over time may develop overuse diseases. The frequency and the speed with which these diseases may arise is not regulated, but is subject to the correct management of the body, in other words, the implementation of all the preventive measures designed to limit their development.
Taking into account the biomechanics of the athletic movement of weight lifting, the joints most affected by overuse can be[6]:

- the knee;
- the spine;
- the shoulder.

Furthermore, it should not be forgotten that the other joints involved in the athletic movement can become subject to inflammatory or degenerative pathologies or cause painful symptoms in another anatomical district. In Osteopathy this is called the HYPO vs HYPER concept[7], in other words, in order to make up for the minor movement of a body area (HYPO) the body makes other areas work (HYPER), to maintain a balance. If this new equilibrium is economical, the system will not generate painful symptoms, otherwise the HYPER area will become the location of pain as it is subject to hypersolicitation.
Knee: a typical knee pain (HYPER) for example may be caused by [4]

- loss of mobility (HYPO) of the ankle joint
- loss of mobility (HYPO) of the coxofemoral joint
- fascial retraction (HYPO) of the posterior or anterior kinetic chain.

Spine: lower back pain (HYPER) on the other hand may be caused by a loss of mobility (HYPO) of [4]:

- the lower limb (knee, hip, ankle, fascia retractions)
- backbones (joint and fascial problems)
- the thoracic diaphragm
- the pelvic diaphragm.
- It may also be caused by an instability of the area due to inadequate core training, since the significant dynamic forces that develop during the execution of the technical movement presuppose an important involvement of this structure expressed in terms of functional stabilization[1][8].

Shoulder: the shoulder, being the most unstable and mobile articulation of the human body, requires greater attention[5] because, particularly in weightlifting, as in throwing sports, it is subjected to repetitive stress with considerable angular velocities and considerable external loads, which expose it to the development of instability or impingement[6].

Instability or impingement (HYPER) can be brought on by[5] :

- poor joint mobility (HYPO)
- poor muscle extensibility (HYPO)
- functional instability (HYPO)
- deficit of neuromuscular control (proprioception, coordination)
- muscular imbalance.

Poor joint mobility and poor muscle extensibility[5][6]. By poor joint mobility we do not mean only that of the shoulder unit (stiffness of the posterior capsule during flexion facilitates the ascent of the humeral head towards the coraco-acromial vault, possibly leading to impingement; or the hypermobility of the scapula can alter the scapulothoracic rhythm and subsequently also the glenohumeral rhythm) but also that of the thorax, the dorsal spine, the cervico-thoracic junction, the prone-supination of the forearm.
Consequently, when poor muscle extensibility is apparent, reference is made not only to the shoulder muscles, but also to those of the forearm, arm, cervical and thoracic region.

Functional instability and neuromuscular control deficit[5][6]**.** The functional instability of the shoulder should not be limited to the only alteration of the scapulo-humeral musculature, but it should also be extended to the scapulo-thoracic musculature and to the lumbo-pelvic complex (*core*).
The cuff muscles, in fact, via synergistic contraction exert a primary stabilizing action on the glenohumeral joint in association with the long head of the biceps[6][20].
The scapular muscles, on the other hand, provide a proximal stability of this joint (scapula-thoracic) as a precondition for distal (glenohumeral) stability. Lastly, the core represents the primary element of all stability, as the core complex controls the entire muscular kinetic chain.
To confirm this, studies concerning lumbar stabilization have highlighted:

- an anticipatory contraction of the transverse muscle of the abdomen with each movement of the arm [6][21];
- the presence of a relationship between a scapular dysfunction and a lumbo-pelvic muscular deficit (Young 1996) [6][22];
- good lumbo-pelvic stability guarantees the correct distribution of kinetic energy to the lower and upper limbs.

Proprioception also plays a major role in controlling muscle stabilization: in fact, studies carried out in the last decade have shown that proprioceptive information participates in the timing and planning of movement [6][23][24]. It has been demonstrated that proprioception[8] is the result of a continuous interaction between afferent and efferent impulses.
The most important afferent component is kinesthesia, that is the ability to distinguish the joint position, the relative weight of the parts of the body, the articular movements including direction, amplitude and speed.
The efferent component is the response that follows the afferent stimulus, coordinating and selecting the appropriate muscular contractions, necessary to stabilize the articulation and/or to modify its position so as to prevent excessive displacement.
It must be kept in mind, however, that these *particular proprioceptive and coordination skills are influenced by muscle fatigue that affects their quality*; therefore, when assigning exercises with a high technical content, the condition of profound muscle fatigue must never be reached.

Muscle imbalance[5][6]. Muscle imbalance can lead to the development of impingement. In fact, the most important mechanism for preventing impingement is the maintenance of the humeral head depression mechanisms, which is entrusted to the correct balance of the cuff muscles. In addition, the lower fibers of the cuff balance the tendency of the deltoid to develop upward traction of the humeral head ensuring, during movement, the so-called dynamic centering of the humeral head inside the glenoid.
In addition to this aspect, it must be taken into account that in so-called *overhead* sports there can be a strain on the extrarotators (supraspinatus, infraspinatus, teres minor) with respect to the deltoid and the pectoralis major. This will lead to a greater hyposthenia of the depressors than of the elevators of the humeral head with the consequent predisposition to conflict.
In conclusion, regardless of the articulation considered, the measures to be seriously taken into account are:

- balanced muscle strength between agonists and antagonists muscles in the various parts of the body;
- good core strength;
- good joint mobility;
- good muscle extensibility;
- good proprioceptive and coordination skills.

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HUMAN TALENT: GENERAL OVERVIEW

BY VLADIMIR ISSURIN


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Since the first publications of Francis Galton, the nature of human talent has remained the focus of persistent efforts of many scholars and analysts in various areas of science and culture. The general idea that nature and nurture in their distinct proportion predetermine appearance and development of talent in a given domain became extremely popular and widely discussed both among the scientists and practitioners in different branches of education and management.

The main directions of these debates were associated with the definition and explanation of the phenomenon of talent, possibilities of its earlier discovery, and strategy for its further development until achievement of true excellence in a given domain. Of course, it would be a mistake to consider the problem of Athletic Talent without its connection to a large body of knowledge related to human talent itself. Therefore, a short overview of talent is placed below.

BASIC POSITIONS RELATED TO THE PHENOMENON OF HUMAN TALENT

Of course, because there is no unanimity in understanding the nature of talent, its definitions differ substantially. From this position, the most comprehensive and unequivocal quotation can be offered: *a special ability that allows someone to reach excellence in some activity in a given domain*.

A better clarification of this general declaration requires assignment of five substantial properties of talent (Howe et al., 1998):

1) Existence of hereditarily transmitted structures that determine its innate nature;
2) Availability of early indicators, allowing experts to identify the presence of talent (although it may not be evident during preliminary observation);
3) The early indications of talent allow prediction of future success of the individual in the given domain;
4) The talented individuals form a relatively small part of the evaluated sub-population;
5) Talents are usually domain-specific.

Let's consider the above properties of true talent based on general concepts and evidence from available literature. There is a common belief that true talents have a strong contribution from heredity-related features and that these form the basis for a special "gift" or aptitude for a certain activity. These genetically predetermined human features can be reasonably qualified as an innate component of talent. The authority of experts emphasize the biological nature of genetically transmitted talents and claim that such terms like "giftedness" and "aptitude" are frequently used for characterization talent in the earlier stages of its recognition (Cagne, 1993; Eysenck, 1995).

The earlier indications of talented children were always the focus of biological and educational experts. The common position is that talents are usually recognized by parents and teachers, but may also be discovered fortuitously (Howe et al., 1998). Of course, various activities give different opportunities for discovering talent; music prodigies can be recognized at 3-5 years, whereas extraordinary abilities in chess or mathematics need some period of preliminary education and can be revealed a bit later. In any case, earlier indications are actively used for reasonable prediction of great professional success in the future.

The objective recognition of gifted children is associated with serious difficulties. The quantity of talented children in the normal population is under debate, although the value of 10% has been specified by several experts from different domains (Carroll, 1993). Presumably, the appearance of an exceptionally gifted child is a unique case with a probability of about 1%. General logic and experiences support the declaration that talent is domain-specific. Such kind of specificity can be partly explained by high concentration of prodigies on activities within the domain of their giftedness, although neurophysiological prerequisites of this selectivity cannot be ruled out.

An original concept, termed the Differentiated Model of Giftedness and Talent (DMGT), has been recently elaborated by Gagné (2005). The author proposed that specific talents in the domains of mathematics, art, music, science etc. occur on the basis of hereditarily transmitted gifts as a result of environmental influences from family, school, formal, and informal activities.

Bearing in mind that extraordinary abilities of an individual are at least partly predetermined by bio-

logical background, it is likely that these neurological and psychosomatic factors may predetermine exclusive potential in one domain but not in other. Two of the most disputable questions regarding talent are: How strong and decisive is the impact of inborn hereditary factors on the future actualization of talent? And, to what extent is the role of nurturing decisive in the accomplishment of exceptional abilities and skills? Let's consider two polar versions of the interpretation of this dualism.

ARGUMENTS AND FINDINGS IN SUPPORT OF THE CONCEPT OF "NATURAL TALENT"

The general position that is popular among many scholars and analysts claims that "natural talent" is firmly determined by inborn, genetically transmitted features and that these have primary and decisive importance in the achievement of excellence in a certain domain. This position is argued based on evidence collected and clustered in three directions, namely: (1) very early manifestation of extraordinary abilities and skills, (2) achievement of outstanding mastery in a certain domain in the absence of teaching, instruction, and external assistance, (3) availability of biological traits and indicators affecting achievement of excellent performance. These three groups of evidence are considered below.

Early discovery of exceptional abilities and skills

The major part of earlier discoveries of extraordinary abilities and skills belongs to the domain of music. The literature presents a large number of examples of very early manifestation of musical talent by child prodigies; one of the classic descriptions relates to Mozart. This genial composer started to play piano at three years old and showed outstanding mastery on the clarinet and the violin at age five, when he created his first composition.

One more example relates to the world-famous composer of the 20th century, Igor Stravinsky (Russia, USA). According the self-report of this great musician, he started to play piano at age two, when he was hardly able to walk.

A more recent example belongs to Midori Got: world-recognized, Japanese born American and virtuous violinist. Her incredible musicality was discovered at age two, when her mother, a professional violinist, noticed that Midori was humming a theme of Bach, which she heard during her mother's rehearsal.

At the age of 11, Midori Got debuted with the New York Philharmonic Orchestra in the prestigous program of the New Year's Eve Gala. Now she has one of the leading positions in the world music community.

Chess is another domain where earlier discoveries of innate talent have many examples. Perhaps one of the most impressive examples refers to Robert Fisher, the eleventh World chess champion and one of the most famous chess prodigies. Robert Fisher started to learn chess with his sister at age six using a primitive, teach-yourself book. For two years he played chess with sister or alone without coaching or external support.

Afterwards, he entered into the local chess club and received coaching from the highly professional grandmaster William Lombardy. At age 14, Bobby Fisher became the youngest winner of the USA Open Championship. Since then he has taken part, successfully, in many highly prestigious events and remains one of the greatest creative players in the history of chess.

Another example of a chess prodigy refers to the outstanding Hungarian player, Judith Polgar. Unlike the legendary Robert Fisher, she began with a formal chess education, being coached by her father, László Polgar. At that time, Judith was about three years of age. Judith was trained with her two sisters, who also became world-recognized chess players. She started to take part in tournaments at age six and obtained 1st position in the Women's World rankings at age 12. She maintained this leading position until she retired, 26 years later. Judith received the highly prestigious status of grandmaster at age 15, even earlier then Bobby Fisher. Therefore, she was the youngest chess player ever who received this honorable status.

The list of prodigies with extraordinary abilities in mathematics could start with the great historical personality, Evariste Galois (1811-1832). As a teenager, Galois solved a problem that had been standing for 350 years. The problem was concerned with necessary and sufficient conditions for a polynomial functions, which were later implemented into fundamental chemistry, physics, and economics (Livio, 2006).

Modern history contains a large number of exclusively talented young mathematicians, which can be illustrated by two impressive examples. Jason Levy (born 1972) began studies at York University in Toronto at age 10 and graduated the whole course at 14 with a Specialized Honored B.A. in Mathematics. He received a M.Sc. degree at age 15 and completed the PhD program at age 20.

Another example of a mathematician child-genius is Promethea Olympia Kyrene Pythaitha (born 1991). According the family report, she started to read at age 1 and achieved an IQ of 173. At age 7, she began a college-level calculus program and completed a bachelor's degree in Mathematics from Montana State University by age 13.

The biographies of the Nobel Prize winners in Physics, Enrico Fermi and Wolfgang Pauli, provide examples of early discoveries of their magnificent talents and creativity. Another Nobel Laureate, Rabindranat Tagore of India, who was the first Asian to win the Nobel Prize in Literature, created his first poem at age 8 and published dramas at age 16.

The history of art presents many examples of early discovery of natural talent. One of the most impressive refers to the life story of the great painter, Pablo Picasso. At age 8, Picasso created the excellent painting *Picador*, that has recieved world recognition as the first masterpiece of a great Spanish artist.

Summarizing the above-presented evidence, we can conclude that earlier discoveries of superior abilities and skills give convincing support to existence of natural talent. This assumption can be argued by findings of numerous studies including long-term research embracing the entire life span, from infancy to adulthood. It was established that memory measured in infants aged 2–4 months could predict the future IQ of the individual (Freeman, 2001). Moreover, the newborns that habituated faster have a preferable chance to obtain higher IQs than others (Colombo, 1993).

All that is presented above and much other evidence has shown very early discoveries of incredible human skills and abilities that are definitely associated with hereditary input. However, critically oriented analysts argue that all of the mentioned examples appear and are developed in favorable environmental conditions and cannot be considered as an embodiment of *natural talent* per se. Indeed, favorable family conditions and parental support play an important role in the life story of child prodigies. However, there are well-documented cases where the highest level of professional mastery was achieved in the absence of any support or elementary instruction. These cases are considered below.

Achievement of outstanding mastery without professional support and assistance

Numerous data has been reported on children who acquired perfect skills and/or abilities in a certain domain without available learning opportunities and without preliminary instruction or assistance. The classic examples of such inborn talents can be found in the history of mathematics. Namely, Ramanujan Srinivasa, the mathematician genius of India (1887–1920), who was born in poor family and did not receive a systematic education in mathematics. At age 15, he started his self-education using a book containing a list of 6,000 theorems. Following his creative efforts, Ramanujan generated his own, original theorems and has published them in scientific journals. Finally, this great scientist-autodidact made valuable discoveries in the theory of numbers, mathematical analysis, infinite series, and continued fractions. The contributions of Ramanujan Srinivasa in world science are recognized by the international mathematical community (Zohar, 2001).

One of the most illustrative examples of talent creation people who did not receive preliminary, professional preparation or external instructions relates to the appearance of self-educated African sculptors from the Shona region of Zimbabwe. In his late 50's, a white farmer who owned a farm called Tengenenge discovered a large storage of malleable stone suitable for indigenous carving. The farmer engaged a number of local inhabitants who expressed their readiness for the acquisition of stone carving and sculpting skills. These volunteers received elementary conditions for creation, such as work place, instruments, and materials. During a certain time span, these art newcomers obtained appropriate skills and created very original sculpting masterpieces in African style that received high appreciation from the experts of the Zimbabwe National Gallery. A bit later, the masterpieces of the Shona sculptors became popular among world recognized art experts and were introduced in exhibitions and galleries of Europe, Australia and the United States. Art professionals noted a similarity between African masterpieces and paintings of Picasso and Modigliani; of course, Shona sculptors have never seen or heard of the creation of these genial masters (Kasfir, 2007).

The two above examples provide strong evidence that great talent can appear and be developed exclusively in a natural background, being strongly associated with innate predispositions.

Availability of biological traits and markers

A large amount of studies devoted to the examination of biological prerequisites of natural talent can be subdivided into two groups: (1) studies of several biological traits, mostly neurological, affecting appearance and development of extraordinary skills and/or abilities; (2) research projects realized within human genetics.

The first group includes precise electrophysiological measurements of brain functions, structural organizations, and activities. A number of neurological traits have been mentioned as possible sources of influence on excessively high abilities, i.e. left-handedness, hemispheric laterality, high rate of

glucose metabolism, various blood flow estimates, prenatal exposure to increased content of testosterone etc. (Howe et al., 1998). It was established that appropriate brain characteristics appear to be contributors of high abilities in different, specific domains. Interestingly, cortical representation of the left hand's digits in string players, like violinists, is much larger than in the general population. To note, the left hand is specifically responsible for fingering the strings during playing (Schlaug et al., 1995). Indeed, various visual, auditory, and somatosensory functions have appropriate representations in the brain and may reflect differences between more and less talented people.

The second group embraces evidence from studies of molecular genetics that have discovered a large number of genetic markers that allow for the identification of a predisposition toward a certain mode of activity. For instance, cognitive abilities form the basis for general intelligence and creative activities in various branches of science and technology. Let's consider the findings of molecular genetics that have examined the role and predictive potential of several genetic markers of cognitive giftedness. A study from Plomin with associates (1994), was devoted to the investigation of hereditary indicators of IQ. Genotypes of people with a high, medium, and low level of IQ were compared with regards to expression of DNA markers in genes, which were suggested to be regulators of neural functioning. The authors revealed two markers, among many others, that significantly predict the difference between people with a high or low IQ.

Another project of molecular genetics was devoted to the identification of DNA markers associated with the general cognitive ability of schoolchildren (Fisher et al., 1999). The authors compared pooled DNA from 51 highly cognitive and 51 control children with average abilities. They found 11 markers that were significantly different in the two subgroups of children. Furthermore, three of the 11 indicated markers were confirmed as the most predictive and informative. The authors reasonably concluded that these findings open new perspectives in cognitive neuroscience.

One more genetic study was conducted with regards to etiology of Absolute Pitch (AP) as an indicator of extraordinary musicality (Theusch et al., 2009). The researchers investigated 73 families in which at least two family members possess AP; in total, 220 people. DNA samples were collected for further analysis. The authors found that at least one gene promotes the genesis of AP, although several genetic factors vary within and between different populations. Nevertheless, they localized one region where AP has significant linkage on chromosome 8q24.21. Therefore, the study results support the position that genetic factors have a high contribution on the etiology of musical talent.

One more remark can be made with regards to the role of early nurturing in talented individuals. It is very likely that children with exceptional abilities in some domain such as music, art, etc. evoked the pronounced interest of parents and teachers and they initiated intensive tutoring, special education, and training, aiming to reinforce their gift (Rutter,1998). In this case, the primary reasons for early nurturing were the gift itself and its recognition by competent persons.

Summarizing this section, it can be suggested that the existence of innate talent as well as its decisive role in achievement of extraordinary abilities and excellence in certain domain is supported by many findings and evidence from different branches of human activities. Despite this, the serious examination of available literature reveals a large body of publications in which authors have found many arguments against the "innate talent" concept. They emphasize the role and importance of nurturing factors and consider education and highly dedicated practice the decisive determinants of talent. These contrasting arguments are presented below.

EVIDENCE AND CONCEPTS CONTRADICTING THE PARADIGM OF NATURAL TALENT

A review of the available literature reveals a large number of publications where the existence of natural talent is considered doubtful or even illusory. The proponents of these critical declarations usually attribute extraordinary abilities and skills of several individuals to highly dedicated, persistent practice and training. They propose a number of arguments that may supposedly reduce the importance of innate factors in achievement of excellence in a given

domain. Let's consider these arguments and evidence below.

Arguments against the existence of natural talent

The critical arguments supporting the dominant role of practice in attainment of superior skills and abilities operate with lack of objective and reliable predictors of talent, lack of difference in learnability of hypothetically gifted and less gifted children, and insufficient accuracy of talent predictors. Let's consider these critical arguments below.

Existence of early predictors of giftedness. There is a great amount of evidence concerning the lack of early predictors of giftedness and talent. For instance, Manturzewska (1986) studied biographies of 165 professional polish musicians and found very few reports on their extraordinary musicality in early childhood. Similar outcomes have been received in retrospective studies of outstanding artists (Sloane & Sosniak 1985) and mathematicians (Gustin 1985). The cited authors attributed superior abilities of the most successful individuals to parental support and earlier deliberate practice of studied respondents. To date, authors have compared performance trends of superior individuals with less successful people who also attained a high professional level. It can be suggested that these counterparts of superior performers obtained their high professional level using a valuable contribution of innate prerequisites, although their influence was not as strong as in more talented individuals.

Learnability of hypothetically gifted children. There is evidence that highly successful, young musicians do not reveal any advantages in acquisition of professional skills when spending a similar amount of time practicing as other children (Sloboda et al., 1996). In addition, several analysts have claimed that even prominent composers passed through sufficiently long periods to obtain appropriate mastery. They spent 10 years or more to achieve a high level in their profession (Simonton, 1991).

One more argument relates to the existence of sensitive periods when an individual expresses heightened responsiveness to any new information, enabling ease and more successful acquisition and development of new skills and abilities. The classic example of such increased sensitivity refers to the acquisition of a new language by young children who learn various linguistic forms and constructions easily and quickly; for adults, this process is associated with higher efforts and difficulties. It can be suggested that appropriate exploitation of sensitive periods reinforces the impact of environmental but not inborn factors.

Insufficient accuracy of talent prediction and identification. Several authors have noted that available methods of measurement and prediction of talent are far of accurate. It has been specified that a number of important circumstances are usually not taken into account. They are: age of earlier evaluation, volume, content and quality of preliminary practice, external motivation, and a familial support (Tesch-Romer, 1998). The author has stressed that these relevant factors are usually not evaluated objectively but based on retrospective reports of parents or family members. Moreover, the

probability of predicted success is often very low because success on the highest level is rare and affected by many unpredictable circumstances.

The accuracy of various predictive programs was repeatedly examined by serious sport analysts. Namely, Lidor with associates (2009) who inspected the applicability of widely used physiological and anthropological variables as predictors of future athletic excellence. Based on data of a numerous studies, they did not find plausible evidence of earlier differentiation between highly talented and less talented youngsters.

The sport science literature has rare examples of longitudinal studies where the data of world-class athletes were compared with data of lower level but highly qualified athletes. These data are presented futher on.

The theory of 10 years of deliberate practice

This theory was proposed about two decades ago and was initially based on the extensive data collected among the students of a music academy and highly professional musicians (Ericsson et al., 1993). Subsequently, the authors have found support of this theory by collecting data from highly professional mathematicians and high-level athletes, mostly from chess and tennis. The framework of this theory presupposes that obtaining the highest level of performance (so called, *expert performance*) demands 10,000 hours or 10 years of deliberate practice in the chosen domain. Deliberate practice was defined as *high quality, high concentration practice that is not usually inherently enjoyable*; practice activities must become increasingly more complex over time, and practice must be done with the primary goal of improving performance.

The founder of this theory, Prof. Ericsson (1998), emphasizes the role of motivation; this factor strongly influences the effectiveness of deliberate practice in most successful individuals. The author claims that habitual activities assume effortless executions that do not stimulate progression in expert performance. In contrast, highly motivated individuals plan, control, and monitor a higher level of their activities, prompting more pronounced enhancement of skills and abilities than less successful performers. Following this premise, the effortful pursuit of mastery, rather than innate factors, determines achievement of excellence, i.e. talent. The proponents of priority of environmental factors and deliberate practice claim, for instance, that the phenomenal musicality of Mozart was predetermined by his earlier involvement in deliberate practice but not by his superior inborn abilities (Howe et al., 1998).

Additional contribution to the theory of deliberate practice was completed by Simonton (1999) who recognized the multidimensional nature of talent that contains physiological, psychological, and physical components. However, in his conceptual model, the author emphasized the role of environmental factors, distinguishing the importance and specificity of performance determinants and determinants of skill acquisition. Following the Simonton model of performance, these determinants form the basis for an individual's capacity within a competitive environment whereas determinants of skill acquisition affect successfulness of the learning process. As the author claimed, the interaction of these factors produces a multiplicative effect where environmental impact is overlooked under hereditary input.

The "rule of 10 years" became popular and widely considered among the experts in athlete's preparation; its applicability to reality of high-performance sport will be discussed in Chapter 5.

SUMMARY

Summarizing this chapter, it is worth noting a number of conclusive remarks related to the general comprehension and interpretation of the problem of innate talent. The above-presented data mostly relate to research where talent was studied with regards to various branches of human activities. It can be claimed that the majority of researchers and analysts draw the conclusion that hereditarily transmitted factors are decisive contributors for extraordinary abilities and excellence, which are qualified as talent. Importantly, convinced advocates of natural talent do not deny the necessity and importance of purposeful education, highly dedicated practice, and persistent training. On the other hand, the supporters of priority of environmental factors in human talent will not always admit to a contribution of inborn features in achievement of

pure excellence in a given domain.

These general positions and contrasting arguments definitely affect our understanding of the current situation in sport science and sport practice. However, a certain specificity, and even uniqueness, of sport reality give us a substantial privilege in the recognition and final identification of talent. Indeed, the inherent competitiveness of sport and availability of objective indicators of excellence provide analysts with the key for final qualification of the talented individual based on his/her achievements and records in world sport.

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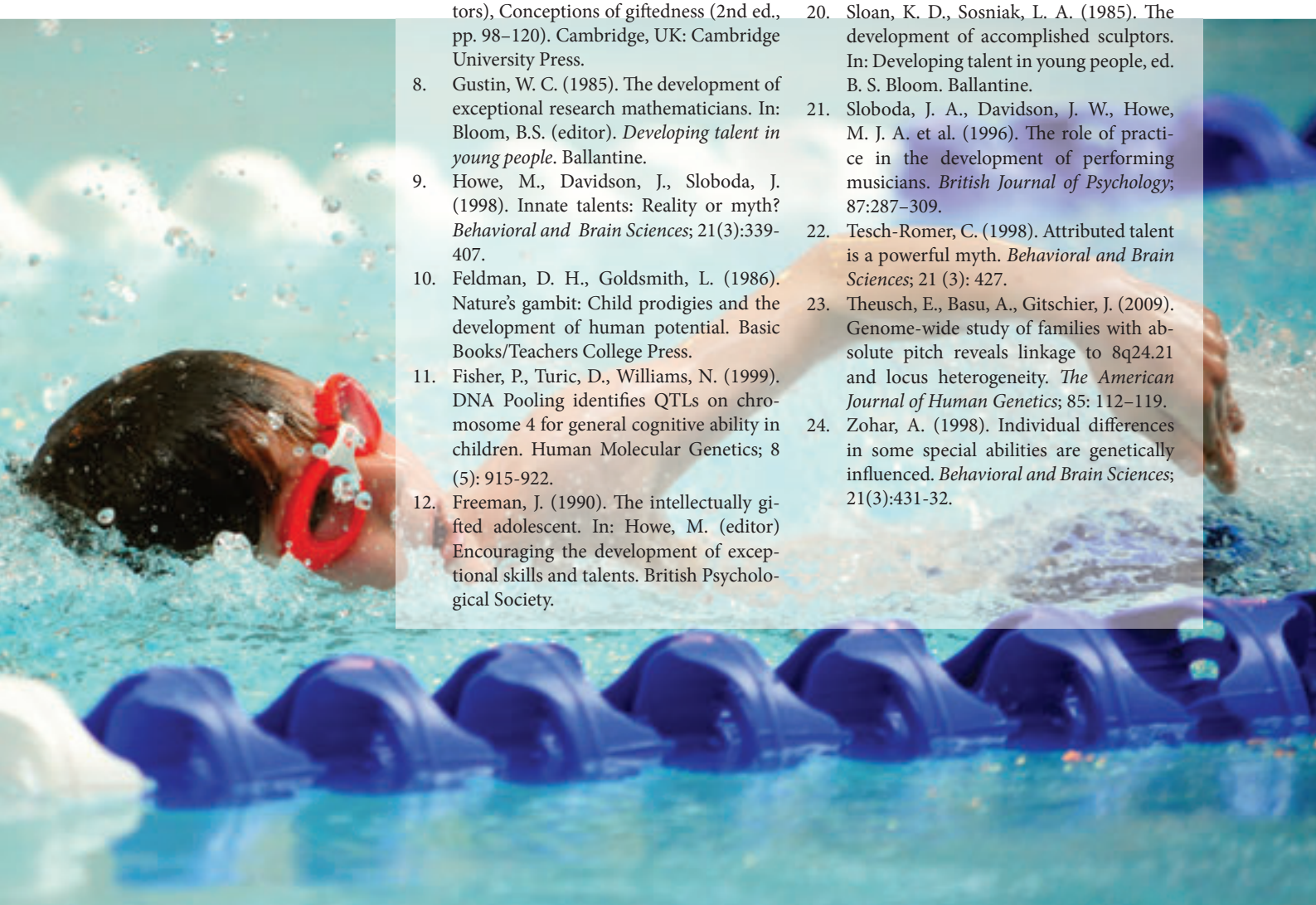

WHY DOPING?

BY FRANCESCO RICCARDO


Contrôle
Anti-Dopage
le Tour France

Before illustrating various psychological dynamics that induce some individuals to resort to doping substances, we should bear in mind that doping is tantamount to taking drugs and that doping is punishable by law; people take drugs to enhance their sports performance, using cocaine or amphetamines to be better prepared to face the difficulties posed by tasks of various kinds. Put like that, it would seem almost natural to resort to the use of substances that help normal psycho-physical faculties to promote performance, be it sports, working, sexual and so on. A bit like taking a multivitamin to give us a little boost. So the question to ask perhaps is not, "why doping?" But "why do we need to resort to doping?".

The word "need" implies a "lack". In 1954, the American psychologist Abraham Maslow (1908-1970) devised the concept of "Hierarchy of Needs" and illustrated it in his book, *Motivation and Personality*. This scale of needs is divided into five different levels, from the most basic (necessary for the survival of the individual) to the most complex (of a social nature). The individual fulfils himself by passing through the various stages, which must be satisfied progressively. This scale is internationally known as "The Maslow Pyramid". The levels of need classified as follows:

1. Physiological needs (hunger, thirst, etc.)
2. Safety needs (security and protection)
3. Love and belonging needs (intimacy and a sense of connection)
4. Esteem needs (prestige, accomplishment)
5. Self-actualisation needs (realizing one's own identity, achieving potential and occupying a satisfactory position in the social group).

According to Henry Alexander Murray (1893-1988), however, needs are intended as a drive or internal forces that direct the individual and push him to act in the surrounding environment, with the aim of changing situations that can lead to the satisfaction of the same. Murray hypothesised a close relationship between the environment that stimulates and pushes the individual, and the internal forces that produce the movement, reaching the conclusion that the perception and interpretation of events are directly linked to the integration of these two fundamental forces.
Bertrand Russell (1872-1970), philosopher, logical, mathematician, Welsh activist and essayist, argued that "to be without some of the things you want is an indispensable part of happiness". Whereas, necessity expresses a primary need of the organism, whose lack of satisfaction does not consent it to live adequately, it is connected to states of tension that require to be satisfied through a homeostatic process, they are active throughout life and are non-objective, in other words, they do not arise from the encounter between the object and the subject; desire, on the contrary, is always connected to an object.
There would be no desire without an object and, at the same time, it would not be conceivable to relate to "objects" without the desire for them. Desire is therefore a compromise between the subject, his basic needs and the environment. Desires are born from the dynamic encounter between the self and the environment. They have a secondary origin to needs that, instead, represent the biological basis of the living being. All needs stem from two principles: "the conservation of the species" and "the preservation of the individual". An example: the innate and physiological need for food. The need to be fed, for example, can apparently correspond to the desire for food. A feeling of hunger naturally requires food, but the need is to be fed. The desire connected to the object that will lead to the satisfaction of the need will replace the need as a consequence of the reiteration of the objective experiences of regulating the physiological need.

The hungry child, through his previous experiences, will therefore desire first the individual who will feed him (the object) and, later, the food. In their studies of the attachment bond between parents and children, between 1958 and 1965, psychologists Harry Frederick Harlow and his wife Clara Mears raised macaque pups, depriving them of their mother; the monkeys had only two maternal substitutes: one made of soft cloth and the other of wire; the latter had an incorporated baby bottle to which the hungry monkeys attached themselves to suckle the milk. After repeated observations, the psychologists noticed that the

monkeys spent most of the time attached to the soft shape, even if it was devoid of bottles, and they attached themselves to the metallic shape only to eat.

After a few weeks, the monkeys became sad and frightened because of the lack of physical contact and interaction. When the monkeys grew up, they behaved like "bad mothers": they showed indifference to their little ones, did not nurse them, did not rebel if something happened to the little ones and in the end attacked and rejected them.

Need and its positive fulfillment are indispensable for desire to be instrumental to the life of the individual. Difficulties arise in the case of an ineffective satisfaction of the basic need, or the unsuitable or partial satisfaction of it. Adequate desires arise in conditions where the underlying need has been recognised by the subject and is validly fulfilled by the surrounding environment and the development process has been less conditioned by defensive mechanisms. A dysfunctional desire comes from an environment that is incapable either of providing the appropriate satisfaction to the need, or of recognising it. The process of development is often complex to identify and the material that can allow it to be recomposed is almost always unconscious, due to defensive mechanisms.

An example of dysfunctional desire is the search for food by virtue of a need for attachment, such as the experience of binge eating in eating disorders (DCA). Another example is the use of drugs (Frances R. et al (1994), *Psychodynamics*, in Galanter M., Kleber HD, *Treatment of substance use disorders*, Masson, Milan 1998) by subjects who nourish strong feelings of guilt (to be explored in therapy) and resort to self-destructive behaviour; or deficits in the development of some ego defenses and deficits in healthy affective experiences predispose the individual to substance abuse and alcoholism. Rado (Rado S., 1926, *The Psychic Effects of Intoxication: Attempts at a Psycho analytic Theory of Drug Addiction, Int. J. Psycho-analysis, VII*) and other authors with the reference to oral erotism and narcissistic structure, Moreno (Moreno M, 1976, *The new drug addicts, in Psychotherapy and Social Criticism*, Sansoni, Florence) and Parenti (Parenti F, 1987), Alfred Adler, (Laterza, Bari), the spoiled child (a child who is unprepared and inadequate for the purposes of life and tending to think only of himself), or the neglected child (as illustrated by A. Lowen in "*Bioenergetics*", Feltrinelli 2007, concerning the children of parents unable to satisfy the fundamental

rights of the child), describe a type of character consisting of emotional immaturity, depression, inconclusiveness and deep insecurity. This depends on the fact that the adolescent drug addict can not reach an "adult" emotional level in the way he relates to his parents. According to Adler (Adler A., 1920, *Praxis und Theorie der Individualpsychologie*, Adler A., 1927, Menschenkenntnis), the search for pleasure is at the root of the behaviour that leads to addiction. Those who have stopped fighting in the face of life's difficulties since childhood, compensating themselves with daydreaming, will be inclined to seek means to provide pleasure in adult life. The addict is unable to face the adversities of life and tends to search for momentary pleasures. Many consider it right to drink to ward off negative thoughts and improve the mood. Typical situations in which a person takes drugs are those in which you want to escape a request that life offers. Humiliations or sorrows make morphine and alcohol desirable, which are "daydreams for adults".

The human being interfaces with external reality through the desires that only in a small part are directly accessible to our conscience. Repression, denial and other defensive processes that act in the course of existence tend to mask many desires, especially those subjectively rejected, and to conceal them below the level of consciousness. This is the dense web of desires, that is, a tight-knit network that operates mostly without the glimmer of awareness and which, inevitably, influences and controls our existence, our behaviours, our relationships.

Having said that, even if not exhaustively considering the complexity of the psychological dynamics involved, the dysfunctional behaviour of resorting to doping is similar and comparable to that which induces some subjects to resort to the use of substances and/or alcohol. The individual who decides to take performance enhancing drugs, more or less consciously, trades his health with his own image, be it corporeal (real or idealised) or relative to his social representation (to be winners, to have power). Attention to the body in this case is not a healthy pursuit of well-being, of balance, but the obsession with its prestige and form drives towards the attainment of a level of misleading, therefore unattainable perfection. And where there is no real well-being understood as the pleasure of feeling and living one's body through the awareness of its sensations, its potential and its limitations, the most obvious compromise is to use it as a bio-mechanical tool to reach "pleasure", in the form of winning a medal at all costs. Unfortunately, the pleasure that derives from this is only a substitute for real pleasure, as it passes through self-destructive behaviour, and, based on the theoretical premises made earlier, one avoids confronting the "lack" that created an "emotional void" to be filled at all costs to alleviate suffering, to avoid seeing one's vulnerability, to escape the fear of failure, to avoid encountering an object that has not been able to satisfy one's desire.

Doping is well suited to helping the individual achieve this goal, overcoming limits imposed by both bio-psycho-social and ethical-moral-legal factors. Among the social-environmental causes, we can find excessive expectations and pressure from surrounding environments: the social myth of success appears to be largely responsible and can be decidedly seductive for teenagers; also the progressive general decline of the conscience, in the ethical sense or in the sense of awareness, when faced with the myth of success, of high earnings and of image. Excessive sporting commitment stimulated in the athlete responds to the function of sustaining self-esteem and an identity founded exclusively on competitive success and social prestige and then, increasingly, on the fear of losing that "winning" identity.

Excessive stress and the consequent, growing anxiety to contain and reduce it. Hence the need to resort to doping even with the most reassuring functions, therefore a functional operation, in this phase, also to reduce stress. Which translates, obviously, into a further motivational reinforcement to take doping substances. But every external pressure always meets a body that must face it. If the individual has a very insecure "ID" and consequent fear of failing (high anxiety) and/or an excessively competitive and perfectionist "ID", which reveals an already present narcissistic fixation, the use of doping substances will facilitate the task, favouring the achievement of the goal.

Other pseudo motivations are those that try to justify the use of doping substances as a shortcut for a quick reconquest of lost form following an injury, or if an athlete wants to use pharmacological substances to control pain, energy and psychophysical activation.
Once again, in this case, having everything immediately refers to the childish dynamics of a child who does not tolerate frustration and who has made impulsivity his reason for living, that gave him the possibility to obtain what he wanted; in this case, most likely his parents were not able to "frustrate" him in the best way, they were unable to use, as it would have been necessary, the words "NO" and "YES". The basic psychological dynamic that supports doping is:

- ✓ an extreme refusal to know oneself and accept one's limits
- ✓ the declaration of incapacity to bear the risk of failure in the competitions
- ✓ a way that favours the identification with the unique and indispensable sporting victory
- ✓ affirmation of oneself
- ✓ in addition, making the athlete believe he can become invincible and seducing him with the mirage of victory, makes him substantially the victim of his fear of losing; in order not to deal with this fear, it activates self-destructive behaviour.

To evaluate the motivational orientation, we can refer to task orientation (for which the individual is interested in showing a certain degree of competence/mastery) and Ego orientation (for which the individual wants to demonstrate their skill level in comparison with others (F. Bertuccioli, in Monica Messina, *Laboratory of Neurosciences* - University of Cagliari, 2002; Duda JL, Nicholls JC, 1992, *Dimension of Achievement Motivation, in Schoolwork and Sport*, in Journal of Educational Psychology, 84, 3, 99.209-9).

But why does task and Ego orientation have important implications for the development of a motivation that favours the use of doping? Because, especially in adolescents, the type of orientation is closely linked to self-esteem, moral behaviour and lifestyle, with particular attention to eating habits, the habit of movement and the consumption of drugs. It is easy to understand that children who play sports because they are task-oriented, that is, want to commit themselves to improve, are those who have a solid self-esteem and do not seek confirmation of their value by confronting others. They are also less afraid of failures because their success mainly consists of making personal progress thanks to a long-term commitment. On the other hand, ego-oriented youths, those who benefit from excelling over others, tend to have low self-esteem; they therefore try to confirm their own value by confronting each other and endure defeats badly because at every failure they are forced to question the value of their person as a whole. It has also been pointed out that task orientation is in positive relation with the perception of sport as an amusing activity, while on the contrary the ego orientation would reduce the intrinsic interest for the same (Duda, Nicholls, 1992).

A survey conducted in Rome in 2000 showed that 9.9% of boys between the ages of 11 and 13 resort to supplements, especially containing creatine and amino

acids, and that the percentage grows with age. Not to mention the disproportionate use among the very young of products, such as the famous Red Bull, containing, among other things, high doses of a stimulant such as caffeine: the intake is more frequently associated with a high level of ego orientation and a low level of self-efficacy, while correlated with a low level of task orientation. This result is more markedly evident in males than females. This means that young people who resort to the use of exogenous substances such as supplements, to improve their physical condition, are more frequently those who are motivated to achieve success with the least possible effort, demonstrated by a low orientation to the task.

We could summarise risk factors in three clusters:

- ✓ Individual factors: Ego motivated orientation, excessive orientation to success
- ✓ Highly impressionable, low level of morals and unhealthy life habits.
- ✓ Family and friendship factors: excessive reinforcement of success, poor family support, negative example, lack of rules.
- ✓ The sports and social system also contribute an inclination towards doping through the negative examples of the champions, the infringement of the rules of fair play, the inadequacy of anti-doping controls, the medicalisation of society, the excessive value to one's image.

Zygmunt Bauman argues that "the society of individuals is a society of lonely and isolated people who are afraid of not having the right characteristics to achieve success"; according to Bauman, our time "is marked by an obsessive concern for the body", considered as an "instrument of pleasure" and therefore delivered "as a meal to all the attractions the world has in store" (Bauman Z., *Liquid Love. On the Frailty of Human Bonds*)

Cahn (Cahn R, *The End of the Couch?* 2002) points out that what seems peculiar to the current world is the fact that the fear of not being able to do something has taken the place of guilt. The sense of anguish is no longer dealt with by the mind, it is now only through the concrete support of 'objects' or external reality, through the enhancement of one's body or behaviour according to the cult of performance, technical mastery, tangible success in any field. The risk, concludes Cahn, is that these narcissistic needs end up by imposing themselves on the totality of the mind, to the point of eclipsing the role of limits and prohibitions. In an extremely competitive culture such as today's, with marked narcissistic traits that impose a model conforming to its expectations, there is no longer any space for the expression of the individual Self, suffocated and trapped by the force of these external pressures. The goal that an individual must achieve is no longer self-expression and the affirmation of the Self, but rather to create a model appropriate to the context to be accepted, seen, considered, paying an important price: denying one's individuality. In this regard, there is a TV commercial in which this aspect is evident: the scene is set in a waiting room for a job interview, with the various candidates awaiting their turn; one of them looks at the photos of former company executives on the wall and sees that they were all bald. He leaves the room and comes back bald. When the executive opens the door and of course, he's bald, the others realise they have lost. In order to achieve the goal, the "winner" has changed his image modeling it on that of another winning and powerful figure.

But why the association of doping with addiction? Because doping, similar to psychoactive substances, by activating a system of natu-

ral reward leads to the reiteration of deviant behaviour and therefore to addiction. Natural physiological impulses, given the perceived pleasure and the incentive value of this, encourage the individual to repeat the action. In this way, the functions are motivated, so having food and eating is better than being hungry, drinking is better than being thirsty, having sex is more pleasurable than not having it and so on. To reward the individual for the natural functions performed (and therefore learned and memorised) a brain circuit called the reward system intervenes, which gratifies or repays with pleasure, with a sense of well-being, fullness, satisfaction and even euphoria on a more or less intense level; it is like saying that pleasure is the "exchange currency" although in this case, it is not naturally enduced. We are so sensitised to this simple relationship, action - result, that environmental stimuli (people, things, sounds, places) or even thought, can trigger the desire.

The same compulsive sports competition can be compared to a form of drug addiction not only for physiological reasons (stimulation of the release of endorphins) but also for psychological ones. We know that intense exercise also increases the secretion of prolactin, corticosteroids and the growth hormone; these different hormones, associated with endorphins, can change our mood.

Reaching a goal, thanks exclusively to the efforts made, satisfies and gratifies the competitor, because he is aware that his performance is the result of his sweat and "natural endogenous doping". A drug addict always has to contend with a great deal of suffering. He is a human being who lives with major psychic effort. And when a person like this encounters drugs, he experiences a feeling of freedom and well-being that he has never known, living the so-called "honeymoon" to use the paradox of Austrian, Claude Olievenstein. The drug protects him from anguish in a fantastic way. (L. Cancrini, 1982 *Quei temerari sulle macchine volanti* - Study on the Therapies of Drug Addicts).

The behaviour of those who resort to doping is part of the psychological and psychopathological dynamics of drug addiction. The difference is once again the social significance of the behaviour implemented: a doper violates the law, breaks the rules, cheats, but basically does not present a threat to society, unlike the addict, who is seen as a potential danger. Parent do not consider it a problem if their teenage son starts out in the gym weighing 60 kg and after a year weighs 80, with impressive muscles; indeed in many cases, they feel a sense of pride, thus reinforcing the behaviour of the child, who does not feel any sense of guilt for his actions.

Winning a medal by employing these illegal systems does not scare a parent, perhaps because the side effects are not immediate, even if in some cases they have occurred dramatically.

Trading anabolics is prohibited and punishable by law just as trading narcotics. Buying these products means feeding the illegal market of these substances. The choice to resort to doping is the result of discord between needs, expectations, desires, drives, feelings of guilt, conflicts and deficits. The pleasure that is drawn is illusory and destined to collapse sooner or later, often leaving room for even severe psychiatric syndromes. We can in fact identify the psychological effects as:

- ✓ Early effects: states of euphoria, increased self-confidence, energy, self-esteem, increased enthusiasm and motivation. In this phase, fatigue decreases, pain tolerance improves, and symptoms of hyperactivity such as insomnia, increased libido, agitation, and irritability often appear.
- ✓ High dose effects: loss of inhibition and lack of judgment, with unstable and manic mood swings.
- ✓ Effects after prolonged use: tendency to be suspicious, polemical, impulsive and very aggressive. Sometimes these effects can be particularly intense and increase until they lead to violence, hostility and anti-social behaviour. In some cases, this anger can lead to very dangerous actions such as suicide attempts, or even murder.

In order to further clarify the argument, while not assuming to cover its entire complexity, I also refer to some aspects concerning neurophysiology. There are some areas of the CNS (Kandel ER, Schartz JH, Jessel TM, 2001, Principles of Neuroscience) that are part of that circuit, called the reward:

- ✓ The Ventral Tegmental Area containing the pyrophenes of dopaminergic neurons belonging to the mesolimbic dopaminergic system and which is widely implicated in the brain reward system, both physiologically and under the stimuli of drugs. The so-called VTA is important in cognition, motivation, addiction and drug addiction, in emotions related to love, and is involved in various mental disorders.
- ✓ The nucleus accumbens is a small region rich in dopamine (the neurochemical related to pleasure) and, functionally, is part of the limbic system, known for its fundamental role in emotional behaviour, pain and pleasure.

The mesolimbic system originates in the ventral tegmental area and ends in the nucleus accumbens, in the amygdala (centre of integration of higher neurological processes such as emotions, also involved in emotional memory systems. It is active in the comparison system of the stimuli received with past experiences) and in the hippocampus (memory). It plays an important role in natural motivated behaviour (nourishment, reproduction).

Drugs act on the brain reward system, although the brain has not evolved to respond to drugs but to natural stimuli like food, water, sex, social interaction, rewarding us with pleasure because we nourish ourselves, because we generate, etc. Obtaining adequate responses to these natural stimuli was therefore of utmost importance for the survival of the species, reproduction and the general concept of well-being. Understanding the natural reward system means understanding that it is equally possible to be dependent on drugs, considering that during its evolutionary path, man has discovered how to stimulate this system artificially, precisely with drugs. In conclusion, it is possible to support the idea that those who resort to doping on a conscious level know that they are committing an offence and take the risks, both legal and those related to health but, in any case, because of their personality, they are willing to take the risks just to live a moment of pleasure, partially realising the fluidity of this pleasure, a pleasure that is ephemeral, not felt fully and therefore not rooted in his Self, but in the False Self (Donald Winnicott, 1965. *Maturational Processes and the Facilitating Environment: Studies in the Theory of Emotional Development*), that is, a pathological modality of development of the identity that starts from the earliest states of child development, where the child does not find in the mother a reflection of his needs and desires, but grows according to her needs and desires and gradually learns to found their sense of identity in acquiescing to the demands of others. If this is the only way experienced by the child to ensure the closeness and affection of significant figures, it is because the latter have obvious psychological difficulties and fail,

in spite of themselves, to provide containment and validation to his emotional states. The trap is around the corner because, when we become adults, we literally end up not knowing who we are anymore, unable to come into contact with authentic desires and needs, thus becoming slaves to social judgment and the approval of others, and incapable of accessing an authentic dimension of desire and relational intimacy.

This is where responsibility comes into play, starting from the family, and extended to all operators of the sporting and institutional world in preventing the phenomenon of doping through doping and awareness programmes: those who resort to doping must be seen not as the "monster" to plaster on the front page, as was the case of racewalker, Alex Schwazer, 50 km Olympic champion in Beijing 2008, who resulted positive at an anti-doping control on the eve of the 2012 London Olympic Games, but as a victim of an enlarged context that through various pressures favoured this behaviour. The real question we must ask ourselves is not why an individual resorts to doping, but what the Others wanted from that individual, what the Others have done to elicit such behaviour. Only by widening the spectrum of responsibilities without stigmatising the individual who adopts this behaviour, will it be possible to prevent the phenomenon of doping; we must get to the root of the problem seeing as the normal channels of information, awareness, prevention and repression of the phenomenon have proved to be not very incisive. We must entrench a culture that must go against the culture of winning at all costs, a culture that should not only exalt winning behaviours, but one that places a value on defeats and failures, without making them shameful experiences, thereby undermining the already precarious or nonexistent self-esteem. Many early childhood experiences full of demands for perfectionist behaviour have not been given space to learn from mistakes without receiving criticism which is often humiliating or, even worse, manipulated by presumed parental love conditioned by receiving "a well done task" in exchange. I have often heard parents say to their children: "if you do this well, mummy will love you very much!" And the child, who cannot do without maternal and parental love in general, will strive to satisfy the maternal desire, not feeling his own needs and not recognising his own desire. At what psychological price do you get a "good child"? What subtle violence is maternal love capable of?

In "*The Drama of the Gifted Child: The Search for the True Self*", psychoanalyst Alice Miller (2008) emphasises that the "gifted child" who is the pride of his parents, is capable of picking up on the unconscious needs of parents and adapting to them, by silencing his own most spontaneous feelings (anger, indignation, fear, envy) that are unacceptable to the "big people". In this way, the development of the most authentic personality is stifled and the child will suffer from emotional insecurity and a sort of psychic impoverishment. As an adult, he will either be depressed, or hide behind a facade of maniacal grandeur.

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The official journal of the European Weightlifting Federation

PNEI, POSTURE, PERFOR-MANCE

PART ONE

BY N. BARSOTTI, M. BRUSCOLOTTI

INTRODUCTION TO PNEI

PNEI is the acronym for the term PsychoNeuroEndocrinoImmunology**,** a discipline that studies the bidirectional relationships between the psychological and biological systems, describing how the psyche is able to modulate the functioning of our body up to the point of modulating the 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 (Bottaccioli 2005).

In PNEI, the knowledge acquired in the 1930s from the fields of endocrinology, immunology, neuroscience and biology converge within a single model. To quote Francesco Bottaccioli, founder in Italy of SIPNEI (Italian Society of PsychoNeuroEndocrinoImmunology): «PNEI presents a model of research and interpretation of health and illness, which sees the human organism as a structured and interconnected unity where the biological and psychological systems influence each other reciprocally. This vision is the basis for new integrated approaches to the prevention and therapy of the most common diseases, especially of the chronic type and, at the same time, outlines the possibility of transcending the historical philosophical oppostion between mind and body, as well as the scientific, twentieth century oppostion between medicine and psychology, breaking free from the reductionism which assigns the body to the first and the psyche to the second» (Bottaccioli 2010).

From the historical point of view, the founder of the research of the unitary functioning of the organism is most certainly Hans Selye, who in 1936 demonstrated that the stress response is independent from the nature of the stimulus (Seyle, 1936), however, under the paradigmatic aspect, PNEI draws on the biopsychosocial paradigm introduced by Engel in 1977, in a historical article published in *Science* (Engel 1977). By contrasting the dominant thought of the scientific community of the age, in other words, the reductionist model, Engel tells us that a person's health (or illness) cannot be reduced exclusively to the biological aspect, but we must also consider the psychological and social aspect, highlighting therefore the importance of relationships and the environment in which we live.

The research and the diagnosis that refer to the biopsychosocial model is growing exponentially, and in this case Goldstein's words are particularly significant: Scientific integrative medicine is not a treatment method or discipline but a way of thinking that applies systems concepts to understand normal physiology and clinical disorders, providing a framework for understanding complex and dynamic challenges to our integrity as organisms and, in turn, for developing novel treatments based on this complexity and dynamism" (Goldstein 2013).

THE COMPLEXITY OF THE PNEI NETWORK

Given the impossibility of explaining the complexity of the functioning of the human organism in just a few lines, we will try to briefly describe how the activation of the stress axis determines the involvement of the various biological systems.

In fact, when faced with emotional stress, which may not necessarily be approaching an important competition or the phases before it, but also the complex network of relationships and environmental demands to which the elite athlete is subjected, the two stress systems will be activated, the nervous (activation of the orthosympathetic nervous system) and the endocrine. Both systems will stimulate the adrenal glands to release mainly catecholamines (adrenaline and noradrenaline) and cortisol.

These molecules will stimulate the immune system cells to release pro-inflammatory cytokines into the environment which, via afferent nerve and mood pathways, will reach our central nervous system, stimulating various brain areas and, in particular, the hypothalamus and hypophysis (negative feed-back regulation of the stress axis). The stimulation of these two cerebral areas will hyperactivate some neuroendocrine axes and hypoactivate others. All this obviously is necessary to provide the athlete with the best behavioural and biological response in order to cope with the stress at hand.

This mechanism is activated, exactly in this way, even if the sti-

mulus is antigenic (Bottaccioli & Bottaccioli 2017).

We can therefore easily understand how whenever the athlete is subjected to stress, for example during the phases of training, or when problems arise with the team, all the biological systems are activated to allow him to address the stimulus appropriately.

These complexities of functioning also involve the structure of our body: muscles and bones. According to the scientific literature of recent years, the muscles can in all respects be considered immunoendocrine organs: under stimulation they release many molecules: IL-6, IL-10, TNF- , cannabinoids, IGF-1, anandamide, serotonin, noradrenaline, BDNF and other neuropeptides that partly regulate local functions, and in part go into the circulation, targeting the brain. This is one of the reasons why after physical activity we feel more relaxed and calm and why it is advisable to do physical activity even in our golden years: the brain receives more neurotrophic molecules (Chiera et al., 2017). However, if the stimulus is excessive and the body is under stress, it produces too much cortisol, there is an increase in muscle myostatin levels, protein degradation and atrophy of the fibres linked to strength, in some cases leading to a reduction in sports performance (Schakman et al. 2013).

Let's take another example, this time examining the bone. Osteoblasts produce a particular, non-decarboxylated osteocalcin that is introduced into the circulatory stream and targets two tissues: the pancreas, where it stimulates the production of insulin, improving its sensitivity, and the testicles, where it stimulates the production of testosterone (Oury et al 2011) .

INTRODUCTION TO THE PRINCIPLES OF INTEGRATED POSTURE

This functional complexity has obviously also been applied to the study of posture in order to try to understand its mechanisms. It is therefore difficult to justify that even today in prestigious literature we find the explanation of the complex phenomenon «posture» according to the explanation of the so-called «compression principle», according to which the bones load weight onto each other inside the «polygon stucture», that is, inside our feet and that move thanks to the muscular contraction that follows the principle of levers (Barsotti, 2014). This interpretation does not differ much from the one given in the 1600s by Giovanni Borelli, physician, astronomer, mathematician and philosopher of the time. He was the first to explain movements in space of man by applying to the body the same mechanical principles that were used to build the machinery of the time (Chiera et al., 2017).

In actual fact, we have known since the beginning of the 80s that the compression principle is not suitable to explain our statics: indeed, many studies have shown its ineffectiveness. Among these, one of the most interesting was led by a group of engineers who x-rayed the standing view of the knee of a 47-year-old woman to calculate the distance between the tibia and the femur. Once the measurement was taken, she was loaded with twice her body weight and a new x-ray was subsequently taken. Contrary to what would be expected, according to the compressive principle, the distance remained unchanged (Terayama et al., 1980).

Also the principle of levers is not suitable to explain our movements. This theory was brilliantly refuted during the First International Fascia Congress held in Harvard in 2007. Taking as an example the lifting of a child by an adult, it was explained how it was impossible to find a fulcrum, a point of support necessary for the hands to lift (Gracovetsky, 2007).

Over the years, researchers have tried to find new models of interpretation. Among these, the most famous and popular today is the Postural Tonic System (PTS) of posturology. This system should be explained clearly, also from the historical point of view. The model was in fact born in 1986, the work of a group of French scholars headed by Gagey. This is certainly not a coincidence. The 1980s witnessed the culmination of research according to the reductionist model. Therefore, while in the medical/biological field everybody was searching for the ultimate cause of all pathologies through the mapping of the human genome, the postural field was looking for the receptor that was the ultimate cause of all postural alterations. From the language used we can see that the PTS model is the son of a reductionist paradigm. In fact, in the texts we see how the human body is constantly compared to a computer (typical language of reductionism) and simplified to almost insignificance: our static is in fact consented by a series of «inputs» given by the various receptors of the body (eyes, ears, stomatognathic system, podalic receptors) that send stimuli to a «central computer» (the brain) which, in turn, «processes outputs» capable of regulating muscle tone. If there are any postural alterations, it is sufficient to perform exclusion tests (readapted by neurology) and use specific instruments (stabilometric platform, kinesiography, etc...) that will tell us which receptor has been altered. It will be enough to correct this and magically, correct posture will be restored (Gagey, 1995). All this was then clinically translated into assessing the occlusion, plantar support and vision and then intervening by placing mouth guards, orthotics or glasses with optical prisms. PTS has led to deviant clinical synthesis, in which it was claimed to use a plantar support instead of a mouth guard or to modify the occlusion through orthotics! Also with reference to the stabilometric platform and kinesiography, recent reviews on the subject have confirmed the lack of accuracy, due to a percentage of false positives that in some cases reach 80% (Michelotti et al 2011)! It would therefore be necessary to limit the use of this method of evaluation, strongly reductionist, also because the system has generated an economic business that has little to do with the therapeutic aspect.

THE BIOTENSEGRITY MODEL

This is currently the most comprehensive and complex paradigm used to explain our static and our kinetics. The tensegrity model was developed in the architectural world by Buckminster Fuller and Kenneth Snelson. The former is considered the father of tensegrity. His goal was to create a future in which man could live in harmony with nature (Edmondson, 1987). Fuller noticed that the very forms of nature were finite systems of energy, given by the simultaneous action of tensive and compressive forces and where the behaviour of a system is not the result of the sum of the individual parts, but of their interactions (Scarr 2014).

However, it was his pupil Kenneth Snelson, who actually put into place what was subsequently called «energetic geometry» through the realisation of the «Early X-Piece», two X shapes of wood suspended one over the other by wires (Ibidem). Fuller described this realisation as follows: «This pioneering work has before us the possibility of structures in which form and function are truly [...] one, and the visible configuration of the sculpture is simply the revelation of other invisible forces» (Heartney 2009, p.20).

The tensegrity structures are stable thanks to the distribution and balancing of the entire structure that can easily and effectively adapt to mechanical stressors (Ingber, 2003).

Snelson pursued his career as a sculptor by making tensile compositions consisting of elements in compression, the components (basically pipes), which never touch each other are suspended by taut wires or cables; while the rods act on the struts trying to bring them together, exerting a centripetal force on the structure, the latter resist this thrust, while exerting a centrifugal force (Stamenovic and Wang, 2011). Through these mechanisms we can have a balanced and stable structure,

totally independent of gravity and shape changes. This is why the tensegrity structures are light: mechanical stress is immediately distributed throughout the entire structure (Levin, 1990).

The first to apply these concepts to the human body was Stephen Levin, an orthopedic surgeon. Not convinced of what he had studied at University (compression model and levers), in 1975 Levin went to the Museum of Natural History in Washington to study dinosaur skeletons with paleontologists. In fact, according to the compression model, the bones of these enormous animals should have been broken by weight (Chiera et al., 2017). Levin coined the term «mesokinetic», in other words, motion of the bodies derived from the tissues deriving from the mesoderm, such as the fascia. His idea was to go beyond the reductionist view that bones, muscles and connective tissue are separate entities. According to Levin, the mesokinetic system becomes an entity in which the laws of tensegrity can be applied (Scarr, 2014).

According to this model, the bones represent the rods of Snelson's sculptures, while the myofascial system represents the wire (Ingber, 1998). Only at this point can we finally explain how the upper limb and the jaw are stabilised structures even though they hang respectively on the rachis and the skull (Levin, 2002). However, if we apply these concepts by analogy to other bone structures, we observe that the tibia is attached to the femur, just as the latter (Swanson, 2013) is attached to the pelvis, etc. (Levin, 2002).

The joints, therefore, receive only cyclic loads given by movement and, during kinetics, the chondrocytes produce synovial fluid, so it's no wonder that recent reviews call into question the shock-absorbing role of the menisci (Andrews, 2011).

Furthermore, mesokinetics finally provides a theoretical substrate for myofascial chains, which can be described as mechanical continuity circuits that guarantee coordinated movements with low energy consumption (Swanson, 2013). It follows that by applying biotensegrity to myofascial chains, we finally have a model capable of integrating each part of the body into one, effective, coherent unity (Ingber, 2008).

In conclusion, therefore, we can say that the constant tension of the tissues, combined with the neuromuscular junctions, allows a quick response to proprioceptive stimuli and those arriving from the central nervous system. This explains why bodily alterations, the incorrect use of posture, the presence of lesions or tissue scars modify the tension balance of the body, jeopardising the functionality of the organism (Ibidem).

This vision of posture makes us understand why the PTS model is reductionist and simplistic!

BIOTENSEGRITY APPLIED AT THE CELLULAR LEVEL

It was Donald Ingber, Professor Emeritus of Harvard, who applied the tensegrity principles at the cellular level. As a university student, he encountered Snelson's work during a sculpture class and, with a stroke of genius, realised that cells followed the same laws (Ingber, 1993).

He then applied these laws to the cytoskeleton and observed that (Tadeo et al., 2014):

a) the microtubules are in compression, just like the rods of Snelson's sculptures, and move the nuclear membrane away from the cell membrane;
b) intermediate filaments and microfilaments are taut, just like the wires in Snelson's works, bringing the nuclear membrane closer to the cell membrane.

Thanks to this eureka moment, we have discovered that the cell has a dynamic, three-dimensional and constantly changing structure (Lele et al., 2007).

The cytoskeleton also connects externally to the extracellular matrix (ECM) of the surrounding fascia via special membrane proteins: integrins and caderins (Stamenovic and Wang, 2011); internally, on the other hand, it is in continuity with the chromatin.

It follows that every movement of the body (articular or visceral) modifies the tension of the ECM which in turn, reshaping the cytoskeleton, changes the gene expression (epigenetic effect on a mechanical basis) (Swanson, 2013).

Thanks to Ingber, a new field of biology, meccabiology, was born. It is in fact impossible not to pay attention to the mechanical forces that are exerted on the cell (Ingber, 2006) and, not surprisingly, all the medical sectors are now studying their properties, based on which they understand the onset and development of various pathologies. Let's take a simple example: we have seen that, if the fascial substrate is particularly tense, the cells release excessive quantities of prostaglandins (PG) into the environment, thus facilitating the appearance of inflammation. If, on the other hand, the tissues are in normotension, physiological quantities of PG are released (Reily et al., 2003).

With regard to posture, we can therefore conclude that the human being is composed of a single continuum, and the body is a hierarchical tensegrity system, from the intracellular level to that of the whole organism. Furthermore, with regard to kinetics, we know that mobility is transmitted to the whole system and that its energy is stored and released through the distortion and normalisation of the entire body form.

CAUSES OF ALTERATION OF THE FASCIA: NOT JUST MECHANICAL

Too often, those concerned with posture believe that all the alterations of the fascia depend on biomechanical imbalances, traumas, surgical interventions or, even worse, only on podalic, occlusal or visual alterations: in reality, the fascial tension state is very much affected by the systemic metabolism. Let's take some examples: we have already seen that under stress the HPA axis is activated with its two main systems, the orthosympathetic nervous and the endocrine. The former, in the periphery, will release various pro-inflammatory cytokines including TGF-β1 at the receptor level. This molecule allows the transformation of fibroblasts, typical connective cells, into myofibroblasts, in other words, into cells with contractile filaments capable of generating a fascial tension that is maintained over time: the contractures of myofibroblasts are in

fact slow, long lasting and consume little energy. This rigidity will mechanically stimulate the peripheral receptors, which will then release larger amounts of TGF-β1, thus generating a vicious circle (Bhowmick, et al., 2009). The endocrine system of the stress axis, however, also contributes to the increase of fascial rigidity: the catecholamines and cortisol in fact activate biochemical processes favouring the formation of fibrosis, tissue adhesions and scars that are more extensive and strong. These strong contractions generate mechanical stresses that can be assimilated by integrins that alter cellular biochemistry, favouring inflammatory phenomena and predisposing to the formation of tumours (Tomasek et al., 2002).

On the other hand, a correct activation of the HPA axis, as can occur during the warm-up before a race or training, allows a temperature increase induced by the orthosympathetic nervous system, the activation of muscle metabolism and the release of specific enzymes

that make the MFS malleable and ready for physical exertion (Chiera et al., 2016).

Therefore, both physical and emotional stress management in athletes is crucial. It is in fact this complexity that over time will cause alterations which will modify posture and the ability to adapt it to the technical movement, thus facilitating the onset of injuries.

In this context, the nutritional aspect is an additional factor: having a pro-inflammatory diet alters the elasticity of the fascial components, just as not respecting sleeping/waking patterns (not sleeping at night significantly increases the level of cortisol in the bloodstream) leads to a loss of tissue elasticity. The same thing happens even if the athlete is subjected to continuous workloads without having the right quantity or quality of rest (Schleip et al., 2012).

FASCIA, NERVOUS SYSTEM AND BODY-MIND INTEGRATION

In recent years, research has significantly contributed to the understanding of communication between body and mind in a bidirectional sense. The brain, in fact, registers at various levels the spatial configuration of the organism, the structure of musculoskeletal structures and internal organs, the vital biochemical parameters, as well as the mechanical and biochemical changes related to behaviours and events. In turn, «the images of the body, represented in the maps, are able to exert a constant influence on the same body from which they originate» (Damasio, 2012).

Brain maps are also a source of emotions and feelings, starting from primordial ones, which are then elaborated and modulated by the psychic dimension of the autobiographical self (Ibidem).

But how do bodily stimuli arrive at the brain? Mainly by the stimulation of the nerve receptors that are found within the fascial fabric: indeed, there is evidence that this activation is closely related to the viscoelasticity of the tissue around them. Which means that if our fascia is in normo-tension, we send correct stimuli to our central nervous system: if instead, this is particularly tense or loose, for all the reasons that we have previously expressed, our brain will be hypostimulated (Swerup & Rydqvist, 1996).

The most recent classifications of the somato-sensory system divide the receptors into two macro-categories: System A, which includes proprioception and exteroception; and System B, which includes interception and nociception (D'alessandro et al., 2016).

Without going into the details of the circuits activated by stimulation of the two systems, it is interesting to observe how, at the proprioceptive level, the sensory fibres are numerically greater (3: 1) than the motor fibres connected to the mechanoreceptors. This means that the human being listens to its body regardless of whether the person is aware of it or not. From all this it follows that the fascia is the body's largest proprioceptive organ (Schleip, 2003).

Moreover, if we analyse the motor circuits, we see that there is a particular one called baso-thalamo-cortical. This circuit is subdivided into five sub-circuits and it is fundamental to observe that one of these is a purly emotional type and precisely for this reason closely related to the amygdala (Squire et al., 2013). All this information has contributed to the birth of a new approach to neuroscience called Embodied Cognitive Science: according to this vision, the psyche can only be understood if one considers its relationship with the sensory and motor reaction capacities of the organism: it does not exist in a void and, assuming that it is confined to the brain, this organ is not isolated, but has a very close relationship with the rest of the body (Gallagher & Zahavi, 2008).

Another central pathway in body/mind communication is the interoceptive one via the lamina I-spino-thalamo-cortical pathway, totally different from the proprioceptive one. To understand how important this receptor stimulation is, just look at the ratio between inter-effectors and all other body receptors that is 7: 1! This means that at any given time of day our body sends information about our inner state to the brain (Craig, 2002). It is no coincidence that in recent years, the definition of inter-selection has significantly changed and expanded. «Bud» Craig, the leading researcher in this field, has defined it as «a personal experience of the body state» (Ibidem) that correlates to many sensations: pain, Medically Unexplained Symptoms (MUS) as well as the explained ones, negative emotions, affective and anxiety disorders, regulation of emotions, meditation, decision making, self-awareness and consciousness, subjective perception of time, eating disorders, water and food intake, sexual functions, empathy, hypnosis, etc ... (Ceunen et al ., 2016).

From a neurological point of view, the interoceptive pathway arrives at the back of the insula, where information is not yet conscious. Subsequently, these stimuli pass to the insula media where they integrate with the information coming from the secondary somatosensory cortex, that is the area that processes the proprioceptive stimulations, from the visual, auditory, vestibular and also from the hippocampus (memory) and the amygdala (emotions). Finally, all of this integrated information passes to the front insula where integration with the areas related to rationality, to the subjective history of the person takes place: anterior cingulate, orbitofrontal cortex, dorsolateral prefrontal cortex (Craig, 2002).

Moreover, this interoceptive pathway is part of the cortico-limbic circuits involved in the evaluation of personal life events, conditioning the physiological and behavioural responses to these events. Translated into simpler terms: when making decisions, the athlete is strongly influenced by interoceptive sensations (Chiera et al., 2017). Therefore, it would be useful for specific work to be carried out during training in order to train the correct body perception.

PERFORMANCE

It is clear that based on what we have just stated, postural assessment is something highly complex, where the static and dynamics of an athlete are influenced by lifestyle and by his ability to manage stress in the most complex sense of the term.

It is therefore no coincidence that in recent years there has been a significant increase in the scientific publications that integrate the biopsychosocial and neuroscience aspects with that of sports.

In fact, in order to obtain high-level performance, all areas of the brain should work in an associated and optimal way to perform specific movements (Nielsen & Cohen, 2008). If the motor cortex is used, for example, for the treatment of nociception as part of the experience of pain, it cannot perform motor output at its best and this will not allow the athlete to achieve the best performance or, even more seriously, will facilitate the onset of injuries due to non-perfect movements (Puentedura and Louw, 2012).

In fact, in athletes with experiences of major stress, or anxiety, or depression, there were changes in brain neurological networks resulting in inadequate decision-making. The same increase in emotional responsiveness, associated with increased activity of the amygdala and sympathetic NS, correlates to the reduction of the attention areas and to an increased risk of injury.

It is therefore no coincidence that all psychological interventions, aimed at managing stress, are effective in the prevention of ac-

cidents compared to controls in subjects at risk. Increasing the background of information, as well as performing practical exercises, influences the athlete's motivation to adopt preventive behaviour and modify his attitudes and beliefs about lifestyle and actions related to accident prevention (Ivarsson et al. ., 2016).

The study by Slimani et al. on footballers is therefore particularly interesting (2016), where it has been shown that an interdisciplinary programme (physical, technical, tactical and cognitive) is fundamental for achieving the same objectives. The psychological techniques used were: self-talk, imagination, relaxation, goal setting and biofeedback. The results of the study were surprising: optimisation of athletic performance in team sports, improvement of the recruitment of motor units, greater mental resistance, team cohesion, improvement of the execution of technical skills (dribbling, passing, control), increase in footballer's specific performance, increased self-confidence and motivation, improved mood and greater effectiveness during preparation, decreased competition anxiety, technical errors and performance strategy. Other studies also add improvement in sports performance (Brown & Fletcher, 2016), endurance, strength and power (McCormick et al., 2015).

If we take into consideration the recovery from sports injuries, we observe that in general the insiders focus almost exclusively on the physical damage and not on the psychological one, even if the athletes display tension, confusion, hostility, loneliness, fear, irritability and anxiety, also given by the isolation from the context. It is clear, based on what we have seen in this article, that such psychosocial responses on emotions influence behaviour and physical recovery. It is therefore necessary to work adding the motivation aspect to the post-injury recovery plan, to reduce recovery times (Covassin et al., 2015).

It is not surprising that relaxation, visualisation, goal setting and positive self-talk techniques have been found to be effective in rehabilitation, as they improve concentration, increase confidence, motivation, control emotional responses, increase sports skills and performance strategy, above all creating vivid and realistic images: including vision, sound, smell, touch, taste, body positioning, to give a detailed image of the environment and insert emotional responses and moods (Ibidem). For further details, refer to the sports biopsychosocial model linked to the injuries of Williams & Andersen (1998), which include cognitive, behavioural, emotional and environmental variables, such as personality, stress history and coping.

The integrated approach is also particularly useful in accelerating recovery from complicated fractures and in reducing the risk of relapse. Physical and emotional stress, in fact, can lead to amenorrhea/decrease in testosterone and bone resorption: an adequate caloric intake, proper hydration and proper rest, on the other hand, reduce osteoclastic activity (Miller and Best, 2016) .

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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.

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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.

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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.

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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.

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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.

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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).

The official journal of the European Weightlifting Federation

Spanish resumenes

POR QUÉ LOS JÓVENES DEBEN ENTRENAR CON SOBRECARGA
Antonio Urso
SM (Ita), n.º 10, año IV, mayo-agosto de 2018, págs. 4-12
El autor aborda la necesidad de reconsiderar todas las falsas creencias sobre el entrenamiento y la formación de los jóvenes, que deben realizarse mediante la utilización de sobrecargas, desmontando el mito de que la sobrecarga sea perjudicial y que se deba evitar durante toda la etapa juvenil. Asimismo, expone los resultados de una serie de estudios científicos que apuntan en el sentido opuesto e invitan, por tanto, a readaptar la teoría y la práctica. Se trata de un trabajo que, en el fondo, rompe un esquema consolidado del pasado y muy difícil de cambiar.

LA BIOMECÁNICA DEL SARCÓMERO COMO ORIGEN DE LA FUERZA MUSCULAR. PARTE I
Donato Formicola
SM (Ita), n.º 10, año IV, mayo-agosto de 2018, págs. 14-25
El sarcómero es la parte más pequeña de las células del músculo estriado voluntario en las que se realiza la contracción. Los estudios actuales sobre las interacciones moleculares realizados con técnicas de nanotecnología han permitido observar con mayor detalle las características electrodinámicas y mecánicas del sarcómero que permiten confirmar los conceptos fisiológicos, neurológicos y bioquímicos que sientan las bases de la contracción muscular.
En la era de la nanotecnología, es posible ampliar a la escala de percepción humana el movimiento del sarcoplasma, el líquido denso presente en las células musculares, que genera la resistencia mecánica y electromagnética en un espacio molecular infinitesimal. En este artículo se utilizarán las propiedades mecánicas de los cristales de material elástico y las de los motores a propulsión para describir, con una constante variación de escala, de nanométrica a milimétrica, la morfología y la fisiología de los sarcómeros.
Cambiando la escala se puede comprender mejor cómo un sarcómero puede generar fuerza. Atribuir algunas propiedades de los cristales de material elástico a las células musculares ha permitido actualizar algunas estrategias de entrenamiento y nutrición a fin de acelerar los resultados deportivos, instalar microchips en los sarcómeros para controlar la síntesis de proteínas y restablecer los tejidos contráctiles dañados, y controlar prótesis y extremidades biónicas inteligentes para aumentar las posibilidades de que las personas superen sus propios límites de fuerza y capacidad de movimiento.

"EXPRESIÓN" DE LA FUERZA EN EL LEVANTAMIENTO DE PESAS
Andrew Charniga
SM (Ita), n.º 10, año IV, mayo-agosto de 2018, págs. 26-33
El autor toma en consideración el aspecto de la expresión facial durante los ejercicios de levantamiento de pesas para poner de relieve tanto las diferencias entre sexos (forma masculina y forma femenina de expresar la fuerza) como el significado de la expresión facial como auténtica manifestación de fisiología de la tensión muscular.
Según el autor, la fuerza aplicada es a efectos prácticos sinónimo de virilidad. Los hombres están en clara ventaja respecto a las mujeres debido a que cuentan con más masa muscular y con huesos y tendones más grandes, además de una concentración de testosterona diez veces superior, entre otras cosas.
La expresión facial del culturista en acción se suele asociar a las tres características de la virilidad: rabia, agresividad y asertividad. La agresividad expresada en el rostro (en especial si va acompañada de una mueca) de alguien que trate, por ejemplo, de levantar un peso, es una imagen de resistencia, que parecería reflejar, en términos psicológicos, la exclusividad masculina de la fuerza humana. No obstante, no está claro cómo puede responder a este estereotipo, que es un fenómeno fisiológico y psicológico a partes iguales, una mujer culturista. La asertividad y la agresividad son cualidades que no se relacionan estrechamente con la feminidad.
En los artículos especializados no se mencionan casi nunca las diferencias entre ambos sexos en las expresiones faciales relacionadas con la tensión muscular. Los estudios sobre las diferencias entre sexos en la expresión facial suelen estar relacionados con las emociones o la identificación del sexo a partir de la expresión facial. Sin embargo, faltan estudios sobre las diferencias en la expresión facial de hombres y mujeres en un deporte de máxima tensión como es el levantamiento de pesas. Se espera que en estudios futuros se puedan poner de manifiesto las posibles diferencias en las modalidades de levantamiento de barras pesadas.

LA IMPORTANCIA DEL CALENTAMIENTO Y DE LA RECUPERACIÓN PARA PREVENIR ACCIDENTES
Maura Mannucci
SM (Ita), n.º 10, año IV, mayo-agosto de 2018, págs. 34-43
Examen del significado y de las modalidades de ejecución óptima del calentamiento previo al entrenamiento y a la competición y de la recuperación. El autor también aborda el tema del estiramiento (si hacerlo o no, cuándo y cómo) y los problemas más específicos de la halterofilia a fin de limitar en la mayor medida posible el riesgo de accidentes.
Durante la contracción muscular, los iones de calcio entran en el sarcómero, se unen a la troponina, que mueve los filamentos de tropomiosina, lo que permite que las moléculas de actina se unan a los extremos móviles de la miosina y se produzca el acortamiento de la fibra muscular. En estos últimos 60 años de investigación biológica, se han presentado diferentes modelos biomecánicos para describir estas rápidas secuencias de acciones y reacciones musculares. Asimismo, se conoce cómo todo el sarcómero transforma su energía química en energía mecánica de contracción. No obstante, cómo pueda concentrar tal fuerza mecánica en los extremos sigue siendo objeto de estudio.
En el presente artículo se exponen las teorías más modernas sobre el modelo biomecánico de contracción del sarcómero, partiendo de los conceptos de hemisarcómero y de diferencial linear autobloqueante. Según estas teorías, la contracción de la célula muscular es la suma de fenómenos biomecánicos que se generan en los dos lados de un mismo sarcómero de forma independiente.
Estos conceptos, además de inspirar el desarrollo de aplicaciones biotecnológicas innovadoras para permitir que las personas vivan la experiencia de la hiperfuerza, pueden explicar algunas de las respuestas fisiológicas anómalas que el tejido muscular manifiesta tras haber sido estimulado por un ejercicio excéntrico intenso.

EL TALENTO HUMANO: VISIÓN GENERAL
Vladimir Issurin
SM (Ita), n.º 10 año IV, mayo-agosto de 2018, págs. 46-57
El texto constituye el primer capítulo de un libro del mismo autor, dedicado por completo al talento humano. Se presentan las posiciones fundamentales respecto del fenómeno que definimos como talento, las consideraciones que apoyan al concepto de talento natural, el descubrimiento precoz de habilidades y competencias excepcionales, el logro de una maestría excepcional sin asistencia ni apoyo profesionales adecuados, la existencia de rasgos y de marcadores biológicos, las pruebas y los conceptos que desmienten el paradigma del talento denominado "natural" y de su existencia, y la disponibilidad de indicadores objetivos de excelencia para identificar el talento en el deporte.

EL PORQUÉ DEL DOPAJE
Francesco Riccardo
SM (Ita), n.º 10, año IV, mayo-agosto de 2018, págs. 56-65
El autor afronta el tema crucial de por qué se llega al dopaje: las necesidades de las personas y la forma en que se satisfacen y la elección de recurrir a sustancias prohibidas. Las diferentes responsabilidades, sobre las cuales hay que hacerse preguntas importantes.

PNEI, POSTURA Y PRESTACIÓN (PRIMERA PARTE)
Nicola Barsotti & Marco Bruscolotti
SM (Ita), n.º 10, año IV, mayo-agosto de 2018, págs. 66-77
Se presenta la PNEI, que es el acrónimo del término "psiconeuroendocrinoinmunología", una disciplina que estudia las relaciones bidireccionales entre la mente y los sistemas biológicos, y que describe cómo la primera puede regular el funcionamiento de nuestro organismo e incluso de la expresión génica (efecto epigenético) y explica cómo, por el contrario, los sistemas biológicos modifican el propio pensamiento. Todo ello permite que las personas puedan responder de la mejor forma posible a los factores de estrés ambiental, ya sean de tipo psicológico o antigénico. En la PNEI convergen en un mismo modelo los conocimientos adquiridos a partir de los años treinta del siglo pasado en los ámbitos de la endocrinología, la inmunología, las neurociencias y la biología.

Russian

ПОЧЕМУ МОЛОДЫЕ ЛЮДИ ДОЛЖНЫ ТРЕНИРОВАТЬСЯ С ОТЯГОЩНИЯМИ
Antonio Urso
S M (Ita), n.º 10, anno IV, maggio-agosto 2018, pp . 4-12
Автор рассматривает проблему необходимости пересмотра всех ошибочных представлений о тренировке и воспитании молодёжи, который должен осуществляться в том числе и путём использования отягощений. Развенчивает миф о том что использование отягощений вредно и что надо воздерживаться от их использования в юношеском возрасте.
Автор представляет серию результатов научных исследований которые привели к совершенно другим результатам приглашая к переосмысливанию накопленных знаний и спортивной практики. Речь идёт о работе, которая в конечном итоге разрушает устоявшуюся в прошлом модель которую очень сложно изменить.

БИОМЕХАНИКА САРКОМЕРА, ОСНОВЫ ПРОИСХОЖДЕНИЕ МЫШЕЧНОЙ СИЛЫ. ПЕРВАЯ ЧАСТЬ
Donato Formicola
SM (Ita), n.º 10, anno IV, maggio-agosto 2018, pp . 14-25
Саркомер это самая маленькая часть добровольных поперечнополосатых мышечных клеток в которых происходит сокращение. Современные исследования о молекулярных взаимодействиях, реализованные используя наноскопические методы, позволили более подробно наблюдать электродинамические и механические характеристики саркомера без которых невозможно подтвердить физиологические, неврологические е биохимические концепции лежащие в основе мышечного сокращения.
В эпоху нанотехнологий можно оценить по шкале человеческих представлений движение саркоплазмы, густой жидкости присутствующей в мышечных клетках, создающей разные виды механической и электромагнитной выносливости создаваемые в бесконечно малом молекулярном пространстве. В этой статье механические свойства кристаллов эластичного материала и двигательных моторов используются для описания, с постоянным варьированием масштаба от нанометрического до миллиметрического, морфологии и физиологии саркомера.
Изменяя критерии можно лучше понать как саркомер в состоянии генерировть силу. Приписывание некоторых свойств кирсталлв эластичного материала мышечным клеткам позволило обновать некоторые стратегии тренировки и питания, ускоряя рост спортивных результатов, установить микрочипы в саркомерах для контроля синтеза белка и восстаноления повреждённых сократительных тканей, контролировать протезы и умные бионические конечности для повышения возможностей человека превзойти свои пределы силы и двигательных способностей.

«ПРОЯВЛЕНИЕ » СИЛЫ В ТЯЖЁЛОЙ АТЛЕТИКЕ
Andrew Charniga
SM (Ita), n.º 10, anno IV, maggio-agosto 2018, pp . 26-33
Автор рассматривает аспект выражения лица во время выполнения упражнений тяжёлой атлетики, подчёркивая различия между мужским и женским полом (мужская и женская форма проявления силы) и значение мимики как истинной манифестации физиологии мышечного напряжения.
По словам автора, сила применяемая для практических целей, является синонимом мужественности. Мужчины имеют явные преимущества по сравнению с женщинами, поскольку характеризуются большей мышечной массой, значительно большими костями и сухожилиями, коме того уровень тестостерона у мужчин в десять раз выше, чем у женщин и т. д.
Выражние лица бодибилдера во время выполнения упражнения часто связано с тремя характеристиками мужественности: гневом, агрессивностью, напористостью. Агрессивность, выраженная на лице (особенно если с гримасой) у спортсмена который например пытается поднять штангу, это образ сопротивления, который, по видимому, отражает в психологическом смысле, мужскую исключительность человеческой силы. Пока не ясно однако каким образом женщина культуристка может вписаться в этот стереотип, что является одновременно физиологическим и психологическим феноменом. Напористость и агрессивность это качества которые не связанны тесно с женственностью.
В специальной литературе почти нет упоминаний о различиях полов в выражении лица которое связано с мышечным напряжением. Исследования о различиях в выражении лица между полами связаны обычно с эмоциями и/или идентификацией пола. Тем не мение, существует очень мало исследований касающихся различий между полами в выражении лица в таком виде спорта как тяжёлая атлетика которая отличается максимальной напряжённостью. Надеемся что подобные исследования могут выявить различия в способе поднятия больших отягощений (штанг).

ВАЖНОСТЬ РАЗМИНКИ (РАЗОГРЕВА) И ОХЛАЖДЕНИЯ ДЛЯ ПРЕДОТВРАЩЕНИЯ НЕЧАСТНЫХ СЛУЧАЕВ
Maura Mannucci
SM (Ita), n.º 10, anno IV, maggio-agosto 2018, pp . 34-43
Статья представляет собой обзор знаний о значения и методах оптимальной реализации разминки перед тренировкой и перед соревнованиями и охлаждения. Автор рассматривает так же проблему стретчинга-разтяжки (да или нет, если да то когда и как) и более конкретные проблемы тяжёлой атлетики с тем чтобы максимально ограничить риск травм.
Во время мышечного сокращения ионы кальция проникают в саркомер и связываются с тропонином который двигает филаменты тропомиозина чтобы позволить актинам связаться с двигательными терминалами миозина и реализовать сокращение мышечных волокон. В последние 60 лет в биологических исследованиях были представлены различные биомеханические модели с целью описания этих быстрых последовательностей молекулярных акций и реакций. Каким образом весь саркомер превращяет свою химическую энергию в механическую энергию сокращения это уже известный факт. Однако как саркомер в состоянии разделить подобную механическую силу на своих концах всё ещё является объектом изучения.
Настоящяя статья анализирует самые современные теории биомеханической модели сокращения саркомера, базируясь на понятиях полусаркомера (расстояние между линеей M и линеей Z) и линейного самоблокирующегося дифференциала. Согласно этим теориям, сокращение мышечной клетки это сумма биомеханических феноменов которые генерируются в двух сторонах одного и того же саркомера независимо друг от друга.
Эти понятия, помимо того что они вдохновляют на разработку инновационных биотехнологических исследований, позволяющих человеку испытать опыт сверхсилы, способны объяснить некоторые аномальные физиологические реакции мышечной ткани стимулированные интенсивными упражнениями уступающего (эксцентрического) характера.

ТАЛАНТ ЧЕЛОВЕКА: ОБЩАЯ ХАРАКТЕРИСТИКА
Vladimir Issurin
SM (Ita), n.º 10, anno IV, maggio-agosto 2018, pp . 44-55
Статья предствляет собой первую главу книги автора, которая полностью посвящена таланту человека. В статье представлены фундаментальные положения о феномене которое определяется как талант; идеи которые поддерживают понятие природного таланта; раннее определение исключительных навыков и способностей; достижение исключительного мастерства при отсутствии помощи и профессионально адекватной поддержки; наличие биологических признаков и маркеров; доказательства и концепции которые оповергают парадигму и существование так называемого природного таланта; наличие объективных показателей передового опыта для идентификации таланта в спорте.

ПОЧЕМУ ДОПИНГ?
Francesco Riccardo
SM (Ita), n.º 10, anno IV, maggio-agosto 2018, pp . 54-63
Автор рассматривает очень важную проблему начала использования допинга: потребности личности и способы их реализации, решения применять запрещённые вещества. Разные виды ответственности о которых необходимо задавать серъёзные вопросы.

ПНЕИ (PNEI), ПОЛОЖЕНИЕ ТЕЛА, ПРОИЗВОДИТЕЛЬНОСТЬ (РАБОТОСПОСОБНОСТЬ). ПЕРВАЯ ЧАСТЬ
Nicola Barsotti & Marco Bruscolotti
SM (Ita), n.º 10, anno IV, maggio-agosto 2018, pp . 66-77

В статье представлена концепция ПНЕИ (PNEI), аббревиатура термина Psico-Neuro-Endocrino-Immunologia (Психо – Невро – Эндокринная Иммунология), дисциплина которая изучает двунаправленные отношения между психикой и биологическими системами, описывая как психика в состоянии модулировать функционирование нашего тела и даже модулировать генетичекую экспрессию (эпигенетический эффект) и объясняя, с другой стороны, как различные биологические системы изменяют само мышление. Всё это позволяет людям реагировать наилучшим образом на стрессоры внешней среды как прхологического так и антигенного характера.
В теории ПНЕИ знания приобретённые в тридцатых годах прошлого века в области эндокринологии, иммунологии, неврологии и биологии объединяются в одну модель.

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