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Calzetti & Mariucci Editori

PUBLISHER
Calzetti & Mariucci Editori
By Roberto Calzetti Editore srl
Via del Sottopasso 7 – Loc. Ferriera
06089 Torgiano (PG) Italy
Phone / Fax +39 075 5997310 – 5990017
E-mail: info@calzetti-mariucci.it
Web: www.calzetti-mariucci.it

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Strada Cardio 58 – Zona industriale Galazzano
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studiostampa NEW AGE

CORRESPONDENCE
EWF – Viale Tiziano 70 Roma
E-mail: presidente@federpesistica.it
E-mail: secretariat@ewfed.com
E-mail: info@calzetti-mariucci.it

COMMUNICATION AND WEB AREA
· Colin Buckley
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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.

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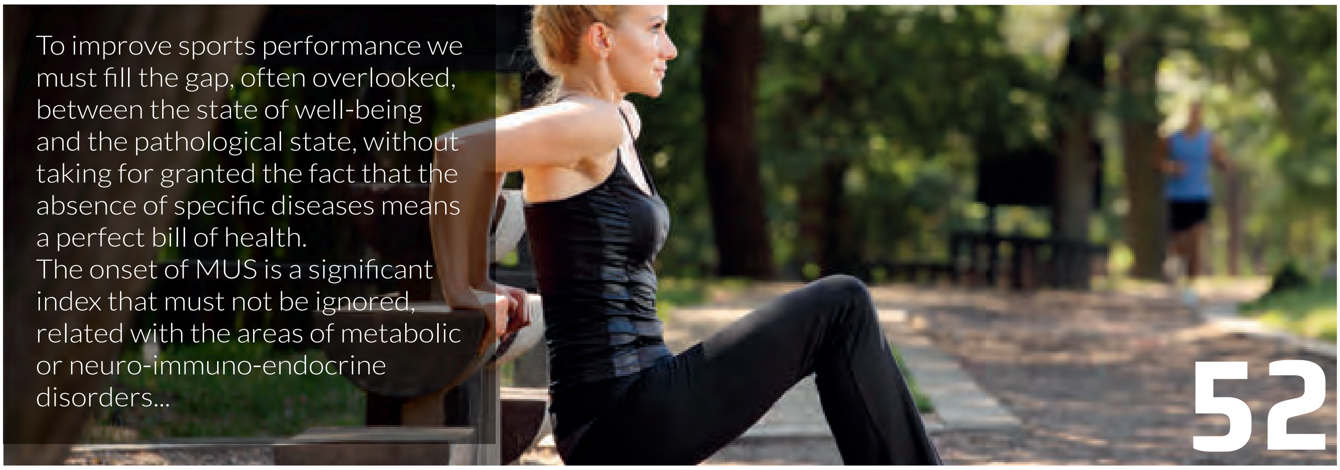
SUMMARY



To improve sports performance we must fill the gap, often overlooked, between the state of well-being and the pathological state, without taking for granted the fact that the absence of specific diseases means a perfect bill of health.
The onset of MUS is a significant index that must not be ignored, related with the areas of metabolic or neuro-immuno-endocrine disorders...

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One of the most important aspects related to the problems of motor control, and therefore also learning, is related to the phenomena that affect feedback. Feedback is all the information that the individual who carries out a movement has the ability to receive and process, and that allows him to control the movement and perform it more effectively.

The official journal of the European Weightlifting Federation

EDITORIAL

Human beings and movement

My apologies if I constantly return to this topic, but movement is taking on an increasingly important role, naturally in an overall view of performance at any level. Movement is the basis of qualification in high levels of specialisation; I specialise if I have a basis which I can specialise on. But what exactly am I specialising, is it not movement?
I am writing this today with more conviction than yesterday, and with greater determination than before. A belief that was reinforced after attending last year's Olympic and Paralympic Games. I don't want to talk about the actual results, I am more interested in how they have evolved, the ways in which the body expresses itself, by organising, creating and personalising in a set space and time, with resolute accuracy, a precise functional sequence of movements following clear rules: competition rules.
So: space, time and accuracy. These three elements are the basis of every sport, and represent the key to its understanding and interpretation. All human performance is organised within these elements, and when one or more does not fit in with others, the result is always different from what the sports rules dictate.

Having been fortunate to experience the various competitions first hand, I was particularly impressed with the organisational aspects of movement of various athletes in various sports. I was amazed how Olympic athletes first and foremost, were capable of reaching the same result as their opponents, by doing things, within a repetitive biomechanical system, which were often clearly different in terms of the strategic organisation of the movement: posture, technique, use of muscle chains and psychological approach.

I was going over my notions of biomechanics and discovered that many elements, among the theoretical and practical aspects, often showed totally incomparable differences in more than one case. It was extraordinarily fascinating to observe in some athletes, the fluidity with which the motor sequences engaged, creating a seemingly simple (movement?) framework, almost within everyone's reach. And I wondered, for example, how could I have trained that movement through the development of strength, also taking into account

how much strength? Which and how many preparatory exercises would I have performed? It is by no means easy, however many considerations came into play in things already seen many times, if not directly on the competition field, then at least on television, even if the observations are not exactly the same, strange as it may appear.
But the final blow, so to speak, was dealt at the Paralympic Games. All the considerations made, all the reflections stimulated by the observation of Olympic athletes were to be completely forgotten. The Biomechanics that we have all studied more or less in depth with those athletes, and in relation to that type of performance, can no longer exist in the realm of Paralympics. There are no longer references within the same sport. The disabilities are different, sometimes too different, so you cannot even attempt to make analogies of any kind. How do you qualify and subsequently specialise such an athlete? What, if any, is the methodological approach in each sport to create the basics of movement? How do you measure the adaptations? Do these aspects go hand in hand with the technology of the competition equipment (non-specific tools and specific tools: wheelchairs, straps, prostheses and more? It all becomes more complicated, it almost seems as if there are no longer any rules, or maybe there is an infinite number of rules. In fact, if we thought in this way, it would undermine the readjustment phenomenon of the human-machine, even in extreme biomechanical conditions. These athletes can do "things" far better than those improperly called able-bodied people. They are proof of the infinite resources within us, set aside but not abandoned. Existing and available when necessary, to be used and put into action in extreme circumstances or upon the extreme desire to act, to express an ability.
All this raises further considerations and subsequently sparks new questions: with the knowledge we have at our disposal today, are we still able to bring out the best in the athletes we consider to be the "luckiest"? Or there are aspects that still escape us, sides where light needs to be shed, particular points of view to be accentuated?

Perhaps we should put everything into a new melting pot and carefully mix and blend all the ingredients, both old and new.
Human movement still harbours many secrets and has lots more to reveal. Naturally, we need to know how to query it.

Antonio Urso
EWF President

PROTEIN SUPPLEMENTATION AND STRENGTH/POWER PERFORMANCE

BY JAY R. HOFFMAN

Proteins are nitrogen-containing substances that are comprised of amino acids. They form the major structural component of muscle, and other tissues in the body. Proteins are not the primary or a desired source of energy, but during periods of nutrient deprivation they can be used to produce energy. For proteins to be used by the body, they are first degraded to their simplest form, amino acids. There are twenty amino acids identified that are needed for growth and metabolism, and are categorized as either being essential or nonessential. Nonessential amino acids are synthesized by the body and do not need to be consumed in the diet, whereas essential amino acids cannot be synthesized endogenously and must be consumed in the diet. However, there are non-essential amino acids that are considered to be 'conditionally essential' which means that there may be times when obtaining some of these nonessential amino acids becomes vital for maintaining health. Absence of any of the essential amino acids from the diet can limit the ability for muscle to grow or be repaired.

DAILY PROTEIN REQUIREMENTS

Consuming a high level of protein and preserving lean body mass in the body is important during periods of intense physical training and training overload. In order to sustain muscle protein balance during periods of stress and/or high intensity activity, diet alone may not be sufficient. The use of protein supplements can or perhaps should be used to attenuate muscle proteolysis and promote muscle protein accretion (Hoffman, et al., 2015). Daily protein needs are determined by the ability to maintain a positive balance between protein degradation and protein synthesis. If protein degradation exceeds protein synthesis the body is considered to be in a catabolic state, but if protein synthesis exceeds protein degradation the body is considered to be in an anabolic state. A positive balance results in an increase in skeletal muscle mass as opposed to a negative balance, which results in a loss of skeletal muscle. In general, the protein requirement for an adult to maintain a positive protein balance is 0.8 g·kg·day-1 body mass. For individuals who are active their protein needs appear to be greater and dependent on the type of physical activity being performed. Individuals performing strength and power activities have greater daily protein need than individuals involved in sub-maximal but sustained activities (e.g., endurance activities). Both groups of active individuals though require a greater daily protein intake than their sedentary colleagues.

Resistance exercise has been shown to stimulate both protein synthesis and protein degradation, but in a fasted state protein degradation will still exceed protein synthesis (Biolo et al., 1997). When protein is ingested following exercise, the increase in muscle protein synthesis is between 50% and 100% greater than that seen from resistance exercise only (Biolo et al., 1997). Other investigators have reported that the combination of oral ingestion of amino acids and resistance exercise may produce a 3.5 fold increase in muscle protein synthesis (Miller et al., 2003). Although resistance exercise and protein intake can each increase muscle protein synthesis, the combination of the two is clearly superior in eliciting significant gains. Strength/power athletes appear to have a greater daily protein requirement than other segments of the population. In studies examining high versus low daily protein intakes, higher protein consumption was associated with greater gains in protein synthesis, muscle size, and body mass (Hoffman et al., 2006; 2007; Lemon et al., 1992). Fern and colleagues (1991) compared two daily doses of protein ingestion (3.3 vs. 1.3 g•kg 1•day 1) in subjects performing a 4-week resistance training program. Significantly greater elevations were observed in protein synthesis, which was also reflected by significant gains in body mass were observed in the subjects consuming the higher daily protein intake. In a study of previously untrained individuals consuming 2.62 g•kg 1•day 1 versus 0.99 g•kg 1•day 1 during resistance training resulted in greater elevations in protein synthesis, but no differences in muscle growth or strength were noted between the groups (Lemon et al., 1992). Considering that subjects were previously untrained, the significant gains in strength were likely related to neural adaptations and not to any muscle structural changes. In studies on competitive strength/power athletes (collegiate football players) increases in protein ingestion do appear to result in greater performance results. Resistance trained athletes consuming 2.0 g•kg 1•day 1 for 12 weeks showed greater gains in strength than a similar group of strength/power athletes consuming 1.2 g•kg 1•day 1 (Hoffman et al., 2007).

Daily protein intakes ranging from 1.2 and 1.7 g•kg 1•day 1 are recommended for strength/power athletes to maintain a positive nitrogen balance (Rodriguez et al., 2009). However, much of the evidence supporting this daily protein range has been based upon studies examining recreational athletes. Investigations on competitive strength/power athletes are limited. One study examining college football players compared three different daily protein intakes (1.2 g•kg 1•day 1, 1.7 g•kg 1•day 1, and 2.4 g•kg 1•day 1) and found no significant differences in strength or lean body mass between the groups, but the greatest gains in strength (1-RM squat and bench press) were seen in the group consuming the highest daily protein intake (Hoffman et al., 2006).

USE OF PROTEIN SUPPLEMENTATION

Dietetic and sports medicine organizations generally take a conservative approach to supplementation. Consensus among these organizations is that protein needs can generally be met through food sources. However, these organizations also acknowledge the role that protein and amino acids have in optimizing the training response and enhancing recovery, and how the timing of ingestion may provide significant benefits (Rodriguez et al., 2009). In addition, supplementation is also convenient and efficient for providing immediate protein needs to enhance recovery.

The benefits of protein supplementation has been demonstrated in a recent meta-analysis performed on studies examining the ability of protein supplementation to enhance the adaptive responses of skeletal muscle to resistance exercise (Cermak et al., 2012). Results were examined from 22 randomized controlled studies. To be included in the analysis each study needed to have a supplementation group that consumed a minimum of 1.2 g•kg•day-1 of protein taken in combination with a prolonged resistance training program of at least 6-weeks. The analysis concluded that protein supplementation in combination with resistance training, in either young (23 ± 3 y) or older (62 ± 6 y) adults, can significantly augment the gains in lean body mass, cross-sectional area of both type I and type II muscle fibers and strength. The mechanism leading to greater strength and size development through protein supplementation is not clearly defined. However, one of the benefits associated with protein consumption following an intense workout is in its ability to enhance the recovery and remodeling processes within skeletal tissue (Tipton et al., 2004). Several studies have reported a decrease in the extent of muscle damage, attenuation in force decrements, and an enhanced recovery from protein ingestion following resistance exercise (Cooke et al., 2010; Hoffman et al., 2010; Hulmi et al., 2009; Kraemer et al., 2006; Ratamess et al., 2003). This would potentially results in a higher quality workout during the next training session, which can stimulate greater adaptation in the muscle compared to those who do not consume the protein. How the timing of protein ingestion affects this response will be discussed later.

SOURCE OF PROTEIN; DOES IT MAKE A DIFFERENCE?

Protein consumption from meals can be consumed from a variety of sources that are from animal and/or plant origin. Similarly, protein supplements can also be from the same variety of sources. However, of interest to many athletes is which protein is most effective in maximizing performance gains. A protein that contains all of the essential amino acids is considered to be a complete protein. Proteins from animal sources are complete proteins. In contrast, proteins from vegetable sources are incomplete in that they are generally lacking at least one of the essential amino acids.

Thus, vegetarians who get their protein from vegetable sources will need to consume a variety of vegetables, fruits, grains, and legumes to ensure consumption of all essential amino acids. Protein from vegetable sources are generally less efficient than animal proteins (Hoffman and Falvo, 2004).

Animal proteins

The common animal proteins typically found in protein supplements include whey, casein and bovine colostrum. Whey is a general term that typically denotes the translucent liquid part of milk that remains following the process (coagulation and curd removal) of cheese manufacturing. Whey protein accounts for 20% of the protein content milk. It contains high levels of the essential and branched chain amino acids. There are several varieties of whey protein that result from various processing techniques. These include whey powder, whey concentrate, whey isolate, and whey hydrolysate. Whey protein powder is more commonly used in the food industry as an additive in food products, and not seen in sports supplements. Whey concentrate,

whey isolate and whey hydrolysate contain more biologically active components and proteins, which make them a very attractive supplement for the strength/power athlete (Hoffman and Falvo, 2004; Hoffman et al., 2015). Whey concentrate is comprised of 70% – 80% protein and is the most common form of whey protein found in sport supplements (Hulmi et al., 2010). Whey isolates contains 90% protein with minimal amounts of lactose or lipids making it ideal for individuals who are lactose intolerant. Whey hydrolysate is thought to provide an accelerated rate of absorption as the manufacturing process of creating a hydrolysate (i.e., partially digested) is thought to enhance absorption and utilization of amino acids (Hulmi et al., 2010). Although evidence is limited regarding enhanced gastric emptying or faster appearance of amino acids in the plasma, hydrolysates have been shown to enhance the insulin response compared to whey concentrate or isolate (Hulmi et al., 2010), and may improve recovery compared to whey isolate (Buckley et al., 2010).

Casein accounts for nearly 70-80% of the total protein in milk, and is responsible for its white color. Similar to whey, casein is a complete protein. It exists in milk in the form of a micelle, which is a large colloidal particle. Once ingested it forms a gel or clot in the stomach. The ability to form this clot makes it very efficient in nutrient supply. The clot is able to provide a sustained release of amino acids into the circulation, sometimes lasting for several hours (Boirie et al., 1997).

Bovine colostrum is the "pre" milk liquid secreted by mothers in the first few days following birth. This nutrient-dense fluid provides immunities and assists in the growth of developing tissues in the initial stages of life. Although colostrum is not as common as whey and casein as a supplement, it does present interesting potential as a supplement. Ingestion of colostrum has been reported to significantly elevate insulin-like-growth factor 1 (IGF-1) (Mero et al., 1997) and enhance lean tissue accruement (Antonio et al., 2001). However, the efficacy of colostrum supplementation has yet to be seen.

Vegetable proteins

As discussed earlier, to provide for all of the essential amino acids, a combination of various types of vegetable proteins need to be consumed. Popular sources include legumes, nuts and soy. One advantage for consuming vegetable proteins is a likely reduction in saturated fat and cholesterol ingestion. Soy, from the legume family, is the most widely used vegetable protein source. It is a complete protein with a high concentration of branched chained amino acids. Soy proteins are also associated with health benefits including reducing plasma lipid profiles and blood pressure (Hoffman and Falvo, 2004). There are three distinct categories of soybeans; flour, concentrates, and isolates. Soy flour is the least refined form, and is commonly found in baked goods. Soy concentrate is more palatable and has a high degree of digestibility. It is often found in nutrition bars, cereals, and yogurts. Isolates are the most refined soy protein and contains the greatest concentration of protein, but contains no dietary fiber. Soy isolates are very digestible and easily introduced into foods such as sports drinks and health beverages.

Which Has the Greater Benefit Amino Acids or Whole Proteins?

Both essential amino acids and whole proteins appear to be beneficial in stimulating muscle protein synthesis. One study demonstrated that arterial amino acid concentrations are approximately 100% higher than resting levels following ingestion of essential amino acids but only 30% following whey protein ingestion (Tipton et al., 2007). These results indicate a greater amino acid availability to active muscle. In addition, the amino acids were provided with a carbohydrate whereas no carbohydrate was provided with the whey protein. This likely enhanced the uptake of amino acids into the muscle by stimulating a greater insulin response.

Comparison between Whey and Casein Protein

Studies on performance effects of whey versus casein ingestion in strength/power athletes are limited. Kerksick and colleagues (2006) compared a carbohydrate placebo, 40 g of whey protein and 8 g of casein, to 40 g of whey protein and 8 g of amino acids (5 g of branch chain amino acids and 3 g of glutamine) per day in resistance trained men for 10-weeks. The group ingesting the whey and casein combination experienced a greater increase in lean body mass, but no differences were noted between the groups in strength gains. Another study compared 24 g of whey ingestion to 24 g of daily casein supplementation in collegiate female basketball players for 8-weeks (Wilborn et al., 2013). Significant improvements were noted in both groups in lean body mass, strength and power. No differences were observed in any of the body compositional or performance measures between the groups suggesting that both proteins are beneficial.

Comparison of Soy versus Animal Protein

There are clear health benefits associated with soy protein consumption, however the main question is whether of soy is provides the similar effect as an animal-based protein in stimulating protein synthesis and muscle protein accretion. Tang and colleagues (2009) compared equivalent content of essential amino acids (10 g) as either whey hydrolysate, micellar casein or soy protein isolate consumed following 4-sets per exercise of a 10 – 12 repetition maximum (RM) on both unilateral leg press and knee extension exercises. Whey protein ingestion resulted in a significantly greater increase in plasma leucine concentrations during the 3-h recover period than both casein and soy proteins. In addition, whey protein ingestion stimulated muscle protein synthesis to a greater extent than both casein and soy. These differences were attributed to the faster absorption of whey protein and the faster increase of leucine in the circulation acts as a leucine 'trigger' to stimulate muscle protein synthesis. Evidence also exists suggesting that whey protein can stimulate protein signaling to a greater magnitude than soy protein (Anthony et al., 2007; Mitchell et al., 2015).

One study compared the effect of whey or soy protein ingestion in previously untrained men and women participating in a 9-month periodized resistance training program (Volek et al., 2013). No significant differences were seen between the groups in 1-RM bench press or squat strength. However, significantly greater increases in lean body mass was observed in participants consuming whey than soy following 3-, 6- and 9-months of training. In addition, fasting leucine concentrations were significantly elevated (20%) and post-exercise plasma leucine increased more than 2-fold in the

whey group. An additional study on experienced resistance trained comparing soy and whey protein supplementation (20 g per day for two weeks) reported that participants consuming the soy protein had an attenuated testosterone response to an acute training program (Kraemer et al, 2013). In addition, the investigators also reported that whey protein ingestion may blunt the cortisol response to exercise.

Present understanding appears to support the use of milk, or animal-based proteins to maximize muscle protein synthesis and changes in lean body mass. This is likely related to differences in protein quality as milk proteins contain a greater concentration of leucine.

IMPORTANCE OF LEUCINE FOR MUSCLE PROTEIN SYNTHESIS

Leucine is a potent stimulator of muscle protein synthesis (Cuthertson et al., 2005). When it is combined with a carbohydrate elevations in muscle protein synthesis appeared to be sustained (Dreyer et al., 2008). Leucine appears to increase muscle protein synthesis in a dose-dependent manner. In an animal study rats were fed a meal that contained either 10%, 20% or 30% whey or soy protein (Norton et al., 2009). The whey protein meals contained 47 mg, 94 mg and 142 mg of leucine, respectively, while the soy protein meals contained 29 mg, 60 mg and 89 mg of leucine, respectively. Feedings of 10% soy protein, containing 29 mg of leucine did not stimulate muscle protein synthesis, but feedings of 10% whey protein containing 47 mg of leucine did initiate protein synthesis. As leucine content increased from either whey or soy ingestion an increase in muscle protein synthesis was noted. This was the first study to indicate that a specific threshold may be needed to initiate muscle protein synthesis, and if protein content is not sufficient (i.e., not reaching this threshold) then the anabolic processes may be blunted.

PROTEIN TIMING. ACUTE EFFECTS

When protein is consumed following a workout the anabolic response appears to be greater the closer the protein was consumed to the workout. No differences were noted in muscle protein synthesis when 6 g of essential amino acids with 35 g sucrose were provided one or three hours following a resistance training workout in untrained subjects (Rasmussen et al., 2000). However, when this same combination of essential amino acids and carbohydrate was infused immediately before exercise, the increase in muscle protein synthesis was significantly greater compared to infusion occurring immediately post-exercise (Tipton et al., 2001). Amino acid infusion immediately prior to the training session resulted in a 46% increase in amino acid concentration within skeletal muscle immediately post-exercise and an 86% elevation one hour post-exercise, which was significantly greater than those values seen from the same amino acid and carbohydrate infusion occurring immediately following the training session. The pre-exercise ingestion of amino acids appeared to increase the rate of delivery (2.6 fold greater) and subsequent uptake by of amino acids to skeletal muscle during exercise.

The faster absorption capability of whey protein has important implications for increasing the rate of protein synthesis following a training session. One of the first comparisons between casein and whey protein supplementation examined protein synthesis rates following a 30 g feeding (Boirie et al., 1997). Ingestion of whey protein resulted in a rapid appearance of amino acids in the plasma, while ingestion of casein resulted in a slower rate of absorption, but provided for a more sustained elevation in plasma amino acid concentrations. As a result of the fast absorption rate of whey, a more rapid increase in protein synthesis (68%) was observed within approximately two hours following ingestion. Casein ingestion though stimulated a more sustained elevation in protein synthesis, with a peak synthesis rate of approximately 31% above baseline. However, the sustained effect of casein resulted in a significantly higher leucine balance 7 hours following ingestion with no change from baseline seen at that time point following whey consumption. Others have also reported a faster increase in protein synthesis in whey than casein ingestion, with the greater protein synthesis seen in casein over an extended period of time (Tipton et al., 2004). When whey protein was provided in multiple ingestions over four hours and compared to a single serving of whey or casein (total protein consumed was equivalent), the multiple ingestion periods resulted in a greater net leucine oxidation than a single feeding of either casein or whey (Dangin et al., 2002). Considering that there may be a heightened sensitivity in skeletal tissue following a workout (Hoffman et al., 2015), ingestion of whey protein immediately following the training session may enhance muscle remodeling and recovery.

PROTEIN TIMING: TRAINING RESPONSE

In one of the initial studies examining the effects of protein timing in young (21 – 24 years) recreational male bodybuilders, 40 g of whey isolate and 43 g of carbohydrate (glucose) were provided either immediately before and after each resistance training session or in the morning and evening (Cribb and Hayes, 2006). Significantly greater gains in lean body mass, cross-sectional area of type II fibers, contractile protein content, and strength were seen in the pre- and post-workout feeding group compared to the morning and evening feeding group. The effect of protein timing in experienced, resistance trained athletes did not appear to be as beneficial. Hoffman and colleagues (2009) investigated the effects of protein timing in experienced, competitive college football players. The players were randomized into three groups. The first group consumed a 42 g protein supplement pre- and post-workout; the second group consumed the same supplement, albeit in the morning and evening; and the third group were not provided any supplement and served as the control group. Significant strength and power improvements were reported in all three groups, with no between-group differences observed. It is important to note though that the average daily protein intake for all three groups ranged from 1.6 – 2.3 g·kg-1 body mass. The results of this study suggest that if dietary protein intake is at, or exceeds recommended levels for a strength–power athlete (1.6 g·kg·day-1), additional protein from a supplement, regardless of when it is ingested, may not provide any further advantage. In addition, all three study groups were in a positive nitrogen balance, suggesting that protein intakes were sufficient in meeting the athlete's protein needs. It is also important to note that the length of the investigation was only 10 weeks. This may not have been long enough to see differences in performance gains from nutrient timing in experienced, competitive strength/power athletes. Another potential factor influencing the results of that study is that the supplement contained only collagen protein and no carbohydrate. This may have delayed nutrient absorption, and subjects may have missed the window of adaptation. Thus, additional research still appears necessary to determine the potential benefits associated with protein ingestions surrounding a workout in experienced, resistance trained athletes, who consume a relatively high daily intake of protein.

HOW MUCH PROTEIN SHOULD BE CONSUMED PER INGESTION?

The need for a greater daily protein intake among strength/power athletes is no longer debatable. However, the amount of protein that should be consumed per ingestion is not well understood. Studies have used various quantities of protein per ingestion, ranging from 6 g of amino acids to more than 40 g of whole protein, amino acids or proprietary blends in various combinations. The biggest question is whether there is a ceiling on the effectiveness of the quantity of protein that can be effectively used per ingestion. One study examined post-exercise protein drinks containing 0, 5, 10, 20, or 40 g protein (Moore et al., 2009). Protein was consumed following an acute bout of leg extension exercise, while muscle protein synthesis was measured over the subsequent four hour period. Results indicated that muscle protein synthesis increased with each increase of protein quantity up to 20 g. No differences were observed between the 20 g and 40 g dose. Whether a multi-joint structural exercise such as the squat, or a normal training routine (6 – 7 exercises using 3 – 4 sets per exercise), would stimulate further increases in protein synthesis at higher doses is not known. Witard and colleagues (2014) also examined the dose-response relationship between various amounts of whey protein ingestion on myofibrillar protein synthesis in experienced in resistance trained men who were not competitive athletes. Doses of 0, 10, 20 and 40 g of whey protein isolate were ingested 10-min following resistance exercise. Both moderate (20 g) and high (40 g) doses of whey protein stimulated a greater response of myofibrillar muscle protein synthesis than the lower (10 g) dose. However, no differences were seen in muscle protein synthesis between 20 g and 40 g feedings, confirming the work of Moore et al (2009). These studies suggest that an upper limit of muscle protein synthesis is seen with 20 g feedings. However, it is important to acknowledge that the body mass of the participants in these investigations was approximately 80 kg. Whether larger individuals can utilize greater amounts of protein remains largely unknown. Still, how much protein is consumed per ingestion may be less important that the pattern of protein ingestion.

Recent studies have examined the pattern of daily protein intake. Moore and colleagues (2012) provided 80 g of whey protein per day to young, resistance trained men who were randomized into three different groups. One group consumed the protein in a pulse fashion (8 x 10 g of whey protein every 1.5 h); another group used an intermediate ingestion fashion (4 x 20 g every 3 h); and the final group consumed the protein in a bolus fashion (2 x 40 g every 6 h). Ingestion occurred following an acute bout of knee extension exercise (4 set of 10 repetitions using 80%1RM). Rates of protein synthesis were significantly greater for the pulse ingestion format compared to the intermediate and bolus formats (32% and 19%, respectively). Further inferential analysis showed likely small and moderate increases in whole-body protein turnover for the pulse and intermediate ingestion formats compared to the bolus ingestion format. Thus, the pattern of protein ingested appears to impact whole-body protein metabolism. Areta and colleagues (2013) using the same research methodology as the previous study reported that all three ingestion protocols increased myofibrillar protein synthesis, throughout the 12 h recovery period (ranging from 88% - 148%). However, the intermediate ingestion pattern elicited the greatest levels of myofibrillar protein synthesis than the other two ingestion patterns. Thus, it does appear that protein ingestion every three hours has the potential to maximize muscle mass development.

DR. JAY HOFFMAN

holds the rank of full professor in the Sport and Exercise Science program at the University of Central Florida. He is presently the Department Chair of Education and Human Sciences and Director of the Institute of Exercise Physiology and Wellness.

Dr. Hoffman is a fellow of the American College of Sports Medicine and the National Strength and Conditioning Association (NSCA).

He served as President of the National Strength and Conditioning Association Board of Directors from 2009-2012. Dr. Hoffman also served on the Board of Directors of the USA Bobsled and Skeleton Federation. Dr. Hoffman holds a unique perspective in his sport science background. Prior to his academic career he signed free agent contracts with the NY Jets and Philadelphia Eagles of the NFL and the Tampa Bay Bandits of the USFL. A dual national of the USA and Israel, Dr. Hoffman commanded the Physiological Unit of the Israel Air Force and served as a Research Officer in the Combat Fitness Unit of the IDF during his military service. Dr. Hoffman has been honored or awarded the 2007 Outstanding Sport Scientist of the Year from the NSCA, 2005 Outstanding Kinesiology Professional Award from the Neag School of Education Alumni Society of the University of Connecticut, 2003 Educator of the Year NSCA, and 2003 Neag School of Education Outstanding Alumni Research Award (University of Connecticut).

Dr. Hoffman's primary area of study focuses on physiological adaptations resulting from nutritional and exercise intervention. Dr. Hoffman has published more than 200 articles and chapters in peer-reviewed journals. His books Physiological Aspects of Sport Training and Performance, Norms for Fitness, Performance, and Health, and Program Design were published by Human Kinetics. A Practical Guide to Designing Resistance Training Programs and Total Fitness for Baseball were published by Coaches Choice. Further sharing his research and findings, Dr. Hoffman has lectured at more than 380 national and international conferences and meetings.

References

1. Anthony TG, McDaniel BJ, Knoll P, Bunpo P, Paul GL, McNurlan MA. Feeding meals containing soy or whey protein after exercise stimulates protein synthesis and translation initiation in the skeletal muscle of male rats. J. Nutr. 137:357-362, 2007.
2. Antonio, J., Sanders, M., Van Gammeren, D. The effects of bovine colostrum supplementation on body composition and exercise performance in active men and women. Nutr. 17:243-247, 2001.
3. Areta JL, Burke LM, Ross ML, Camera DM, West DW, Broad EM, Jeacocke NA, Moore DR, Stellingwerff T, Phillips SM, Hawley JA, Coffey VG. Timing and distribution of protein ingestion during prolonged recovery from resistance exercise alters myofibrillar protein synthesis. J Physiol. 591:2319-2331, 2013.
4. Biolo G, KD Tipton, S Klein and RR Wolfe. An abundant supply of amino acids enhances the metabolic effect of exercise on muscle protein. Am. J. Physiol. Endocrinol. 273:E122-E:129. 1997.
5. Biolo G, Maggi SP, Williams BD, Tipton KD, Wolfe RR: Increased rates of muscle protein turnover and amino acid transport after resistance exercise in humans. Am j Physiol 1995, 268:E514-520.
6. Boirie Y, Dangin M, Gachon P, Vasson MP, Maubois JL, and Beaufrere, B. Slow and fast dietary proteins differently modulate postprandial protein accretion. Proc. Natl. Acad. Sci. 94:14930-14935. 1997.
7. Buckley JD, Thomson RL, Coates AM, Howe PRC, DeNichilo MO, Rowney MK. Supplementation with a whey protein hydrolysate enhances recovery of muscle force-generating capacity following eccentric exercise. J. Sci Med. Sport. 13:178-181, 2010.
8. Cermak NM, Res PT, de Groot L, Saris WHM, van Loon LJC. Protein supplementation augments the adaptive response of skeletal muscle to resistance-type exercise training: a meta-analysis. Am. J. Clin Nutr. 96:1454-1464, 2012.
9. Cooke MB, Rybalka E, Stathis CG, Cribb PJ, Hayes A. Whey protein isolate attenuates strength decline after eccentrically-induced muscle damage in healthy individuals. J. Int. Soc. Sports Nutr. 7:30, 2010.
10. Cribb PJ, Hayes A: Effects of supplement timing and resistance exercise on skeletal muscle hypertrophy. Med Sci Sports Exerc 38:1918-1925, 2006.
11. Cutherbertson D, Smith K, Babraj J, Leese G, Waddell T, Atherton P, Wackerhage H, Taylor PM, Rennie MJ. Anabolic signaling deficits underlie amino acid resistance of wasting, aging muscle. FASEB J. 19:422-424, 2005.
12. Dangin M, Boirie Y, Guillet C, and Beaufrere B. Influence of the protein digestion rate on protein turnover in young and elderly subjects. J. Nutr. 132:3228S-3233S. 2002.
13. Dreyer HC, Drummond MJ, Pennings B, Fujita S, Glynn EL, Chinkes DL, Dhanani S, Volpi E, Rasmussen BB. Leucine-enriched essential amino acid and carbohydrate ingestion following resistance exercise enhances mTOR signaling and protein synthesis in human muscle. Am J Physiol Endocrinol Metab. 294:E392-E400, 2008.
14. Fern, E.B., R.N. Bielinski, Schutz Y. Effects of exaggerated amino acid and protein supply in man. Experientia 47:168-172, 1991.
15. Hoffman JR and Falvo MJ. Protein – Which is best? J. Sports Sci. Med. 3:118-130, 2004.
16. Hoffman, JR, Ratamess NA, Tranchina CP, Rashti SL, Kang J, Faigenbaum AD. Effect of protein ingestion on recovery indices following a resistance training protocol in strength/power athletes. Amino Acids 38:771-778, 2010.
17. Hoffman JR, Ratamess NA, Tranchina CP, Rashti SL, Kang J, Faigenbaum AD. Effect of protein supplement timing on strength, power and body compositional changes in resistance-trained men. International Journal of Sport Nutrition and Exercise Metabolism 19:172-185, 2009.
18. Hoffman JR, Ratamess NA, Kang J, Falvo MJ, Faigenbaum AD. Effect of protein intake on strength, body composition and endocrine changes in strength/power athletes. Journal of the International Society of Sports Nutrition 3:12-18, 2006.
19. Hoffman, JR, Ratamess NA, Kang J, Falvo MJ, Faigenbaum AD. Effects of protein supplementation on muscular performance and resting hormonal changes in college football players. Journal of Sport Science and Medicine 6:85-92, 2007.

20. Hoffman JR, Stout JR and Moran DS. Protein Supplementation and Athlete Performance. In Ostojic SM (ed) Human Health and Nutrition New Research. Nova Science Publishers, Inc: Hauppauge NY. 49 – 68, 2015.
21. Hulmi JJ, Lockwood CM, Stout JR. Effect of protein/essential amino acids and resistance training on skeletal muscle hypertrophy: A case of whey protein. Nutr. Metab. 7:51, 2010.
22. Hulmi, JJ, Kovanen V, Selanne H, Kraemer WJ, Häkkinen K, Mero AA. Acute and long-term effects of resistance exercise with or without protein ingestion on muscle hypertrophy and gene expression. Amino Acids 37:297-308, 2009.
23. Kerksick CM, Rasmussen CJ, Lancaster SL, Magu B, Smith P, Melton C, Greenwood M, Almada AL, Earnest CP, Kreider RB. The effects of protein and amino acid supplementation on performance and training adaptations during ten weeks of resistance training. J Strength Cond Res. 20:643-653, 2006.
24. Kraemer WJ, Ratamess NA, Volek JS, Hakkinen K, Rubin MR, French DN, Gomez AI, McGuigan MR, Scheet TP, Newton RU, Spiering BA, Izquierdo M, and Dioguardi FS. The effects of amino acid supplementation on hormonal responses to overreaching. Metabolism. 55: 282-291. 2006.
25. Kraemer WJ, Solomon-Hill G, Volk BM, Kupchak BR, Looney DP, Dunn-Lewis C, Comstock BA, Szivak TK, Hooper DR, Flanagan SD, Maresh CM, Volek JS. The effects of soy and whey protein supplementation on acute hormonal responses to resistance exercise in men. J. Amer. Coll. Nutr. 32:77-74, 2013.
26. Lemon PWR, Tarnopolsky MA, MacdougaL JD, Atkinson SA. Protein requirements and muscle mass/strength changes during intensive training in novice bodybuilders. J. Appl. Physiol. 73: 767-775. 1992.
27. Mero A, Miikkulainen H, Riski J, Pakkanen R, Aalto J, Takala T. Effects of bovine colostrum supplementation on serum IGF-I, IgG, hormone, and saliva IgA during training. J. Appl. Physiol. 83:1144-1151, 1997.
28. Miller SL, Tipton KD, Chinkes DL, Wolf SE, Wolfe RR. Independent and combined effects of amino acids and glucose after resistance exercise. Med. Sci. Sports Exerc. 35:449-455. 2003.
29. Mitchell CJ, Della Gatta PA, Petersen AC, Cameron-Smith D, Markworth JF. Soy protein ingestion results in less prolonged p70S6 kinase phosphorylation compared to whey protein after resistance exercise in older men. J. Int. Soc. Sports Nutr. 12:6, 2015.
30. Moore DR, Areta J, Coffey VG, Stellingwerff T, Phillips SM, Burke LM, Cléroux M, Godin JP, Hawley JA. Daytime pattern of post-exercise protein intake affects whole-body protein turnover in resistance-trained males. Nutr Metab (Lond). 16:91, 2012.
31. Moore DR, Robinson MJ, Fry JL, Tang JE, Glover EI, Wilkinson SB, Prior T, Tarnopolsky MA, Phillips SM. Ingested protein dose response of muscle and albumin protein synthesis after resistance exercise in young men. Am J Clin Nutr. 89:161-168, 2009.
32. Norton LE, Layman DK, Bunpo P, Anthony TG, Brana DV, Garlick PJ. The leucine content of a complete meal directs peak activation but not duration of skeletal muscle protein synthesis and mammalian target of rapamycin signaling in rats. J. Nutr. 139:1103-1109, 2009.
33. Rasmussen BB, Tipton KD, Miller SL, Wolf SE, and Wolfe RE. An oral essential amino acid-carbohydrate supplement enhances muscle protein anabolism after resistance exercise. J. Appl. Physiol. 88: 386-392. 2000.
34. Ratamess NA, Kraemer WJ Volek JS, Rubin MR, Gomez AL, French DN, Sharman MJ, McGuigan MR, Scheet TP, Hakkinen K, Newton RU, Dioguardi FS. The effects of amino acid supplementation on muscular performance during resistance training overreaching. J. Strength Cond. Res. 17:250-258. 2003.
35. Rodriguez NR, DiMarco NM, Langley S. Nutrition and athletic performance. Position stand of the American College of Sports Medicine, American Dietetics Association and Dieticians of Canada. Medicine and Science in Sports and Exercise 41:709-731, 2009.

36. Tang JE, Moore DR, Kujbida GW, Tarnopolsky MA, Phillips SM. Ingestion of whey hydrolysate, casein, or soy protein isolate: effects on mixed muscle protein synthesis at rest and following resistance exercise in young men. J. Appl. Physiol. 107:987-992, 2009.
37. Tipton KD, Elliot TA, Cree MG, Aarsland AA, Sanford AP, Wolfe RR. Stimulation of net muscle protein synthesis by whey protein ingestion before and after exercise. Am. J. Physiol. Endocrinol. Metab. 292:E71-E76. 2007.
38. Tipton KD, Elliot TA, Cree MG, Wolf SE, Sanford AP, Wolf RR. Ingestion of casein and whey proteins result in muscle anabolism after resistance exercise. Med. Sci. Sports Exerc. 36: 2073-2081. 2004.
39. Tipton KD, Rasmussen BB, Miller SLl, Wolf SE, Owens-Stovall KK, Petrini BE, Wolfe RR. Timing of amino acid-carbohydrate ingestion alters anabolic response of muscle to resistance exercise. Am. J. Physiol. Endocrinol. Metab. 281:E197-E206. 2001.
40. Volek JS, Volk BM, Gomez AL, Kunces LJ, Kupchak BR, Freidenreich DJ, Aristizabal JC, Saenz C, Dunn-Lewis C, Ballard KD, Quann EE, Kawiecki DL, Flanagan SD, Comstock BA, Fragala MS, Earp JE, Fernandez ML, Bruno RS, Ptolemy AS, Kellogg MD, Maresh CM, Kraemer WJ. Whey protein supplementation during resistance training augments lean body mass. J. Amer. Coll. Nutr. 32:122-135, 2013.
41. Wilborn CD, Taylor LW, Outlaw J, Williams L, Campbell B, Foster CA, Smith-Ryan A, Urbine S, Hayward S. The Effects of Pre- and Post-Exercise Whey vs. Casein Protein Consumption on Body Composition and Performance Measures in Collegiate Female Athletes. J. Sports Sci. Med. 12:74-79. 2013.
42. Witard OC, Jackman SR, Breen L, Smith K, Selby A, Tipton KD. Myofibrillar muscle protein synthesis rates subsequent to a meal in response to increasing doses of whey protein at rest and after resistance exercise. Am J Clin Nutr. 99:86-95, 2014.

THE ROLE OF FEEDBACK IN ATHLETE LEARNING

BY MONICA PALIAGA

One of the most important aspects related to the problems of motor control, and therefore also learning, is related to the phenomena that affect feedback.
Feedback is all the information that the individual who carries out a movement has the ability to receive and process, and that allows him to control the movement and perform it more effectively.

There are two types of feedback:

- **Intrinsec feedback**, which refers to the information coming from the sensory system of the individual who performs the movement. It is therefore related to the information resulting from one's own movement, that the individual is able to receive and process through their own analyzers: visual, tactile, acoustic and vestibular
- **Extrinsic feedback**, which refers to the information coming from sources external to the individual performing the movement, such as the coach (verbal and non-verbal information) or by watching a video. In this case only the acoustic and visual analyzers are used.

Extrinsic feedback, therefore, needs to be somehow "translated" into a motor language, in the sense that the visual and acoustic information must be integrated with the vestibular and proprioceptive information of the intrinsic feedback.
Hence the need for the instructor or coach to refer their external feedback to the internal feedback of the athlete, and then find words and actions that facilitate such communication, putting the athlete in a position to link the verbal instructions of the coach with their own motor perceptions.
Extrinsic feedback can be further divided into two types:

- **feedback on results**, which informs the individual if their movement has reached its target;
- **feedback on the performance**, relative to the way the movement is executed.

The coach can then use the feedback on results to tell the athletes whether or not the objectives have been reached (for example: "the throw was low"), or to tell them about the characteristics of the movement that produced that result (for example:" you have to keep your elbow higher to throw higher").
According to Magill (1980), the coach's extrinsic feedback always has a dual function:

1. The **informative function**: concerns what has already been said about the information that the coach makes available to the athlete, so that the latter can connect it to his internal information in order to control his movement better and to achieve increasingly higher levels of efficiency;
2. The **reinforcement function**, on the other hand, concerns the effect that any coach feedback produces on the athlete's emotional sphere.

Every action of the coach affects the motivation, the drive and the self-esteem of the athlete. Each intervention the coach makes, however, has itself a dual function; any feedback providing information on movement, contains elements of psychological reinforcement; and conversely, any reinforcement feedback provides information on how the coach saw the movement and as a result, even unintentionally, expresses his own judgment of the athlete.
For this reason, feedback, like all communication processes, has an impact on a relational level, that influences the coach-athlete relationship.
This effect is particularly important when feedback is used after errors made by the athlete: in practice, it is the most common occurrence; in this case, the feedback is a coach's reaction to something negative performed by the athlete. This type of feedback, if repeated over time, can pass from the objective level of error correction, to the subjective and relational level: the athlete may interpret corrective actions as criticism of his person or his personality, and think that the coach has a low opinion of him.

It is always wise, therefore, to consider the dual function of feedback (informative and reinforcement) and appropriately dose instructions that have a negative value with those that have a positive meaning, bearing in mind that the messages transmitted to athletes can also be of a nonverbal nature.

Many studies have investigated the important characteristics of feedback:

1) the rate at which the coach must provide the feedback, which depends on the athlete's motor skills level. As the athlete improves, the feedback will be more and more spaced out, to allow him to use the external information and connect it to the internal sensory information. During the athlete's technical evolution, the function of feedback should move from predominantly reinforcement to the more information-oriented. Feedback is much more effective when the athlete demonstrates a request, a need of information: the coach must not then "bombard" the athletes with feedback, but will have to motivate them to search for information, encouraging active participation in learning, trying to convey instructions and suggestions, when he feels that the athlete really needs them;

2) the accuracy of the feedback, in other words, the kind of specific information that the coach provides the athlete with respect to the result obtained. Magill and Wood (1986) and Rogers (1974) have shown that both performance and learning increase as a result of accurate and detailed information: however, there is a limit to accuracy beyond which there is a deterioration in results. Newell and Kennedy (1978) believe that this limit is affected by age; as one grows older, there is a greater ability to use more and more accurate information;

3) the most appropriate time to intervene with feedback.
When extrinsic feedback is provided immediately after an athlete has completed his movements, instead of waiting a few seconds, the learning is not so effective, because it hinders the elaboration process of the athlete's intrinsic feedback, and the time to evaluate his mistakes. Enough time must be given to athletes for each of these activities, before providing feedback.

It is critical that the coach stimulates interest and attention in young athletes, to solicit the conscious and responsible participation in the physical activity, especially when it is directed to learning and mastering techniques. Young athletes must be enthusiastic and involved in their own learning process in order to reach the necessary autonomy to manage it themselves.

MONICA PALIAGA
Psychologist with a Masters in Sports Psychology from the Italian Association of Sport and Exercise Psychology and International Sports Coaching Certification from the Tim Gallwey "Inner Game" School

BODY WEIGHT CATEGORIES IN WEIGHTLIFTING

Comparing results of the Olympic Games and World and European Championships from 2005 to 2016.

BY F. JAVIER FLORES AND JUAN C. REDONDO


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Body weight categories in weightlifting. Comparing results of the Olympic Games and World and European Championships from 2005 to 2016.

The main goal of this article is to make a descriptive analysis category by category of the results of the Olympic Games (OG) and World and European Championships (WC and EC) since 2005, when the competition rules set a minimal progression of 1.0 kg after any successful attempt for the same athlete, until the 2016 Olympic Games celebrated in Rio. The idea behind this descriptive analysis is to take a snapshot of the last results during the most important competitions for the European weightlifting, observing the best and worst categories and competitions and the trend of results during the period studied (2005-2016).

To facilitate reading, the article has been divided into two parts, analyzing firstly the male results and secondly the female results. According to the code of colors used in the preparation of the figures and tables, green color represents Olympic Games and red and grey colors represent World and European Championships respectively. To analyze combined data of these three competitions, blue and pink colors have been used to represent male and female data respectively.

The results shown in this paper are taken from IWF's website on 08/28/2016 and consist of three Olympic Games, nine World Championships and eleven European Championships for the period studied. The criterion to choose the competitions studied was the introduction on 2005 of the current technical regulation on the progression of the barbell load in multiples of 1.0 kg. The doping cases found after the download date of results could alter the results shown in this article.

Results for men

The average of total for the top 3 (Figure 1) and top 10 (Figure 2) male ranked lifters in each body weight category show a similar trend. The total achieved during WC and OG is similar with a light trend to achieve better results for OG. Equally the results of EC are the lowest of the three types of the competitions studied.

For the top 3 classified athletes (Figure 1), the average of lost per-

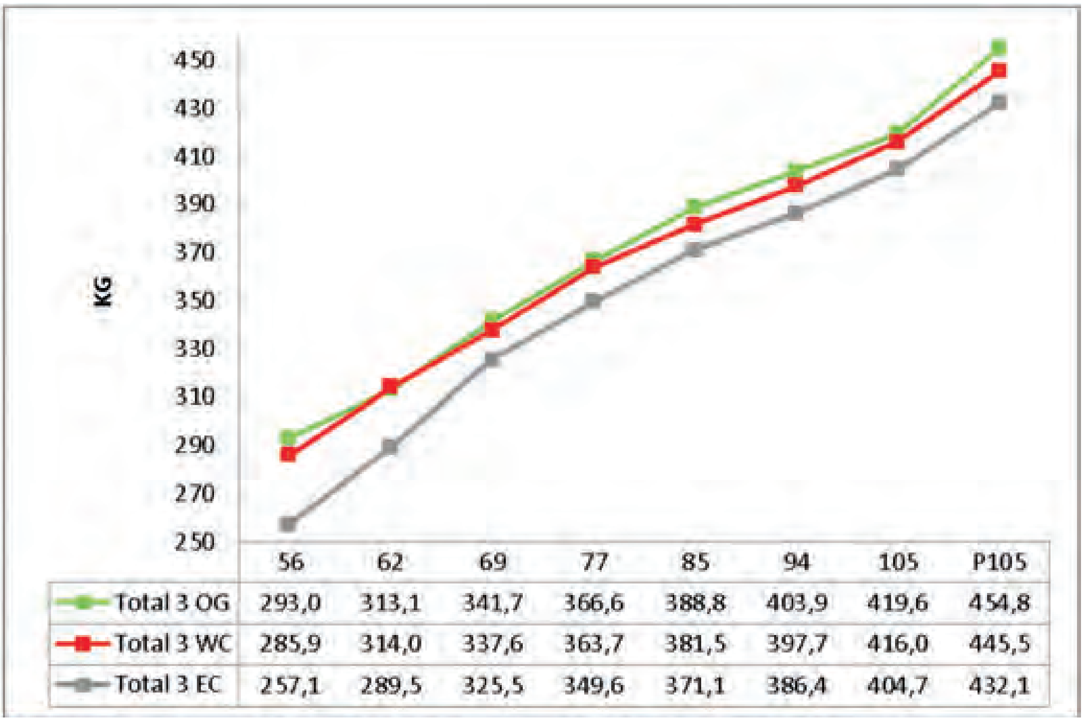

Figure No. 1
AVERAGE OF TOTAL FOR TOP 3 MALE ATHLETES IN OG, WC AND EC.

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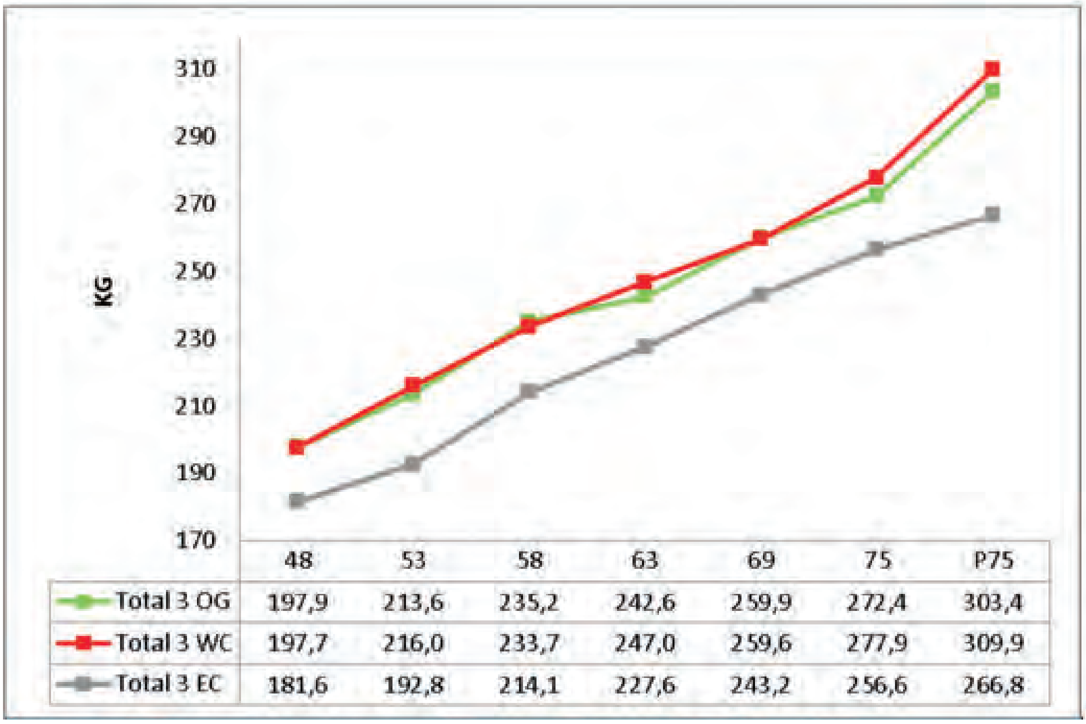
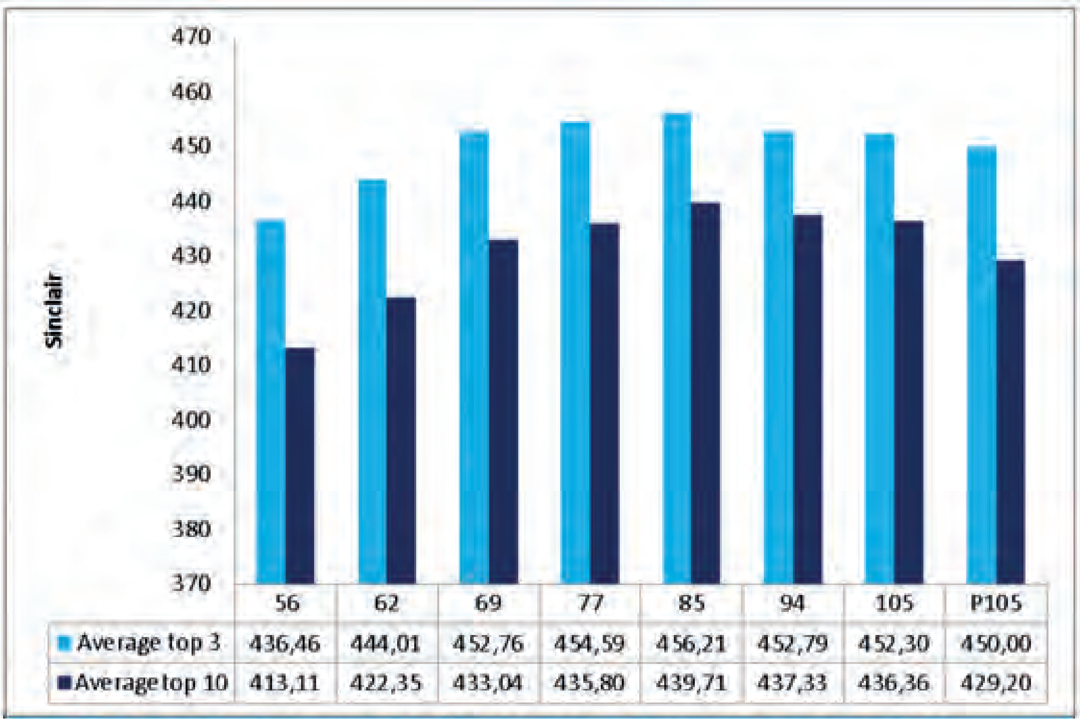
formance for EC respect average of performance achieved during OG and WC is -4.58 % ± 1.96, being 56 kg the farthest category of the indicated percentage with a loss of -10.07 %. On the other hand, 105 and 85 kg are the categories where the lost level of performance for EC is lower with -2.70 and -2.74 % respectively. Same trend is observed comparing the top 10 ranked athletes (Figure 2), where the average of lost performance for EC respect OG and WC is -5.75 ± 1.95 %. In the same way, 56 kg represents the category with greater loss (-10.67 %), and 105 kg the category with lower loss of performance (-3.81 %) in regards to the average of performance achieved during OG and WC.



	48	53	58	63	69	75	P75
Total 3 OG	197,9	213,6	235,2	242,6	259,9	272,4	303,4
Total 3 WC	197,7	216,0	233,7	247,0	259,6	277,9	309,9
Total 3 EC	181,6	192,8	214,1	227,6	243,2	256,6	266,8

Figure No. 2
Average of total for top 10 male athletes in OG WC and EC.

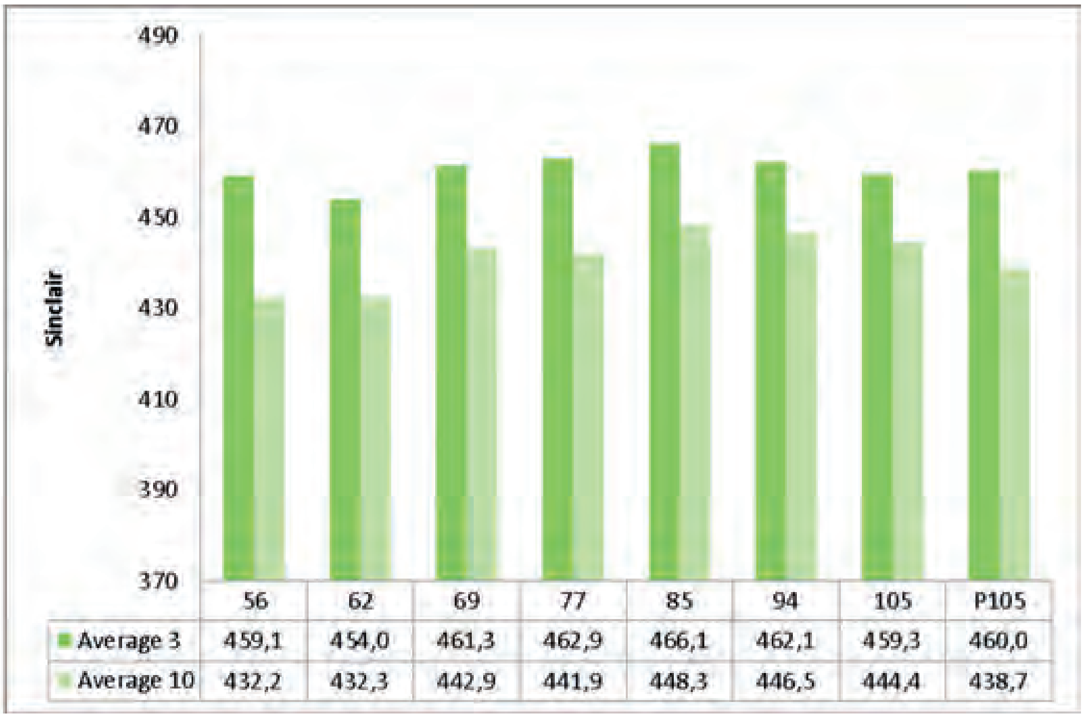


	56	62	69	77	85	94	105	P105
Average top 3	436,46	444,01	452,76	454,59	456,21	452,79	452,30	450,00
Average top 10	413,11	422,35	433,04	435,80	439,71	437,33	436,36	429,20

Figure No. 3
Average Sinclair scores for top 3 and top 10 male athletes in the OG, WC and EC.

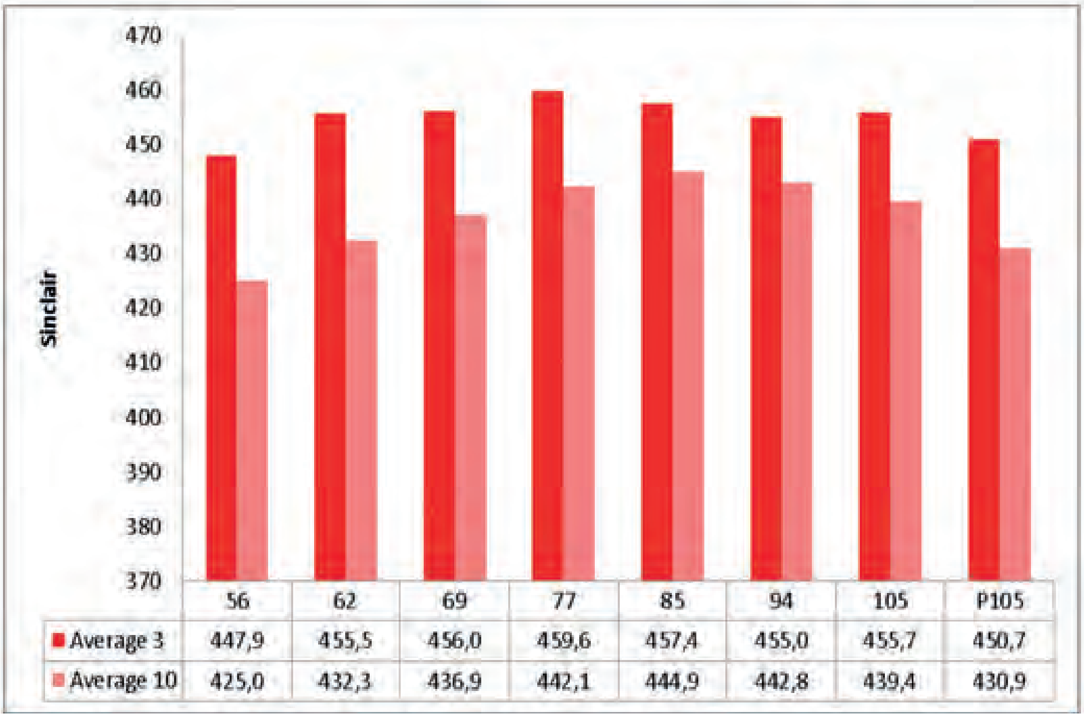
Figure 3 shows the average Sinclair scores on the top 3 and top 10 male athletes during OG, WC and EC in the period studied(from 2005 up to 2016 OG).

The same trend is observed for top 3 and top 10 data, being the highest and lowest average Sinclair scores for 85 and 56 categories. Analyzing each competition separately, OG on Figure 4, WC on Figure 5 and EC on Figure 6, we can observe how the highest average Sinclair for the top 3 ranked athletes was achieved on 85 kg in OG and EC and 77 kg in WC. Taking into account top 10 athletes classified, 85 kg is the category with highest average Sinclair through the 3 competitions. Analyzing the lowest average Sinclair scores obtained separately of the three competitions studied for the top 3 athletes; 62 kg achieves the lowest averages Sinclair scores during OG while



	56	62	69	77	85	94	105	P105
Average 3	459,1	454,0	461,3	462,9	466,1	462,1	459,3	460,0
Average 10	432,2	432,3	442,9	441,9	448,3	446,5	444,4	438,7

Figure No. 4 AVERAGE SINCLAIR SCORES FOR TOP 3 AND TOP 10 MALE ATHLETES DURING OG.

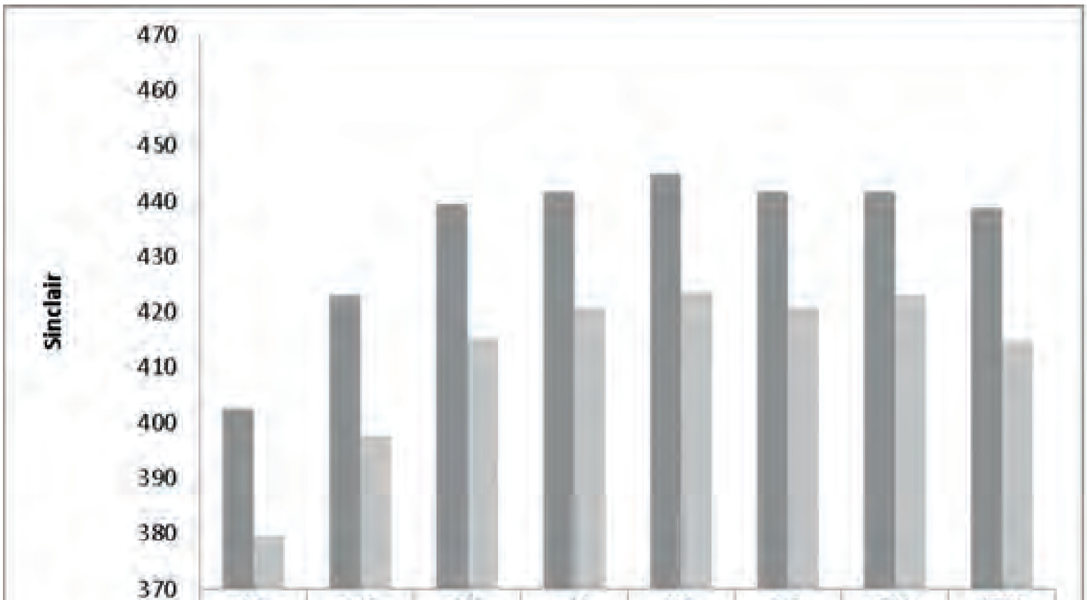


	56	62	69	77	85	94	105	P105
Average 3	447,9	455,5	456,0	459,6	457,4	455,0	455,7	450,7
Average 10	425,0	432,3	436,9	442,1	444,9	442,8	439,4	430,9

Figure No.5 AVERAGE SINCLAIR SCORES FOR TOP 3 AND TOP 10 MALE ATHLETES DURING WC.

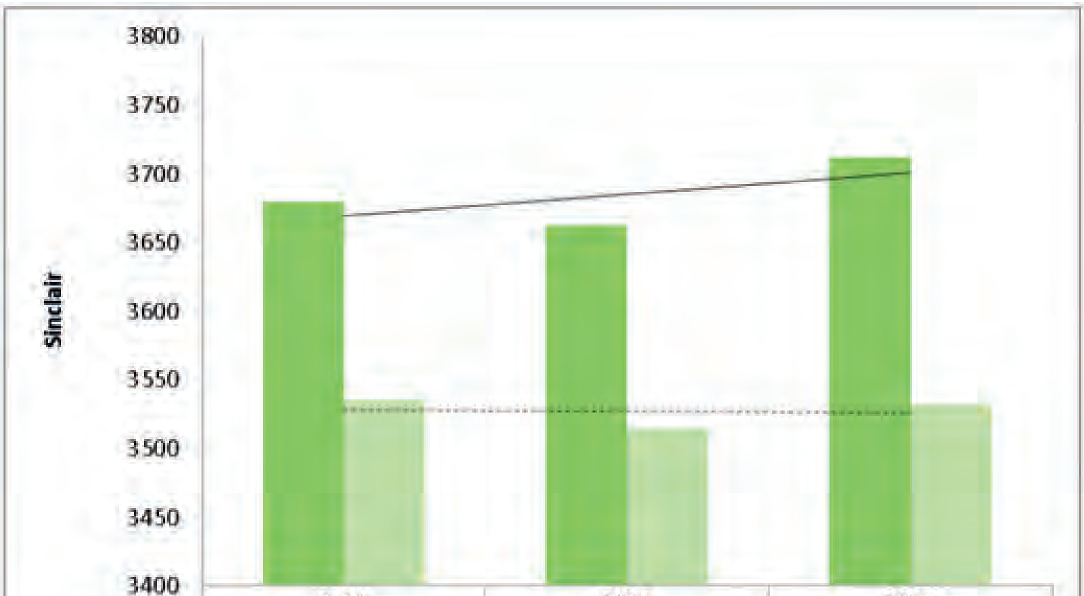
56 kg obtains the lowest averages Sinclair scores during WC and EC. Finally, comparing the top 10 athletes, 56 kg remains like the body weight category reporting lowest average Sinclair scores while 85 kg shows the highest average Sinclair scores during the three competitions analyzed. Figures 7, 8 and 9 show the summary average Sinclair scores by categories and the tendency line of the top 3 and top 10 male ranked athletes classified per competition.

In the OG the level of performance to top 10 athletes it seems to remain stable during the three editions of OG studied, however the tendency line of the 3 medalists shows an increasing trend from Beijing up to Rio like in WC (for top 3 and top 10 athletes). Moreover, in EC the average Sinclair for top 10 tends to grow however for the top 3 shows a clearly decreasing trend.



	56	62	69	77	85	94	105	P105
Average 3	402,6	423,0	439,5	441,7	444,9	441,8	441,7	438,8
Average 10	379,7	397,8	415,2	420,6	423,7	420,7	422,9	414,5

Figure No. 6
Average Sinclair scores for top 3 and top 10 male athletes during EC.



	2008	2012	2016
Sum top 3	3679,8	3662,8	3711,5
Sum top 10	3535,0	3513,9	3532,4

Figure No. 7
Sum of average Sinclair scores of all categories for top 3 and top 10 male athletes in the OG.

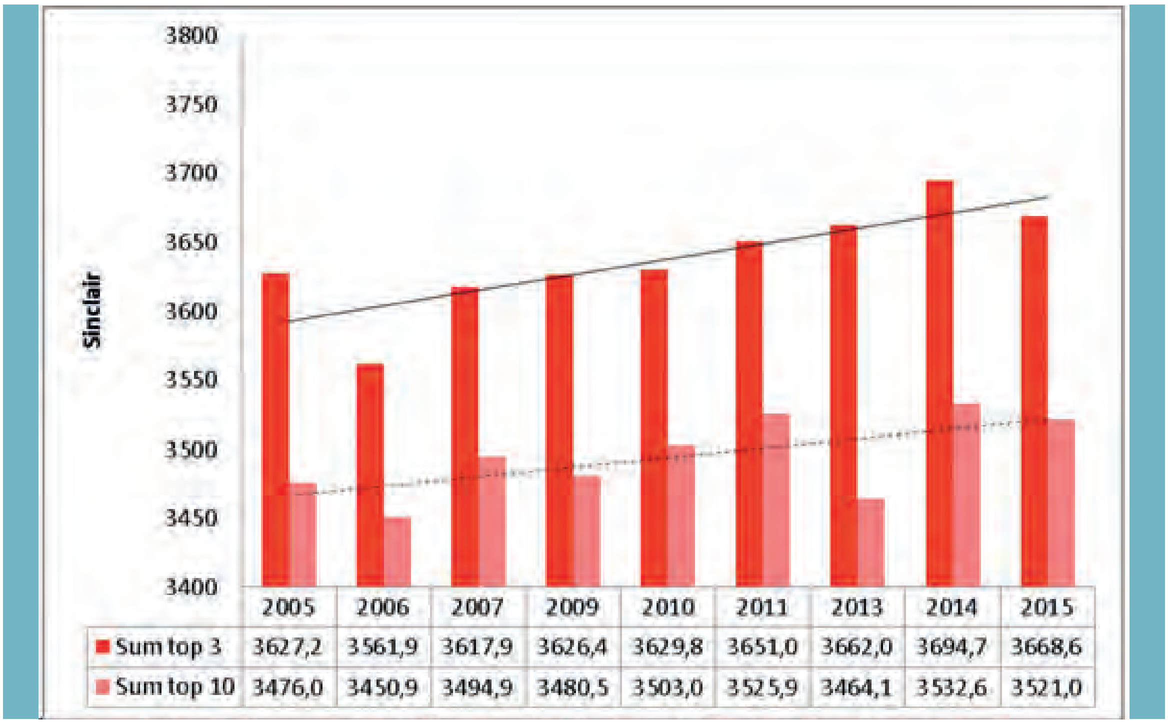


Figure No. 8
Sum of average Sinclair scores of all categories for top 3 and top 10 male athletes in the WC.

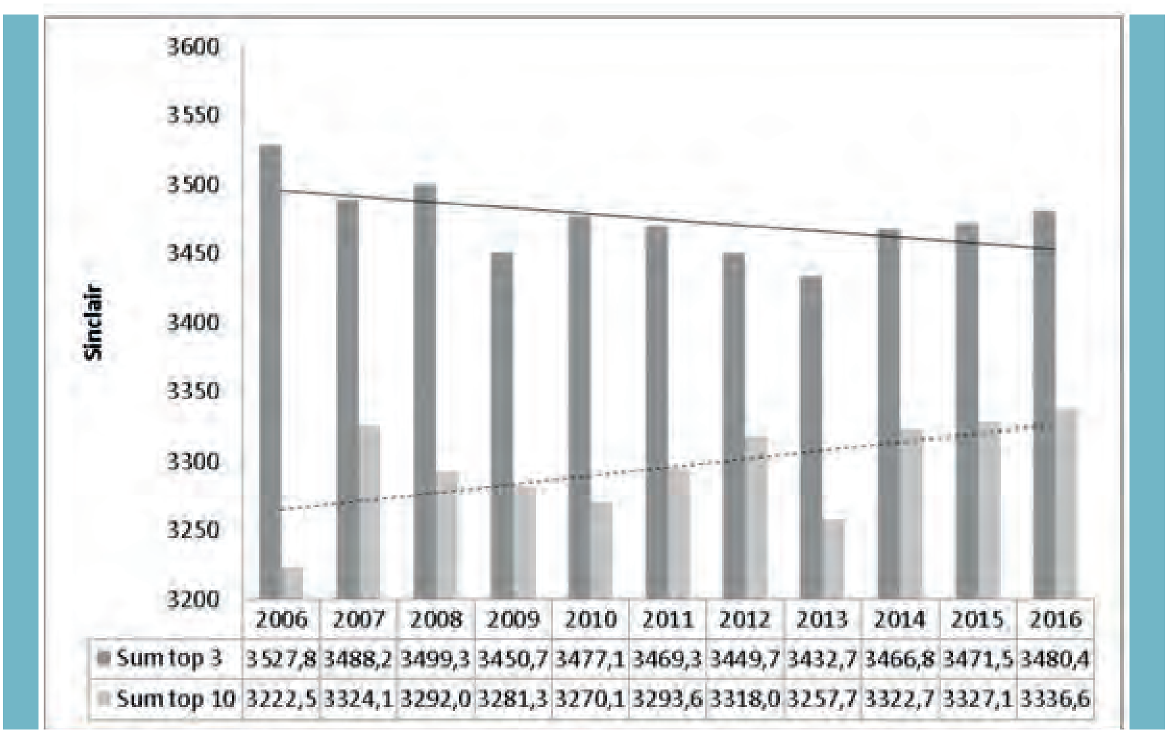


Figure No. 9
Sum of average Sinclair scores of all categories for top 3 and top 10 male athletes in the EC.

Tables 1, 2 and 3 show the differences between average Sinclair scores achieved by the top 3 and top 10 male athletes classified per competition (OG, WC and EC) and year of edition.
The highest average Sinclair scores by category and year are:

- OG top 3: 2016; 85 kg category (471.89 ± 3.73 points)
- OG top 10: 2008;105 kg category (452.4 ± 14.32 points)
- WC top 3: 2014; 105 kg category (471.15 ± 2.89 points)
- WC top 10: 2011; 94 kg category (455.92 ± 6.37 points)
- EC top 3: 2011; 85 kg category (456.14 ± 8.41 points)
- EC top 10: 2006; 94 kg category (439.23 ± 142.30 points)

On the other side of the coin **the lowest average Sinclair scores by category and year** are:

- OG top 3: 2008; 62 kg category (445.71 ± 15.01 points)
- OG top 10: 2016; 62 kg category (426.88 ± 16.61 points)
- WC top 3: 2006; 62 kg category (436.01 ± 10.94points)
- WC top 10: 2013; 56 kg category (416.92 ± 28.00 points)
- EC top 3: 2009; 56 kg category (389.3 ± 4.90 points)
- EC top 10: 2007; 56 kg category (355.58 ± 15.98 points)

The trend in the Tables 1, 2 and 3 show like the heavy weight categories, 85 kg and more achieve the best results. On the contrary light weight body divisions 56 and 62 kg report the lowest results.

Table 1 - Average Sinclair scores of the top 3 and top 10

	56		62		69		77	
	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
2008	454,21	432,13	445,71	426,96	460,25	440,92	459,35	449,1
2012	452,62	432,33	464,32	442,95	454,89	441,19	458,18	431,3
2016	470,35	432,03	451,84	426,88	468,72	446,66	471,21	445,26

Table 2 - Average Sinclair scores of the top 3 and top 10

	56		62		69		77	
	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
2005	438,28	421,4	449,78	417,36	456,6	429,08	448,29	430,88
2006	437,61	426,57	436,01	422,47	441,34	421,86	452,72	438,53
2007	440,8	422,63	450,03	431,16	458,66	440,05	456,75	445,8
2009	444,75	417,8	457,01	440,15	454,75	434,44	469,36	451,2
2010	449,27	423,57	459,17	441,41	444,08	432,87	462,84	444,57
2011	444,33	425,18	458,9	439,77	456,13	442,94	465,61	443,57
2013	448,68	416,92	462,65	426,95	465,3	440,59	461,46	440,34
2014	462,89	440,01	460,61	434,24	462,02	441,21	456,4	437,74
2015	464,37	430,99	465,57	437,13	464,99	449,31	462,96	446,67

Table 3 - Average Sinclair scores of the top 3 and top 10

	56		62		69		77	
	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
2006	399,29	376,64	443,77	381,34	441,4	394,73	447,14	397,49
2007	411,71	355,58	417,14	407,23	442,33	425,1	452,94	437,22
2008	392,11	363,13	422,05	383,79	446,84	423,19	453,31	427,43
2009	389,3	373,95	417,1	389,29	450,18	428,28	432,74	416,92
2010	400,03	387,33	432,49	404,08	435,56	395,51	445,22	419,6
2011	403,56	394,1	423,94	401,07	441,83	419,86	434,34	407,11
2012	416,26	383,29	420,73	400,46	431,5	422,85	435,05	425,68
2013	400,06	376,78	408,06	387,67	435,07	413,17	427,01	412,57
2014	402,99	394,72	424,05	410,8	430,74	410,5	438,21	423,06
2015	408,06	390,97	420,87	404,68	440,82	416,25	442,88	425,84
2016	405,3	380,57	422,89	405,29	438,42	418,3	449,43	433,22

male athletes during the OG by categories

85		94		105		p105	
Top 3	Top 10	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
467,21	447,47	461,67	451,46	466,56	452,4	464,85	434,56
459,25	446,09	470,62	446,09	450,31	434,07	452,62	439,85
471,89	451,19	454,08	441,85	460,92	446,81	462,53	441,72

male athletes during the WC by categories

85		94		105		p105	
Top 3	Top 10	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
460,03	453,51	456,97	444,38	454,16	439,23	463,04	440,13
449,48	438,75	448,14	440,8	450,59	437,56	446,02	424,36
453,75	440,8	450,95	441,57	454,28	440,13	452,63	432,77
455,94	444,35	447,54	437,62	452,82	433,89	444,2	421,03
455,84	445,77	459,19	447,64	453,03	438,69	446,38	428,46
453,55	444,01	463	455,92	462,79	444,74	446,71	429,77
459,54	442,15	455,7	436,42	450,59	432,52	458,08	428,19
466,34	451,53	462,84	446,61	471,15	446,45	452,43	434,77
462,33	442,97	450,31	434,24	451,46	441,09	446,57	438,63

male athletes during the EC by categories

85		94		105		p105	
Top 3	Top 10	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
452,74	417,1	447,2	439,23	454,72	410,08	441,51	405,93
447,06	429,77	445,92	432,68	427,3	423,38	443,75	413,18
444,83	427,3	444,4	425,17	441,42	417,13	454,35	424,87
441,76	433,85	440,2	408,98	445,82	430,23	433,57	399,81
442,24	414,19	438,67	407,11	443,18	424,32	439,68	417,92
456,14	430,28	443,3	412,19	445,81	426,18	420,41	402,79
432,11	422,14	444,17	429,01	437,34	414,35	432,5	420,22
451,29	424,55	429,67	411,44	442,82	419,25	438,73	412,24
449,23	420,65	437,33	412,75	439,11	425,1	445,17	425,14
435,56	419,13	453,08	424,87	440,11	432,1	430,09	413,22
440,71	421,28	436,09	424,69	440,66	429,35	446,85	423,93

Table 4 - Highest and lowest results per competition.

	Top 3		Top 10	
	Sinclair †	Weight	Sinclair †	Weight
Highest Olympic games category.	466.12	85	448.25	85
Highest World Championships category.	459.19	77	445.64	85
Highest European Championships category.	444.88	85	425.25	85
Highest combined category of OG, WC and EC.	456.03	85	439.71	85
Lowest Olympic games category.	453.96	62	432.16	56
Lowest World Championships category.	447.71	56	424.81	56
Lowest European Championships category.	402.61	56	382.37	56
Lowest combined category of OG, WC and EC.	436.84	56	413.11	56

† Values are given as average Sinclair scores of the all of competitions studied.

Table No. 4 shows highest and lowest results in OG, WC, EC and the combination of these three competitions of the male body weight categories. As you can observe on this table, 85 kg is the category with highest results during the competitions studied except for WC 77 kg category analyzing the top 3 athletes. On the other hand 56 kg represents the lowest results for all competitions excepting for the top 3 OG where they were achieved by 62 kg category.

Table 5 - Best and worst male competition.

	Top 3		Top 10	
	Sinclair †	Year	Sinclair †	Year
Best Olympic Games	3711.54	2016	3535.00	2008
Best World Championship	3694.68	2014	3532.56	2014
Best European Championship	3499.31	2008	3499.31	2008
Worst Olympic Games	3662.81	2012	3513.87	2012
Worst World Championship	3561.91	2006	3450.90	2006
Worst European Championship	3432.71	2013	3222.54	2006

† Values are given as sum of average Sinclair scores of every category by championship.

Table No. 5 reports the best and worst edition of the top 3 and top 10 ranked male athletes of the OG, WC and EC. The results show how the top 3 and top 10 analysis are coincident except for the worst EC top 3 which was for 2013 edition while for the top 10 the worst EC edition was 2006. Equally the best OG for the top 3 was achieved during Rio 2016 and for the top 10 in Beijing 2008.

Table 6 - Highest and lowest male Sinclair scores to obtain the different medals.

	Highest			Lowest		
	Sinclair †	Weight	Year	Sinclair †	W eight	Year
Sinclair gold medal (OG)	481.31	56	2016	451.31	105	2012
Sinclair silver medal (OG)	478.71	p105	2008	443.83	62	2008
Sinclair bronze medal (OG)	467.91	85	2016	431.48	62	2008
Sinclair gold medal (WC)	484.39	69	2014	439.61	56	2006
Sinclair silver medal (WC)	474.16	p105	2005	431.43	62	2006
Sinclair bronze medal (WC)	467.83	105	2014	422.64	62	2005
Sinclair gold medal (EC)	469.28	85	2006	394.92	56	2009
Sinclair silver medal (EC)	460.9	85	2011	381.31	56	2008
Sinclair bronze medal (EC)	460.02	p105	2008	374.65	56	2008

† Values are given as Sinclair achieved by the athlete.

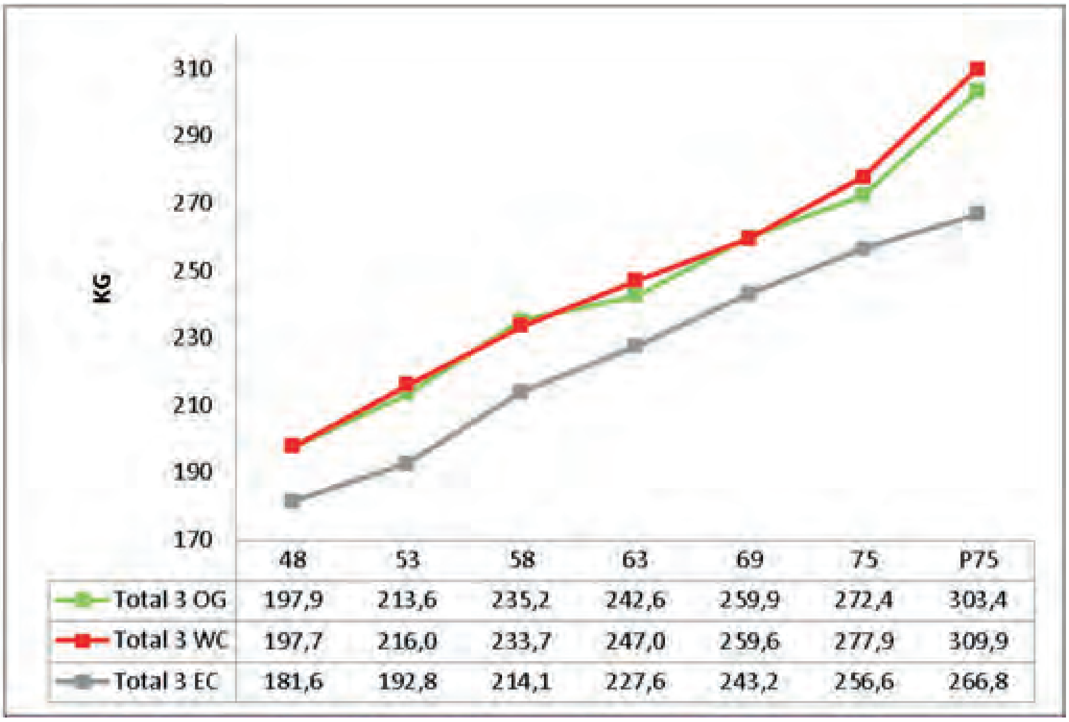
Table No.6

Finally the analysis of the highest and lowest average Sinclair scores by medal color and competition are reported on Table 6. In general terms studying Table 6 the lowest Sinclair scores are achieved in light weight-body divisions except for the gold medal in OG which is obtained in 105 kg category. On the contrary highest Sinclair scores are obtained in heavy weight divisions except for the gold medal in OG where 56 kg category reports the highest Sinclair scores.

Results for women

The same analysis is applied to the female athletes using the similar figures and tables as in the case of the male weightlifters presented above. The average of total for the top 3 (Figure 10) and top 10 (Figure 11) ranked female lifters in each body weight category show a similar trend and results for OG and WC. Just as it happens in the male analysis, the results of EC are the lowest of the three types of the competitions studied.

For the top 3 classified athletes (Figure 10), the average of lost performance for EC respect average of performance achieved during

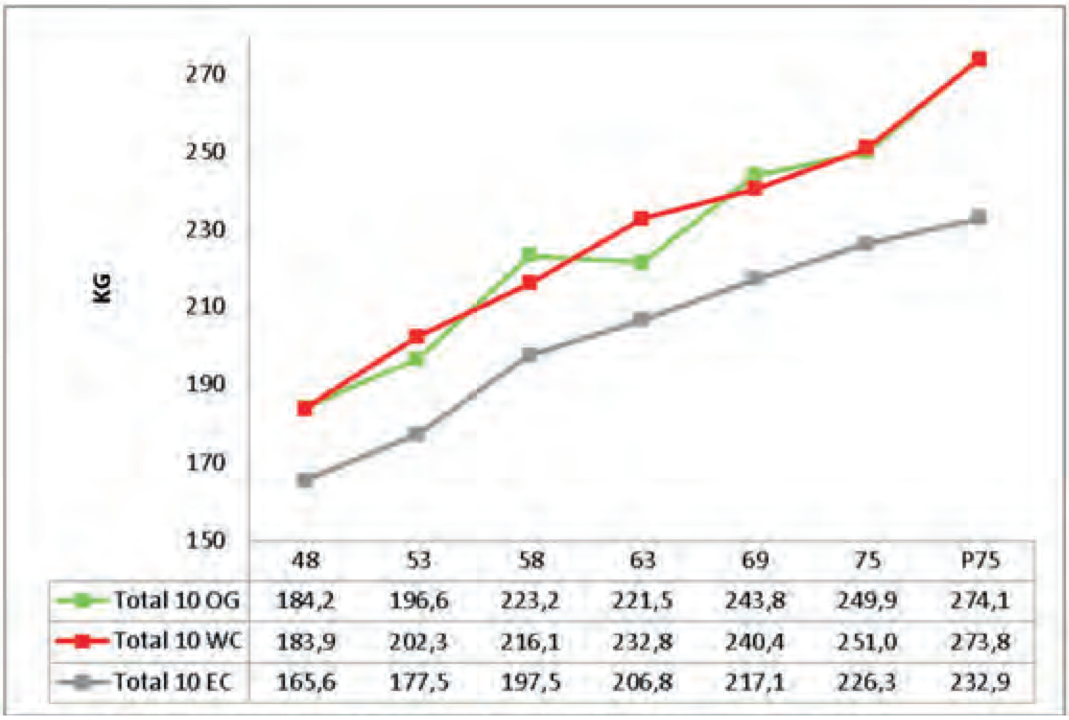


	48	53	58	63	69	75	P75
Total 3 OG	197,9	213,6	235,2	242,6	259,9	272,4	303,4
Total 3 WC	197,7	216,0	233,7	247,0	259,6	277,9	309,9
Total 3 EC	181,6	192,8	214,1	227,6	243,2	256,6	266,8

Figure No. 10
AVERAGE OF TOTAL FOR TOP 3 FEMALE ATHLETES IN OG, WC AND EC.

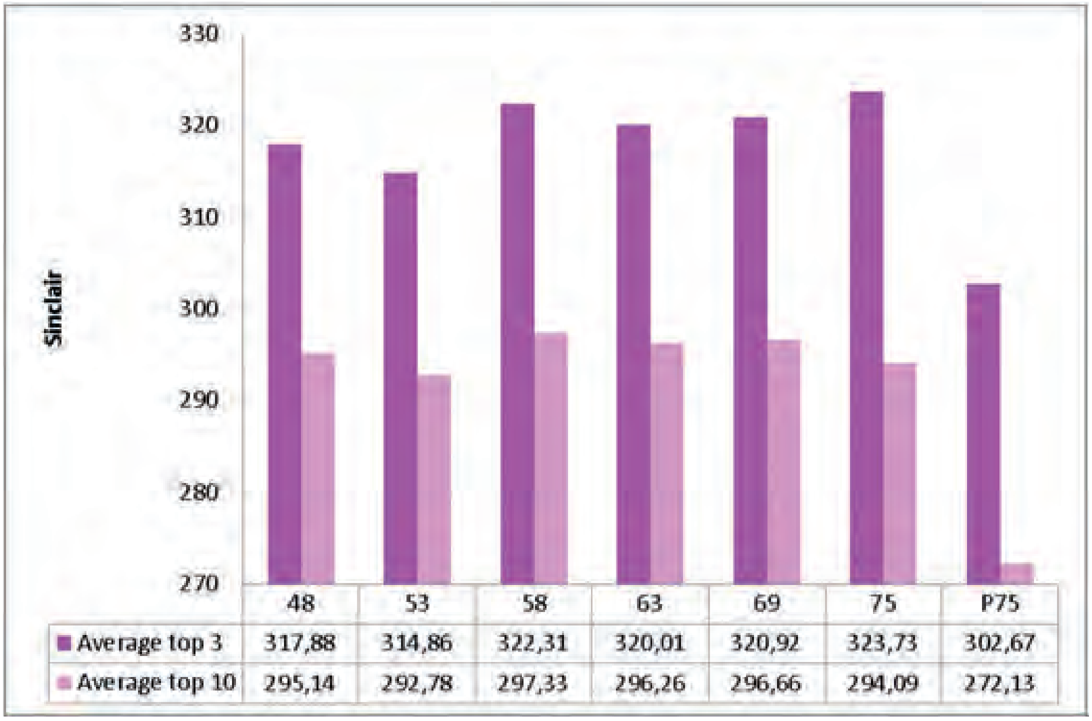
OG and WC is -8.99 % ± 1.76, being p75 kg the farthest category of the indicated percentage with a loss of -13.89 %. On the other hand, 69 is the category where the lost level of performance for EC is lower with -6.32 %. Same trend is observed comparing the top 10 ranked athletes (Figure 11), in which the average of lost performance for EC respect OG and WC is 10.92 ± 2.89 %. In the same way,p75 kg represents thecategory with greater loss (-14.94 %), and 58 kg the category with lower loss of performance (-8.61 %) respect the average of performance achieved during OG and WC.

Figure 12 shows the average Sinclair scores on the top 3 and top 10 female athletes during OG, WC and EC in the period studied (from 2005 up to 2016 OG). The highest average Sinclair scores of the top 3 athletes are reported for 58 and 75 kg categories (322.31 ± 16.67 and 323.73 ± 12.61 respectively). The lowest result is clearly achieved in the p75 kg category (302.67 ± 17.64). To the top 10 ranked athletes, p75 kg shows equally the lowest score (272.13 ±17.12), however, the highest results are very close between them reporting 58 kg as the highest score with 297.33 ± 13.16 closely followed for 48, 63, 69 and 75 kg categories with the follow results respectively: 295.14 ± 15.33, 297.33, 13.17, 296.26 ± 17.29, 296.66 ± 17.31, 294.09 ± 13.73.



	48	53	58	63	69	75	P75
Total 10 OG	184,2	196,6	223,2	221,5	243,8	249,9	274,1
Total 10 WC	183,9	202,3	216,1	232,8	240,4	251,0	273,8
Total 10 EC	165,6	177,5	197,5	206,8	217,1	226,3	232,9

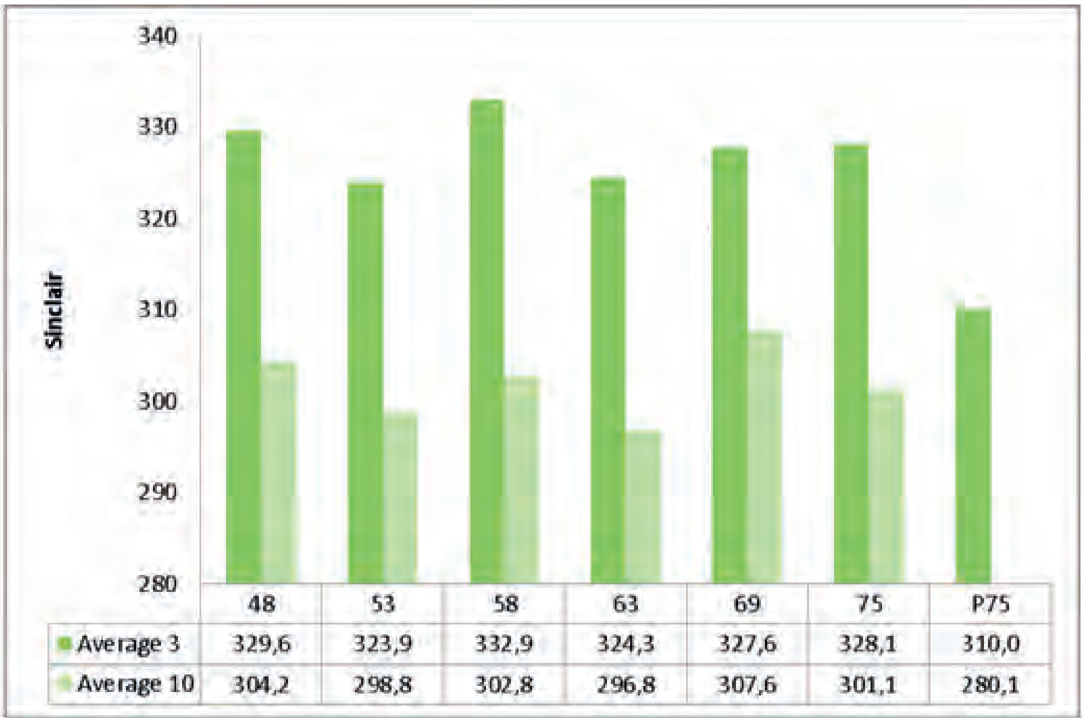
Figure No. 11
AVERAGE OF TOTAL FOR TOP 10 FEMALE ATHLETES IN OG, WC AND EC.



	48	53	58	63	69	75	P75
Average top 3	317,88	314,86	322,31	320,01	320,92	323,73	302,67
Average top 10	295,14	292,78	297,33	296,26	296,66	294,09	272,13

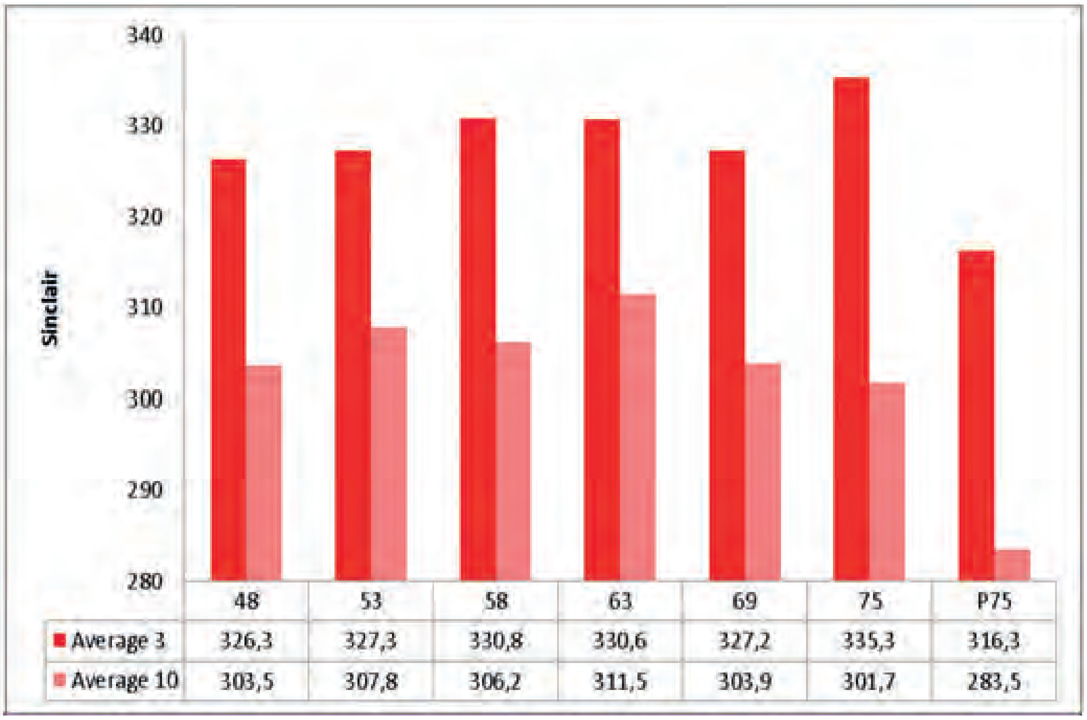
Figure No. 12
AVERAGE SINCLAIR SCORES FOR TOP 3 AND TOP 10 FEMALE ATHLETES IN THE OG, WC AND EC.

As in the male analysis, Figures 13, 14 and 15 study each category per competition separately. In the top 3 ranked female athletes the highest averages Sinclair scores are obtained in 58 kg for OG (Figure 13) and 75 kg for WC and EC (Figures 14 and 15). To the top 10, the highest averages Sinclair scores are achieved in 69 kg, 63 kg and 58 kg respectively for OG, WC and EC and the lowest for both the top 3 and top 10 are founded in p75 kg category.



	48	53	58	63	69	75	P75
Average 3	329,6	323,9	332,9	324,3	327,6	328,1	310,0
Average 10	304,2	298,8	302,8	296,8	307,6	301,1	280,1

Figure No. 13
AVERAGE SINCLAIR SCORES FOR TOP 3 AND TOP 10 FEMALE ATHLETES DURING OG.



	48	53	58	63	69	75	P75
Average 3	326,3	327,3	330,8	330,6	327,2	335,3	316,3
Average 10	303,5	307,8	306,2	311,5	303,9	301,7	283,5

Figure No. 14
AVERAGE SINCLAIR SCORES FOR TOP 3 AND TOP 10 FEMALE ATHLETES DURING WC.

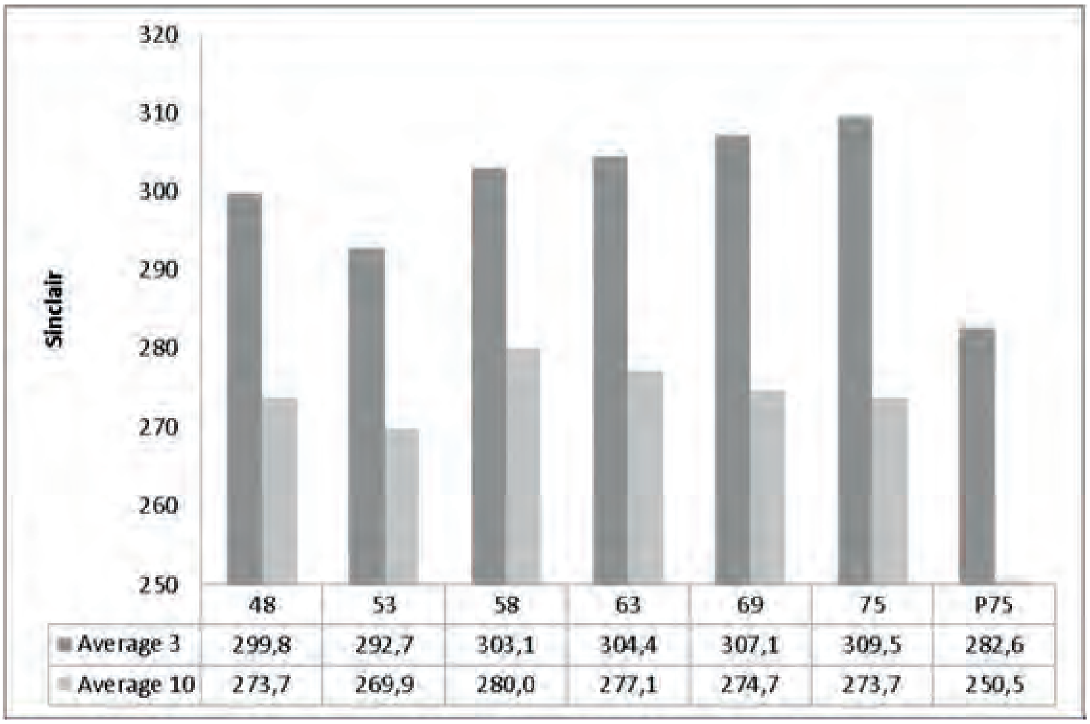


Figure No. 15
AVERAGE SINCLAIR SCORES FOR TOP 3 AND TOP 10 FEMALE ATHLETES DURING EC.

Figure No. 16
SUM OF AVERAGE SINCLAIR SCORES OF ALL CATEGORIES FOR TOP 3 AND TOP 10 FEMALE ATHLETES IN THE OG.

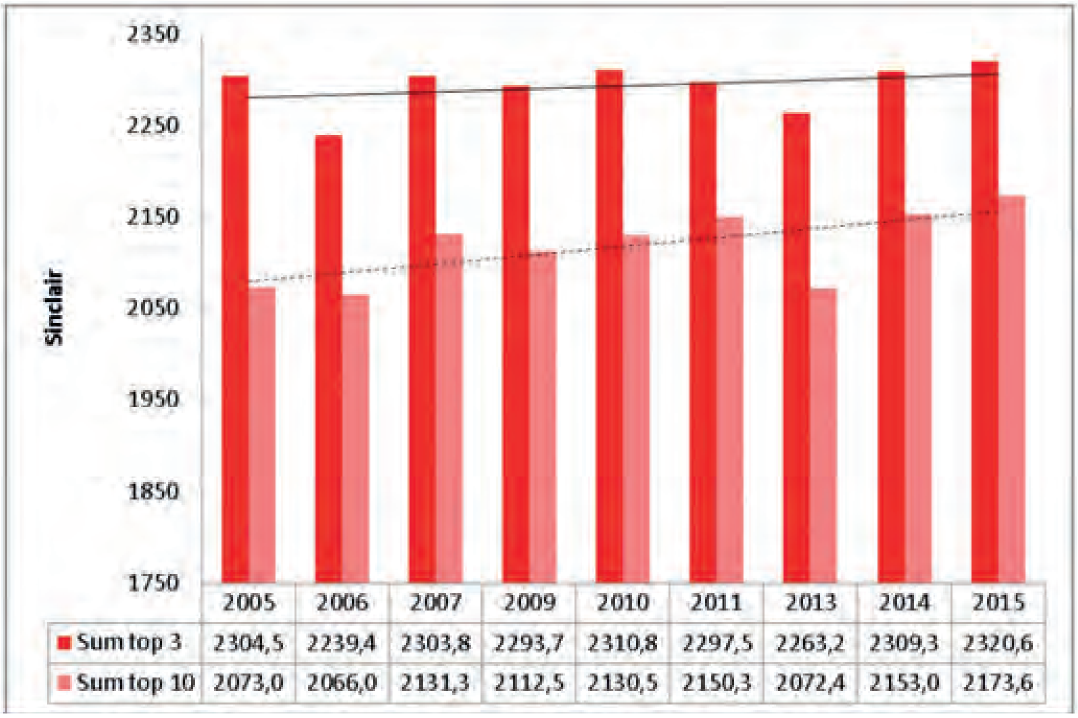


Figure No. 17
SUM OF AVERAGE SINCLAIR SCORES OF ALL CATEGORIES FOR TOP 3 AND TOP 10 FEMALE ATHLETES IN THE WC.

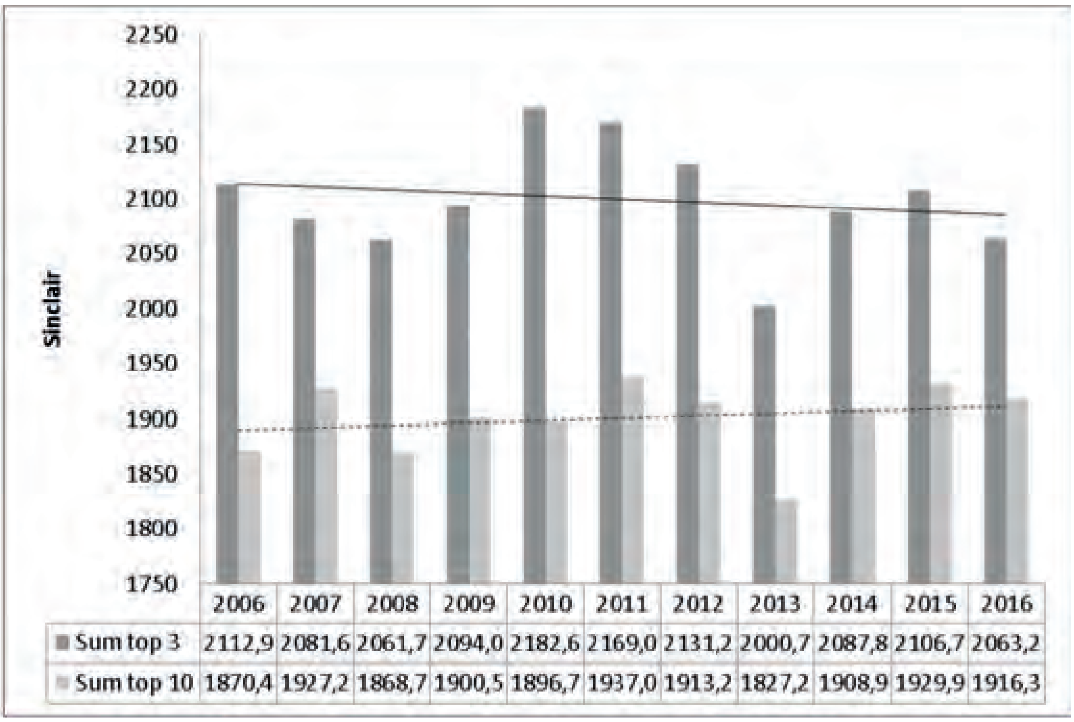


Figure No. 18
SUM OF AVERAGE SINCLAIR SCORES OF ALL CATEGORIES FOR TOP 3 AND TOP 10 FEMALE ATHLETES IN THE EC.

Figures 16, 17 and 18 show the summary average Sinclair scores by categories and the tendency line on the top 3 and top 10 female ranked athletes classified per competition. To the OG, the level of performance on the top 3 and top 10 athletes shows a similar trend during the three editions of OG studied with a progressive decrease of the results from Beijing to Rio, being the tendency line to results of top 3 and top 10 athletes almost parallel.
By contrast, the tendency lines reported by WC (Figure 17) show an increase of the results for both analysis (top 3 and top 10), with a higher slope for top 10 results. So, as in the case of the analysis of Figure 16 for the OG, on Figure 18 we can observe how the tendency line of the top 3 results of EC performance tends to decrease, and on the contrary, the level of the top 10 tends to increase during the period studied.

Tables 7, 8 and 9 show the differences between average Sinclair scores achieved by the top 3 and top 10 female athletes classified per competition (OG, WC and EC) and year of edition.
The highest average Sinclair scores by category and year are:

- OG top 3: 2012. 75 kg category (340.19± 15.59 points)
- OG top 10: 2012. 69 kg category (310.41± 15.69 points)
- WC top 3: 2010. 75 kg category (348.88 ± 6.45 points)
- WC top 10: 2015. 58 kg category (318.21 ± 20.70points)
- EC top 3: 2011. 75 kg category (336.86 ± 17.48 points)
- EC top 10: 2012. 53 kg category (290.44 ± 16.96 points)

On the opposite side **the lowest average Sinclair scores by category and year** are:

- OG top 3: 2008. p75kg category (292.45 ± 31.78points)
- OG top 10: 2008. 2008. p75 kg category (268.04 ± 27.08 points)
- WC top 3: 2005. p75kg category (297.65 ± 10.46 points)
- WC top 10: 2005. p75kg category (274.47 ±33.11 points)
- EC top 3: 2013. p75kg category (244.77 ±20.61 points)
- EC top 10: 2013. p75kg category (230.29 ± 20.74 points)

The trend in the Tables 7, 8 and 9 shows how 75 kg category achieves always the best results for the top 3 analyses and for each competition studied. On the contrary, p75 kg show the lowest results for both top 3 and top 10 analyses during the three competitions studied. Observing the top 10 ranked athletes, the highest average Sinclair scores shows a greater variability, reporting the highest results on different categories; 69 kg, 58 kg and 53 kg respectively for OG, WC and EC, while p75 Kg reports the lowest results in the 3 types of competitions studied.

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Table 7 - Average Sinclair scores of the top 3 and

	48		53		58	
	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
2008	335.02	308.69	326.87	302.93	328.84	308.85
2012	335.02	300.71	335.74	310.29	337.42	289.43
2016	318.65	303.27	309.1	283.29	332.51	310.02

Table 8 - Average Sinclair scores of the top 3 and

	48		53		58	
	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
2005	331,84	307,61	332,53	301,59	335,05	302,28
2006	326,12	301,93	325,7	303,98	330,64	300,38
2007	332,92	312,6	324,72	310,94	332,37	310,73
2009	339,83	313,92	326,24	305,34	320,19	291,33
2010	341,6	308,52	322,09	308,08	329,64	309,86
2011	318,68	293,91	333	315,8	331	314,08
2013	308,61	284,43	315,35	298,35	322,85	298,07
2014	315,23	297,15	335,56	313,46	329,59	310,65
2015	321,44	311,84	330,41	312,46	345,54	318,21

Table 9 - Average Sinclair scores of the top 3 and

	48		53		58	
	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
2006	300,72	268,53	282,21	260,64	322,03	285,45
2007	305,01	281,69	284,55	271,44	305,13	285,87
2008	322,01	281,21	290,84	275,43	299,17	273,84
2009	294,74	265,66	286,82	272,95	298,88	275,38
2010	311	269,97	305,97	271,67	306,85	273,28
2011	305,99	275,26	287,83	257,87	293,7	272,53
2012	296,58	275,34	307,11	290,44	302,44	286,55
2013	278,75	257,84	287,05	262,74	298	277,07
2014	292,23	272,35	289,85	254,59	296,71	281,02
2015	293,43	280,38	288,35	265,95	307,09	285,14
2016	296,82	282,83	309,45	284,78	304,15	283,97

top 10 female athletes during the OG by categories.

63		69		75		p75	
Top 3	Top 10	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
317.52	302.8	331.85	305.38	327.74	303.82	292.45	268.04
319.75	286.52	325.77	310.41	340.19	304.3	333.13	287.36
335.74	301.01	325.32	307.01	316.34	295.1	304.33	285

top 10 female athletes during the WC by categories.

63		69		75		p75	
Top 3	Top 10	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
329,89	292,57	335,58	293,72	341,93	300,8	297,65	274,47
320,2	297,18	312,84	289,8	319,06	291,45	304,81	281,24
334,66	308,56	332,39	305,86	339,89	300,14	306,88	282,44
326,79	316,11	326,96	307,83	333,18	300,11	320,49	277,86
325,25	310,62	320,88	301,79	348,88	301,79	322,49	289,85
333,74	319,98	329,04	307,88	338,25	314,71	313,79	283,97
335,3	312,47	332,77	310,31	326,17	292,64	322,14	276,14
335,89	328,65	331,13	309,17	334,26	304,94	327,6	289,02
333,44	317,34	323,31	308,84	335,83	308,3	330,62	296,65

top 10 female athletes during the EC by categories.

63		69		75		p75	
Top 3	Top 10	Top 3	Top 10	Top 3	Top 10	Top 3	Top 10
313,85	274,76	305,73	262,07	313,13	275,02	275,27	243,91
300,37	279,5	310,15	280,75	303,19	282,26	273,15	245,64
305,04	287,78	293,27	271,04	291,65	241,13	259,73	238,25
310,7	283,48	310,47	275,83	309,12	273,62	283,3	253,53
318,94	283,21	321,09	258,85	336,56	283,66	282,18	256,01
324,6	288,08	313,58	280,41	336,86	282,83	306,41	280,03
286,8	266,83	320,17	281,97	304,48	266,9	313,61	245,2
280,57	258,84	310,42	272,91	301,17	267,49	244,77	230,29
310,49	281,63	296,05	281,78	305,34	280,06	297,13	257,46
301,12	267,36	304,35	283,16	309,27	283,39	303,12	264,53
296,46	277,15	293,03	272,62	293,89	274,1	269,4	240,81

Table 10 - Highest and lowest female category per competition.

	Top 3		Top 10	
	Sinclair †	Weight	Sinclair †	Weight
Highest Olympic games category.	332.92	58	304.22	48
Highest World Championships category.	333.57	75	313.29	63
Highest European Championships category.	309.51	75	282.31	58
Highest combined category of OG, WC and EC.	323.42	75	297.33	58
Lowest Olympic games category.	309.97	P75	280.13	P75
Lowest World Championships category.	315.50	P75	283.80	P75
Lowest European Championships category.	282.36	P75	282.55	P75
Lowest combined category of OG, WC and EC.	302.61	P75	272.13	P75

† Values are given as average Sinclair scores of the all of competitions studied.

Table No. 10 SHOWS HIGHEST AND LOWEST RESULTS OF OG, WC, EC AND THE COMBINATION OF THESE THREE COMPETITIONS OF THE FEMALE BODY WEIGHT CATEGORIES. AS YOU CAN NOTICE, THE RESULTS OF THE TOP 3 RANKED ATHLETES REPORT 75 KG AS THE HIGHEST AND P75 KG AS THE LOWEST CATEGORY DURING THE COMPETITIONS STUDIED EXCEPT FOR THE BEST OG CATEGORY WHERE 58 KG ACHIEVES THE HIGHEST RESULTS. ON THE OTHER HAND, IT EXISTS A HIGHER VARIABILITY FOR THE BEST TOP 10 RANKED ATHLETES, REPORTING 48 KG AND 63 KG AS THE HIGHEST CATEGORIES DURING OG AND WC AND 58 KG CATEGORY AS THE HIGHEST CATEGORY FOR EC AND THE COMBINATION OF THE THREE COMPETITIONS STUDIED. AS IN THE TOP 3 ANALYSIS, THE LOWEST CATEGORY FOR THE TOP 10 RANKED ATHLETES REMAINS BEING P75 KG.

Table 11 - Best and worst female competition.

	Top 3		Top 10	
	Sinclair †	Year	Sinclair †	Year
Best Olympic Games	2327.02	2012	2100.51	2008
Best World Championship	2320.59	2015	2173.64	2015
Best European Championship	2182.59	2010	2061.71	2008
Worst Olympic Games	2241.99	2016	2084.70	2016
Worst World Championship	2239.37	2006	2065.96	2006
Worst European Championship	2000.73	2013	1827.18	2013

† Values are given as sum of average Sinclair scores of every category by championship.

Table No. 11 REPORTS THE BEST AND WORST EDITION OF THE TOP 3 AND TOP 10 RANKED FEMALE ATHLETES OF THE OG, WC AND EC. THE RESULTS ON TABLE 11 SHOW HOW THE TOP 3 AND TOP 10 ANALYSES ARE COINCIDENT EXCEPT FOR THE BEST OG AND BEST EC.

Table 12 - Highest and lowest female Sinclair scores to obtain the different medals.

	Highest			Lowest		
	Sinclair †	Weight	Year	Sinclair †	Weight	Year
Sinclair gold medal (OG)	359.29	69	2008	312.2	p75	2016
Sinclair silver medal (OG)	350.13	p75	2012	278.57	p75	2008
Sinclair bronze medal (OG)	332.53	58	2012	277.82	p75	2008
Sinclair gold medal (WC)	363.27	p75	2014	307.48	p75	2005
Sinclair silver medal (WC)	350.91	75	2010	301.59	p75	2005
Sinclair bronze medal (WC)	341.65	75	2010	276.71	p75	2011
Sinclair gold medal (EC)	350.78	75	2011	241.3	p75	2013
Sinclair silver medal (EC)	339.65	75	2010	266.03	p75	2009
Sinclair bronze medal (EC)	327.81	75	2010	231.74	p76	2013

† Values are given as Sinclair achieved by the athlete.

Table No.12

Finally the analysis of the highest and lowest average Sinclair scores by medal color and competition is reported on Table 12. As we can see on Table 12 the lowest Sinclair scores are achieved by all medals and competitions in the heaviest category (p75 kg). On the other hand, 75 kg for EC medals and silver and bronze medals in WC is the category with highest Sinclair scores. During OG, the highest Sinclair scores for gold, silver and bronze medals are obtained in different categories (69 kg, p75 kg and 58 kg respectively).

CONCLUSIONS

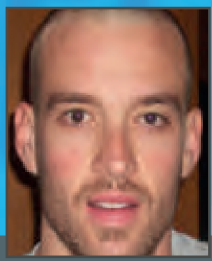
The snapshot presented in this work is a brief study which compares the results obtained in the Olympic Games and World and European Championships since the technical regulation of progression load was changed in 2005. Some of the conclusions that can be drawn from this analysis are:

- For men, the tendency shows how the highest results are obtained in 85 kg categories and the lowest outcomes are achieved by the light weight divisions 62 kg and specially 56 kg.
- For women, the variability among categories and competitions is higher than men, finding usually the highest results in 75 kg category and clearly occupying the lowest position for p75 kg category.
- As for the best results obtained by type of competition, these are usually achieved during the OG closely followed by the WC and clearly below we find with the results obtained in the EC.
- Tendency of performance by competitions: for men and the top 3 analyses, trend line shows how the performance is increased throughout the different editions of the OG and WC, showing a clear decrease tendency for EC. On the other hand, studying the tendency of the top 10 ranked athletes the performance in EC and WC is increased and is a plateau for OG.
- Tendency of performance by competitions: for women, the trend line shows the same pattern of behavior as in the case of men for EC and WC. For OG the tendency of the results is shown stable with a slight downward trend.

This comparison of body weight categories and competitions allows to compare the differences performances obtained between categories, competitions and editions since 2005, when the competition rules set a minimal progression of 1.0 kg after any successful attempt for the same athlete.

JUAN C. REDONDO

PHD (UNIVERSITY OF VALLADOLID, SPAIN). PROFESSOR OF THE PHYSICAL ACTIVITY AND EDUCATION DEPARMENT (UNIVERSITY OF LEON, SPAIN). BACHELOR DEGREE IN PHYSICAL EDUCATION (POLYTECHNIC UNIVERSITY OF MADRID, SPAIN).



F. JAVIER FLORES

SECRETARY OF THE NATIONAL SCHOOL OF COACHES OF SPANISH WEIGHTLIFTING FEDERATION. TECHNICAL STAFF OF SERVICE OF PHYSICAL EDUCATION AND SPORTS (UNIVERSITY OF SALAMANCA, SPAIN). BACHELOR DEGREE IN PHYSICAL ACTIVITY AND SPORTS SCIENCES (UNIVERSITY OF LEON, SPAIN). BACHELOR DEGREE IN PHYSICAL EDUCATION TEACHER (UNIVERSITY OF VALLADOLID, SPAIN).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SPORTS PERFORMANCE. MUS, STRESS AND CHRONIC LOW-GRADE INFLAMMATION

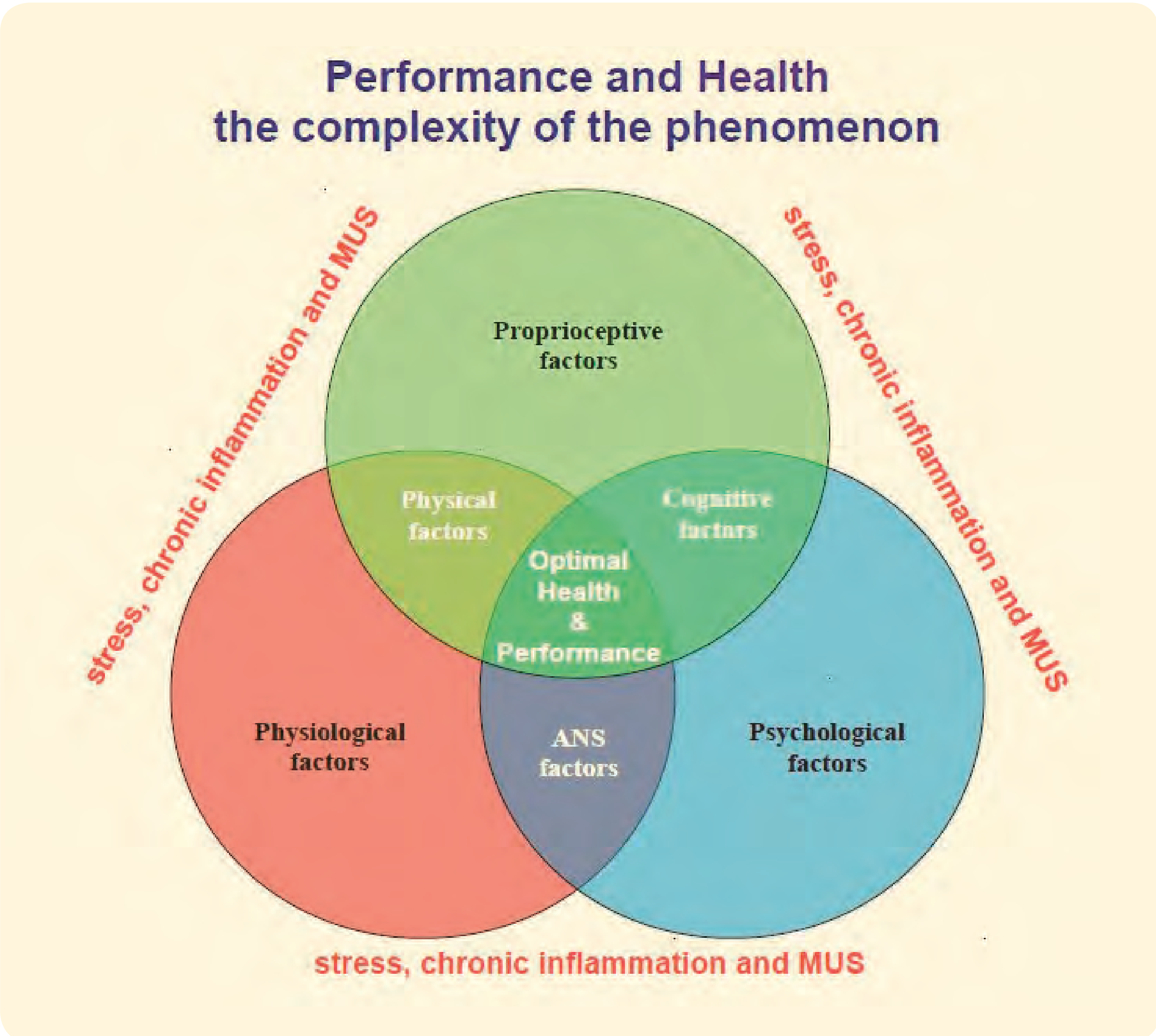
BY DARIO BOSCHIERO

An athlete's **sports performance** is clearly influenced by his/her state of well being, but despite being a shared principle, it is not so easy to obtain a clear picture which can assess the overall state of well-being and physical and mental performance.

In today's world, the need to increase or maintain performance is an obligatory passage, not only in sports, but in all areas of our complex life, with an increasing demand for adaptability in conditions presenting persistent **stressors** or stimuli. **Physchophysical performance** is a multidimensional concept, which includes physiological, psychological, physical, cognitive, proprioceptive and autonomic variables.

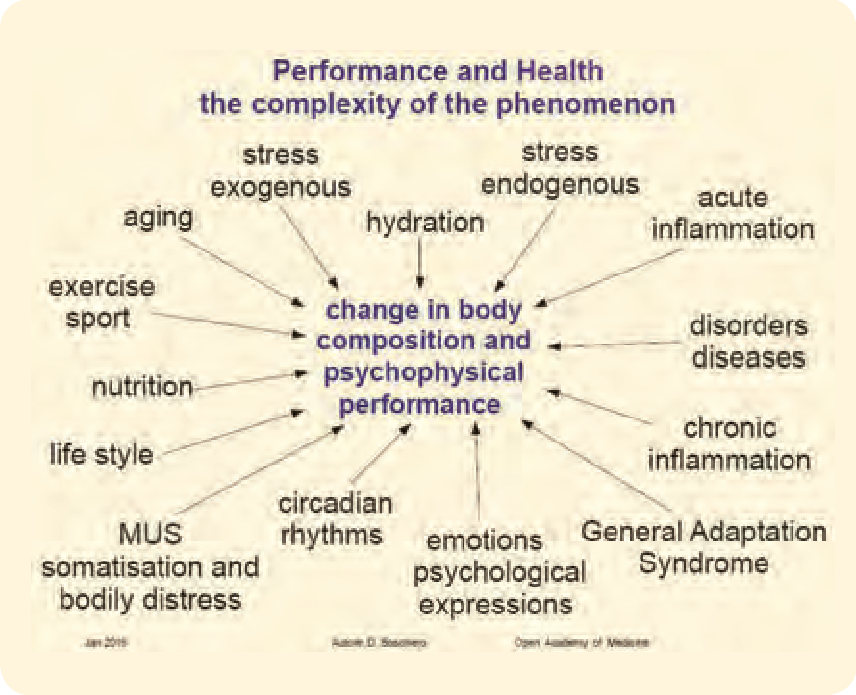
It is a highly complex phenomenon regulated by the **Stress System**, the low-grade inflammatory processes, the circadian rhythms, and the most important elements of the body composition, such as muscle, IMAT, fat and bone. While an athlete's health tends to be generally above average, he/she requires specific assessments that go beyond the generic meaning of the term "well-being"." In order to favour an increase in performance, we need to evaluate all the types of imbalances that, without amounting to defined clinical outcomes, reduce the well-being and the physical and mental performance of the athlete.

The initial feedback of **subjective perception of well-being** is found in the onset of **MUS** (Medically Unexplained Symptoms), a series of subclinical disorders of a functional nature extensively analysed in international literature.



- chronic and persistent fatigue not relieved by sleep;
- mood disorders;
- hands and feet constantly cold;
- persistent insomnia or sleepiness;
- anxiety, apathy;
- changes in appetite (excessive hunger or lack of appetite);
- heartburn, stomach fullness, bloating after meals, nausea;
- constipation or altered bowel movement;
- irritable bowel syndrome;
- altered perspiration.

(examples of MUS – Medically Unexplained Symptoms)



Quite a large part of the population (predominantly adults) suffer, or have had several episodes of Medically Unexplained Symptoms, defined by the most accredited international literature as a category which encompasses a variety of disorders, only rarely leading to a precise diagnosis, and remaining quite frequently within the limits of altered clinical pictures, but not to the point of being pathological.
Literature has developed considerably since the 1980s, mainly because of the increasing incidence of the phenomenon, considered nowadays as one of the most frequent, costly and complex problems in general practice.
One of the initial hurdles with respect to the formulation of an approach to the phenomenon was, in all probability, the confinement of this kind of problems within an unspecified area of psycho-social disorders which general practitioners distances themselves from, referring patients to specialists.
The progress made in the analysis of the interactions between the nervous, endocrine and immune systems has created new horizons both in the medical and sports fields; in particular, thanks to the integration of the extensive literature on Stress.

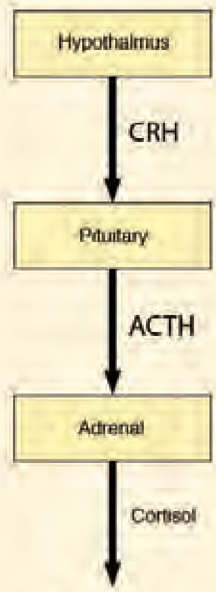
STRESS

Literature describes "stress" as a form of adaptation of the organism (this is called the "General Adaptation Syndrome") to stimuli known as "stressors".
A stressor can be generically defined as an element capable of altering the homeostatic state (nowadays literature on the subject tends to talk about allostasis, rather than homeostasis) of the organism; that element may have various forms, and belong to the most diverse categories: indeed it can be psychosocial or strictly physical, the distinction, however, does not implicate significant changes in the body's reaction mechanisms. **What is currently considered to be essentially a fact, was one of the most unexpected features of stress: regardless of the type of stimulus, whether it be intense physical effort or worrying for an exam, the activation mechanisms are remarkably similar.**
The reactions to the stressors are determined by the activation of the nervous and endocrine systems; in both cases, the perception of stressors is located in the brain, and it is from there that the stress signals depart.
On the endocrine level, the reaction to stress is expressed through the activation of the HPA (Hypothalamic-Pituitary-Adrenal) axis, the ultimate consequence of which is the secretion of glucocorticoids by the adrenal cortex, while on a **nervous level, the stressors involve the activation of the Sympathetic Nervous System.**

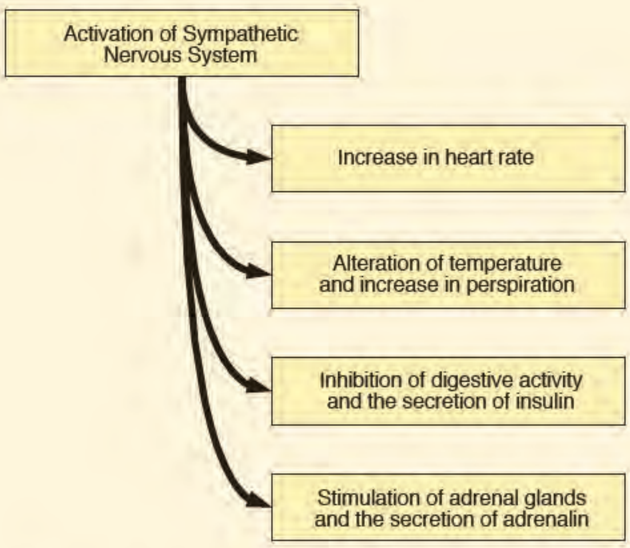
That being the case, it is no wonder that literature has documented, and continues to document, the effects on our general health caused by the prolonged activation of reactions to stress. The increase of circulating glucocorticoids, the loss of their circadian rhythm and the excessive activation of the sympathetic nervous system alone are the direct or indirect risk factors for high incidence of disorders such as obesity, high blood pressure and mood disorders (anxiety, depression). **Before the onset of obvious manifestations, the persistent activation of the response to the stressors is associated to the onset of MUS** and the loss of mental and physical performance, and when these phenomena are under control and treated, the risk of full-blown disease (usually to the detriment of the system most at risk for the specific subject) consequently increases. **Based on the findings of the scientific community, therefore, individuals with MUS should be carefully analysed in order to clarify the genesis of the symptomology, and to implement the most appropriate strategies.**

Literature on stress has quite rapidly classified the **stress reaction stages** based on their chronological dynamics, that respects the phases of the so-called GAS (*General Adaptation Syndrome*):

- **alarm:** the phase in which the stressor is "recognised" and in which the reaction to the stress begins according to the previously described mechanisms;
- **adaptation or resistance:** the real reaction to the stressor, when the body attempts to rebalance and recover homeostasis; based on the body's responsiveness, on the intensity or the extent of the stressors, or the concurrence with other previous stressors, this stage could have normal duration or persist over time, without actually recovering homeostasis, which leads to the next stage - exhaustion;
- **exhaustion:** this represents a chronic or persistent reaction to stress; the body is by now unable to recover homeostasis; this is the most damaging stage as prolonged exposed to the phenomenon may increase the risk of physical and psychic pathologies.



On the endocrine level, the reaction to stress provokes the activation of the HPA axis, with the subsequent secretion of glucocorticoids, the final product of the chain of interactions.



On a nervous level, the reaction to stress provokes the activation of the Sympathetic Nervous System.

Stress is also generally differentiated according to its final consequences, based on the principle that one stressor may on the whole be considered "positive" or "negative", depending on whether the body is able to react to it or not, and re-establish physiological homeostasis; in this case we refer to:

- **eustress:** indicates the stress that leads to an adjustment reaction by the organism, which can then return to a state of physiological homeostasis; from this point of view, the initial stressor takes on the form of a positive stimulation for the body, be it a constructive or pleasant psychosocial stimulation, or an functional immuno-endocrine adjustment;
- **distress:** is the type of stress that results in the loss of the organism's homeostasis, usually associated with an excessive or persistent activation of the reaction to the stressors, ultimately **associated with emotional or physical disorders.**

One of the main problems, in relation to the functional or diagnostic assessment of stress, is the wide variety of elements to be considered as potential stressors, ranging from psychosocial stimuli to organic diseases, from nutritional imbalances to physical activity.

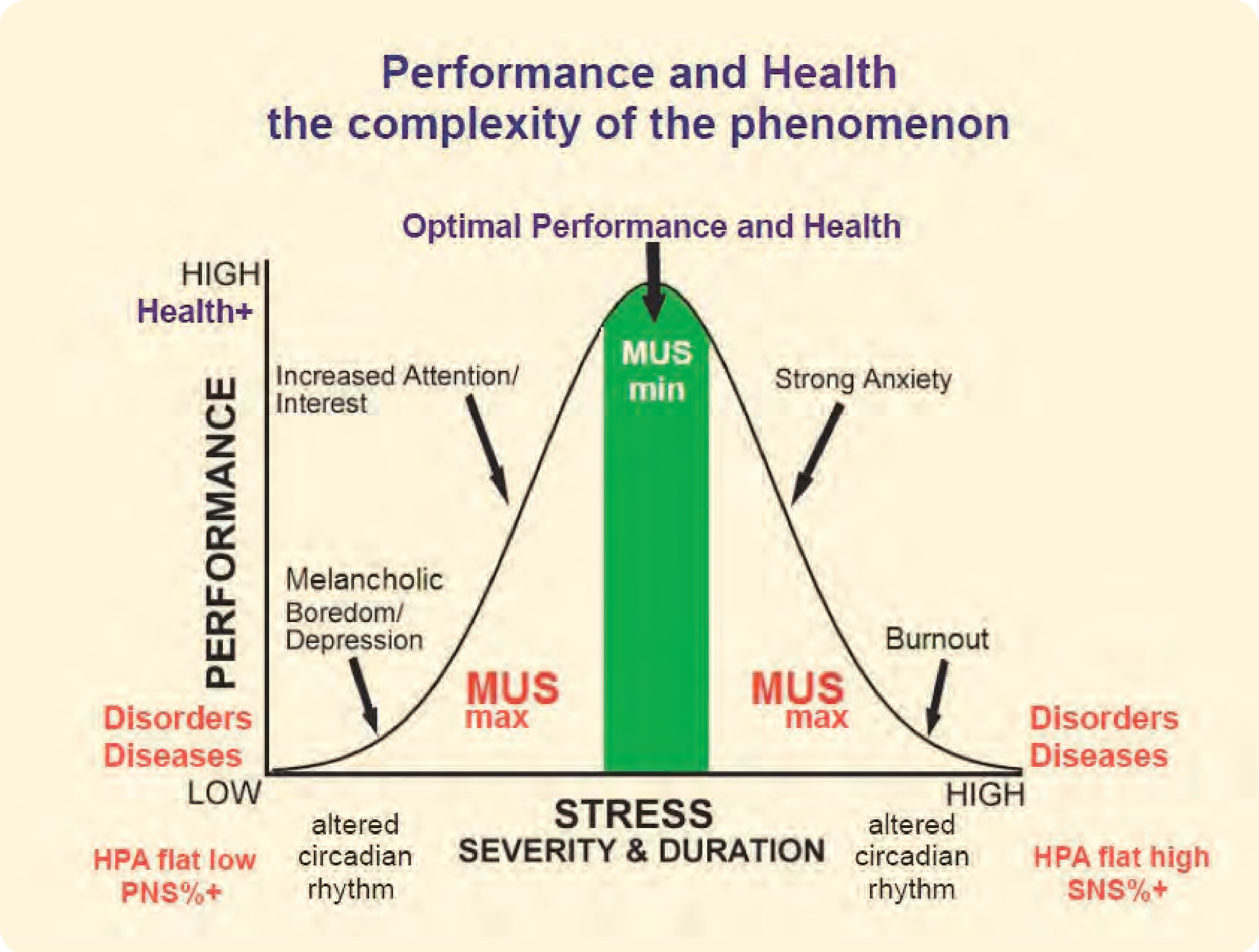
In addition, the **time variable associated with different types of stressors or stimuli** (endogenous and/or exogenous) and the organism's adaptive capabilities lead to important changes with different psychophysical pathways that over time can sustain negative loops with a **strong presence of medically unexplained symptoms, chronic low-grade inflammation, body composition changes and significant loss of mental and physical performance.**

This type of symptoms, although not amounting to specific pathological conditions, is indicative of an impairment in the physiological balance of the organism, **often related to the chronic nature of inflammatory processes, chronic stress, unhealthy eating habits, alterations of physiological hormone balances or of their physiological circadian rhythms.**

To improve sports performance we must fill the gap, often overlooked, between the state of well-being and the pathological state, without taking for granted the fact that the absence of specific diseases means a perfect bill of health.

The onset of MUS is a significant index that must not be ignored, related with the areas of metabolic or neuro-immuno-endocrine disorders; investigation into the causes of the symptoms and the adoption of specific recovery strategies, as well as allowing the containment and regression of symptoms, prevents the escalation of the factors involved in their creation, involving new and more serious systemic interactions that could lead to specific diseases. The same non-specificity of MUS, however, prevents classification or accurate treatment, as the same symptom can result from a number of problems, when not by the concomitant interaction of pathogenic processes of a different nature.Focusing on the specific case therefore requires more data correlation and comparison, in addition to those on vague and non-specific symptoms. Indicators of primary importance can be obtained by means of differential analysis tests of body composition such as muscle, bone, total fat, visceral fat, IMAT, HPA axis, etc. as well as of heart rate variability and the autonomic nervous system testing with SDNN, RMSSD, scatter, etc. There is no doubt that, for the athlete, monitoring hydration levels, the distribution of intra and extracellular fluids, muscle content, fat types, the quantity and quality of minerals, and the ability of the autonomic nervous system to adjust (Heart rate Variability), play a crucial role.

Any conditions of systemic or intracellular dehydration are particularly significant in this context, linked both to the shortage of bicarbonate and phosphate buffer systems, and to increased cell death, and the consequent migration of cell fluid into the extracellular matrix. One of the main issues related to a low level of hydration is the difficulty of transport and absorption of nutrients (minerals, for example), an aspect which plays a key role for the athlete.



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The differential analysis of body composition allows the monitoring of key parameters related to muscle mass, the primary factor for the maintenance of tone and sports performance: the tendency to lose muscle mass is not a rare phenomenon, whether it be related to problems of an endocrinological, metabolic or chronic inflammatory nature, a periodic detection of the ratio of skeletal muscle, fat mass) and fat types (IMAT intramuscular fat, VAT visceral adipose tissue) must not be neglected, before implementing any nutritional corrections or preparing specific training strategies. In order to improve the athlete's nutritional habits, the value of the basal metabolic rate and the daily rate (BMR, 24EE) must be taken into account as they are metabolic parameters directly related to the metabolic structure of the individual and the relationship between muscle mass and fat. The preservation of muscle mass, however, is not the only aspect influencing the body's metabolic rate, which may undergo more or less substantial alterations also due to chronic inflammatory processes, and to the relative degree of systemic inflammation; persistent inflammation in fact, stimulating neuro-immuno-endocrine alterations, results in changes in metabolism, generally by decreasing the metabolic capacity of the individual. The differential analysis of the body composition (e.g. BIA-ACC) is useful in this case where it can express the **HPA axis index** value (performance of the cortisol rhythm), an indicator of the integrity of cell membranes correlated to the degree of systemic inflammation and the loss of intracellular fluids and muscle mass.

Complementing the systemic parameters, the overall health picture can be further clarified by a survey of the athlete's **ability to adjust and adapt based on the analysis of the autonomic nervous system** (e.g. PPG) and **heart rate variability (HRV)**. Parameters such as SDNN (general health index and adaptive capacity) and RMSSD (ratio of the **vagal/ parasympathetic activation and anti-inflammatory capacity**) also allow us to assess the degree of endogenous anti-inflammatory regulation, **highlighting the factors behind the symptomology and the loss of mental and physical performance.**

DARIO BOSCHIERO
President and Founder of the Open Academy of Medicine, London, UK, Venice, ITALY
Founder and Coordinator of the project "MUS - Medically Unexplained Symptoms, Chronic Inflammation and Clinical Nutrition"
Director of R&D in BioTekna – Biomedical Technologies

Download the MUS self-assessment sheet:
http://www.biotekna.com/schede/MUS.pdf

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References

1. Epstein RM, Shields CG, Meldrum SC, Fiscella K, Carroll J, Carney PA, Duberstein PR, Physicians' responses to patients' medically unexplained symptoms, Psychosom Med, 2006 Mar-Apr, 68(2):269-76;
2. Ringsberg KC, Krantz G, Coping with patients with medically unexplained symptoms: work-related strategies of physicians in primary health care, J Health Psychol, 2006 Jan, 11(1):107-16;
3. Takahashi T, Ikeda K, Ishikawa M, Kitamura N, Tsukasaki T, Nakama D, Kameda T, Anxiety, reactivity, and social stress-induced cortisol elevation in humans, Neuro Endocrinol Lett, 2005 Aug, 26(4):351-4;
4. Buckley TM, Schatzberg AF, Aging and the role of the HPA axis and rhythm in sleep and memory-consolidation, Am J Geriatr Psychiatry, 2005 May, 13(5):344-52;
5. Buckley TM, Schatzberg AF, On the interactions of the hypothalamic-pituitary-adrenal (HPA) axis and sleep: normal HPA axis activity and circadian rhythm, exemplary sleep disorders, J Clin Endocrinol Metab, 2005 May, 90(5):3106-14;
6. Gluck ME, Geliebter A, Hung J, Yahav E, Cortisol, hunger, and desire to binge eat following a cold stress test in obese women with binge eating disorder, Psychosom Med, 2004 Nov-Dec;66(6):876-81;
7. Backhaus J, Junghanns K, Hohagen F, Sleep disturbances are correlated with decreased morning awakening salivary cortisol, Psychoneuroendocrinology, 2004 Oct, 29(9):1184-91;
8. Crofford LJ, Young EA, Engleberg NC, Korszun A, Brucksch CB, McClure LA, Brown MB, Demitrack MA, Basal circadian and pulsatile ACTH and cortisol secretion in patients with fibromyalgia and/or chronic fatigue syndrome, Brain Behav Immun, 2004 Jul, 18(4):314-25;
9. Woivalin T, Krantz G, Mantyranta T, Ringsberg KC, Medically unexplained symptoms: perceptions of physicians in primary health care, Fam Pract, 2004 Apr, 21(2):199-203;
10. Smith RC, Korban E, Kanj M, Haddad R, Lyles JS, Lein C, Gardiner JC, Hodges A, Dwamena FC, Coffey J, Collins C, A method for rating charts to identify and classify patients with medically unexplained symptoms, Psychother Psychosom, 2004 Jan-Feb;73(1):36-42;
11. Mello Ade A, Mello MF, Carpenter LL, Price LH, Update on stress and depression: the role of the hypothalamicpituitary-adrenal (HPA) axis, Rev Bras Psiquiatr, 2003 Oct, 25(4):231-8;
12. Smith RC, Lein C, Collins C, Lyles JS, Given B, Dwamena FC, Coffey J, Hodges A, Gardiner JC, Goddeeris J, Given CW, Treating patients with medically unexplained symptoms in primary care, J Gen Intern Med, 2003 Jun, 18(6):478-89;
13. Chan O, Inouye K, Riddell MC, Vranic M, Matthews SG, Diabetes and the hypothalamo-pituitary-adrenal (HPA) axis, Minerva Endocrinol, 2003 Jun;28(2):87-102;
14. Gaillard RC, [Interactions between the immune and neuroendocrine systems: clinical implications], J Soc Biol, 2003, 197(2):89-95;
15. Albrecht S, Naugle AE, Psychological assessment and treatment of somatization: adolescents with medically

unexplained neurologic symptoms, Adolesc Med, 2002 Oct, 13(3):625-41;

16. Reid S, Whooley D, Crayford T, Hotopf M, Medically unexplained symptoms--GPs' attitudes towards their cause and management, Fam Pract, 2001 Oct, 18(5):519-23;
17. Gaillard RC, Interaction between the hypothalamo-pituitary-adrenal axis and the immunological system, Ann Endocrinol (Paris), 2001 Apr, 62(2):155-63;
18. Blazejova K, Nevsimalova S, Illnerova H, Hajek I, Sonka K, [Sleep disorders and the 24-hour profile of melatonin and cortisol], Sb Lek, 2000, 101(4):347-51;
19. Harbuz MS, Chronic inflammatory stress, Baillieres Best Pract Res Clin Endocrinol Metab, 1999 Dec, (4):555-65;
20. Shanks N, Harbuz MS, Jessop DS, Perks P, Moore PM, Lightman SL, Inflammatory disease as chronic stress, Ann N Y Acad Sci, 1998 May 1, 840:599-607;
21. Leal AM, Moreira AC, Food and the circadian activity of the hypothalamic-pituitary-adrenal axis, Braz J Med Biol Res, 1997 Dec, 30(12):1391-405;
22. Harbuz MS, Conde GL, Marti O, Lightman SL, Jessop DS, The hypothalamic-pituitary-adrenal axis in autoimmunity, Ann N Y Acad Sci, 1997 Aug 14, 823:214-24;
23. Van Cauter EV, Polonsky KS, Blackman JD, Roland D, Sturis J, Byrne MM, Scheen AJ, Abnormal temporal patterns of glucose tolerance in obesity: relationship to sleep-related growth hormone secretion and circadian cortisol rhythmicity, J Clin Endocrinol Metab, 1994 Dec, 79(6):1797-805;
24. Selye H, Forty years of stress research: principal remaining problems and misconceptions, Can Med Assoc J. 1976 Jul 3;115(1):53-6;
25. Selye H, Stress and distress, Compr Ther. 1975 Dec;1(8):9-13;
26. Selye H, Confusion and controversy in the stress field, J Human Stress. 1975 Jun;1(2):37-44;
27. Selye H, Fortier C, Adaptive reaction to stress, Psychosom Med. 1950 May-Jun;12(3):149-57;
28. Selye H, Stress and the general adaptation syndrome, Br Med J. 1950 Jun 17;1(4667):1383-92;
29. Selye H, Horava A, Stress, Tidsskr Nor Laegeforen. 1953 Mar 1;73(5):195.
30. Chrousos GP. Stress and disorders of the stress system. Nat Rev Endocrinol. 2009 Jul;5(7):374-81.
31. Tsigos C, Stefanaki C, Lambrou GI, Boschiero D, Chrousos GP. Eur J Clin Invest. 2014 Nov 28. doi: 10.1111/eci.12388. Stress And Inflammatory Biomarkers And Symptoms Are Associated With Bio-Impedance Measures.
32. Rainer Straub, The Origin of Chronic Inflammatory Systemic Diseases and their Sequelae 2015
33. Straub RH, Ehrenstein B, Günther F, Rauch L, Trendafilova N, Boschiero D, Grifka J, Fleck M. Clin Rheumatol. 2016 Apr 26. Increased extracellular water measured by bioimpedance and by increased serum levels of atrial natriuretic peptide in RA patients-signs of volume overload.
34. Stefanaki C, Peppa M, Boschiero D, Chrousos GP. Eur J Clin Invest. 2016 Jul 19. doi: 10.1111/eci.12659. Healthy Overweight/Obese Youth: Early Osteosarcopenic Obesity Features.

The official journal of the European Weightlifting Federation

THE PERIODIZATION OF TRAINING IN PRACTICE, SCIENCE AND SCIENCE FICTION

BY VITO LEONARDI

The official journal of the European Weightlifting Federation

I have read several times President Antonio Urso's editorial which appeared in issue no.18/2016 of "Strength & Conditioning. The science of human movement", and continue to marvel at the extraordinary and various insights it provides. These range from the development of so-called complex systems to considerations on the essence of human motor skills, then returning once again to the endless debate on the effects of intensive training and the distribution of training loads.

In the quite recent past, a vast number of studies have been carried out on the subject, and an equal number of works and guidelines have been published dating back to the historical periodization of the 1960s by L.P. Matveyev.

Much time has passed since then and scientific research has not come to a halt, on the contrary, it is tirelessly advancing, investigating in all directions on the most hidden aspects that underlie human performance; however, all this research, must obviously respect observation times, which do not go beyond 8/12 weeks and do not continue for decades.

Nevertheless, we can still see an improvement of performance levels that, without exception, encompasses all sports, but which is also related to many other factors, such as the use of new materials, an increased interest in sport, modern analytical technologies and, of course, the sad phenomenon of doping. Doping is a curse for sport; not only does it ruin its image and compromise the health of athletes, but as the effects overlap, it obscures to a greater extent the dynamics that regulate the body's adaptation to the pressure of physical exercise. At any rate, in order to achieve these results, we have increased training loads to unprecedented levels. We have gone from occasional workouts, or training just before the next race in the early twentieth century to working out every day, twice a day, three times a day ...

Where we will stop?

It is true that under this tremendous pressure we have produced excellent results, but we have also often failed along the way, and sometimes the health of athletes has been put on the line.

When will we stop?

There are without a doubt limits to the capabilities of human performance, but where are they located? Every time we make predictions we have always been proved wrong by the facts, but surely there must be limits.

What is today's conceptual framework of the periodization model, what is researchers' critical view, what do we know today, what could we know tomorrow, what might we never know?

LOOKING BACK

There is no question that strength is a very important factor of performance, at least in the vast majority of sports. However, the ability of strength, in other words, what can actually be transferred to the passive locomotor apparatus, the bones, depends on a number of factors on which it is not always possible to take action, such as the anthropometric ratios and the physiological section of the muscles. Excluding illicit drug injections, there are only two other ways: improving the activation of the nervous system, and/or increasing muscle mass. All methodologies, albeit with different perspectives, are based essentially on these possibilities.

In the past, strength seemed such a universal ability, expendable in any type of physical performance, a kind of cashier's check so to speak. But the conflicting aspects it manifested were soon to suggest different names: speed strength, explosive-resistant strength, absolute strength, names that we now understand from a physiological rather than physical point of view, that is, how the energetic processes are activated inside the muscles and not in the movements of bodies because, in physics, strength is defined in a vector format, expressed in Newtons and is neither slow nor fast, however, slow and fast are the movements of the bodies subject to it.

It was soon understood that the different expressions of this ability implied methodologies of equally different developments; it was a unique ability that changed in appearance like a chameleon, but above all we began to understand the relationship between these differences.

In the 1930s, physiologist A.V. Hill discovered a very important connection. It was common knowledge that by as resistance increases, the speed of execution decreases: Hill showed that this decrease occurred hyperbolically as opposed to linearly: the speed of execution is maximal with a zero load and is zero with a maximum load, a condition in which the maximum

strength exerted equals the opposite force to overcome. In the graph that illustrates the strength-velocity ratio we can see the maximum mechanical power that a muscle is able to express. Even more importantly, in practice it became obvious that this hyperbolic trend could not be modified with training, but only oriented either more towards speed or more towards strength, or at any rate raised without changing its hyperbolic character.
In the 1960s, Italian academics Margaria R., Marchetti M., Cavagna G.A., Prampero P.E. and Mognoni P. significantly contributed to the development of physiological and mechanical models, in reference to the force/length ratio.
In the 1970s, E. Hennemann discovered that, at any speed of contraction, the red fibers are always the first to come into play, which has considerable significance for the purpose of the athletic build.
All this still did not clarify another aspect, namely the extremely important aspect of time, given that the vast majority of sporting activities are carried out in a very short time, a condition in which the different muscle fibers play a central role. Studies carried out in the former Soviet Republics in the 1960s on the strength-time ratio indicated a trend which was also not linear, but rather in the shape of an italics S. This indicated the rapid strength index, in other words, the time taken by the muscle to reach its peak of maximum force, but more importantly, the steepest part of the curve, which indicates the most explosive moment (force gradient). Therefore, two individuals may have the same peak of maximum force, but reach it at different times, just as two cars may have the same speed, but not the same acceleration.

It goes without saying that in performances with very short execution times, maximum force has a relative rather than an absolute role: therefore, what matters very often is the expression of strength in the unit of time required: the key concept of muscle power. And again, performances with times which are not clearly defined, may give rise to the complete manifestation of the strength possessed, and even of greater intensity if this comes about by means of a particular form of contraction, defined eccentric. But nothing is simple, everything is complicated.
The fact that the different performance requirements led to stren-

gth lasting over time and also to the maximum intensity possible gave rise to performance characteristics which were not exactly and exclusively muscular, but rather depended on the systems of transforming and using energy.

Initial studies on human energy systems date back to the early decades of the last century, when in 1923, Krogh and Linhard defined the oxygen debt theory and maximum oxygen consumption. In 1927, while studying integrative phenomena between the different energy sources available in the body, Linhard was the first to demonstrate greater economy in running, by means of keeping a steady pace. The attempt, among others, to represent the main physical performance ability of man in a coherent framework was put forward by Gundlach in 1968.

In the three ordinates of space x, y, z, we have maximum force (Fmax), maximum power (Pmax) and velocity (V) over time (T), so that the relationships between the individual abilities can be expressed functionally.This model is still of interest today, especially for the purpose of a conceptual representation, although mutual interrelationships cannot be precisely placed.

Strength, speed and endurance move away from the zero point as their dimension increases, resulting in an irreconcilable conflict between them. So why, albeit in varying percentages, do certain dependencies continue to remain within the different motor skills?

To quote the standard scientific approach: Why a thing "is" rather than "is not", and why is it so and not otherwise?

EVOLUTION AND THE DEVELOPMENT OF THE TRAINING THEORY

A body works as a result of a complex system in which the various organs are involved, to varying extents, in carrying out external work. In sport, the increase of motor potential is the main theme of a vast amount of literature, with elements which are not always unambiguous. At present, we still have fragmentary scientific evidence on the logic of the laws governing the processes of physical adaptation to intense exercise. Preparation aimed at high results, in any sport, today appears more than ever as an organization of specific stimuli aimed not only at an increase in the potential of bio-energetic performance, but also at the ability to use this same potential. Now, for such use we must take into account a variety of other factors, which are equally specific and refer to special abilities, such as technique, health, on the personality of the individuals. However, several elements are involved in the definition of a problem, and it becomes more difficult to have a unique and comprehensive conceptual picture. The boost scientific research has experienced in recent decades is, in the history of the studies in question, of an unprecedented scope, and ranges from the physiological to the mechanical sphere, from the psychological to the social and naturally, there are more schools of thought which, while not rejecting the indisputable data of research, assign to them a different context. So, what stage are we at? Today we follow the correct idea that the organization of training bases its laws on living matter's ability to adapt to external stimuli, if these can act according to complex dynamics, but within the tolerance limits of the actual individual. The genetic aspect alone represents an essential starting point that explains how different individuals using the same training will not obtain the same results. This individuality is the first reason why precise conclusions cannot be drawn on the effectiveness of the stimuli that structured exercise has on the body, as a general rule, although studies carried out on identical twins can provide further information. Neither mild or random, nor intense stimuli produce adaptation effects in the body. It is the laws of nature, the same that led to the evolution and the subsequent extinction of particular species, when the environment changed too abruptly. We should also remember that the external environmental pressure is crucial for life: in the absence of this, we observe a functional and structural reduction which affects all organs and systems, without exception.

But how does this mechanism work?

Briefly, it can be stated that: at a state of rest, the various biological systems are stabilized in a condition of equilibrium, defined "homeostatic balance", which can be lost due to physical stress and external agents, determining state defined "heterostasis". Influenced by intensity, duration and the action of agents as a whole, many physiological parameters are raised, while others are lowered.

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Again, it is important that some of these may exist in a very wide "range", such as the heart rate that may range from 40 beats per minute to over 200, and others with much more reduced levels, as is the case of blood lactate. The return to normal, however, takes place over very different times, which depend on the state of adaptation of the individual: from just a few minutes, such as in the heart rate, to days in the case of reactive proteins (CRP) and creatine kinase (CK) or a few hours, as in the case of fatty acids.

This kind of reorganization earthquake is necessary as through more complex processes, it triggers a state of mobilization of energy resources, of protein activation, as well as defense mechanisms including the immune system, in other words, very complex biochemical reactions. The initial lowering of the functional potentiality is subsequently supercompensated by a higher level, as a reaction of the organism, provided that - if repeated over time - it leads to the summation effects that profoundly change all the biological systems of the organism, above all those that most directly were involved. Training, therefore, is founded on a simple principle: the dichotomy between the loss and reorganization of homeostatic balance. It only appears simple, as can be observed in figure 1.

It has already been stated that stimuli which are too mild, or too intense prove ineffective and that they must repeated over time; but at what intensity should they be compared, and what features should the time sequence of the stimuli have?

Moreover, the very idea of overcompensation resulting from training stimuli implicitly acknowledges an increase in load according to the most diverse solutions, and which is still at the centre of a heated debate.

In the early 1960s, the methodology of training came from experience, while the intricacies between general, specific and technical

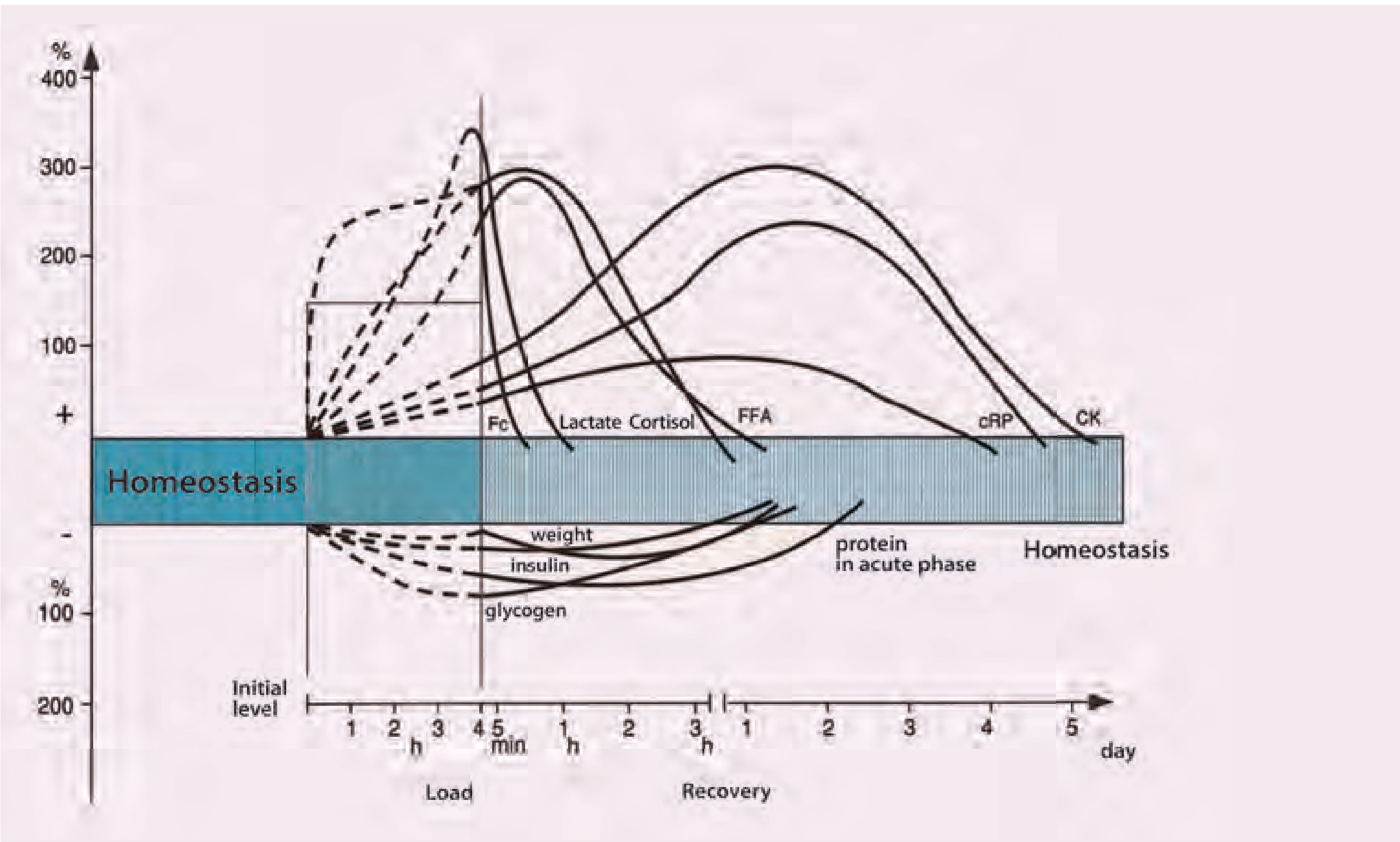

Figure No. 1

Schematic representation of the alteration of the state of homeostasis produced by a load for a duration of 4 hours. The return to normality of some parameters has a different time span and can last for several days (HR, heart rate; FFA, free fatty acids; CRP, C-reactive protein; CK, creatine kinase), G. Newman 1987.

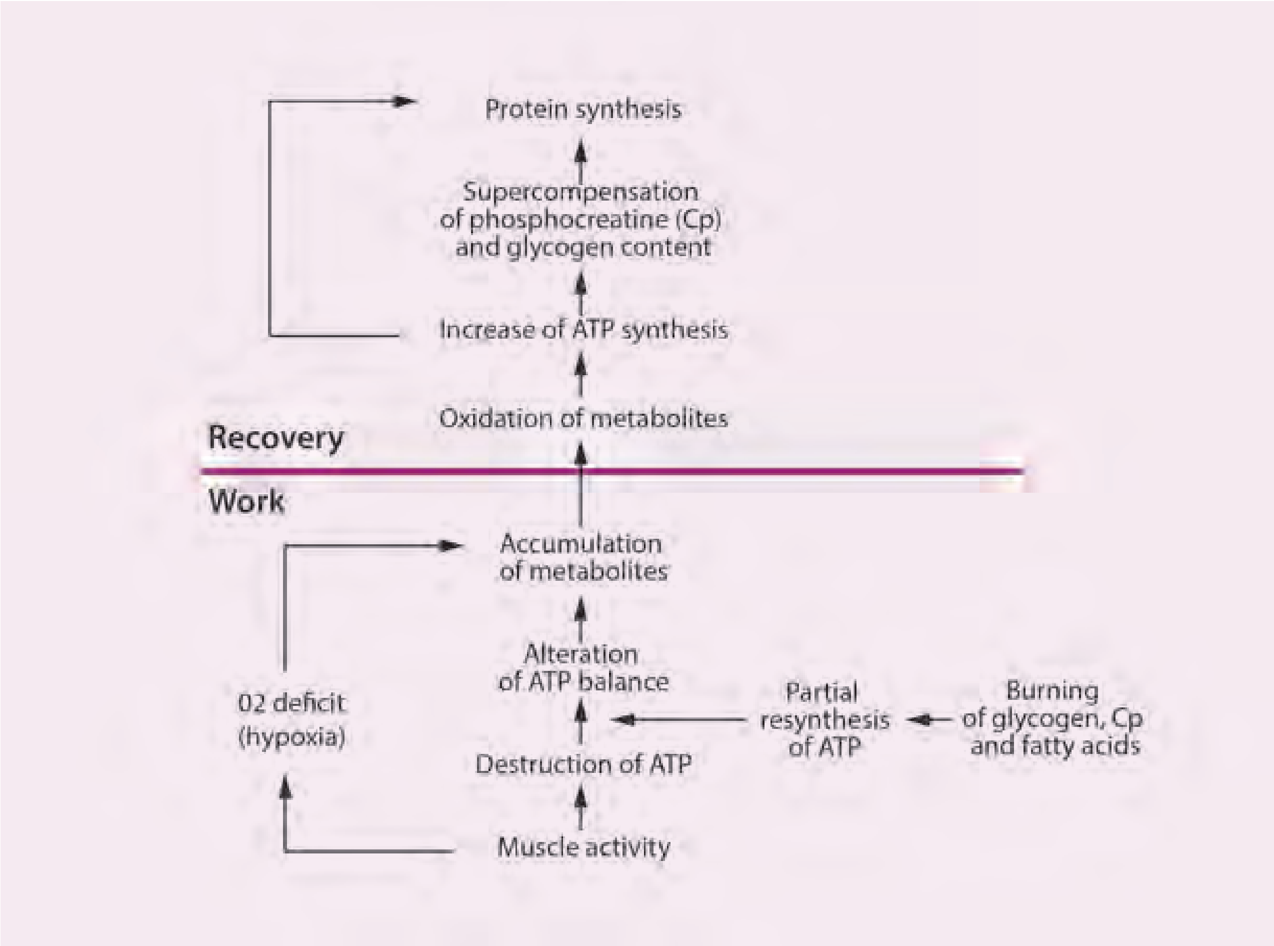

Figure No.2
THE SEQUENCE OF REPARATIVE BIOSYNTHESIS IN MUSCLES DURING THE RECOVERY PERIOD AFTER PHYSICAL EFFORT.

preparation were more whimsical and controversial; a basic concept however remained unchanged, the progressive nature of the training load during the career of athletes. To complicate matters, in the manner of Chinese boxes, one inside the other, motor skills not only counteract each other but have different times of development, just as various organs and systems during the developmental stages of adolescence.

It can be said that auxology, the science that studies the laws of development and growth, is indeed highly conservative: no overloads before the age of fourteen, an outdated concept, that still prejudicially resists (see Behringer et al. 2010). But it was, and still is, this heterochrony of adaptation that creates the biggest problems, especially in the field of youth sport, because some physical performance abilities have very long activation times, incubation periods, which are almost deaf to training stimuli, compared to other more immediate responses, such as joint mobility, coordination and motor learning.

In the mid-1980s, these problems were at the centre of a heated international debate when Winter, prompted by the work of Martin (1982), presented his Theory on Sensitive Phases. According to the author, these are the ontogenetic moments during which the body proves to be more predisposed to the development of certain “qualities and types of tasks”. Once these phases have elapsed, it is no longer possible to fully develop the factors of the motor value. In other words, a kind of imprinting, a “now or never” challenge.

According to Bauer (1988), this alleged sensitivity is nothing but the result of development pressures in adolescence, though this does not imply real imprinting in the human being, as is observable in some species of animals. Can there be a youth training theory distinct

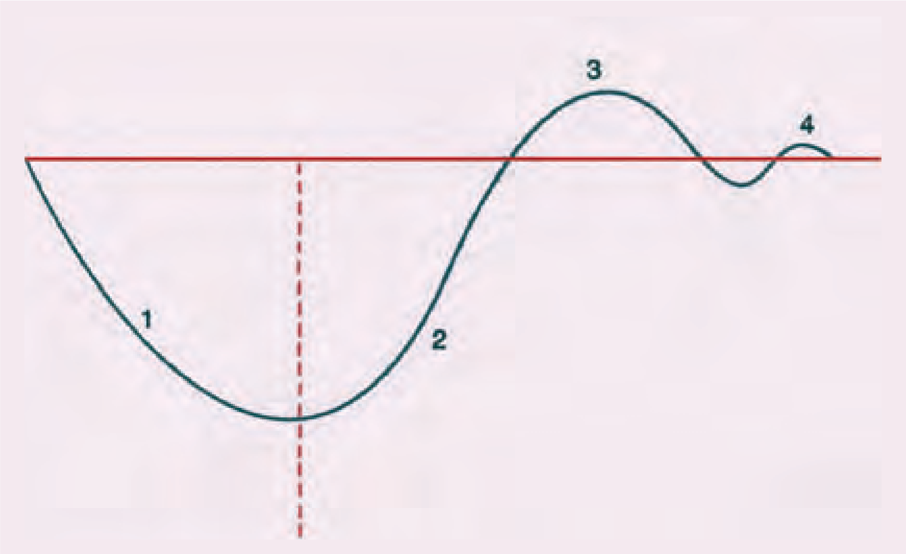

Figure No. 3
Diagram of energy consumption during a workout and its restoration during recovery:
1 - consumption,
2 - restoration,
3 - supercompensation,
4 - return to the initial level; Jakowlew (1978).

from training at the highest level? But let's take a step back.

In 1964, an extraordinary work was produced by Prof. L. Matveyev, of the Central Institute of Physical Culture in Moscow, a text that soon became famous the world over "The Periodization of Training".

Not only was this work of considerable substance, it also represented an extraordinary event because, in 1965, during the Cold War, up until the demolition of the former Soviet Socialist Republics, studies were conducted were kept hidden and covered like a military secret, such was the importance of State athletics. The work of Matveyev provided significant contribution to the rationalization of training and in many ways, ended empiricism. What exactly did this work entail? According to Matveyev, the effectiveness of the training process is based on an "undulating" load structure divided into phases: the preparatory phase, the competition phase, the maintenance phase. The idea of his periodization is to place the individual components of the whole process in a sequence in which the basic unit is the cycle of weekly sessions, called the microcycle. A number of microcycles comprises a greater amount of time called the mesocycle, and a number of mesocycles makes up a time frame defined the macrocycle: they are all connected to each other by consequential purposes. Therefore we have basic, preparatory, training and maintenance mesocycles. The basic idea is that the body, under the pressure of training, cannot proceed linearly in its evolution, but does so in a upwards trend, with stages leading to the conclusion of an annual cycle of activities, which includes competitions. Within a year, in fact, the body's current adaptation reserves would (and here the conditional is a must) be momentarily exhausted and then after a transi-

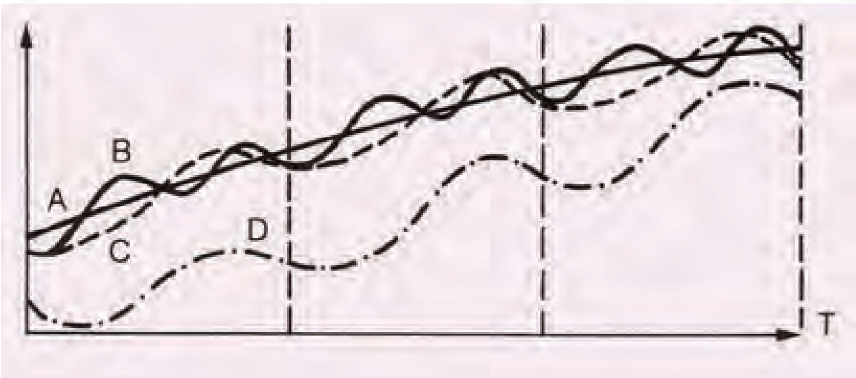

Figure No.4
The Diagram of the dynamics of the process of adaptation in the conditions of sports activities. A indicates the trends of long-term changes, relatively stable in the athlete's body of the athlete, over a number of years of activity; B and C are continuous annual changes in functional indexes, which have a temporary, unstable nature and are based on the compensation mechanisms that guarantee the maintenance of the required functional level for the period of stabilization of the adaptation process; D: alongside the increase of motor potential the possibility of its comprehensive utilization in sport performance develops (from Verchosanskij 1985).

tion period, they would pass to a higher level.
But with the same organization? We shall see later; meanwhile, from Platonov to Verchosanskij to Tschiene, to name but a few, there isn't an author who does not acknowledge organization in phases or stages with load periods, in the logic of training, albeit with different content.

What do these stages involve?

- Firstly, the initial assimilation of a general, non-specific adaptation through the effect of the repetition of single training workouts, and then as the sum of the same.
- Then triggering a deep functional restructuring of the data, not only by cell enlargement, but also by the coordination of the various systems in response to the demands of specific locomotor activity.
- The third phase should consolidate stable and enduring adaptation with high functional abilities. This climax, however, cannot be maintained for long.
- The fourth and final stage would be to reduce the complex of training stimulations to allow a complete regeneration of the organic structures.

Although these principles are generally shared today, we must recognize that they are still
incomplete for the definition of a general training model. According to many academics, we are still stuck in the adaptation syndrome described by Selye in 1956, that is, the perspective of an adjustment of the body consequential to the load and the deployment of its reserves. In practice, in fact, during the athletes' career, the return to a general non-specific adaptation appears totally unlikely in the training protocols, whereas today there is an increasing tendency to focus on the competition content, if not on the competition itself as irreplaceable training. On the other hand, it is undeniable that the increase in the number of top competitions in the world has interfered, from the physical and physiological point of view, with preparation programmes because, it must be said, the conceptual framework of Matveyev was founded on the physiological response of the body, and not on the system of multiple competitions. It was no longer possible for the athletes to have direct access to the most important competitions without a selection mechanism. So at this point, is it necessary to formulate a "competition theory"? asks Peter Tschiene. The problem primarily concerns team sports characterized by a system of multiple competitions. In recent years, scientific production in the world has increased significantly; many studies have investigated specific aspects of muscular and energetic activity from Bosco to Tyanij, from Schmidblacher to Tschiene, to name but a few. Even the technical and coordinative aspects and the psychological component of training and competition are not neglected. What is missing, however, is a coherent picture, especially of the very long-term effects. In training we have immediate effects and delayed effects, and it is clear that the former are the most studied and reliable, while the delayed effects are lost in the mass of different "stories."

Due to increasingly widespread criticism and in response to the needs of contemporary sport Matveyev revised his opinions in 1991. What were those changes?

- Firstly, greater cohesion between preparation and the multiple competition system in the annual or multi-year process;
- An integrative concept of the individual components as a more harmonized overall training process.

In brief, the previous concepts were expanded upon and extended, and, more importantly, they increase the possibility of different perspectives. Basically a more open theory, but one that will triggered criticism. In fact, in the background of this review lie the principles expressed by Selye, and a firm belief to structure training into periods. In the mid-nineties, a heated international debate was sparked off about the inadequacy of certain fundamentals, involving some of the world's leading specialists on the subject. But before that time, no one, absolutely no one, had openly challenged Matveyev, one of the fathers, if not, the father, of the most popular training theory. The most corrosive criticism came in the form of a famous article published in "Sports Culture", by another great name, Prof. Jury Verchosanskij, for many years active in our country at the School of Sport in Rome.

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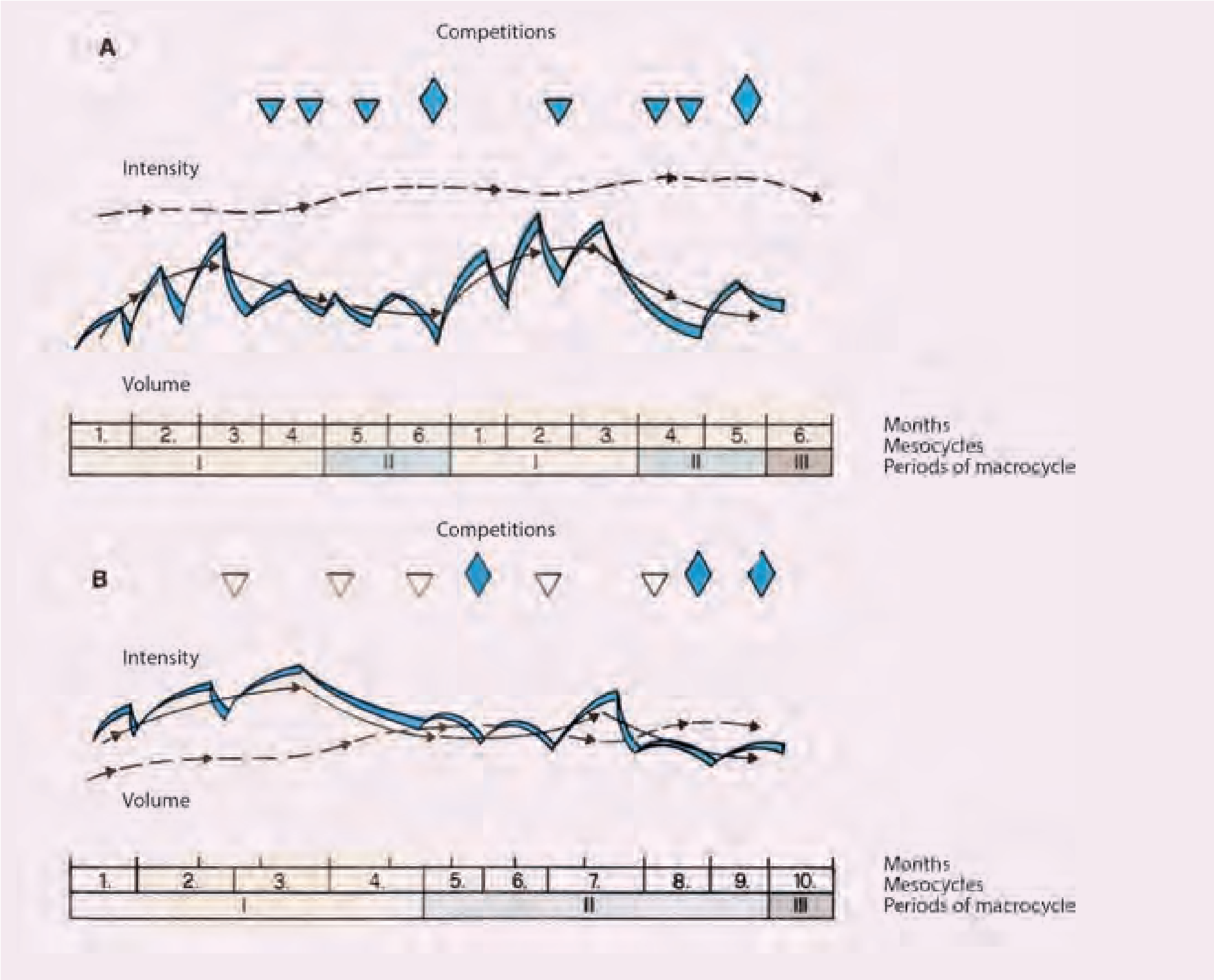


Figure No.5

DIAGRAM OF DYNAMIC LOAD UNDULATIONS IN THE MACROCYCLE. ABOVE: (A) IN SPEED STRENGTH SPORTS. BELOW (B): IN SPORTS THAT REQUIRE ENDURANCE. THE CONTINUOUS LINES INDICATE THE DYNAMIC LOADS IN THE BASIC EXERCISES, THE ARROWS INDICATE THEIR INTENSITY.

In a lengthy and verbose article, what surprises readers is not the content, which had already been put forward both by Verchosanskij and others, but the resentful manner in which the same concepts are presented over and over again. Matveyev is accused of being purely academic, far from reality, with ideas resembling school physical education programmes rather than high-level sports, also because he often refers to educating strength and speed .... ". His conceptual framework, with a poor technological background, does not take into account sporting skill or, above all, the most recent advances in biology and related sciences. It continues to impress on skills transfer, on abilities, in other words on the most typical aspects of physical education rather than on sport" (Verchosanskij,1998).

Incidentally, even P. Tschiene had debated the problem of the laws of the structure and the transfer which appeared highly unlikely, at least at a high level. In the 1980s Battinelli had already argued that although motor learning is more specific than general, it does lack a certain generality. But critics also pointed the finger at Verchosanskij's biological theory: "This hypothetical equation of the biological aspect and the essence of training would be non-specific, although this statement does not in the least mean a reduction in the phenomenon of adaptation ... While biological laws regulate the structure, the operation and development of the organism, maintains Tschiene, the training

theory is governed by the laws of the structure, by its working order, by the development of sport itself as a global and complex phenomenon, and not accountable to a single science."

In any case, the most controversial issue, which undermines the model of classical periodization, is the return to general preparation which by now is no longer included in the training protocols, at least in high level sport. Moreover, as we have already said, the extension of the competition calendars, the demands of commercialized sport do not allow athletes to obtain the best result possible in the biological sense. It is impossible to think that athletes can stay in top form for the entire competition season .... Is a new theory necessary? In the model proposed by Matveyev, the organization of the training process, which as previously stated consists of a sum of fundamental units, the microcycles, implies that the effect of the load is represented only by volume and intensity. The undulating trend, in particular of volume, had led to applications exaggerated to the contrary of what Verchosanschij proposes in his "block" structure, or concentrated forms of load, but this was true only for elite athletes. We must acknowledge that in Matveyev's organization of loads there are different trends in the volume curves between strength and endurance sports, much more pronounced in the former than in the latter, and flatter because of lower physiological intensity.

A non-undulating organization of these curves, by jumps or steps would however be justified in shorter cycles and under special conditions.

If we compare the two different conceptual frameworks, we can see in the annual preparation of both, a pre-competition period, a period of the competition, a transition period, all with different terminologies (cycle, stage, major cycle, etc.) with the difference, of no small importance, that in the Verchosanskij model, there is a form of a concentrated load, a block, that depending on which of the stages, falls within the specific locomotor regime of the activity.

The idea, however, of introducing maximum load intensity peaks in the logic of training, is hardly new. Harre in 1971, Platonov in 1984, and Matveyev himself had understood its importance, understood as a "complex and total load." Verchosanskij's block structure, in addition to being a tool for monitoring and directing training, is also a form of training. In conclusion, while Matveyev is credited with having understood that load increases cannot be distributed linearly, but in an undulating manner, according to a predominantly extensive concept of volume and intensity, Verchosanskij understood the value of the specific locomotor regime of activity and the possibility of producing better effects with concentrated forms of load during the various training cycles. It was predictable that sooner or later, in view of the importance of the specific regime of activity, the role of motor coordination "in a practice unpolluted by the cybernetic theory" would be discussed, as was the case in an article by P. Bellotti.

For these authors, abiding by the basic assumption that coordination is intended as a flow of stimuli produced by the central organs towards the peripheral organs, it is not possible, in this approach, to identify the phenomena in a cybernetic perspective that can be described in more or less complex algorithms ... "the problem of motor coordination presents itself as a dissociation between theory and practice to which, today, theory not only succumbs, but cannot even find a sense of belonging" (Y. Verchosanschij, P. Bellotti, SDS, no.50 year XIX, pp. 2/4, 2000). And so we moved from the theory of "cognitive maps" in vogue in the sixties thanks to Preiban, Miller and Galanter, to the scheme devised by Schmidt, the psychokinetics of J.P. Le Boulche, to the opinions of other authors and then returned to the N. Bernstein's speech in the 1930s on the substantial insolubility of the control of movements, a "problem to be solved more in a biological sense that a pedagogical one", recognized today as "Bernstein's Problem".

We seem to be going back in time to many decades ago when training content was basically competition activity more or less repeated in its structure.

But how can we explain the reinterpretation of previous theories? There is no doubt that bringing together in one coherent framework the different factors that come into play in sporting success is a daunting, if not impossible task. But this is not enough, you may know very well what to do without knowing how to do. In practice, no coach takes the indications in various publications too seriously, but, more likely, they adopt protocols based on their own experience, on the connections between the different stages of preparation, on the different contents of multiple competitions ... so how can we summarize and coordinate all this?

Firstly, it seems increasingly clear that the whole adaptation process must revolve around specific competition activity. Anokin in the mid-70s had already called for a theory of action and a theory of functional systems. This, put more simply, means recognizing a series of initial parameters in order to structure the organization of training. If this approach is simpler in a closed skills sport involving jumping or throwing, it becomes much more complex in an open structure such as team games, for the huge variety of related motor actions and the state of constant unpredictability that characterizes them.

In any case, the final reference of

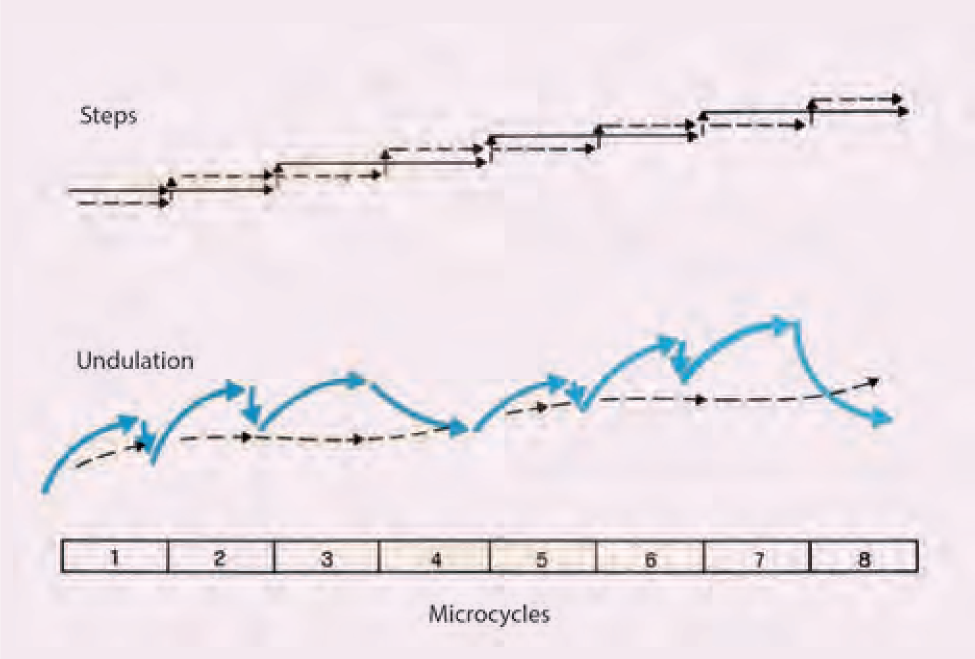


Figure No. 6
Diagram of the main forms of dynamic loads in a series of microcycles. The arrows indicate the trend of the dynamics of the load volume, the dotted arrows indicate intensity.

training seems certain as a specific process of adaptation, even if we have always known that to learn how to run you have to run and to learn how to swim you have to swim. The idea, though substantially correct, that more extensive preparation could lead to better results was so often taken to the extreme, that it often translated not only into a waste of time, but also into inducing adaptations that led to more to the ability to increase train rather than to the achievement of high competitive results.

This new concept of economy in itself has important significance that changes the standards no longer conceived as fatigue-rest, but as consumption-recovery. The accumulation of muscle metabolites, therefore, assumes a positive role, which pushes the phenomena of cell re-synthesis towards a higher level of functional reorganization, not to be eliminated at all costs. The increase in the volume of work in itself, and the state of consequent fatigue cannot be a necessary condition to improve sports performance in the absence of the qualitative characteristics of the work carried out. According to Verchosanskij, from the point of view of the new approach, as regards the volume of the load, the most important goal is indicated in the efficacy of high stimuli, using the smallest volume of load possible, maintaining them over time in intervals which are neither lower nor higher than those necessary for the completion of protein synthesis. If the training stimuli come into play when recovery is incomplete, the effects produced by the previous ones effects are suppressed, if the timing is too late, they disappear, but if they act at the climax, they find the best conditions for subsequent adaptations (Verchosanskij, 1996).
We seem to be returning once more to the starting point of Selye's stress theory; not that we had lost sight of this essential point, but we have probably been driven towards a psycho-pedagogic approach more similar to physical education than to the biological - physiological approach of stimulus-adaptation phenomena of intense physical activity.
But it is actually during intense and prolonged physical activity that we realize the difficulties that we gradually face.

- In the long-term, regular training principles tend to lose their initial effectiveness. There are two hypotheses, either because the body **exhausts** its ability to respond, or simply because at **high states of adaptation these principles no longer apply**. Here is an example: when engineers designs the hull of a vessel, they apply the physical laws of fluids, but these apply to **water in its liquid state, not as a solid or gas**. So, do laws always apply, or only under certain conditions?

In Newtonian physics the momentum Q = m.v. is given by mass and velocity, the latter may change but the mass remains constant. This is true only for small speeds, in the speed of light the mass increases infinitely by the theory of relativity. Can it similarly be assumed that in athletes at very high stages of adaptation, the methods used do not show the prime effectiveness for a change of "state" of the body? In this context, intensive training in athletes would induce a particular physical state, a "singularity" to adopt a term from physics, where the principles on which all the preparation was built are no longer applicable.

- The stimuli induced in the organism brings about additional effects which may be positive but also negative, as can be the simultaneous intake of multiple drugs. Verchosanskij rightly indicates this complex as a "potential training of exercises" referring to the effects as a whole, therefore the whole is more than the sum of its single parts.
- What could be the right "mix" in the training stages in different sports?
- Over time, the more one motor skill is developed, the less this happens for others, it's as if - as a whole - they failed to co-exist, although they retain the dependency between each other. Two hypotheses are plausible: either the body does not have the ability to pay all at once the cost of these adaptations, or the latter are in conflict with each other: in fact, an all-round athlete is almost impossible.
- Different motor skills have different development times, a phenomenon known as heterochrony of adaptations.

In other words, not all organs adapt simultaneously.

- In youth training, the changes induced by exercise are superimposed on the processes of growth and development which increases difficulties.
- During the overcompensation phases, there are "boomerang" effects, such as the fast myosin IIx that declines in resistance training, but then doubles about after several months of inactivity.
- Lastly, there are problems of relationships between general and specific physical preparation, the problem of technical acquisitions, of adaptation processes, and psychological implications which have not been mentioned so as not to create further confusion on the topic.

Many theories by many authors (Matveyev, Harre, Martin, Schnabel, Weineck, Platonov, Verchosanskij) have been put forward in an effort to insert into a coherent framework an entire set of phenomena related to training.
Many of these, however, still lack experimental confirmation. An initial distinction is made between general and special principles, the first corresponding to all training areas, the second refer to individual aspects such as technical-coordinative, rehabilitative or scholastic purposes (cf. Kruger 1988 109, SAB 1988 113). In addition, Schnabel and Muller (1988-97) propose a further differentiation between principles in sports training and principles of training.
"We intend "principles in sports training" when it comes to principles that go beyond the area that is the subject of it, but that are interpreted specifically. The principles of sports training on the

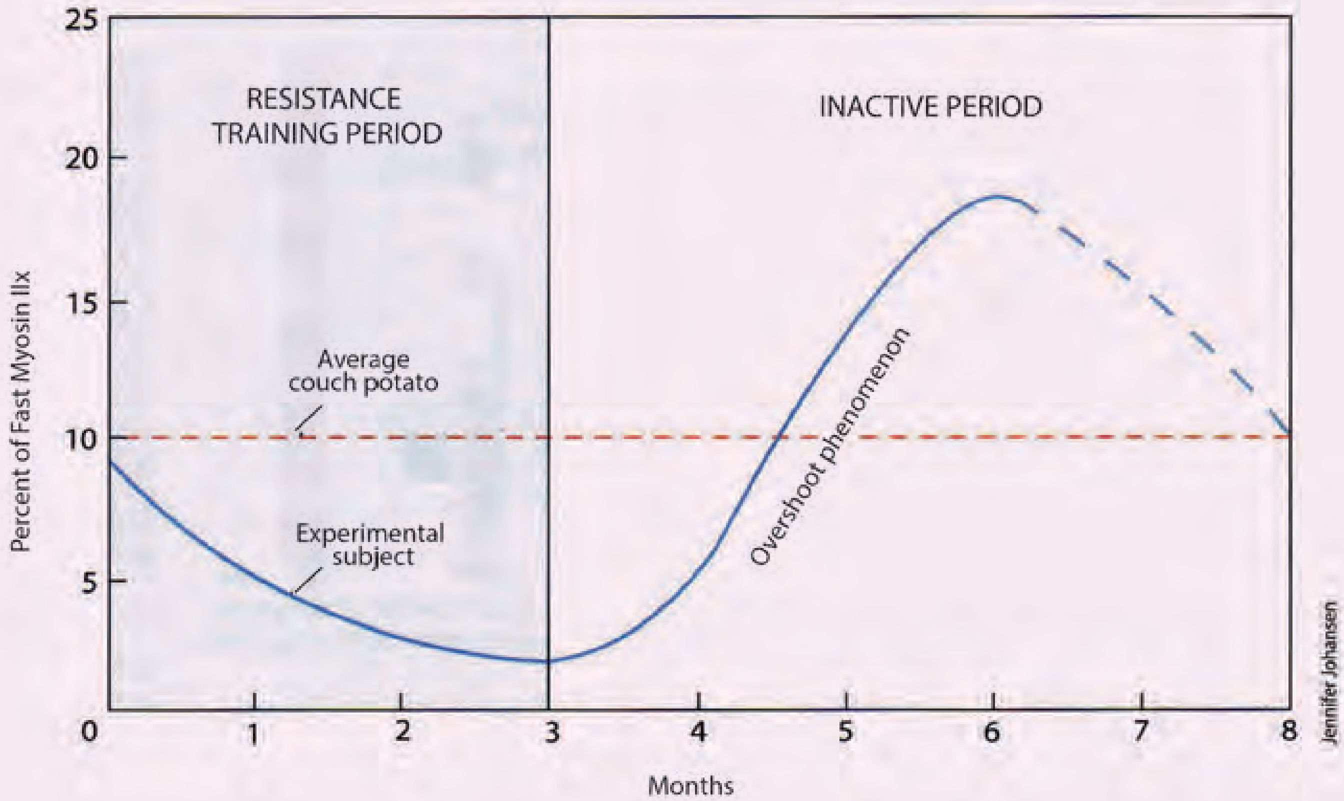


Figure No.7
UNEXPECTED EXPERIMENTAL RESULTS HAVE PRACTICAL APPLICATIONS FOR THE ATHLETE. THE FAST IIX MYOSIN DECLINED AS EXPECTED DURING RESISTANCE TRAINING. BUT WHEN TRAINING STOPPED, RATHER THAN SIMPLY RETURNING TO THE PRE-TRAINING LEVEL, THE RELATIVE AMOUNT OF IIX ROUGHLY DOUBLED THREE MONTHS INTO DETRAINING. SO WHAT DOES THIS MEAN FOR THE SPRINTER, TO WHOM IIX IS CRUCIAL? PROVIDE FOR A PERIOD OF REDUCED TRAINING BEFORE A COMPETITION.

other hand are valid only within training itself "(Schnabel, Muller, in 1988/98 Weineck op.cit.).

Further distinction is made between principles and rules: the former possess a greater degree of generalization, but are materialized by rules: "the rules are necessary for the interpretation of a principle, and explain how it is to be applied in certain sectors and phenomena in the process of sports training "(Schnabel, Muller, 1988.99 cit.).

According to J. Weineck (op.cit.), the plurality of individual principles, some of which differ in no small part from author to author, can be divided into four main groups:

- **Loads principles**
- **Training cycles principles**
- **Specialization principles**
- **Proportionality principles**

If endless combinations are possible with seven musical notes, then the numerous "rules" and "principles" can allow us to "go crazy" in an attempt to formulate a theory that can guide long term planning and control.

But what is a theory?
A theory should interpret the data collected, it must then provide the possibility to make predictions about phenomena that have never been observed or measured. If these predictions are confirmed, the theory is accepted, otherwise it is modified or replaced by another in accordance with the available data. Sometimes, theories resist with the introduction of ad hoc corrective action, but the more corrective action is introduced, the weaker the theory becomes until it finally collapses.
Attempts at explanation built around an observed phenomenon are called hypotheses. These hypotheses usually include ideal models to give meaning to the observations and the facts available. When a hypothesis finally appears to fit the observation, it is promoted to a theory, perhaps an explanation in mathematical terms, that connects the data collected and makes them comprehensible.
The theories that fully conform to the experimental observations, in a variety of conditions, are called laws: Isaac Newton's law of universal gravitation not only explains apples falling from trees, but also to some extent the motion of the planets around the sun.

There is, however, a problem: the observation itself disturbs the observed system: this phenomenon was realized at the beginning of the last century in a study of subatomic elementary particles; does it not also apply even more so to a biological system? Over the last few decades, countless studies have appeared in dedicated literature extensively explaining the dynamics of the human organism's adaptation under certain conditions, but as yet we do have not a totally complete and consistent picture.
Perhaps in the distant future we will have all the elements so as to construct mathematical models that can describe and predict the optimal development of performance factors? They would be extremely complex differential equations; but what is a differential equation? It describes the evolution of a system, as for example the parabolic curve of the launch space probe or when a stone is thrown, in order to determine its position at all times. It is necessary, however, to know all the initial conditions, such as the height of the release, the speed, the angle of inclination, the air resistance, the coefficient of form ...

if just one of these data is missing, the equation then has infinite solutions. The first initial condition lies in the genetic potential of performance, the first cause that recalls the prime mover of Aristotle from which all phenomena derive. This is the most crucial point, and although we have a complete mapping of the human genome, this is not enough; an individual is not just the sum of their genes, but of its epigenome, in other words, the set of environmental and structural changes in its DNA which can decode sequences contained in them to translate them into proteins, but cells of the human body do not all contain the same DNA sequences: in other words, we need to know its "genetic mosaic." Even if we did possess all the data, we could never predict events like diseases, accidents and the like, which would jeopardize the biological system in evolution, inevitably leading to results in probabilistic terms. The term probabilistic is incorrect, and relates to the resulting randomly predictable phenomena; the lottery theory is an example. Only 6 numbers between 1 and 99 come out, the number of possible combinations is enormous, but in any case, it is finite. In 1917, E.N. Lorenz opened the doors to a new science, the science of chaos, better defined as deterministic chaos, concerned with understanding if behind phenomena characterized by absolute unpredictability, there are concealed detailed rules and laws, and to what extent we are able to predict the time evolution of a complex system, in short, if chaos has its own laws. The science of chaos can be applied to many fields: meteorology, stock exchange trends, the development of a social group, the development of a biological system, the origin of the universe... At the basis of the chaos theory, there is the property of the dynamic systems known as "sensitive dependence on initial conditions." The main method of analysis is to observe the evolution of a chaotic behavior in a space, called the phase space, marked by "attractors", precisely because the system is attracted to them. For example, a pendulum swings according to back and forth phases, tracing an elliptical path that becomes a point when the motion stops. The phases represent the oscillations and the attractor is gravity. By analogy, we can reasonably assume that the periodization of training proceeds in terms of loading and unloading phases attracted by the body's increasingly evident tendency to functional reduction. Chaotic systems, however, have particular properties and their attractors are called "strange attractors". They have two features: the first is the scale invariance or self similarity; the second is that they have a fractional as opposed to a full size: fractals. The human body is full of examples of self-similarity: the shape of the pulmonary bronchioles, the intestinal villi, the capillaries of the circulatory system and the cerebral convolutions have all, at different levels, a certain degree of geometric similarity.

A chaotic system is typically not linear, which means that its evolution can be described by a pool of equations, at least one of which is not linear, in other words, it is not expressed as a linear combination of the variables and of a constant, as it contains at least one different term of degree, such as a squared variable or a product of two unknowns. This is because chaotic behaviour is not always associated with the number of variables but rather with the specific interaction between even just a few of them. If we consider the set of factors that are the basis of the construction of sports performance and the unpredictable events that may arise in the longer term, we do not have, at least for now, any hope of predictability due to both the lack of reliable data and the necessary computing power. The only certainty, as Antonio Urso wisely and rightly put it, consists in the uncertainty of the result. What can be suggested to those involved in the world of sports training is to start from conceptual understanding, because knowledge always precedes know-how, the contextualized understanding and vice versa, with the continuous monitoring of cause and effect. Will there ever be a training theory capable of explaining, giving scientific advice on the laws that regulate the body's adaptation to the long term intensive exercise?

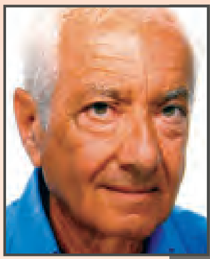
There are three possibilities:

1. there is a basic theory unifying all sports, from which you can attempt to derive and build all the phases of the training process;

2. there is no single theory, if not in a very general sense. Each sports category requires different organic functions that obey different laws;

3. there is no unified theory, beyond a certain stage of adaptation: further developments can be neither described nor expected, but only assumed in so far as the methodologies implemented and random disturbing factors lead to completely unpredictable results subjected to a principle that may be defined as "the principle of uncertainty."

Supposing that one day science will provide us with precise instructions, in the face of everything being predictable and certain, what will become of man's hopes, fears and illusions?
Would we really want to know just how much time we have left?



VITO LEONARDI

Graduated in "Sports Science" and former professor at the ISEF of Naples (College of Physical Education) and at the "Parthenope" University of Naples, he has also collaborated with University "St. Antipolis "in Nice. He is an FGI international referee and has held several positions within the same federation, in addition to creating coaching programs. Leonardi was the Director of "SRDS" of Campania from 2002 to 2008, he is a national lecturer and Chairman of the FIPCF Regional Committee of Campania. He has published four books and numerous works in federal journals, and has been a speaker at various conferences.

References

1. ALBERTI G, ARCELLI E, IMPELLIZZERI F, GUALTIERI D, L'allenamento intermittente della forza, SdS, 2002, 56, pp. 46-53

2. ALBERTS B, BRAY D, LEWIS J, RAFF M, WATSON JD, Molecular Biology of the cell, 2nd Ed., New York-Londra, Garland Publishing, 1989, 613-625

3. AA. VV., Atti del primo stage di aggiornamento sugli aspetti fisiologici e fisiopatologici dell'allenamento alle prestazioni di massima potenza muscolare, Roma, Scuola Centrale dello Sport, Centro di documentazione, 1970

4. AA. VV., (a cura di) LEONARDI V., Ricerca e formazione, Napoli, SdS Campania, 2005 – 2006 – 2007, pp. 112, 132, 138

5. ANDERSON B, Stretching, Waldech – Dehzinghansen, 1988

6. ANOCHIN PK, Teoria dei sistemi funzionali (testo in lingua originale), Mosca, 1975

7. ABE T, KUMAGAI K, BRECHUE WF, Fascicle length of leg muscles is greater in sprinters than distance runners, Med. Sci. Sports Exerc.,32 2000, 6, 1125.

8. ASCHIMDIT W, BONING D., SCHENEIDER G, MAASSEN, N, Volume sanguigno e sport di resistenza, SdS, 1994, n° 31, pp. 27–31

9. ASTRAND PO, RODAHL K, Textbook of work physiology, Human Kinetic, 2003

10. BARBA F, TAFURI D, L'allenamento: teoria e metodologia, Idelson-Gnocchi ed, Napoli, 2007

11. BERNSTEIN NA, The control and regulation of movements, Oxford, Pergamon Press, 1976

12. BERNSTEIN NA, Fisiologia del movimento, Roma, Società Stampa Sportiva, 1984,

13. BILLETER R, HOPPLER H, Le basi della contrazione muscolare, SdS, 1996, n° 34, pp. 2–14

14. BAUER J, Allenamento e fasi sensibili, SdS, 1988, n° 13-14, pp. 50-55, 21-25

15. BATTINELLI T, Capacità motorie generali e specifiche, SdS, 1983, n° 2, pp. 22-29

16. BEHRINGER M, VOM HEEDE A, MESTER J, L'influenza dell'allenamento della forza nello sport giovanile, SdS n°84, pp. 11-20

17. BISCIOTTI GN, Aspetti fisiologici del lavoro intermittente, SdS, 2004, n° 22, pp. 60–61, pp. 90–94

18. BISCIOTTI GN, Allenamento eccentrico e prevenzione dei danni muscolari, SdS, 2006, n° 71, pp. 39–42

19. BOMPA T, Periodizzazione dell'allenamento sportivo, Perugia, Calzetti e Mariucci ed., 2001

20. BORDE A, Gli esercizi generali dell'adattamento, SdS, 1987, n° 7-8, pp. 28-38

21. BOSCO C, Elasticità muscolare e forza esplosiva nelle attività sportive, Roma, Società Stampa Sportiva, p. 335

22. BOSCO C, KOMI PV, Mechanical characteristics and fiber composition of human leg extensor muscle, Eur. J. Appl. Physiol. 41:275-284, 1979b

23. BOSCO C, VIITASALO JT, Potentiation of myoelectrical activity of human muscles in vertical jumps, Electromyogr.Clin. Neurophysiol, 22, 7: 549-562, 1982

24. BOSCO C, La relazione forza–velocità e la prestazione, SdS, 1983, n° 2, pp. 10–13

25. BOSCO C e AA, Dynamometer for evaluation of dynamic muscle work, Eur. J. Appl. Physiol, 1995, n° 70, pp. 379 – 386

26. BRACALE M, Appunti al corso di elettronica biomedica, Napoli, Facoltà di Scienze Motorie, 2003

27. BRANCACCIO P, LIMONGELLI FM, D'APONTE A, NARICI M, MAFFULLI N, Changes in skeletal muscle architecture following a cycloergometer test to exhaustion in athletes. Journal of Science and Medicine in Sport 2008 :11; 538—541

28. BUHRLE M, Complements of maximum performance, power speed symposium on motion biology, Budapest, 26–28 May 1982

29. CARZOLA G, La valutazione delle capacità aerobiche, SdS, 2006, n° 68, pp. 13 – 18 (seconda parte), SdS, 2006, n° 67, pp. 21–39 (prima parte)

30. CARZOLA G, PETIBOIS C, LEGER L, Lattato ed esercizio fisico: miti e realtà, SdS, 2001, n° 53, pp. 25–33

31. CASATI S, Biomeccanica clinica in fisioterapia, Torino, Minerva Medica ed., 2007

32. CAVAGNA GA, Biofisica del muscolo, del circolo e della respirazione, Libreria Cortina, Milano, 1971

33. CHATARD JC, Allenamento e recupero, Perugia, Calzetti e Mariucci ed., 2008

34. COMETTI G, Metodi di allenamento ed esercizi con la pliometria, Perugia, Calzetti e Mariucci ed., 2008

35. COMETTI G, Moderni metodi di potenziamento muscolare, aspetti pratici, teorici, Perugia, Calzetti e Mariucci ed., 1998

36. COMETTI G, Resistenza alla forza o forza resistente?, SdS, 2001, n° 52, pp. 35–39

37. COMETTI G, ALBERTI G, La resistenza ai salti, SdS, 2007, n° 72, pp. 23–29

38. COMETTI G, ONGARO L, ALBERTI G, Stretching e performance sportiva, SdS, 2004, n° 60–61, pp. 47–59

39. CORTILI G, Introduzione alla biomeccanica delle prestazioni di massima potenza muscolare, Atti del I stage sugli aspetti fisiologici e fisiopatologici dell'allenamento alle prestazioni di massima potenza muscolare, Roma, SdS, 1970

40. COSTILL D, FOX EL, Energetics marathon runninig, Med, Sci, Sports Exerc. 1, 1969, pp. 81–86

41. COUTTS AJ, RAMPININI E, MARCORA SM, CASTAGNA C, IMPELLIZZERI FM, Heart rate and blood lactate correlates of perceived exertion during small sided soccer games, J. Sci, Med. Sport, 12, 2009, pp 79-84

42. DAL MONTE A, Fisiologia e medicina dello sport, Firenze, Sansoni, 1997

43. DAL MONTE A, La valutazione funzionale dell'atleta, Firenze, Sansoni ed, 1983

44. DALLA VEDOVA D, GALLOZZI C, Nuovi occhi per l'allenatore, SdS, 2006, n° 71, pp. 7 -14

45. D'ANDREA L, D'ANDREA A, Possiamo prescrivere al cardiopatico stabilizzato un'attività non protetta in palestra, InternationalJurnal Sports Cardiology, n° 8, Roma, pp. 173–179

46. D'ANDREA L, D'ANDREA A, ROMANO P, PANETTA V, I nostri tempi del "Progetto" Sport – Terapeutico, atto I: la scheda cicloergometrica per la prescrizione, Torino, Medicina Dello Sport, vol. 61, n° 1, pp. 89–95

47. DI PRAMPERO PE, Metabolic and circulatory limitation to VO2 max at the whole animal level, J Exp. Biol, 1985, p. 115, pp. 319–332

48. DONSKOJ DD, ZATZIORSKIJ, VM, Biomeccanica, Roma, Società Stampa Sportiva ed., 1983

49. FARRELL PA, WILMORE JH, COYLE EE, BILLING JE, COSTILL DL, Plasma lactate accumulation and distance running performance, Med. and Sci. in Sport, 1979, 11, pp. 338-344

50. FLEK SJ, CRAMER WJ, Designing resistence training programs, Champaing, II Human Kinetics, 2003

51. FOX EL, BOWERS RW, FOSS ML, The Physiological Basis of Physical Education and Athletics. Dubuque, 1989, IA: Brown

52. FOX E, MATHEWS D, Physiological basis of physical education and athletics, 3° ed. Filadelfia W.B. Saunders, 1981

53. FROHNER G, WAGNER K, Peso corporeo e costituzione fisica nello sport, SdS, 2001, n° 53, pp. 15–24

54. FROHNER G, Capacità di prestazione ed apparato locomotorio e di sostegno, SdS, 2000, n° 49, pp. 25-32

55. GALLOZZI G, La valutazione della forza, SdS, 1996, n° 34, pp. 22 -35

56. GAMBETTA V, New trends in training theory, NSA, New Studies in Athletics, 1989, pp.3, pp. 7–10

57. GARUFI G, Documentation C.G.G. Colloquium Competition, GG., LILLSEVED, 2001

58. GARUFI G, Manuel formationdesmoniteurs, Articoli Tecnici, F.I.G., 1994

59. GARUFI G, TAFURI D, VAIRA L, Ginnastica, teoria, metodologia e didattica, Napoli, Idelson – Gnocchi ed, 2008, pp. 359

60. GOLDSPINK G, TABARY C, TABARY JC, TARDIEU C, TARDIEU G, Effect of denervation on the adaptation of sarcomere nuber and muscle extensibility to the functional length of the muscle, J. Phyiol, 236, 1974, 3, 733-742

61. GROSSET JF, MORA I, LAMBERTZ D, PEROT C, Changes in stretch reflexes and muscle stiffness with age in prepubescent children, J, Appl. Physiol., 102, 2007, pp. 2352-2360

62. GULINELLI M, La concezione della periodizzazione e lo sviluppo di una teoria dell'allenamento, SdS, 1999, n° 18, pp. 3–4

63. GUNDLACH H, Testverfahrenzur Prufung der Sprintschnelligkeit, Theorie und Praxis der Korperkultur,18, 1969, pp. 224-229.

64. HARRE D, La rapidità e il suo sviluppo, SdS, 11, 1987, pp. 31-35

65. HARTMANN U, La soglia anaerobica questa "desparicida", SdS, 1998, 43, pp. 22-30

66. HETTINGER T, Isometrisches Muskeltraining , 2 ed., Thieme, Stoccarda, 1966

67. HETTINGER T, Muskelkraft training, G. Thime, Verlang, 1973

68. HILL AV, LUPTON H, Muscolar exercise, lactate acid and the supply and utilization of oxigene, Quart. J.Med. 1923, 16, pp. 135-171

69. HILL AV, The designe of muscles, Brit. Med. Bull., 1956, 12, p. 165

70. HOLLMANN W (a cura di), Zentrale Themen der Sportmedizin, Springer Verlag, Berlino- Heidelberg - New York, 1972

71. HOLLMANN W, MADER A, I limiti delle capacità di prestazione dell'organismo umano dal punto di vista fisiologico, SdS, 2000, n° 47–48, pp. 2–10

72. INCALZA P, Le zone di intensità aerobica nelle discipline cicliche di durata, SdS, 2001, 52, pp.57-62

73. ISHIKAWA M, DOUSSET E, AVELA J, KYROLAINEN H, KALLIO J, LINNAMO V, KUITUNEN S, NICOL C, KOMIP V, Changes in the soleus muscle architeture after exhausting stretch-shortening cycle in exercise in humans, Eur. J. Appl. Physiol. 2006, n°4

74. ISSURIN V, LUSTING G, Allenabilità e differenze di genere, SdS, 2007, n° 72, pp. 3-12

75. ISSURIN V, LUSTING G, Unità di allenamento e periodizzazione a blocchi, SdS, 2007, n° 75, pp. 9–17

76. ISSURIN V, SHKIJIAR V, La struttura a blocchi dell'allenamento, SdS, 2002, n° 56, pp. 6–9

77. JACOBS I, KAISER P, TESCH P, Muscle strength and fati-

The official journal of the European Weightlifting Federation

gue after selective glycogen depletion in human skeletal muscle fibers, Eur. J. appl. Physiol., 1981, 46, pp.47-53

78. JAKOWLEW NN, Biochemische und morphologische-Veraderungen der Muskelfasern in Abhangigkeit von der Art des Trainings, Medizin und Sport, 18,1978, pp. 161-164

79. JESPER L, ANDERSON PS, SALTIN B, Atleti si nasce o si diventa?, Le Scienze, 2000, n° 387, pp. 49–57

80. KINDERMANN W et al, Anpassungsersheinungen durch Schul- und Leistungssport, im Kindesalter, Sportwissenschaft, 1978, 8, pp. 222-234

81. KAIJSER L, Limiting factor for aerobic muscle performance, Acta Physiol. Scand. Suppl., 1970, 346, 1-96

82. KARLSSON J, OLLANDER B, Muscle metabolites with exhaustive static exercise of different duration. Acta Physiol. Scand., 1972, 86, 309.

83. KAWAKAM Y, ABE T, FUKUNAGA T, Muscle fibre pennation angles are greater in hypertrophied than in normal muscles, J. Appl. Physiol., 1993, n° 74(6), pp. 2740-2744.

84. KEARNEY JT, La preparazione degli atleti olimpici, Le scienze, 1996, n° 335, pp. 52–63

85. KLAUSEN K, SECHER NH, KLAUSEN P, HARTLING O, TRAPJENSEN J, Central and regional circulatory adaptations to one-leg training, J. Appl. Physiol., Respirat. Environ. ExercisePhysiol., 1982, 52, pp. 976-983.

86. KOMI PV, Stretch- shortening cicle: a powerful model to study normal and fatigued muscle. J. Biomech, 2000, n°33, pp. 1197-1206

87. KROGH A, LINHARD J, The changes in respiration at the trantition from workto rest, J. PHYsiol53, 1919/20, pp. 431-437

88. KRUGER A, Zur Gultigkeit von Trainingprinzipien in Massensport, Theorie und Praxis der Korperkultur, 1988, 37, pp. 109-113

89. LE BOULCHE JP, Verso una scienza del movimento umano, Roma, Armando ed, 1975 pp. 359

90. LETZELTER S, EGGERS R, Struttura delle fibre muscolari e prestazione sportiva, SdS, 2000, n° 50, pp. 37-44

91. LUPO S, GALLOZZI C, DAL MONTE A, Primi risultati ottenuti con il nuovo dinamometro isometrico MK7 nella valutazione della forza degli atleti, Med. Sport, 40, n°5, 1987, pp. 285-295

92. MADELLA A, Principi metodologici e considerazioni sull'uso dei test nella pratica sportiva, SdS, n° 10, pp. 12-19

93. MADER A, LIESEN H, HECK H, PHILIPPI H, ROSI R, HOLLMANN PV, Zur Beurteilung der sportartspezifischen Ausdauerleistungs fahigkeit im Labor, Sportarzt u. Sport Med. 1976, 27, pp. 80-88, 109-112

94. MANONI A, Biomeccanica e divisione strutturale della ginnastica artistica, Roma, Società Stampa Sportiva ed., 1987, p. 229

95. MARCHETTI M, SALLEO A, FIGURA F, CALISTRONI E, Aspetti fonomiografici ed elettromiografici della massimizzazione della forza muscolare in atleti sollevatori di peso, Arch. Fisiol. 1970

96. MARGARIA R, CERRETELLI P, MARCHI S, ROSSI L, Maximum exercise in oxygen, Int. Z. Angevw. Physiol. 1961, 18, pp. 465-467

97. MARGARIA R, CERRETELLI P, MANGILI F, Balance and kinetics of anaerobic energy release during strenouos exercise in man, J. of appl. Physiol., 1964, 19, p. 623

98. MARGARIA R, Fisiologia muscolare e meccanica del movimento, Biblioteca della EST, Mondadori, 1975

99. MARTIN D, Grundlagen der Trainingslehre I und II,2 ed Hoffmann Verlag, Schondorf, 1979 and 1982

100. MATWEJEW LP, Il problema della periodizzazione dell'allenamento sportivo, Mosca, FISKUL'TURA Sport, 1964

101. MATWEJEW LP, L'allenamento e la sua organizzazione, SdS, 1990, n° 18, pp. 3-9

102. MATWEJEW LP, Grundlagen des sportlichen Trainings, Sportverlag, Berlino, 1981

103. McARDLE WD, KATCH FI, KATCH VL, Alimentazione nello sport, Casa Editrice Ambrosiana, 2005

104. MEINEL K, Teoria del movimento, Roma, Società Stampa Sportiva ed., 1984

105. MEERSON FZ, L'adattamento e lo stress, Il Corriere Unesco, 1987

106. MILLER G, GALENTER E, PREIBAN K, Plans and the structure of behaviour. New York Rinehart and Winston, 1960

107. MOGNONI P, La storia dei record, SdS, 1983, 3, pp.10-15

108. MULLIGAN JF, Fisica 1, Firenze, Cremonese ed., 1993

109. NARICI M, CERRETELLI P, Changes in human muscle architeture in disuse-atrophy evaluated by ultrasound imaging. J. Gravit. Physiol. 1998, n°5, pp.73-74.

110. NEWAM G, L'adattamento nell'allenamento della resistenza, SdS, 1994, 30, pp. 59-64

111. OWEN T, Fatigue, Rest and Exercise, Canad M. A. J., 1942

112. PELLIS G, STUPAR G, PRIMOSSI G, GOMBACCI A, Forza massima teorica, metodologia ed applicazioni, Costanza, 1996, XVI Symposium Interregionale di biomeccanica dello Sport

113. PETRINI ING, Corso di biomeccanica, parte 2°, applicazioni della statica alla meccanica, Università degli Studi di Pavia, dipartimento di Meccanica Strutturale, petrini@unipv.it

114. PLATONOV NV, Supercompensazione, carichi, adattamento ed alcuni altri problemi della Scienza dello Sport, SdS, 2005, n° 65, pp. 49–60 (prima parte)

115. PLATONOV NV, L'organizzazione dell'attività e dell'allenamento e di gara, teoria generale della preparazione degli atleti degli sport olimpici, Calzetti e Mariucci, 2004

116. PLATONOV NV, Adattamento a lungo termine e periodizzazione, SdS, 2002, n° 57, pp. 2–9

117. PLATONOV NV, BULATOVA M, La periodizzazione dell'allenamento nel nuoto giovanile, SdS, n°11, pp. 92, p. 25, pp. 2–10

118. PLATONOV VN, Supercompensazione, carichi, adattamento ed alcuni altri problemi della Scienza dello Sport, SdS, 2005, n° 66, pp. 11–22

119. PLATONOV VN, I principi della preparazione a lungo termine, SdS, 1994, n° 30, pp. 2-10

120. PLATONOV VN, Le tappe conclusive della carriera degli atleti di alto livello, SdS, 2004, n° 60 – 61, pp. 3-12

121. POZZO R, SACRIPANTI A, ZANETTI E, Biomeccanica della pesistica moderna, Roma, F.I.L.P.J.K., 1997

122. ROBINSON S, Experimental studies of physical fitness in relation to age, ArbeitsPhysiol, 1938, 10, pp. 251-323

123. SACRIPANTI A, Fondamenti di allenamento, Roma, F.I.L.P.J.K., 1995, p. 67

124. SACRIPANTI A, La match–analysis, SdS, 2007, n° 72, pp. 13–21

125. SALTIN B, Capacità aerobiche ed anaerobiche, SdS, 1987, n° 10, pp. 2-1; n°11 pp. 6-13; 1988, n° 12, pp. 43-49

126. SCHNABEL G, HARRE D, BORDE A, Scienza dell'allenamento, Ed. Arcadia, Vignola (MO), 1998

127. SCHNABEL G, MULLER C, Wesen. Funktion und Eigenschaften der methodischenPrinzipien der Korperkultur, 37, 1988, pp. 95-101

128. SCHIMDT RA, The Schema concept, human motor behavior: un introduction hillisade, 1982

129. SCHMIDBLEICHER D, Adattamenti neuronali e metodi di allenamento della forza, SdS, 1983, n° 2, pp. 1-21

130. SELYE H, The stress of life. New York , 1956, Mc Grew-Hill Book Co., Iuc

131. STEGEMANN H, KINDERMANN W, Bestimmung der individuellen anaeroben Schwelle bei unterschiedlich Ausdauer trainierten aufgrund des Verhaltens der Laktatkinetikwahrend der Arbeits-und Erholungsphase, Dt. Z. Sportmed., 1981, 8, pp. 213 e segg.

132. TANNER JM, Auxologia, Utet, 1981

133. TESCH PA, LARSSON L, Muscle hypertrophy in body-builders, Europ. J. appl. Physiol., 49 (1982), 301-306

134. TIDOW G, WIEMANN K, Zur interpretation und Veränderbarkeit von Kraft-Zeit-Kurvenbeiexplosiv-ballistischen Krafteinsätzen, Dt. Z.Sportmed, 44 (1993), 92-103 (parte I); 136-150 (parte II)

135. TIHANIJ J, Aspetti fisiologici e meccanismi della forza, SdS, 1983, n° 2, pp. 23–27

136. TIHANIJ J, Fisiologia e meccanica della forza, SdS, 1988, n°13, pp. 12–17

137. TSCHIENE P, Il nuovo orientamento nelle strutture dell'allenamento, SdS, 2000, n° 47–48, pp. 13–28

138. TSCHIENE P, Lo stato attuale della teoria dell'allenamento, SdS, 2001, n° 52, pp. 2–6

139. TSCHIENE P, Le prospettive della struttura dell'allenamento, SdS, 2002, n° 56, pp. 2–5

140. TSCHIENE P, Una diversa teoria dell'allenamento, SdS, 1988, n° 13, pp. 34-37

141. URSO A, Le basi dell'allenamento sportivo, Calzetti e Mariucci, 2012

142. URSO A, Ancora più complesso - i dubbi di John Kiely-Strenght&Conditioning. Per una Scienza del movimento dell'uomo, FIPE, N°18, 2016, Calzetti e Mariucci Ed.

143. UMILI A, Cinesiologia applicata per fitness e body building, Roma Società Stampa Sportiva, 1999, p. 215

144. VERCHOSHANSKY YV, VERCHOSHANSKAYA N, Il cambiamento dei paradigmi nella teoria dell'allenamento sportivo, SdS, 2007, n° 74, pp. 35-42

145. VERCHOSHANSKY YV, L'adattamento a lungo termine, SdS, 1990, n° 18, pp. 10-14

146. VERCHOSHANSKY YV, Componenti e struttura dell'impegno esplosivo di forza, SdS, 1996, n° 34, pp. 15–21

147. VERCHOSHANSKY YV, Verso una teoria e metodologia scientifiche dell'allenamento sportivo, SdS, 1998, n° 41-42, pp. 40-50

148. VIRU A, La valutazione del carico allenante, SdS, 1994, n° 31, pp. 2–8

149. VITASALO J, KOMI P, Force time characteristics and fiber composition in human leg extensor muscle, Eur. J. Appl. Phydiol, 1978, n° 40, pp. 7–15

150. WASSERMANN B, Zur Optimierung sportlicher tecniken in den tecnisch-kompositorischen Sportarten-dargestilt am Beispiel des Gerateturnens, Theorie und Praxis der Korpekultur, 1980, 29, pp. 991-992

151. WEINECK J, Anatomia sportiva, Perugia, Calzetti e Mariucci ed., 2008

152. WEINECK J, L'allenamento ottimale, Perugia, Calzetti e Mariucci ed., 2001

153. WIEMANN K, KLEE A, Stretching e prestazioni sportive di alto livello, SdS, 2000, n° 49, pp. 9–15

154. WILMORE JH, PARR RB, GIRANDOLA RN, Physiological alterations consequent to circuit weight training, Medicine and Science in Sports and Exercise, 1978, n° 10, pp. 79-84.

155. WILMORE JH, COSTILL DL, Attività fisica sport e invecchiamento, SdS, 2004, n° 60-61, pp. 39-46

156. WINTER R, Le fasi sensibili, SdS, 1986, n° 6, pp. 6-10, 1993, n° 28-29, pp. 122-129

157. WYDRE G, Lo stretching e i suoi metodi, SdS, 2001, n° 51, pp. 39-48

158. WIRTH K, SCHIMDBLEICHER D, La periodizzazione nell'allenamento della forza rapida, SdS, 2007, n° 74, pp. 13–20

159. ZACIORSKIJ VM, KULIK NG, SMIRNOV JL, Die Wechselbeziehungenzwischen den korperlichen Eigenschaften, Theorie und Praxis der Korperkultur, 19 (1970), 141-157.

160. ZATSIORSKY V, KRAMER WJ, Donne e allenamento della forza, SdS, 2008, n° 74, pp. 17–28

161. ZATSIORSKY V, KRAMER WJ, Science and practice of strength training, Champaign, III Human Kinetic, 2007

162. ZATSIORSKY VM, Science and practice of strength traininig, Champaign, III, Human Kinetic, 1995

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PREPARATION OF MANUSCRIPTS

1. Title page

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

Title page without the name of the Authors

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

3. Summary and Keywords

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

4. Text

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

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

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

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

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

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

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

5. Bibliography

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

6. Acknowledgements

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

7. Figures

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

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

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

8. Tables

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

Costs for Authors

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

Terminology and measurement units

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

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

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

Conversion factors selected:

- 1 N = 0.102 kg (force);
- 1J = 1 N • m = 0.000239 kcal = 0.102 kg • m;
- 1 kj = 1000 N • m = 0.239 kcal = 102 kg • m;
- 1 W = 1 J • s-1 = 6.118 kg • m • min.

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

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Spanish resumenes

SUMINISTRO DE COMPLEMENTOS PROTEÍNICOS Y RENDIMIENTO DE FUERZA Y POTENCIA
Jay R. Hoffman
SM (ing), n.º 7, año III, mayo-agosto 2017, págs. 4-17
Está bien aceptado que los deportistas de fuerza y potencia entrenados tengan una mayor ingestión de proteínas. La mayoría de los dietistas harían hincapié en el consumo de proteína para lograr estos objetivos; no obstante, la mejor forma de proporcionar proteínas en determinados momentos alrededor del entrenamiento es mediante un aporte complementario. Es interesante la atención que se ha dado recientemente al momento de aportar las proteínas; asimismo, existen pruebas que respaldan su eficacia. Sin embargo, los datos relativos al deportista experimentado no son concluyentes y la información reciente indica claramente la importancia de ingerir proteínas varias veces al día para mantener un nivel constante de síntesis de proteínas en los músculos.

LA IMPORTANCIA DEL FEEDBACK EN EL APRENDIZAJE DEL DEPORTISTA
Monica Paliaga
SM (ing), n.º 7, año III, mayo-agosto 2017, págs. 18-21
El autor examina brevemente el significado y la utilidad del feedback en el entrenamiento y la competición, distingue entre el feedback intrínseco y el extrínseco, y describe, en relación con este último, los dos aspectos que inciden en el resultado y el rendimiento. A continuación, describe de forma sucinta algunas características importantes del feedback: la frecuencia, la precisión y el momento más oportuno para darlo.

CATEGORÍAS DE PESO CORPORAL EN EL LEVANTAMIENTO DE PESAS. COMPARACIÓN DE LOS RESULTADOS DE LOS JUEGOS OLÍMPICOS Y LOS CAMPEONATOS MUNDIALES Y EUROPEOS ENTRE 2005 Y 2016
F. Javier Flores y Juan C. Redondo
SM (ing), n.º 7, año III, mayo-agosto 2017, págs. 22-44
El principal objetivo del presente artículo es hacer un análisis descriptivo por categorías de los resultados de los Juegos Olímpicos y los campeonatos mundiales y europeos desde 2005, cuando las normas de la competición establecían una progresión mínima de 1,0 kg tras los intentos exitosos del mismo deportista, hasta los Juegos Olímpicos de 2016, celebrados en Río. La idea que subyace a este análisis descriptivo es tomar una instantánea de los últimos resultados obtenidos durante las competiciones más importantes de levantamiento de pesas en Europa, observando las mejores y las peores categorías y competiciones, y la evolución de los resultados alcanzados durante el período estudiado (2005-2016).

RENDIMIENTO DEPORTIVO: SIM, ESTRÉS E INFLAMACIÓN CRÓNICA LEVE
Dario Boschiero
SM (ing), n.º 7, año III, mayo-agosto 2017, págs. 46-55
El autor expone de forma resumida el significado de rendimiento deportivo, de SIM (síntomas inexplicables médicamente) y de relación e interdependencia entre los sistemas nervioso, endocrino e inmunitario. Después pasa a exponer el concepto y las fases del estrés, que enmarca en las etapas de adaptación y de entrenamiento en vista del rendimiento deportivo, y menciona la necesidad de hacer un control y un seguimiento del estado de salud general.

LA PERIODIZACIÓN DEL ENTRENAMIENTO ENTRE PRÁCTICA, CIENCIA Y CIENCIA FICCIÓN
Vito Leonardi
SM (ing), n.º 7, año III, mayo-agosto 2017, págs. 56-80
El autor aborda el tema de la periodización del entrenamiento, uno de los más consolidados de toda la problemática del proceso de entrenamiento, al que estudiosos y entrenadores dedicaron una gran atención en los últimos decenios del siglo pasado, con la intención de definir las dificultades de organizar las cargas de entrenamiento en el tiempo, comprender la esencia y el significado de las mismas, y llevar a la práctica los principios, a fin de cumplir el objetivo fundamental de determinar la forma del deportista en el momento más importante de la temporada de competición.
Comienza mencionando estudios históricos sobre la periodización, teorizada en la Unión Soviética, desde los primeros trabajos de Matveev que posteriormente continuaron otros, debatiéndose entre la adhesión y la crítica, a veces feroz, a este autor que, por otro lado, con el tiempo modificó de forma importante su pensamiento inicial.
Asimismo, el autor hace referencia a los estudios y los estudiosos europeos, incluso con respecto a temas que solo guardan relación con el de la periodización, y se detiene en estudios clásicos como los de Hill, Selye, Verchoshansky y Jakovlev, entre otros muchos, para poner en común los distintos planteamientos en una visión del entrenamiento como proceso que integra aspectos innumerables y complejos.

Russian

ИБЕЛКОВЫЕ ДОБАВКИ И ПРОИЗВОДИТЕЛЬНОСТЬ В СИЛОВЫХ И МОЩНОСТНЫХ ВИДАХ СПОРТА

Jay R. Hoffman

Повышенное потребление белка у подготовленных спортсменов силовых и мощностных видов спорта хорошо понято. Большинство диетологов подчёркивает что для достижения этой цели необходимо использование пищевого белка. Способность обеспечить спорсменов белком в определённые момены времени связанные с тренировочным процессом может быть эффективно достигнуто используя белковые добавки. В последнее время акцент на точное время потребления белка приобретает большой интерес благодаря некоторым доказательствам которые демонстрируют его эффективность. Тем не менее, данные не являются окончательными когда речь идёт об опытных спортсменах. В последнее время информационне данные ясно свидетельствуют что потребление белковых добавок несколько раз в день очень важно для поддержания повышенного синтеза мышечного белка.

РОЛЬ ОБРАТНОЙ СВЯЗИ (FEEDBACK) В ОБУЧЕНИИ СПОРТСМЕНОВ

Monica Paliaga

Автор кратко анализирует значимость и пользу обратной связи и процессе тренировки и во время соревнований, делая различие между внутренней обратной связью и внешней обратной связью. Что касается внешней обратной связи делается акцент на два аспекта обратной связи которые влияют на результат и на производительность. Автор кратко описывает некоторые важные характеристики обратной связи: частота, точность и наиболее подходящий момент для использования.

ВЕСОВЫЕ КАТЕГОРИИ В ТЯЖЁЛОЙ АТЛЕТИКЕ. СРАВНЕНИЕ РЕЗУЛЬТАТОВ ОЛИМПИЙСКИХ ИГР И ЧЕМПИОНАТОВ МИРА И ЕВРОПЫ В ПЕРИОД 2005-2016

F. Javier Flores and Juan C. Redondo

Основная цель этой статьи заключается в анализе, категория за категорией, результатов Олимпийских игр (OG) и Чемпионатов Мира и Европы (WC и EC) в период с 2005 – когда правила соревнований предусматривали минимальный прогресс 1.0 кг после успешной попытки спортсмена – до Олимпийских игр в Рио де Жанейро. Идея этого анализа описательного характера это «снимок» последних результатов показанных во время важных соревнований евпропейской тяжёлой атлетики, анализируя лучшие и худшие результаты категорий и сорквнований и тенденции результатов в течении исследуемого периода (2005-2016).

СПОРТИВНЫЕ РЕЗУЛЬТАТЫ. MУС (MUS, MEDICALLY UNEXPLAINED SYMPTOMS), СТРЕСС И ХРОНИЧЕСКОЕ ВОСПАЛЕНИЕ НИЗКОЙ СТЕПЕНИ

Dario Boschiero

Автор кратко излагает значение производительности и спортивной производительности, феномена МУС (Medically Unexplained Symptoms), взаимосвязи и взаимозависимости нервной, эндокринной и иммунной систем. Переходит затем к анализу понятия «стресс» и фаз стресса в связи с различными фазами адаптации и тренировочного процесса с точки зрения спортивных результатов, делая акцент на необходимости контроля и мониторинга общего состояния здоровья спортсмена.

ПЕРИОДИЗАЦИЯ ТРЕНИРОВКИ: ПРАКТИКА, НАУКА И НАУЧНАЯ ФАНТАСТИКА

Vito Leonardi

SM (ing), n.º 7, anno III, maggio-agosto 2017, pp . 56-80

Автор рассматривает тему периодизации тренировки ка одну из наиболее важных проблем тренировочного процесса, которая заслужила – в последние десятилетия прошлого века – большое внимание со стороны ученых и тренеров, которые хотели решить проблемы временной организации тренировочных нагрузок и понять суть и смысл периодизации, воплотить на практике её принциры для достижения основной цели: достижения спортивной формы в самый важный момент спортивного сезона.

Статья начинается с исторического исследования о проблеме периодизации, ставшей теорией в Советском Союзе, начиная с первых работ профессора Матвеева, исследования клторые затем были продолжены благодаря другим учёным, которые либо принимали идеи либо жестоко критиковали идеи Матвеева, который кроме того со временем демонстрировал значительное изменение своих первоначальных мыслей о периодицации.