SCIENTIFIC MAGAZINE

1

The official journal of the European Weightlifting Federation. Year 1 Number 1 - April - July 2015

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SCIENTIFIC MAGAZINE

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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

Over the years a number of papers have been devoted to the weightlifter's warm up for competition. Some of this information is more than 50 years old. However, in the interim there have been a number of changes to the technical rules of weightlifting competitions.

56

36

Competition can influence the hormonal and performance outcomes in weightlifters. For instance, the salivary C (Sal-C) concentrations of Olympic weightlifters were found to be more than twofold higher during actual competition, than a simulated event.

Why a new magazine?

In this era of excessive information, do we really need to put pen to paper again? A series of words generally makes up a message; who is the message in this magazine for? Is it a magazine about sport? And why the continuous focus on strength?

These were just some of the questions that the EWF, along with the support of its distinguished friends of the Editor's Scientific Committee, deliberated on before going ahead with this magazine, which I can assure you, was no easy task: lots of questions and plenty of answers, many of them exciting and stimulating; some gave rise to more questions and new doubts; in the end, the moment we are living in, our passion and a host of right ideas led us to believe that this magazine was necessary, and this is not just our biased opinion. We wanted to publish a magazine that contained all the knowledge and information that we had always hoped to find in other magazines or, more pretentiously, in library books and in literature. And this was no marketing blitz either; albeit a legitimate idea, it never crossed our minds, because if that were the case perspective, it would have been much simpler to produce a news bulletin rather than a magazine.

We wanted to focus on a quality journal, a prestigious publication that could, in some way, convey to a wide readership our point of view on the evolution of training, and, in particular, on the evolution of strength training applied to weightlifting.

Strength. That wonderful magic which mankind throughout the ages has used to defend himself, to hunt, find food, reproduce and reach higher goals; the force with which human beings have competed (with themselves and with others) to win, to rejoice, to lose and so become stronger, but above all, it has allowed mankind to evolve from a quadruped to Homo erectus. Strength was a major element in standing up to observe and dominate the surrounding area and beyond: slowly and steadily or with bursts of strength, mankind has come a long way. Strength was also paramount to the development of man's cognitive abilities, the ability to move in his immediate surroundings, to interact with the environment and to process the ensuing stimuli.

Evolving through strength has indeed been a beautiful journey, and to thank nature for this gift and pay homage to her, man has created styles of movement: sport. Man discovered, invented, explored sport. No sport can express its style without resorting to strength, no coach can encourage his athlete to perform without calling on his strength. Not a minute of the day or night goes by when we are not forced to fight against and win over the force that dominates our planet and the system we orbit in: gravity. Even when we must convince somebody of something, we use strength of words and mind. If all this is true, then it is clear that we needed to dedicate a space that dealt primarily with scientific reasoning for those who strive to obtain physical advantages from the development of strength (arrogance excluded).

It was necessary to understand how strength can influence a performance model or if getting stronger is enough to win a competition.

Of course, answering these questions alone is a truly difficult task and, conscious and aware of this, we need to find as many travel companions as possible along the way.

We must invest in culture, the vehicle with which we can spread knowledge and experience. The world of sport needs to reflect on the importance of culture and we feel it is our duty to set the ball rolling and continue on this journey.

Training centres, gyms and any place where physical activity is carried out, are vital spaces, along the same lines as a doctor's surgery where health issues are treated with medicine, because a strong man is a healthy man. For this reason, training professionals, coaches and personal trainers are not figures that can be improvised, nor must they be lacking in scientific knowledge and practical expertise. It's no coincidence that they are called movement therapists; just as "tout court" therapists treat health problems, movement therapists are capable of "healing" sports performance, together they must return athletes to play following injuries or pathological situations.

This magazine, therefore, is aimed at professionals with a capital **P**. For all of the above reasons, with this new cultural vehicle we want to create an exchange of expertise and find in our area of competence, which is already so vast, a non-static response to the needs of both amateur and professional sport.

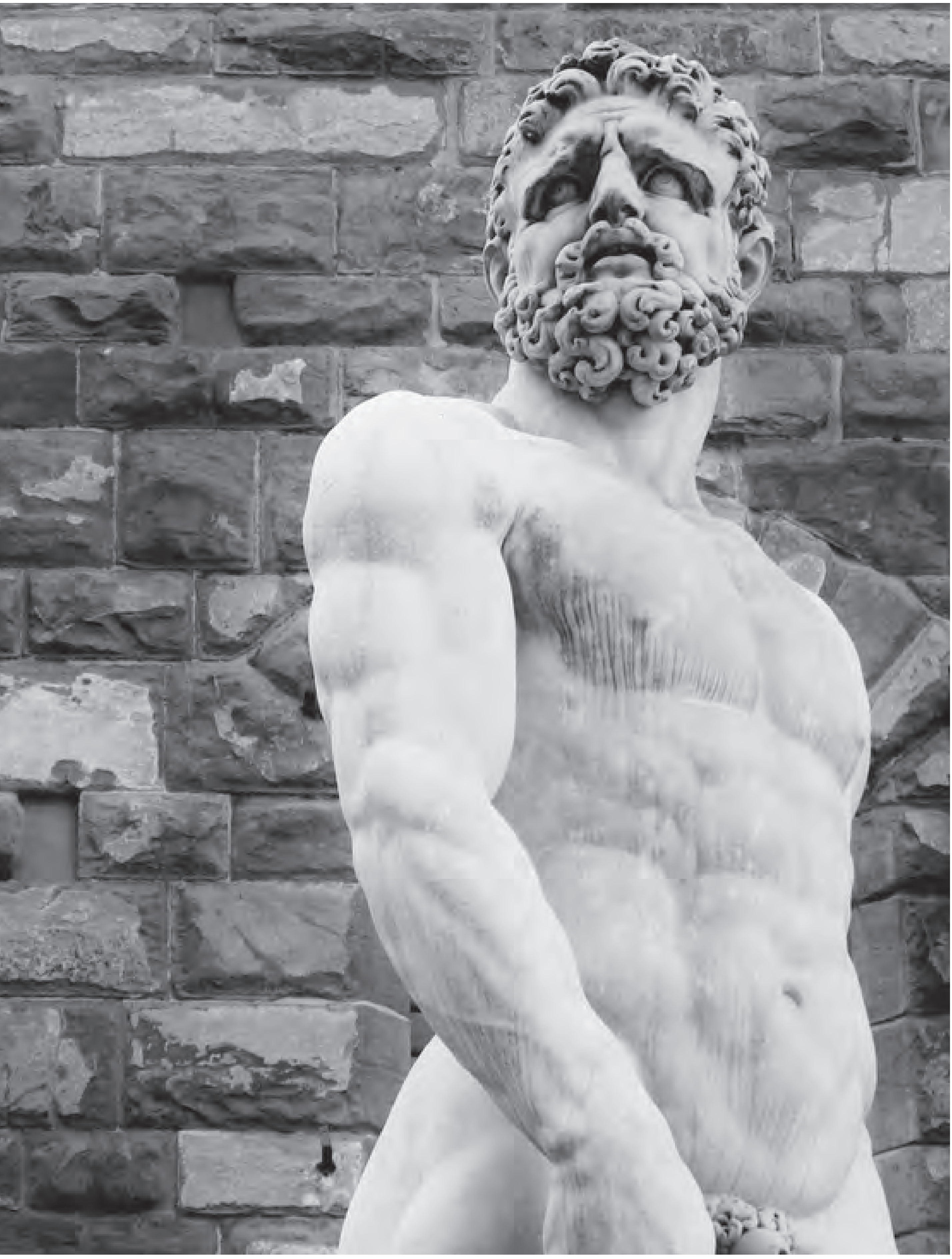
We truly hope to gather as many illustrious authors as possible so that this new-born magazine can spread the culture of the science of training. Sincere thanks to all those who are already part of this initiative and to those who will be involved in the near future.

Antonio Urso
EWF President

MYTH OF STRENGTH

If it is true that from the dawn of time man has raced and fought either out of need or for sport, it is equally true that he has always taken pride in his own strength, displaying it in all kinds of tests, at times extravagant: lifting and bearing weights, throwing, stretching, bending, breaking, tackling, pushing and pulling were just some of the exercises they engaged it. In addition, «until the appearance of firearms, physical strength was the main resource of fighters, who relied on it for their survival» (Georges Lambert).

BY LIVIO TOSCHI



At a later stage, when men began competing in sports contests, they realised that in order to win they would have to train methodically, drawing, perhaps, on the experience of famous physicians. To increase their strength they did the appropriate exercises, amongst which - obviously - weightlifting, by ingeniously using what they had at hand, such as boulders, logs and halteres, a type of metal or stone dumbbell, in the quest for maximum functionality. Naturally, without today's extremely accurate barbells, it was a difficult task to measure one's strength and impossible to compete at a distance. And yet, at the dawn of civilisation, there were plenty of contests which became more and more frequent thanks to the use of special equipment, such as the "yardstick".

The idea of a big, strong man has always incurred fear and commanded respect. We need only think of giants or cyclopes. In the *Odyssey*, Homer tells of Polyphemus, who threw "the top of a mountain" at Ulysses' ship (Book IX), and the Laestrygonians who sank Laertes' fleet with «immense boulders» (Book X). Ancient epic poems exalt the feats of the Phoenician Hercules, Melqart, of Gilgamesh the Sumerian King and of the Pharaoh, Amenhotep II.
And who has never heard of the giant Philistine warrior, Goliath, slain by David's slingshot, or the giant Libyan Antaeus, crushed by the arms of Hercules? All characters that could identify with the *The Colossus* painted by Francisco Goya.

Hoards of giants fills the pages of novels and the world of fables, such as Gargantua and his son Pantagruel, sprung from the imagination of François Rabelais, and Gulliver, the main character in Jonathan Swift's novel.

In our time, other strength heroes have been created by the fertile imagination of writers and illustrators. In the marvellous world of comics how could we forget, among others, Popeye and Obelix, *Il Grande Blek* and Lothar (Mandrake's crime-fighting companion) and of course, Walt Disney's Hercules?

Poland's Henryk Sienkiewicz, Nobel Prize winner for Literature in 1905, at the end of the 1800s wrote the novel *Quo vadis*?, brought to the big screen in 1913 by Enrico Guazzoni for the Cines di Roma, which gave life to the super strong Ursus, interpreted by Roman weightlifter Bruto Castellani. The film Cabiria (1914), directed by Giovanni Pastrone and shot in Turin, marked the birth of Maciste, played by rise of strongmen, played by Genoan docker, Bartolomeo Pagano.

Many sports champions tried their at acting in the so-called "strongman's cinema" (or athletic-acrobatic", according to Mario Verdone's definition). Amongst these was Trieste native, Giovanni Raicevich, unrivalled wrestler and holder of various weightlifting world records. He starred in 9 films, including Il re della forza (1920): the King of Strength, a most appropriate title.

GILGAMESH STRANGLES A LION - RELIEF ON KHORSABAD PALACE (VII CENTURY B.C.) LOUVRE, PARIS

In the film, *L'uomo della foresta* (1922), he played a sort of Tarzan and the most important scene saw him overcome two bulls that the "bad guys" had tied to his feet and hands and that were supposed to tear him apart. In 1959 cinema called on Primo Carnera, former champion boxer and new catch world champion to play the giant Antaeus in the new film *Hercules Unchained*, directed by Pietro Francisci, with "Mister Universe", Steve Reeves. Who better than Carnera, even if he was well over 50 years old, could interpret the mythical character that only the son of Zeus could defeat in wrestling?

Samson, Atlas and especially Hercules are the most important

MILO, MARBLE STATUE BY EDME DUMONT, (1754) 78CM - LOUVRE, PARIS

HERCULES AND ANTAEUS, BRONZE STATUE BY ANTONIO POLLAIOLO (1475 CIRCA) 45CM - MUSEO DEL BARGELLO, FLORENCE.

symbols of the eternal myth of strength. According to legend, Samson's strength lay in his hair. The Old Testament recounts that, having broken the strings that the Philistines had bound him with, he exterminated his enemies (a thousand men) with a donkey's jawbone. Ambushed in the city of Gaza by the Philistines, he rips open the gates and carries them on his shoulders to Mount Hebron. Samson, like Hercules and many other heroes and athletes (for example, Polydamas of Skotoussa, Astyanax of Miletus, Kera of Argo and even Cyrene, the Thessalian nymph), killed a lion with his bare hands on his way to Timnah. Betrayed by Delilah, to whom he had revealed the secret of his energy, in other words, his long locks, he was captured, blinded and condemned to turning a heavy. However, his hair slowly grows back and with it returns his strength. Samson has his revenge when he is taken to the temple of Dagon: he braces against the two central pillars and bent them with all his might causing the temple to collapse. He was found dead with many Philistines beneath the rubble. (*Judges, 13-16*).

The second last of the 12 Labours of Hercules was to bring King Eurystheus some golden apples, like those the goddess Gea gave to the goddess Hera as a wedding gift for her marriage to Zeus. The tree of the golden apples was in the garden of Hesperides, at the ends of the earth, and was guarded by a gigantic serpent named Ladon, coiled around its trunk. In this garden, Atlas the Titan, son of Iapetus and father of Hesperides, bore on his shoulders the celestial sphere on his shoulders, condemned to do so by Zeus after the

Titanomachy. The legend of Atlas intertwines with that of Hercules, who during his journey never failed to flex his powerful muscles: first he takes on and defeats the Nereus the sea god, who refused to show him the way to the garden; then he frees from chains Atlas' brother Prometheus, whose liver was eaten by a eagle by day and grew back by night; then he lifted and crushed the Libyan giant Antaeus, son of Gea; and finally he slew the hostile King of Egypt, Busiris, who was intent on sacrificing him to Zeus.

The Mycenaeans (or Achaeans) were a warlike people, whose deeds beneath the walls of Troy were sung by Homer in the Iliad. For them, wrote Richard Mandell, «winning a public match or lifting a large boulder in front of an audience, when these activities were socially approved and ritually performed could be regarded as a indication in favour of the gods». Homer often exalted the might of his heroes: the dreadful Telamonian Ajax, for example, lifted heavy wooden beams as if they were twigs and hurled them at his enemies, knocking out Hector, saved only by the help of Aphrodite.

ATLAS AND THE HESPERIDES, OIL ON CANVAS BY JOHN SINGER SARGENT (1925) - MUSEUM OF FINE ARTS, BOSTON

In the Greek world there is evidence of many other men with supernatural strength, such as the giant boxer Glaucus of Caristo (in Euboea), Olympic champion in 520 B.C., who straightened the blade of a plough by hammering it with his bare fist; twice Greek champion athlete, Theagenes of Thasos (V century. B.C.), celebrated by Pausanias and Plutarch for his 1,400 victories in pankration and boxing, the aforementioned Polydamas, Thessalian Olympic champion in 408 B.C. with just one arm managed to block a chariot in flight and one day he grabbed a bull by its hoof so tightly that in order to free itself, the bull left its hoof in the champion's hand. Polydamas died trying to hold up the collapsing roof of a cave so that his friends could run to safety.

Milo of Croton is famous for his success in wrestling - 7 victories at the Olympic Games, ± at the Pythian Games, 9 at the Nemean Games and 10 at the Isthmian Games. He was also endowed with incredible strength. A disciple of Pythagoras, during a banquet held by the master with his pupils, Milo showed his prowess by supporting the crumbling ceiling of the room after a pillar collapsed. Legend has it that he held a pomegranate so tightly in his hand that nobody could pry it open, yet the fruit was not even bruised. Moreover, it appears that the same Milo personally placed the statue dedicated to him by his fellow countryman, the sculptor Damea, in the sacred sanctuary of Olympia. One of the most celebrated feats was when he carried an ox on his shoulders through the stadium at Olympia. Milo, however, suffered a stinging defeat against Titormus of Aetolia, in what we can define as the most ancient weightlifting contest ever documented.

N° 1 / April-July 2015

SAMSON PULLS DOWN THE PILLARS OF THE HOUSE, ILLUSTRATION BY MARC CHAGALL

Having abandoned contests, in 510 B.C. he led the Crotonian army in the bloody battle against the Sybarites: «He launched himself in the fray – recounts Diodorus Siculus – wearing his Olympic crowns and in a manner similar to Hercules, wearing a lion-skin and carrying a club». Although the enemy troops were overpowering, the fury of Milo led his men to victory.

Weightlifting is a noble and ancient sport, whose origins are lost in the halo of mystery, from which emerge powerful figures of gods and heroes, giants and cyclopes, athletes and strongmen, who lie on the boundary between history and legend. Their fame still shines today and will continue to do so everywhere and eternally because the myth of strength is boundless. It lives in us all and is a never-ending source of inspiration for literature and art for all peoples.

It is a cultural heritage that weightlifting must cultivate with increasing commitment. The fruits will no doubt be plentiful.

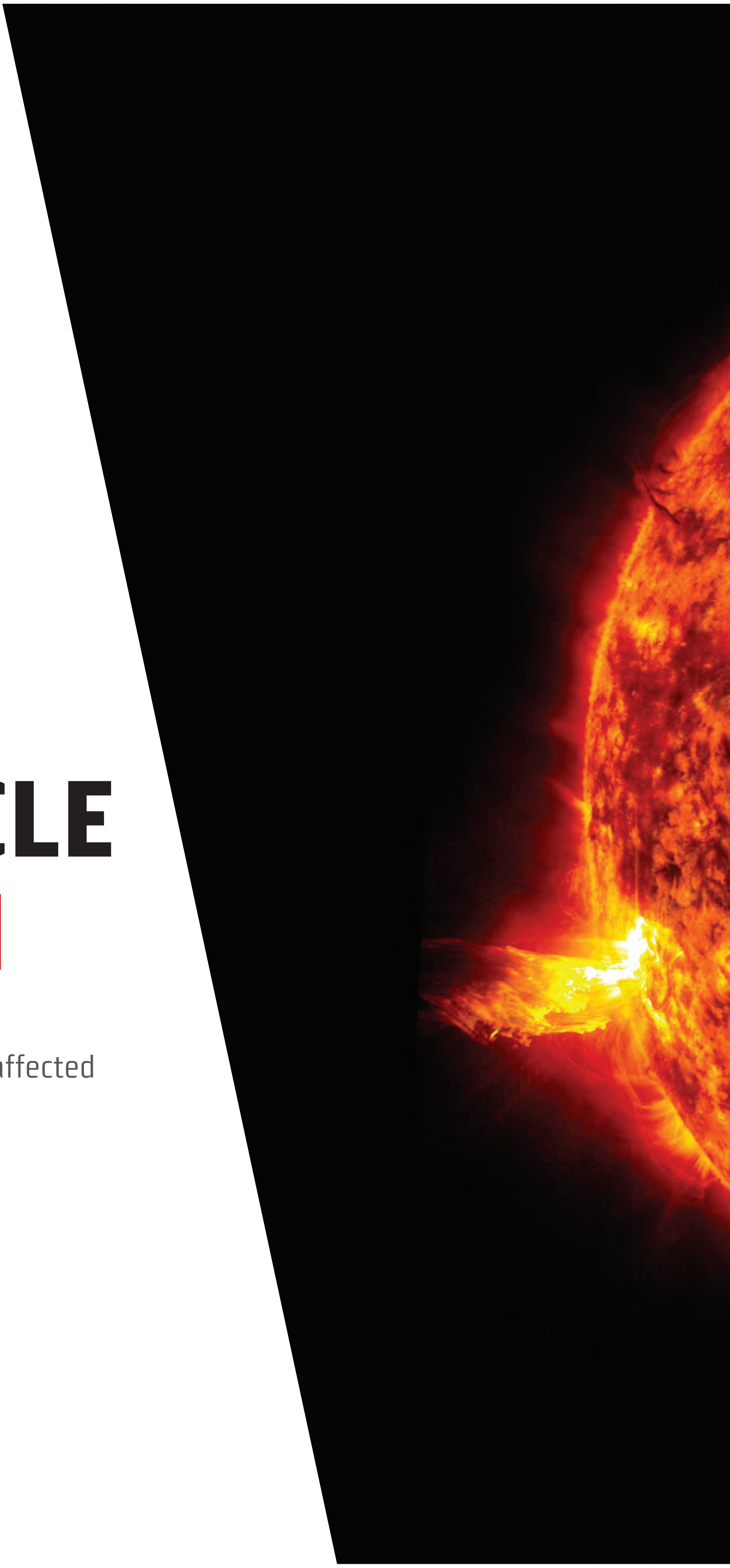
HERCULES BEARS THE CELESTIAL SPHERE - BRONZE STATUE BY GIAMBOLOGNA - CIVICHE RACCOLTE DEL CASTELLO SFORZESCO, MILAN

LIVIO TOSCHI

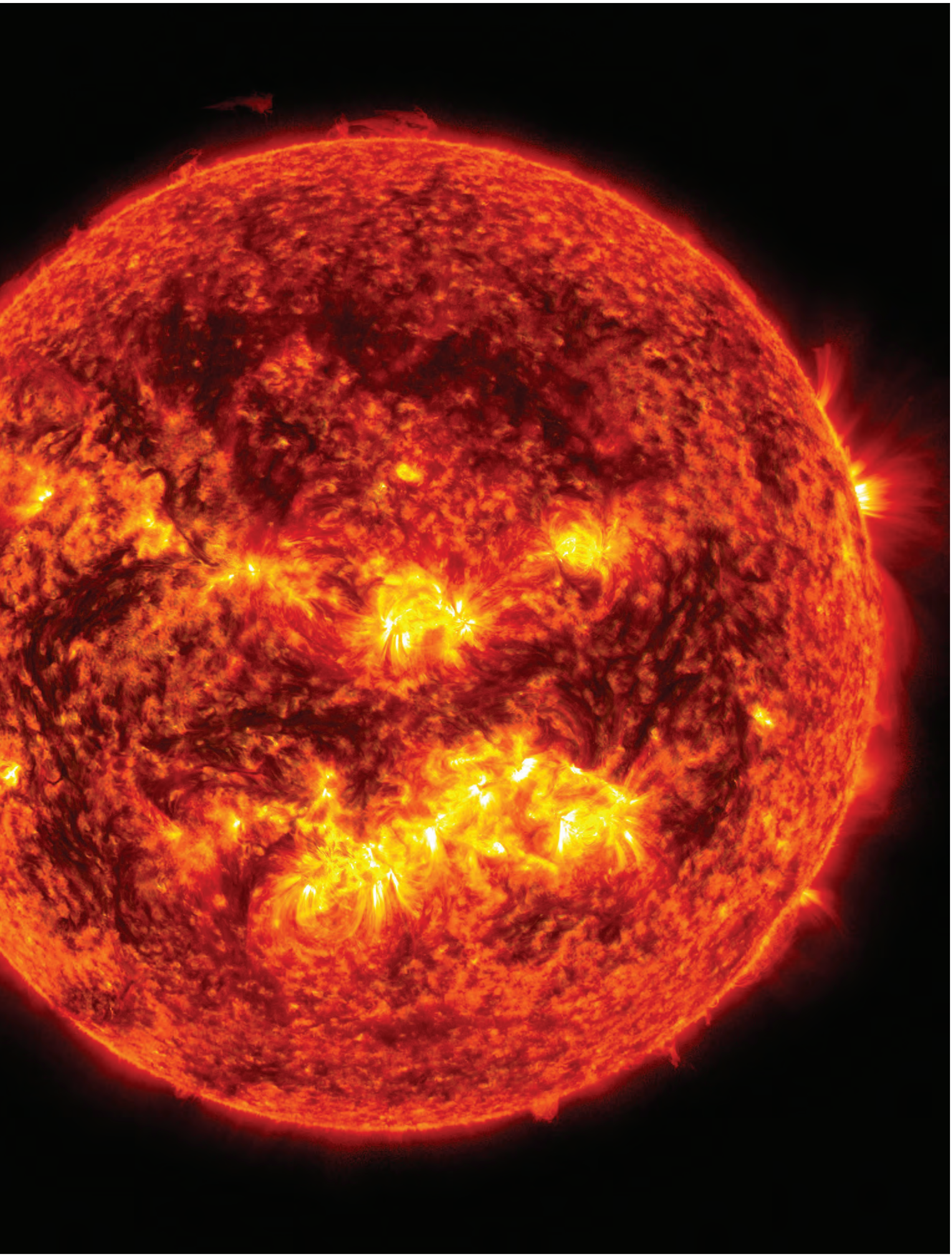
A QUALIFIED ARCHITECT, HIS INTERESTS EXTEND TO SPORTING FACILITIES AND THE HISTORY OF SPORT. HE IS THE HISTORICAL AND ARTISTIC CONSULTANT OF THE ITALIAN KARATE, JUDO, WRESTLING AND MARTIAL ARTS FEDERATION, OF THE ITALIAN WEIGHTLIFTING FEDERATION, OF THE SAN MARINO WRESTLING, JUDO AND WEIGHTLIFTING FEDERATION AND ALSO OF THE EUROPEAN WEIGHTLIFTING FEDERATION. HE IS A HISTORY LECTURER AT THE NATIONAL FIJLKAM SCHOOL AND AT THE SAN MARINO JUDO SCHOOL. IN THE SPORTS ENVIRONMENT HE HAS WRITTEN 15 BOOKS AND NUMEROUS ARTICLES AND HAS ORGANISED MANY EXHIBITIONS.

SOLAR ENERGY AND MUSCLE STRENGTH

It all began with a bone disease that affected thousands of children



BY MENOTTI CALVANI



In 1889, 20 of the 21 young lions born in London zoo died, all presenting bone deformities very similar to those described in children in 1645 by Daniel Whistler, a student of Medicine at the University of Leyden, Netherlands in his famous thesis entitled "*Inaugural Medical Disputation of the Children's Disease of the English which the inhabitants idiomatically called the rickets*". The first complete description of the disease was, in fact published in England by Francis Glisson, a Cambridge doctor, who in 1650 published a Latin treatise entitled "***De Rachitide***", hence the English term ***rickets***.

THE HOBBITS IN THE SAGA OF THE ENGLISH WRITER JRR TOLKIEN, WOULD ALWAYS TRIUMPH OVER THEIR ENEMIES BECAUSE THEY ARE EXPOSED TO THE LIGHT OF THE SUN AND EAT PROPERLY. AS AFFIRMED BY AN ARTICLE IN THE DECEMBER 2013 ISSUE OF MEDICAL JOURNAL OF AUSTRALIA.

Prior to the lions, a veritable epidemic of rickets struck the children of London with a high mortality rate that reached 300 in 1,000! The shape of the children's bones of the entire skeleton were deformed, with an abnormal curvature of the long bones, which were less solid due to a gross impairment in ossification. The bone appeared, in fact, less resistant and affected children were prone to infectious diseases.

The babies were born healthy and became ill before 4 years of age. Doctors at the time excluded that the disease was contagious or hereditary, and as it was more common in poor areas of the city, they suspected that it was somehow linked to the economic conditions of the families. In fact, during the Renaissance, rickets struck the Medici family in Florence, who certainly had no financial problems!

Rickets was not a new disease as it had already been described in the papyri of the ancient Egyptians and, in ancient Rome, the doctors acknowledged the presence with an impact far greater than that which afflicted the Greek population and considered it to be a disease linked to the poor hygiene of mothers.

Not knowing the cause, it was impossible to implement a therapy. Glisson, author of ***De Rachidite***, proposed wrapping the bones in tight bandages to force the "bent" bones to grow straight; however, since time immemorial, mothers had always swaddled babies as shown by small votive sculptures found in Crete dating back to 2600-2000 BC. Sacred art is full of images of newborn Jesus wrapped in swaddling clothes. The concept that swaddling infants was an excellent way of helping children grow without bow legs survived until some years ago, and, albeit for different reasons, it is once again taking off in the USA. In some parts of the world, it is thought that bandaging the lower limbs of female infants ensures straight legs and a wide pelvis.

The Diet Factor

In nutritional terms, the lions in London Zoo were not treated as wild kings of the jungle, their diet was very refined, consisting only of boneless meat! Dr. John Bland-Sutton, a luminary doctor, very famous in England at the time, he was called to the bedside of the lions, and, convinced that the disease was linked to the lack of fat and calcium in the diet, goat's meat and ground bones supplemented with milk both for mother lions and their cubs and, for the latter, a good dose of cod liver oil. The lions got better, Bland-Sutton's experiment was not published, but the results were exploited by Edward Mellamby, also convinced that rickets was related in some way to nutritional deficiencies: he induced the disease in dogs adopting a fat-free diet!

He then gave the sick animals vitamin B_1 (yeast), vitamin C (orange juice) without success, but he prevented the disease by giving foods

Figure no. 1
A) Child with rickets (1896); B) Rickets is also present in modern times; C) Dogs with a fat-free diet developed rickets and led to the discovery of vitamin D; D) votive statuettes, Crete 2600-2000 BC; E) Ambrogio Lorenzetti, Madonna with Child (1319); F) In the early 1900s, in order to keep their children with them at the workplace, mothers wrapped up their babies and put them, like umbrellas, into little carts with wheels (called Scannedda, Capicarru or other terms, depending on the location).

rich in fat and vitamin A (milk, butter, cod liver oil). Vitamin A had been identified in 1920, but it had been considered a ***milk accessory factor*** since 1816, when dogs fed on bread alone died after 50 days with serious eye injuries, and since 1912 when the same diet induced the lack of growth in rats: both conditions were treated with the administration of milk. Vitamin A, was contained in milk, but also in the liver, which was effective in the treatment of night blindness, cured by the Egyptians and Romans by placing mashed animal liver on the eyes. Was rickets related to vitamin A deficiency? Another step was necessary. Cod liver oil was chemically manipulated in order to destroy the vitamin A it contained: denatured oil, devoid of vitamin A, could no longer treat the problems of night vision, but retained its effectiveness against rickets. The substance, which differed from vitamin A, capable of curing rickets, was called vitamin D because, in chronological order, its discovery came after that of vitamins A, B and C.

This marked the beginning of the use of cod liver oil as a preventative and whole generations have been drinking gallons of cod liver oil, with many children trying to escape the sickening odour and taste of the "precious "liquid.

The oil worked, but the chemical structure of the therapeutic factor called "vitamin D" was unknown!

The Light Factor

In 1861, the French physician, Trousseau, had already asserted that rickets, in addition to a poor diet, was linked to the lack of sun exposure. In 1890, the first article was published that correlated geographical distribution and prevalence of rickets: more numerous cases of rickets were evident when moving north and decreasing sun exposure. In addition, the Industrial Revolution, which began at the end of the 1600's had shifted the population from the countryside to the cities, which became more and more crowded with houses separated by very narrow streets where the sun never shone; this situation was exasperated by the thick blanket of smog caused by the use of coal. At the end of

FIGURE NO. 2
A) 65 MILLION YEARS AGO, THE FALL OF AN ASTEROID FILLED THE ATMOSPHERE WITH DUST THAT BLOCKED THE SYNTHESIS OF CHLOROPHYLL IN PLANTS AND THE PRODUCTION OF VITAMIN D IN DINOSAURS; B) ATMOSPHERIC POLLUTION IN LONDON AT THE END OF THE 1800S: INFANT MORTALITY ROSE TO 300/1,000; C) THE ATMOSPHERE OF SALZBURG WAS NOT DIFFERENT FROM THAT OF LONDON - MOZART'S POOR HEALTH IS ATTRIBUTED BY MANY TO A SEVERE VITAMIN D DEFICIENCY; D) THE ADMINISTRATION OF COD LIVER OIL TO PUPILS; E) CHILDREN EXPOSED TO SUNLIGHT ON THE VERANDA OF MEIDLING HOSPITAL IN VIENNA (1923); F) HULDCHINSKY SUCCESSFULLY TREATS POLISH CHILDREN SUFFERING FROM RICKETS WITH THE FINSEN LAMP (1919).

1800's, 90% of children in Leyden (Netherlands) and Boston were suffering from rickets. English children (and with them the lions in London Zoo) were more likely to get sick than those who lived in the tropics or in the savannas, or simply in places with good exposure to sunlight.

At the end of World War I, Vienna also suffered from a veritable epidemic of rickets and an experiment was put in place to test and compare the therapeutic effect of fish oil and sun exposure. The children were divided into 4 groups. One group followed a standard diet, one group had the same diet + liver oil, one group spent a part of the day on a veranda with a substantial amount of clothing, the last group spent same hours on a veranda, but with less clothing so as to take the sun. The group treated with oil and the group exposed to the sun improved, unlike the other two groups, which remained unchanged. In addition to the fish liver oil, the "sun bath", a method of prevention and treatment was introduced, but at those latitudes and with that pollution, it was not a sound practice. In Warsaw, the situation was no different and, in 1919, Polish doctor Huldchinsky thought to solve the problem using the lamp that the Danish physician Finsen had invented to produce "***chemical rays of the sun***" and with which he had cured tuberculosis skin, earning him the Nobel Prize in 1903. Huldchinsky's intuition proved correct, the children were cured without the disgusting fish oil that in a time of famine was not easy to find.

Vitamin D and sunlight

In 1923, Harry Steenbock (Wisconsin), discovered that food irradiated with ultraviolet light cured animals suffering from rickets: it was the beginning of the spread of irradiated foods, which was a great business and, above all, another blow to rickets. Vitamin D became a real fashion, fortifying food, drinks, creams, soaps and even shaving creams.

In 1930, Adolf Windaus (Berlin) clarified the formula of vitamin D and described its formation from cholesterol, but we had to wait until 1972 for a complete description of its metabolism.

We now know that the first steps occur in the skin by the action of sunlight that transforms a metabolite of cholesterol (7-idrossico-

FIGURE NO. 3
A) HARRY STEENBOCK DISCOVERS THAT FOOD IRRADIATED WITH ULTRAVIOLET LIGHT CAN HELP CURE RICKETS; B) AND C) A MILK BOTTLE CAP AND BEER CANS CONTAINING VITAMIN D OBTAINED BY EXPOSURE TO ULTRAVIOLET LIGHT; D) MUSHROOMS AFTER IRRADIATION ARE AN EXCELLENT SOURCE OF VITAMIN D2, NOTE THE "TAN" SEVERAL HOURS FROM THE START OF EXPOSURE TO UV LIGHT.

lestero- him) into pre-vitamin D and the body temperature which, in turn, transforms the pro-vitamin into Vitamin D_3, which leaves the skin and reaches the liver where it is modified 25OH-Vit. D_3: the molecule that is dosed in the blood to assess the metabolism of vitamin D. The last stage is at the level of the kidneys, where 25OH-D_3 is modified into the more active 1-25 $(OH)_2$ Vitamin D_3.
Also plants, that are exposed to sunlight, produce vitamin D_2 (animals produce D_3), starting from a molecule, ergosterol, similar to that of cholesterol. On average, vitamin D_2 is 2-3 times less powerful than vitamin D_3.
Not all of the sunlight participates in the synthesis, only the part whose wavelength is between 315 and 280 nanometres, commonly known as Ultraviolet B Light (UVB) differentiating from UVA (400-315 nm) and UVC (280-100 nm).

Things to Know

Exposure to light through windows is not utilisable for synthesis, as the glass almost completely blocks the UVB.
The skin provides for the synthesis of 90% of the necessary vitamin D, the rest is supplied by the diet (salmon, egg yolk, fish, cereals, fortified milk, etc.). Cod liver oil is by far the food with the highest content of Vitamin D, 15 millilitres contain the 1,360 International Units (IU). This concentration depends on the diet of marine microalgae which, under the action of sunlight, produce large amounts of vitamin D: in one year microalgae under the action of the sun produce more than 120 billion tons of organic carbon (!).
The daily requirement varies from 200 International Units (IU*) for children, to 600 IU for over seventy year olds (*40 IU = 1 microgram). The skin must be exposed to sunlight at least 5 minutes a day, bare face, arms, legs. Much depends on the time of exposure and the season, it is estimated that in the summer, 5-10 minutes of sun exposure between 10 and 15 induce the synthesis of 10,000 IU. Vitamin D synthesized in the summer is stored in adipose tissue and acts as a deposit for the needs of winter. In winter, vitamin D synthesis does not occur at latitudes higher than 35° (latitude of Agrigento 37.18 N, 41.54 Rome, Milan 45.28 N). As the saying goes: ***You do not synthesize vitamin D_3 if your shadow is longer than you***.
The skin of the elderly produces less vitamin D. A 70 year old man has - in his skin - 25% of the 7-dehydrocholesterol (precursor of vitamin D) that a 20 year old has. Considering 30 ng/ml as the limit of sufficiency, the prevalence of vitamin D deficiency in over 65 year olds often exceeds 60% and 50% in postmenopausal women. It is estimated that in Italy, 70-80% of people over 69 are lacking in vitamin D. The use of sunscreen blocks the synthesis processes of the skin.

The obese have low levels of vitamin D in their blood that easily dissolves in fats and is sequestered in the excess of adipose tissue.

- Deficiency: <20 ng / ml
- Renal: <30-32 ng / ml
- Sufficiency: 30-32 ng / ml
- Optimal levels: 40-70 ng / ml
- Toxic levels:> 150 ng / ml + hypercalcemia

Table no. 1
Defining blood levels of vitamin D

Skin colour is of huge importance as the light the complexion, the greater the synthesis of vitamin D. This phenomenon is linked to an evolutionary process that has come about with human migration from equatorial areas, where Homo Sapiens appeared, to regions closer and closer to the poles. The energy intensity of light at the equator is very high and can overcome the barrier of the skin and damage the DNA of cells; to protect themselves from this danger early humans developed a high capacity for synthesis of melanin that gives the dark colour of the skin and acts as a filter for solar radiation. In moving northwards, man gradually diluted the melanin content and with it the colour of his skin so as to allow the reduced solar irradiation to not have filters that blocked the synthesis of vitamin D: the selection of the colour of the skin of the Nordic populations was determined by the need to synthesize vitamin D with the exception of the Eskimo tribes who, although living in the arctic circle, in areas with low UV radiation, have kept their dark skin because the reduced synthesis of the vitamin is abundantly compensated by their diet of fish and animals that feed on fish, notoriously rich in vitamin D.

The darker the complexion, the lower, with the same solar irradiation, is the skin's synthesis of vitamin D.

Functions of vitamin D

The alterations in the bones in rickets initially concentrated attention on the role of vitamin D in the metabolism of calcium. It has been determined that vitamin D plays an essential role in calcium balance:

- Determines calcium absorption in the intestine
- Adjusts the absorption of calcium and phosphorus in the kidneys
- Regulates the reabsorbtion of bone calcium by acting on osteoclasts
- Along with Parathyroids, it keeps the blood levels of calcium necessary for the ossification

But in recent years it has been discovered that the functions of vitamin D go far beyond calcium affecting the functioning of the whole body and the finding was not unexpected, considering that **vitamin D is not** a vitamin! **It is, in actual fact, a hormone that is very similar in structure to other hormones that are derived from cholesterol.**

Vitamin D cannot be a vitamin, as vitamins are substances introduced with food indispensable for life but not synthesized by the body: Vitamin D is synthesized by the skin.

Vitamin D is a hormone because it is able to act on distant cellular system selective and specific binding with a protein (the Vitamin D Receptor) that uniquely recognises it, in the same way a lock recognises its key.

The vitamin D receptor has been identified in the cells of all organs; once bound to the vitamin, and only if bound, it attaches to predisposed points of the DNA and regulates the transcription.

Today we know that the vitamin D-receptor complex regulates more than 1,000 genes and influences activities such as, among many others (Table 2).

Immunity	Glucose metabolism
Inflammation	Cell proliferation
Calcium metabolism	Trophism of the nervous and muscular system

Table no. 2
Activities that presents evident influence of the vitamin D-receptor complex.

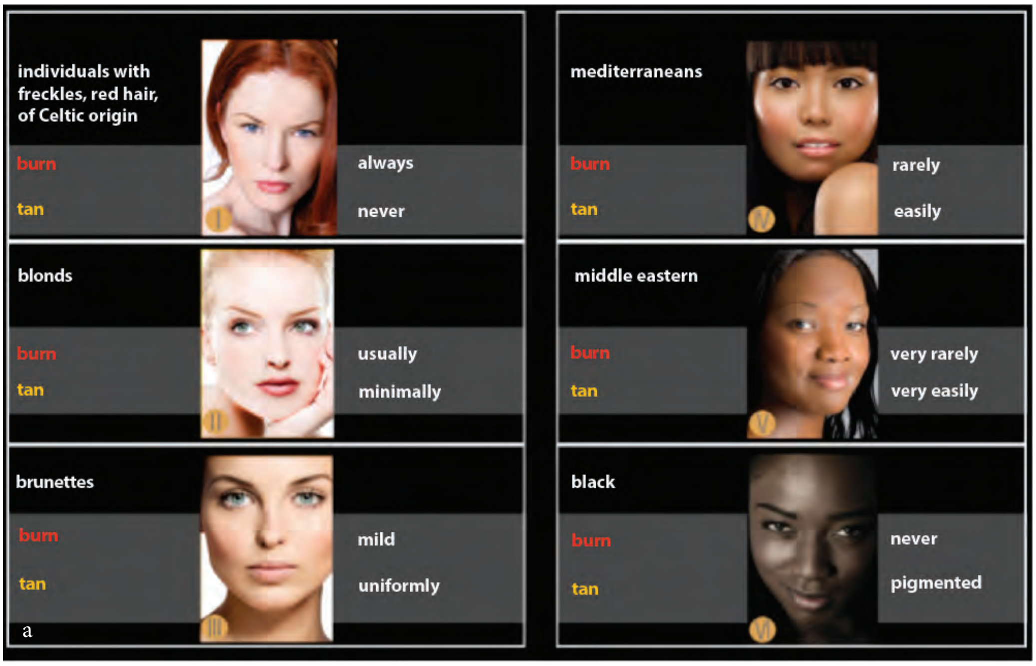


FIGURE NO. 4
A) SKIN PHOTOTYPES ACCORDING TO FITZPATRICK: COMPLEXION IS THE EVOLUTIONARY ADAPTATION OF THE MIGRATION OF THE PRIMORDIAL BLACK RACE TOWARDS AREAS WITH LOW SOLAR RADIATION. B) GWYNETH PALTROW (GRADE I / II FITZPATRICK) SAYS SHE SUFFERS FROM SEVERE HYPOVITAMINOSIS D DUE TO A LACK OF EXPOSURE TO THE SUN. (AUTHOR: FRANCIS ANTOGNARELLI)

Vitamin D and athletic performance

The use of the Finsen lamp improved not only the situation of bone, but also the strength of the patients. Long before evidence was available that the anti-rickets factor acted on the muscle, in 1927, the German Swimming Federation suggested to improve the performance of the swimmers exposing them to UV rays: many accused them of doping, but the experiment continued. From the 1930s improvements began to show in athletes performances with the use of lamps and / or treatment with vitamin D. In 1968, the extraordinary performance of long jumper, Bob Beamon, after a period acclimatization in situation of high solar radiation, led to an increased interest in the properties of vitamin D.

Vitamin D deficiency in athletes

A growing number of scientific studies shows a situation of insufficient vitamin D in athletes. Among the causes, in addition to a reduced nutritional intake, we must consider the reduced endogenous synthesis that should ensures more than 90% of the needs. Given the importance of vitamin D for performance and especially for the health of the athlete, monitoring plasma levels should be done systematically, taking into account:

- **Seasonality**: levels are higher in summer. Best performances in training and in competition are obtained in summer and autumn, periods in which the levels of vitamin D are higher. Many athletes have problems in winter and in the spring, when they run out of their stores produced during the summer months. A recent survey, conducted in spring, revealed that 81% of football players of New York Giants were clearly deficient. One study evaluating the seasonal differences in women gymnasts and runners showed a 15 ng / ml level of vitamin in the winter period, compared with 25ng / ml of the summer period in 75% of patients.
- **Skin colour**: dark phototypes are at high risk; the African-Americans in the National Football League showed average levels of 20.4 ng / ml compared to 30.3 ng / ml of their Caucasian teammates. It was determined that African Americans need 10 times longer UVB exposure times to

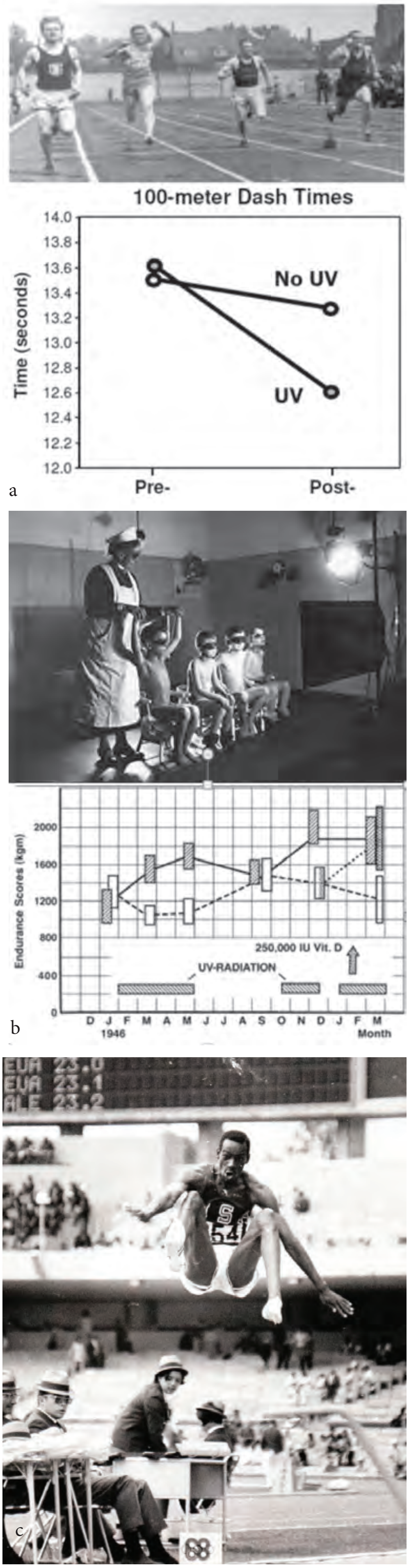


FIGURE NO. 5
IN 1938, RUSSIAN DOCTORS USED UV RAYS IN ADDITION TO TRAINING METHODS FOR STUDENTS IN THE 100, RESULTING IN A MARKED IMPROVEMENT IN THEIR PERFORMANCE; B) IN 1952, IN GERMANY, THE USE OF RADIATION AND/OR ADMINISTRATION OF VITAMIN D TO CHILDREN IN ELEMENTARY SCHOOLS DURING NON-SUMMER MONTHS, DETERMINES A MARKED IMPROVEMENT IN CYCLE ERGOMETER PERFORMANCE; C) 1968 OLYMPIC GAMES MEXICO CITY, BOB BEAMON IMPROVES THE RECORD JUMP BY 55 CM.

reach the same levels of vitamins D as Caucasians. However, individuals with Fitzpatrick skin type Type 1 are equally at risk for their reluctance to exposure to sunlight for fear of getting burned.

- **Latitude**: in winter, latitudes above 35° do not have sufficient irradiation. It must be considered that many Olympian athletes, originating from areas with lower latitudes, showed levels of insufficiency (for example, 42% of outdoor athletes and 80% of Israeli indoor athletes): latitude is not a guarantee!
- **Indoor activities**: it is by far the highest risk factor, especially in the presence of all the others. Deficiencies of vitamin D were detected in 94% of basketball players and 83% of gymnasts.
- **Type of clothing**: over-dressed women of the Middle East are at high risk, but so are those who protect themselves with clothes for fear of burns.
- **Using sunscreen**: synthesis decreases in the months of maximum radiation. In our hemisphere a daily exposure of a few minutes in the summer would be sufficient and appropriate.
- **Musculoskeletal trauma and post-trauma recovery:** levels of vitamin D in football players hospitalised for trauma were an average of 19 ng/ml, significantly lower than their companions who had not suffered from trauma. Recovery after surgery for traumatic anterior cruciate ligament was more rapid in those with levels> 30NG/ml.
- **Bone Health**: bone density is related to the plasma levels of vitamin D. In situations of deficiency (blood levels <30 ng / ml), the intestinal absorption of calcium drops to 10-15%, whereas it rises to 30% with vitamin D levels > 30 ng / ml. Levels above 40 ng / ml protect against bone fractures and represent a safety limit to reduce stress micro-fractures, very common in runners and jumpers.
- **Muscular strength**: a correlation has been demonstrated between plasma concentrations of 25 (OH) D_3 and power, muscle strength, speed and high

N° 1 / April-July 2015

$25(OH) D_3$	10 NG/ML	20 NG/ML	30 NG/ML	40 NG/ML	50 NG/ML
RICKETS	←				
ATROPHY OF MUSCLE FIBRE TYPE II + FALLS		←			
RISK FRACTURES AND MICROFRACTURES				←	
OPTIMISING MUSCLE FUNCTION					→

TABLE NO. 3
CRITICAL LEVELS OF VITAMIN D AND RELATED PATHOLOGIES.

jump. Levels below 20 ng / ml induce the loss and atrophy of type II fibres, with the consequent loss of strength, especially in the proximal areas, reduction of power, height and speed in the jump and a reduction in performance in general. In older individuals, loss of muscle fibre type II is responsible for falls.

- **Inflammation and Immunity**: athletes with levels below 38-40 ng / ml are at high risk of the onset and recurrence of colds especially of the upper airways. In the marathon runners, the concentrations of inflammation markers, TNF-alpha and interleukin-6 are elevated when concentrations of 25 (OH) D fall below 32 ng / ml.
- **Muscle pain**: a variable percentage between 89 and 93% of patients with chronic musculoskeletal pain have vitamin D deficiency
- **Sleep disorders**: a high percentage of subjects with sleep disorders have low levels of vitamin D. Levels should be maintained at 60-80ng / ml.

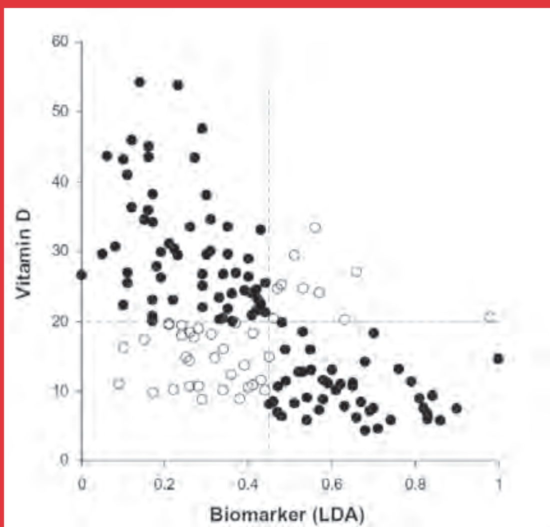
FIGURE NO. 6
A) JOSEPH PILATES, BORN IN 1883 IN MÖNCHENGLADBACH (GERMANY), LATITUDE 51° 12 ', INVENTOR OF THE HOMONYMOUS TECHNIQUE, SUFFERED FROM RICKETS AS A CHILD; B) MUHAMMAD ALI: DARK SKIN, LONG PERIOD OF INDOOR ACTIVITIES, MULTIPLE HEAD INJURIES: SUFFERS FROM PARKINSON'S DISEASE. HIS DAUGHTER HAS CREATED A FOUNDATION FOR THE STUDY OF VITAMIN D IN PARKINSON'S; C) JENNY AND SUSANNA KALLUR, TWIN SWEDISH CHAMPIONS 110 M HURDLES, BOTH HAD STRESS MICROFRACTURES IN AUGUST 2009: LIGHT SKIN TYPE, RUNNING AND JUMPING, LIVING IN SWEDEN (LATITUDE> 55 ° N).

- **Diseases of the nervous system**: Parkinson's, Dementia, Depression, Multiple Sclerosis, head trauma are conditions associated with low plasma levels of vitamin D.

Vitamin D is not a vitamin, it is a hormone with important functions in the maintenance of homeostasis of the organism. Is not an ergogenic substance as it does not improve performance, but its deficiency has severe consequences on the health and performance of the athlete.

An algorithm for the approximate calculation of vitamin D levels

THE REGRESSION ANALYSIS ELABORATED BY MC CARTY ET AL., CAN BE USED, CALCULATING THE BIO-MARKER (**B**) OF VITAMIN D DEFICIENCY.



B (X) = X1 + 0.011X2 · 0207 - 0092 + 0.007X3

WHERE:

X1 IS THE RACE (1 = WHITE, 2 = BLACK) X2 IS THE BODY MASS INDEX (KG / M2)

IN THE CASE OF **B** = 0.4, THE APPROXIMATE LEVEL OF VITAMIN D IS EQUAL TO 20 NG / ML

Courtesy of NSCA® National Strength and Conditioning Association

KINEMATIC ANALYSIS OF THE SNATCH LIFT WITH ELITE FEMALE WEIGHTLIFTERS DURING THE 2010 WORLD WEIGHTLIFTING CHAMPIONSHIP

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Alaaddin Keykubat Campus, Konya, Turkey

Courtesy of FIPE

INTRODUCTION

The 1987 World Weightlifting Championship was the first such event in which female weightlifters participated as competitors ([9,16]). Not until the 2000 Olympic Games in Sydney did female weightlifters contest the snatch and clean and jerk at an Olympic event ([21]). Despite increasing interest in female weightlifting after 1987, the number of studies focused on the snatch performances of female weightlifters in World Championships and Olympic games is relatively limited compared with the number of studies focused on males.

The results of female weightlifters in 9 categories in the 1987 World Weightlifting Championship showed that women could generate higher short-term power outputs than previously documented; however, their powers were lower than those of men both in absolute terms and relative to body mass ([9]). According to reported values from the 1998 World Championship, women lifted greater loads and exerted more power in the second pull than men, but the duration of their second pull, their maximum vertical barbell velocity, and their maximum barbell height were lower ([14]). The authors of another study found that the mechanical work done by men to vertically displace the barbell was greater in the first pull than in the second pull and that the mechanical work done by women was similar in both phases. Additionally, female weightlifters flexed their knees less and more slowly than men during the transition phase, in which elastic energy is stored, and they dropped under the barbell more slowly in the turnover and catch phases ([16]). The larger horizontal displacement of the barbell by women in the 69-kg category of the 1999 US Men's and Women's Weightlifting Championships was accounted for by the inconsistent or irregular displacement of the barbell, and less than half of the females' snatch attempts displayed the optimal toward-away-toward horizontal bar trajectory. Moreover, as the load of the barbell increased, the drop-under time also increased, whereas the drop-under displacement, the maximum vertical displacement, and the maximum vertical velocity of the barbell decreased ([21]). The differences between the characteristics of snatch lifts by male and female weightlifters have been reported to be caused by women's recent participation in weightlifting, a lack of experience and weightlifting skills, insufficient training, and other variables ([9,12,14,16,21]).

In weightlifting, a higher performance level can be achieved by decreasing the total work done and by more effectively utilizing the power-generating ability of the muscles ([21]). A comparative analysis detecting the changes in the recent performances of elite female weightlifters in the snatch lift event in comparision to previous data reported in the literature can show the importance of different kinematic variables in achieving a higher performance.

In conclusion, there has been considerable research into the variables involved in weightlifting for men and relatively few studies for women. And the latest one of those few studies analyzed data taken from national-level women weightlifters competed in 1999, more than a decade ago ([21]). Hence, analyzing data obtained from elite female weightlifters competed in 2010 can demonstrate the development of the snatch technique in women weightlifters and provide additional and useful information for coaching. The objective of this study was to determine the kinematics of snatch lifts by elite female weightlifters who won gold medals in the 2010 World Weightlifting Championship, an Olympic qualifying competition, and compare the results with previous data reported for men and women.

The research hypothesis of this study was that the analysis of the snatch lift performances of elite female weightlifters in this study would exhibit important differences in kinematic variables when compared with previously reported data for weightlifters, providing useful information for athletes and their coaches to utilize in training and competition.

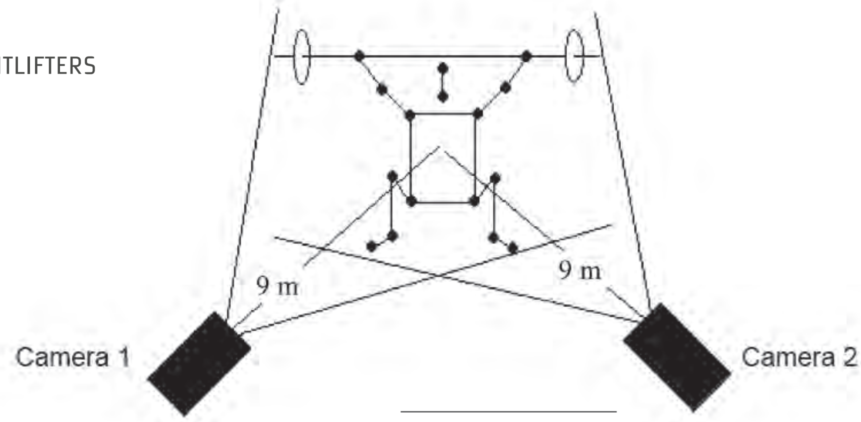
METHODS

Experimental Approach to the Problem

This study was descriptive in nature. The data for this study were collected only from female world champion weightlifters in 7 categories in the 2010 World Weightlifting Championship. To determine the development of female snatch performance, the collected data were then analyzed and compared with data for male and female weightlifters reported since the 1987 World Weightlifting Cham-

Subjects	Weigth category (kg)	Age (y)	Height (cm)	Body weight (kg)	Result (kg)
1	48	27	150	47.88	93
2	53	19	162	52.84	100
3	58	**25**	**156**	**57.67**	**103**
4	63	28	163	62.59	112
5	69	27	171	68.23	116
6	75	24	175	74.67	134°
7	+75	19	176	96.93	145*
Mean ± SD		24.14 ± 3.76	164.71± 9.79	65.83 ± 16.43	114.71 ± 18.81
° Senior World record * Senior and junior world record					

Table no. 1
The caracteristics of elite female weightlifters



pionship, the first event in which female weightlifters participated as competitors.

Subjects
This study was conducted in accordance with the guidelines set forth by the Institutional Review Board of Selcuk University. The data used in this study were obtained from the 2010 World Weightlifting Championship in Antalya, Turkey. Necessary permissions for visual recordings were obtained from the Turkish Weightlifting Federation and the World Weightlifting Federation. The heaviest successful lifts of 7 women who won gold medals were analyzed (Table 1). The snatch lift in the female 75-kg category was a senior world record (134 kg), and the snatch lift in the female kg category was a senior junior world record (145 kg).

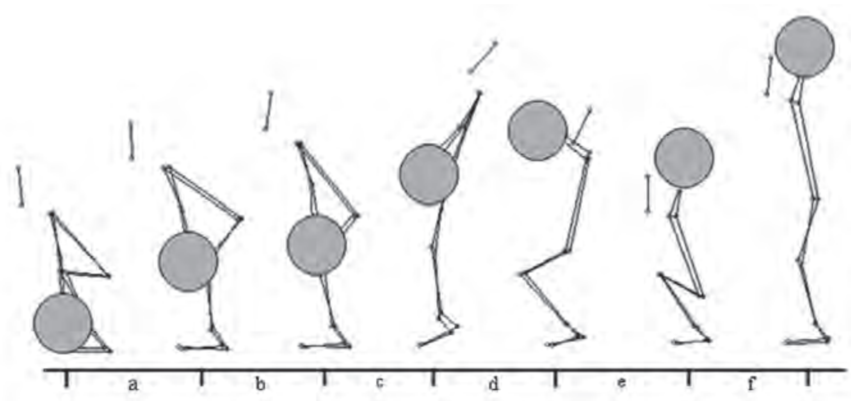


Figure no. 2
The phases of the snatch: (A) the first pull, (B) the transition, (C) the second pull, (D) the turnover under the barbell, (E) the catch phase, and (F) the rising from the squat position.

Procedures
Two digital cameras were positioned on the diagonal level of the platform at a distance of 9 m from the weightlifters, forming an approximate 45° angle with the sagittal plane of the weightlifters (Figure 1). The snatch lifts were recorded using 2 digital cameras (Sony DCR-TRV18E, Tokyo, Japan), which captured images at 50 fields per second. The lift-off of the barbell was used to synchronize the 2 cameras.

To determine the 3-dimensional kinematic data of the barbell and the angular kinematics of the hip, knee, and ankle joints during the snatch lifts, 1 point on the barbell and 5 points on the body were digitized using the Ariel Performance Analysis System (APAS, San Diego, CA, USA). The digitized points included the little toe, ankle, knee, hip, and shoulder on the right side of the body. In addition to these points, the digitized point on the barbell was located on the medial side of the right hand.

A rectangular cube with a length of 250 cm, a depth of 100 cm, and a height of 180 cm was used to calibrate the movement space. The 3-dimensional spatial coordinates of the selected points were calculated using the direct linear transformation procedure with 12 control points. The calibration cube was placed on the platform before the competition, recorded, and then removed. The raw position and time data were smoothed using a low-pass digital filter. Based on the residual analysis, a cutoff frequency of 4 Hz was selected ([15,16]).

The snatch lift was divided into ± phases: (a) the first pull, (b) the transition, (c) the second pull, (d) the turnover under the barbell, (e) the catch phase, and (f) the rising from the squat position (Figure 2). The phases were determined according to the change in direction of the knee angle and the height of the barbell ([2,15,19]). The first 5 phases of the lift, from the lift-off of the barbell to the catch phase, were studied as follows—the first pull:: from barbell lift-off until the first maximum knee extension; "the transition phase": from the first maximum knee extension until the first maximum knee flexion; "the second pull": from the first maximum knee flexion until the second maximum extension of the knee; "the turnover under the barbell": from the second maximum extension of the knee until the achievement of the maximum height of the barbell; "the catch phase": from the achievement of the maximum height of the barbell until stabilization in the catch position.

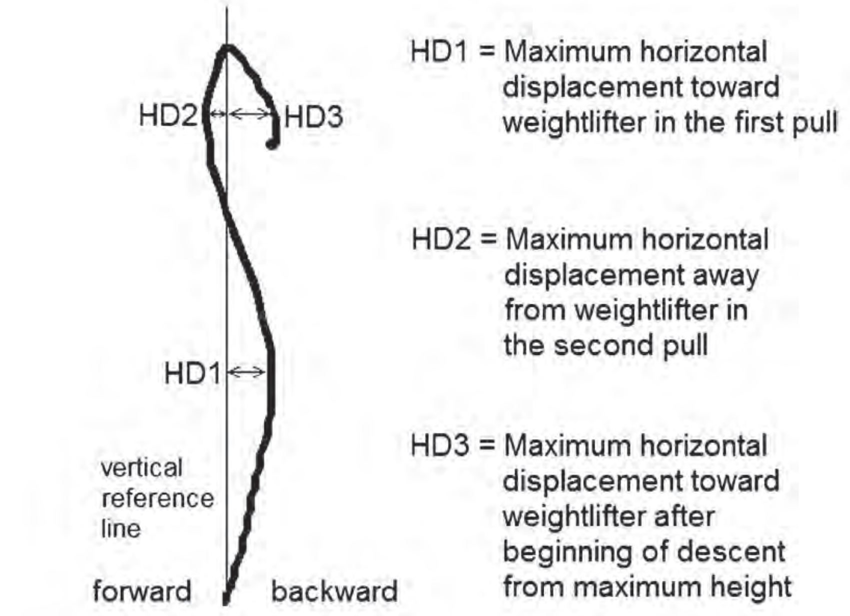


FIGURE NO. 3

THREE KEY HORIZONTAL POSITIONS OF THE BARBELL IN THE SNATCH LIFT.

The angular displacements and velocities of the ankle, knee, and hip joints were analyzed to investigate the angular kinematics of the lower body. In addition, the kinematics of the barbell were calculated. A vertical line drawn through the starting position of the barbell was used as a reference to determine the horizontal displacement of the barbell ([8]). Movement of the bar toward the lifter was regarded as a positive horizontal displacement, and movement of the bar away from the lifter represented a negative horizontal displacement (Figure 3).

The work performed on the barbell during the first and the second pulls was calculated from changes in the barbell's potential and kinetic energies. These calculations included the vertical work done by lifting the barbell. The power output of the weightlifter was calculated by dividing the work done in each phase by the duration of the phase. The relative power and work values were calculated by dividing the absolute work and power values by the lifter's body mass. The calculated power outputs only included the vertical work done by lifting the barbell (11).

Statistical Analyses

The assumption of normally distributed data was checked using a *p*-plot and the Anderson-Darling test. The paired *t*-test was used to determine the kinematic differences between the first and second pulls, and the multivariate Wilks' Lambda (λ) test with Bonferroni correction was used to compare the angular kinematics during the first and second pulls and the differences between the durations of the phases. A significance level of $p \leq 0.05$ was used.

RESULTS

A significant difference was found between the durations of the first 4 phases ($\lambda = 0.024$; $p < 0.05$). The duration of the first pull (0.60 ± 0.08 s) was significantly greater than the durations of the transition phase (0.14 ± 0.01 s), the second pull (0.17 ± 0.01 s), and the turnover under the barbell (0.21 ± 0.02 s). The duration of the turnover was greater than the durations of the second pull and the transition phase ($p < 0.05$).

The angular displacements and velocities of the ankle, knee, and hip joints in the second pull were greater than those in the first pull. The average knee angle was 66.32 ± 12.96° in the starting position and 134.14 ± 4.73° at the end of the first pull, followed by flexion of approximately 11.02 ± 5.32° in the transition phase and 159.09 ± 2.74° at the end of the second pull. The differences between the angular velocities of the ankle, knee, and hip joints during the first pull ($\lambda = 0.135$; $p < 0.05$) were significant. Significant differences were also found in the joint angular velocities during the second pull ($\lambda = 0.231$; $p < 0.05$). During the first pull, the maximum knee angular velocity was greater than the maximum ankle and hip angular velocities ($p < 0.05$). The maximum hip angular velocity was also greater than the maximum ankle angular velocity in the first pull ($p < 0.05$). During the second pull, the maximum hip angular velocity was greater than both the maximum knee angular velocity ($p < 0.05$) and the maximum ankle angular velocity ($p < 0.05$). The angular velocities of the knee during the first pull and the hip during the second pull were greater than those of the other 2 joints (Table 2).

The vertical displacement of the barbell during the first pull (from lift-off until the end of the first pull) was 29.34 ± 6.24 cm and during the second pull, it was 25.91 ± 2.81 cm (Table 3). Although the distance of the barbell from the point of lift-off to the end of the first pull was greater than that in the second pull, no significant difference was found between the displacement of the 2 phases ($t = 1.215$; $p = 0.270$). Conversely, the maximum vertical linear velocity of the barbell was greater in the second pull than in the first pull (*t*

Courtesy of FIPE

	First pull	Second pull	
Maximum ankle extension angle (°)	120.95 ± 3.95	149.06 ± 5.23	13.234*
Maximum knee extension angle (°)	134.14 ± 4.73	159.09 ± 2.74	12.845*
Maximum hip extension angle (°)	88.09 ± 7.87	185.86 ± 5.39	27.151*
Decrease in knee angle during the transition phase (°)	11.02 ± 5.32		
Maximum ankle angular velocity (rad·s^{-1})	11.02 ± 5.32	5.96 ± 1.34	8.828*
Maximum knee angular velocity (rad·s^{-1})	3.79 ± 1.11	5.92 ± 1.05	4.619*
Maximum hip angular velocity (rad·s^{-1})	3.79 ± 1.11	7.86 ± 1.52	9.615*
*p , 0.05.			

Table no. 2
Angular kinematics of the ankle, knee, and hip joints in the first and second pulls.

	Mean ± SD
Vertical kinematics	
Barbell height at the end of the first pull (cm)	52.16 ± 6.36
Barbell height at the end of the second pull (cm)	92.60 ± 6.12
Maximum barbell height (m)	1.18 ± 0.19
Drop displacement (cm)	13.72 ± 2.94
Maximum vertical velocity of the barbell in the first pull (m·s^{-1})	0.99 ± 0.19
Maximum vertical velocity of the barbell in the second pull (ms·s^{-1})	1.68 ± 0.14
Horizontal kinematics	
Horizontal displacement toward weightlifter in the first pull (cm)	5.92 ± 3.11
Horizontal displacement away from weightlifter in the second pull (cm)	1.83 ± 4.62
Horizontal displacement toward weightlifter after beginning of descent from maximum height (cm)	4.39 ± 3.43

Table no. 3
Linear kinematics of the barbell.

	First Pull	Second Pull	t-Value
Absolute work (J)	391.50 ± 84.25	314.65 ± 42.76	3.499*
Relative work (J/kg)	6.02 ± 0.79	4.90 ± 0.75	4.057*
Absolute power (W)	642.74 ± 159.04	1847.62 ± 336.06	13.472*
Relative power (W/kg)	9.85 ± 1.35	28.95 ± 3.02	15.625*
*p , 0.05.			

Table no. 4
Mechanical work and power output in the first and second pulls.

N° 1 / April-July 2015

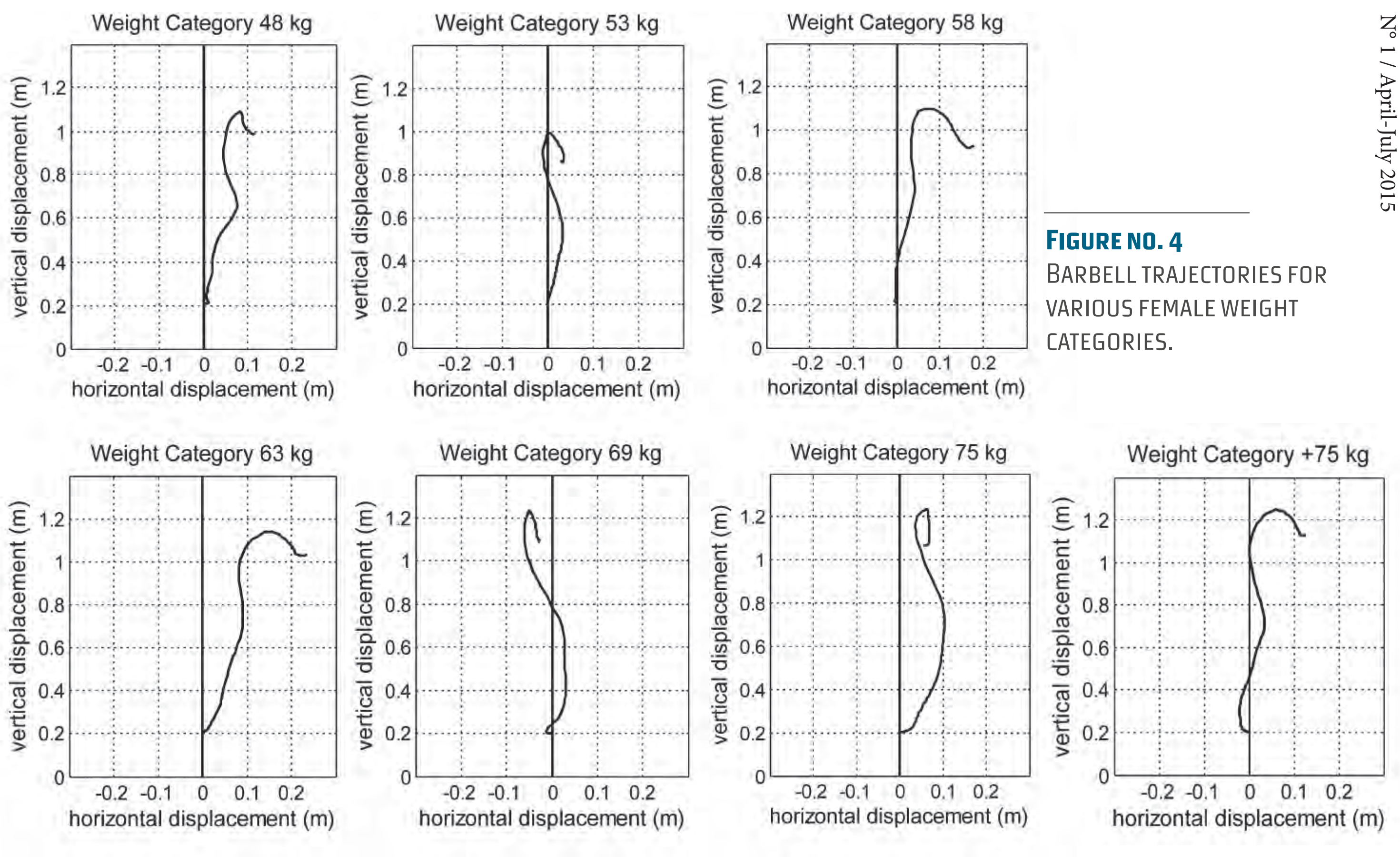


FIGURE NO. 4
BARBELL TRAJECTORIES FOR VARIOUS FEMALE WEIGHT CATEGORIES.

= 10.533; $p < 0.05$). The barbell moved between 4 cm (21 to 3 cm for Subject 5) and 9 cm (0 to 9 cm for Subject 4) toward the body during the second pull (Figure 3). During this pull, however, the barbell also moved between 1 cm (9–8 cm for Subject 4) and 9 cm (3 to 26 cm for Subject 5) away from the body, crossing the vertical reference line of the barbell before lift-off. After the drop from the maximum height, the barbell moved from 0 cm (6–6 cm for Subject 6) to 10 cm (7–17 cm for Subject 3) toward the body, and a negative value was observed for 1 weightlifter (69 kg), as the barbell was fixed in front of the vertical reference line. The work values during the first pull were significantly higher than those of the second pull. Conversely, the power output during the second pull was significantly higher than that of the first pull (Table 4). The work values of the first pull were greater than the power values of the second pull.

DISCUSSION

In weightlifting, load is an important variable that plays a determining role in the magnitudes of the vertical and horizontal kinematics of the barbell. Previous work has shown the most distinctive effect of increased barbell weight to be an increase in the pull duration and a decrease in the maximum and average pull velocities, the maximum barbell height, and the power output ([13]).

The average value of the barbell weights of the heaviest snatch lifts in the 2010 Women's World Weightlifting Championships was greater than those in the 1987 and 1998 competitions by 45% and 18%, respectively ([9,14]). The duration of the first pull in the current study, which was the longest of all 4 phases, was significantly greater than previously reported results due to the maximal lift performance of the female weightlifters ([15,16]). Conversely, the duration of the second pull was shorter than that in the 1987 Women's World Weightlifting Championship ([9]) and longer than that in the 1998 event ([14]). The duration of the first pull for national-level female weightlifters in the 69-kg category was shorter than that found in this study, but the duration of the second pull for these women was nearly twice as long as that found in this study ([21]). The relatively longer duration of the first pull detected in this study was attributed to the maximal barbell weights. In addition, the increased average snatch lift indicated an increase in the skills and strength of the female weightlifters (Figure 4).

Our results were not consistent with those of Gourgoulis et al [16], who reported that the mechanical work performed during the first pull was less than that performed during the second pull for women. However, the snatch lift results for men were similar as follows: the mechanical work performed during the first pull was greater than that performed during the second pull, and the power output during the second pull was greater than that of the first pull [2,7–9,15]. The greater work values during the first pull in the current study suggest an increase in the strength of female weightlifters and the use of a snatch pattern similar to that of male weightlifters. During the first pull of the snatch lift, changes in the barbell's kinetic and potential energies were greater, and the lifters had to exert a considerable amount of work over a long period to overcome the inertia of the barbell [15]. During the second pull, the lifters had to work much more quickly than in the first pull because of the short duration of the second pull. The first phase of the total pull is relatively slow and can be considered to be strength oriented, whereas the second pull is faster and can be considered to be more power oriented [9,17,18]. The power output generated for the vertical displacement of the barbell during the second pull, an indicator of explosive strength, was lower for female than for male weightlifters, and this can be explained by the relatively lower vertical velocity of the barbell when used by women [16]. The large improvements observed in the performance of female weightlifters between 1987 and 1998 are connected to technique changes during the second pull [14]. The relative power output during the second pull has increased by 80% according to the relative power output in total pull in female weightlifters, and by 53% in men weightlifters. The power values of faster and slower movements for women, such as the second and complete pulls, were consistently higher percentages of the values for men [12].

In previous studies, an optimal barbell trajectory has been taken as an indicator of a mechanically effective pull and a proper technique [1,3,8,20–24]. The horizontal displacement of the barbell during the snatch is one of the kinematic variables used to assess weightlifting technique [21]. The horizontal movement of the barbell during the pull phase should be considered an effective application of muscle power [22]. As the horizontal displacement of the bar increases during the lift, the lifter must exert more energy to control the loaded barbell [4,21]. The optimum trajectory is affected by relative body segment lengths and other leverage factors, such as muscle attachment points [8]. However, the role that anthropometric factors play in the determination of the optimal barbell trajectory is unclear [21].

As shown in Figure 3, 3 key position values have been identified for the horizontal movement of the barbell during the snatch [8]. The first horizontal movement of the

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barbell is toward the weightlifter, away from the vertical reference line drawn through the position of the bar just before lift-off during the first pull. This value was always found to be positive. The second value was often negative, indicating movement of the bar away from the lifter toward the opposite side of the vertical reference line during the second pull. The third value, the distance of the bar from the vertical reference line just after the beginning of descent from the maximum height, was usually positive. These 3 horizontal movements of the barbell have been described as positive-negative-positive or toward-away-toward displacement patterns ([8,21]). The horizontal displacement of the barbell by men has been reported to be between 3 and 9 cm in the first pull, between 3 and 18 cm in the second pull, and between 3 and 9 cm just after the beginning of descent from the maximum height ([8]). The average horizontal displacement of the barbell has been reported to be 3.65 cm during the first pull and the transition phases for national-level female weightlifters and 6.29 cm for men at the Olympic level. During the second pull, the average horizontal displacement was 1.88 cm for women and 3.87 cm for men ([16]). The toward-away-toward displacement pattern of the barbell during the first and second pulls was similar for men and women, and no significant differences were observed between the genders ([16]). A gender-based difference was found in the horizontal movement of the barbell during the second pull: the barbell moved away from female lifters and crossed the vertical reference line, whereas it moved horizontally away from male lifters without crossing the vertical line ([16]). In another study, the barbell trajectory of female lifters was different from that of males, and an optimal toward-away-toward pattern was observed in less than half of the female lifters (6 of the 14 lifts, approximately 43%) ([21]). In the present study, only 2 of the 7 elite female weightlifters (53 kg and 69 kg categories) exhibited an optimal toward-away-toward pattern. Hoover et al ([21]) have reported that most of the literature pertaining to optimal trajectories during the snatch has considered skilled to elite men. The horizontal displacement values of the barbell for highly skilled female weightlifters in this study were within the recommended limits for an effective snatch technique. However, the observed trajectory of the barbell was consistent with the results of Gourgoulis et al ([15]) for male weightlifters. In most cases, the barbell did not cross the vertical reference line before lift-off in the current study (Figure 4).

It was found that the maximum height of the barbell in women weighlifters in this study was lower than those reported but greater than the results found for men ([8,9,14,16]). The height loss from the maximum height of the barbell until the squat position was similar to the drop displacement recorded for men lifters but smaller than that of females ([16,21]). Lifting the barbell effectively requires minimizing both the maximum height of the barbell at the end of the turnover and the loss of height during the drop under the barbell to the catch position ([8,16,22]). A lower maximum height and the drop displacement distance are among the most important indicators of an effective technique for a maximal snatch lift in elite female weightlifters.

The absence of a notable dip during the transition phase is characteristic of better weightlifters ([2]) and indicates an effective technique ([1,22]). During the transition, the vertical force on the barbell diminishes. This, in turn, decreases the vertical velocity of the barbell although smoothing and accelerating the transition and produces a smaller decline in velocity ([8]). The presence of 2 clear peaks in the vertical velocity of the barbell is suggestive of an ineffective technique ([2]). In the present study, an ineffective technique was detected in only 1 (48 kg) of the 7 weightlifters. The vertical linear velocity of the barbell decreased by 13% in the transition phase, and 2 distinct peaks were observed. In an earlier study, the maximum vertical linear velocity during the second pull and the maximum height of the barbell after the second pull were higher in national-level female than in male Olympic champions ([16]). In addition to gender, skill level affected this result, and the vertical kinematics of the barbell decreased in elite weightlifters, especially in men ([14]). Skill-related factors affected snatch performance, and highly skilled weightlifters achieved a relatively lower barbell height during the catch phase and faster drop during the turnover under the barbell ([4,16]).

In this study, the maximum extension of the knee angle during the first pull was lower than that reported for men, whereas it was greater than that reported for female weightlifters ([16]). Knee flexion during the transition phase for female weightlifters was similar to the values reported in the literature, whereas it was lower than values reported for men ([16]). The maximum extension angle of knee joints during the first pull affects explosive strength during the second pull. By flexing the knee joint at a greater extension angle at the end of the first pull, the biomechanics of the phase are maximized and elastic energy is effectively used. During the transition from the first pull to the second pull, knee flexion is used to realign the lifter relative to the barbell, and this movement is referred to as the double knee bend ([5,6]). Knee flexion during the transition phase has similar effects to that observed during the countermovement in vertical jumps ([16]). This countermovement and the second bending flexion of the knees during the snatch lift may be performed rapidly enough to store recoverable elastic energy and elicit a stretch reflex immediately after the concentric contraction of the knee and hip joint extensor muscles ([10]).

The extension angle of the ankles during the second pull, which is used to increase power output, was considerably higher in this study than the values reported for

Nº 1 / April-July 2015

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women in the literature, whereas the values of the extension angle of the hip and knee joints were similar ([16]). Furthermore, the extension velocities of the hip, knee, and ankle joints during the second pull, when explosive strength is needed, were much greater than the extension velocities of the same joints during the first pull. The knee extension velocity during the first pull was greater than that of the ankle and hip, and the hip extension velocity was greater than that of the ankle. The hip extension velocity was greater than both the ankle and the knee extension velocities during the second pull. Thus, the knee angular velocity was the greatest during the first pull, whereas the hip angular velocity was the greatest during the second pull. This finding was consistent with the results of Baumann et al ([2]) who suggested that faster execution of the second pull contributed to the explosiveness of the second pull ([15]).

Although the magnitudes of the linear kinematics, the angular kinematics of the lower limbs, and the other energetic characteristics found in this study were not entirely consistent with those reported in the literature, the performances of the elite female weightlifters in the 2010 World Weightlifting Championships were improved compared with reported values, and a snatch-lift pattern similar to that of male weightlifters was observed.

PRACTICAL APPLICATIONS

The snatch techniques of elite female weightlifters in the 2010 World Weightlifting Championships were analyzed in this work. Thewomen weightlifters in this study exhibited superior performanceswhen comparedwith previously reported results since 1987. Although their pulling velocities and explosive strength values were less than those of male weightlifters, the increase in the average load lifted, the mechanical energy during the first pull, and the power output during the second pull indicated an increase in strength and skill levels of female weightlifters since then. On the other hand, although relatively similar to those ofmen, the barbell trajectories of the successful snatch lifts performed by the world champion women weightlifters were different from each other. This finding of the present study suggest that successful lifts are not necessarily dependent on a single and specific barbell trajectory pattern but that they are more a result of power output. In addition, it was found that the greater the power output, which is related to vertical velocity of the barbell, the more consistent the horizontal barbell displacement patterns were with those reported for men weightlifters. As a result, coaches can focus more on training techniques that develop maximum strength for greater mechanical work during the first pull and increase the explosive strength of the extensor muscles about the hip, knee, and ankle joints during the second pull.

References

1. Bartonietz, KE. Biomechanics of the snatch: toward a higher training efficiency. Strength Cond J 18: 24–31, 1996.
2. Baumann, W, Gross, V, Quade, K, Galbierz, P, and Schwirtz, A. The snatch technique of World Class Weightlifters at the 1985 World Championships. Int J Sport Biomech 4: 68–89, 1988.
3. Bruenger, AJ, Smith, SL, Sands, WA, and Leigh, MR. Validation of instrumentation to monitor dynamic performance of Olympic weightlifters. J Strength Cond Res 21: 492–499, 2007.
4. Burdett, RG. Biomechanics of the snatch technique of highly skilled and skilled weightlifters. Res Q Exerc Sport 53: 193–197, 1982.
5. Enoka, RM. The pull in Olympic weightlifting. Med Sci Sports 11: 131–137, 1979.
6. Garhammer, J. Performance evaluation of Olympic weightlifters. Med Sci Sports Exerc 11: 284–287, 1979.
7. Garhammer, J. Power production by Olympic weightlifters. Med Sci Sports Exerc 12: 54–60, 1980.
8. Garhammer, J. Biomechanical profile of Olympic weightlifters. Int J Sport Biomech 1: 122–130, 1985.
9. Garhammer, J. A comparison of maximal power outputs between elite male and female weightlifters in competition. Int J Sport Biomech 7: 3–11, 1991.
10. Garhammer, J and Gregor, R. Propulsion forces as a function of intensity for weightlifting and vertical jumping. J Appl Sport Sci Res 6: 129–134, 1992.
11. 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.
12. Garhammer, J. Weightlifting performance and techniques of men and women. In: International Conference on Weightlifting and Strength Training. P.V. Komi, ed. Lahti, Finland: Gummerus Printing, 1998. pp. 89–94.
13. Garhammer, J. Barbell trajectory, velocity and power changes: Six attempt and four world records. Weightlifting 19: 27–30, 2001.
14. Garhammer, J, Kauhanen, H, and Hakkinen, KA. Comparison of performances by woman at the 1987 and 1998 world weightlifting championships. Selected Publications-John Garhammer [Internet]. Available at: http://www.csulb.edu/;atlastwl/98vs87womenWLcompare(poster).pdf. Accessed August 05, 2011.

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15. Gourgoulis, V, Aggelousis, N, Mavromatis, G, and Garas, A. Threedimensional kinematic analysis of the snatch of elite Greek weightlifters. J Sport Sci 18: 643–652, 2000.
16. Gourgoulis, V, Aggeloussis, N, Antonıou, P, Chritoforidis, C, Mavromatis, G, and Garas, A. Comparative 3-dimensional kinematic analysis of the snatch technique in elite male and female Greek weightlifters. J Strength Cond Res 16: 359–366, 2002.
17. Gourgoulis, V, Aggeloussis, N, Kalivas, V, Antonıou, P, and Mavromatis, G. Snatch lift kinematics and bar energetics in male adolescent and adult weightlifters. J Sports Med Phys Fitness 44: 126– 131, 2004.
18. Gourgoulis V, Aggeloussis N, Garas A, and Mavromatis G. Unsuccessful vs. successful performance in snatch lifts: a kinematic approach. J Strength Cond Res 23: 486–494, 2009.
19. Hakkinen, K, Kauhanen, H, and Komi VP. Biomechanical changes in the Olympic weightlifting technique of the snatch and clean and jerk from submaximal to maximal loads. Scand J Sports Sci 6: 57–66, 1984.
20. Hiskia, G. Biomechanical analysis of world and Olympic champion weightlifters performance. In: Proceedings of the Weightlifting Symposium. A. Lukacsfalvi and F Takacs, eds. Budapest, Hungary: International Weightlifting Federation, 1997. pp. 137–158.
21. Hoover, DL, Carlson, KM, Christensen, BK, and Zebas, CJ. Biomechanical analysis of women weightlifters during the snatch. J Strength Cond Res 20: 627–633, 2006.
22. Isaka, T, Okada, T, and Fuanto, K. Kinematic analysis of the barbell during the snatch movement in elite Asian weightlifters. J Appl Biomech 12: 508–516, 1996.
23. Stone MH, O'Braynt, HS, Williams, FE, and Johnson, RL. Analysis of bar paths during the snatch in elite male weightlifters. Strength Cond J 20: 30–38, 1998.
24. Vorobyev, AN. A Textbook on Weightlifting. In: Ttrans. W.J. Brice, ed. Budapest, Hungary: InternationalWeightlifting Federation, 1978. pp. 172–242.

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THE EFFECTS OF TRAINING VOLUME AND COMPETITION ON THE SALIVARY CORTISOL CONCENTRATIONS OF OLYMPIC WEIGHTLIFTERS

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INTRODUCTION

Cortisol (C) is an important steroid hormone mediating resistance training adaptations. Tradi- tionally, C is regarded as the primary catabolic hormone, because it decreases protein synthesis and increases protein breakdown (3,40). Likewise, the antianabolic properties of C are linked to the attenuation of anabolic hormones such as testosterone (T) and growth hormone (3). However, changes in C secretion may be a prerequisite for the repartitioning of metabolic resources during exercise and training (40). It is important to note that the majority of C (95–99%) is bound to proteins in blood, with the remaining portion (1–5%) circulating freely, thereby representing the biologically active hormone (9).

Training volume is a key factor influencing endogenous hormones. For example, adjustments in resistance training volume can elevate or reduce C concentrations (13,14,18, 20,21,23). Some training studies have also reported correlations between the individual changes in the T/C ratio and strength adaptations (13,22,23). In female weightlifters, the changes in the T/C ratio also negatively correlated to the changes in load volume and to improvements in force production (18). Thus, the physiological stressors imposed by different volumes of training may influence these hormones and subsequent performance. It is possible that these outcomes are largely driven by the stress hormone C.

Competition can also influence the hormonal and performance outcomes in weightlifters. For instance, the salivary C (Sal-C) concentrations of Olympic weightlifters were found to be more than twofold higher during actual competition, than a simulated event (32). The 1 repetition maximum (1RM) lifts were also greater during the actual competition. Similarly, a rise in C concentrations has been implicated in the performance and behavioral outcomes in other sports competitions (12,36–38). In this environment, the psychological stressors of competition may be the prime regulator of C and performance. To our knowledge, no research has examined the effects of both training volume and competition (simulated and actual) on the C concen- trations of Olympic weightlifters.

Another limitation of the literature is the amount of time between pre and posttraining assessments, which can span from several weeks to months (21–23). Intuitively, monitoring weekly workouts would allow for a more thorough analysis of those factors mediating training adaptation and how adjustments in 1 variable (e.g., volume) might affect others (e.g., hormones and performance) (5,18). Most studies have also assessed the bound hormone in blood, rather than the biologically active free hormone. Saliva offers a stress-free method for monitoring blood free hormones and the bio- available portion (i.e., free plus albumin bound) that is potentially available to target tissue (2,16).

This study sought to assess the effects of training volume and competition on the Sal-C concentrations of Olympic weightlifters. It was hypothesized that the weekly changes in Sal-C concentrations would positively mirror the weekly changes in training volume. It was also hypothesized that Sal- C concentrations and 1RM performance would be greater in an actual rather than a simulated competition.

METHODS

Experimental Approach to the Problem

This study was designed to evaluate the effects of training volume and competition on the Sal-C concentrations of Olympic weightlifters. The basic design was based on published research (5,18,32). In the first part of this study, Sal-C concentrations were monitored across 5 workouts to assess the weekly effects of changes in training volume. In the second part, Sal-C concentrations and 1RM performance from 2 simulated and 2 actual competitions were compared. Cortisol was assessed in saliva, a surrogate marker of the blood-free hormone (2,16). The snatch and clean and jerk exercises were assessed during competition, these being the main exercises for Olympic weightlifters (28).

Subjects

Five male (age 21.2 ± 3.8 years, height 171.4 ± 4.7 cm, body mass 82.0 ± 22.8 kg) and 4 female (age 23.8 ± 4.6 years, height 161.1 ± 5.5 cm, body mass 68.6 ± 15.3 kg) weightlifters with an average training experience of 4.7 ± 3.1 and 4.6 ± 1.8 years, respectively, volunteered for this study. The best 1RM lifts for the snatch, clean and jerk, and the Olympic total were 119.4 ± 27.8, 150.8 ± 34.6, and 270.2 ± 62.4 kg for men and 66.6 ± 15.8, 83.6 ± 18.8, and 150.3 ± 34.6 kg for women. All subjects had competed in national and international weightlifting competitions before this study, and each had a National ranking in the top 5 for their weight class and age. Subjects were informed of the experimental risks and signed an informed consent form before the start of this investigation. The investigation was approved by an Institutional Review Board (Waikato Institute of Technology, Hamilton, New Zealand) for the use of human subjects.

Week	Training volume	Total sets	Loading range
1	High	200	42-100% 1RM
2	Low	75	42-100% 1RM
3	High	200	42-100% 1RM
4	High	209	42-100% 1RM
5	Low	86	42-100% 1RM

*1RM = 1 repetition maximum.

Table no. 1
Training volume across the experimental period.*

Training Procedures

The 2 study aims were addressed concurrently across a 5-week period during the competitive season. Subjects were training 1–2 times daily, 5 days a week from Monday to Friday. Each training workout involved 3 main exercises; snatch, clean and jerk, and the front squat. The order of exercises was consistent across each workout, as outlined above. The assessed workouts were performed on the first training day (Monday) of weeks 1–5. Weekly training volume was described as being either 'high' or 'low,' based on the total number of sets completed across the 3 main exercises (Table 1). The criterion for a high-volume week was the performance of 200 or more sets, with 100 or less sets performed across a low-volume week. Competition data (see below) were included in these calculations. Workout duration differed considerably, depending on whether a high- or low-volume session was undertaken, and generally ranged from 45 to 120 minutes. Despite the weekly differences in volume, a similar loading range or training intensity (% of personal best 1RM lifts) was employed by subjects across each week (Table 1).

Competition Procedures

The competition procedures were based on previous research (32). The simulated competitions were performed under normal training conditions (i.e., venue, time of day, exercises), but longer recovery periods (.5 minutes) were used with greater loading intensities and fewer repetitions to replicate an actual event. Single repetition lifts were performed with increasing loads until a successful 1RM lift was achieved. The simulated competitions were performed on the last training day (Friday) of weeks 1 and 4, with the actual competitions performed at the end (Saturday) of weeks 2 and 5. The snatch and clean and jerk exercises were assessed during the competition settings. The performance results for the Olympic total lift (i.e., sum of the snatch and clean and jerk) were also calculated. To account for gender differences in body size, relative 1RM (rel1RM) performance was calcu- lated by dividing the measured 1RM by fat-free mass in kilograms. The pretraining values for fat-free mass were used to normalize the 1RM data from weeks 1 and 2, with the posttraining values applied to the 1RM data from weeks 4 and 5.

A standard warm-up was performed before training and competition comprising low-intensity aerobic exercise, light lifts (Olympic bar only) focusing on technique, and stretching of the major muscle groups. The assessment of Olympic lifts by trained weightlifters are highly reliable with coefficients of variation from 2.3 to 2.7% (28). Lifting platforms and standard gymnasium equipment were used during the training and competition procedures including squat racks, Olympic barbells and free weights (Eleiko Sports, Halmstad, Sweden). The training workouts and simulated competitions were conducted between 3 PM and ± PM, with the actual competitions undertaken between 10 AM and 4 PM. This difference was unavoidable because of the prior scheduling of training and the weightlifting events. However, the effect of diurnal variations on Sal–C secretion (26) and sporting performance (8) was minimized, to some extent, by ensuring that individuals were assessed at the same time of day during all procedures. There was further consistency during the actual competitions with subjects tested at the same time of day.

Each weightlifter was instructed to maintain their normal dietary intake across this experiment (5). Daily information on nutritional intake and training loads were noted in a diary and examined at the completion of the study. The food consumed by each subject was similar before each trainingn and competition session, as were the frequency and timing of these meals. Thus, the study population exhibited consistent nutritional habits across the experimental period, and this helped to partially offset the nutritional effects on Sal-C (15), because each subject acted as their own control. Subjects also monitored their hydration levels each day by recording fluid intake.

Body Composition

Body composition was assessed on the first and last days of this study using a wall-mounted stadiometer, electronic scales (SECA 702, Birmingham, United Kingdom) and skinfold measurements taken by a qualified anthropometrist using body fat callipers (Holtain, Crymmych, United Kingdom). The sum of 4 skinfolds (i.e., subscapular, suprailliac, biceps, triceps) was converted to a body fat percentage using a standard formula (10). The same tester performed all of the body composition analyses.

Hormone Assessment

The saliva samples (1 ml) were collected before and after the assessed training workouts, simulated competitions, and actual competitions using standard procedures (5,6). Briefly, sugar-free gum (Extra-peppermint, Wrigley's, Auckland, New Zealand) was first used to increase saliva flow for a short period, after which a small saliva sample was collected in sterile containers and stored at 220°C. To prevent saliva contamination, no hot drinks or food were taken 1 hour before each session. Saliva was assayed in duplicate using a commercial enzyme-immunoassay kit (Salimetrics, State College, PA, USA) and the manufacturer's instructions. Cortisol assay sensitivity was 0.012 $mg \cdot dL^{21}$ with interassay coefficients of variation ranging from 10 to 13%, based on high and low control samples in each assay. The Sal-C concentrations of men and women are similar both at rest and in response to exercise (11,25,27,39), so the hormonal data were subsequently pooled for analysis.

Statistical Analyses

Changes in body composition from pre to posttraining were assessed using paired *t*-tests. The effects of weekly training on Sal-C concentrations were examined using a 2-way (workout 3 sample) analysis of variance with repeated measures. The pooled differences in Sal-C concentrations and 1RM performance between the simulated and actual competitions were compared using paired *t*-tests.

Power calculations revealed values of 0.95–0.97 and 0.39–0.46 for the Sal-C results during competition and training, respectively, based on an alpha level of 0.05 and a sample size of 9 subjects. Relationships between the Sal-C and 1RM competition data were examined using Pearson product moment correlation coefficients. Significance was set at an alpha level of p # 0.05.

	Pretraining	Posttraining
Age (y)	22.3 ± 4.2	
Height (cm)	166.9 ± 7.3	
Body mass (kg)	76.0 ± 20.0	76.2 ± 19.8
Body fat (%)	21.8 ± 7.0	21.5 ± 7.1†
Fat-free mass (kg)	59.0 ± 14.2	59.3 ± 14.1
*Values are given as mean 6 SD. †Significantly different from pretraining p , 0.05.		

Table No. 2

Subject information pre and posttraining.*

RESULTS

There were no significant changes in body mass and fat-free mass across the training period (Table 2). Body fat percentage decreased slightly posttraining ($p < 0.05$). No significant main workout and sample effects and no interactions were found when examining the weekly changes in Sal-C concentrations with training ($p > 0.05$, Figure 1).

No significant main effects or interactions were identified for the Sal-C, and 1RM data across either the simulated or actual competitions ($p > 0.05$). Thus, data from each compe- tition setting were pooled for analysis. Pre and post Sal-C values were higher during the actual (vs. simulated) competitions ($p < 0.001$, Figure 2), but no significant changes (from pre to post) in Sal-C occurred across either condition ($p > 0.05$).

The pooled 1RM and rel1RM values for the clean and jerk, and the Olympic total lift, were both found to be greater in the actual (vs. simulated) competitions ($p < 0.05$, Table 3). The snatch 1RM and rel1RM lifts were not significantly different ($p > 0.05$). Significant correlations were found between individual Sal-C concentrations before the simulated competitions and the snatch, clean and jerk, and Olympic total 1RM lifts ($r = 0.48–0.49$, $p < 0.05$). No significant correlations were identifi between these parameters during the actual com- petitions ($r = 0.09–0.012$, $p > 0.05$) or between Sal-C and the rel1RM lifts in either competition ($r = 0.16–0.27$, $p > 0.05$).

DISCUSSION

This study on Olympic weightlifters revealed 3 main findings: First, the weekly changes in training volume had no apparent effect on Sal-C concentrations; second, actual competitions produced higher Sal-C concentrations and superior 1RM lifts (clean and jerk, Olympic total) than the simulated compe-

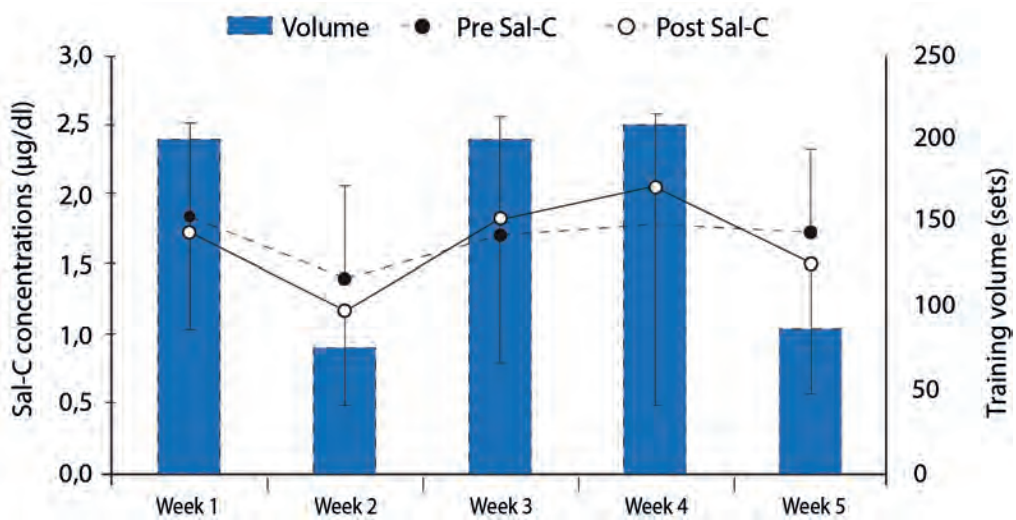

FIGURE NO. 1
WEEKLY CHANGES IN TRAINING VOLUME AND SALIVARY CORTISOL (SAL-C) CONCENTRATIONS (MEAN ± SD).

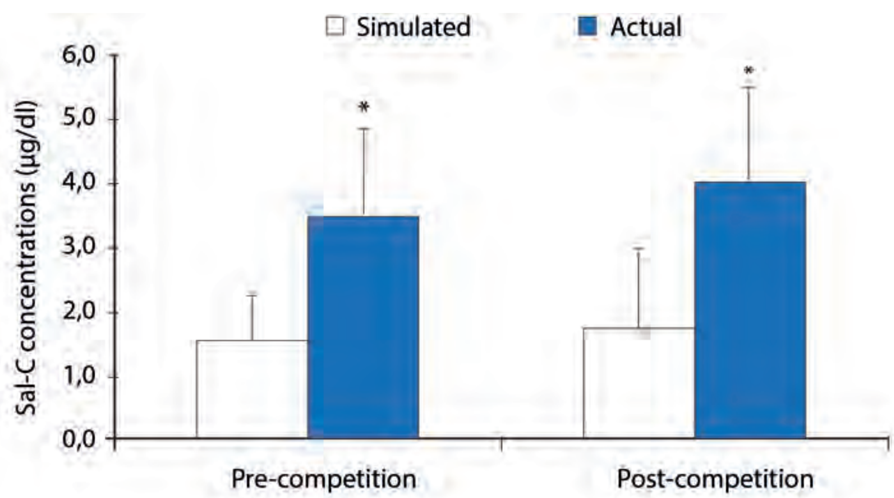

FIGURE NO.2
POOLED DIFFERENCES IN SALIVARY CORTISOL (SAL-C) CONCENTRATIONS
BETWEEN THE SIMULATED AND ACTUAL COMPETITIONS (MEAN ± SD).
*SIGNIFICANTLY DIFFERENT FROM THE SIMULATED COMPETITIONS P <0.001.

	Snatch	Clean and Jerk	Olympic total
Simulated competitions			
1RM (kg)	92.8 ± 34.7	114.7 ± 42.0	207.4 ± 76.6
Rel1RM (kg[kg21]FFM)	1.5 ± 0.3	1.9 ± 0.4	3.4 ± 0.7
Actual competitions			
1RM (kg)	94.1 ± 35.4	117.4 ± 41.7‡	211.5 ± 77.0‡
Rel1RM (kg[kg21]FFM)	1.6 ± 0.3	2.0 ± 0.4‡	3.5 ± 0.7‡

* 1RM = 1 repetition maximum; FFM = fat-free mass; Rel1RM = relative 1 repetition maximum.
† Values are given as mean ± SD.
‡ Significantly different from the simulated competitions $p < 0.05$.

Table no. 3
Pooled differences in 1RM performance between the simulated and actual competitions.*†

titions; third, individual Sal-C concentrations before the simulated competitions correlated to all of the 1RM lifts.

Adjustments in training volume have been shown to alter C concentrations in male and female weightlifters (13,14,18,20, 21,23). In general, the greater the training stress (i.e., higher training volume and intensity) imposed on the neuromus- cular system, the greater the C changes occurring. The lack of any significant Sal-C responses over the 5 weeks of this study could be explained by the absolute volume of training, the time of exposure to different training volumes, and the competition phase, relative to previous research. Baseline C concentrations at the start of this study could also be important in this regard. Previous studies also suggest that C modifications may affect the T/C ratio and thus one's ability to express strength and recovery from training and competitions (13,18,22,23). This is difficult to confirm with only C monitored in this study and given the low statistical power of the training results.

The actual weightlifting competitions produced higher (128–130%) Sal-C concentrations than the simulated ones, which could be explained by the greater challenge, motiva- tion, and stress presented by a real event (32,35). Highly trained athletes might also possess an adrenal system that responds more to competition (i.e., greater C response) than lesser trained individuals (32,37). Other competition factors influencing hormone secretion include physical fitness, physical effort or exertion, mood, motivation, coping styles, and player position (35). We recognize that the Sal-C results in this study might be affected by circadian variation (26), because the actual events began earlier in the day than the simulated ones. However, the differences in Sal-C concen- trations between the respective competitions were still much greater than time-matched control data (26,39). Nutritional intake is another confounding variable when assessing Sal–C levels (15).

The 1RM lifts in the actual competitions were generally superior (1.9–2.6%) to that seen in the simulated events and this may be explained by the concomittant increase in cortisol concentrations. Similarly, improvements in the 1RM per- formance of Olympic weightlifters were noted during actual (vs. simulated) competition when Sal-C also increased by more than twofold (32). A rise in C levels has been observed in many sporting competitions (11,12,25,31,36–38), and these hormonal changes often enhanced the performance and behavioral outcomes. For example, judoists displaying higher Sal-C levels also had higher motivation to perform and obtained the better outcome (36), and higher C levels were found in judo winners when compared with losers (38). These data confirm suggestions that C may be essential for working capacity and performance (40). Thus, acute eleva- tions in C may actually benefit athlete performance during competition.

Positive correlations were demonstrated between individual Sal-C concentrations, and the 1RM lifts during the simulated competitions, similar to previous work (5,6,32) This work implies that higher Sal-C concentrations (on an individual level) may also benefit 1RM performance during weight training procedures. No significant relationships were observed during the actual competitions, which could be explained by individual variation in the adrenal responses to the competitive environment, especially since participant C levels were already elevated. Nevertheless, the correlations in this study only approached moderate strength and notwith- standing the fact that they still only reflect casual relation- ships between variables. Other research on weightlifters have also reported no discernable relationships between these variables (4,13), possibly resulting from differences in training procedures and study design.

The mechanism(s) by which elevated C levels may improve athlete performance is multifactorial. Cortisol may contribute to human and muscle performance by regulating or con- trolling energy metabolism (40), motor cortex function (34), the electrophysiological properties of muscle (7), and intra- cellular signals (30). Additionally, C can affect brain neural activity (29) and cognitive function (24,33), and this has further implications for the expression of human movement in sport. Further research is needed to elucidate those C-related mechanisms contributing to athletic performance. This information would help in the management, assessment, and training of athletes within their sporting environment.

Other limitations of this study include the lack of a non- training control group and the small number of subjects recruited, although the pool of Olympic weightlifters available for research is limited. Indeed, the size of our study population is consistent with that of other studies in this area (1,4,14,17–19,21). We also acknowledge the possible con- founding effects of treatment order, or any interactions thereof, given the current study design (i.e., simulated competitions before the actual

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competitions) and the differences in training volume before the respective com- petitions (i.e,. high- and low-volume weeks). However, these are inherent problems when working with elite athletic groups so the observed findings do reflect the actual sporting environment. Finally, we acknowledge that other hormones (e.g., T, growth hormone, insulin-like growth factor 1, catecholamines) may help to regulate athlete performance, but their discussion is beyond the scope of this article.

In conclusion, actual competitions produced greater Sal-C responses than simulated competitions, and this appeared to benefit the 1RM performance of Olympic weightlifters. Individuals with higher Sal-C concentrations also tended to exhibit superior 1RM lifts during the simulated competitions.

PRACTICAL APPLICATIONS

The results of this study suggest that higher C concentrations may benefit weightlifting performance. Consequently, greater emphasis should be placed upon the monitoring of C to establish normative values and training standards for in- dividual weightlifters or weight-trained athletes, and to assist with performance prediction in this sport. Researchers and practitioners could potentially use different strategies (e.g., nutrition, physical and psychological activities), or address the timing of exercise (i.e., diurnal variation), to modify C concentrations during training and competition, thereby reducing the potential for overreaching and over- training while augmenting weightlifting performance.

References

1. Ahtiainen, JP, Pakarinen, A, Alén, M, Kraemer, WJ, and Häkkinen, K. Muscle hypertrophy, hormonal adaptations and strength development during strength training in strength-trained and untrained men. Eur J Appl Physiol 89: 555–563, 2003.
2. Arregger, AL, Contreras, LN, Tumilasci, OR, Aquilano, DR, and Cardoso, EML. Salivary testosterone: A reliable approach to the diagnosis of male hypogonadism. Clin Endocrinol 67: 656–662, 2007.
3. Crewther, B, Keogh, J, Cronin, J, and Cook, C. Possible stimuli for strength and power adaptation: Acute hormonal responses. Sports Med 36: 215–238, 2006.
4. Crewther, BT and Cook, C. Relationships between salivary testosterone and cortisol concentrations and resistance training performance in Olympic weightlifters. J Sports Med Phys Fit 50: 371–375, 2010.
5. Crewther, BT, Lowe, T, Weatherby, RP, and Gill, N. Prior sprint cycling did not enhance training adaptation, but resting salivary hormones were related to workout power and strength. Eur J Appl Physiol 105: 919–927, 2009.
6. Crewther, BT, Lowe, T, Weatherby, RP, Gill, N, and Keogh, J. Neuromuscular performance of elite rugby union players and relationships with salivary hormones. J Strength Cond Res 23: 2046–2053, 2009.
7. Dlouhá, Hand Vyskočil, F. The effect of cortisol on the excitability of the rat muscle fibre membrane and neuromuscular transmission. Physiol Bohemoslov 28: 485–494, 1979.
8. Drust, B, Waterhouse, J, Atkinson, G, Edwards, B, and Reilly, T. Circadian rhythms in sports performance–an update. Chronobiol Int 22: 21–44, 2005.
9. Dunn, JF, Nisula, BC, and Rodbard, D. Transport of steroid hormones: Binding of 21 endogenous steroids to both testosterone-binding globulin and corticosteroid-binding globulin in human plasma. J Clin Endocrinol Metab 53: 58–68, 1981.
10. Durnin, JV and Rahaman, MM. The assessment of the amount of fat in the human body from measurements of skinfold thickness. Br J Nutr 21: 681–689, 1967.
11. Edwards, DA, Wetzel, K, and Wyner, DR. Intercollegiate soccer: Saliva cortisol and testosterone are elevated during competition, and testosterone is related to status and social connectedness with teammates. Physiol Behav 87: 135–143, 2006.
12. Filaire, E, Sagnol, M, Ferrand, C, Maso, F, and Lac, G. Psychophysiological stress in judo athletes during competitions. J Sports Med Phys Fit 41: 263–268, 2001.
13. Fry, AC, Kraemer, WJ, Stone, MH, Koziris, LP, Thrush, JT, and Fleck, SJ. Relationships between serum testosterone, cortisol, and weightlifting performance. J Strength Cond Res. 14: 338–343, 2000.
14. Fry, AC, Kraemer, WJ, Stone, MH,Warren, BJ, Fleck, SJ, Kearney, J, and Gordon, SE. Endocrine responses to overreaching before and after 1 year of weightlifting. Can J Appl Physiol 19: 400–410, 1994.
15. Gibson, LE, Checkley, S, Papadopoulos, A, Poon, L, Daley, S, and Wardle, J. Increased salivary cortisol reliability induced by a proteinrich midday meal. Psychosom Med 61: 214–224, 1999.

16. Gozansky, WS, Lynn, JS, Laudenslager, ML, and Kohrt, WM. Salivary cortisol determined by enzyme immunoassay is preferable to serum total cortisol for assessment of dynamic hypothalamicpituitary-adrenal axis activity. Clin Endocrinol 63: 336–341, 2005.
17. Haff, GG, Carlock, JM, Hartman, MJ, Kilgore, LJ, Kawamori, N, Jackson, JR, Morris, RT, Sands, WA, and Stone, MH. Force-time curve characteristics of dynamic and isometric muscle actions of elite women Olympic weightlifters. J Strength Cond Res 19: 741–748, 2005.
18. Haff, GG, Jackson, JR, Kawamori, N, Carlock, JM, Hartman, MJ, Kilgore, LJ, Morris, RT, Ramsey, MW, Sands, WA, and Stone, MH. Force-time curve characteristics and hormonal alterations during an eleven-week training period in elite women weightlifters. J Strength Cond Res 22: 433–446, 2008.
19. Häkkinen, K, Keskinen, KL, Alén, M, Komi, PV, and Kauhanen, H. Serum hormone concentrations during prolonged training in elite endurance-trained and strength-trained athletes. Eur J Appl Physiol Occup Physiol 59: 233–238, 1989.
20. Häkkinen, K and Pakarinen, A. Serum hormones in male strength athletes during intensive short term strength training. Eur J Appl Physiol Occup Physiol 63: 194–199, 1991.
21. Häkkinen, K, Pakarinen, A, Alén, M, Kauhanen, H, and Komi, PV. Relationships between training volume, physical performance capacity, and serum hormone concentrations during prolonged training in elite weight lifters. Int J Sports Med 8: S61–S65, 1987.
22. Häkkinen, K, Pakarinen, A, Alén, M, Kauhanen, H, and Komi, PV. Neuromuscular and hormonal adaptations in athletes to strength training in two years. J Appl Physiol 65: 2406–2412, 1988.
23. Häkkinen, K, Pakarinen, A, Alén, M, and Komi, P. Serum hormones during prolonged training of neuromuscular performance. Eur J Appl Physiol Occup Physiol 53: 287– 293, 1985.
24. Hsu, FC, Garside, MJ, Massey, AE, and McAllister-Williams, RH. Effects of a single dose of cortisol on the neural correlates of episodic memory and error processing in healthy volunteers. Psychopharmacology 167: 431–442, 2003.
25. Kivlighan, KT, Granger, DA, and Booth, A. Gender differences in testosterone and cortisol response to competition. Psychoneuroendocrinology 30: 58–71, 2005.
26. Linder, EE. The effect of heavy resistance exercise on the circadian rhythm of salivary cortisol in women. UWL: J Undergrad Res VI: 1–4, 2003.
27. McGuigan,MR, Egan, AD, and Foster, C. Salivary cortisol responses and perceived exertion during high intensity and low intensity bouts of resistance exercise. J Sports Sci Med 3: 8–15, 2004.
28. McGuigan, MR and Kane, MK. Reliability of performance of elite Olympic weightlifters. J Strength Cond Res 18: 650–653, 2004.
29. Papir-Kricheli, D and Feldman, S. Modifications in single cell activity in the rat midbrain during the iontophoretic application of cortisol. Exp Neurol 79: 576–581, 1983.
30. Passaquin, AC, Lhote, P, and Rüegg, UT. Calcium influx inhibition by steroids and analogs in C2C12 skeletal muscle cells. Br J Pharmacol 124: 1751–1759, 1998.
31. Passelergue, P and Lac, G. Saliva cortisol, testosterone and T/C ratio variations during a wrestling competition and during the postcompetitive recovery period. Int J Sports Med 20: 109–113, 1999.
32. Passelergue, P, Robert, A, and Lac, G. Salivary cortisol and testosterone variations during an official and a simulated weightlifting competition. Int J Sports Med 16: 298–303, 1995.
33. Putman, P, Antypa, N, Crysovergi, P, and Van Der Does, WAJ. Exogenous cortisol acutely influences motivated decision making in healthy young men. Psychopharmacology 208: 257–263, 2010.
34. Sale, MV, Ridding, MC, and Nordstorm, MA. Cortisol inhibits neuroplasticity induction in human motor cortex. J Neurosci 28: 8285–8293, 2008.
35. Salvador, A. Coping with competitive situations in humans. Neurosci Biobehav Rev 29: 195–205, 2005.
36. Salvador, A, Suay, F, González-Bono, E, and Serrano, MA. Anticipatory cortisol, testosterone and psychological responses to judo competition in young men. Psychoneuroendocrinology: 364–375, 2003.
37. Snegovskaya, V and Viru, A. Elevation of cortisol and growth hormone levels in the course of further improvement of performance capacity in trained rowers. Int J Sports Med 14: 202–206, 1993.
38. Suay, F, Salvador, A, González-Bono, E, Sanchís, C, Martínez, M, Martínez-Sanchis, S, Simón, VM, and Montoro, JB. Effects of competition and its outcome on serum testosterone, cortisol and prolactin. Psychoneuroendocrinology 24: 551–566, 1999.
39. Vining, RF, McGinley, RA, Maksvytis, JJ, and Ho, KY. Salivary cortisol: A better measure of adrenal cortical function than serum cortisol. Ann Clin Biochem 20: 329–335, 1983.
40. Viru, A and Viru, M. Cortisol–Essential adaptation hormone in exercise. Int J Sports Med 25: 461–464, 2004.

WEIGHTLIFTING AND THE KNEE

The knee joint can certainly be considered among the most stressed joints in sports alongside the elbow and shoulder. In particular, it has been observed that when practising Olympic weightlifting, the knee is subjected to repeated flexion-extension movements with heavy loads, undoubtedly producing functional stress, as occurs in other sports, where technical skills require repetitive, sudden and ballistic movements of the knee: football, handball, tennis, volleyball, basketball, jumps (long, triple and high), fencing, cycling, skiing and gymnastics.

BY ANTONIO URSO, NICOLA VOGLINO


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The official journal of the European Weightlifting Federation

Statistics usually demonstrate that competitive athletes are much more affected by "overuse" syndromes or direct trauma to the knee joint. Data show that male athletes, by slightly higher percentage, are more affected than their female counterparts.

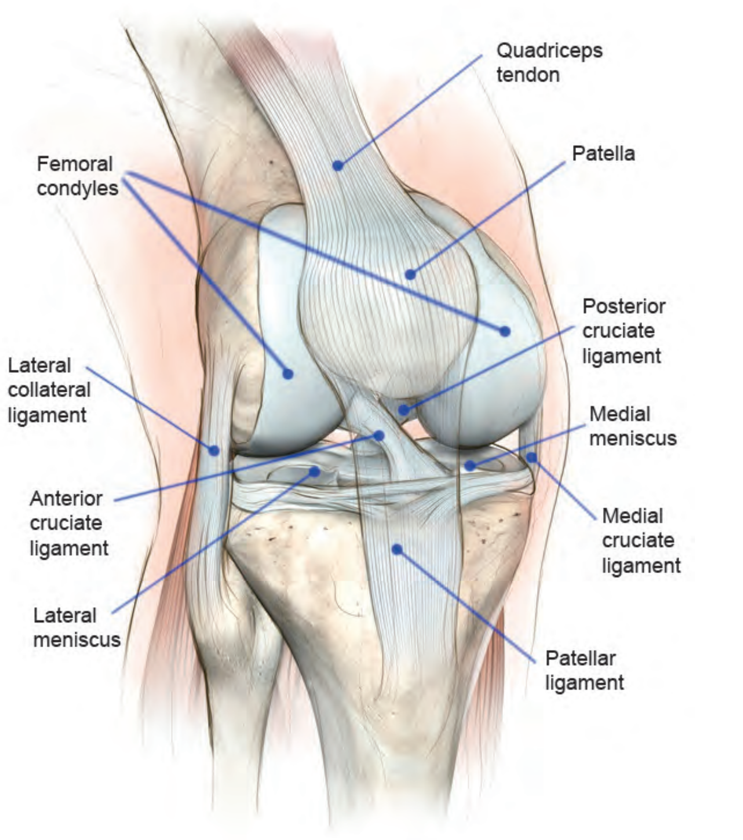
Among athletes in general, in epidemiological terms, the most frequent pathology of the knee is patellar tendonitis which, according to data from Curwin, represents 80% of cases. However, before studying the numbers that the statistics provide on traumatology in general and lifters in particular, let us take a look at the entire anatomical and functional structure of this extraordinary joint.

THE ANATOMY

The knee is made up of two major joints, the patellofemoral and tibiofemoral. The joint, considered as a whole, is circumscribed by a fibrous or articular capsule, covered by the synovialmembrane, or synovium, and is stabilised by the collateral and cruciate ligaments, by the menisci, tendons and muscular system. The joint surfaces are covered with strong, flexible cartilage known as hyaline cartilage.

The **patellofemoral** joint is formed by the surface area of the patella joint, divided into two facets, the medial and lateral, and by the femoral trochlea. The contact areas, and therefore the relative loads on the bone surfaces, vary in relation to the degrees of flexion-extension of the knee. The contact area never exceeds one third of the patellar surface and is maximal at 45° flexion. At 90° flexion, the lower part of the patella (apex) is located on the upper portion of the femoral trochlea.

The **tibiofemoral** joint is formed by the two femoral condyles, the medial and lateral, the former being more voluminous with symmetrical curvature, the latter being smaller and asymmetrical.



The tibial component is represented by the tibial plateau, in turn formed by two hemiplates - medial and lateral. The first is wide and concave, the other is less conspicuous and convex. The tibial plate is tilted by about 10° in the antero-posterior direction, to encourage maximum knee flexion. The centre of the tibial surface is occupied by a prominent bone, the intercondylar eminence, formed by the tibial spines, front and rear, preceded and followed by two depressions, the so-called area anterior intercondylar and posterior intercondylar area. The spherical configuration of the articular surfaces shows little congruence that, in reality, when the knee is intact, is guaranteed by the meniscal structures that extend the contact surfaces and provide joint stability.

The collateral, medial and lateral ligaments are fibre-elastic, ribbon-like formations stretched between the distal femurol metaphysis (final part) and proximal tibial metaphysis, the medial ligament, and the lateral ligament of the femur and fibula.They have the important function, together with other anatomical structures, of ensuring stability of the joints in the medio-lateral direction.

Unlike cruciate ligaments that have a cylindrical structure and once damaged lose continuity and must be surgically reconstructed, collateral ligaments, with their typical band structure, if damaged can heal if properly protected with a knee brace.
The anterior and posterior cruciate ligaments are, on the other hand, are robust cylindrical structures that ensure the necessary stability to the knee joint in the anteroposterior direction and during rotation.

The anterior cruciate ligament on the femur inserts into the posterior part of the medial surface of the lateral femoral condyle in the shape of an arc of a circle. Its fibres run in an oblique course. The anterior part is straight whereas the posterior is convex. The anterior cruciate ligament has an average length of 35-40 mm (intra-articular part) and an average width of about 1 cm.
The posterior cruciate ligament is stretched between the rear part of the lateral surface of the medial condyle of the femur and, like the anterior cruciate, its femoral insertion is similar to the arc of a circle. Its fibres run a horizontal course. The posterior ligament also has an average length of between 35-40 mm, but its width is greater than in the front: 13-15 mm, on average. The characteristic of this ligament is its tibial insertion that, unlike the insertions of the anterior cruciate and the femoral insertion of the posterior cruciate, it appears extra-articular. It is in fact situated in a bone depression located on the posterior cortex of the tibia, about 1 cm below the articular surface.
There are two menisci, medial and lateral. The medial meniscus has the shape of a semicircle and a length of about 3.5 cm, it has a triangular cross section and is of increasing thickness in the anteroposterior direction. It is formed by the anterior horn, which inserts into the intercondylar anterior of the tibia, by the body, which represents the continuation of the joint capsule and the posterior horn, inserted in the intercondylar posterior tibia. The lateral meniscus forms an almost complete circle and covers a larger area than its tibial plateau counterpart. It too consists of an anterior horn, a body and a posterior horn, it originates from the anterior tibial intercondylar area and inserts into the posterior region of the tibia. The lateral meniscus, because of its structure and the type and location of its insertions, is much more mobile than the medial meniscus and this explains the lower incidence of traumatic injuries compared to the medial.

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The menisci play a key role in the congruence between the femoral and tibial articular surface. Any alteration, however small, of the structure of the meniscal fibro-cartilage tissue leads to a higher load transmission on the tibial cartilage and subchondral bone. For this reason, the aim of arthroscopic meniscus surgery should be to save as much meniscal tissue as possible.

PHYSIOLOGY

Due to its anatomical structure, the knee joint has very poor intrinsic stability, which corresponds moreover to great mobility. The proper functioning of the joint, therefore, is closely related to the integrity of the intra-articular structures and the tone-trophism of the extension and flexion muscular system of the lower limbs.

In particular, good muscle tone of the extension group (quadriceps femoris and tibialis anterior) and the flexors (biceps femoris, medial and lateral gastrocnemius, soleus) ensures the correct articular ratio of bone heads and ligamentous and meniscal structures, while not overloading the physiological articular mechanism with irregular friction.

The knee joint capsule surrounds and contains intra-articular anatomical structures. Its function, however, is not purely that of a container. The knee capsule is the structure from which extra-articular ligaments of the knee originate and to which they adhere: the main ones being the collateral ligaments and alar ligaments of the patella. Fibre-elastic capsular plica (infra, supra- and medio-patellar), if hypertrophic and inflamed, become symptomatic and indicate arthroscopic lysis.

The synovial membrane lines the inner surface of the joint capsule. The functions of the synovium are essential to ensure the proper functioning of the knee joint. The synovial membrane regulates the amount and quality of the synovial fluid. The function of the intra-articular fluid is to lubricate the sliding surfaces of the joints, to protect the cartilage that lines the joint surfaces, to 'digest' worn cells and small cartilaginous fragments of the macrophages contained within.

The increase in synovial fluid (joint effusion or hydrarthrosis) is indicative of a non-specific joint disease. The synovial fluid increases as its quality deteriorates with age, systemic diseases (gout, rheumatoid arthritis, joint infections), but can also increase following damage to intra-articular structures (meniscal or cartilage) or hypo-tone-trophism of the muscle of the lower limbs that as we have seen, causes an overload of the joint.

When the effusion is a consequence of a sprain with ligament injuries, the blood spilled by tissue injury fuses with the synovial fluid and forms a typical effusion known as hemarthrosis.

BIOMECHANICS

The articulation or ROM (range of motion) of the knee is in 0° in extension and 135-140° in flexion and is permitted by the rolling of the convex surfaces of the condyles on the tibial plateau. The extreme degrees of flexion, from about 130 to 140 ° (squatting), are acquired with posterior translation of the condyles on the tibial articular surface. The joint motion is in relation to both the shape of the bony components and the ligamentous insertions. With the knee in full ex-

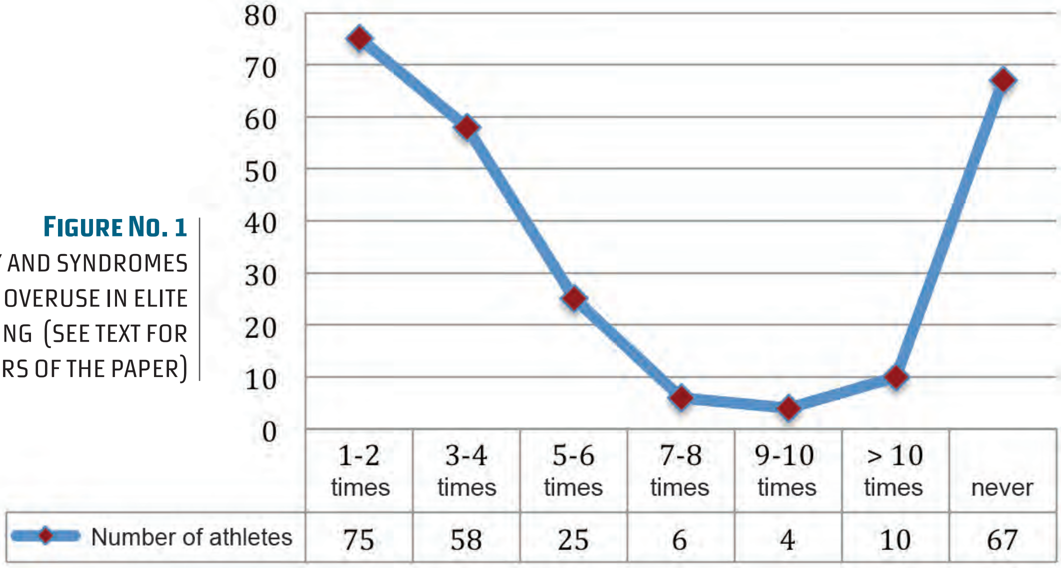


FIGURE NO. 1
INJURY AND SYNDROMES OF OVERUSE IN ELITE POWERLIFTING (SEE TEXT FOR AUTHORS OF THE PAPER)

tension, the collateral ligaments are stretched and the front surface of the meniscus is maintained between the tibia and femur.

In flexion, the menisci move backwards (as it is more mobile, the lateral meniscus in a more accentuated manner than the medial), the tibia rotates on the femur in a lateral direction, the collateral ligaments relax (the lateral one to a greater extent). When the knee is flexed, medial-lateral joint stability is ensured by other structures such as tendons and ligaments, as well as by the collateral ligaments.

INJURY AREA	NO. OF CASES	% OF TOTAL
SPINE	130	23.1
KNEE	**107**	**19.1**
SHOULDER	99	17.7
HAND	56	10.0
NECK	30	5.4
THORACIC VERTEBRAE	27	4.8
QUADRICEPS	18	3.2
PUBIC AREA	15	2.7
ELBOW	14	2.5
HIP	14	2.5
HAMSTRINGS	13	2.3
TIBIA	10	1.8
CALVES	9	1.6
FEET	6	1.1
ANKLE	5	0.9
CHEST	2	0.4
ABDOMINALS	1	0.2
TOTAL	**560**	**100%**

These structures are formed by the medial meniscus, the flexor tendon accessories (gracilis and semitendinosus) and the 'goose foot' in the medial compartment, and by the lateral meniscus, the popliteus tendon, the iliotibial band and the biceps tendon in the lateral compartment.

The anterior cruciate ligament consists of an anteromedial (AM) bundle and a thicker, posterolateral (PL) bundle. When the knee is extended, the AM bundle is slack and the PL bundle is tight; in flexing the knee, the bundle AM extends, while the rest of the ligament is relaxed. In flexion, the AM bundle represents the main impediment against the anterior displacement of the tibia.

The posterior cruciate ligament is divided into two bundles: anterior and the posterior. When the knee is extended, the front bundle is relaxed and the posterior bundle is stretched. The opposite occurs in bending.

The anterior cruciate ligament is a brake for both hyperextension and for intra- and extra-rotation; the posterior acts against the posterior displacement of the tibia with the knee flexed but does not oppose hyperextension.

Affected joint	% relative to women	% relative to men
Elbow 27%	Back 27%	Quadriceps 32%
Quadriceps 21%	Elbow 26%	Elbow 31%
Back 14%	Quadriceps 20%	**Knee 16%**
Knee 12%	Shoulder 20%	Hip 11%
Foot 7%	Foot 7%	Fingers 5%
Shoulder 7%		Feet 5%
Hands 6%		
Tibia 3%		
Hip 3%		

What are the figures related to knee pathologies in weightlifting? In general, is this sport really so wearing on those practising it?
According to statistics it would not seem so. Very interesting data emerged from a longitudinal study conducted in Germany by J. Siewe, J. Rudat, M. Röllinghoff, UJ Schlegel, P. Eysel and JWP Michael of the

Universities of Cologne, Halle and Heidelberg, entitled: Injuries and overuse syndromes in Powerlifting, a sport that presents some similarities to weightlifting.

The longitudinal study was performed on 245 elite athletes throughout their careers, highlighting what has been shown in the chart below (Figure 1).

The interesting result is that related to the fact that 27% of athletes (67) never reported problems to the knee joint during their sporting career.

In weightlifting, a study by Calhoon G. and A. Fry of "Human Performance Laboratories - University of Memphis, published in the" Journal of Athletic Training ", entitled: "Injury rates and profiles of elite competitive weightlifters", demonstrated how the knee, after the back, accounts for the most significant amount of injuries, even if the figures are very low.

Out of 560 case studies, injury to the knee represents only 19.1% with the following types of injury out of 107 cases:

- Overuse: 7 cases, accounting for 6.5%;
- Tendinitis: 91 cases, 85%;
- Other: 9 cases, 8.4%.

The following data refer to non-training days due to injury:

- 1 day in 102 cases, accounting for 95.3%
- 1 week in 4 cases, accounting for 3.8%
- 3 weeks in 1 case, 0.9%
- > 3 weeks in no case, equal to 0.0%.

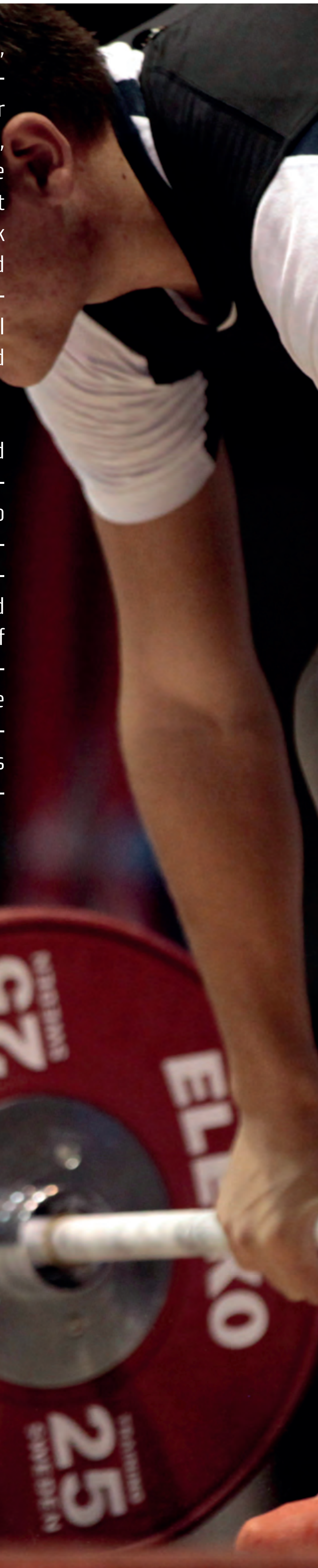
Another interesting comparison was made between the number of hours of training in competitive weightlifting senior and injury. The figure that emerges is quite comforting. Out of 1,000 hours of high intensity specific training, the number of injuries varies from 1 to 4.
This is not the case for other sports:

- Ice Hockey: 62/1,000
- American Football: 16/1,000
- Handball: 13.5 / 1,000
- Combat Sports: 20.1 / 1,000
- Rugby: 6.9 / 1,000

Paradoxically, Olympic weightlifting has the same high level of knee injury, for the number of hours of specific training, as dance which, in this statistical study showed the following data: 1.5 to 4 injuries per 1,000 hours.

In high-level lifters, it was also reported, in comparison to the sedentary population with an average of 14%, the wear phenomenon of the patellar cartilage, rarely bilateral and more evident in the knee of the leg used in the sagittal thrust that moves forward in the clean and jerk exercise, probably due to a massive, rapid and simultaneous contraction of the quadriceps femoris, which creates additional pressure on the quadriceps tendon and on the patellar ligament.

Another interesting study was conducted by the Medical Committee of the European Weightlifting Federation from 2002 to 2009, recording injuries in every European Championship, differentiating between male and female athletes. Compared to a statistically significant number of cases (about 3,500 participating athletes), once again, the data related to knee injury are very low in men, and completely absent in women, despite the stress generated in such a high level of competition.



Recommended reading

1. Calhoon G & Frey A, Injury Rates and Profiles of Elite Competitive Weightlifters, J Athl Train, 1999 Jul-Sep; 34(3): 232–238

2. Siewe J, Rudat J, Röllinghoff M, Schlegel UJ, Eysel P, Michael JW, Injuries and overuse syndromes in powerlifting, Int J Sports Med. 2011 Sep;32(9):703-11.

N° 1 / April-July 2015

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COMPARISON OF WARM UP PROTOCOLS OF HIGH CLASS MALE AND FEMALE WEIGHTLIFTERS

"The warm up should not be fatiguing.
On the contrary, it should invigorate the sportsman to perform the exercises".
(A.N. Vorbeyev, 1988).

BY ANDREW CHARNIGA, JR.


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Over the years a number of papers have been devoted to the weightlifter's warm up for competition. Some of this information is more than 50 years old. However, in the interim there have been a number of changes to the technical rules of weightlifting competitions.

For instance, there are now two competition exercises instead of three, two minutes instead of three to prepare if an athlete follows himself/herself for the next attempt on the platform, and one minute instead of two minutes to begin lifting the barbell on the platform after the athlete has been called.

However, without question, the most dramatic change to the weightlifting program over past 50 years has been the inclusion of women weightlifters. The question as to whether there are, or for that matter need be, different warm up protocols for women weightlifters has not received any attention.

Data collected at the 2008 Olympics provided the impetus to look into this question. The specific warm up loading of the four Chinese female gold medalists in Beijing represented a substantial departure for what is widely considered to be a reasonable competition warm up protocol for any sport!

Olympic and World Champion CAO Lei rests between warm up lifts at the 2009 World Weightlifting championships.

THE WEIGHTLIFTER'S WARM UP FOR COMPETITION

Most any formal definition of a warm up for athletic competition would go something like this: "to briefly exercise in preparation." The key element of this broad definition is the brevity of exercise. This is probably the most widely accepted, reasonable definition of an athlete's warm up. The idea is to prepare physically and psychologically to perform the upcoming work in the competition without becoming fatigued, i.e., to create an optimum state of readiness to perform in competition.

A.N. Vorobeyev, Olympic and world weightlifting champion, MD, and a preeminent weightlifting sport scientist defined the purpose of the warm up simply: "*It should invigorate the sportsman to perform the exercises.*"

The Soviet era Weightlifting Textbook (A.N. Vorbeyev, 1988. Translated by Andrew Charniga, Jr.) outlined the parameters of the weightlifter's competition warm up:

"*The special warm up begins 15 to 20 minutes before being called to the competition platform. The exercises with the barbell are the final preparation of the body for the performance. Without rushing, sportsman should do 4 to 5 sets of lifts with rest intervals of 3 to 4 minutes between them. The first warm up sets are with 60 to 70% of the limit (taking into account the individual peculiarities of the athlete and the weight class). Five to ten kilos are added to the barbell with each succeeding attempt. Three lifts are done with the first two sets and the rest with 1 to 2 lifts.*"

Vorobeyev goes on to recommend that the final warm up weight should be 10 to 15 kilos below the athlete's first attempt in competition.

The basic parameters recommended by Khairullin (1993, 2002) are presented in the references section. However, the quantities of lifts and sets include partial lifts and good mornings to warm up the muscle groups individually. This procedure is inconsistent with our observations at the world championships and Olympic Games and is difficult to quantify for analysis.

Furthermore, regardless of the training system one employs, Russian, Bulgarian, Chinese, or various permutations thereof, the following fact is central to success in weightlifting competitions:

The fundamental parameters of lifts with 90% and above weights in the snatch and the clean and jerk are different than lifts with 80%, 70%, or less. Consequently, all other factors being equal, in theory, the more lifts a weightlifter is able to execute in the competition exercises with 90% and above weights, the better prepared the lifter is to be successful with near maximum and maximum weights.

Spasov and Tsarvulkov (1983) observed that 12 attempts on the competition platform required approximately 18 minutes. This rule of thumb is connected with the technical rules of 1979 where an athlete had two minutes from the time his name was called to begin the exercise and three minutes if he followed himself to the platform. The current rule stipulates one minute and two minutes respectively, which obviously makes this indicator invalid. In some cases, 12 platform attempts conceivably could require only 12 to 15 minutes.

According to Vorobeyev's recommendations, the weightlifter should begin with about 60% of the anticipated maximum result which is approximately 12 to 13 attempts before being called to the platform; this is in accordance with the technical rules of the late 1980s.

A good practical example of the aforementioned warm up parameters was given in R.A. Roman's book The Training of the Weightlifter some twenty years earlier (1968).

According to Roman, (at that time the USSR national coach) Vladimir Belayev (USSR, 82.5 kg class) performed the following warm ups and competition attempts at the 1966 World weightlifting championships in East Berlin:

Snatch

90/2, 100/2, 110/2, 125/1 x 2:
1st attempt 135, (125/1) 2nd 145,
3rd 147.5 (a new world record).

There were a total of five preliminary warm up sets (the other lift with 125 kg was done because of the long wait between 1st and 2nd attempts) and a total of eight preliminary lifts. The first warm up weight was 61% of the competition maximum (147.5); the final warm up was 10 kg below the opening weight of 135 kg or approximately 93% of this weight.

It should be noted that this is occurred about 50 years ago; the lifter is a male and the athlete completed the press competition before proceeding to the snatch.

In the revised version of the same book, The Training of the Weightlifter (1974) Roman offered this warm up for the snatch:

50/3 x2, 70/2 x2, 90/1, 105/1, 115/1 x 2.

This sequence was to be followed by two snatch pulls with 127.5 kg which was to be the 1st attempt on the platform. The rationale to performing two pulls with the 1st attempt weight was to tune the athlete's nervous system to reach the maximum height of lifting prior to the first attempt. Soviet research showed that two or three lifts with the same weight are necessary to enable a lifter to raise a given weight to the maximum height. Therefore, if the athlete stopped at 115 kg, in theory he may not be as well prepared to raise 127.5 kg high enough on the first attempt to complete the exercise. Please note that this method to include pulls in the final approach is no longer employed at the international level.

Roman offered these warm up variations for the clean and jerk:

1st variant with Belayev USSR: 100/2+1, 130/2, 150/2, 160/1, 170/1: competition attempts with 185, 185, 190

2nd variant with Kurentsov USSR: 100/2+1, 120/1+2, 130/1, 140/1, 155/1: competition attempts with 167.5 (or 170), 175, 177.5.

3rd variant with Kurentsov USSR: 130/2, 140/1, 155/1: competition attempts with 167.5, 175 and 177.5 kg.

In all three variants there were 3 to 5 sets, 4 to 9 total lifts.

Seven years after the publication of Roman's book, Spasov and Tsarvulkov (1983) analyzed the warm up loading of the champions of the 1965, 1979, and 1982 World championships. They determined that the mean number of warm up sets and lifts increased and the rest period between sets decreased from 1965 to 1982. This was due, they believed, to the rise in absolute weights lifted in all weight classes which required more time and lifts to achieve the desired result.

Model warm up variants were established earlier by Spasov and Tsarvulkov (1979) based on analysis of top lifters at the world championships. This data appears in the table along with converted data from Roman's recommendations (≥60% and others designate the percentage of the maximum results achieved in competition on that day for data presented in all tables).

ATHLETE/WT.CL	EXERCISE	#≥60-≤79%	#≥80-≤89%	#≥90%	TOTAL
BELAYEV/82.5	SNATCH	6	2	0	8
ROMAN/TEXT	SNATCH	2	2	2*	6*
SPASOV/TS./82.5	SNATCH	2	2	1	5
LU YONG/2009	SNATCH	4	2	1	7

TABLE 1. COMPARISON OF ROMAN'S RECOMMENDATIONS (1974) FOR SNATCH WARM UPS WITH SPASOV AND TSARVULKOV'S (1979) AND SOME DATA FROM 2009 WORLD WEIGHTLIFTING CHAMPIONSHIPS.

ATHLETE/WT.CL	EXERCISE	#≥60-≤79%	#≥80-≤89%	#≥90%	TOTAL
BELAYEV/82.5	C & J	4	1	1	6
ROMAN VARIANT 2	C & J	3	1	0	4
KURENTSOV/75	C & J	5	1	0	6
SPASOV/TS./82.5	C & J	2	1	1	4
LU YONG/85	C & J	4	0	1	5

TABLE 2. COMPARISON OF ROMAN'S MODELS (1974) FOR C & J WARM UPS WITH SPASOV AND TSARVULKOV'S (1979) AND DATA FROM 2009 WORLD WEIGHTLIFTING CHAMPIONSHIPS.

INDICES	SNATCH 1965	C&J 1965	SNATCH 1979	C&J 1979
# SETS (AVERAGE)	6.69	5.39	9.10	8.57
#LIFTS TOTAL	10.91	7.07	14.72	11.07
REP/SET	2.28	1.71	3	3
TIME TO 1ST	2.11	2.11	3.03	3.25
AVERAGE REST/MIN.	2.24	2.36	2.20	2.32

TABLE 3. COMPARISON BETWEEN WARM UPS OF 1965 EUROPEAN CHAMPIONSHIPS AND 1979 WORLD WEIGHTLIFTING CHAMPIONSHIPS (ALEXANDER TSARVULKOV, ANGEL SPASOV, SCIENTIFIC METHODICAL BULLETIN, 03:17-20:1980, INTERNATIONAL WEIGHTLIFTING FEDERATION)

Two pulls, not snatches

A comparison between Roman's recommendations with the theoretical optimum of Spasov and the actual warm ups of 2008 Olympic and 2009 world champion Lu Yong (CHN), i.e., data from 30 to 50 years apart, show that the procedures are very similar. In all four cases there were only two lifts with weights in the 80 to 89% zone of intensity, 0 to 2 with # 90% and an average of 7 total lifts from 60%. Table 2. Comparison of Roman's models (1974) for C & J warm ups with Spasov and Tsarvulkov's (1979) and data from 2009 World Weightlifting Championships.

Similar to the snatch data presented in table 1, the warm up loading of the clean and jerk in table 2 over the 50 year interval is almost identical: an exact mean of 5 lifts (range 4-6) with 60; 0 – 1 with both # 80- 89 and 90%. So, the textbook recommended warm up loading for the male weightlifter, the theoretical and the practical, have remained relatively constant for almost 50 years.

The data presented in table 3, collected by Spasov and Tsarulkov, contrasts the mean warm up indices between 1965 and 1979. It is obvious that the lifters of 1979 performed more warm up lifts and more lifts with approximately the same rest period between warm up sets. This circumstance the authors attributed to the higher overall results of 1979 and the greater fitness of the athletes of this time because the training loading had increased substantially over that 14 year period.

However, the authors did not take into account the fact that there were three lifts in 1965. The possibility of the warm up loading for the first exercise (the press) would reduce the overall warm up required for the snatch, which in turn would affect the third (C&J) was, apparently, not taken into account. Also, it should be noted that the aforementioned Bulgarian data counted weights less than 60% of maximum in the total, whereas we have counted only warm up lifts with 60% in tabulating the total number of lifts executed in warm ups.

The data in table 4 shows clearly that the mean number of lifts, tabulating from the 60% zone to the first attempt in competition for both exercises and both

Snatch/wt.cl.	Athletes	≥60-79%	≥80-89%	≥90%	Total Lifts
48 – 63 kg	10	7.5	5.4	4.5	17.4
69 – +75 kg	11	5.4	3.1	2.8	11.3
C & J					
48 – 63 kg	10	4.0	3.1	1.3	8.4
69 – +75 kg	11	4.6	2.2	1.4	8.2
Males/Snatch					
56 – 77 kg	9	5.4	2.6	1.3	9.3
85 - +105 kg	16	4.1	2.7	1.4	8.2
C & J					
56 – 77 kg	9	3.2	1.6	1.8	6.6
85 - +105 kg	13	2.2	1.5	.92	4.6

Table 4. Mean number of warm up lifts in each intensity zone of female and male weightlifters at 2009 World Weightlifting Championships.

World Weightlifting Champion and World Record Holder Wang Mingjuan (CHN) wrapped in blanket between warm up lifts at 2009 World Weightlifting Championships.

genders, exceed the theoretical optimum of Spasov and Tsarulkov established in 1979 and the model protocols of Roman established in 1968.

For instance, the optimum number of lifts recommended by Spasov and Tsarulkov in the weight class range of 52 to 75 kg for the snatch was 6 to 8. The corresponding mean figure for the males in 2009 was 9.3 and between 11.3 to 17.4 for females (all females investigated).

This was essentially the same situation for the clean and jerk. The mean number of lifts recommended by the Bulgarians was 5.8 for the weight classes 52 to 75, whereas in 2009 the mean for 56 to 77 kg was found to be 6.6 for males and 8.3 for females (table 3).

The data collected shows today's athletes are doing a few more warm ups in the higher intensity range and in less time. This is due in part by the fact that the 'A' sessions of World Championships and Olympic Games are restricted to 8 to 12 lifters. With the shorter times for the athlete to begin a lift (one minute) and if necessary follow him/herself to the platform, two minutes today, versus three minutes in 1979, the overall duration of a competition between the top 10 to 12 lifters is shorter, i.e., more intense in the current era.

Today's lifters do more work in less time than those of 1965 and even the lifters of 1979. This indicates today's athletes possess a high specific work capacity, but it is also an indication the loading (both training and competition) has continued to evolve following the end of the three lift era.

The three lift era of 1965 was not a purely speed strength era as is the two lift era of today. Athletes and coaches believed more recovery time was required (table A). For instance, even as late as 1988 in his weightlifting textbook Vorobeyev recommended warm up sets be spaced 3 to 4 minutes apart, i.e., to prevent fatigue. However, today some females sequence warm up sets in less than half this time.

GENDER DIFFERENCES IN THE WEIGHTLIFTER'S WARM UP

A closer look at the warm up lifts of today's high class female lifters revealed that there is not a big difference between male and female (excluding the Chinese women) warm up protocols.

From the data presented in tables 4 to 6 it is obvious that today there are essentially two warm up protocols for today's high class weightlifter: the traditional (both genders) and the Chinese warm up (females only).

For instance, in table 4 the mean number of snatch lifts from 60% to the first platform attempt is 17.4 for females in the lighter weight classes (48 to 63 kg) and only 9.3 for males (56 to 77 kg). This would appear to indicate that females require significantly more warm up loading than males. However, the data in table 5 reveals that the actual difference between today's female lifters, exclusive of the Chinese, and the males (inclusive of Chinese men) is for the most part insignificant, i.e., 10.0 vs. 9.3.

The data for the clean and jerk is similar. The mean number of lifts for the females (collectively) in the lighter weight classes (table 3) was 8.4 versus 6.6 for the men (56 to 77 kg). But, when the loading of the Chinese females is excluded, the picture is radically different: 4.7 lifts for non-Chinese women from ≥60% versus 6.6 lifts for males and 5.0 for the heavier women versus 4.6 for the heavier men.

SNATCH/WT.CL.	ATHLETES	≥60-79%	≥80-89%	≥90%	TOTAL LIFTS
48 – 63 KG	6	4.7	3	2.3	10
69 – +75 KG	7	3.3	2.1	1.1	6.5
C & J					
48 – 63 KG	7	2.0	1.4	1.3	4.7
69 – +75 KG	8	2.9	1.5	.63	5.0

TABLE 5. MEAN NUMBER OF WARM UP LIFTS IN EACH INTENSITY ZONE OF FEMALE WEIGHTLIFTERS AT 2009 WORLD WEIGHTLIFTING CHAMPIONSHIPS, EXCLUDING CHINESE FEMALE LIFTERS.

SNATCH/WT.CL.	ATHLETES	≥60-79%	≥80-89%	≥90%	TOTAL LIFTS
48 – 63 KG	6	11.2	7.7	8.0	26.9
69 – +75 KG	4	11.0	6.0	5.5	22.5
C & J					
48 – 63 KG	6	5.3	7.0	6.7	19.0
69 – +75 KG	4	4.8	4.3	2.3	11.4

TABLE 6. MEAN NUMBER OF WARM UP LIFTS IN EACH INTENSITY ZONE OF CHINESE FEMALE LIFTERS WEIGHTLIFTERS AT 2009 WORLD WEIGHTLIFTING CHAMPIONSHIPS AND 2008 OLYMPICS.

Female weight divisions 48 to 63 and 69 to +75; male classes: 56 to 77 and 85 to +105.

THE CHINESE WARM UP

A comparison of the data in tables 6 and 7 reveals there is huge qualitative and quantitative disparity between the Chinese warm up and the rest of the world, regardless of gender. It may be easier to envision this disparity by placing the actual loading of the four categories of warm up discussed side by side: Chinese female, 2009 world champion female, 2009 world champion male, and the theoretical optimum of Spasov and Tsarvulkov.

The warm up of CAO Lei presented in table 8 is more than twice the volume of 2009 female world champion Podobodova's with five times more lifts in the ≥90% zone of intensity. CAO's warm up is almost three times volume of the theoretical optimum with five times more lifts in the ≥90% zone and likewise has five times more ≥90% lifts than 2009 male world champion LU.

The data in table 9 of the clean and jerk is similar to that of table 8. CAO's warm up volume and intensity are significantly larger than the other two athletes and the theoretical optimum.

The warm up data presented in table 8 and 9 of the loading of two females and one male (all world champions) compared with a theoretical optimum determined in 1979 for male lifters of that era illustrates three peculiarities of the modern warm up.

First, today's athletes of both genders do more lifts with higher intensity weights, in less time, than the male lifters of thirty to fifty years ago.

Second, the warm up protocols of today's female lifters (excluding the Chinese) are very similar to

SNATCH/WT.CL.	ATHLETES	≥60-79%	≥80-89%	≥90%	TOTAL LIFTS
48 – 63 KG	6	4.7	3	2.3	10
56 – 77 KG	9	5.4	2.6	1.3	9.3
69 – +75 KG	7	3.3	2.1	1.1	6.5
85 - +105 KG	16	4.1	2.7	1.4	8.2
C & J					
48 – 63 KG	7	2.0	1.4	1.3	4.7
56 – 77 KG	9	3.2	1.6	1.8	6.6
69 – +75 KG	8	2.9	1.5	.63	5.0
85 - +105 KG	13	2.2	1.5	.92	4.6

TABLE 7. COMPARISON OF MEAN NUMBER OF WARM UP LIFTS IN EACH INTENSITY ZONE OF FEMALE AND MALE WEIGHTLIFTERS AT 2009 WORLD WEIGHTLIFTING CHAMPIONSHIPS, EXCLUDING DATA OF CHINESE FEMALE LIFTERS.

	CAO L		POD. S		LU XI.		T.O.
SET	WT.	%	WT.	%	WT.	%	
1st	15						
2nd	15						
3rd	35/2						
4th	35/2						
5th	45/2	35%					
6th	45/2	35%					
7th	65/1	51%					
8th	75/2	60%					
9th	75/2	60%			20		
10th	85/2	66%			20		
11th	85/2	66%	15		20		
12th	95/2	74%	15		60/3		
13th	95/2	74%	45/2	34%	60/2		
14th	100/2	78%	65/2	49%	60/1		
15th	105/2	82%	80/1	61%	90/2		
16th	110/2	86%	90/1	68%	110/2	63%	34%/3
17th	110/2	86%	90/1	68%	110/2	63%	47%/3
18th	115/1	90%	100/1	80%	120/2	69%	61%/2
19TH	115/1	90%	110/1	83%	130/2	75%	74%/1
20th	120/1	94%	115/1	87%	140/2	80%	81%/1
21st	120/1	94%	120/1	91%	150/1	86%	88%/1
22st	120/1	94%	115/1	87%	160/1	92%	95%/1
1st	120		125		165		
2nd	125		130		170		
3rd	128	100%	132		174		

TABLE 8. COMPARISON OF SNATCH WARM UP LOADING AND COMPETITION ATTEMPTS BETWEEN TWO FEMALES AND ONE MALE: CAO LEI (75 KG CHN 2008 OLYMPICS) SVETLANA PODOBODOVA (75 KG KAZ) AND LU XIAOJUN (77 KG CHN) BOTH AT 2009 WORLD CHAMPIONSHIPS COMPARED WITH THEORETICAL OPTIMUM (T.O.) OF SPASOV AND TSARULKOV (1979)

	CAO L		POD. S		LU XI.		T.O.
SET	WT.	%	**WT.**	%	**WT.**	%	
1st	15						
2nd	15						
3rd	45/2+2*						
4th	45/1+2						
5th	65/1+2						
6th	65/1+2						
7th	85/1+2						
8th	85/1+1				60 2+2		
9th	105/1+1	68%			60 1+1		
10th	105/1+1	68%	15		60 1+1		
11th	115/1+1	75%	55/2+2		100 1+1		28/3
12th	115/1+1	75%	75/1+2		100 1+1		39/3
13th	125/1+1	81%	95/1+1	59%	130 1+1	64%	50/2
14th	125/1+1	81%	95/1+1	59%	130 1+1	64%	62/1
15th	135/1+1	88%	115/1+1	72%	150 1+1	74%	73/1
16th	140/1+1	91%	130/1+1	81%	170 1+1	83%	**84/1**
17th	145/1+1	94%	130/1+1	81%	180 1+1	88%	**90/1**
18th	145/1+1	94%	140/1+1	87.5%	190 1+1	93%	**95/1**
1st	147		150		200		
2nd	154		155		204		
3rd	~~159~~		160		~~211~~		

TABLE 9. COMPARISON OF CLEAN AND JERK WARM UP LOADING AND COMPETITION ATTEMPTS BETWEEN TWO FEMALES AND ONE MALE: CAO LEI (75 KG CHN 2008 OLYMPICS) SVETLANA PODOBODOVA (75 KG KAZ) AND LU XIAOJUN (77 KG CHN) BOTH AT 2009 WORLD CHAMPIONSHIPS COMPARED WITH THEORETICAL OPTIMUM (T.O.) OF SPASOV AND TSARULKOV (1979)

those of today's male weightlifters.

Third, the warm up protocol of the Chinese women is substantially larger of any male or female, of any era, especially the number of lifts in the higher intensity zones.

For instance, the Chinese women lifters in the 48 to 63 kg classes performed 15.7 lifts of 80% range versus 5.3 for the other high class females of the same weight classes and only 3.9 for high class males of 56 to 77 kg classes (tables 6,7), i.e., 3 to 4 times the intensity of "normal" high class lifters of both genders.

The data in table 9 vividly illustrates another peculiarity of the Chinese warm up. All athletes reduce the absolute number of warm up lifts, especially in the 80% range for the clean and jerk exercise, but less so for the Chinese females.

The obvious reason for limiting the number of clean and jerk warm ups is that with generally fewer lifters in a session competing with less time to perform the exercises, there is a relatively shorter break between the snatch and clean and jerk exercises; i.e., the athlete's muscles are still warm from the snatch competition.

However, the Chinese lifter CAO Lei not only did a significantly larger number of high intensity lifts 10 versus 6 and 4 (table 9) for the other female and male respectively, but a total of 18 sets of clean and jerk warm ups versus 9 and 11 for the other female and male respectively.

CAO performed this relatively large volume and intensity despite the relatively short break between exercises and the small number of lifters in the session, i.e., the shorter, overall duration of the competition. She began the warm up for the clean and jerk, from the very beginning with 15 kg, even though it was preceded by a huge warm up and the actual competition in the snatch.

The warm up of the Chinese female weightlifter may be the largest in volume and intensity in all of sport.

Another comparison of warm up protocols between two females and the theoretical optimum is of interest. The data in table 10 of the gold medalist LI (CHN) and the silver medalist Novikava (BLR), both 58 kg class lifters and the theoretical optimum established for 56 kg males in 1979, is an example of this.

The bodyweights of the female athletes and theoretical optimum are very close. The Belarus female performed a higher volume and intensity warm up than theoretical optimum established for a male of 1979.

However, LI's warm up of 29 sets was the largest of all athletes investigated. She performed each set approximately 1.5 minutes apart, i.e., half the optimum rest period recommended by Vorobeyev in 1988.

The warm up of LI Xueying presented in table 10 is the single largest, longest warm up of any athlete studied. It is significantly larger than both the silver medalist Novikova and the theoretical optimum of Spasov and Tsarulkov for a high class male lifter of the era dating back to 1979.

Over the course of 29 warm up sets, LI never sat down. For the most part she never rested long enough between sets to catch her breath. During the short break between the snatch and the clean and jerk competition, LI put on a heavy winter coat while sitting for a period of less than 8 to 10 minutes. It really can not be classified a warm up in the traditional meaning of the term; it was more a unique application of physiology and physics.

	LI Xu		Nov. A		T.O.
Set	Wt.	%	Wt.	%	(56 kg)%
1st	15				
2nd	35/4				
3rd	35/3+2*				
4th	35/4+1				
5th	35/3				
6th	45/3				
7th	45/3				
8th	45/3				
9th	55/2				
10th	55/2				
11th	55/2				
12th	55/2				
13th	65/2	61%			
14th	65/2	61%			
15th	75/2	70%			
16th	80/2	75%			
17th	85/2	80%	15		
18th	85/2	80%	15		
19th	85/2	80%	45/2		
20th	90/2	84%	45/2		
21st	90/2	84%	65/2	65%	
22nd	95/1	89%	65/2	65%	
23rd	95/1	89%	65/2	65%	45%/3
24th	95/1	89%	75/2	75%	54%/3
25th	95/1	89%	80/1	80%	64%/3
26th	98/1	91%	85/1	85%	72%/2
27th	98/1	91%	85/1	85%	82%/1
28th	100/1	93%	80/1	85%	91%/1
29th	100/1	93%	90/1	90%	96%/1
1st	100		95		
2nd	105		100	100%	
3rd	107	100%	~~106~~		

TABLE 10. COMPARISON OF CLEAN AND JERK WARM UP LOADING AND COMPETITION ATTEMPTS BETWEEN TWO FEMALES AND ONE MALE: CAO LEI (75 KG CHN 2008 OLYMPICS) SVETLANA PODOBODOVA (75 KG KAZ) AND LU XIAOJUN (77 KG CHN) BOTH AT 2009 WORLD CHAMPIONSHIPS COMPARED WITH THEORETICAL OPTIMUM (T.O.) OF SPASOV AND TSARULKOV (1979). 35/3+2* DENOTES THREE SQUAT SNATCH LIFTS FOLLOWED BY TWO OVER HEAD SQUAT LIFTS.

To briefly sum up the data collected, today's top weightlifters, both male and female, excluding the Chinese women, perform a very similar warm up protocol to the athletes of 30 to 50 years ago. Today's males and females do a few more lifts in the 60% intensity zones in less time than the athletes (male only) of 30 to 50 years ago, stipulated in part by the changes in the technical rules whi-

World Weightlifting Champion and world record holder Wang Mingjuan (CHN) wrapped in blanket between warm up lifts at 2009 World Weightlifting Championships.

ch permit less time to prepare for the first attempt on the platform, fewer athletes in a competition session, and less time for an athlete to follow him/herself to the platform, with generally larger weights lifted today.
Generally this indicates today's athletes possess a higher level of psychological and physical preparedness.
However, since we have identified what in all probability is a unique warm up protocol in all of sport, apparently taken to the precipice of fatigue, it is necessary to examine this phenomenon more closely.
After comparing the data in table 6 to all of the other data presented, some going back 50 years, two questions about the Chinese warm up come to mind. Given the universal belief that the warm up for competition in any sport is to prepare and not fatigue the athlete, the two questions are why and how.
Why would these women do so many warm ups when today's high class lifters of both genders do so much less?
How do you perform so many warm up lifts and not become fatigued or at least compromise your potential in the competition, i.e., how can it work?

WHY AND HOW

"The strength and speed of movement can be enhanced by the utilization of elastic forces; the economy of movement can be enhanced by recuperation of the mechanical energy while diminishing the loss through dissipation" (V.M. Zatsiorsky, 1981).

Consider our analysis of the warm up loading of the four Chinese gold medalists at the 2008 Olympics presented in table 11.

The volume of warm up lifts presented in table 11 is unusually large to say the least. However, the most atypical figures are the large number of lifts in the 90% zones in both exercises. None of the other elite athletes investigated, male or female, were even close to this volume of high intensity lifts.
Whether in spite of, or because of, the Chinese method of preparation for the 2008 Olympic competition was extraordinarily successful, i.e., the four Chinese females made 23 of 24 attempts in the competition.
Even the lone missed attempt was more than accessible. When asked afterwards why she missed her final weight of 159 kg in the clean and jerk (the gold me-

Athlete/wt	≥60-79%	≥80-89%	≥90%	Total Lifts	Fin/1rst kg	%Fin of 1st	Suc.
Snatch							
ChenXiexia/48	14	2	9	25	90/90	100%	3
ChenYan/58	6	8	8	22	100/100	100%	3
LiuChunhon/69	14	8	6	28	120/120	100%	3
Cao Lei/75	14	6	5	25	120/120	100%	3
C & J							
Chen Xiexia/48	3	3	5	11	110/113	97%	3
Chen Yan/58	7	3	4	14	125/130	96%	3
LiuChunhon/69	8	5	1	14	145/145	100%	3
Cao Lei/75	4	3	3	10	145/147	99%	2

Table 11. Warm up lifts of the four Chinese female gold medalists at 2008 Olympics.
Notations: The percentages for the various zones (60 to 79% for instance) are based on the maximum weight achieved on that day. Fin/1st - the final warm up weight over the first attempt weight on the platform; %Fin of 1st - ratio of final warm up weight to first attempt on the competition platform; Success - number of successful lifts in the competition for that exercise.

dal was already assured), CAO Lei said thoughts of her recently departed mother distracted her concentration.

From our analysis of all 15 weight classes at the 2009 World Weightlifting Championships we found that ratio of the final warm up to the first attempt was primarily between 94 to 96% for the women (excluding the Chinese) and 94 to 97% for all males with 95% being the most frequent final warm up for the females and 96% for the males.

In the clean and jerk the largest proportion of final attempts were with 95 to 96% for the females and 92 to 97% for the men. The most frequent occurring final warm up for the females was with 96% whereas it was 92%, 95%, and 97% evenly for the men.

Compare these ranges for all the high class athletes male and female, exclusive of Chinese females, with those in table 11. The mean final warm up in the snatch was 100% of the first attempt, whereas the rest of the "normal" elite weightlifters investigated performed at most one lift with heaviest warm up weight.

"The last warm up weights in the snatch should be 7.5 to 12.5 kg below 1st attempt and 10 to 20 kg for C&J" (A.N. Vorobeyev, 1988).

The Chinese lifted an atypical 100% of the first attempt. Furthermore, each Chinese lifter performed 2 to 3 lifts with 100% of the first attempt in snatch warm ups. The mean final warm up of the Chinese females for the clean and jerk was 98%.

In both exercises the Chinese warm up far exceeded not only the volume, but especially the intensity of the rest of the world's high class lifters, regardless of gender. The Chinese warm up with final warm up lifts of very high intensity in comparison with that of elite males and non-Chinese elite female weightlifters is followed by moderate incremental weight increases for the competition attempts. This is in conformity with the theoretical conclusions of P.A Dobrev ("Retrospective Analysis of the Practical Preparation of the Weightlifter," (Budapest, International Weightlifting Federation Coaching medical seminar in Varna, Bulgaria 1983, pp. 102-125.): "The realization of three good lifts in the snatch and the clean and jerk with minimal increases of the weight is an objective criterion of the high level of the physical and technical preparation and for a comparatively high psychological stability."

The Chinese women gold medalists at the Beijing Olympics realized an extraordinarily high level of psychological stability. They performed three lifts with 100% of their opening weights on the competition platform in the snatch to be followed successfully by three successful lifts with weights of near maximum and maximum weights.

The relatively massive intensity of the snatch warm up was followed by a slightly lesser but, nonetheless, atypically high intensive warm up for the clean and jerk.

THEORETICAL CONSIDERATIONS WITH REGARDS TO THE CHINESE WARM UP

In all probability the Chinese warm up method reduces the likelihood the athlete will alter the optimum coordination structure to perform the exercises with near maximum and maximum weights.

In our experience (after many years as a competitive weightlifter and first hand observations of numerous international competitions) the most common manner a male weightlifter prepares for a maximum effort is to proceed with a pyramiding aggressive approach, through a biological chain the first link of which is testosterone, i.e., testosterone + aggression (anger) + adrenaline = stronger muscular contraction.

However, with this aggressive, androcentric approach, the athlete risks disrupting the optimum coordination structure of the exercise from unnecessary co-activation of muscle antagonists and inappropriate rhythm. For example, the weightlifter's muscles have to switch from contraction to relaxation in a fraction of a second. This is hard to do effectively if you are in a psychologically aggressive "lather."

A viable alternative to this "biological chain of aggressiveness" may very well be the Chinese warm up. Here prolonged, multiple repetition of exercises, even with high intensity weights, facilitates the movement of the body to perform the exercises with maximum weights without an aggressive approach.

In our opinion, the facilitating mechanism is heat which is built up

MENG SUPING (CHN) COVERED IN BLANKETS DURING WARM UPS AT 2009 WORLD WEIGHTLIFTING CHAMPIONSHIPS

over the course of the warm up and preserved close to the point of discomfort, to the precipice of fatigue.

Our theory is that heat facilitates the retention of some stored strain energy in the viscero–elastic tissues. This arises from the prolonged elevation of body temperature accumulated after many warm up lifts. In its turn, this facilitates economy of movement in performance of the exercises, i.e., through more effective storage and release of strain energy from the muscles, tendons, and ligaments. Consequently, the Chinese female lifters following this warm up procedure place less emphasis on pyramiding levels of muscular effort, i.e., where the athlete tries to become more aggressive with each incremental increase in the weight of the barbell.

In sport, the unusual peculiarities of weightlifting make creation of the optimum movement coordination difficult. A.N. Vorobeyev, 1988, noted in addressing this issue.

"The increasing weight of the barbell which is one of the fundamental 'peculiarities' of weightlifting training forces the lifter to alter the entire system of muscular tension and even the movement rhythm; thereby, it complicates the coordination structure of the exercise.

"The lifting of a limit weight is a complex matter: a) the athlete has to constantly change the weight of the barbell, which forces him to alter the coordination of muscular tension; b) the athlete is unable to perform the snatch and the clean and jerk with the competition weight repeatedly because of the limit loading" [A.N. Vorbeyev, Tiiazhelaya Atletika, 1988. Translated by Andrew Charniga, Jr.).

So, the increasing weight of the barbell, the varying of muscular tension to perform the exercises commensurate with the altering weight of the barbell, and the difficulty of performing (practicing) the competition weights in the snatch and the clean and jerk with near maximum and maximum weights defines the extraordinary complexity of weightlifting.

Consequently, the high class weightlifter has achieved a high level of inter-muscular and intra-muscular coordination under difficult conditions.

Coordination is connected first and foremost with the ability to relax muscles. An aggressive approach to lifting maximum weights in weightlifting, where the creation of high muscular tension at high speed must be disciplined, unlike power lifting for instance, is not necessarily conducive to establishing and maintaining the most efficient motor coordination; which must be performed against a backdrop of muscle relaxation, very similar to that achieved by high class sprinters in track and field.

Therefore, according to our theory, the extra body heat facilitates the elastic recoil of strain energy from tendons, muscles, and ligaments. This extra heat accumulated as a result of the Chinese warm up can facilitate preservation of the optimum coordination structure of the exercises while providing the source of the extra force necessary to lift the increasing weight of the barbell.

The risk of disrupting motor coordination can be minimized with this "prolonged elevation of body heat" warm up because the athlete dispenses with a heightened state of psychological agitation and performs the exercise in a more relaxed state, i.e., the extra heat facilitates the extra effort required to lift bigger weights.

The reduction of blood and muscle viscosity athletes experience from what is considered a normal, relatively brief warm up of low to moderate intensity probably cannot stimulate the physiological enhancements which accompany a warm up protocol atypically large in volume and intensity.

The primary purpose of the warm up for any sport is to prepare the athlete physically and psychologically for optimum performance in the competition, which of course precludes exercising to the point of fatigue, or even close to it. However, the Chinese warm up, especially the final high intensity lifts which precede the maximum attempts on the platform, on the

SVETLANA PODOBODOVA (KAZ) WAITS BETWEEN WARM UP LIFTS AT THE 2009 WORLD WEIGHTLIFTING CHAMPIONSHIPS WITHOUT EXTRA MEANS TO PRESERVE BODY HEAT.

LI XUEYING (CHN) WAITS OUT OF BREATH BETWEEN WARM UP LIFTS AT THE 2009 WORLD WEIGHTLIFTING CHAMPIONSHIPS, WEARING THREE LAYERS OF CLOTHING FROM THE WAIST UP.

surface, would appear to be the antithesis of this notion.

The Chinese females perform each exercise so many times heat has to be the mechanism which facilitates elastic recoil of strain energy from the muscles, tendons, and ligaments, i.e., each preceding lift of pyramiding weights facilitates a retention of strain energy to perform more economically, the heavier weights which follow.

Consequently, the physical and psychological toll of all the work performed in the warm up is less than conventional logic would dictate. The lifter can approach the forthcoming maximum weight with the same relatively relaxed effort with weights for the final warm up; the accumulated heat is to the female weightlifter what aggressiveness is to the male in his approach to lifting maximum weights with an absence of actual aggressiveness.

We believe the female weightlifter who has performed this prolonged warm up has tapped into heretofore unrecognized, special biological reserves which facilitate the lifting of maximum weights, even though the athlete may still be winded and have accumulated an atypically high body heat as she approaches the near maximum and maximum weights on the competition platform.

HEAT

"... aggression in men is natural ... in women it is unnatural ... or if not unnatural, prohibited. Aggression is part and parcel of what distinguishes male from female" (Colette Dowling, 2000).

Consider for a moment the effort required to start a lawnmower (a two stroke engine) by pulling on a cord which provides the mechanical energy to start the engine. When the engine is cold, it may take several pulls with much effort to get the engine to turn over. However, if after the mower has been running for some minutes, it stops suddenly; then, if you try to restart it immediately in the usual manner, a single pull with minimal effort is all the mechanical energy needed to get it running.

This phenomenon can not only be attributed simply to a lower viscosity of the oil from running the engine. The heat of the engine accumulated, not totally dissipated, from running the machine has to have contributed to the less mechanical energy needed to restart it.

We believe this analogy explains why what would seem to be a large, ostensibly fatiguing warm up would allow a weightlifter to perform a maximum lift without maximum psychological excitation, i.e., without recruiting more mechanical energy from volitional muscular contraction.

The accumulated heat may contribute to a more effective release of strain energy accumulated in the viscera–elastic tissues, already an integral part of the performance of the weightlifting exercises but, nonetheless, facilitating further the volitional muscular effort required to lift the barbell.

So, based on this theory, an athlete who executes less warm up lifts needs more mechanical energy (more tugs of the cord on the lawn mower) and a more aggressive approach because there is less un - dissipated heat energy available. It is known that the mechanical efficiency of modern internal combustion engines is only about 25%. Approximately 60% of the energy generated from combustion of gasoline is lost through heat. About half from the exhaust and half from the engine (Ben Knight, (Scientific American 2:52:2010). So, 60% of the energy produced in the form of heat is lost.

The Chinese females go to unusual lengths to generate what would seem an unnecessarily high body heat through a large warm up loading. And, likewise, their atypical measures to preserve it under normal room temperature conditions lends practical credence to our theory that creation and retention of heat energy plays an assistant role in performing the weightlifting exercises with maximum weights.

We believe the Chinese warm up is more applicable to females. Pyramiding levels of aggressiveness accompany the rising weight of the barbell are typical of male weightlifters. This is usually absent with the female weightlifter. Our observations of many international level athletes, over the course of many years, has convinced us that more often than not females exert maximum effort in the absence of overt aggression, i.e., in a more relaxed state.

Lifting or otherwise exerting maximum force in a relaxed state offers distinct advantages.

The technically proficient weightlifter's muscles are used repeatedly over the course of raising a barbell from the floor to arms length overhead. These same muscles must switch at high speed back and forth from contraction to relaxation, while at the same time the muscles which are relaxing maintain some optimum tension; the weightlifter must instantaneously reverse direction of movement from up to down.

It is to the lifter's advantage to perform these actions against an overall backdrop of muscle relaxation so that unnecessary muscle tension will not impede speed of movement. This being the case, elevated body heat can theoretically play an assistant role.

ANOTHER WHY QUESTION

Another why question which has to be raised after all of this analysis is: why bother? Why would a weightlifter select to perform so much work in warm ups when the standard loading, modified upwards slightly by today's weightlifters of the past 50 years and more, can suffice? Weightlifters of both genders performed successfully at the 2009 World Weightlifting Championships warming up with the same or similar protocol employed by Vladimir Belayev (USSR) at the 1966 World Weightlifting Championships in East Berlin.

Part of the answer to this question should be obvious.

World and Olympic Champion Cao Lei placidly lifts 150 kg (two times bodyweight).

The Chinese women perform their atypical, in all of sport, warm up for weightlifting because they believe it works and has proven to be effective for reaching high results at competitions. The other part of the answer to this question may not be so obvious: should the rest of us in the weightlifting world abandon the old warm up protocols and adopt the Chinese exercise to the precipice of fatigue, high heat method?

References

1. Polyakov, V.A., "Individual – Psychological Features of Top Weightlifters at the Moscow Olympics", Weightlifting Yearbook, 68-72:1983, Livonia, Michigan, Sportivny Press. Translated by Andrew Charniga, Jr.

2. Polyakov, V.A., "Reliability of the Weightlifter's Performance in Competition", Moscow, Tiazhelaya Atletika 67-70:1977; Translated by Andrew Charniga, Jr. Sportivny Press©.

3. Genov, F. "The Length of the Weightlifter's Psychological Preparedness on the Platform Depending on the Increasing Weight of the Barbell", Moscow, Tribuna Masterov, 118 - 126:1969. Translated by Andrew Charniga, Jr. Sportivny Press©.

4. Roman, R.A., The Training of the Weightlifter, Moscow, FIS, 1968. Translated by Andrew Charniga, Jr. Sportivny Press©.

5. Vorobeyev, A.N., Tiiazhalaya Atletika Moscow, FIS, 72-74:1988. Translated by Andrew Charniga, Jr. Sportivny Press©.

6. Vorobeyev, A.N., Tiiazhalaya Atletika Moscow, FIS, 1977. Translated by Andrew Charniga, Jr. Sportivny Press©.

7. Khairullin, R., "Rational Structure of the Warm Up", Moscow, Olymp 17: 1993. Translated by Andrew Charniga, Jr. Sportivny Press©.

8. Khairullin, R., "The Championships unrealized potential", Moscow, Olymp 3-4:34-37:2002. Translated by Andrew Charniga, Jr. Sportivny Press©.

   The parameters of the warm up for the snatch:
   - The general warm up begins 17 to 33 minutes before the athlete is called to the competition platform;
   - The duration of the general warm up is two minutes;
   - The special warm up begins 11 to 32 minutes before the athlete is called to the platform;
   - The number of warm up sets for the snatch is 7 to 14;
   - The number of warm up lifts with the barbell is 8 to 22;
   - The rest period before the first attempt on the platform is 2 to 5 minutes;
   - The difference in weight between the final warm up lift and the first attempt is 7.5 to 25 kg.

   The parameters of the warm up for the clean and jerk:
   - The beginning of the special warm up for the clean and jerk begins 12 to 30 minutes before the athlete is called to the platform;
   - The number of warm up sets is 5 to 10;
   - The number of warm up lifts is 5 to 13;
   - The rest period before the first attempt on the platform is 2 to 5 minutes;
   - The difference in weight between the final warm up and the first attempt is 7.5 to 30 kg (in one case it was 42.5 to 50 kg).

9. Spasov, A. Tsarvulkov, A., "On Some problems Concerning the Structural Buildup of Warming Up for Highly Classified Weightlifters," Budapest, International Weightlifting Federation Coaching medical seminar in Varna, 1983; 126-134.

10. Spasov, A. Tsarvulkov, A., "Pre – Start Warm Up – An Essential Factor for High Performance," Budapest, Scientific Methodological Bulletin, International Weightlifting Federation, publishers; 3:17-20:1980. Comparison between warm-ups of 1965 European Championships. And 1979 {Alexander Zarvulkov, Angel Spasov, Scientific Methodical Bulletin, 03:17-20:1980, International Weightlifting Federation}

11. Dobrev, P.A., "Retrospective Analysis of the Tactical Preparation of the Weightlifter," Budapest, International Weightlifting Federation Coaching medical seminar in Varna, 1983; 102-125. "The realization of three good lifts in the

snatch and the clean and jerk with minimal increases of the weight is an objective criterion of the high level of the physical and technical Preparation and for a comparatively high psychological stability…. The last warm up weights in the snatch should be 7.5 to 12.5 kg below 1st attempt and 10 to 20 kg for c&J."

12. Medvedyev, A.S., "Training Load and Its Intensity and Structure of Volume with Female Lifters of Russia, PRC and Bulgaria at the Preparatory and Competition Periods," Proceedings of the Weightlifting Symposium, Olympia, Greece; 69 -81:1993 International Weightlifting Federation, Budapest, Hungary, publishers.

13. Verkhoshansky, Y.V., Fundamentals of the Special Physical Preparation of Ahtletes, Moscow: Fizkultura I Sport, 16:1988. Translated by Andrew Charniga, Jr., Sportivny Press©.

14. Suggs, T. "Behind the scenes", Strength and Health, 09:71:1968.

15. CAO, Wenyuan, "Training Difference Between Males and Females," Proceedings of the Weightlifting Symposium, Olympia, Greece; 97-101:1993 International Weightlifting Federation, Budapest, Hungary, publishers.

WHAT THE BUSINESS WORLD CAN TEACH A COACH ABOUT RESOURCE MANAGEMENT

Coaches often find themselves fighting for funding, facilities, and equipment, but what coaches should really treasure is their most valuable resource: time. In business, time is money, so project management professionals constantly track and analyze time for efficiency.

BY ANN SWISHER

In weightlifting, ensuring that time (e.g., training hours) and resources (e.g., reps) are allocated properly is the task of the coach, and doing it well is one of the keys to making your projects (e.g., athletes) successful. Unlike the business world where projects can take longer than expected and run over budget, the date of the Olympic Games, or your next big meet, will not move back a week if you made an error in planning. Coaches should consider learning resource allocation strategies from the business world to help them make the most of the limited time basis, athletes are limited by the time until the next meet and balancing the demands of training, work, and family. Plus, athletes only have the physical and mental energy to train for a small fraction of each day. Are you confident that you are optimally spending each minute of training working toward your short- and long-term goals?

To help answer this question, we can borrow an idea from project managers: a good exercise for coaches is to list all the training activities for the next day, week, or block of training and note the amount of time scheduled for each activity. te weightlifter who lifts twice per day. The coach lists lifting, massage/recovery, and mental training as the top three training priorities for the day. However, after examining the list, the coach discovers the time spent is not entirely reflective of those priorities. The highest prioritized training activities for the day differ appear to be lifting, warm-up, and mid-section work.

After analyzing the schedule for this day, the coach realizes that training time needs to be reallocated and used more effectively so that training does not take fi

they have to work with an athlete.

In the long term, coaches are fighting against the time until an athlete moves from junior to senior ranks or the time until an athlete's physical peak is over. In the short term, on a daily or weekly Does your time allocation reflect your training priorities and goals? Do you have enough time to fit in all the activities you would like to include? Let's look at an example of this type of analysis for an average Monday of training for an eli ve-and-a-half hours. The optimized version of Monday's workout eliminates very low-priority work such as competition tactics and medicine ball work. Other areas like warm-ups and lifting can be run more efficiently to cut down

Monday		
Training Activities	**Time in Minutes**	**% of total time**
Lifting	140	41%
Warm-up	35	11%
Mid-section	25	8%
Mental training	20	6%
Massage/recovery	20	6%
Pre-/post-training nutrition	20	6%
Stretching/flexibility	20	6%
Film review	15	5%
Box jumps/plyos	15	5%
Competition tactics	10	3%
Medicine ball	10	3%
Sprints	0	0%
Totals	**330**	**100%**

on overall time. The revised plan looks like this:

Monday		
Training Activities	**Time in Minutes**	**% of total time**
Lifting	120	50%
Massage/recovery	60	25%
Mental training	25	11%
Warm-up	15	6%
Pre-/post-training nutrition	10	4%
Film review	10	4%
Stretching/flexibility	0	0%
Mid-section	0	0%
Box jumps/plyos	0	0%
Competition tactics	0	0%
Sprints	0	0%
Medicine ball	0	0%
Totals	**240**	**100%**

Even though the total lifting time is reduced, the time spent lifting is a higher percentage of the total training time.

This revised training program does a much better job of allocating time and meeting the needs of the athlete, eliminating one-and-a-half hours from training.

Coaches doing this exercise for the first time are often surprised to see a large percentage of time spread across several low-priority items. Faced with a finite amount of training time, coaches first work to trim the low-priority items, but they also must look at their own efficiency when running a training session. Are you organized, on time, and well prepared to transition between activities? Do you give clear and concise instructions? Salvaging time does not always mean removing activities; it may also mean being more time-efficient across the board. Making better use of a few minutes per day may seem insignificant, but over the course of a season those minutes translate into hours of training time.

The simple exercise of allocating time for a day, a week, or a season can be very helpful for coaches, and this type of analysis can be as general or as detailed as you like. For example, you can also analyze the lifting portion of the training, breaking down the time or reps spent on each major lift. Quantifying and categorizing how training time is allocated is the first step to ensuring its efficient allocation.

Another beneficial use of this analysis and optimization of time is for athletes and coaches to sharpen training priorities together. Over the course of a coach-athlete relationship, there comes a time where the coach begins to include the athlete in training decisions and the relationship becomes more collaborative. When coaches and athletes independently prioritize training goals and collectively agree on the best training program, athletes may be more fully invested in their training. A fully invested athlete is more likely to make good use of his time in and out of training and to maximize effort put into each rep in the weight room.

Regularly examining the macro-level training plan and comparing it to the micro-level day-to-day and week-to-week training helps maximize the effectiveness of training time by keeping coaches on track and athletes engaged in the training process. Coaches invest a tremendous amount of time, energy, and expertise in their athletes. To maximize the return on your investment, you need to tightly monitor your resources with the same zeal as businesses by prioritizing and allocating training time effectively.

Editorial guidelines

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

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

EDITORIAL MISSION STATEMENT

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

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

Original research

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

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

Type of articles and their total length

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

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

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

GUIDELINES FOR THE PRESENTATION OF ORIGINAL RESEARCH WORK TO BE PUBLISHED

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

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

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

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

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

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

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

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

PREPARATION OF MANUSCRIPTS

1. Title page

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

Title page without the name of the Authors

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

3. Summary and Keywords

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

4. Text

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

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

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

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

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

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

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

5. Bibliography

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

6. Acknowledgements

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

7. Figures

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

Adobe Photoshop (.psd)

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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

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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

EL MITO DE LA FUERZA
Livio Toschi
SM (ing), n.º1, año I, abril-junio 2015, pp. 4-9

Desde los albores de la historia, el hombre ha disfrutado mostrando su fuerza en las pruebas más variadas y extravagantes. Cuando empezó la época de las competiciones deportivas, los hombres se percataron de que para destacar, debían entrenarse de forma metódica: para aumentar su fuerza practicaban ejercicios apropiados, uno de los cuales era naturalmente el levantamiento de pesas, utilizando diversos objetos como rocas, troncos y halteras.
Sansón, Atlas y especialmente Hércules son los símbolos más significativos del eterno mito de la fuerza. No obstante, cada época y lugar cuenta con hombres de inmenso vigor, como el imbatible luchador Milón de Crotona, que se enfrentó al legendario boyero Titormo en la que se considera la competición de levantamiento de pesas documentada más antigua.
El levantamiento de pesas es un deporte noble y antiguo cuyos orígenes se pierden en el fascinante halo del mito, de donde emergen poderosas figuras de dioses y héroes, gigantes y ciclopes, pero también de atletas y hombres de fuerza excepcional, que están entre la historia y la leyenda. Su renombre sigue vivo en la actualidad y perdurará porque el mito de la fuerza es eterno para la humanidad, mora en nuestras almas y es una inagotable fuente de inspiración para la literatura y la expresión artística de numerosos pueblos. Es una herencia cultural que el levantamiento de pesas ha de fomentar con creciente compromiso y pasión y cuyos beneficios serán sin duda cuantiosos.

ENERGÍA SOLAR Y FUERZA MUSCULAR
Menotti Calvani
SM (ing), n.º1, año I, abril-junio 2015, pp. 10-21

La disgresión del autor sobre la vitamina D y su función compleja y esencial en la vida del hombre fue extensa y apasionante: del raquitismo a los factores de la alimentación y la luz solar, las funciones de la vitamina D y su peculiar característica de ser una hormona capaz de regular (en la unión de la vitamina D y su receptor) más de 1.000 genes e influir en actividades como la inmunidad, la inflamación, el metabolismo del calcio y de la glucosa, la proliferación celular y el trofismo del sistema nervioso y del músculo. El autor aborda también la función de esta hormona especial en el rendimiento deportivo y en el mantenimiento de la homeostasis general del organismo.

ANÁLISIS CINEMÁTICO DE LA TÉCNICA DE ARRANCADA REALIZADO EN LEVANTADORAS DE PESAS DE ALTO NIVEL DURANTE EL CAMPEONATO MUNDIAL DE HALTEROFILIA DE 2010
Hasan Akkus
SM (ing), n.º1, año I, abril-junio 2015, pp. 22-35

El objetivo de este estudio fue determinar el trabajo mecánico, la producción de fuerza, el movimiento angular de la extremidad inferior y el movimiento lineal de la barra en el primer y el segundo tirón de la arrancada durante la competición femenina en el Campeonato Mundial de Halterofilia de 2010 (competición de calificación olímpica), y de comparar las actuaciones de arrancada de las levantadoras de pesas con las documentadas en la bibliografía especializada. Se analizaron los ejercicios de arrancada que se completaron con las cargas más pesadas de siete deportistas ganadoras de medallas de oro. Se grabaron las arrancadas con dos cámaras Super-Video Home System (50 imágenes/s) y se digitalizaron manualmente los puntos del cuerpo y de la barra mediante el Ariel Performance Analysis System. Los resultados indican que la duración del tirón inicial fue sensiblemente mayor de la duración en la fase de transición, en el segundo tirón y en el encaje bajo la barra ($p < 0,05$). Las velocidades máximas de distensión de la extremidad inferior en el segundo tirón fueron notablemente mayores de las velocidades máximas de distensión en el primer tirón. Las distensiones más rápidas se observaron a la altura de la rodilla durante el primer tirón y de la pelvis durante el segundo tirón ($p < 0,05$). Las trayectorias de la barra para las arrancadas más pesadas de estas deportistas de alto nivel fueron parecidas a las de los hombres. La velocidad máxima vertical de la barra fue mayor en el segundo tirón que en el primero ($p < 0,05$). El trabajo mecánico realizado en el primer tirón fue mayor que en el segundo, mientras que la fuerza producida en el segundo tirón fue mayor que en el primero ($p < 0,05$). A pesar de que las amplitudes de los movimientos lineales de la barra, los movimientos angulares de la extremidad inferior y otras características de expresión de la energía no reflejaron con precisión las documentadas en la bibliografía, el esquema de la arrancada de las levantadoras de pesas de alto nivel fue parecido al de los hombres.

LOS EFECTOS DE LA INTENSIDAD DE ENTRENAMIENTO Y DE LA COMPETICIÓN EN LAS CONCENTRACIONES DE CORTISOL EN LA SALIVA DE LOS DEPORTISTAS QUE PRACTICAN EL LEVANTAMIENTO DE PESAS OLÍMPICO
Blair T. Crewther, Taati Here y Justin W. L. Keogh
SM (ing), n.º1, año I, abril-junio 2015, pp. 36-45

En este estudio se han examinado los efectos de la intensidad de entrenamiento y de la competición en las concentraciones de cortisol en la saliva (Salivary Cortisol, Sal-C) de los deportistas que practican el levantamiento de pesas olímpico. Los levantadores de pesas de sexo masculino ($n = 5$) y femenino ($n = 4$) proporcionaron muestras de saliva durante un estudio de cinco semanas de duración. El primer objetivo fue evaluar los efectos semanales de una intensidad de entrenamiento elevada (≥ 200 series) y baja (≥ 100 series) en el Sal-C. El segundo objetivo fue comparar las concentraciones de Sal-C y la ejecución de una repetición máxima (1RM) durante dos competiciones simuladas y dos competiciones reales. Se evaluó el rendimiento utilizando las técnicas de arrancada (snatch) y de dos tiempos (clean and jerk) y el levantamiento olímpico completo. Los datos obtenidos en cada situación competitiva se asociaron antes del análisis. No se produjeron cambios semanales significativos en las concentraciones de Sal-C ($p < 0,05$).
Las competiciones reales produjeron concentraciones de Sal-C más elevadas (128-130 %) ($p < 0,001$) y levantamientos de 1RM superiores (1,9-2,6 %) para la técnica de dos tiempos y el levantamiento olímpico completo, en comparación con las competiciones simuladas ($p < 0,05$). Las concentraciones de Sal-C antes de las competiciones simuladas resultaron ser directamente proporcionales a todos los levantamientos de 1RM ($r = 0,48$-$0,49$; $p < 0,05$). En conclusión, las competiciones reales produjeron respuestas de Sal-C mayores que las competiciones simuladas, lo cual parece ser una ventaja para la ejecución de 1RM de los deportistas que practican el levantamiento olímpico. Asimismo, los deportistas con concentraciones de Sal-C más elevadas tendían a realizar levantamientos de 1RM superiores durante las competiciones simuladas. En vista de estos resultados, debería concederse más importancia al seguimiento del cortisol (C) para establecer valores normativos, normas de entrenamiento y para ayudar a hacer previsiones de las ejecuciones.

LA RODILLA EN LA PRÁCTICA DE LA HALTEROFILIA
Antonio Urso y Nicola Voglino
SM (ing), n.º1, año I, abril-junio 2015, pp. 46-55
Los autores exponen de manera fácil la anatomía de la articulación de la rodilla, su fisiología y biomecánica, y ponen en relación los temas tratados con la práctica de la halterofilia, puesto que es una especialidad que puede someter a dicho complejo articular a un gran esfuerzo. Al contrario de lo que podría imaginarse, la práctica de la halterofilia no parece ser traumatizante para esta articulación, incluso a niveles altos y altísimos, ya sea en hombres o en mujeres.

LA FIABILIDAD EN LA ACTIVIDAD COMPETITIVA Y LOS PROTOCOLOS DE CALENTAMIENTO DE LAS MEJORES LEVANTADORAS DE PESAS. NUEVO MÉTODO
Andrew Jr. Charniga, Petr Poletaev y Rustem Khairullin
SM (ing), n.º1, año I, abril-junio 2015, pp. 56-71

Los autores definen lo que se da en llamar "fiabilidad en la actividad competitiva de los deportistas", esto es, la capacidad de competir con eficacia y un rendimiento estable, y a continuación analizan, presentando un amplio conjunto de observaciones, los protocolos de calentamiento de las mejores levantadoras de pesas del ámbito internacional. Se concentran en las diferencias de género existentes en el calentamiento previo a la competición y describen las características, los beneficios y las diferencias de otros métodos del sistema de calentamiento adoptado por las deportistas de China.

QUÉ PUEDE ENSEÑAR EL MUNDO DE LOS NEGOCIOS A UN ENTRENADOR EN MATERIA DE GESTIÓN DE LOS RECURSOS
Ann Swisher
SM (ing), n.º1, año I, abril-junio 2015, pp. 56-71

Con frecuencia, los entrenadores han de luchar por encontrar fondos, instalaciones y equipamiento, pero lo que deberían valorar en realidad es su recurso más preciado: el tiempo. En el mundo de los negocios, el tiempo es dinero y, en consecuencia, los profesionales de la gestión de proyectos controlan y analizan constantemente el tiempo para aumentar la eficiencia.


ZIEL
155
SWEDEN

Russian

МИФ СИЛЫ

Livio Toschi

С незапамятных времен люди старались демонстрировать свою силу в самых различных и экстравагантных ситуациях. С началом эпохи рождения спорта, человек понял что для того чтобы добиться успеха надо методично тренироваться: для развития силы начали выполнять специальные упражнения. Естественно что одно из этих упражнений было поднятие тяжестей, используя различные объекты (камни, брёвна, штанги). Самсон, Атлант и особенно Гекулес являются наиболее известными символами вечного мифа силы. Каждая эпоха и каждый народ имеют примеры людей огромной сылы: непобедимый борец Милон из Кротоны бросивший вызов легендарному пастуху Титрому в самом старейшем документированом соревновании по тяжёлой атлетике. Тяжёлая атлетика это благородный и старейший вид спорта; его рождение имеет очарование мифа который дает жизнь мощным фигурам борцов, героев, гигантов и циклопов, а так же спортсменов и людей исключительной силы, чья жизнь находится между историей и легендой. Их слава жива до сих пор и будет жить вечно потому что миф силы вечен для человечества; миф силы живет губоко в сердцах людей и представляет собой бесконечный источник вдохновления для литературы и искусства многих народов. Тяжёлая атлетика должна пропагандировать, с большой привеженностью и страстью, это культурное наследие плоды которого несомненно будут изобильными.

СОЛНЕЧНАЯ ЭНЕГИЯ И МЫШЕЧНАЯ СИЛА

Menotti Calvani

Автор начинет свою статью с очень интересного и глубокого экскурса о витамине Д и о его важной роли в жизни человека: начиная от рахита до таких факторов как диета и солнечный свет, как роль витамина Д и его особенная фунгкция гормона, который в состоянии регулировать (в сочетании с витамином Д-рецептором) более 1000 генов и воздействовать на иммунитет, на воспалительные процессы, на метаболизм кальция и глюкозы, на пролиферацию клеток и на трофизм нервной и мышечной систем. Кроме того Автор обсуждает роль этого особенного гормона для достижении спортивных ризультатов и для поддержании гомеостаза организма.

КИНЕМАТИЧЕСКИЙ АНАЛИЗ УПРАЖНЕНИЯ «РЫВОК» У ТЯЖЁЛОАТЛЕТОК ВЫСОКОГО УРОВНЯ ВО ВРЕМЯ ЧЕМПИОНАТА МИРА ПО ТЯЖЁЛОЙ АТЛЕТИКЕ

Hasan Akkus

Целью данного исследования было определить механическую работу, силу, угловые кинематические характеристики нижних конечностей и линейные кинематические характеристики штанги в первой и во второй тяге упражнения «рывок» во время Чемпионата Мира по тяжёлой атлетике (женщины) 2010 года (квалификационные сорквнования на олимпиаду) и сравнить результаты выступления тяжёлоатлеток в рывке с данными специализированной литературы. Были проанализированы успешные выполнения упражнения «рывок» с очень высокими весами у 7 спортсменок завоевавших золотые медали. Упражнения регистрировались двумя телекамерами «Super-Video Home System» (50 изображений в секунду); точки на теле спортсмена и на штанге были зацифрированы вручную с помощью «Ariel Performance Analysis System». Результаты демонстрируют что длительность начальной тяги была значительно выше чем длительность переходной фазы, второй тяги и фазы стабилизации под штангой ($p<0.05$).

Максимальная скорость разгибания нижней конечности во второй тяге была значительно выше по сравнению с первой тягой. Самая высокая скорость разгибания была отмечена на уровне колена во время первой тяги и на уровне таза во время второй тяги ($p<0.05$). У спортсменок высокого уровня траектории штанги в упражнениях с наибольшими весами были похожими на траектории штанги у тяжёлоатлетов мужчин. Максимальная вертикальная скорость штанги была выше во второй тяге по сравнению с первой ($p<0.05$). Механическая работа в первой тяге была выше чем во второй, а сила проявленная во второй тяге была выше чем в первой ($p<0.05$). Даже если параметры линейных кинематических характеристик штанги, угловых кинематических характеристик нижней конечности и других характеристик проявления энергии не соответствуют в точности данным описанным в специальной литературе, схема упражнения рывка у спортсменок высокого уровня была аналогична схеме спортсменов мужчин.

ЭФФЕКТ ОБЪЕМА ТРЕНИРОВОЧНОЙ И СОРЕВНОВАТЕЛЬНОЙ НАГРУЗКИ НА КОНЦЕНТРАЦИЮ КОРТИЗОЛА В СЛЮНЕ СПОРТСМЕНОВ ВЫПОЛНЯЮЩИХ ОЛИМПИЙСКИЕ УПРАЖНЕНИЯ ТЯЖЁЛОЙ АТЛЕТИКИ

Blair T. Crewther, Taati Here e Justin W. L. Keogh

Это исследование изучило результаты воздействия объема тренировочных и соревновательных нагрузок на концентрацию кортизола в слюне (Salivary Cortisol, Sal-C) спортсменов выполняющих олимпийские упражнения тяжёлой атлетики. У тяжёлоатлетов (мужчины: 5; женщины: 4) брались анализы слюны в течении 5 недель. Первая цель исследования: анализ недельного эффекта большого объема тренировочной нагрузки (200 серий) и низкого объема тренировочной нагрузки (100 серий) на Sal-C. Вторая цель исследования: сравнение концентрации Sal-C и результата выполнения 1Rm (максимальное повторение) во время соревнований (2-х симулируемых (моделлированных) соревнований и 2-х реальных соревнований). Результаты были оценены на основе анализа следующих упражнений: рывок (snatch), толчок (clean and jerk) и комплексное олимпийское упражнение. Результаты полученные во время всех «соревновательных сценариях» были ассоциированы с результатами полученными перед экспериментом. Не были отмечены значительные недельные изменения в концентрации Sal-C ($p > 0,05$).

Во время реальных соревнований была отмечена более высокая концентрация Sal-C (128-130%) ($p <0,001$) и более высокий результат в максимальном повторении (1Rm) (1,9-2,6%) в рывке, в толчке и в комплексном олимпийском упражнении по сравнению с симулируемыми соревнованиями ($p < 0,05$). Отдельные результаты концентрации Sal-C перед симулируемыми соревнованиями были прямо пропорциональны результатам во всех максимальных повторениях 1Rm ($r = 0,48-0,49$, $p < 0,05$). В заключении отмечается что реальные соревнования оказали более высокий эффект на Sal-C по сравнению с симулируемыми соревнованиями. И это рассматривается как преимущество в выполнении 1Rm для спортсменов выполняющих олимпийское упражнение тяжёлой атлетики. Кроме того, участники эксперимента с более высокими концентрациями Sal-C демонстрировали тенденцию к достижению более высоких результатов в выполнении 1Rm во время симулируемых соревнований. На основе этих результатов можно сказать что необходимо уделять более высокое внимание мониторированию кортизола (С) для определения нормативных значений, тренировочных стандартов и для прогнозировании производительности.

КОЛЕННЫЙ СУСТАВ В ТЯЖЁЛОЙ АТЛЕТИКЕ

Antonio Urso, Nicola Voglino

Авторы демонстрируют, в интересной и простой форме, анатомию, физиологию, биомеханику коленного сустава, связывая эти аргументы с реальностью тяжёлой атлетики, поскольку этот вид спорта затрагивает значительным образом этот суставный комплекс. Вопреки тому что можно было представить, тяжёлая атлетика (даже элитного уровня) не провоцирует травмы этого сустава как у тяжёлоатлетов так и у тяжёлоатлеток.

«НАДЕЖНОСТЬ» СПОРТИВНОЙ ДЕЯТЕЛЬНОСТИ И ПРОТОКОЛЫ РАЗМИНКИ ТЯЖЁЛОАТЛЕТОК ВЫСОЧАЙШЕГО УРОВНЯ. НОВАЯ МЕТОДОЛОГИЯ

Andrew Jr. Charniga, Petr Poletaev, Rustem Khairullin

Под так называемой «надёжностью» соревновательной деятельности авторы понимают способность спортсменов эффективно участвовать в соревнованиях, показывая стабильные результаты. Далее авторы анализируют, представляя результаты обширной серии наблюдений, протоколы разминки спорсменок высочайшего международного уровня, сосредоточивая внимание на половых различиях во время предсоревновательной разминки, и описывая особенности, преимущества и различия этого вида разминки с другими видами разминки используемые китайскими спортсменами.

ЧЕМУ МИР БИЗНЕССА МОЖЕТ НАУЧИТЬ ТРЕНЕРА В ОБЛАСТИ УПРАВЛЕНИЯ РЕСУРСАМИ

Ann Swisher

Тренерам часто приходиться «бороться» за получение финансовых ресурсов, за спортивные помещения и тренировочное оборудование. Но тренеры должны реально оценить самый главный ресурс: время. В мире бизнеса, время это деньги. Поэтому специалисты в области прфессионального управления проектами должны постоянно анализировать и расчитывать время необходимое для их реализации.

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