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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

Non – contact, and, even many contact injuries to the lower extremities of NFL players should be viewed from the standpoint of the 'canary in the coal mine'. Why? Because tens of thousands of young athletes coaches and so forth, follow the same irrational training methods as the elites in sport.

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Almost all combat sports have weight categories for competitions. The basic assumption is that individuals with the same body mass have similar physical strength and similar limb length. The aim is to make fighting fair by pairing athletes with comparable physical characteristics.

EDITORIAL

Youth and Sport

The three issues of our 2018 magazine, starting from the current issue, will be mainly dedicated to publications on the topic of "young people and movement", one of the most serious and empowering themes for society as a whole: hence the (emblematic) title of this editorial!

This direction embarked on by the Scientific Committee (and fully endorsed by the Editorial Committee and the EWF - SM) once again highlights what international scientific literature proposes on these issues but, in particular, takes stock of the situation on what has been done (very little) and what is missing (a lot). Unfortunately, and in no uncertain terms, as we can clearly see, much more needs to be done than what has been done so far, and there is a tangible disinterest in and disregard for these issues, but - even more dramatically - there is a lack of real skills, those acquired with the study, the doctrine and the experience (guided, of course) on the field. This Europe of ours, for example, has not yet solved the diversification of specializations for coaches involved in introduction to movement and those who deal with sports (only a few countries have made this investment): two very different professions (and two arts); both beautiful, but different, substantially and essentially different. I repeat with insistence, apologizing to our readers in advance, that I consider sport a process of specialization of basic movement skills, so if the latter are lacking in young people, it will be very difficult to then specialize in a sport, assuming that they wish to reach a competitive level. So: sport and society! What does this marriage consist of? The fact is that physical activity and sport activity are two determining indicators of the social status of a country. I think I'm right in saying that, were we to analyze what Italy does in this context, we would agree, without fear of denial, that the evolutionary level of our country is somewhat questionable.

No lawmaker, from the post-war period to the present day, and in particular since the foundation of the European community, has taken this aspect into careful consideration, building the foundations for a lasting culture and a fruitful relationship between professionals and young people. There has never been a specific interest on the part of schools (with of course the few exceptions), even today when we know for a fact - from the many studies in neuroscience - that the children who do regular physical activity are destined to have a higher IQ compared to their sedentary peers. There is no room for objections or discussion on these statements: volumes of scientific literature all point in this direction; yet it almost seems that all of this makes no difference to the lawmakers. There is no sensibility, on the contrary: from a careful analysis, it seems to me that there is almost a form of rage against movement. There was even talk about reducing the physical education programme in schools to just one hour a week, when world research on the minimum daily physical activity standards, I repeat daily, states that young people must do 45 minutes of high intensity activity.

It must be said that the families are also largely responsible. They have never protested by setting up action committees in favour of compulsory daily movement at any level of education. Perhaps the families do not care, or only partially care, about what science says regarding the well-being of their children, perhaps they have no interest in their children being smarter and healthier than those who do no activity. All of this is paradoxical, it is paradoxical the resignation that is creating, or rather has already created two generations of inactive individuals, with insane consequences on the quality of their physical and mental life, or on the overall wellness of people. We are beings designed to move. We must fight against the immobility of institutions towards physical inactivity that has horrifying numbers in Europe. This firstly cultural, and also physical inertia against movement almost seems to have received a resigned nod of approval from society as a whole. And the responsibility of doctors, or most of them, should not be forgotten or ignored.

The World Health Organization states that the first drug to prescribe for humans is movement, regularly underestimated and substituted with chemical palliatives, orthoses or anything else on the market. Movement (a "drug" without any side effects) is not prescribed, as it should be, for preventive or therapeutic purposes. After all, the culture of movement is lacking even in the world of pediatrics, whose specialists are the first in contact with families, and who could spread the culture of movement. For years now the International Academy of Pediatricians has been endorsing the role of movement, considered as a compulsory and indispensable phenomenon for man, just as eating, drinking and sleeping.

What more can I say, dear readers? Sport is already suffering and the situation will undoubtedly worsen if society is not trained and prepared to move correctly. Perhaps it is also our fault, after having read this article, if we do nothing to advocate physical activity every day, at every opportunity, constantly, always! This magazine will try, of course it will try! It will try to make its contribution in this sense: and we will all try to give information to professionals as well as to ordinary readers, so that we can "save" young people from the degenerative cultural processes linked to physical inactivity. I truly believe that we can do it.

Antonio Urso
EWF President

Strength development in the GROWING YEARS

BY FRANCESCO FELICI, FEDERICA MARZOLI

INTRODUCTION

The idea that muscle is capable of generating strength is so deeply rooted in the image that every individual has of oneself that it almost seems trivial and taken for granted. It is only when we lose our strength, or do not have enough, that we realize how important it actually is for every type of activity. It is not surprising, therefore, that there are people who devise methods to improve (or recover) the ability to produce strength, these people are coaches. From the pioneering studies of G.A. Borelli (De Motu Animalium), much is known today about the molecular mechanisms of muscle strength production in our species. However, a lot more needs to be learnt about the ways in which the central nervous system governs and coordinates the production of strength in each single circumstance, from simple gestures, without movement, to complex and hypercomplex ones. The scientific investigation of the functioning of the sensory-motor system (SM) is undoubtedly very complex and this is probably the main reason why most researchers active in neuromuscular physiology prefer to devote their efforts to other topics which, by nature, are more easily confined to a limited number of variables. However, for both a coach and a rehabilitator, having access to adequate information in this regard is essential. This is particularly true if one considers that special terrain the individual finds itself in during the growing years, whether they practice a sport or not, be it competitive or amateur, be they a boy or a girl. In this regard, the first responsibility of a coach and doctor is not to cause harm to people who place their in them. Why then is there a gaping lack of information related to peripheral (muscle) responses and central (nervous system) strength training especially in young athletes?

The purpose of this brief revision of the literature is to take stock of the current state of knowledge on this subject. Due to space requirements, we will leave aside the question of muscular adaptations (another aspect of youth sport with very little information), focusing on the results relative to the neural control of strength production. This choice is based on the consideration that, at least until a certain stage of development, evident muscular hypertrophy after training is often so low-key that is goes unnoticed.

Moreover, the strength that can be obtained with both general and specific exercises is undeniable, even at a young age. It is well known, in the adult, that qualitative changes of the motor movement can be explained by the neural adaptations that are obligatorily activated by a strength training programme (Masci et al, 2010). These adaptations can be described starting from the analysis of the electrical activity generated by a contracting muscle. This electrical activity of the muscle fibres is a "certified copy" of the one sent to the muscle by the alpha motor neurons and can be recorded using a non-invasive technique, surface electromyography (SEMG). Most of the studies taken into consideration in the following review are based on the SEMG technique.

ISOMETRIC AND ISOKINETIC CONTRACTIONS: SEMG

Most of the literature, concerning the study of strength production in young athletes, focuses on the study of isometric contractions. A positive aspect of this type of contraction is that there is no influence from the anthropometric variables of the individual, but rather from the tension-length and strength-velocity relationships. In fact, Kanehisa et al. 1995 have shown that, even in isometric contractions, the maximum strength produced depends, but not only, on muscle mass and body size. In fact, in their work, involving prepubescent individuals, there was no significant gender difference, while the maximum (absolute) strength differed significantly between the sexes after puberty. De Ste Croix (2007) states that in both sexes, from early childhood to puberty, strength in boys and girls increases linearly by a similar percentage per year. At around 13/14 years, however, the isometric strength of boys grows at a much faster pace until 18 years of age, whereas girls' strength reaches a plateau (Parker et al., 1990). Several studies have been conducted on the increase in strength in puberty and it has emerged that boys acquire more strength per cross-section of muscle than girls (Grosset et al., 2005). In a recent study, Falk et al. (2009a) studied 10 prepubescent girls and 15 young women during an isometric flexion of the elbow,

taking into account: the rate of torque development (RTD), electromechanical delay (EMD) and peak rate of torque development (peak RTD); it was found that RTD and peak RTD have lower values for girls than for young women. However, it is interesting to note that, after the normalization of the data compared to the transverse section of the muscles, the peak of torque development (peak RTD) was similar in women and girls (8.2±2.74 vs. 8.44±1.65 $Nm \cdot cm^2$ respectively), as was the RTP, normalized compared to peak RTD was 6.21±1.94 vs. 7.30±2.26 $Nm \cdot s^{1}$/ Nm ($p < .05$); the EMD, on the other hand, always recorded higher values in girls (p= 0.6). In our opinion, and also according to the authors of the study in question, this could indicate that differences in the production of strength between the subjects could depend on the cross section of the muscle, but also on a different way of recruiting the motor units. The same author, Falk et al. (2009b), conducted a further study on the same topic, but on the male sex: he compared 15 boys (age 9.7±1.6) and 16 men (age 22.1±2.8) during the execution of a maximum voluntary contraction of the elbow (MVC), in extension and in flexion. During flexion, the RTD was lower in boys than in men (19.5±5.8 vs. 68.5±11.0 Nm), even after normalization of data compared to the transverse section (CSA); the EMD was also significantly lower in boys (75.5±28.4 vs. 47.6±17.5 ms). The data were similar also for the extension, with the exception of the peak RTD, since the differences recorded among the subjects, relative to the peak of torque development, disappeared after the normalization with respect to the CSA.

Once again these results seem to point us towards a “nervous conception” of strength production: children and young people do not seem to be less strong than adults, they are only less capable of recruiting and/or using their motor units to a “higher threshold” than adults.

It is a well known fact, however, that although it is very convenient from the experimental point of view, the isometric contraction is not very representative of muscle activation during the course of normal daily activities, and even less than that which occurs during physical exercise. To date, it is accepted that the “isokinetic” modality, while continuing to be much more typical of the laboratory than of real life, is a better experimental condition to characterize the functioning of the neuromuscular system (Wiggin et al., 2006) and, moreover, well tolerated and easily learned even at a young age. Seger and Thorstensson (2000) conducted a longitudinal study on 16 boys, aged between 11 and 16, investigating changes in anthropometric measurements and strength production, and in particular on the possible differences between genders in strength production after puberty and in the neural activation of the muscle. Strength production in eccentric and concentric isokinetic contractions at 45, 90 and 180°$\cdot s^{-1}$, and electromyographic activity (SEMG) of the vastus lateral were measured on two occasions: before and after puberty, separated by a 5-year interval. At the beginning of the study, at 11 years of age, there were no gender differences: boys and girls showed equal values of strength production at all angular velocities, both in concentric and eccentric contraction, and had similar electromyographic activation levels.

After puberty, the ability to produce strength, as was expected, significantly increased in both sexes, with more noticeable gains in males than in females. More specifically, males selectively increased their strength production in eccentric contraction (relative to body mass), thus indicating a specific action in the quality of strength production. The electromyographic activity, however, was not particularly sensitive to gender, growth or contraction mode (concentric to eccentric), remaining practically unchanged under all conditions. It is noteworthy that, when the time was normalized with respect to the SEMG, after puberty, both sexes showed a greater production of strength per unit of activation during the eccentric contraction with respect to the concentric. This points to improved electromechanical efficiency during eccentric contraction that would not be linked to development. Lastly, the strength-velocity relationship presented a model similar to that of adults, before and after puberty, without gender differences. In the face of the undoubted quality

represented by having followed the same individuals before and after puberty, significant limits of this work are the variety of sports the individuals practiced, mainly recreational, and the time between the assessments (5 years).

Other studies have however tried to exploit the characteristics of the strength-velocity curve of children in an effort to understand what were the optimal working speeds for the latter (De Ste Croix et al., 1999, 2002). It has been found that speeds above 125°/sec are often difficult to sustain for prepubescent children; the range of velocities used in pediatric studies goes from 12.5°/sec in children aged 9 to 14 years, to 310°/sec in 16 year old adolescents (Ellenbecker, 1995). A more recent longitudinal study was performed by Degache et al. (2010) which also showed that there is a significant correlation between age and strength production capacity; 79 young soccer players aged between 11 and 15 were analyzed and a peak was found in the increase of isokinetic strength between 12 and 13 years of age, correlated therefore to sexual maturation.

These variations in strength values are much more evident in boys than in girls; the latter, regardless of puberty, show a plateau in the expression of strength at around 14 years, whereas in males there is an increase from 7 to 18 years of age with a peak of variation at around 12/13 years, in correspondence of sexual maturation. There is an important article by Grosset et al. (2005), supporting the theory of "nervous conception" of strength production by young athletes. The study compares the electromyographic activity of the triceps surae muscle of children between 7 and 11 years of age with that of young adults, using the ITT technique (Interpolated-twitch technique); this technique is very common for measuring the recruitment of motor units.

The results showed that the children had a significantly higher activation deficit than adults and that this deficit decreased with age. This study suggests that children recruit fewer motor units during a MVC. Another interesting article was published by Mitchell et al. (2011): the author compared children who did artistic gymnastics and swimming, not athletes; he concluded that the speed of muscle activation is much greater in sports that require rapid and precise movements. In fact, the recorded RTD has shown that gymnasts, or those who are specifically trained in power and speed, have a much greater velocity than non-athletes, and even than those who do swimming (gymnasts 6.1, swimmers 4.7, non athletes 1.5 $N \cdot m \cdot s^{-1}$) ($P < .05$).

GUIDELINES

The analysis of the above studies leaves us, once again, with a sense of incompleteness of information. It goes without saying that, if young people are not encouraged and/or exposed to environments that allow them to practice sports, they will never improve their motor skills or develop muscle strength. However, the doubt is legitimate, when and how do we train strength in a specific way? During pre-adolescence there is a high degree of neuromuscular plasticity, which is why, the previous period, namely childhood, should simply "prepare the ground" in view of all the adaptations that can be created during preadolescence. The term "prepare the ground" refers to the training of athletes for the correct execution of all those exercises useful for the development of strength production (Lloyd et al., 2012).

In the study, "*The Youth Physical Development Model: A New Approach to Long-Term Athletic Development*", Lloyd et al. attempt to outline the significant stages of children's development, identifying as a crucial phase the period from 2/3 years of age to 11, a period in which, according to the authors, coaches should be involved in teaching basic generic movements (running, jumping, etc., coordination skills, fundamental movement skills (FMS)), and sport-specific skills (SSS). The interesting aspect of Lloyd's study is that, and it is specified, FMS and SSS must increase as the child's structure increases: at 2-5 years the body's structure is not suitable for the increase of loads, at 5-10 years it is possible to increase the repetitions of the SSS, but with natural loads. At around 10-14 years, repetitions may be increased, even in conditions of instability (proprioceptive boards, variation of surfaces) and the variation of the main work regimes (aerobic and anaerobic lactic acid).
A meta-analysis conducted by Behringer et al. (2011) showed that specific strength training can improve not only the production of strength but also the intra and inter muscular coordination of school-age children; the latter seems to improve more in children than in adolescents.
Among the different combinations of sets and repetitions, the most frequent programme was 2/3 sets of 8/15 repetitions for 6-8 exercises with loads between 60% and 80 % of 1 RM. The correct volume for children, according to the meta-analysis by Behringer et al. (2011), varies with the variation, not only of age, but also of the degree of competence that young people have in the subject. Therefore, beginners should first learn the correct technique of performing the exercise with light loads, moving on to moderate loads, and then modulating them according to their goals.
In our opinion, the goals should be individually identified for each athlete by the "goal setting" process and consequently inserted in a suitably planned period.

CONCLUSION

The knowledge on the control of strength production is clear: the pre-adolescent individuals show a much higher degree of strength production compared to the hypertrophy of their muscle fibres. This is due, in large part, to factors of a nervous nature such as the recruitment of the motor units, the frequency of discharge of the motor units and the agonist-antagonist interaction.
These parameters are modified with strength training and it is also certain that adults show more marked adaptations and a greater level of strength production than children with the same training protocol; this is because children have more difficulty in recruiting motor units, in addition to a hormonal component which has not yet stabilized.
It is therefore clear that the maturation of nerve factors plays a fundamental role in motor performance during growth. However, research in this area is hampered by the difficulty in studying these processes, especially through non-invasive techniques.
Much remains to be done.

Bibliography

1. Degache F., Richard R., Edouard P., Oullion R., and Calmels P. The relationship between muscle strength and physiological age: A cross-sectional study in boys aged from 11 to 15. Annals of Physical and Rehabilitation Medicine, 53, 180-188, 2010
2. De Ste Croix M., Armstrong N., Welsman R. Concentric isokinetic leg strength in pre-teen, teenage and adult males and females. Biol Sport; 16: 75-86 , 1999
3. De Ste Croix M., Armstrong N., Welsman R., et al. Longitudinal changes in isokinetic leg strength in 10-14-year olds. Ann Hum Biol; 29: 50-62, 2002
4. De Ste Croix M. Advances in paedatric strength assessment: Changing our perspective on strength development. Journal of Sports Science and Medicine, 6:292-304, 2007
5. Ellenbecker S., Roetert P. Concentric isokinetic quadriceps and hamstring strength in elite junior tennis players. Isokinet Exerc Sci; 5: 3-6, 1995
6. Falk B., Brunton L., Dotan R., Usselman C., Klentrou K. and Gabriel D. Muscle strength and contractile kinetics of isometric elbow flexion in girls and women. Pediatric Exercise Science, 21:354-364, 2009a
7. Falk B., Usselman C., Dotan R., Brunton L., Klentou P., Shaw J. and Gabriel D. Child-adult difference in muscle strength and activation pattern during isometric elbow flexion and extension. Applied Physiology, Nutrition and Metabolism, 34:609-615, 2009b
8. Grosset J., Mora I., Lambertz D. and Perot C. Age-related changes in twitch properties of plantar flexor muscles in prepubertal children. Pediatric Research, 58:966-970, 2005
9. Kanehisa H., Yata H., Ikegawa S. and Fukunaga, T. A cross-sectional study of the size and strength of the lower leg muscles during growth. European Journal of Applied Physiology, 72:150-156, 1995
10. Lloyd R., Oliver J. The youth physical development model: A new approach to long-term athletic development. *Strength Cond J.*, 34:61–72, 2012
11. Masci I., Vannozzi G., Gizzi L., Bellotti P., Felici F. Neuromechanical evidence of improved neuromuscular control around knee joint in volleyball players. Eur J Appl Physiol. 108:443–450, 2010
12. Mitchell C., Cohen R., Dotan R., Gabriel D., Klentrou P., Falk B. Rate of muscle activation in power- and endurance-trained boys. Int J Sports Physiol Perform. 6(1):94–105. 34, 2011
13. Parker F., Round M., Sacco P. and Jones A. A cross-sectional survey of upper and lower limb strength in boys and girls during childhood and adolescence. Annals of Human Biology, 17:199-211, 1990
14. Seger Y., and Thorstensson A. Muscle strength and electromyogram in boys and girls followed through puberty. European Journal of Applied Physiology, 81:54-61, 2000
15. Wiggin M., Wilkinson K., Habetz S., Chorley J. and Watson, M. Percentile values of isokinetic peak torque in children six through thirteen years old. Pediatric Physical Therapy, 18:3-18, 2006

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Protected: Reverse Engineering Injury Mechanism and the Consequences of Forward Engineering

BY BUD CHARNIGA


15

Squatting under and receiving a heavy barbell at high speed without negative consequences; disproves the common myth ligaments and joints are susceptible to injury from fast, large range of motion exercises.

Five previous essays explored the possibility of a concept of reverse engineering as a means to ascertain the etiology of common sport injuries by analyzing circumstances in weightlifting, where one would logically expect an injury to occur; but no injury is manifest. A reverse engineering analysis begins with the 'why' someone is not injured under circumstances an injury should certainly occur. Insight from this analysis is applied to determine why serious lower extremity injuries in non – contact running, jumping and so forth, should not only not occur; but should not be commonplace in the USA.

In essence, the logic of reverse engineering injury centers around practical experiences with already known outcomes. Whereas, for want of a better term, 'forward engineering' begins and ends with guesses founded on false truisms. A number of these false truisms underpinning forward engineering have been have been elucidated in previous essays such as:

"The demands placed on the muscles and ligaments of the knee joint during deep squats are severe. A much safer alternative would be the half squat exercise." Luttgens, 2002

The hurdlers stretch: "This abnormal stretch places high stresses on the medial structures of the knee joint, which may lead to ligament damage and eventual instability." Luttgens, Hamilton, 2002

Even though these false truisms and many others of the same vein have appeared in respected Kinesiology books, medical texts, journals and the like, for many years; there is no validity offered and no attempt is made to establish proof of such claims. They point to the hazards created by forward engineering, i.e., predicting injury or susceptibility because of assumptions based on the false belief stretching ligaments or bending a a certain way is dangerous.
Why call the spread of the forward engineering ideas a 'hazard'? After many years of print, word of mouth, instructional video and so forth, these ideas become so ingrained in the collective conscience, they are not questioned. Or, in the words of Thomas Paine "A long habit of not thinking a thing wrong gives it a superficial appearance of being right".
These ideas have gained such universal acceptance in the USA that professional teams, university athletics, high schools, elementary schools, fitness magazines, exercise classes are all following the same exercise protocols to restrict knee bends to movement at the hip and knee with minimal movement of the ankle. Furthermore, ankle joints are routinely supported with braces, and/or taped to restrict movement and even feet to shoes beginning already in high school football.

However, the problems created by unsubstantiated forward engineering claims such as stretching ligaments will lead to instability, are incalculable. Enumerable laymen, professional, academic and medical alike, who hear or read of such false ideas; accept them as fact and pass on to others through word of mouth, writings, videos and so forth over a period of many years. Consequently, assuming these ideas are correct the majority never stop to question their veracity.
For instance, consider the following quote about the avalanche of injuries in the NFL by only week 9 of the 2017 – 2018 season:

"Training methods in the NFL are designed to lower and prevent injuries, including ACL tear prevention," Tehrany said.

"I believe that we are looking at a new norm where we need to expect to see and treat more injuries because of the ever-growing strength and speed of the players," Tehrany said. "Unfortunately, we are seeing this in children as well." Dr. Armin Tehrany https://www.foxsports.com/san-diego/story/nfl-injury-bug-continues-to-spread-league-wide-111017

The lack any semblance of logic with that statement from a medical professional, is in the words of Eldrige Cleaver "part of the problem", not the solution. Obviously, the doctor cannot conceptualize irrational training methods can be a significant reason the avalanche of non – contact and even a significant factor in contact injuries in football. Yet, he states without a comment, the same injuries are showing up in children. As the illustrations show children, coaches and athletes at all levels mimic training methods, exercise techniques, taping and other joint supporting activities of the elites in sport.

In point of fact, the excessive injury rate to the lower extremities in the NFL is just the canary in the coal mine for the rest of the athletic community in the USA. Figures 1 and 2 illustrate the expansive effect of some of these false truisms put into practice with children, exercise classes and such.

Figure No. 1

CHILDREN LEARNING TO BEND AT HIP AND KNEES MINIMIZING ANKLES OR FEET TO PERFORM SQUAT EXERCISE. THE FALSE TRUISM ON DISPLAY IS THAT 'PROPER' SQUATTING TECHNIQUE WILL PROTECT KNEES BY SITTING BACKWARDS WHILE KEEPING SHIN VERTICAL.

Figure No. 2

TRAINING LIGAMENTS AND TENDONS IN THE MANNER PICTURED BECAUSE "SQUATS HURT KNEES". THE TRUTH BE KNOWN ,THERE IS ACTUALLY MORE STRESS ON KNEES FROM HALF BENDS THAN BENDING WITH KNEES, HIPS AND ANKLES AS FAR AS POSSIBLE. INSTRUCTIONS ACCOMPANYING THE PHOTO "... THEY HURT KNEES". "MAKE SURE YOUR KNEES STAY IN LINE WITH YOUR FEET—NOT WOBBLING OFF TO ONE SIDE. AND LOWER YOUR BUTT ONLY AS FAR AS YOU CAN WITHOUT LETTING YOUR KNEES BEND FORWARD BEYOND THE TIPS OF YOUR TOES." HTTP://WWW.PREVENTION.COM/FITNESS/HOW-TO-DO-SQUATS-AND-LUNGES-WITHOUT-KILLING-YOUR-KNEES

SIXTY SIX JOINTS

It is common knowledge there are 33 joints in each foot, ankle joint inclusive. As the old philosophers would say "nature does nothing in vain". Consequently, it is nonsensical to assume the human feet with sixty six joints evolved in such a way that all those joints need supportive taping, high top design shoes and/or shoes stiffened to restrict movement. Furthermore, knee bends artificially limiting movement of the shins is a man made solution to some perceived defect in nature's engineering of the human body.

The three illustrations in figure 3 show how ideas from academia, professional and collegiate sports morph into 'safe' exercise techniques. These false truisms spread to high school and collegiate athletics levels where individual interpretations of a bad idea make it worse.

Unfortunately, these examples can only encompass the tip of the tip of the iceberg in terms of the deluge of aberrant ideas which can be found at various levels of the American athletic spectrum; not to mention the spill over from the realms of physical therapy, orthopaedists, personal training, athletic training, and so forth.

"Weightlifting exercises performed with multiple repetitions and with a small amplitude of movement in the joints (and the closer to static tension) causes changes to the muscles' morphology." A. Falameyev, 1985

"Frequent use of static exercises does not contribute to development of the habit to relax the muscles.

The official journal of the European Weightlifting Federation

Figure No. 3

ILLUSTRATIONS OF VARYING DEGREES OF ABJECT STUPIDITY WITH REGARDS TO A FEAR OF BENDING THE ANKLES TO STRENGTHEN LEG MUSCLES. ON THE LEFT, A COMMERCIAL BENCH IS USED TO PERFORM SQUATS IN ORDER TO RESTRICT RANGE OF MOTION. IN THE MIDDLE PICTURE A HIGH SCHOOL FOOTBALL PLAYER IS PROPPED AGAINST A WALL WITH THIGHS AND SHINS FORMING A RIGHT ANGLE WHILE LOADED DOWN WITH THREE 30 KG SAND BAGS. THE COLLEGIATE ATHLETE PICTURED ON THE FAR RIGHT IS 'LEARNING' TO SQUAT WITH FACE AND HANDS AGAINST A WALL TO PREVENT SHINS FROM MOVING.

Naturally, prolonged elevation of muscle tonus is one of the reasons for muscle hypertrophy. Elevated "tonic readiness" preceding speed – strength exercises translates into a diminished ability to perform the motor tasks." Kozlovski, Y.I. Speed – Strength Training of Middle Distance Runners, Kiev, Zdorovaya, 1980

The exercise techniques feature restricted range of motion combined with static conditions which research has shown render a negative influence on performance of dynamic sport exercises. This negative influence includes potential inhibition of the overlooked ability to relax muscles in performing dynamic exercises at high speed.

High speed muscle relaxation is critical to the ability to react to unanticipated circumstances in order to avoid injury. Little if anything appears in the literature regarding a connection between the ability, or lack thereof, to relax muscles and susceptibility to sport injuries. However, the two quotes above from Soviet era sport scientists, assert employing static tension and exercises with small amplitude of movement to train athletes for dynamic sport is not a good idea. Yet, it is these methods that comprise the preponderance of strength and conditioning methods in the USA for athletes in dynamic sports. One can anticipate chronic performance of such exercises to lead to an impairment of or a least a diminished ability to relax muscles. The ability to react to unanticipated circumstances in sport by relaxing muscles to dissipate and or otherwise re – distribute mechanical energy cannot be understated. Muscles have to switch from contraction extremely fast in order for athletes to execute changes of direction at high speed.

Figure No. 4

WORLD CHAMPION FEMALE WEIGHTLIFTER DEFTLY DROPS BARBELL SHAKEN FROM HER GRASP BY EXCESSIVE VIBRATION. THE LIFTER REACTED TO THE FALLING BARBELL WITH RAPID RELAXATION OF THE MUSCULATURE OF THE LOWER EXTREMITIES. THIS ALLOWED HER TO PUSH AWAY FROM THE FALLING WEIGHT. THE INJURY AVOIDANCE QUALITIES ON DISPLAY ARE THE WOMAN'S RAPID OF SWITCHING FROM CONTRACTING TO RELAXING MUSCLES AND OVERALL SUPPLENESS. CHARNIGA PHOTOS.

This skill of course comes in handy to avoid injury. Consider the examples in figures 5-7.

Depicted in figures 5-7 are two different circumstances, very similar, but with distinctly different outcomes. The female weightlifter reacts to the falling barbell by first raising her front foot such that her trunk and head moves slightly towards the falling weight. She raises her foot against the combined mass of her body and dropping barbell. The contrasting photo captures of an elite football player who suffers an ACL tear in part because he is unable to raise his planted right foot until this foot is knocked out from under him by an approaching 2nd tackler.

"What we're finding basically is that when the cleat engages with turf, if it doesn't release at a certain level of torque, then injury can occur. That's why we're seeing so many ankle injuries, ACL injuries."
R. Anderson, 2013

For instance an explanation of the plethora of lower extremity injuries in football would be: ...the "cleats engage with the turf" and don't release in timely manner. This is not credible. The rules of American football limit the length of the cleats to 12.7 mm, hardly long enough to pin the athlete's foot to the ground. Furthermore, whole teams would move about the field slower if their cleats could 'stick' in the turf so easily. On the other hand the foot of the female lifter in our example is literally pinned to the floor by the weight of the barbell. Yet her high speed reaction: contraction/relaxation of muscles, makes what looks like a sure injury a non – event.

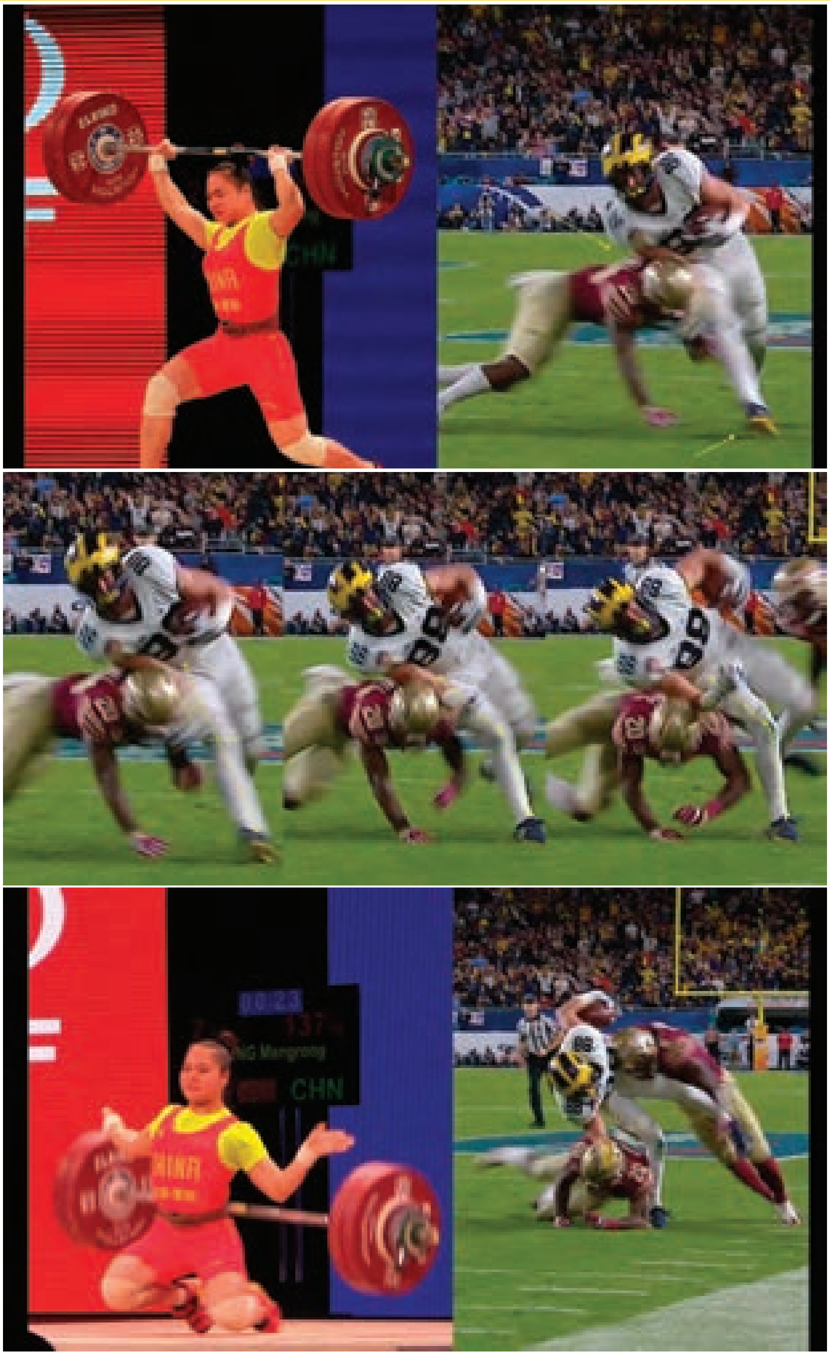


Figure No. 5-7

TWO ANALOGOUS SITUATIONS OF A FEMALE WEIGHTLIFTER AND ELITE COLLEGIATE FOOTBALL PLAYER. THE LIFTER HAS ALREADY REACTED TO THE BARBELL FALLING TOWARDS HER HEAD BY RAISING HER FIRMLY PLANTED FRONT FOOT TO PUSH BACK THEN PUSH AWAY FROM THE FALLING BARBELL TO AVOID INJURY. BY WAY OF CONTRAST THE FOOTBALL PLAYER SUFFERS A KNEE LIGAMENT TEAR AFTER HE HAS BEEN TACKLED. HIS FRONT FOOT IS STILL IN MID – AIR AS HE IS STRUCK IN THE HIP AREA.

EXAMPLES OF ENHANCED (THE FEMALE WEIGHTLIFTER) AND CONSTRAINED (THE FOOTBALL PLAYER) REACTIVE ABILITY TO RELAX MUSCLES TO AVOID INJURY (THE FEMALE WEIGHTLIFTER) AND THE FOOTBALL PLAYER 'REACT' TO INJURY PRODUCING CIRCUMSTANCES. THE ELITE FOOTBALL PLAYER (WHO SUFFERS ACL INJURY) KEEPS HIS RIGHT FOOT PLANTED OVER A RATHER PROLONGED PERIOD OF TIME UNTIL IT IS VIRTUALLY DISLODGED BY ANOTHER TACKLER. BY ANY MEASURE HIS REACTION TO DISSIPATE THE ENERGY OF THE CONTACT IS SO SLOW TO BE ALMOST NON – EXISTENT. BY CONTRAST IN APPROXIMATELY A SIMILAR FRACTION OF A SECOND THE FEMALE LIFTER HAS LONG SINCE MOVED AWAY FROM THE FALLING BARBELL BY RAPIDLY FLEXING LOWER EXTREMITIES.

FORWARD ENGINEERING FROM QUESTIONABLE RESEARCH

"It should also remind us that expert consensus isn't always correct." Chrystia Freeland, Reuters.com 2012

An unfortunate circumstance of a bad idea becoming mainstream, even when such ideas as deep knee bends and certain stretches hurt ligaments have been proven false; various transmutations not only persist; but, appear to be backed up by research, i.e., have "a superficial appearance of being right".

For instance, several such transmutations from the academic community indicate knee bends are ok as long as the thigh, knee and shin stay in line with the foot (no valgus or varus movement) and the shins should remain relatively vertical (movement of the knee beyond the toes cause a 'dangerous' shear). This research fosters false truisms such that exercise protocols are applied and pretty much everyone is bending with thighs, shins and feet in a line; with minimal movement at the ankle joint, and so forth. See the illustrations of children, athletes and exercise classes above.

An example highly questionable research, spawned by the false notion squats hurt knees are the following statements: "… malaligned knee positions may be potentially injurious"; "… inclusion of squats of squats similar to the ballet plie' squat should be cautioned". (*Slater, L., Hart M., "Muscle Activation Patterns During Different Squat Techniques", EWF Science Magazine 8:52-65: 2017)*

Figure No. 8-9

ELITE FEMALE WEIGHTLIFTER SHIFTS KNEES IN AND OUT (VARUS AND VALGUS MOVEMENT) STRAINING TO LIFT A HEAVY WEIGHT. THE BOWING IN AND OUT IS THOUGHT TO PLACE AN UNSAFE STRESS ON KNEE LIGAMENTS. HENCE THE INSTRUCTIONS TO "MAKE SURE YOUR KNEES STAY IN LINE WITH YOUR FEET-NOT WOBBLING OFF TO ONE SIDE". THIS BOWING OCCURS AS A RESULT OF HIP, KNEE AND ANKLE SHIFTING AS ON PIECE, NOT A DEFORMATION OF A SINGLE JOINT. THIS SHIFTING IS A REACTION TO DIFFICULT CONDITIONS OF LEVERAGE IN ORDER TO MORE EFFECTIVELY OVERCOME THE RESISTANCE AND NOT SOME DEFECT. CHARNIGA PHOTOS

The acceptance and ultimately irrational application en mass of this type of research is a prime example of the menace of forward engineering. On the other hand, reverse engineering is connected to the real world of known outcomes. The inward and outward bowing of the knees is not only common in weightlifting, but, especially so with the female lifter. It is not connected with any injury whatsoever. So, labeling this movement "malaligned" is nonsensical. No research, injury statistics or any practical experience to make such statement are cited in support.

The same conclusion can be said about this statement"… inclusion of squats similar to the ballet plie' squat should be cautioned". No research or statistics are presented or cited of ballet dancers made lame from doing plie' squats. Furthermore, if the plie' is dangerous, how in god's name does one practice ballet without this exercise?

CONCLUSIONS

"If everyone is thinking alike, then somebody isn't thinking". General George Smith Patton.

Of course it is not possible to conclude with 100% certainty that the 'safe' techniques such as bench squats, half squats with vertical ankles, taping and bracing of ankles and knees and so forth are the sole cause of the massive rate of lower extremity injury in American sport. However, the fact remains, the overwhelming majority of all of these injuries in American sport problems have same commonality.

Figure No. 10
PROFESSIONAL FOOTBALL PLAYER SUFFERS SUCH SEVERE KNEE DISLOCATION UPON PLANTING HIS LEFT FOOT SURGEONS WERE LUCKY TO SAVE HIS LEG. THE CONTACT WITH THE OPPOSING PLAYER (WHICH CANNOT BE SEEN FROM THIS ANGLE) OCCURRED AFTER THE LEG BROKE AND WAS NOT A FACTOR. FURTHERMORE, NOTE THE LARGE DISPARITY IN THE MUSCLE MASS OF THE PLAYER'S UPPER ARM AND THAT OF HIS CALF MUSCLE. THIS IS A COMMON OCCURRENCE WITH FOOTBALL PLAYERS. THEY DEVELOP UNNECESSARY MUSCLE MASS IN THE UPPER EXTREMITIES WHICH ARTIFICIALLY RAISES BODY CENTER OF MASS; MAKING RAPID SHIFTS IN DIRECTION MORE DIFFICULT.

Most everyone in the USA involved in training and treating athletes for dynamic sports follow these protocols. The extraordinarily high rate of lower extremity injury does not occur in the weight room. These injuries become manifest when the athletes for whom the preponderance of conditioning exercises have been partial range of motion and static movements, switch to dynamic activities: to the football field, soccer field, basketball court, volleyball court, and so forth.

Static movements such as bodybuilding/powerlifting, machine exercises, limited range of motion exercises deemed 'safe' from laboratory measurements are in fact, unsafe over time for athletes whose main endeavor is dynamic sport.

The listing below consists of only some of lower extremity injuries which occur annually in the USA cannot be considered comprehensive due to methods of reporting at various levels of the athletic and medical communities; and, even how an injury is diagnosed. For instance, an injury called a "foot pedal fracture" can be misreported as a Lisfranc because both types which occur in professional football players have been associated with traffic accidents.

Nevertheless, the profoundly negative effect of forward engineering on injury susceptibility is obvious in American athletics; especially, since most everyone training athletes in the USA are employing the same exercise techniques, restricting joint movement, taping and bracing protocols. An opposing argument would be found lacking in credibility; considering the injury statistics presented below:

Annual Incidence of Some Joint/tendon/ligament injuries in the USA:

Knee ligament related:

- *`"More than 30 000 serious knee injuries are projected to occur in female intercollegiate and high school athletics in the US each year. The majority of* *these injuries occur by non-contact mechanisms, most often during landing from a jump or making a lateral pivot while running."Hewett, T., 2012*

- *"There are approximately 250 – 300,000 ACL injuries per year in the USA which happen almost exclusively to athletes, Souryal, T.O.*
- *"The medial collateral ligament is the most frequently injured ligament of the knee." [Phisikul, P., 2006)*
- *Assuming only a 10% differential between ACL and MCL; that equates to approximately 575 – 630,000 torn or otherwise injured ACL/MCLs in the USA annually;*
- *Of just those yearly ACL injuries, at least 140 – 210,000 will require surgery, Souryal, T.O.*
- *"Unfortunately, regardless of treatment, athletes with ACL injuries are up to 10 times more likely to develop degenerative arthritis of the knee." Labella, C. et al, Pediatrics, 05/2014:133:5*
- *"Joint Replacement To Become The Most Common Elective Surgical Procedure In The Next Decades', https://www.ahrq.gov/news/newsletters/e-newsletter/503.html*
- *1,000,000+ joint (knee and hip inclusive) replacement surgeries are performed annually in the USA;*
- *The anticipated annual demand of 3.48 million for knee and 572,000 hip replacement surgeries is expected to outstrip the number of available surgeons by 2030, http://www.prnewswire.com/news-releases/total-knee-and-hip-replacement-surgery-projections-show-meteoric-rise-by-2030-55519727.html*

Ankle Related injuries in USA and professional football

- *An ankle injury is the most common injury in American athletics, by some estimates 45% of all sport injuries are related to the ankle, Kaminski, T., 2013;*
- *Approximately 230,000 Achilles tendon injuries occur annually in the USA; the rate is rising, http://www.clickondetroit.com/health/achilles-tendon-injuries-on-the-rise;*
- *An annual rate of 4 – 10 Achilles tendon ruptures in the NFL has become common.*

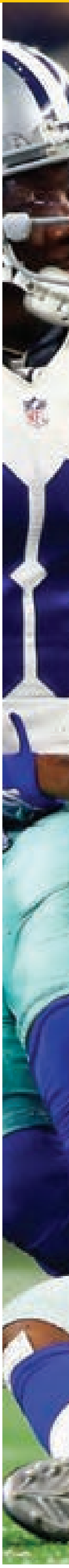
- **Foot Injuries**

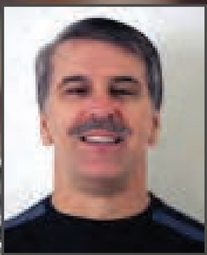
- *"Back in the 2000s, we saw a tremendous rise in foot and ankle injuries in the NFL and we were trying to figure out why this was happening." Anderson, R.B,*
- *"The rate of Lisfranc fractures have been rising in the NFL: Such diagnoses were rare in the 1990s, but from 2000–05, the NFL saw an average of 14.2 per season, which increased to 18.9 from 2006–14", Lareau, C.R., Hsu, A.R., Anderson, R.B,*
- *"Jones fractures commonly occur in professional athletes and operative treatment remains the standard of care in this patient population." Lareau, C.R., Hsu, A.R., Anderson, R.B,*
- *There is no precise data on the number of plantar fascia ruptures and fascitis injuries in the NFL; however, anecdotal evidence suggests the affliction is becoming more common.*

In Contrast to the Problems Caused by Forward Engineering

- *Stress on the Achilles tendon, the foot and the ankle joint in Olympic Weightlifting exercises are arguably among the highest in all of sport;*
- *Ankle and foot injuries, especially Achilles tendon ruptures are virtually unheard of in weightlifting .*
- *The loading on the lower extremities in the weightlifting exercises is extraordinarily high; yet the overall injury rate is low.*

What is the upshot of all of this? Like some contagious disease a single bad idea can morph into various forms and magnify over time with terrible consequences. Non – contact, and, even many contact injuries to the lower extremities of NFL players should be viewed from the standpoint of the 'canary in the coal mine'. Why? Because tens of thousands of young athletes coaches and so forth, follow the same irrational training methods as the elites in sport; and, like some out of control contagious disease, still many more copy them. Anecdotal proof positive of this is the doctor's observation *"Unfortunately, we are seeing this in children as well." Dr. Armin Tehrany.*





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References:

1. *Dept. of Othropedic Surgery UCSF, "Anterior Cruciate Ligament Injury (ACL) Overview" http://orthosurg.ucsf.edu/patient-care/divisions/sports-medicine/conditions/knee/anterior-cruciate-ligament-injury-acl/*
2. Souryal, T.O., "ACL Injury, ACL Tear, ACL Surgery", http://www.txsportsmed.com/acl.php, 2015
3. *Treatment Guide: ACL Injuries, http://my.clevelandclinic.org/ccf/media/Files/ortho/acl-injury-guide.pdf?_ga=1.38845539.1913215647.1489163858*
4. *Mayo Clinic Overview: ACL Injury http://www.mayoclinic.org/diseases-conditions/acl-injury/symptoms-causes/dxc-20167379,*
5. *Hewett, T., "Neuromuscular and Hormonal Factors Associatyed with Knee Injuries in Female Athletes", Sports medicine 29:52000:313-327 http://link.springer.com/arti./10.2165/00007256-200029050-00003; 2012*
6. *American Academy of Orthopaedic Surgeons, "Total Knee and Hip Replacement Surgery Projections Show Meteoric Rise by 2030" http://www.prnewswire.com/news-releases/total-knee-and-hip-replacement-surgery-projections-show-meteoric-rise-by-2030-55519727.html*
7. *Fox, M., "Knee Patients Spending Millions on Wasted Treatments", http://www.nbcnews.com/health/health-news/knee-patients-spending-millions-wasted-treatments-study-finds-n733396*
8. *David Ruiz, Jr., MA[1]; Lane Koenig, PhD[1]; Timothy M. Dall, MS[2]; Paul Gallo, BS[2]; Alexa Narzikul, BA[3]; Javad Parvizi, MD[3]; John Tongue, MD "The Direct and Indirect Costs to Society of Treatment for End-Stage Knee Osteoarthritis", The Journal of Bone & Joint Surgery, Volume 95, Issue 16*
9. Zajac, F.E., "Muscle Coordination of Movement: A Perspective", J. Biomechanics 26:suppl1:109-124:1993
10. *"Achilles Tendon Injury On the Rise", http://www.clickondetroit.com/health/achilles-tendon-injuries-on-the-rise*
11. *http://www.beaumont.edu/press/news-stories/2013/1/beaumont-health-system-joins-american-joint-replacement-registry/ "Joint replacement is becoming more common. More than 1 million Americans have a hip or knee replaced each year.*
12. *http://www.ajrr.net/*
13. *Phisitkul, P. et al, "MCL Injuries of the Knee: Current Concepts Review", Iowa Orthop J, 2006:26:77-90*
14. *Miyamoto, RG, et al, "Treatment of medial Collateral Ligament Injuries", J Am Acad Orthop Surg. 17(3:152-61:2009*
15. *Charniga, A., "It is all connected" I-III; www.sportivnypress.com*
16. *Charniga, A., "Achilles tendon ruptures and the NFL", Practical solutions to the problem of Achilles tendon rupture and the proliferationof injurois to the lower extremities of football players, www.sportivnypress.com*
17. *Charniga, A., "There is no system" I-VI; www.sportivnypress.com*
18. Kaminski, T., et al, "National Athletic Trainers Association Position Statement: Conservative Management and Prevention of Ankle Sprains in Athletes", J. of Athletic Training, 48(4):528-545:2013
19. Lareau, C.R., Hsu, A.R., Anderson, R.B, "Return to play in national football league players after operative Jones fracture treatment", https://www.ncbi.nlm.nih.gov/pubmed/26353796
20. *https://www.foxsports.com/san-diego/story/nfl-injury-bug-continues-to-spread-league-wide-111017, "NFL Injury bug continues to spread league – wide",*
21. *Hunt, K., et al, "High Ankle Sprains and Syndesmotic Injuries in Athletes", Journal of the American Academy of Orthopaedic Surgeons, 23:11;661-673:2015 Wei et al[15] demonstrated the influence of shoes with flexible uppers on talus motion. These shoes allow greater talar eversion and transfer more stress to the AITFL. Thus, the level of shoe constraint may also contribute to syndesmotic injury*
22. *Paine, T., Common Sense, 1776*
23. *Slater, L., Hart M., "Muscle Activation Patterns During Different Squat Techniques", EWF Science Magazine 8:52-65:2017*
24. *https://www.advisory.com/Research/Technology-Insights/The-Pipeline/2011/11/The-jump-in-utilization-rates-for-knee-replacement-and-implications-for-future-demand*
25. *Cerrato, R., "Lisfranc Injuries", http://www.aofas.org/PRC/conditions/Pages/Conditions/Lisfranc-Injury.aspx*
26. Hsu, A., Anderson, R.B., "Foot and Ankle Injuries in American Football", *Am J Orthop*. 2016 September;45(6):358-367
27. Souryal, T.O., "ACL Injury, ACL Tear, ACL Surgery", http://www.txsportsmed.com/acl.php, 2015

NUTRITION for PERFORMANCE

BY GIAN MARIO MIGLIACCIO [1], MICHELE SPREGHINI [2]
1: Sport Science Lab , 2: Fit for Dummies

INTRODUCTION

Reaching the pinnacle of Sport, achieving increasingly greater performances, setting new records is the result of a perfect combination of pieces that, like a perfect puzzle, go together to build the picture which the athlete had only imagined up to that time. A puzzle that the athlete will have to put together but which cannot be altered because every single piece will have a different shape and a specific origin: medicine, physiology, psychology, methodology, technique, nutrition, and so on. One missing piece could result in the perfect image being a missed dream.
A recurring piece, sometimes overlooked by athletes, is that of nutrition. It is an irreplaceable element which, over the years, has become the object of increasingly accurate scientific studies that, with populations of elite athletes, has demonstrated that nutrition is a key factor in performance, but only in the context of a "nutritional program" just as if it was a workout. [1]

We are what we eat

When in 1848, the German philosopher, Ludwig Feuerbach, wrote in an essay the famous phrase "Man is what he eats" (der Mensch ist was er isst), also the subject of discussions and scientific publications[2] [3], he advanced an integrated model of connections between food and the life of the person that concerned not only the physiological aspect, but also the psychosocial one, where every element, from success to stress, was conditioned by the food consumed in everyday life.
For almost two centuries, discussions, studies, research and innovations have ensued, and the field of nutrition is increasingly at the centre of the debate, as the correct intake of food can benefit every requirement of the organism: physical and mental recovery, the state of illness and, of course, performance.
Everything is connected, in a succession of pieces that create a single, original puzzle.
The uniqueness of the athlete is in fact the element that differentiates a puzzle produced on an industrial scale from a unique, inimitable, unrepeatable model. Each piece will be studied in terms of shape, size, consistency bearing in mind the athlete and his/her specific needs. Just as a training programme "modeled" on past Olympic winners would not be suited to our athlete, neither would a diet "inspired" by fashion or business contribute to the specific energy demands of physical activity, athletic performance and post-exercise recovery[4].

NUTRITION AND PERFORMANCE

The scientific evidence demonstrating an ever closer relationship between nutrition and performance has increased exponentially since the end of the 2000s, with a succession of original studies but also of reviews, meta-analyzes and positions taken by the international reference bodies, with the ACSM and IOC being amongst the most authoritative.[5]
The energy needs of an athlete start from his/her body composition and include the correct supply of nutrients and liquids, personalized plans in the pre and post workout, integration during competition, weight reduction strategies, and the use of supplements. Athletes should not be left to their own devices on this course, as the choices made, rather than relying on the correct identification of macro and micro nutrients, would inevitably shift to the only reference parameter: taste.

Planning a nutritional strategy for the athlete does not mean, however, causing or adding stress for the athlete with unjustified daily "weighing" sessions. The trainer will be aware that the Nutritionist's task is to identify a correct strategy and to regularly evaluate the body composition with tests and measurements that are more reliable than the weighting scales: plicometer, BIA or DEXA. Proper nutrition before, during and after exercise will help maintain the correct concentration of glucose in the blood during exercise, maximize performance, and improve recovery time. Of equal importance is maintaining the water-salt balance, the efficiency of the receptors and the correct distribution of energy substrates to the various training intensities. A strategy that focuses on performance must precede and discourage the reduction of macronutrients by the athlete, sudden weight loss, the reduction of micronutrients, or an intake of supplements not justified by objective shortcomings and needs.

MAIN EFFECTS OF NUTRITIONAL STRATEGIES ON PERFORMANCE

Training the athlete through nutrition is therefore an irreplaceable, yet sometimes missing piece, which leads to the closure of the performance puzzle. Just as sports training will be based on dose-response prerequisites in accordance with the athlete's needs, even food training must be tailor-made, so that every necessary element (type of sport, competition, training, frequency and intensity but also special tastes) must be included.

All this leads to precise answers in terms of performance improvement:

- **Glycogen stores**

A pre-competition or pre-exercise accumulation of glycogen stores is one of the goals for an athlete facing a competition that lasts over 60 minutes, but also for athletes who have performance needs of only a few seconds but who, in training, maintain high intensity for prolonged periods. Although carbohydrate loading and unloading techniques are common practice among athletes (among the best known, a three-day period with high intensity workouts and reduced carbohydrate intake, followed by a three-day reduced load period with increased carbohydrate intake), recent studies have shown that comparable effects can be achieved with only 24h of intervention without carrying out the glycogen depletion phase[6] [7]. Athletes who have to sustain physical activities over 90 minutes should consume 10/12g of carbohydrates per Kg of body mass in the 36/48h leading up to the performance, 7/10g for athletes engaged in competitions of shorter duration[8], whereas the effect of high-glycemic carbohydrates performance was not sufficiently demonstrated.

- **The Use of Carbohydrates during Exercise**

Just as carbohydrate intake has significant effects on performance, even links to the nervous system have been particularly effective. Washing out the mouth with carbohydrate-based liquid foods has been shown to trigger oral recep-

tors by bringing the central nervous system to a significant pre-alert state of the motor system[9].
During physical activity, and above all during performance, a correct intake of carbohydrates prevents hypoglycemia by keeping the level of oxidation high. On the other hand, glucose intake is important during the competition, especially for cyclical activities over 60 minutes, from 1g/minute up to a maximum of 1.3g/minute if taken with fructose. This limitation is given by the saturation of the glucose transporter SGLT1 and the GLUT5 for fructose, which therefore limit its assimilation in larger quantities.[10]

- **The Intake of Fats during Exercise**

The correct intake of carbohydrates must also be calculated according to the use of fats as an energy source. While some techniques (e.g. train low - compete high) lead to a better use of fats, excess carbohydrates inhibit their use during physical activity. However, an ideal carbohydrate level helps to create a suitable environment for effective fat oxidation; some studies recommend a reduction in carbohydrates to a level that promotes ketosis, but this strategy could at the same time limit performance in high intensity performance (or in high intensity periods in long distance races, for example during escape tactics, etc.) due to the reduction of glycogenolysis activity. An excess of glucose in athletes with high insulin sensitivity could further influence fat oxidation due to limited efficiency of lipolytic efficiency. [1]

- **The Intake of Proteins during Exercise**

The consumption of protein before and during physical activity, be it of strength or endurance, has been correlated to a better protein synthesis. However, the ingestion of proteins together with carbohydrates did not show improvement in performance compared with the intake of carbohydrates alone.[11]

- **The Intake of Supplements during Exercise**

It is common practice for athletes to resort to supplements because, in general, their effects on performance are indicated. In the athlete's nutritional programme, supplementation is part of the strategy and every part and every aspect must be planned by a professional. The integration of macro-micro nutrients in unsuitable forms and ways can in fact compromise energy production and eliminate the positive effects of the nutritional programme.
Substances such as caffeine, beetroot juice, beta alanine, creatine and bicarbonate are just some of the most popular supplements. Also the integration of vitamins, such as vitamin D, has been shown to play a role in performance. In some areas of Italy, for example, where exposure to the sun is more difficult, the concentration of vitamin D in athletes could fall below optimal levels and therefore influence the control of calcium homeostasis, the regulation of the immune system, cardiovascular health, as well as muscle strength.[12]

WATER AND MINERAL SALTS IN PERFORMANCE

Remaining hydrated and maintaining thermoregulation, and the hormonal support that derive from it during physical activity, training or competition, is one of the key factors that can alter an athlete's performance. Scientific studies on the role of fluids have shown effects on both strength and endurance activities.[13]

Although in recent years the sensitivity of the athlete and coach towards a correct hydration has improved considerably, some indications are to be underlined:

- fluid loss occurs in various ways during physical activity: perspiration, exhalation, urination and pressure regulation;
- fluid loss occurs in every environment and in every sporting activity, including swimming activities;
- the amount of water that can be lost in an hour is between 0.5l and 2.0 litres and is dependent both on the environment, on the type of activity performed, as well as on the individual characteristics of the athlete;
- "thirst" is not a signal that indicates the body is in a state of reduced hydration since the receptors, especially in the adult population, tend not to provide accurate feedback to the central nervous system. The thirst signal comes at a time when you are already at a high risk stage;
- the loss of liquids over 1% may alter the heart rate which will therefore be higher than the aerobic, anaerobic or VO_2max thresholds;
- loss of liquids over 2% can affect nutrient uptake and as a result performance will start to be incompatible with the athlete's health.

Recent studies have focused on rapid weight reduction practices in pre-combat stages in some sports, with the aim of falling into categories deemed more competitive. These practices, justified by international regulations, are no longer supported by the scientific community because they compromise (and even seriously) the athlete's state of health. A loss of up to 10% of body fluids is no longer promoted as a healthy approach in the world of sport. [14]

IMPLEMENTING NUTRITIONAL STRATEGIES WITH THE ATHLETE: PRACTICAL ADVICE

There are no magical nutritional formulas that can make a person move faster, jump higher, lift heavier loads, or get to a ball before others. However, there are winning strategies to make the athlete perform at the maximum of his/her possibilities, in correlation with progressive adaptations thanks to the stimuli created in training to be competitive during the competition, or effective in preparation.

- Avoid fibre consumption prior to workouts, so as not to compromise performance due to the sense of a heavy stomach;
- Do not let too much (6/8 hours), nor too little (2/3 hours) time lapse from the last meal and do not compete until 4 hours have passed as the digestive processes use up oxygen that could contribute to improving performance;
- Respect circadian eating rhythms so as not to alarm the body off-plan binges. The only adjustments to be made are those related to training (obviously supported by the correct diet);
- Plan weight loss accurately and with the correct physiological times to fall into a specific category. Cellular suffering from overly restrictive diets can affect both training and competition performance;
- In the event of nutritional setbacks, always schedule a metabolic reset to return the organism to optimal values, move forward without baggage (it is easier to demolish a house and rebuild it rather than to make quick fixes from time to time);
- The best energy molecules are lipids and saccharides. There is no better or worse one: each individual will respond differently depending on his/her hormonal profile or behavioural habits;
- Any body composition is the result of diet and eating habits developed over years, not just over a few weeks or months. When drawing up a nutritional strategy or a food plan, this must always be taken into account, so as not to rely too much on the diet of recent months. The same goes for nutrition applied to performance;
- Proteins have plastic functions (regeneration, construction, repair), but they are - at the same time - a terrible fuel. If performance needs to be improved, their assimilation and/or their use for energy purposes could be a poor nutritional choice;
- Muscle glycogen is composed of glucose + water; in individuals who tend to accumulate and retain liquids, predisposed to extramuscular "overflow", or other problems encountered during re-feeds, it is better to prepare carbohydrate top-ups from dry sources (cereals, rice cakes, toast, unleavened bread, Wasa crackers, wholemeal biscuits, etc. ...) instead of wet sources (pasta, potatoes, starchy foods in general). In this way, the resynthesis of muscle glycogen will reduce the water stores in order to recharge the muscles;
- When choosing a good nutritional strategy, the various problems of adaptation need to be given their due time. The changes to "adjust the target" should be implemented only after at least 4-5 days from consolidation;
- Fruit is an excellent source of sugar, but it is advisable to choose fruit with a higher content of fructose than sucrose (honeydew melon being the best choice).

Bibliography

1. Role of nutrition in performance enhancement and post-exercise recovery. Beck K.L. et al. s.l. : Open Access Journal of Sports Medicine, 2015.
2. Feuerbach's "Man is what he eats": a rectification. Cherno M s.l. : J Hist Ideas, 1963.
3. Was Feuerbach right: are we what we eat? Cizza G et. al s.l. : J Clinical Invest, 2011.
4. American College of Sports Medicine position stand. Nutrition and athletic performance. ACSM - Position Stand. s.l. : Medicine and Science Sport and Exercise, 2009.
5. IOC consensus statement on sports nutrition 2010. Maughan Ron J et al. s.l. : Journal of Sport Sciences, 2010.
6. Carbohydrate loading in human muscle: an improved 1 day protocol. Bussau VA et al. s.l. : Eur J Appl Physiol, 2002.
7. Rapid Carbohydrate loading after a short bout a near-maximal intensity exercise. Fairchild TJ et al. s.l. : Med Sci Sport Exerc, 2002.
8. Carbohydrate for training and Competition. Burke LM et al. s.l. : J Sport Sci, 2011.
9. Carbohydrate in the mouth immediately facilitates motor output. Gant N et al. s.l.: Brain Research, 2010.
10. Oxidation of combined ingestion of glucose and fructose during exercise. Jentjens RL et al. s.l. : J Appl Physiol, 2004.
11. Is there a need for Protein ingestion during exercise? LJ Van Loon. s.l. : Sports Med, 2014.
12. Effect of Vitamin D supplementation on Performance: a systematic review and meta-analysis. Stockton KA et al. s.l. : Osteoporoses, 2011.
13. Hydration and Muscular Performance: a review. Judelson DA et al. s.l. : Sports Med, 2007.
14. It is Time to Ban Rapid Weight Loss from Combat Sports. Artioli GG et al. s.l.: Sports Med, 2016.

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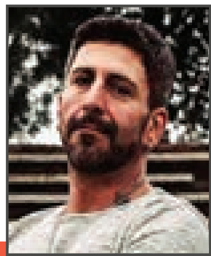

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MAKING WEIGHT

BY FRANCESCO PASQUALONI, FRANCESCO LAMPREDI

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The official journal of the European Weightlifting Federation

RAPID WEIGHT LOSS IN COMBAT SPORTS

Almost all combat sports have weight categories for competitions. The basic assumption is that individuals with the same body mass have similar physical strength and similar limb length. **The aim is to make fighting fair by pairing athletes with comparable physical characteristics.** And this is mostly the case. It is easy to understand, however, how body mass is only a partial indicator of athletic characteristics. It is also possible to shift between weight categories to get an advantage. To do this, athletes try to lose weight quickly before a race - even just a few days prior to it - so as to be assigned to a lighter category at the weigh-in. **The assumption, in this case, is that competing in a category lower than one's "natural" category means being able to count on a more favourable mass/power ratio and a greater limb length, compared to an opponent who competes in his/her "natural" category.**

This practice has, in fact, always been widespread among agonists and "making weight" is a strategy as old as weight categories. The American NCAA in 1997 even prohibited the practice of cutting weight in high school wrestling competitions by subjecting athletes to strict controls and careful educational programmes, but weight loss proved to be too deeply rooted in combat sports. A study by Alderman et al[1] represents this "tradition" very well: athletes no longer showed any behaviour attributable to a rapid decrease in weight in the context of NCAA competitions. However, as soon as the athletes found themselves facing competitions in which weight loss was not forbidden (such as in international competitions) they immediately returned to their old habits with great enthusiasm[1].

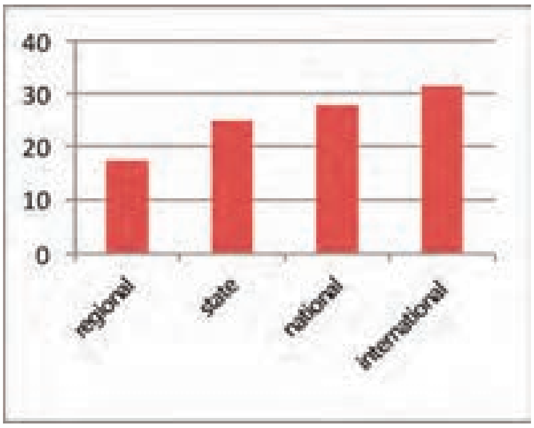

Figure No. 1
THE SCORES OBTAINED BY BRAZILIAN JUDOKAS OF VARIOUS LEVELS ARE REPRESENTED IN A QUESTIONNAIRE SUBMITTED TO THEM BY ARTIOLI ET AL[3]: A HIGH SCORE DENOTES THE SEVERITY OF THE WEIGHT LOSS PROCEDURE. AS THE LEVEL INCREASES, SO DOES THE SEVERITY OF THE PROCEDURE IN QUESTION.

Combat sports are practiced and followed by millions of people around the world. They represent a constantly evolving and extensive business[2][3]. During the Olympic Games, about 1 medal in 4 is conquered in one of these sports. It is evident, therefore, how "making weight" is a topic at the centre of great attention, calling into question the health and performance of athletes their sports careers, the skills of their trainers and health staff, and - of course - the economic interests.

Not considering the heaviest category - which has little interest in this practice - **from 60% to 90% of athletes** (depending on sport, level and age) **reports having cut their weight at least once in their sports career** starting, in most cases, before the age of 15[4]. On average, an athlete loses 5% of his body mass in a very short time, even in less than 5 days. The most frequent mass decreases are of 2-5%, but about 40% of the athletes obtain a reduction of their body weight ranging from 5 to 10%, and reports of a reduction of over 10% are not so rare.[4][5] This cycle of mass loss and reacquisition is repeated on average 2-5 times a year, up to cases in which it is repeated even 10 times[4]. During some events - such as the Olympic Games - the athletes are weighed even 6 times over a period of 14 days.

The ways in which athletes obtain weight loss can be quite varied. In general, the protocols followed all include significant caloric restriction and major dehydration. In addition to cutting liquids, carbohydrates and fats, athletes follow methods ranging from intense aerobic exercise in synthetic clothing, to saunas, to training carried out at high temperatures, up to self-induced vomiting and fasting [4][6]. **As the competitive level rises, weight control procedures become increasingly aggressive**[4]. Moreover, it seems that the athletes most inclined to follow the most severe regimes are those who start the activity at an earlier stage[7].

There are no significant differences between the behaviour of male and female athletes[4]. **Instead, we can observe a trend of increasing severity moving from the heaviest weight classes to the lighter ones.** The practice of rapid weight loss almost disappears in the maximum categories.

We will not consider resources such as diuretics, laxatives and diet pills[6], as there is no doubt about their danger to the athlete's health. Diuretics, in particular, are banned by the World Anti-Doping Agency[8] and are responsible for the largest number of doping cases in combat sports. These substances can also "mask" the presence of prohibited substances during anti-doping tests, increasing the amount of urine and then diluting the substances contained in the urine itself[8].

The aspects that make up this matter are varied and controversial and many questions arise on what are the most efficient protocols, on the effects that this practice can have on the health of athletes and on the changes that could be made to competition regulations. The first question to ask, however, remains if competing in a lower weight category really helps athletes to win more: what effect has rapid weight loss on performance? If it does not help to win, then it is of no interest.

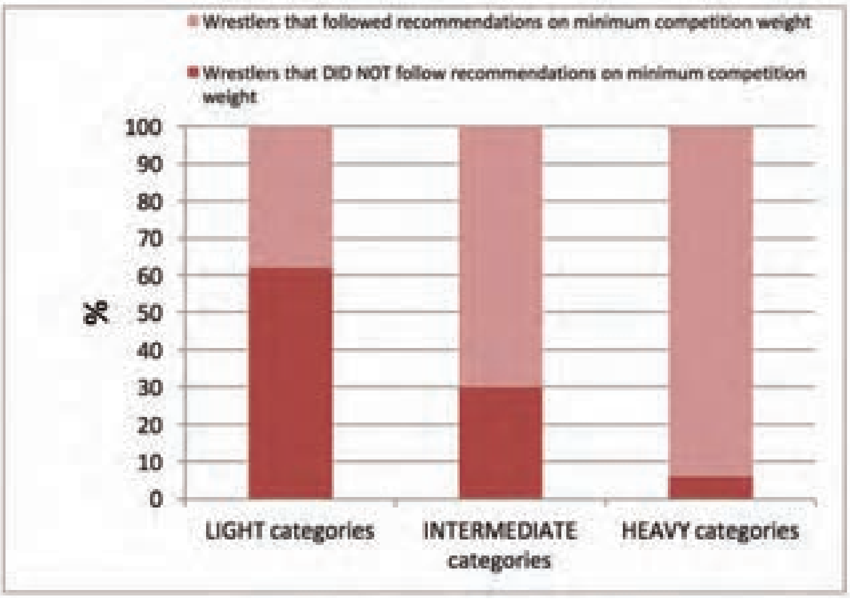

Figure No. 2

The percentages of high school athletes who have reduced their weight beyond the minimum recommended category (Minimum Wrestling Weight) against the percentage of those who carried out weight loss following the indications, respectively in the 4 lightest weight categories, in the 4 intermediate categories and in the 4 heaviest categories[8]. It can be seen that the severity of weight loss and disregard for health and nutritional indications is greater among the light categories and almost non-existent among the heaviest categories.

THE SUCCESS OF WEIGHT CYCLERS

To what extent is it possible to attribute, albeit partially, the success of an athlete to rapid weight loss practices? Several studies have tried to provide an answer to this question.

Wroble and Moxley observed the competitive performance of a group of high school wrestlers (not considering heavyweights) after providing them with an educational programme on good nutrition and the most appropriate ways to lose weight. The two researchers also indicated to athletes what was the minimum weight class to be achieved without incurring health risks, based on their body mass composition at a time of year out of competitions. After the competitions, they interviewed the athletes and were able to conclude that 38% of the wrestlers had competed in a category lower than the recommended one. 57% of these were placed, whereas only 33% of those who had competed following the instructions were placed. **The athletes ranked higher were those who had reduced their body mass beyond the recommended limit**[9]. In reality, the virtue of this data is polluted by the emotional attitude of the athletes: it would appear that the feeling of hunger determines a feeling of anger that in the competition translates into aggression. It should also be emphasized that the severity of weight loss in an athlete also describes to a certain extent his/her determination in general.

Similar results are reported by Alderman et al[1]. In addition, it seems that athletes competing in the same weight category throughout their career are more successful[10]: changing category, in fact, means having to adapt to different opponents with different strength and agility, having to familiarize with a different style of combat and with different strategic tactical approaches[10]: it is not easy to describe the success of an athlete by attributing importance to one factor rather than another. The result of a competition naturally depends on the athlete's technical preparation, on his/her physicality and on the strategic planning, but it also depends on mood, the psychological component and the episodic nature of the competition. For example, athletes associate everything related to the weight loss procedure to negative emotions such as anger, fatigue, tension and exhaustion[11][12]. Therefore, even evaluating the incidence of Rapid Weight Loss is very complicated. Although standardized laboratory tests do not well describe the real competitive performances because they do not consider aspects such as technical skill and competition anxiety, it is necessary to refer to performance, rather than competitive success, in order to break down the total picture, analyze each single part and then rebuild the puzzle.

RAPID WEIGHT LOSS AND PERFORMANCE

The results of Hall and Lane show that between the performances of experienced boxers with one weight during training and another during competitions, (with a weight decrease of about 5%), the performance of athletes engaged in circuit training does not vary substantially[11]. Fogelholm et al confirm that the ability of the neuromuscular system to produce strength is preserved after rapid weight loss: by performing the Wingate test before and after weight loss, the results remain unchanged and the anaerobic performance is not compromised[13]. They do not, however, provide much information on the type of diet followed, nor on the body composition of the athletes. It is interesting to note how athletes adopt weight loss in search of a better performance and have, therefore, the perception of performing better: when they are shown evidence that their performance is actually more or less equal to that prior to weight loss, this generates amazement[11].

According to McMurray et al, during a period of severe caloric restriction, the proportion of carbohydrates taken can make the difference in maintaining or reducing anaerobic performance[14]. The maximal expression of power is linked to the reserves of ATP and phosphocreatine and the composition of the diet shows no effects on it[16][17]. As the average muscle power and total work are not reduced, **the carbohydrate intake of a strongly hypocaloric diet should not fall below 70%** [14]: in this case, in addition to the stored ATP and PC, the glycogen stores are also essential[18]. Low carbohydrate diets combined with intense exercise break down glycogen stores and, consequently, work capacity[19].
The fatigue rate, however, even after 7 days of caloric restriction does not undergo variations, and the composition of the diet has no

effect on it[17][20]. It has also been observed that a diet with a negative energy balance of circa 4200 kJ in an 8-minute run test at 85% of the VO_2max, does not involve a higher metabolic cost, nor changes in performance, at least in the case where this regime lasts 7 days or less[14]. A reduced caloric intake affects a lower lactate response to exercise, indicating a depletion of glycogen stores: 9-18 mM post-exercise plasma lactate concentrations indicate a criticality in the availability of carbohydrates.

A diet that, although hypocaloric, maintains a normal composition of macronutrients does not seem enough to maintain lactate levels, nor the expression of power; if the low-calorie diet, however, provides exaggerated carbohydrate levels **(> 50% of total caloric intake**), the lactate level is however reduced, but does not decrease the level of glycolysis, and the expression of power remains unchanged[14]. Degoutte et al indicates that a **<500g/d carbohydrate intake** may not be sufficient to ensure a rapid and efficient re-synthesis of muscle glycogen after intense exercise[12]. According to Smith et al, however, despite a low intake of carbohydrates, there would be enough energy from other sources (such as the Cori Cycle) to sustain high intensity boxing activity such as 2 matches for a total duration of 9 min played over a 48 hour period[16].

Hickner et al. report a decrease of about 3.5% in upper limb performance - in this case in a protocol based on the arm crank exercise

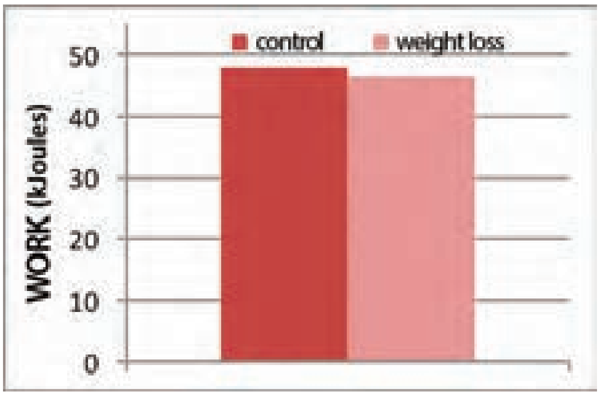

Figure No. 3
TOTAL WORK EXPRESSED IN THE EXERCISE OF ARM CRANK PERFORMED BY ATHLETES WHO CUT WEIGHT (46.5 ± 2.18 KJOULES) AS OPPOSED TO THAT EXPRESSED IN THE CONTROL (48.22 ± 2.29 KJOULES). THE WEIGHT LOSS AFFECTED THE PERFORMANCE BY 3.5% [16].

with a total duration of 6 minutes - following a 4.5% weight loss achieved in 3 days16]. The exercise results in an average increase in lactate values of 1.1 mmol/litre, which identifies an activation of anaerobic metabolism similar to that sustained by wrestlers during a meet. The authors identify glycogen depletion as likely causes of the decline in performance and also a state of dehydration, since an average plasma volume decrease of 6.4% was observed[16]. Another possible cause is ketogenesis due to the low intake of carbohydrates that could decrease the body's ability to buffer metabolic acids [16], which can affect the contractile ability of the muscles[12].

According to an epidemiological study on the wrestlers, rapid weight loss is associated with a high probability of injury[27], a probability that increases during the competition rather than in the training phase[28]. It would, in fact, appear that a reduction of 5% of the body mass influences metabolism, decreasing the synchronization of the muscular contraction[29].

NUTRITIONAL STATE AND PROTEIN METABOLISM

Many studies show that, during rapid weight loss, the body compartment most affected is the lean mass, although to a certain extent, the fat mass also decreases[6][31]. It also seems that athletes tend to lose most of their weight during the last 48 hours, due to increased dehydration.

Retinol binding protein (RBP) and prealbumin (PA) are considered energy and protein nutritional status indices because of their short half-life and because they somehow describe the body's sensitivity to changes in nutrition. Their concentration decreases in the case of a reduced caloric intake (even if the protein intake satisfies the RDA), reduced protein intake (regardless of the energy intake), and in the event that both conditions occur[30]. A study conducted on adolescent wrestlers took into consideration an energetic restriction of about 1706 kcal during the season (~ 54% of the RDA for that age group) and highlighted how in actual fact the protein intake generally recommended for an athlete during development (2.0g / kg bw) was not sufficient to maintain the levels of RBP and PA[30]. The level of essential amino acids decreases, since the reduced caloric intake favours the oxidation of amino acids to produce energy. The concentration in the blood of non-essential amino acids such as glutamine and alanine, however, increases: this is the signal that it enters into the bloodstream to become the substrate of gluconeogenesis in the liver[30].

Many authors argue in fact, that protein intake should increase during the developing years and - more generally - during periods of energy restriction and in situations of strenuous exercise[30]. A major anaerobic effort, in fact, produces an increase in the levels of urea, ammonia and uric acid, a sign of an increase in protein catabolism associated with tissue damage and fatigue[12]. **Athletes who are physically very active and engaged in a rapid weight loss programme, therefore, should consider a higher protein intake at least in line with the RDA references.**

DEHYDRATION

Rapid weight loss always produces a certain degree of dehydration. When the decrease in total body water takes place too quickly, however, it can be very dangerous. In 1997, three college wrestlers died while following a programme of saunas and intense exercise at high temperatures, wearing non-breathable synthetic clothing. It is known that a low level of hydration can compromise the thermo-regulation ability of our body. These athletes had already restricted their diet and reduced their fluid intake. It should be emphasized that these athletes were trying to drop a category by losing about 15% of their weight, so their protocol is to be considered extreme. The type of exercise they carried out produced very high body temperatures that could not be dissipated by convection due to the synthetic clothing. Also due to this type of clothing, the process of perspiration in dissipating heat was ineffective. Postmortem examinations revealed rhabdomyolysis and myoglobinuria, confirming the fact that death had been caused by hyperthermia due to dehydration[22]. Many other cases of death and health impairment due to extreme dehydration practices are documented.

In the context of rapid weight loss, even more moderate procedures than the above mentioned generate a more or less high degree of dehydration. Fogelholm et al attribute a decrease in aerobic performance to dehydration, especially in sub-maximal exercise: the lower hydration results, in fact, in a decrease in plasma volume, an increase in heart rate and electrolyte imbalance[23].

There is evidence, however, that ATP and phosphocreatine do not undergo depletion in skeletal muscle following dehydration [13]. Furthermore, short and maximal efforts are not dependent on the intake of glucose and oxygen, and

anaerobic performance is not affected by dehydration[24][25]. Smith et al report that - by rapidly losing weight through dehydration - the plasma volume and lactate blood concentration of athletes do not change significantly. What is more important, moreover, is that the boxing performance (studied in this case) is not correlated with the plasma volume[26]. Instead, there is a significant increase in sub-maximal heart rate if dehydration exceeds 2% of the hydrated body mass[25].

INTEGRATING AFTER THE WEIGH-IN

The literature concerning athletic performance in relation to rapid weight loss shows very varied results, which are sometimes even contradictory. It is often difficult to interpret the results, since they use different parameters, procedures and assumptions. All results reported to date, for example, study the effects of weight loss by assuming that athletes cannot reintegrate nutrition and hydration after a weigh-in. It can be seen that in reality athletes compete with a body mass greater than that of the weight category to which they were assigned. In most sports competitions, in fact, there is period of time between the weigh-in and the actual start of the competition: this period can vary from a few hours to more than a day and is exploited by athletes for reintegration.

Degoutte et al noted that the activity of 5 Judo meets each lasting 5 minutes induces the same physiological and psychological responses, whatever the caloric intake of the previous 7 days, without altering performance, provided that the diet includes a large proportion of carbohydrates and that fluids can be reintegrated between one meeting and another [12].
According to Fogelholm et al, if the athletes have a period of 5 hours for reintegration after the weigh-in, the effects of dehydration can disappear almost completely and speed, vertical jumping and anaerobic performance are not compromised[13].
Artioli et al observed a group of athletes who had reduced their body mass by 5% in 5 days without a particularly high carbohydrate intake and without specific recommendations. Without the possibility of reintegration, both the strength of the upper limbs and the judo performance in a simulated competition dropped[32]. On the other hand, athletes who were allowed to reintegrate carbohydrates and liquids in the 4 hours between the weigh-in and the start of the competition (recovering up to 50% of the weight lost) kept their performance unchanged, as well as the levels of lactate[32].
The results of the Artioli study also show how weight-cyclers (in other words, athletes with more experience in the practice of weight loss) have probably undergone a metabolic adaptation which allows them to restore the glycogen muscle reserves very quickly: an expert can take advantage of the possibility of reintegration, whereas this might not be the case for a novice[32].

AVOIDING A DROP IN PERFORMANCE

If an athlete must lose more than 5% of his/her body mass in less than a week to return to a certain category, she/he must be aware of the possible health risks and the fact that performance may not be good as expected.
A gradual weight loss (about 1kg/week) would produce better results both in terms of body composition and performance, but the athlete's schedule rarely allows it. Rapid weight loss should ideally aim, however, at a reduction in body fat, muscle atrophy and dehydration. This is why **strength training and the supplementation of BCAAs** during the Rapid Weight Loss phase is useful to preserve muscle mass as much as possible.

Moreover, the diet followed, albeit hypocaloric, should maintain **high carbohydrate levels, higher than 50%** of the total calories.
After a weigh-in it is recommended to consume a lot of fluids and electrolytes, and to take sustained amounts of carbohydrates. If the period between the weigh-in and the competition is very long, creatine supplementation may also be useful.

Finally, if the period between the weigh-in and the start of the competition is less than **3 hours**, then perhaps it is not appropriate to prepare for that competition with a rapid drop in weight, either through dehydration or by cutting carbohydrates: there would not be enough time.

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Bibliography

1. *Alderman BL, Landers DM, Carlson J, Scott JR* – FACTORS RELATED TO RAPID WEIGHT LOSS PRACTICES AMONG INTERNATIONAL-STYLE WRESTLERS - Med Sci Sports Exerc. – 2004
2. *Kim S, Greenwell C, Andrew DPS., Lee J, Mahony DF* – AN ANALYSIS OF SPECTATOR MOTIVES IN AN INDIVIDUAL COMBAT SPORT: A STUDY OF MIXED MARTIAL ARTS FANS – Sport Marketing Quarterly, v. 17 – 2008
3. *Ko YJ, Kim YK, Valachich J* – MARTIAL ARTS PARTICIPATION: CONSUMER MOTIVATION – International Journal of Sports Marketing & Sponsorship, v. 6 – 2010
4. *Artioli GG, Gualano B, Franchini E, Scagliusi FB, Takesian M, Fuchs M, Lancha AH JR* – PREVALENCE, MAGNITUDE, AND METHODS OF RAPID WEIGHT LOSS AMONG JUDO COMPETITORS – Med Sci Sports Exerc. – 2009
5. *Steen SN, Brownell KD* – PATTERNS OF WEIGHT LOSS AND REGAIN IN WRESTLERS: HAS THE TRADITION CHANGED? – Med Sci Sports Exerc. – 1990
6. *Filaire E, Maso F, Degoutte F, Jouanel P, Lac G* – FOOD RESTRICTION, PERFORMANCE, PSYCHOLOGICAL STATE AND LIPID VALUES IN JUDO ATHLETES – International Journal of Sports Medicine – 2001
7. *Kiningham RB, Gorenflo DW* – WEIGHT LOSS METHODS OF HIGH SCHOOL WRESTLERS – Med Sci Sports Exerc. – 2001
8. *Cadwallader AB, de la Torre X, Tieri A, Botrè F* – THE ABUSE OF DIURETICS AS PERFORMANCE-ENHANCING DRUGS AND MASKING AGENTS IN SPORT DOPING: PHARMACOLOGY, TOXICOLOGY AND ANALYSIS – British Journal of Pharmacology – 2010
9. *Wroble RR, Moxley DP* – WEIGHT LOSS PATTERNS AND SUCCESS RATES IN HIGH SCHOOL WRESTLERS – Medicine and Science in Sports and Exercise – 1998
10. *Artioli GG, Franchini E, Nicastro H, Sterkowicz S, Solis M, Lancha AH* – THE NEED OF A WEIGHT MANAGEMENT CONTROL PROGRAM IN JUDO: A PROPOSAL BASED ON THE SUCCESFULL CASE OF WRESTLING – Journal of the International Society of Sports Nutrition - 2010
11. *Hall CJ, Lane AM* – EFFECTS OF RAPID WEIGHT LOSS ON MOOD AND PERFORMANCE AMONG AMATEUR BOXERS – Br J Sports Med – 2001
12. *Degoutte F, Jouanel P, Bègue RJ, Colombier M, Lac G, Pequignot JM, Filaire E* – FOOD RESTRICTION, PERFORMANCE, BIOCHEMICAL, PSYCHOLOGICAL, AND ENDOCRINE CHANGES IN JUDO ATHLETES – Int J Sprts Med - 2004
13. *Fogelholm GM, Koskinen R, Laakso J, Rankinen T, Ruokonen I* – GRADUAL AND RAPID WEIGHT LOSS: EFFECTS ON NUTRITION AND PERFORMANCE IN MALE ATHLETES – Medicine and Science in Sports and Exercise – 1992
14. *McMurray RG, Proctor CR, Wilson WL* – EFFECT OF CALORIC DEFICIT AND DIETARY MANIPULATION ON AEROBIC AND ANAEROBIC EXERCISE – Int J Sports Med -1991
15. *Smith M, Dyson R, Hale T, Hamilton M, Kelly J, Wellington P* – THE EFFECTS OF RESTRICTED ENERGY AND FLUID INTAKE ON SIMULATED AMATEUR BOXING PERFORMANCE – International Journal of Sport Nutrition and Exercise Metabolism - 2001
16. *Pernow B, Saltin B* – AVAILABILITY OF SUBSTRATES AND CAPACITY FOR PROLONGED HEAVY EXERCISE IN MAN – J Appl Physiol – 1971

17. *Jacobs I, Tesch PA* SHORT TIME, MAXIMAL MUSCULAR PERFORMANCE: RELATION TO MUSCLE LACTATE AND FIBRE TYPE IN FEMALES – Medicine and Sports – 1981
18. *Inbar O, Bar-Or O, Dotan R* – AEROBIC AND ANAEROBIC COMPONENTS OF A THIRTY SECOND SUPRAMAXIMAL CYCLING TASK – Med Sci Sports Exerc – 1976
19. *Heighenhauser GJ, Sutton JR, Jones NL* – EFFECT OF GLYCOGEN DEPLETION ON THE VENTILATORY RESPONSES TO EXERCISE – J Appl Physiol – 1983
20. *Hickner RC, Horswill CA, Welker JM, Scott J, Roemmich JN, Costill DL* – TEST DEVELOPMENT FOR THE STUDY OF PHYSICAL PERFORMANCE IN WRESTLERS FOLLOWING WEIGHT LOSS – Int J Sports Med - 1991
21. *Jacobs I* – LACTATE CONCENTRATIONS AFTER SHORT, MAXIMAL EXERCISE AT VARIOUS GLYCOGEN LEVELS – Acta Physiol Scand – 1981
22. HYPERTHERMIA AND DEHYDRATION-RELATED DEATHS ASSOCIATED WITH INTENTIONAL RAPID WEIGHT LOSS IN THREE COLLEGIATE WRESTLERS – NORTH CAROLINA, WISCONSIN, AND MICHIGAN, NOVEMBER-DECEMBER 1997
23. *Foghelholm GM* – EFFECTS OF BODYWEIGHT REDUCTION ON SPORT PERFORMANCE – Sports Medicine - 1994
24. *Houston ME, Marrin DA,Green HJ, Thomson JA* – THE EFFECT OF RAPID WEIGHT LOSS ON PHYSIOLOGICAL FUNCTIONS IN WRESTLERS – Physician Sportsmed – 1981
25. *Horswill CA* – APPLIED PHYSIOLOGY OF AMATEUR WRESTLING – Int J Sports Med – 1992
26. *Smith MS, Dyson R, Hale T, Harrison JH, McManus P* – THE EFFECTS IN HUMANS OF RAPID LOSS OF BODY MASS ON A BOXING-RELATED TASK – Eur J Appl Physiol – 2000
27. *Agel J, Ransone J, Dick R, Oppliger R, Marshall SW* – DESCRIPTIVE EPIDEMIOLOGY OF COLLEGIATE MEN'S WRESTLING INJURIES: NATIONAL COLLEGIATE ATHLETIC ASSOCIATION INJURY SURVELLAINCE SYSTEM, 1988-1989 through 2003-2004 – Journal of Athletic Training – 2007
28. *Green CM, Petrou MJ, Fogarty-Hover ML, Rolf CG* – INJURIES AMONG JUDOKAS DURING COMPETITION – Scandinavian Journal of Medicine & Science in Sports – 2007
29. *Oöpik V, Pääsuke M, Sikku T, Timpmann S, Medijainen L, Ereline J, Smirnova T, Gapejeva E* – EFFECT OF RAPID WEIGHT LOSS ON METABOLISM AND ISOKINETIC PERFORMANCE CAPACITY. A CASE OF STUDY OF TWO WELL TRAINED WRESTLERS – Journal of Sports Medicine and Physical Fitness – 1996
30. *Horswill CA, Park SH, Roemmich JN* – CHANGES IN THE PROTEIN NUTRITIONAL STATUS OF ADOLESCENT WRESTLERS - Medicine and Science in Sports and Exercise – 1989
31. *McCargar LJ, Crawford SM* – METABOLIC AND ANTHROPOMETRIC CHANGES WITH WEIGHT CYCLING IN WRESTLERS – Medicine and Science in Sports and Exercise – 1992
32. *Artioli GG, Iglesias RT, Franchini E, Gualano B, Kashiwagura DB, Solis MY, Benatti FB, Fuchs M, Lancha AH J* – RAPID WEIGHT LOSS FOLLOWED BY RECOVERY TIME DOES NOT AFFECT JUDO-RELATED PERFORMANCE – Journal of Sports Sciences - 2010

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MOTION AND MUSCLE ACTIVITY ARE AFFECTED BY INSTABILITY LOCATION DURING A SQUAT EXERCISE

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INTRODUCTION

Combining a typical resistance training exercise with an instability device, including an unstable surface (e.g., a BOSU ball or Swiss ball) has become increasingly popular in exercise training programs. The perceived training benefits of using instability devices include: increased muscle coactivation with lower force production (4), increased core activation when comparing similar exercises performed on a stable surface (21,23), and strength gains due to neural adaptations (2). It is generally accepted that instability devices are not recommended when the primary objective of the training is to increase strength through muscle hypertrophy (3) or to improve force and power output (12,28). However, the use of instability devices has been recommended for rehabilitation purposes (6,11,21).

When performing a squat exercise with an instability device, a number of options are available to generate an interface between the user and the device. Instability devices have included foam surfaces (12), inflatable disks (1), and a BOSU ball with the dome-side down (8) and up (24). Using these types of devices, instability is generated from a bottom-up approach. The effect of using a top-down instability device, which introduces instability at the hands or upper body, compared with the bottom-up instability, remains unclear.
Previous findings of muscle activation in both the lower extremities and the trunk during a squat movement using instability devices have yielded inconsistent results. McBride et al. (16) found decreases in both force production and averaged integrated electromyography (EMG) values of vastus medialis, biceps femoris, and medial gastrocnemius during isometric squats on an unstable surface (inflated disk beneath each foot). Similarly, Anderson and Behm (1) did not find increases in EMG activity of biceps femoris or vastus lateralis comparing squats with 2 inflatable disks under the feet, with a regular bar on the ground, or while using a Smith machine. Conversely, Youdas et al. (27) found increases in hamstring activity in both men and women surface (foam pad) compared with a stable surface. Anderson and Behm (1) showed greater trunk activation (upper and lower erector spinae, and lower abdominals) during unstable squatting; however, this was contrary to McBride et al. (17) who found no differences in upper erector spinae (at L_1) during stable and unstable squatting using both absolute and relative loads.

The use of instability devices can also enhance an athlete's training regime based on the principle of training specificity, where it is recommended that athletes train the movements of their sport in the same environment as they compete (2,3). An example of this would be training on a BOSU ball to enhance surfing performance, as this is performed on an unstable surface. However, many sports are played on a stable ground with perturbations occurring from the top-down (e.g., body check in hockey, shoulder-to-shoulder hit in football) resulting in destabilization of the trunk from the upper body as opposed to the lower body. To implement unstable training from a top-down perspective, a novel device called the Attitube was created. Briefly, the Attitube is a cylinder that is half-filled with water and uses the natural free-flowing movement of the water to provide instability, which can be placed in the hands or across the shoulders.

The main purpose of this exploratory study was to compare the effects of instability location during a squat exercise on trunk and lower extremity muscle activation patterns and kinematics. Squat exercises were completed under 3 conditions: (i) stable load on a stable surface, (ii) stable load on an unstable surface, and (iii) unstable load on a stable surface. Three-dimensional (3D) motion of the ankle, knee, hip, and trunk were captured, and the velocity of the Bar/Attitube. Additionally, electromyograms were recorded from 12 bilateral muscles of the trunk and lower extremities, and all kinematic and EMG measures were compared between instability devices. It was hypothesized that the activation in the trunk musculature would increase during condition 3 (unstable load, stable surface), whereas condition 2 (stable load, unstable surface) would increase the activation of the lower extremities. For the kinematics, it was speculated that condition 3 would result in the greatest amount of trunk flexion

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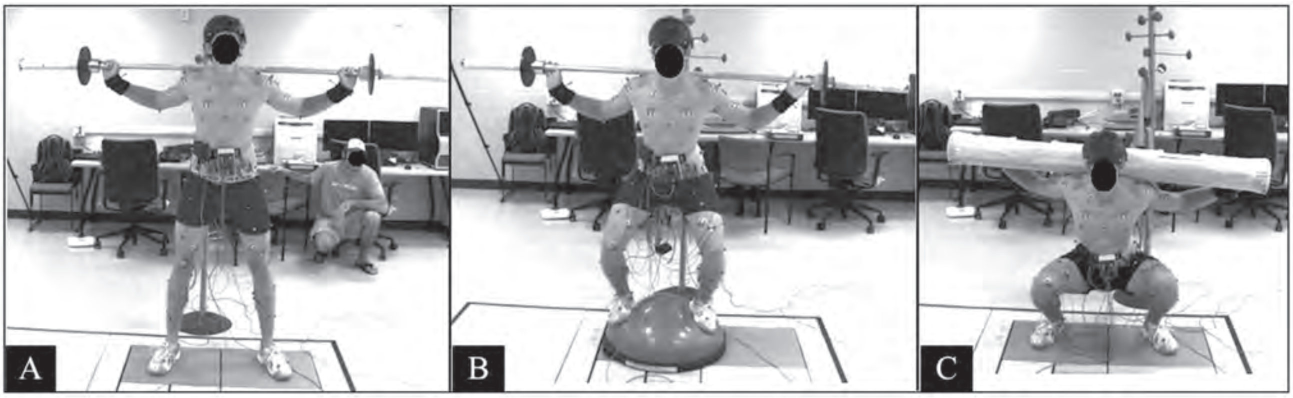

Figure No. 1
Photograph of the equipment used during various stages of the squat exercise.
(A) The Olympic bar during upright, (B) the Olympic bar on the BOSU ball at 50% of the eccentric phase, and (C) the Attitube at peak squat depth.

with the slowest velocity; however, the results of the kinematic data were mainly used to elaborate on explaining the mechanisms behind the electro-myographical activity.

METHODS

Experimental Approach to the Problem

Subjects performed 3 repetitions of a squat exercise under 3 conditions: (a) standard Olympic bar on the floor (BAR); (b) standard Olympic bar on the dome-side of a BOSU ball (BALL); and (c) the Attitube on the floor (TUBE). No detailed instructions on positioning or timing (velocity) were given, as these were dependent variables. Specifically, 3D joint angles from the ankle, knee, hip, and trunk, and vertical velocity of the Bar/Attitube were analyzed along with muscle activation from 24 electrode sites. The eccentric and concentric phases of the squat exercise were each analyzed in 25% intervals for a total of 8 intervals. The intervals and the device conditions were the independent variables.

Subjects

Ten male subjects from a university population were recruited with mean ± *SD* age, mass, and height of 21 ± 3 years, 83.4 ± 14.4 kg, and 1.86 ± 0.09 m, respectively. The age range was 17–28 years. Subjects were free of back pain and recent injury requiring time off of school/work at least 1 year before the collection date. All subjects worked out a minimum of 3 times per week and free-weight squat exercise was a regular component of their workout. The university's research ethics board approved this study and informed consent documents were signed by participants prior to collection. For minimal risk research involving participants 16 years of age and older, parental consent is not required in Canada.

Procedures

Equipment. The Attitube is a cylinder measuring 1.58 m in length and 0.16 m in diameter and weighs 22.68 kg when half-full, which matched the mass of the weighted Olympic bar (21). The Olympic bar measured 2.19 m in length and had a diameter of 0.045 m, whereas the BOSU ball measured 0.625 m in diameter and was 0.20 m in height when unloaded. Before data collection, each participant was given the opportunity to familiarize themselves with the Attitube by practicing with the device outside of the laboratory. Also, before beginning data collection, participants were given another chance to perform a couple of repetitions with the Attitube and the BOSU ball. The authors were able to observe the participants' squat technique during the familiarization session and therefore were confident with each individual's ability to perform the movement. The different instability devices at various stages of the squat are presented in Figure 1: starting position during BAR (Figure 1A), ~50% of the eccentric phase during BALL (Figure 1B), and at peak squat depth during the TUBE (Figure 1C).

Data Collection. All kinematic and EMG data were collected using Vicon Nexus software (Vicon Systems, Ltd., Oxford, United Kingdom). Kinematic data were sampled at 50 Hz, whereas EMG signals were differentially amplified (frequency response 10–1000 Hz, common mode rejection 115 dB at 60 Hz, input impedance 10 GΩ; 3 of model AMT-8; Bortec, Calgary, Canada) and converted from an analog to digital signal at a rate of 2,500 Hz.

After skin preparation, pairs of bipolar silver/silverchloride EMG electrodes with a center-to-center spacing of 2.5 cm (Ambu Blue Sensor N; Ambu A/S, Denmark) were applied bilaterally to 12 muscles of the trunk and lower extremities. Electrodes were placed over the largest portion of the muscle belly of the left (L) and right (R) rectus abdominis (RA) (18), external oblique (EO) (18), internal oblique (IO) (18), latissimus dorsi (LD) (18), upper erector spinae (UES) (18), lower erector spinae (LES) (18), gluteus maximus (GMAX) (26), gluteus medius (GMED) (26), rectus femoris (RF) (26), biceps femoris (BIF) (26), medial gastrocnemius (MGAS) (26), and vastus medialis (VMED) (29). After electrode placement, a 5-minute rest trial was performed with subjects lying supine on a therapy table, and the final 30 seconds were recorded.

Subjects then performed manually resisted maximum voluntary contractions (MVCs) for each muscle to elicit a maximum EMG value to be used for normalization. The trunk muscles used a back extension off a therapy table for UES and LES (18), a modified sit-up for the abdominals (RA, EO, IO) (18), and a lateral pull-down for LD (11). The lower extremity MVCs were performed in the manual muscle testing postures outlined by Kendall et al. (15). The MVC for the quadriceps (VMED, RF) was from a seated knee extension, whereas knee flexion and hip extension from prone were used for BIF and GMAX, respectively. A standing toe-raise with downward resistance at the shoulders was performed for MGAS and side-lying abduction was used for GMED. To minimize effects of fatigue, a rest period of 3–5 minutes between MVC trials was provided.

After completion of the MVC protocol, 75 reflective markers were placed over bony landmarks and in clusters to allow for segment definition and tracking with a 7-camera VICON MX40 motion-capture system (Vicon Systems Ltd., Oxford, United Kingdom). The anatomical markers were placed according to the Visual 3D full-body marker set recommendations (Visual 3D v.4 software; C-Motion, Inc., Germantown, MD, USA). Five markers were also attached to both the Olympic bar and Attitube (2 at either end and 1 near the center) to allow for analysis of the Bar/Attitube velocity.

Subjects then performed 3 consecutive squat repetitions for each of the 3 conditions: BAR, BALL, and TUBE, which were completed in a random order. No specific instructions were given on how to complete each of the squat tasks (e.g., body positioning, timing); subjects were instructed to perform the exercise as they normally would during their regular workout.

Data Processing. Kinematic and EMG data were processed using Visual 3D v.4 software (C-Motion, Inc., Germantown, MD, USA). The marker data were used to define and track the foot, shank, thigh, pelvis, head, and trunk (acromion to iliac crest) segments. Joint angles from the ankle, knee, hip, absolute trunk angles, and trunk angles relative to the pelvis were calculated for each plane of motion according to the right-hand rule using a flexion/extension-lateral bend-axial twist rotation sequence (Table 1). Vertical velocity of the center of gravity of the Bar/Attitube was also calculated, with the positive being upward.

Raw EMG signals were dual-passed with a Butterworth high-pass filter at a 30-Hz cut-off to attenuate heart rate contamination (10) followed by full-wave rectification and

low-pass filtering with a fourth order Butterworth filter with a cut-

Table No. 1
SUMMARY OF POSITIVE JOINT ANGLE MOVEMENT IN EACH PLANE.

Positive joint angles	Frontal plane	Sagittal plane	Transverse plan
Ankle	Eversion	Dorsiflexion	Forefoot
			Adduction
Knee	Adduction	Flexion	Internal Rotation
Hip	Adduction	Flexion	Internal Rotation
Trunck	Right Lateral Bend	Flexion	Left Axial Rotation

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off frequency of 6 Hz to produce the linear envelope of the signal. Each channel of EMG had the rested trial bias removed and was normalized to the maximum value obtained during the appropriate MVC exercise, resulting in the EMG signal being expressed as a percentage of MVC (%MVC).

Each lift was separated into the eccentric (ECC) and concentric (CON) phases by determining the point at which the velocity of the Olympic bar or Attitube reached zero. For analysis purposes, a mean value was calculated at 25% intervals (0–25%, 25–50%, 50–75%, and 75–100%) for each of the 2 phases. For each participant, the 3 repetitions were averaged at each interval to provide a single representation of the squat movement, resulting in a total of 8 values (4 intervals 3 2 phases) for each kinematic and EMG measure.

Statistical Analyses

The Statistical Package for the Social Sciences (SPSS, version 17.0; SPSS, Inc., Chicago, IL, USA) was used for all analyses.Initially, a 2 x 3 x 8 (side [L, R] x device [BAR, BALL, TUBE] x interval [0–25% ECC through 75–100% CON]) repeated measures analysis of variance (RM-ANOVA) was run on each dependent measure. If no effect of side was present, left and right were averaged within subjects and rerun as a 3 x 8 (device x interval) RM-ANOVA. This resulted in 3 x 8 RM-ANOVA being used for each muscle, except LD and UES; all 3 planes for trunk and ankle angles, frontal and transverse plane knee angle, transverse plane hip angle, and the vertical velocity of the Bar/Attitube. A 2 x 3 x 8 RM-ANOVA was used for sagittal knee angles, sagittal and frontal planes of the hip angles, and LD and UES muscles. All differences were considered significant at $p \leq 0.05$ and significant *F*-tests were further analyzed pairwise using a Bonferroni correction. If sphericity was violated, Greenhouse-Geisser corrections were used to determine the degrees of freedom. Intraclass correlations (ICCs) using a 2-way model were performed across the 8 intervals (from 0 to 25% ECC to 75–100% CON) for each dependent measure and condition. For example, biceps femoris in the BAR condition was considered one ICC calculation. This was repeated in each condition for each measure of EMG and kinematic measures in each plane of motion.

RESULTS

Generally, the TUBE decreased ES and GMAX activation while increasing activation in the abdominals, and the BALL condition had the greatest effect on the lower extremities by increasing activation in RF, VMED, BIF, and MGAS. In terms of kinematics, the TUBE decreased trunk flexion, the BALL increased ankle eversion, and both TUBE and BALL trials were performed with a slower vertical velocity than the BAR. Additionally, the peak knee flexion angle did not differ between devices, confirming that the depths of the squat were similar across all conditions.

Electromyography-Trunk Muscles

Both upper and lower ES muscles had lower activation with the TUBE

as shown through significant interactions between device and interval ($F_{14,126} > 1.98$, $p < 0.024$). In UES, no differences were found between the left and right sides for any interval ($p > 0.190$), although the left side showed up to 1.4 times more activation in the BAR than the TUBE at 50–75% ECC through 0–25% CON ($p < 0.033$) (Figure 2). Additionally in LES, the BALL condition had up to 1.5 times greater activation than the TUBE at the beginning (0–25% ECC) and end (25–100% CON) of the movement ($p < 0.018$).

Conversely, the TUBE condition showed higher activation in the abdominal muscles, with a significant interaction between the device and interval on RA ($F_{14,126} = 4.91$, $p < 0.001$) and a significant main effect of device on both EO ($F_{1.09,9.81} = 8.60$, $p = 0.014$) and IO ($F_{2,18} = 5.85$, $p < 0.011$).

Activation of RA was up to 3.3 times greater in the TUBE than in the BALL during the first (0–25% ECC, $p = 0.004$) and last (75–100% CON, $p = 0.01$) intervals. In the oblique muscles, the TUBE condition had 2.8 times greater EO activation than the BAR ($p = 0.045$) and 1.5 times greater IO activation than the BALL condition ($p = 0.036$).

Electromyography

Lower Extremity

The 3 x 8 ANOVA for GMAX, RF, VMED, BIF, and MGAS %MVC each revealed significant interactions between the device and interval ($F_{14,126} > 1.97$, $p < 0.025$). The activation patterns of GMAX were similar during the ECC phase; however, through the middle half of the CON phase (25–75% CON) the activation during the BAR was up to 1.3 times greater than during the TUBE ($p < 0.023$) (Figure 3). Rectus femoris, VMED, and BIF all started with up to 1.9 times greater activation during the BALL condition compared with the BAR at 0–25% ECC ($p < 0.038$). The BALL also showed up to 1.9 times more activation than the TUBE from 0 to 50% ECC in RF, 0–25% ECC in VMED, and 25–50% ECC in BIF ($p < 0.014$). Likewise, the end of the trials (75–100% CON in VMED and 50–100% CON in BIF) showed up to 1.5 times greater activation in the BALL than in the TUBE conditions ($p < 0.029$). Furthermore, using the BALL resulted in increased MGAS activation up to 3.4 times greater than that of the BAR from 0 to 50% ECC and up to 2.6 times greater than the TUBE from 25 to 75% ECC ($p < 0.039$) (Figure 4).

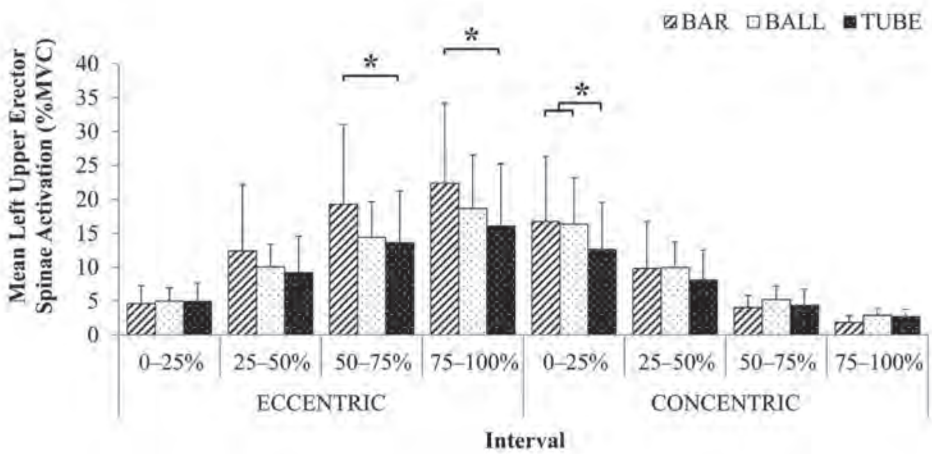
Kinematics

The absolute trunk flexion angle decreased with the TUBE as shown by the significant interaction ($F_{14,126} = 9.24$, $p < 0.001$) (Figure 5). From 50–75% ECC through 0–25% CON, the TUBE showed up to 1.2 times less flexion than both the BAR and BALL conditions ($p < 0.027$). Flexion was also up to 1.2 times less in the TUBE than in the BALL at 25–50% ECC and from 25 to 75% CON ($p < 0.018$) (Figure 5). Relative trunk flexion was 1.5 times less in the TUBE than in the BALL at 25–50% CON ($p = 0.046$), and no other effects of the device on the trunk angle were found in any plane, including frontal and transverse, for both absolute ($p > 0.06$) and relative ($p > 0.23$) angles.

Motion at the ankle was primarily affected by the BALL condition. A main effect of the device on frontal plane motion ($F_{1.07,9.61} = 49.02$, $p < 0.001$) showed that the BALL had up to 4.2 times more eversion than both BAR and TUBE ($p < 0.001$). An interaction of the device and the interval was found for sagittal ankle motion ($F_{18,162} > 4.14$, $p < 0.001$) with dorsiflexion being generally reduced in the BALL from 50 to 75% ECC to 25–50% CON, and reaching a significant difference of

Figure No. 2

MEAN (SD) PERCENTAGE OF MAXIMUM VOLUNTARY CONTRACTION (%MVC) OF LEFT UPPER ERECTOR SPINAE AT EACH INTERVAL. SIGNIFICANT DIFFERENCES BETWEEN DEVICES ARE SHOWN WITH AN ASTERISK (*) AT P ≤ 0.05.



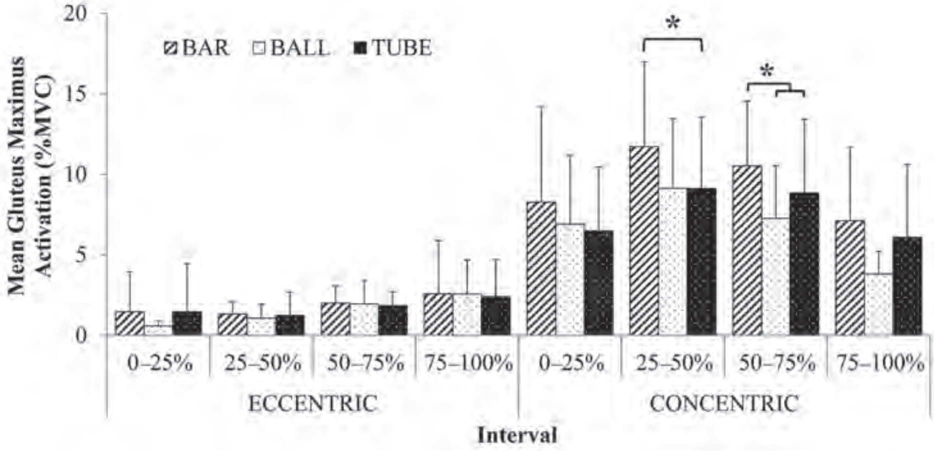


Figure No. 3
Mean (SD) percentage of maximum voluntary contraction (%MVC) of gluteus maximus at each interval. Significant differences between devices are shown with an asterisk (*) at p ≤ 0.05.

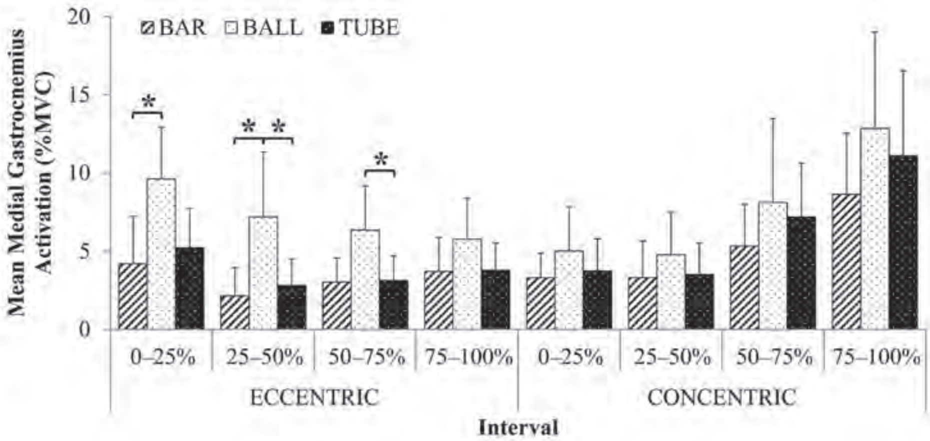


Figure No. 4
Mean (SD) percentage of maximum voluntary contraction (%MVC) of medial gastrocnemius at each interval. Significant differences between devices are shown with an asterisk (*) at p ≤ 0.05.

1.2 times less dorsiflexion in the BALL than in the TUBE at 75–100% ECC (p = 0.043). No significant differences were found for forefoot abduction/ adduction motion (p > 0.163).

Movement at the knee showed variable results, as there were no effects found in the frontal plane (p > 0.483), a 3-way interaction in the sagittal plane ($F_{14,126}$ = 1.79, p = 0.048), and a main effect of device ($F_{2,18}$ = 5.74, p = 0.012) in the transverse plane. Left knee flexion was up to 5.008 greater than right knee flexion in the BALL and TUBE conditions (p < 0.049), yet both sides had identical interval patterns. At the start (0–25% ECC) and end (75–100% CON) of the trial, knee flexion was up to 1.8 times greater in the BALL than in both BAR and TUBE conditions (p < 0.044). However, the peak of the squat depth (75–100% ECC and 0–25% CON) did not differ across the devices (p > 0.071). The velocity of the Bar/Attitube throughout the entire squat movement was lower with the TUBE and BALL as shown by a significant interaction between the device and interval ($F_{14,126}$ = 9.19, p , 0.001) (Figure 6).

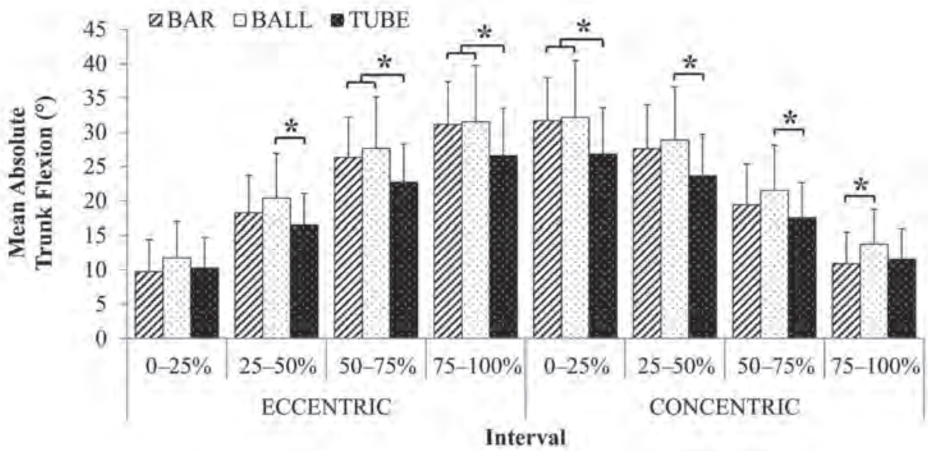


Figure No. 5
Mean (SD) absolute trunk flexion (8) at each interval. Significant differences between devices are shown with an asterisk (*) at p ≤ 0.05.

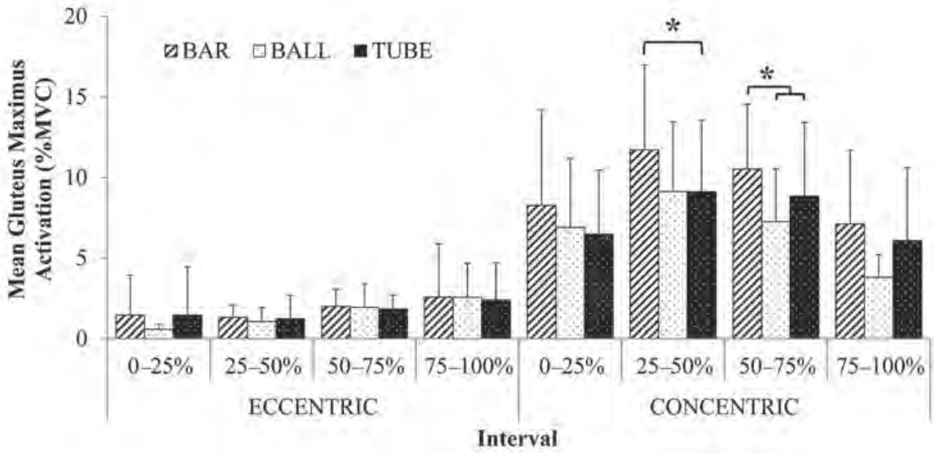


Figure No. 6
MEAN (SD) VERTICAL VELOCITY OF THE CENTER OF GRAVITY OF THE BAR/ATTITUBE ($M\cdot S^{-1}$) AT EACH INTERVAL. SIGNIFICANT DIFFERENCES BETWEEN DEVICES ARE SHOWN WITH AN ASTERISK (*) AT $P \leq 0.05$.

The BAR was performed up to 2.1 times faster than the TUBE at all intervals ($p < 0.043$) and up to 1.3 times faster than the BALL from 25 to 75% ECC ($p < 0.038$). Also, the BALL was 2.0 times faster than the TUBE at the beginning of the trial (0–25% ECC, $p = 0.003$) (Figure 6).

Intraclass Correlations

The ICC r values were considered moderate, strong, and very strong between 0.400–0.599, 0.600–0.799, and 0.800– 1.00, respectively (22). Overall, the EMG ICCs ranged from $r = 0.701$ to $r = 0.976$, and the kinematic ICCs ranged from $r = 0.727$ to $r = 0.999$, indicating strong to very strong reliability of the measures. Specific to each condition, the EMG ICCs ranged from $r = 0.701$ to $r = 0.948$, $r = 0.787$ to $r = 0.976$, and $r = 0.778$ to $r = 0.972$ in the BAR, BALL, and TUBE conditions, respectively. Similarly, the kinematic ICCs ranged from $r = 0.747$ to $r = 0.997$, $r = 0.893$ to $r = 0.999$, and $r = 0.727$ to $r = 0.996$ in the BAR, BALL, and TUBE conditions, respectively.

DISCUSSION

The squat exercise is commonly used within strength and rehabilitation training programs, often including the use of instability devices designed to create an interface between the user and a labile surface located under the feet. This is the first study to analyze the squat exercise using an uneven distribution of mass, which is designed to create top-down instability. Top-down instability could allow for greater specificity of training than the traditional bottom-up instability practices, depending on the parameters of the sport in question.

Generally, the TUBE condition resulted in less trunk flexion and decreased activation levels of ES muscles while increasing the activation of the abdominals. These findings resulted in a partial acceptance of the first hypothesis in that activation of the anterior trunk muscles increased while that of the posterior trunk muscles decreased. The second hypothesis was accepted as the BALL condition tended to increase muscle activation of the lower extremities with the exception of GMAX, which was higher during the stable BAR trial. The quadriceps, hamstrings, and calf muscles all started with greater activation on the BALL through at least the first 25% of the eccentric phase, indicating their role to maintain balance in an unstable condition during the initiation of the movement. Biceps femoris continued this pattern during the latter half of the

concentric phase, further demonstrating the effects of the BALL on the lower limb musculature. Additionally, the frontal plane motion at the ankle was likely due to the design of the BALL itself, thus forcing the subjects into eversion while standing on the BALL (Figure 1B). This could have implications for both strength and balance training programs specifically designed to target the functional stability of the ankle, as balance training has been suggested to improve postural control after lateral ankle sprains (14).

The decreased ES activity during the TUBE trial likely stems from the observed decrease in trunk flexion when compared with the BAR and BALL trials, which showed greater ES activation with more flexion (Figures 2 and 5). Interestingly, even with the reduced trunk flexion observed during the TUBE trial, the trunk flexors (RA, EO, and IO) showed higher activation patterns. This highlights some of the functional differences that the top-down instability offers. The stable (Olympic) bar did not place much demand on the trunk flexors, as the extensors were the most activated to maintain trunk position.

However, the uneven distribution of mass from the free-flowing water tended to place a greater demand on the flexors, which could result in loading "penalties" associated with maintaining spinal stability. Likewise, an increase in trunk flexion from the BAR and BALL trials would lead to an increased extensor moment, also resulting in larger compression and shear forces at the low back. As spinal loading was not measured directly or indirectly, it remains unclear as to which instability device places the greater loading demand on the low back.

In terms of loading, Willardson et al. (25) found no differences in trunk EMG activity during a squat movement between 50% of 1-repetition maximum (1RM) on a BOSU ball and 50% and 75% of 1RM on a stable surface, suggesting that the load itself was a primary factor for altering muscle activation as opposed to the surface. In the current study, it was found in the TUBE trial that abdominal activation increased compared with that in the BAR, even at the same low-level loads. This further highlights some of the differences between the top-down versus the bottom-up instability approach.

Athletes do not require instability devices for strength gain benefits; however, in a general or rehabilitative population, there may be associated health benefits (6). Recently, Desai and Marshall (9) compared trunk muscle activation (RA, EO, and LES) during unweighted squats with 2 air disks under the feet of those with low back pain and those without back pain. The back pain group showed inconsistent results (both increases and decreases of ES activity), and therefore it was concluded that a labile surface may not help rehabilitate the pain group because of adaptive patterns of muscle activation (9). The labile surface affected whole-body balance, not necessarily EMG activity, and could increase the risk of falling (9). Additionally, Miletello et al. (20) found that novices were faster during descent and slower during ascent in a stable squat of 1RM, with the increased acceleration leading to increased risk of knee injury. Furthermore, it has also been suggested that low back muscle endurance is also important to consider, with increased repetitions of less demanding exercises providing low-back health benefits (19). Perhaps using a top-down instability device could be a viable rehabilitation tool option as lower ES activation (Figure 2) with a slower velocity (Figure 6) was found during the TUBE condition, which could increase the endurance and perhaps provide a challenge to the stabilizers such as quadratus lumborum and multifidus, although further research is required to test the efficacy in a clinical setting.

Other potential benefits of the TUBE condition may be found while learning proper squat technique. Presently, the decreased velocity in both ECC and CON phases of the TUBE condition (Figure 6) could help with technique and lower the injury risk for novices. The decreased velocity of the TUBE likely also explains the activation of GMAX (Figure 3), as less of a muscle "burst" was found during the CON phase. This indicated that potentially more focus was on maintaining balance and technique throughout the movement and further highlighted the potential for using a top-down instability device in conjunction with learning proper squat technique, as opposed to increasing muscle hypertrophy.

A possible confounder of these results could stem from the effects of velocity on movement outcomes. For example, Hatfield et al. (13) found that a squat exercise performed under self-selected pace resulted in increased peak power, force, and volume when compared with an intentionally slow movement. Additionally, Bentley et al. (7) showed that as squat cadence increased, so too did peak ground reaction force. As a result, it is quite possible that the EMG outcomes are a direct result of the velocity of each condition, such as the GMAX activation being greater in the concentric phase of the BAR condition. However, it was also suggested that performing a squat under slow conditions could provide training for muscular endurance (13) which could lead to improvements in health in specific regions, such as the low back (19). Furthermore, it is important to note that any changes in EMG due to changes in velocity are still a direct result of the device itself. Thus, training with an unstable device such as the TUBE will cause a slower velocity, which in turn affects the measurement outcomes.

One of the limitations of this study stems from the methodological design and the use of an absolute load instead of a relative load (21). The reason for the low absolute load of 22.68 kg was primarily for safety concerns as the effects of the Attitube device were unknown. Willardson et al. (25) also noted safety concerns when performing squat exercises on a BOSU ball and limited their participants to 50% of a 1RM, compared with 75% of a 1RM on the stable floor. Also, changing the amount of water/space ratio would have altered the instability of the device on a participant-by-participant basis. Increasing the amount of water in the TUBE would in effect decrease the instability, where a completely full

TUBE would essentially be a stable device. Additionally, the novelty of the experimental conditions could have had an impact on the results. Future work could focus on different loads and different speeds as well as long-term training effects to help further elucidate the effects of using a top-down instability device. Furthermore, objective comparisons of muscle activation across exercise-based studies were difficult to make due to varying methodological differences in EMG processing, such as using the linear envelope as opposed to root mean square analysis over the entire signal. Regardless of this fact, similar trends emerged and comparisons can still be made in terms of general increa-

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ses or decreases in muscle activation according to the type of instability device used.

In summary, the effects of the location of instability during a squat exercise were analyzed in terms of 3D motion and muscle activation patterns of the trunk and lower extremities. Top-down instability came from a waterfilled tube, whereas a BOSU ball provided the bottom-up challenge, with a stable condition also included. The concentric and eccentric phases were both analyzed in 25% intervals (8 total) across all measures. In general, changing the location of instability during a squat exercise changed the kinematic and muscle activation patterns of the trunk and lower extremities. The top-down (TUBE) decreased the GMAX prime mover activation while increasing activation of the abdominal muscles, as well as decreasing the amount of trunk flexion. By contrast, the bottom-up (BALL) increased the activation of the quadriceps and hamstrings and directly altered the movement at the ankle. Additionally, both the TUBE and BALL devices affected the velocity of movement with slower squats performed with unstable devices.

PRACTICAL APPLICATIONS

Performing squat exercises with different training devices are often used to enhance training (2) or facilitate rehabilitation (5). Using a top-down training device highlighted the postural demands in using this type of equipment during a squat exercise as shown through the lower velocity, decreased trunk flexion, and increased abdominal EMG activation. Additionally, the bottom-up device had a direct effect on the lower extremities, indicating the potential importance of the location of the instability when considering specific training goals. Overall, the location of the instability during a squat exercise changed the electromyographic and kinematic patterns, which has implications for learning technique, rehabilitation purposes, and setting specific training goals.

REFERENCES

1. Anderson, KG and Behm, DG. Trunk muscle activity increases with unstable squat movements. *Can J Appl Physiol* 30: 33–45, 2005.Behm, DG. Neuromuscular implications and applications of resistance training. *J Strength Cond Res* 9: 264–274, 1995.
2. Behm, DG and Anderson, KG. The role of instability with resistance training. *J Strength Cond Res* 20: 716–722, 2006.
3. Behm, DG, Anderson, KG, and Curnew, RS. Muscle force and activation under stable and unstable conditions. *J Strength Cond Res* 16: 416–422, 2002.
4. Behm, DG and Colado, JC. The effectiveness of resistance training using unstable surfaces and devices for rehabilitation. *Int J Sports Phys Ther* 7: 226–241, 2012.
5. Behm, DG, Drinkwater, EJ, Willardson, JM, and Cowley, PM. The use of instability to train the core musculature. *Appl Physiol Nutr Metab* 35: 91–108, 2010.
6. Bentley, JR, Amonette, WE, de Witt, JK, and Hagan, RD. Effects of different lifting cadences on ground reaction forces during the squat exercise. *J Strength Cond Res* 24: 1414–1420, 2010.
7. Bressel, E, Willardson, JM, Thompson, B, and Fontana, FE. Effect of instruction, surface stability, and load intensity on trunk muscle activity. *J Electromyogr Kinesiol* 19: e500–e504, 2009.
8. Desai, I and Marshall, PW. Acute effect of labile surfaces during core stability exercises in people with and without low back pain.*J Electromyogr Kinesiol* 20: 1155–1162, 2010.
9. Drake, JDM and Callaghan, JP. Elimination of electrocardiogram contamination from electromyogram signals: An evaluation of currently used removal techniques. *J Electromyogr Kinesiol* 16: 175–187, 2006.
10. Drake, JDM, Fischer, SL, Brown, SHM, and Callaghan, JP. Do exercise balls provide a training advantage for trunk extensor exercises? A biomechanical evaluation. *J Manipulative Physiol Ther* 29: 354–362, 2006.
11. Drinkwater, EJ, Pritchett, EJ, and Behm, DG. Effect of instability and resistance on unintentional squat-lifting kinetics. *Int J Sports Physiol Perform* 2: 400–413, 2007.
12. Hatfield, DL, Kraemer, WJ, Spiering, BA, Ha¨ kkinen, K, Volek, JS, Shimano, T, Spreuwenberg, LPB, Silvestre, R, Vingren, JL, Fragala, MS, Gomez, AL, Fleck, SJ, Newton, RU, and Maresh, CM. The impact of velocity of movement on performance factors in resistance exercise. *J Strength Cond Res* 20: 760–766, 2006.
13. Hertel, J. Functional instability following lateral ankle sprain. *Sports Med* 29: 361–371, 2000.
14. Kendall, FP, McCreary, EK, Provance, PG, Rodgers, MM, and Romani, WA. *Muscles: Testing and Function With Posture and Pain.*(5th ed.). Baltimore, MD: Lippincott Williams & Wilkins, 2005.
15. McBride, JM, Cormie, P, and Deane, R. Isometric squat force output and muscle activity in stable and unstable conditions. *J Strength Cond Res* 20: 915–918, 2006.
16. McBride, JM, Skinner, JW, Schafer, PC, Haines, TL, and Kirby, TJ. Comparison of kinetic variables and muscle activity during a squat vs. a box squat. *J Strength Cond Res* 24: 3195–3199, 2010.
17. McGill, SM. Electromyographic activity of the abdominal and low back musculature during the generation of isometric and dynamic axial trunk torque: Implications for lumbar mechanics. *J Orthop Res* 9: 91–103, 1991.
18. McGill, SM. Low back exercises: Evidence for improving exercise regimens. *Phys Ther* 78: 754–765, 1998.
19. Miletello, WM, Beam, JR, and Cooper, ZC. A biomechanical analysis of the squat between competitive collegiate, competitive high school, and novice powerlifters. *J Strength Cond Res* 23: 1611– 1617, 2009.
20. Nairn, BC, Sutherland, CA, and Drake, JDM. Location of instability during a bench press alters movement patterns and electromyographical activity. *J Strength Cond Res* 29: 3162–3170, 2015.
21. Swinscow, TDV. Correlation and regression. In: *Statistics at Square One* (9th ed.): BMJ Publishing Group, 1997. pp. 75–85. Avaiable at: http://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one. Accessed May 4, 2015.
22. Vera-Garcia, FJ, Grenier, SG, and McGill, SM. Abdominal muscle response during curl-ups on both stable and labile surfaces. *Phys Ther* 80: 564–569, 2000.
23. Wahl, MJ and Behm, DG. Not all instability training devices enhance muscle activation in highly resistance-trained individuals. *J Strength Cond Res* 22: 1360–1370, 2008.
24. Willardson, JM, Fontana, FE, and Bressel, E. Effect of surface stability on core muscle activity for dynamic resistance exercises. *Int J Sports Physiol Perform* 4: 97–109, 2009.
25. Winter, DA and Yack, HJ. EMG profiles during normal human walking: Stride-to-stride and inter-subject variability. *Electroencephalogr Clin Neurophysiol* 67: 402–411, 1987.
26. Youdas, JW, Hollman, JH, Hitchcock, JR, Hoyme, GJ, and Johnsen, JJ. Comparison of hamstring and quadriceps femoris electromyography activity between men and women during a single-limb squat on both a stable and labile surface. *J Strength Cond Res* 21: 105–111, 2007.
27. Zemkova´, E, Jelenˇ , M, Kova´cˇikova´, Z, Olle´, G, Vilman, T, and Hamar, D. Power outputs in the concentric phase of resistance exercises performed in the interval mode on stable and unstable surfaces. *J Strength Cond Res* 26: 3230–3236, 2012.
28. Zipp, P. Recommendations for the standardization of lead positions in surface electromyography. *Eur J Appl Physiol Occup Physiol* 50: 41–54, 1982.

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RELIABILITY OF THE ONE-REPETITION-MAXIMUM POWER CLEAN TEST IN ADOLESCENT ATHLETES

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INTRODUCTION

Resistance training has consistently demonstrated to be a safe and effective mode of exercise for children and adolescents provided that age-appropriate training guidelines are followed, and
qualified instruction is available (10,25). Current public health objectives now aim to increase the number of school-age youth who participate in muscle strengthening activities, and the qualified acceptance of youth resistance training by medical and fitness organizations is becoming universal (3,9,23,29). However, methods for evaluating strength and power in younger populations remain controversial. Although 1-repetition maximum (1RM) testing is supported by the National Strength and Conditioning Association (NSCA) and has been used by researchers to assess muscular fitness in healthy children and adolescents (7,9,15,31), some observers remain opposed to maximal lifting in younger populations because of the presumption that high-intensity loading may cause structural damage (2). These differing views reported in the literature have resulted in ambiguity surrounding the issue of strength and power testing in youth. Moreover, little is known about the reliability of muscular fitness testing in young lifters.

In adult athletes, test criteria such as the 1RM power clean are routinely used to develop individualized programs and assess the effectiveness of a training cycle (16,20). The 1RM power clean assessment is unique because it can be used to test strength and power. Unlike traditional resistance exercises such as the bench press and back squat that are performed at a relatively low movement speed, the power clean is an explosive but highly controlled movement that is performed at a maximal movement speed. In the power clean exercise, a barbell is lifted from the platform to the shoulders in a single, continuous, forceful movement. Success with the power clean exercise involves complex and synchronized neural recruitment patterns and may provide a better impression of an athlete's whole body power relative to other resistance exercises. Accordingly, some experts hypothesize that power clean performance may be directly associated with sport-related power (7,19). In adult athletes, the power clean test provides a highly reliable measure of maximum muscular power (21,33). To our knowledge, no similar data exist that evaluate the reliability, validity, or safety of such testing with power clean movements in adolescent athletes. Given the link between power training and sports performance, it is paramount that pediatric researchers and youth coaches establish the reliability of power testing in youth.

The assessment of maximal muscular power is one of the most important determinants of athletic performance (7,11,19). Although field tests such as the standing long jump and vertical jump are typically used to assess anaerobic power in younger populations (6,22,28), weightlifting movements, such as the power clean, are perhaps the best measure of combined whole-body strength

and power (14,19). During the performance of the power clean, the lifter must initially exert high forces to accelerate the barbell through the entire range of pulling without actively decelerating the barbell.

Although our laboratory has examined the safety, efficacy, and reliability of 1RM strength testing in children (12,13,22), an assessment of maximal power clean testing remains unexplored in younger populations. For the 1RM power clean to provide meaningful information to youth coaches and pediatric researchers, it is important to perform a reliability assessment of this measure in young lifters. Information pertaining to the reliability of 1RM testing in younger populations is vital for the accurate assessment of training outcomes and the replication of research experiments.

This information is particularly important relative to the updated NSCA position statement article on youth resistance training that supports maximal lifting in younger populations provided age-appropriate guidelines are followed (9). Hence, the aim of this investigation was to assess the reliability of the 1RM power clean in a group of adolescent athletes.

METHODS

Experimental Approach to the Problem

In this study, we assessed the reliability of the 1RM power clean in trained adolescents who had experience performing weightlifting exercises. Subject performed the 1RM power clean on 2 nonconsecutive test sessions (3–7 days apart) at the same time of the day (late afternoon). Test procedures were administered by a USA weightlifting senior level coach and consisted of a systematic progression in test load until the maximum resistance that could be lifted for 1 repetition using proper exercise technique was determined. This approach allowed us to carefully monitor the response of each subject to the testing protocol, individually evaluate 1RM performance, and assess the reliability of power clean testing in young lifters.

Subjects

The methods and procedures used in this study were approved by the Institutional Review Board for use of human subjects at the College, and informed consent was obtained from all parents and assent was obtained from each subject before participation. Thirty-six male athletes (age 15.9±1.1 years, body mass 79.1±20.3 kg, height 175.1±7.4 cm) volunteered to participate in this study. All the subjects participated in interscholastic sports (primarily American football, basketball, and lacrosse) and were recruited from an after-school strength and conditioning program.

In this after-school program, the participants received daily instructions on weightlifting movements, resistance training, plyometric exercises, and speed and agility from Certified Strength and Conditioning Specialists and weightlifting coaches. As per the guidelines from USA Weightlifting (30), the participants learned how to perform the front squat; Romanian deadlift; and modified cleans, pulls, and presses with a wooden dowel before attempting to perform more advanced exercises. Progression was based on actual motor skill competence and technical proficiency. Proper exercise technique and lifting procedures that included instructions on how to safely "miss" a lift were reinforced during movement preparation activities and training sessions.

Training loads and exercises were progressed over time by members of the coaching staff as confidence and competence to perform advanced multijoint exercises improved. If an exercise was performed incorrectly, the lifters' performance was reassessed by a member of the coaching staff and, if appropriate, the training load was reduced. Only lifters who demonstrated proper exercise technique during training sessions participated in 1RM testing procedures to evaluate progress and determine appropriate training loads. On average, the subjects in this investigation had 16.5 6 1.1 months of experience in performing various weightlifting movements, including the power clean and snatch exercises.

Both the subjects and their parents were informed about the objectives and scope of this project, and they completed a health history and physical activity questionnaire. The exclusionary criteria used were (a) subjects with a chronic pediatric disease and (b) subjects with an orthopedic limitation. All the volunteers were accepted for participation.

Procedures

A USA Weightlifting Senior Level coach who trained several young athletes at the National School-Age Weightlifting Championships evaluated performance on all 1RM lifts. Certified Strength and Conditioning Specialists who had experience testing and training school-age youth assisted with testing protocols. All study procedures took place after school (3:00–5:00 PM) during the Spring semester in a public high school strength and conditioning facility using competitioncaliber Olympic barbells and plates. All the subjects were familiar with 1RM testing procedures and were evaluated individually by qualified professionals. Before testing, all the subjects participated in a 10-minute warm-up session, which included dynamic movement activities for the ankles, hips, shoulders, and wrists.

To perform the power clean exercise, the subjects placed their hands on the barbell slightly wider than shoulder width, with their hips lower than the shoulders and the barbell about 3 cm in front of the lower leg region (shank) with their feet about hip width apart. The subjects were reminded to "set the back" in the proper position with "chest up," elbows rotated outward, and eyes looking forward. The subjects initiated the power clean by deliberately lifting the barbell off the floor with a forceful extension of their knees and hips while keeping their shoulders directly over the barbell. During this phase of the lift, the arms and chest were "tight" and the barbell remained close to the body.

As the barbell rose above the knees, each subject explosively transitioned into the second pulling phase by extending their hips, knees, and ankles as if jumping into the air. When their lower body reached full extension, the subjects forcefully shrugged their shoulders with both elbows fully extended. The subjects avoided the temptation to bend their elbows during this phase of the lift, which is a common error in inexperienced lifters.

As the barbell continued to rise, the subjects quickly flexed their elbows, hips, knees, and ankles to pull their bodies under the barbell to catch the weight in a quarter-squat position with feet about shoulder width apart. By relaxing their grip during the catch phase of the lift, the subjects were able to receive the barbell across their shoulders with both elbows pointing forward. The subjects performed a quarter squat to the standing position once the barbell was located across the front of the clavicles and anterior deltoids. Although the power clean exercise consists of different phases, this movement requires the lifter to quickly and forcefully lift the barbell from the floor to the front of the shoulders in one continuous movement without interruption. Details of the power clean exercise have been previously described (14,26).

In our investigation, the 1RM was recorded as the maximum resistance that could be lifted using proper exercise technique for one repetition. Before attempting a 1RM, the subjects performed a progressive series of 5 submaximal sets of 1–2 reps with moderate to heavy loads (~50–90% of the estimated 1RM). Weights prescribed for warm-up sets and testing were based on a subject's previous weightlifting experience or prior 1RM test results, which were noted on a "testing helper" data sheet. If a weight was lifted with proper form during a 1RM trial, the subsequent 1RM weight attempt was increased by approximately 2.5–7 kg and the subject attempted another 1RM trial after approximately 3 minutes of rest. The increments in weight were dependent on the effort required for the lift and became progressively smaller as the subject approached the 1RM.

Appropriate progression of loading during 1RM trials was determined by a senior level weightlifting coach who trained all the subjects in this investigation. In the case of a failed 1RM lift, the subjects who attempted to maintain proper exercise technique without any major technical flaw in performance were permitted a second attempt at the same weight. Each subject's 1RM was determined within 3–5 trials. Qualified strength and conditioning professionals provided encouragement and reinforced the importance of proper exercise technique throughout all testing sessions with appropriate coaching cues. Three to seven days after the first 1RM trial, the subjects returned to the center in the afternoon and performed the second 1RM trial following the same testing protocol with the same instructors. The subjects were instructed to avoid heavy lifting for 48 hours before each testing session and observe proper nutrition practices, including adequate hydration. Throughout the study period, the subjects were questioned by test administrators for the occurrence of an injury or complaints of muscle soreness.

Statistical Analyses

Statistical procedures were performed using SPSS version 17.0 for windows (Chicago, IL, USA) and SAS version 9.1 (SAS Institute, Cary, NC, USA). Descriptive statistics were calculated for all variables. The relative reliability of the data was determined using a 2-way random effects model ICC(2,*k*), and Pearson correlation coefficient was calculated over the 2 test sessions. A repeated measures analysis of variance was used to evaluate any potential difference between test days, and the significance was set at *p* # 0.05. Bland-Altman plots, linear regression analysis, and typical error analyses (square root of mean square error) were also used to evaluate reliability. Accordingly, minimal differ ences (MDs) needed to be considered real were calculated (typical error 3 1.96 3 square root of 2) to provide a measure of the clinical significance of the observed changes in power clean performance. Data are reported as means and *SD*s.

RESULTS

All the subjects completed the study according to the aforementioned methodology. The 1RM power clean was 70.6 6 19.8 and 69.8 6 19.8 kg on the first and second test session, respectively, with an intraclass correlation coefficient (ICC) of 0.98 (95% confidence interval = 0.96–0.99) and no significant difference in 1RM power clean performance between trials (*p* . 0.05). The Pearson correlation coefficient demonstrated a strong relationship between 1RM captured between test sessions (*r* = 0.98; *p* , 0.0001; Figure 1). The Bland-Altman plot is presented in Figure 2, and it confirmed no systematic shift between 1RM test sessions or association between difference and average with a calculated

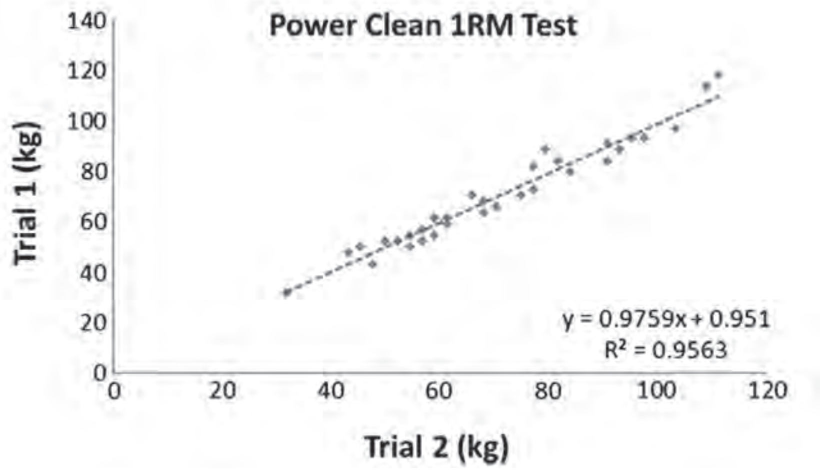

Figure No. 1
SCATTERPLOT DEPICTING THE RELATIONSHIP BETWEEN 1 REPETITION MAXIMUM (1RM) TRIALS. THE 95% CONFIDENCE INTERVAL ABOUT THE SLOPE COEFFICIENT WAS 0.91–1.1.

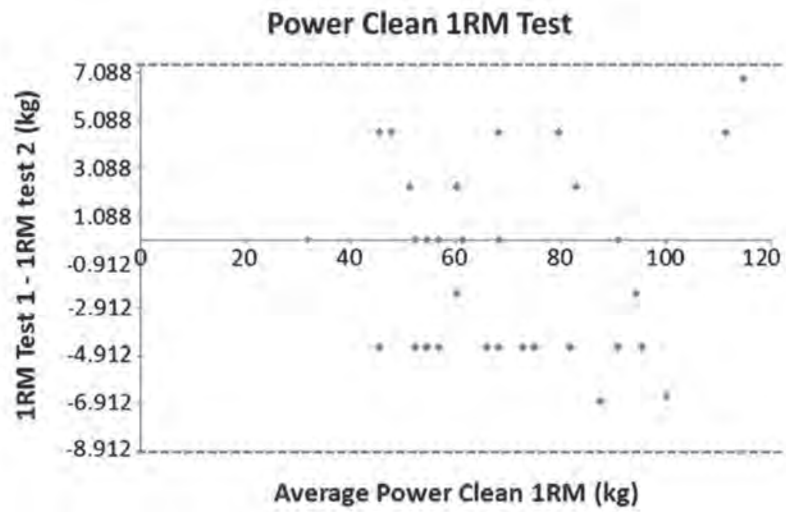

Figure No. 2
BLAND-ALTMAN PLOT OF 1 REPETITION MAXIMUM (1RM) POWER CLEAN PERFORMANCE. THE SOLID LINE REPRESENTS THE MEAN DIFFERENCE BETWEEN RM TRIALS. THE DOTTED LINE REPRESENTS THE 95% CONFIDENCE LIMITS FOR THE MEASURED DIFFERENCE.

Pearson correlation of average vs. between method difference of r = 20.10 (=0.978). Linear regression (between the difference and the average) indicated an r-square of 0.00003, further confirming no association between difference and average measures. The degree of agreement between tests 1 and 2 was also evaluated by the mean difference and the 95% confidence limits. The average difference between the 2 testing trials was 20.751 kg, with a 95% confidence limit (28.912 to 7.412), which indicates that the mean difference or error between test sessions was about 1% of the overall test measure in this population. The typical error to be expected with 1RM power clean between test measures is 2.9 kg. The MD = 8.0 kg indicates that changes .8.0 kg would be reflective of a real change in power performance with a retest or posttraining assessment. No injuries occurred throughout the study, and no complaints of muscle soreness were reported.

DISCUSSION

To our knowledge, no other study has examined the reliability of 1RM power clean testing in young lifters. The results of this investigation indicate that 1RM power clean testing has a high degree of reliability in trained male adolescent athletes when standardized testing procedures are followed and qualified instruction is given. No untoward responses or injury occurred from 1RM testing procedures. Despite previous concerns associated with 1RM power testing in youth (2), our findings support the updated NSCA article on youth resistance training and indicate that the maximal muscular power of healthy trained adolescences can be assessed with the 1RM power clean (9). However, it must be underscored that the subjects in this study were trained adolescent athletes who had experience in performing weightlifting exercises and that all procedures were administered by qualified professionals who were knowledgeable of pediatric resistance training guidelines and the pedagogical aspects of teaching weightlifting to school-age youth. The findings of this study may not be generalizable to untrained youth or to cases in which test protocols are administered by inexperienced professionals.

Although data on 1RM test-retest reliability in younger populations are limited, our data are consistent with those of previous reliability assessments performed on adult athletes. For example, McGuigan and Winchester reported an ICC of 0.98 for 1RM power clean testing in American football players (21). Because the ICC is a measure of relative reliability that examines the consistency of individual scores (32), the observed ICC of 0.99 in this investigation indicates that power clean testing is a highly reliable measure in trained adolescents. We have previously reported ICCs of 0.93–0.98 for the 1RM chest press and leg press tests in children (8–12 years) (12), and others have reported high ICCs on a variety of upper and lower body 1RM strength tests in adults (20). Of potential relevance, ICCs $ 0.90 have been found in children who performed sports-related tests of speed and agility and in adolescents who performed the drop vertical jump (1,31).

Researchers have used the 1RM power clean to assess performance in adolescents, and a recent survey of high school coaches revealed that "Olympic style lifts" and its variations were the most important exercises these coaches prescribed for their athletes (6,8). Of note, data indicate that the risk of sustaining an injury during the performance of weightlifting movements during training or competition is relatively low provided that qualified instruction is available and safety measures are in place (5,10,15).

The Bland-Altman plots presented in Figure 2 show that the limits of agreement are small, suggesting that individual variability between 1RM trials was negligible in our subject population. The Bland-Altman plot also confirmed that there was no systematic shift (i.e., learned effect) between 1RM test sessions. The lack of association between difference and average also confirms that these methods do not provide systematic error. Moreover, linear regression (between the difference and the average) indicated an *r*-square of 0.00003, which represents cumulative and strong evidence that the 1RM test methods employed in the current population yield highly reliable outcome measures. From a practical perspective, highly reliable tests are able to detect small but significant changes in limited sample sizes and provide meaningful information to coaches and sport scientists regarding changes in physical performance (18). These findings indicate that the methods employed in this study would be appropriate to assess the effects of interventions on weightlifting performance in adolescent athletes.

In our investigation, the difference between 1RM testing trials was 0.8 kg (1.1%), and the subjects completed the 1RM tests with a mean of 3.1 and 3.4 trials, respectively, on days 1 and 2. In addition, the typical error to be expected between 1RM power clean trials was 2.9 kg, and it appears that a change of at least 8.0 kg is needed to identify real changes in power clean performance over time. The high reproducibility of 1RM power clean testing and acceptable measurement error in this study was likely because of a number of factors. Our population of adolescents had, on average, 16 months of experience in performing a variety of weightlifting movements in a structured strength and conditioning program. The subjects progressed from basic movements (e.g., front squat) to more complex movements (e.g., power clean) as competence and confidence improved. Although training frequency varied throughout the year depending on sport participation and school vacations, most of the subjects participated in strength and conditioning activities at least twice per week and received constructive feedback on proper form and technique from weightlifting coaches. As previously noted by Kraemer et al. (20), the process of increasing the weight to a true 1RM can be enhanced by prior familiarization with the testing exercise and the expertise of investigators who evaluate the performance of each lift. Of interest, Blazevich and Gill found significantly reduced reliability in an unfamiliar squat strength test in healthy adults who had at least 1 year of resistance training experience (4).

Despite the growing popularity of weightlifting by high school athletes and their coaches in the United States (8,27), only limited normative data are available on the power clean exercise for comparison. In the present investigation, the subjects lifted approximately 70 kg on the 1RM power clean, whereas the reported 50th percentile for this lift in 14to 15-year-old high school American football players is 79 kg (17). Factors including training experience, testing procedures, quality of performance, and body mass may have influenced the observed differences in performance. Also, the subjects in our investigation participated in a variety of sports including American football, lacrosse, and basketball.

The results of this investigation indicate that 1RM testing of the power clean exercise can be used to track progress, develop personalized programs, and assess the effectiveness of youth strength and conditioning programs. In addition, 1RM testing can provide motivation during yearly training cycles. However, the proper administration of maximal strength and power testing procedures requires qualified instruction and consistent feedback on technical movements and desired intensity progression. Although these tests can be used by pediatric researchers and youth strength and conditioning professionals to assess training-induced gains in strength and power, field tests such as the standing long jump or vertical jump may be more appropriate in physical education classes as a general index of muscular fitness in youth.

This study attempted to determine the reliability of the 1RM power clean in trained adolescent athletes. Our substantive findings are consistent with those of similar tests measured in adults (21,33) and are supportive of previous investigations that examined 1RM strength testing in children (12,13). We found that technique-driven 1RM power clean testing has a high degree of reproducibility in trained adolescents and can be safely evaluated in young athletes provided that standard testing procedures are followed. However, no conclusions can be made regarding the reliability of power clean testing in inexperienced young lifters. Future research might focus on establishing normative 1RM power clean data for male and female high school athletes for comparative evaluations of maximal muscular power to ageand gender-matched peers.

PRACTICAL APPLICATIONS

Muscular power is a key component to athletic ability in many sports, and there is growing interest in strength and conditioning in schools and youth sport training centers. The key finding from this study is that the 1RM power clean demonstrates excellent test-retest reliability and acceptable measurement error in trained adolescent male athletes. Because it is paramount for youth coaches to assess performance with tests that are reliable, the 1RM power clean can be added to protocols available to qualified professionals to monitor training-induced changes in strength and power and determine whether a real change in performance has occurred. It is also important for youth coaches to be able to reliably determine if gains in performance after a training program are real or an artifact of the measurement error associated with the test used to assess changes in performance. Our findings indicate that a difference in 1RM power clean performance of ,2.9 kg between tests is an expected variation for this exercise. In addition, it appears that a change of at least 8.0 kg is needed to identify a real change in 1RM power clean performance as a result of strength and conditioning program in this young population.

Although administering 1RM power clean tests according to the procedures outlined in this study may yield reliable data, unsupervised testing procedures or poorly performed exercises are not recommended under any circumstances because of the potential for injury and reduced validity of test measures (24). Substantive and consistent instruction from qualified professionals is an integral component for achieving highly reliable test measures in young athletes who need to develop the coordination and skill technique to perform these lifts correctly. Because of the high degree of reproducibility demonstrated in this study, the 1RM power clean can be considered a useful and meaningful test in high school strength and conditioning programs provided criteriabased testing guidelines are followed and practitioners have experience measuring parameters of weightlifting performance in young lifters.

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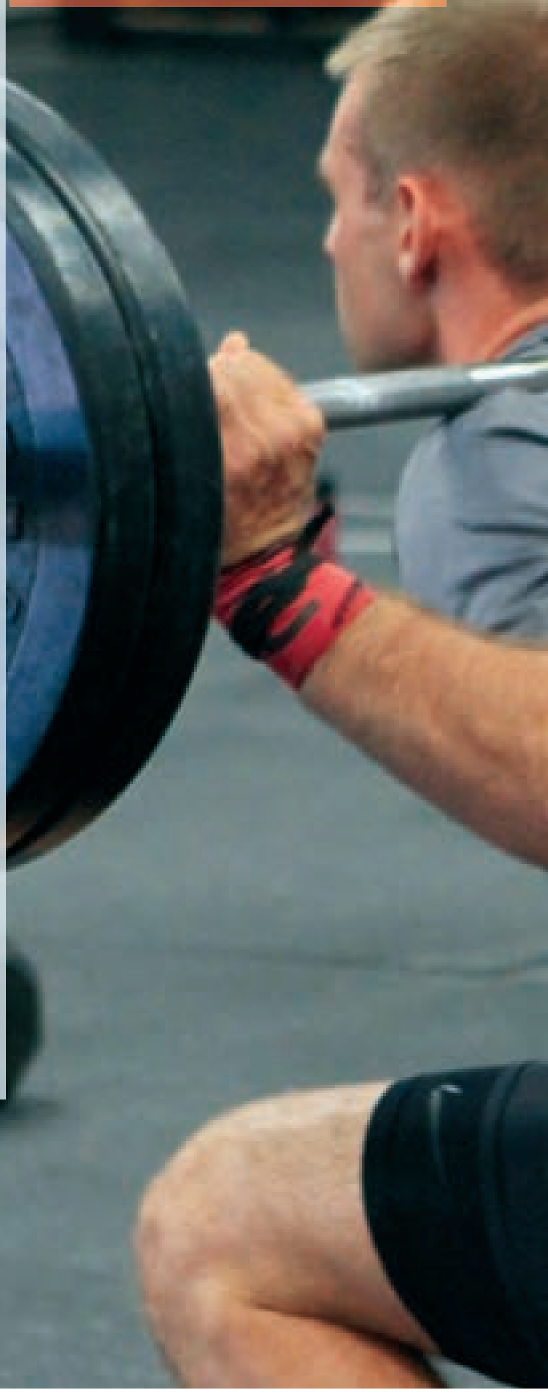

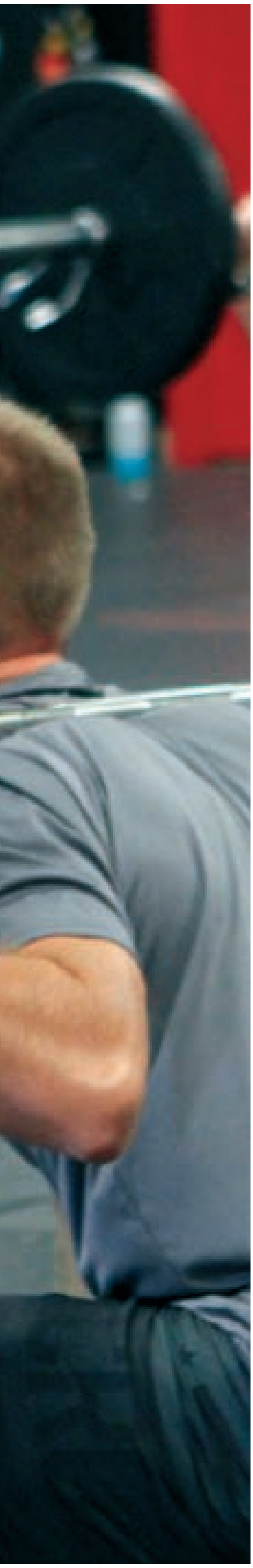

REFERENCES

1. Alricsson, M, Harms-Ringdahl, K, and Werner, S. Reliability of sports related functional tests with emphasis on speed and agility in young athletes. *Scand J Med Sci Sports* 11: 229–232, 2001.
2. American Academy of Pediatrics. Strength training by children and adolescent. *Pediatrics* 121: 835–840, 2008.
3. Behm, DG, Faigenbaum, AD, Falk, B, and Klentrou, P. Canadian society for exercise physiology position paper: Resistance training in children and adolescents. *Appl Physiol Nutr Metab* 33: 547–561, 2008.
4. Blazevich, A and Gill, N. Reliability of unfamiliar, multijoint, uniand bilateral strength tests: Effects of load and laterality. *J Strength Cond Res* 20: 226–230, 2006.
5. Byrd, R, Pierce, K, Rielly, L, and Brady, J. Young weightlifters' performance across time. *Sports Biomech* 2: 133–140, 2003.
6. Channell, BT and Barfield, JP. Effect of Olympic and traditional resistance training on vertical jump improvement in high school boys. *J Strength Cond Res* 22: 1522–1527, 2008.
7. Cronin, J and Sleivert, G. Challenges in understanding the influence of maximal power training on improving athletic performance. *Sports Med* 35: 213–234, 2005.
8. Duehring, MD, Feldmann, CR, and Ebben, WP. Strength and conditioning practices of United States high school strength and conditioning coaches. *J Strength Cond Res* 23: 2188–2193, 2009.
9. Faigenbaum, A, Kraemer, W, Blimkie, C, Jeffreys, I, Micheli, L, Nitka, M, and Rowland, T. Youth resistance training: Updated position statement paper from the National Strength and Conditioning Association. *J Strength Cond Res* 23: S60–S79, 2009.
10. Faigenbaum, A and Myer, G. Resistance training among young athletes: Safety, efficacy and injury prevention effects. *Br J Sports Med* 44: 56–63, 2010.
11. Faigenbaum, A and Westcott, W. *Youth Strength Training*. Champaign, IL: Human Kinetics, 2009.
12. Faigenbaum, A, Westcott, W, Long, C, Loud, R, Delmonico, M, and Micheli, L. Relationship between repetitions and selected percentages of the one repetition maximum in healthy children. *Pediatr Phys Ther* 10: 110–113, 1998.
13. Faigenbaum, AD, Milliken, LA, and Westcott, WL. Maximal strength testing in healthy children. *J Strength Cond Res* 17: 162–166, 2003.
14. Garhammer, J. A review of power output studies of Olympic and powerlifting: Methodology, performance prediction, and evaluation tests. *J Strength Cond Res* 7: 76–89, 1993.
15. Hamill, B. Relative safety of weight lifting and weight training. *J Strength Cond Res* 8: 53–57, 1994.
16. Harman, E and Garhammer, J. Administration, scoring and interpretation of selected tests. In: *Essentials of Strength and Conditioning*. T. Baechle and R. Earle, eds. Champaign, IL: Human Kinetics, 2008. pp. 249–292.
17. Hoffman, J. *Norms for Fitness, Performance and Health*. Champaign, IL: Human Kinetics, 2006.
18. Hopkins, WG. Reliability of power in physical performance tests. *Sports Med* 31: 211–234, 2001.
19. Hori, N, Newton, H, Nosaka, K, and Stone, M. Weightlifting exercises enhance athletic performance that requires high-load speed strength. *Strength Cond J* 27: 50–55, 2005.
20. Kraemer, W, Ratamess, N, Fry, A, and French, D. Strength training: Development and evaluation of methodology. In: *Physiological Assessment of Human Fitness*. P. Maud and C. Foster, eds. Champaign, IL: Human Kinetics, 2006. pp. 119–150.
21. McGuigan, M and Winchester, JB. The relationship between isometric and dynamic strength in collegiate football players. *J Sports Sci Med* 7: 101–105, 2008.
22. Milliken, LA, Faigenbaum, A, Loud, R, and Westcott, W. Correlates of upper and lower body muscular strength in children. *J Strength Cond Res* 22: 1339–1346, 2008.
23. Mountjoy, M, Armstrong, N, Bizzini, L, Blimkie, C, Evans, J, Gerrard, D, Hangen, J, Knoll, K, Micheli, L, Sangenis, P, and Van Mechelen, W. IOC concensus statement: Training the elite young athlete. *Clin J Sports Med* 18: 122–123, 2008.
24. Myer, G, Quatman, C, Khoury, J, Wall, E, and Hewett, T. Youth vs. adult "weightlifting" injuries presented to United States Emergency rooms: Accidental vs. non-accidental injury mechanisms. *J Strength Cond Res* 23: 2054–2060, 2009.
25. Myer, G and Wall, E. Resistance training in the young athlete. *Oper Techn Sports Med* 14: 218–230, 2006.
26. Newton, H. *Explosive Lifting for Sports*. Champaign, IL: Human Kinetics, 2002.
27. Pierce, K, Bryd, R, and Stone, M. Youth weightlifting—Is it safe? *Weightlifting USA* 17: 5, 1999.
28. Safrit, M. *Complete Guide to Youth Fitness Testing*. Champaign, IL: Human Kinetics, 1995.
29. United States Department of Health and Human Services. 2008 Physical Activity Guidelines for Americans. Available at: www.health.gov/paguidelines, 2008. Accessed December 8, 2010.
30. USA Weightlifting. *USA Weightlifting Club Coach Manual*. Colorado Springs, CO: USA Weightlifting.
31. Walsh, M, Ford, K, Bangen, K, Myer, G, and Hewett, T. The validation of a portable force plate for measuring force-time data during jumping and landing tasks. *J Strength Cond Res* 20: 730–734, 2006.
32. Weir, J. Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. *J Strength Cond Res* 19: 231–240, 2005.
33. Weiss, L, Moore, C, Schilling, B, Ermert, R, Fry, A, and Chiu, L. Reliability and precision of multiple expressions of hand power clean bar velocity. *J Strength Cond Res* 19: e36, 2005.

SPORT, HUMAN MOVEMENT AND EMOTIONS

BY ANGELA MAGRINO, GENNARO GATTO, VINCENZO D'ONOFRIO

INTRODUCTION

Adolescents find themselves facing a series of evolutionary tasks that may be overcome more, or less successfully. With regard to physical and sexual development, they may achieve, for example, a good relationship with their bodies and live sexual development without particular anxiety. Other tasks are related to relational development: the adolescent can feel capable or not to cultivate good relationships with peers and adults; the tasks related to the sense of identity are related to the construction of a project and a sense of self that is consistent with what they want (Gambini, 2008). The affirmation of oneself, recognizing oneself as a person, takes place thanks to two apparently contradictory impetuses: separation which implies differentiating oneself from others and at the same time identifying oneself (the emphasis is on affinities); these impetuses are integrated into a harmonious process.

In the adolescent phase, processes of elimination of the synapses and the production of cerebral cortex (Fauci & Braunwald 2008) occur which can be modified by the body experiences. In terms of the body and movement, we can speak about the sense of belonging of one's body, proprioception, the evaluation - conscious or not - of position in space, of kinesthetics, the sensation of movement and acceleration (Andorlini, 2015): practicing sport is therefore also a process of knowledge. The peer group, just like a sports group, becomes a privileged place to get to know each other, to feel esteemed, to identify and differentiate, to experiment and find one's place (De Pieri, 1995), in which to know one's limits, victories and defeats, as well as being an imaginary place in which to feel exposed to the judgment and the gaze of others. Self-esteem, understood as a fundamental pillar of a positive identity, is, in this sense, recognized and appreciated by others (Gambini, 2008). Should negative and risky behaviours arise in response to stress, one can speak of *emotional distress* (anxiety to face evolutionary tasks), *maladjustment* (widespread malaise in order to avoid overcoming developmental tasks), and even *deviance* (antisocial behaviour). It is important to pick up on any distress signs the adolescent displays in order to intervene promptly and appropriately before it transforms into something more serious: a structured situation of marginality and antisocial conduct. The relative plasticity of psychological functioning and of the restructuring processes of personality, typical of this stage in life, requires psychological intervention, which does not necessarily coincide with psychotherapeutic treatment.

REVIEW OF STUDIES

Recent studies have linked the pleasant and painful emotional states in athletes and the efficiency of sports performance, emphasizing the importance of the emotional climate and of motivation (Ruiz et al., 2016). In particular, it is assumed that a good motivational climate has a positive impact

on the athlete's motivation and on functional anger, at the same time constituting a negative predictor of the intensity of anxiety and dysfunctional anger. Body image disorders are less common in elite athletes, as well as a positive self-talk (De Carlo 2012).

In recent literature, many authors have dealt with the correlation between exercise/movement on the one hand and aggressive feelings on the other (Williams & Gill, 2000); some have discovered a positive relationship (e.g., Kreager, 2007), while others have found the opposite (e.g., Mason & Wilson, 1988). Although contradictory results are present in literature, sport and movement are widely recognized and recommended as

a way to reduce aggressive feelings and anger (e.g., Cusimano, Nastis, & Zuccaro, 2013; Gee, 2011; Kerr & Grange, in press; Warden, Grasso, & Luyben, 2009). This has been confirmed by recent studies, which have highlighted a decrease in aggressive feelings as an effect of movement (Perls, 2016). The individuals participated in different types of sports (rowing and combat sports). There was a significant decrease in feelings of anger among boys, particularly among those who practiced rowing and karate (Gatto/D'Onofrio SDS 109). Leith (1982) proposes various psycho-social factors within competition that could be linked to an increase in aggressive feelings, including the frustration that derives from the failure to achieve individual goals. In contrast to competition, we find direct cooperation to achieve common goals (Tjosvold, 1998). The latter appears to be associated with the formation of a positive social identity, as well as high self-esteem (e.g., Luhtanen & Crocker, 1992), accompanied by a reduction of aggressive feelings. Recently, some studies have dealt with the general perception of the self and positive emotions and good self-esteem related to movement and sport in individuals with physical disabilities (Shapiro et al., 2010). In particular, these positive feelings and the development of sporting abilities seem to be linked to a reduction of disability indexes such as loneliness and social closure. Other disabled teenagers who have never practiced sport demonstrate an increase in feelings of distrust and shame (Valsecchi, Marquez, 2009).

HUMAN MOVEMENT

Numerous studies confirm that physical movement plays an important role in human growth and development. It *promotes physical, mental, social and moral formation* (Raffuzzi et al., 2006). Movement is inscribed in the human genetic code and physical-sport activity has existed since the first civilizations: if prehistoric man had been limited in his different expressions of movement and in the adaptation to the environmental dynamics, the human species would not have survived. As a consequence, it had to be productive, efficient, performing so much so that the oldest sport is walking (D'Onofrio, 2013), one of the ways that man naturally developed to move without the aid of external means (Minetti, 1995).
Upright posture and human motility are the result, the current consequence, the rapid synthesis, the fruit of a long phylogenetic process, which, according to the time line, lasted only a few million years.
From quadrupedism to bipedalism, movement has characterized the species in its ontogenetic development and represents the most archaic and primitive expression of man (D'Onofrio, 2013). A body capable of moving in the "world", in which the child, in a very

short time, experiments all the phases that man has experienced in his evolutionary process.
The structuring and functional expression of the movements is created from the very first exploratory curiosities. The simple and natural motility allows the child to learn how to move as a cultural condition, becoming social and relevant in the educational relationship, if within the context of a community.

Vayer states that what constitutes the pivot of educational action is the construction of the body schema and that *to the extent that the child has the use of his body, he can learn the elements of the world around him and establish relationships between them, in other words, develop his intelligence. It is at the level of the bodily experience that the disturbances of the individual's personality and, therefore, psychism arise.*
Educating about movement means allowing the expression of basic and expert motor skills.
Moving in a competent way is the conquest of skills that offer us the opportunity to act in context, starting from the elementary forms of basic motor and postural schemes, to the most complex technical-tactical expressions (situational intelligence): intended as experiments of new movements in a creative and elaborative way, in order to carry out the action, refine the movement and improve motor behavior.
Physical-sporting activity affects not only the organic area, but also the emotional-emotional one, the cognitive area, the social area and movement in turn is influenced by motivational processes as well as by mnemonic, emotional, affective and social aspects that characterize the personality of man.

Lao Tzu, a Chinese philosopher who lived in the 6th century BC, claimed that "a journey of a thousand miles begins with a single step". The first step to understanding human motor skills as the original form of play, of motor-sports practice, of physical education and in a broader sense of motology (the science concerned with 360° movement), is almost certainly marked by the choice to place it at the origin of all cognitive development.
Cognitive processes are involved in motor control, in the organization of movement and in sports performance in order to understand the ways of learning motor and/or sports skills, or how to describe excellent performances (Cei, 1998).

Learning to know and carefully observe body language is important even if it is a language lacking in verbality. It is an instrument of expression, of relation that has the same structural complexity of the other languages in common and has a specific grammar, semantics, poetry and a motor morphology.
Human movement may certainly be also interpreted as a language where action is to sound as gesture is to speech and behaviour is to proportions (Zocca, 2009).
It is action and gesture at the same time: both manifest emotional states, behaviours, ways of being, and constitute the basic platform of subsequent learning.
In the work of physical movement, cognitive memory and motor memory are also involved, which allow the mind to be able to recall and reactivate learning processes and styles: it is a cognitive conscious mechanism.
In order to maintain a high degree of skill, sports-motoring memories must be enhanced through continuous practice with training and diversifying task-stimuli, both in sport for all and in the sport of absolute performance.
Physical movement relieves tension and is the ideal instrument for reharmonizing emotions; it is the means that modifies stress and weakens the causes of anger and envy.
Human movement, even merely walking (D'Onofrio, 2013), is a prophylaxis, it is the acquisition of healthy lifestyles that contrast the development of chronic-degenerative diseases; is the ally for the promotion of individual and social health.
Motor play, intended as fun, develops bodily-kinesthetic-emotional intelligence and understanding and sense of limits. It is the education of respecting rules and training to build a healthy culture of coexistence and respect for others; it is fair play and a vehicle for the transmission of social values and relations.
Sport is a powerful tool that discourages episodes of violence (bullying, for example), enhancing the control of aggression and encouraging the consolidation of personality traits, self-esteem and a sense of self-efficacy.

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It is a means that promotes the development of autonomy and the ability to collaborate with others, increasing the ability to overcome and face difficulties.

Motor-sports practice offers an educational context and presents itself as an antagonistic factor to distress, to drug addiction and to all forms of behavioural problems. The potential of sport and movement in general does not come about automatically: it is the role of adult figures (parents, coaches, sports managers) and the team experience that make it possible for sport to provide young people with an effective educational context. (Raffuzzi et al., 2006).

DEFINING DISTRESS

The theme of *distress* indicates a feeling of unease, of being out of place. The term distress refers to both lack of comfort and embarrassment that inhibits the spontaneity of behaviour. Evolutionary distress is used to define a condition transversal to all adolescents, referring to the confrontation with the tasks of development of age and the correlated anxiety; maladjustment as a state of widespread malaise for not being able to overcome one or more development tasks; behavioural problems as the highest form of distress (Gambini, 2008). Physicality can be an expression of problematic relationships with oneself and with others. If - in the course of development - if expressions of anger, sadness, disgust, love, desire or fear, are regularly met with punishment, criticism or rejection, one can learn to block the bodily

expressions of these feelings by inhibiting the movements that form them: the vocalizations in the throat, the expelling of breath in sobbing, the angry flash of the eyes, or the sad face, the movements of pushing away, grasping, or striking out, of reaching out or escaping (Kepner, 1997). As Perls states: "It is rather in the big, overt movements which we make in our environment that we run the greater risks of incurring humiliation, suffering embarrassment, or in various ways bringing down punishment on ourselves (Perls et al., 1951, p.117). Working on the body, therefore, can become an expression of the self and of one's own physicality. As Perls states: "with some degree of orientation recovered we can then begin to regain the ability to move about and manipulate ourselves and our environment constructively" (Perls et al., 1951, p.117). "One way to become transformed is to act, to move one's body, to be expressive, alive (...) awareness cannot remain vital by itself inside of us, ... that its full vitality is asserted in activity and, later, a sense of completion" (Zinker, 1983, p.82).

Sport is an area in which physicality, social image and the perception of the self take on importance (Cunti, 2015). Individual and collective distress seems to be produced also by the cultural, economic and social environment in which people, groups and collectives find themselves. It appears that a form of nihilism characterizes young people (Galimberti, 2007). One of the functions of movement is to allow the relational relationship with external forms (objects and tools, people), provide for the finalization of gestures (take, pull, push, shift and move) and expand the comfort zone, moving from distress to ease, through the profound perception deriving from the body in action (Gray Cook, 2008).

Another function is the improvement of balance that allows us a more relaxed presence and a feeling of "comfort" in our surroundings (Chek 2001). In an athlete, an emotion of distress can easily result in a symptom related to the effector organ of the movement (the muscle) and prevent free practice. Spasms, fasciculations, tremors, muscle cramps, stiffness or lack of strength, heavy uncoordinated mechanical gestures, are movement limiters. A pain that does not arise immediately after practice (DOMS syndrome) may be the effect of exercises performed without the physiological fluidity of the movement. On the contrary, relaxed, fluid practice, even at a muscular level, can lead to what are called flow experiences (De Carlo 2012), exaltation of the movement that occurs naturally and with the right performance.

THE BODY AND EMOTIONS

When looking at the person as a whole, we recognize that a large part of emotional life involves the somatic experience, what is called the experience of feeling. Another important aspect is the expression of feeling that occurs through movement, we manipulate and shape the environment, we relate and react to others, we define and modulate boundaries, defending our organismic integrity (Kepner, 1997). As far as the *body* is concerned, the first being in the world is corporeal, visibility is bodily, the basis of knowledge is perceptual and bodily. It is the present being, and being present (Collacchioni, 2012, pp. 34- 35).

The term *Body* derives from the Latin *corpus*, organism, structure, portion of matter with properties of extension, divisibility, impenetrability; *Corporeity*, from the Latin *corporeitas*, underlines the lived experience related to the body and has a central role in psychopathology (Cunti, 2015). With the overcoming of the mind/body dualism that has roots in Greek culture, of the dichotomy confirmed in modern times by Descartes between thought (*res cogitans*) and corporeity (*res extensa*), the body becomes a subject-object that allows immediate and direct contact with reality, a living body (Leib). The unity of our experience can fail when the physical sensations and motor components (bodily aspects) of experiences both past and present are separated from the verbal and imaginative aspects of experience. According to Gestalt psychology, in the latter case the *contact* is disturbed, a physical expression of an incomplete self, a denied movement or feeling (Kepner, 1997). From the recent contributions of neurosciences, emotions are fundamental to the memory of our experiences; we can forget the events, but continue to relive the emotions and the physical reactions connected to them.

The *body identity*, under construction in adolescence, depends on the experience that children encounter, for example social models that often propose unattainable ideals. The signs of serious dissatisfaction are sent out by the body, distress is expressed through specific symptoms and manifestations (obesity and eating disorders). The body can therefore manifest problematic relationships with the self and with others. When contact with the other is lost, contact with oneself is also lost (Barbon and Tauriello, 2007): in this sense, the recovery of contact with oneself is of significant importance.

The *body image* is gradually constructed, starting from the initial phases of the life cycle, acquiring more and more importance especially in adolescence. It is "that picture of our body which we form in our mind, that is to say the way in which the body appears to ourselves" (Schilder, 1935, p.35). An internal representation that is built over time in a dynamic way also influenced by a cognitive-affective component (Posavac, 2002); it

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depends, therefore, on internal factors (past experiences, impulses) and external factors (cultural models). Different from the bodily scheme understood as a perceptual and objective schema of our body based on kinesthetic and proprioceptive sensations. The dissatisfaction of body image can be defined as the set of negative and dysfunctional evaluations with respect to weight and body image(Garner et al., 2002). It can be linked to important negative psychopathological consequences, in addition to being one of the major risk factors and maintenance for eating disorders (Fairburn et al, 2003).

Distress and body are related to feeling ill at ease, an emotional malaise, experienced through the body and shown with postures, gestures, behaviours, intonation of voice and in other ways, differentiated by age. The distress manifests itself in clearly evident problematic behaviours, or through silent behaviour of escapism, somatization/pathologies/difficulties of various kinds. Identity is continuously formed through relationships with others, with the environment: in these contexts every person "feels" good, bad, accepted, excluded, at ease or uncomfortable. Distress characterizes every person, in some moments of their existence and in different contexts, such as at school. In sport, the body space appears to be influenced by what the adolescent feels: whether or not to occupy the space, to approach others or not, the choice of an individual or group sport, indoor or outdoor, are all externalizing behaviours of a feeling that can be highlighted during practice. The correct timing of the gesture can be an expression of insecurity, slowness or acceleration due to insecurity and lack of self-confidence (Andorlini 2015).

Recently, neuroscience has highlighted how *emotion* aims at the survival of the organism but, at the same time, its roots are found in the internal representations that the mind has of its own body (Damasio, 1994). According to phenomenologists, there is a body as a visible and concrete *Gestalt* form; the body we feel and with which we feel, the living body *Leib*, (Galimberti, 1993).

The word emotion comes from the Latin *emovère* (*ex = outside + movere = to move*) literally to bring out, to move. According to Greenberg and Safran (1987), emotions are both tendencies to action and bodily sensations. For example, fear mobilizes people for flight and prepares us for coherent action; anger prepares us for attack; sadness leads either to a source of comfort or to thoughts that enhance this sadness: "I am alone, nobody takes care of me". Emotions set the priority of the goals and organize us in view of specific actions (Frijda, 1986): sadness can imply a search for help,

and anger involves a revision of the boundaries, it puts distance. The elements of the emotional patterns are (Elliot et al., 2007):

- situational-perceptive: past or current person's environment and immediate awareness of the current situation and episodic memories;
- expressive-bodily: includes immediate physical sensations, expressions of emotions (e.g. facial expressions);
- behavioural-motivational: desires, needs, intentions (e.g. being safe); tendencies to action;
- nuclear process: organizing all the components around a particular emotion (e.g. a strong fear).

From the point of view of cognitive theories (Leahy et al., 2013), emotions include a series of processes, which characterize the "experience of an emotion". They also include a cognitive assessment as well as a physical sensation, an intentionality (an object), a "feeling" (or quality), a motor behaviour and, in most cases, an interpersonal component. When we experience "anxiety", for example, we recognize that we are worried about not being able to finish a job respecting the fixed time limits (evaluation), we feel an acceleration of the heartbeat (physical sensation), we focus on our skills (intentionality), we feel our lives are (mood), we feel physically agitated and restless (motor behaviour) and we can communicate that we are going through a really terrible day (interpersonal component). In Gestalt psychotherapy, the existential event called feeling is a totality that includes bodily sensations, mental events, images and thought (inner verbalization), movements and the environment; but clearly a significant part of this whole is constituted by bodily sensations (Kepner, 1997).

With regard to the emotion of the anger treated in this article, with the term anger we can refer to a feeling and a behaviour. According to H. D. Johns, fury is an emotional structure, a process by which we structure a fear in another sentiment or affective manifestation that is more constructive, more acceptable or more tolerable (Johns, 1999).
In this work, we will focus on *functional anger* understood as a modality of expression of a need for self-affirmation related to the definition of self, the sense of power, integrity, personal capacity (Kepner, 1997).

COMPETITION AND SPORTING COMPETITIVENESS

As far as competitiveness is concerned, psychology defines it as motivated behaviour stemming from a need for self-affirmation and self-fulfillment (Cunti, 2015). Its primary drive is aggression (Costabile, 1996) or socialized aggression. One of the contexts of life in which competitiveness manifests itself is sport. *Competition* (from the Latin *Cum+petere*, go together, converge at the

same point) indicates the race, the challenge in which one is measured against an opponent to conquer supremacy and/or obtain a record. There are many points of view. According to a psychological perspective, the drive to compete could be a manifestation of feelings of inferiority towards the other, at a non-conscious level.

Competition could be a cathartic opportunity to release aggressive impulses. In reference to ethology, according to Lorenz (1963), competition is an innate, not an acquired characteristic. In the socio-cognitive perspective, individuals are not aggressive by nature but can become so by imitation (Bandura, 1977). The neural mirroring mechanism is activated not only in the observation of movement, but also at the sight of an instrument or piece of equipment, giving a meaning in tactile terms (shooting sports, weapons). Competing from an educational sporting point of view means testing one's skills in comparison with others. Understanding that in group sports a champion cannot excel on his/her own but needs the team, understanding that in individual sports you must undergo training processes, discipline, and that you are alone, therefore, more exposed to judgment in terms of visibility: these are the basic processes of the formation of personal identities. In the field of sport education, competition is more closely linked to the concept of collaboration. According to *ecology of mind* (Bateson 1972) there is a dialectic relationship between needs for personal recognition and needs for recognition from others.

DISCUSSION AND CONCLUSIONS

In relation to counseling in sports, it is important to pay attention to both one's own and others' experience and to the body - posture, body attitude, body language, paraverbal communication (tone of voice, speed, volume), occupation of space, timing in movement. Body communication is important, the counselor gets personally involved in order to increase the awareness of one's body, relationship, empathic abilities, awareness of one's emotional resonances. Body, emotion and communication become fundamental parts of the educational process within an authentically empathic relationship (Cunti, 2015).

Emotional literacy is very significant; in particular, movement can be considered as a way to positively channel emotions such as anger. It is the way in which anger is managed that can define the negative side of anger itself.

Learning to manifest one's anger means knowing oneself, knowing one's needs, expressing them, distinguishing what makes us feel good from what makes us bad; learning how to express anger in a healthy way also helps us to build more authentic relationships with the people around us. Thanks to the understanding of messages and meta-messages, people can tune in emotionally with each other. This theme is very important in a time characterized by so-called emotional illiteracy (Galimberti, 2007).

From a psychological point of view, and in particular regarding Transactional Analysis (Johns, 1999):

- denial of a feeling does not eliminate it;
- the identification and acceptance of a sentiment does not place it outside our control;
- the identification and acceptance of a destructive feeling tend to attenuate it and place it under cognitive control.

In order to accept anger therefore, it is important to:

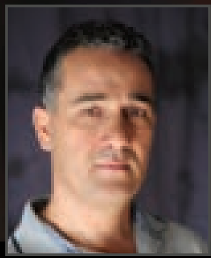
a) get in touch with the feeling;
b) identify it;
c) bring the feeling to the surface;
d) decide what to do with it.

There are some ways to attenuate a feeling with the decision to: sublimate (shift the energy from the feeling to a channel that is not its direct expression), or discharge (through pseudo-hostile behaviour). Among the ways to communicate effectively, the author talks about affirming ones needs and desires when it is time to express them (assertiveness), (Johns, 1999). Communicating is an intrinsic necessity: *it is impossible not to communicate* (Watzlawick, 1971) because every behaviour is a form of communication. In an interactive process, interlocutors influence each other both through words and through actions. The second axiom of communication states that all information, in addition to presenting an aspect of content, contains a relationship regarding gestures, postures, expressions. In some pathological situations, paradoxical, verbal and non-verbal injunctions are repeated, in which communication assumes a strongly contradictory character (Bateson, 1972).

Sport education seems to play an important role in the processes of inclusion, as an instrument of socialization and integration for the population groups at risk of exclusion (for example, the disabled). *Sport* becomes a context of acceptance, expression, sharing, communication, which plays the fundamental social function of encouraging participation. The purpose, besides inclusion, is the well-being of the person, as an instrument of prevention/adaptation and effective antidote of exclusion (European Commission, 2003).

In conclusion, it is important to pick up on the signs of distress, malaise, low self-esteem and the degree of risk in which adolescents find themselves in order to intervene promptly and, where possible in advance, appropriately, through multidisciplinary interventions where a range of professions such as doctor, psychologist-psychotherapists and motologists (specialist in Motor Sciences) work together to stimulate the recovery of the evolutionary process.

Possible future food for thought is teaching movement and sport under the umbrella of *disabilities*, which embraces conditions such as invisibility and shame of one's body.



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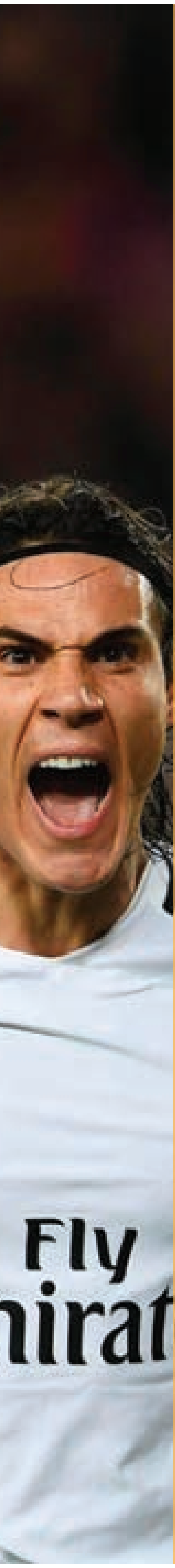

References

1. Andorlini A. (2015) Allenare il movimento. Calzetti & Mariucci Editori, Torgiano (PG).
2. Bandura A (1977), *Social Learning Theory*, Prentice Hall, Englewood Cliffs.
3. Bateson G (1979) *Mind and Nature: A necessary unit*, Gregory Bateson (Trad. Mente e Natura, Adelphi, Milano, 1984).
4. Chek P (2001) , Movement that matters, Publisher; C.H.E.K Institute, 2001
5. Collacchioni L (2012), *L'essenziale è invisibile agli occhi. Sentire, pensare, promuovere l'integrazione scolastica e sociale*, Aracne Roma.
6. Cook G, Burton L (2008), The importance of primitive movement patterns
7. Costabile A (1996), *Agonismo e aggressività. Dinamiche di interazione nello sviluppo infantile,* Franco Angeli, Milano.
8. Cunti A. (2015), *Corpi in formazione. Voci pedagogiche.* Franco Angeli, Milano.
9. Cusimano MD, Nastis S & Zuccaro L. (2013). Effectiveness of interventions to reduce aggression and injuries among ice hockey players: A systematic review. *Canadian Medical Association Journal,* 185(1), E57–E69. doi:10.1503/cmaj.112017
10. Damasio RA. (1994), *L'errore di Cartesio: Emozione, ragione e cervello umano*, Adelphi, Milano.
11. D'Onofrio V. (2013), La Camminata. Due passi tra natura e sapere. Calzetti &Mariucci Editori, Torgiano (PG).
12. Gatto G, D'Onofrio V. L'attività fisico-sportiva e la musica. Rivista SDS-Scuola dello Sport Anno XXXV N° 109, Aprile-Giugno 2016
13. Elliot R, Watson, JC, Goldman RN (2007), Apprendere le terapie focalizzate sulle emozioni. *American Psychological Association.*
14. European Commission (2003), *Social exclusion, Activation, and Welfare. Proceedings of a Dialog Workshop*, Brussels, Dg Research (RTD) with DG Employment and social Affairs (EMPL). Fairburn (2003), Cognitive behaviour therapy for eating disorders: a "transdiagnostic" theory and treatment. *Behaviour Research and Therapy*, 41, 50- 528.
15. Fauci A, Braunwald E (2009), Neurologia, Mc Graw Hill.
16. Galimberti U. (2007), *L'ospite inquietante. Il nichilismo e i giovani.* Feltrinelli, Milano.
17. Gambini P (2008), Dimensione del disagio adolescenziale. Risultati di un ricerca empirica. *PPS*, Vol. 14, N 2, 299- 320.
18. Garner DM (2002), *Body image and anorexia nervosa. In Cash & Pruzinsky (Eds), Body image: A handbook of theory, research and clinical practice* (295- 303). New York: Guildford Press Greenberg, L. S., & Safran, J. D. (1987a). *Emotion in psychotherapy: Affect, cognition and the process of change.* New York: Guilford Press.
19. Leith, L. M. (1982). The role of competition in the elicitation of aggression in sport. *Journal of Sport Behavior*, 5(4), 168–174.
20. Lorenz K. (1963), *L'aggressività*, il Saggiatore Milano, 1976.
21. Luhtanen RK & Crocker J. (1992). A collective self-esteem scale: Self-evaluation of one's social identity. *Personality and Social Psychology Bulletin*, 18(3), 302–318. doi:10.1177/0146167292183006
22. Johns HD. (1999), *Paura* e *collera nel quotidiano*. Cittadella Editrice, Assisi.
23. Kepner JJ. (1997), *Il lavoro con il corpo in psicoterapia*. FrancoAngeli, Milano.
24. Kreager DA. (2007). Unnecessary roughness? School sports, peer networks, and male adolescent violence. *American Sociological Review*, 72(5), 705–724. doi:10.1177/ 000312240707200503.
25. Mason G & Wilson P. (1988). *Sport, recreation, and juvenile crime: An assessment of the impact of sport and recreation upon aboriginal and non-aboriginal youth offenders*. Canberra: Australian Institute of Criminology.
26. Palmonari A (2001), *Gli adolescenti*. Bologna. Il Mulino.
27. Perls FS et al. (1951), *Gestalt therapy*, Julian, New York, 1973; trad it: *Teoria e pratica della psicoterapia della Gestalt*, Astrolabio, Roma, 1971.
28. Perls FS et al. (2016), Does Exercise Reduce Aggressive Feelings? An Experiment Examining the Influence of Movement Type and Social Task Conditions on Testiness and Anger Reduction. *Perceptual and motor skills*, Vo. 122 (3), 971- 987.
29. Posavac SS. (2002), Predictors of woman's concern with body weight: the roles of perceived self-media ideal discrepancies and self- esteem, *Eating Disorders*, 10, 2:153- 160.
30. Ruiz C et al. (2016), Predicting athletes' functional and dysfunctional emotions: The role of the motivational climate and motivation regulations. *Journal of Sports Sciences*, p. 1-9. Robert L. Leahy Dennis Tirch Lisa Napolitano A (2013), *La regolazione delle emozioni in psicoterapia*. Guida pratica per il professionista, Eclipsi.
31. Shapiro DR et al (2010), The relationships among sport self-perceptions and social well-being in athletes with physical disabilities. *Disability and Health Journal Volume 7, Issue 1, Pages 42-48.*
32. Schilder P. (1935), *The image and appearance of the human body: studies in the constructive energies of the psyche*. London K, Trench P, Trubner & co. (1986). L'immagine di sè lo schema corporeo, Franco Angeli, Milano.
33. Tjosvold D. (1998). Cooperative and competitive goal approach to conflict: Accomplishments and challenges. Applied Psychology, 47(3), 285–313. doi:10.1111/ j.1464-0597.1998.tb00025.x
34. Vayer P. (1968). Educazione psicomotoria e ritardo mentale. Armando Editore, Roma.
35. Watzlawick P, Beavin JH, Jackson DD (1967), *Pragmatica della comunicazione umana*, Astrolabio Ubaldini, Roma.
36. Williams L & Gill DL. (2000). Aggression and pro-social behavior. In D. L. Gill (Ed.), *Psychological dynamics of sport and exercise* (2nd ed., pp. 239–254). Champaign, IL: Human Kinetics.
37. Cei A. (1998). Psicologia dello Sport. Bologna: Il Mulino, pp.8-9.
38. Raffuzzi L, Inostroza N, Casadei B. Per uno sport che aiuta a crescere, 'L'Approccio Centrato sull'Atleta". ACP – Rivista di Studi Rogersiani - 2006
39. Zinker J, Searching for clarity, *Pilgrimage*, 11 (2), 1983, 79- 85.

Editorial guidelines

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

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

EDITORIAL MISSION STATEMENT

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

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

Original research

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

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

Type of articles and their total length

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

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

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

GUIDELINES FOR THE PRESENTATION OF ORIGINAL RESEARCH WORK TO BE PUBLISHED

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

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

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

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

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

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

PREPARATION OF MANUSCRIPTS

1. Title page

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

Title page without the name of the Authors

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

3. Summary and Keywords

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

4. Text

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

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

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

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

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

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

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

5. Bibliography

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

6. Acknowledgements

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

7. Figures

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

Adobe Photoshop (.psd)

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PowerPoint (.ppt)

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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).

Spanish resumenes

EDAD EVOLUTIVA Y PRODUCCIÓN DE FUERZA
Francesco Felici & Federica Marzoli
SM (ita), n.º 9, año IV, enero-abril de 2018, págs. 4-11
El objetivo de esta breve revisión de la literatura es analizar el estado actual del conocimiento sobre el tema de la producción de fuerza en la edad evolutiva, con especial atención a los resultados relacionados con el control neural de la producción de fuerza. Esta elección se basa en la consideración de que, al menos hasta una determinada etapa del desarrollo, la evidente hipertrofia muscular causada por el entrenamiento es tan discreta que a menudo pasa totalmente desapercibida. Por otra parte, es innegable también la ganancia de fuerza en la edad joven gracias a la realización de ejercicios tanto genéricos como específicos. El conocimiento en materia del control de la producción de fuerza es explícito: los sujetos en edad prepúber muestran un nivel de producción de la fuerza netamente superior respecto a la hipertrofia de sus fibras musculares. Esto es debido, en un elevado porcentaje, a factores de naturaleza nerviosa como el reclutamiento de las unidades motoras, la frecuencia de descarga de las unidades motoras y la interacción agonista-antagonista. Estos parámetros se modifican con el entrenamiento de la fuerza y es verdad que los adultos muestran también unas adaptaciones más palpables y un valor de producción de fuerza más elevado respecto a los niños, con el mismo protocolo de entrenamiento; esto se debe a que los niños tienen más dificultades para el reclutamiento de las unidades motoras, además de un componente hormonal todavía inestable. Por consiguiente, cabe deducir que la madurez de los factores nerviosos desempeña un papel fundamental en el rendimiento motor durante el crecimiento.

PROTEGIDO: INGENIERÍA REVERSA EN EL MECANISMO DE LESIÓN Y LAS CONSECUENCIAS DE LA INGENIERÍA DIRECTA
Bud Charniga
SM (ita), n.º 9, año Iv, enero-abril de 2018, págs. 12-21
En este artículo se contempla la idea de aplicar el concepto de la ingeniería reversa en la halterofilia y en el estudio de los accidentes: ¿qué debemos considerar cuando analizamos una situación en este deporte en la cual lógicamente cabría esperar que se produjera un accidente, pero no se produce? Un análisis de ingeniería reversa consiste en el análisis detallado del funcionamiento, diseño y desarrollo de un objeto o de un evento con el propósito de producir un nuevo evento que tenga un funcionamiento análogo, pero con una mejor o mayor eficiencia. En el caso de la halterofilia, un análisis de este tipo parte de la pregunta: "¿por qué el atleta no ha sufrido una lesión al realizar un ejercicio o un movimiento que debería sin duda haberle provocado una lesión?". El autor aplica este tipo de análisis al fútbol americano, deporte en el que existe una altísima incidencia de accidentes en los miembros inferiores, y se plantea la posibilidad de que todos estos accidentes estén relacionados con el tipo de entrenamiento que realizan los atletas diariamente para entrenar esta zona tan importante para su deporte. La conclusión de este estudio es la posibilidad de afirmar que las lesiones en los miembros inferiores tan frecuentes en el fútbol son además provocadas por unas rutinas de entrenamiento totalmente equivocadas.

NUTRICIÓN PARA EL RENDIMIENTO
Migliaccio Gian Mario, Spreghini Michele
SM (ita), n.º 9, año IV, enero-abril de 2018, págs. 22-29
En una breve revisión, los autores debaten temas de gran actualidad y significado en la práctica deportiva: nutrición y rendimiento, estrategias nutricionales y rendimiento (provisiones de glicógeno, uso de carbohidratos, grasas o proteínas durante el ejercicio, uso de suplementos durante el ejercicio), agua y sales minerales en el rendimiento, la práctica de las estrategias nutricionales.

HACER EL PESO
Francesco Pasqualoni, Francesco Lampredi
SM (ita), n.º 9, año IV, enero-abril de 2018, págs. 30-39
Los autores argumentan el tema de "hacer el peso", práctica que se realiza en todos los deportes que poseen distintas categorías de peso para la competición. Por consiguiente, el problema que se debate en este análisis con una extensa bibliografía es el del "Rapid weight loss" (Pérdida rápida de peso), con especial hincapié en el estado nutricional y metabolismo proteico, en la deshidratación, en la integración después del control del peso, en cómo evitar una bajada de rendimiento.

EL MOVIMIENTO Y LA ACTIVIDAD MUSCULAR SE VEN AFECTADOS POR LA POSICIÓN INESTABLE PROPIA DEL EJERCICIO DE SENTADILLAS
Nairn BC, Sutherland CA, Drake JD.
SM (ing), n.º 9, año IV, enero-abril de 2018, págs. 40-53

El entrenamiento del ejercicio de sentadillas con el utilizo de dispositivos que generan inestabilidad se ha popularizado cada vez más por un montón de razones. Muchos dispositivos generan inestabilidad en los pies y provocan un trastorno ascendente; sin embargo, no está del todo claro el efecto de un dispositivo de inestabilidad descendente durante un ejercicio de sentadillas. Para inducir inestabilidad en la parte superior del cuerpo, se utiliza un cilindro lleno de agua llamado Attitube. Este estudio analizó los efectos de la posición inestable (descendente, ascendente y ninguna inestabilidad) durante un ejercicio de sentadillas en términos de cinemática y activación muscular. Diez participantes varones fueron equipados con 75 marcadores reflectantes para monitorizar la cinemática del tobillo, rodilla, cadera y tronco y con la Barra/Attitube, y se registró una electromiografía de 12 músculos bilateralmente. Se realizaron sentadillas con una barra olímpica sobre una superficie estable, una barra olímpica sobre una pelota BOSU (PELOTA, ascendente), y el cilindro Attitube sobre un suelo sólido (TUBO, descendente). El TUBO mostró una reducción de hasta 1,5 veces en la activación del músculo erector de la columna y una flexión del tronco hasta 1,5 veces menor si se realizaban a una velocidad reducida. También se constató una mayor activación abdominal en el TUBO, con una activación oblicua 2,8 veces superior en comparación con la posición estable. La PELOTA aumentó la eversión del tobillo y la flexión de la rodilla con una mayor activación muscular en el gastrocnemio, los bíceps femorales y los cuádriceps. En general, la variación de la posición de inestabilidad durante un ejercicio de sentadillas cambió los patrones de movimiento y de activación muscular del tronco y de las extremidades inferiores. Esto proporciona información para futuras investigaciones relacionadas con la rehabilitación, el aprendizaje de una técnica de sentadillas adecuada y para escenarios concretos de entrenamiento.

FIABILIDAD DE LA PRUEBA POWER CLEAN CON UN LEVANTAMIENTO MÁXIMO EN ATLETAS ADOLESCENTES
Faigenbaum AD, McFarland JE, Herman RE, Naclerio F, Ratamess NA, Kang J, Myer GD
SM (ing), n.º 9, año IV, enero-abril de 2018, págs. 54-63
Aunque para evaluar la fuerza y la potencia en atletas adultos se utiliza generalmente el test power clean, no se ha analizado la fiabilidad de esta medición en poblaciones más jóvenes. Por consiguiente, el objetivo de este estudio era determinar la fiabilidad del power clean 1 levantamiento máximo (1RM) en atletas adolescentes. Treinta y seis atletas varones (edad 15,9 ± 1,1 años, masa corporal 79,1 ± 20,3 kg, altura 175,1 ±7,4 cm) que llevaban más de un año de entrenamiento de halterofilia realizaron un test power clean 1RM por la tarde de 2 días no consecutivos después de llevar a cabo los procedimientos estandarizados. Todos los procedimientos de la prueba fueron supervisados por un entrenador experimentado de halterofilia y consistió en una progresión sistemática en la carga de prueba hasta establecer la resistencia máxima que puede levantarse durante un levantamiento utilizando la técnica adecuada. Se analizaron los datos con la ayuda de un coeficiente de correlación intraclase
(ICC[2,k]), un coeficiente de correlación de Pearson (r), repetidos análisis de las mediciones de la varianza, un gráfico de Bland-Altman y análisis de los errores típicos. El análisis de los datos reveló que las mediciones de la prueba eran altamente fiables con un ICC test-retest de 0,98 (intervalo de confianza del 95 % = 0,96-0,99). La prueba mostró la existencia de una estrecha relación entre las mediciones 1RM en los ensayos 1 y 2 ($r = 0,98$, $p < 0,0001$) sin diferencias significativas en el rendimiento del power clean entre ensayos (70,6 ± 19,8 vs. 69,8 ± 19,8 kg). Los gráficos de Bland-Altman confirmaron la inexistencia de un cambio sistemático en 1RM entre los ensayos 1 y 2. El error típico previsto entre los ensayos de power clean 1RM es 2,9 kg, y se necesita un cambio de al menos 8,0 kg para determinar un cambio real en el rendimiento del levantamiento entre las pruebas en levantadores de pesas jóvenes. No se produjeron lesiones durante el período de estudio, y el protocolo de prueba fue bien tolerado por todos los sujetos. Estos resultados indican que el test power clean 1RM presenta un alto grado de reproducibilidad en atletas adolescentes varones entrenados cuando se siguen los procedimientos de prueba estandarizados y se proporcionan instrucciones expertas.

DEPORTE, MOVIMIENTO HUMANO Y EMOCIONES
Angela Magrino, Gennaro Gatto & Vincenzo D'Onofrio
SM (ita), n.º 9, año IV, enero-abril de 2018, págs. 64-75
Promover el bienestar psicofísico a través de la educación del movimiento, del deporte y de las emociones, significa favorecer asimismo cambios equilibrados y armónicos en la manera de sentirse consigo mismo y con el entorno circundante, además de fomentar la plasticidad neural y el aprendizaje. Este tema adquiere especial relevancia en un período de la vida como la adolescencia, que se caracteriza por la presencia de cambios profundos a nivel físico y psíquico. En esta etapa del ciclo vital, puede aparecer la inadaptación, por ejemplo, por la visión y el sentimiento distorsionado del propio cuerpo. Es importante trabajar la imagen corporal, la comunicación, y con carácter preventivo, educar las emociones -cómo la rabia- con el fin de que estas encuentren posibles canales y formas de externalización y de intercambio para evitar, por ejemplo, una posible manifestación violenta. Un posible futuro motivo de reflexión es la educación del movimiento y del deporte en la discapacidad, que añade temas como la invisibilidad y la vergüenza del propio cuerpo.

Russian

ДЕТСКИЙ И ПОДРОСКОВЫЙ ВОЗРАСТ И РАЗВИТИЕ СИЛЫ

Francesco Felici & Federica Marzoli

SM (Ita), n.º 9, anno IV, gennaio-aprile 2018, pp. 4-11

Целью этого краткого обзора научной литературы является анализ современного состояния знаний о проблеме развития силы в детском и пороcковом возрасте, уделяя особое внимание результатам связанным с нейронным контролем развития силы. Это обоснованио тем что по крайней мере до определённой стадии развития, гипертрофия мышц, достигнутая благодаря тренировке, часто бывает такой низкой, что остаётся незамеченной. Более того, нельзя оспорить тот факт что в подросковом и юношеском возрасте прирост силы достигается благодаря использованию упражнений как общего так и специфического характера.

Знания о контроле развития силы ясно показывают что субъекты препубертатного возраста демонструруют значительно более высокую степень развития сылы по сравнению с развитием гипертрофии мышечных волокон. Это обусловлено в значительной степени факторами нервного характера: вербовкой двигательных единиц, частотой разряда двигательных единиц и взаимодействием агонистов и антагонистов. Эти параметры изменяются благодаря силовой тренировке; используя один и тот же протокол тренировки, взрослые субъекты демонстрирут более заметную адаптацию и более значительное развитие силы по сравнению с детьми. Это связано с тем что дети встречают больше трудностей что касается реклутирования двигательных единиц, кроме того у детей гормональный компонент ещё не стабилизовался. Поэтому ясно что развитие нервных факторов играет фундаментальную роль для двигательной работоспособности в период развития.

УСТАНОВЛЕННО: ОБРАТНОЕ ПРОЕКТИРОВАНИЕ МЕХАНИЗМА ТРАВМИРОВАНИЯ (REVERSE ENGINEERING INJURY MECHANISM) И ПОСЛЕДСТВИЯ ПЕРЕДОВОГО ПРОЕКТИРОВАНИЯ (FORWARD ENGINEERING)

Bud Charniga

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В этой статье автор исходит из идеи применения обратного проектирования о анализа (reverse engineering) в тяжёлой атлетике и изучению несчастных случаев: о чём думаем когда анализируем ситуацию в этом виде спорта, где согласно логике предвидятся травмы, но эти травмы не происходят? Обратное проектирование (reverse engineering) заключается в детальном анализе функционирования, проектирования и развития объекта или события с целью создания нового события с аналогичным функционированием совершенстуя или повышая эффективность этого события. В тяжёлой атлетике анализ такого типа начинается с вопроса: почему у спортсмена не было травм во время выполнения упражнения или движения, которое несомненно, привело бы к травме? Автор применяет этот анализ к американскому футболу, где наблюдается очень высокий процент травм нижних конечностей, ставя проблему: можно ли сказать что эти травмы так или иначе связаны с типом тренировки которую спортсмены ежедневно используют для развития нижних конечностей, очень важной зоны для этого вида спорта. В заключении это исследование позволяет сказать что травмы нижних конечностей, столь частые в американском футболе, вызваны в основном полностью неправильными тренировками.

ПИТАНИЕ И СПОРТИВНАЯ ПРОИЗВОДИТЕЛЬНОСТЬ

Migliaccio Gian Mario, Spreghini Michele

SM (Ita), n.º 9, anno IV, gennaio-aprile 2018, pp. 22-29

В этом кратком обзоре авторы анализируют актульные темы большой значимости для спортивной практики: питание и спортивная работоспособность, стратегии питания и тренировки (запасы гликогена, использование углеводов, жиров, белков и пищевых добавок во время физических упражнений), роль воды и минеральных солей для спортивной работоспособности, практика стратегий питания.

«ДЕЛАТЬ ВЕС»

Francesco Pasqualoni, Francesco Lampredi

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Авторы рассматривают тему «делать вес», то есть пракику встречающуюся во всех видах спорта в соревнованиях которых предусмотрены весовые категории. В этом обзоре рассматривается проблемя «быстрой потери веса» используя богатую библиографию, с углублённым анализом состояния питания и белкового метаболизма (обмена), обезвоживания, интеграции после контроля веса, и избежания потери работоспособности.

ДВИЖЕНИЕ И АКТИВНОСТЬ МЫШЦ ПОДВЕРЖЕНЫ ВЛИЯНИЮ НЕУСТОЙЧИВОСТИ ПОЛОЖЕНИЯ ВО ВРЕМЯ ТРЕНИРОВКИ С ИСПОЛЬЗОВАНИЕМ ПРИСЕДАНИЙ С ОТЯГОЩЕНИЕМ (SQUAT).

Nairn BC, Sutherland CA, Drake JD.

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Тренировка с использованием приседаний с отягощениям (squat) в условиях неустойчивости приобретает, по множеству причин, всё большую популярность. Многие устройства создают нестабильность ног и пертурбацию поднятия (bottom-up); однако эффект нисходящей (top-down) неустойчивости во время приседания остается неясным. Для создания нестабильности верхней части тела используется водонаполненный цилиндр «Attitube». Исследование проанализировало влияние нестабильности положения (сверху вниз, top-down; снизу вверх, bottom-up; отсутствие нестабильности) во время упражнения squat с точки зрения кинематики и активации мышц. Десять участников (мужчин) экперимента были оснащены 75 светоотражающими маркерами для отслеживания кинематики лодыжки, колена, бедра и туловища и устройством «Attitube»; электромиография регистрировала 12 мышц (двусторонно). Упражнение squat выполнялось с олимпийской штангой на устойчивой поверхности, с олимпийской штангой на « BOSU» (BALL, bottom-up) и с устройством «Attitube» на твёрдой почве (TUBE, top-down). Упражнение TUBE, top-down продемонстрировало 1,5-кратное уменьшение активации мышц разгибателей спины (erector spinae) и сгибания туловища при выполнении упражнения с низкой скоростью. При выполнении упражнения TUBE отмечалась более высокая активация мышц живота, более высокая (до 2,8 раз) наклонная активация по сравнению со стабильным состоянием. При выполнении упражнения BALL повышался выворот лодыжки и сгибание колена с более высокой активацией икроножной мышцы, двуглавой мышцы бедра и четырёхглавой мышцы. В целом, изменение локализации нестабильности во время приседания с отягощением изменяет модель движения и мышечной активации туловища и нижних конечностей. Это предоставляет информацию для будущих исследований в области реабилитации, обучения правильной технике приседания с отягощением и конкретных программ тренировки.

НАДЕЖНОСТЬ ТЕСТА 1RM POWER CLEAN (ОДНОКРАТНОЕ МАКСИМАЛЬНОЕ ПОВТОРЕНИЕ (1ПМ) СИЛОВОГО ВЗЯТИЯ НА ГРУДЬ) ДЛЯ СПОРТСМЕНОВ ПОДРОСТКОВОГО ВОЗРАСТА.

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Faigenbaum AD, McFarland JE, Herman RE, Naclerio F, Ratamess NA, Kang J, Myer GD

Несмотря на то что тест power clean (силовое взятие на грудь) обычно используется для оценки уровня развития силы и мощности у взрослых спортсменов, его надёжность для молодых спортсменов не изучалась. Поэтому целью этого исследования было определение надёжности теста однократного максимального повторения силового взятия на грудь у спортсменов подростков. Тридцать шесть спорсменов мужского пола (возраст: 15,9 ± 1,1 года; масса тела: 79,1 ± 20,3 кг; рост: 175.1 ±7,4 cm) с опытом тренировки с использованием упражнеий тяжёлой атлетики больше одного года выполняли тест 1RM power clean в течении двух непоследовательных дней (во второй половине дня) используя стандартизированную процедуру. Все процедуры теста контролировались тренером высокого уровня по тяжёлой атлетике. Процедуры заключались в систематичекой прогрессии тестовой нагрузки до определения максимального сопротивления (нагрузки) которое можно выполнить 1 раз используя надлежащую технику упражнений. Полученные данные анализировались используя коэффициент внутриклассовой корреляции (ICC[2,k]), коэффициент корреляции Пирсона (r), дисперсионный анализ с повторными измерениями, график Bland-Altman и анализ типичных ошибок. Анализ данных показал что тестовые показатели были высоконадёжными демонстрируя ретестовую надёжность ICC = 0,98 (95% доверительного интервала = 0,96-0,99). Тестирование показало также высокую взаимосвязь между значениями 1RM в испытаниях 1 и 2 (r = 0.98, p < 0.0001) с незначительной разницей выполнения power clean в испытаниях (70,6 ± 19,8 и 69,8 ± 19,8 кг). Графики Bland-Altman подтвердили несущественную разницу значений 1RM в первом и во втором испытании. Типичная погрешность значения 1RM ожидаемая между первым и вторым испытанием составила 2,9 кг и указано изменение по крайней мере равное 8 кг для определения реального изменения производительности упражнения от теста а тесту у молодых спортсменов. Во время исследования не было травм и все участники хорошо переносили протокол тестирования. Эти данные свидетельствуют о том что тест 1RM power clean имеет высокую степень воспроизводимости у тренированных спортсменов подростков (мужского пола) когда соблюдаются стандартизированные процедуры тестирования и даются квалифицированные инструкции.

СПОРТ, ЧЕЛОВЕЧЕСКОЕ ДВИЖЕНИЕ И ЭМОЦИИ

Angela Magrino, Gennaro Gatto & Vincenzo D'Onofrio

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Развивать благоприятное психофизическое состояние посредством воспитания движения, спортивной деятельности и эмоций означает способствовать развитию сбалансированных и гармоничных изменений помогающих человеку быть в гармонии с самим собой и с окружающей средой, коме того способствует развитию нейронной пластичности и совершенствованию процесса обучения. Эта тема приобретает особое значение в период подросткового возраста, который характеризуется глубокими изменениями на физическом и психическом уровне. На этом этапе жизненного цикла дискомфорт может проявляться, например, в искажённом видении и ощущении своего тела. Важно работать над образом тела, над общением и, в превентивных целях, воспитывать эмоции – например эмоции гнева – с целью того чтобы находить возможные каналы и формы экстернализации и разделения с другими своих эмоций, избегая таким образом формы их насильственного проявления. Возможное направление для будущих размышлений заключается в воспитании к движению е к спорту при инвалидности исследуя такие темы как желание невидимости и стыд своего тела.


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