Roots of Sports Medicine

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Summary

It is difficult to define Sports Medicine as it involves multiple aspects of health and various professionals, and because health care demands of sportsmen and people that exercise are very varied.
The origins of Sports Medicine as the oldest science that treats and prevents disease are described, as well as the use of exercise as a therapy, which is attributed to Herodicus, teacher of Hippocrates, and which is considered the very beginning of Sports Medicine. The ultimate expression of the origin of this discipline owes to Galen, who practices it as gladiator physician, who starts a fundamental aspect of Sports Medicine as multidisciplinarity and who practices the profession not only as a treatment of injuries, but also as instruction in the preparation of athletes.
Since then there has been an evolution in the development of this discipline through various doctors in later historical periods which can be considered as precursors of nowadays Sports Medicine, the first book written on the subject being prominent among them, *De arte gymnastica* by Bernardino Ramazzini in the seventeenth century.
The first article on exercise physiology, published in USA in 1855 by WH Byford in the *American Journal of the Medical Sciences,* is quoted, as well as the progress that took place at the beginning of the contemporary era.
The origin and characteristics of the most important international societies in Sports Medicine, such as the FIMS and EFSMA, are described. Relations between Sports Medicine and other sports sciences are pointed out, and finally the current situation of Sports Medicine in regards to training and recognition in Europe is described.

Key words:
Sports Medicine.
History of Medicine.
Training. Associations.

Orígenes (raíces) de la Medicina del Deporte

Resumen

La definición de la Medicina del Deporte resulta complicada porque implica múltiples facetas de la salud y diversos profesionales, y porque las demandas de atención médica por parte de los deportistas y personas que realizan actividad física son muy variadas.
Se describen los orígenes de la Medicina como ciencia más antigua que diagnostica, trata y previene la enfermedad, así como la utilización del ejercicio como terapia, que se atribuye a Heródico, maestro de Hipócrates, y que se considera como el inicio de la Medicina del Deporte. La máxima expresión del origen de esta disciplina se debe a Galeno que la ejerce como médico de gladiadores, que inicia un aspecto primordial de la Medicina del Deporte como es la multidisciplinaridad y que ejerce la profesión, no sólo como tratamiento de las lesiones, sino también en la instrucción de la preparación de los atletas.
Desde entonces se ha ido produciendo una evolución en el desarrollo de esta disciplina a través de diversos médicos en épocas históricas posteriores y que se pueden considerar como los precursores de la Medicina del Deporte actual, destacando el primer libro escrito sobre la materia, *De arte gymnastica,* por Bernardino Ramazzini en el siglo XVII.
Se cita el primer artículo sobre fisiología del ejercicio publicado en EEUU en 1855 por WH Byford en la revista *American Journal of the Medical Sciences,* así como los avances que se fueron sucediendo en los inicios de la era contemporánea.
Se describe el origen y características de las sociedades internacionales de mayor relevancia en Medicina del Deporte, como la FIMS y la EFSMA. Se destacan las relaciones de la Medicina del Deporte con otras ciencias del deporte para terminar con la descripción de la situación actual de la Medicina del Deporte en lo que se refiere a la formación y reconocimiento en Europa.

Palabras clave:
Medicina del Deporte.
Historia de la Medicina.
Formación. Sociedad.

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Introduction

Sports medicine has always been difficult to define because it does not involve just one area but a wide scope of health care of professionals and recreationally active individuals by providing them curative, rehabilitative and preventive medical services. Athletes and active individuals demand expertise and sport-specific knowledge varying from musculoskeletal problems to environmental stresses, from cardiological to dermatological, from endocrinological to psychological questions. Moral, legal and health related difficulties (such as doping) of the professional athlete pose a unique and complex picture to medical doctors. Finally, prevention is an area of increasing specialized interest, knowledge and expertise. Many believe that sports medicine will make its most significant contributions in the area of prevention. Participation in all forms of physical activity at all levels and its benefit to health and quality of life is quite clear.

There has been a growing need and therefore an interest in sports medicine among European countries over the last century due to increased participation in physical activities following many national projects promoting these programs. The aim of this article is to give an historical back ground of both medicine and science articulating them into sports medicine and sport sciences. Attempting to handle the roots of sports medicine requires firstly identifying the main stream of medicine. Furthermore, medicine is also a scientific discipline and needs to justify the relations with other areas, especially with sport sciences.

Historical roots of medicine and sports medicine

The question; HOW TO LIVE HEALTHY, is very old and crucial. The issue of living in health is somewhat directly related to diseases, diagnosis and treatment. Medicine is the oldest profession handled this problem and is considered as a science of diagnosing, treating and preventing diseases.

These fundamental practices date back to thousands years ago and primitive man has followed many natural folk ways till medicine was probably first institutionalized by Ancient Egyptians. The earliest known physician is an Egyptian, Imhotep (B.C.2980) and his name was given to a temple university in Men-Nefer (Memphis) where (so-called tha father of medicine) Hippocrates partly followed his school there. In those days, fertile soil of the River Nile used to be called as KE-METH and Ancient Egyptian physicians as SUNU or SWNW (pronounced sewnew). These were Kemetic (Egyptician) priest-magician-physicians or healers. The integration of the two terms; KE-MET SUNU is pronounced as MET-SWNW which is very close to the Latin term MEDICINA. KE sound is the article so not pronounced with MET and the term possibly be adopted by Ancient Greek Scholars and than transformed to Latin in time, as some authors indicate.

The evolution of medicine has shown a distinct characteristic which is based upon and entirely dependent on human health. For example, wrapping the corpse with linens for mummification has probably lead to taping and bandaging for fixation of broken and injured extremities in later years. Regarding medicine and exercise (more specifically sport), the first use of therapeutic exercise is credited to Herodicus, who is thought to have been one of Hippocrates' teachers.

Only after Ancient Greek physicians like Hippocrates and Galenos and also Islamic physician Avicenna (or Ibn-I Sina), medicine was dissociated from religion to a secular practice. These three pillars of modern medicine served this profession as documenting their observations and differentiating medicine from metaphysic. That's why, in English, PHYSICIAN refers to medical doctor who is studying the nature of what is a disease. In other words, physicians study the matter and energy in physical terms related to health and disorders.

If we come to the term "science", it is derived from Latin word "scientia" which means the knowledge of something. More spesifically, "scire" in Latin means to know, distinguish or seperate something from another, or scindere. Until the enlightenement, the word science meant any systematic or exact, recorded knowledge. Science, that time, had similar broad meaning that philosophy had. Philosophy was moral science and others were natural sciences. More recently, science has come to be restricted to "natural science" only, which is than broken down into physical and biological areas. In the meantime, social science is also included as soft science in the field of science because this uses the scientific methodology as well[1].

Here comes the question whether medicine is a scientific discipline or not? Try to remember, you might possibly have first visited a doctor as a child patient long time ago. This first contact is always regarded that medicine is a clinical practice only. However, as you are all very well aware, there is a heavy research component in clinical studies. Therefore, some medical scholars have emphasized that medicine is the art of healing which uses scientific methods. The term "doctor" in Latin is another word for explaining the physician and means teacher[2].

Until the 2nd century AD, when the first *"team doctor"*, Galen (131-201), was appointed as doctor of the gladiators in Pergamum Kingdom, the physician only became involved if there was an injury. Whether or not there was good communication between the trainer-coach and the team physician back then is a matter of speculation. What is clear however is that from its beginnings, sports medicine has been multidisciplinary with the obligation not only to treat injuries but also to instruct and prepare athletes[1].

Galenos recommends that; Take fresh air, get a good sleep, eat and drink properly, control emotions and empty bowel once a day!

He adds; "NO ACTIVITY IS EXERCISE UNLESS YOU BECOME BREATHLESS".

Of course, not only ancient Egyptian physicians, Hippocrates and Galen, but also some other physician names are also pronounced by several authors who have contributed to the development of sports medicine. Avicenna (Ibn-I Sina 980-1036), Gerolamo Mercuriale (1530-1606), Bernardino Ramazzini (1633-1714), August Bier (1861-1949) and Arlie V.Bock (1888-1984) were some of the names provided a basis for sports medicine by developing techniques to promote health and fitness and ensure the safety and well-being of everyone who participates in athletic competition[3].

Let's take a closer look at Avicenna's contributions to medicine. Avicenna is Persian, born in Buhara (980) and died in Hamedan (1037). He became a doctor at the age of 19 and wrote 450 articles out of which 240 are available today and 40 are related to medicine. His two famous

boks in medicine are *Kitabü'ş-Şifa* and *El-Kanun fi't-Tib*. El-Kanun fi't-Tıb (Law of Medicine) was the main textbook until 1650 in many European Medical Schools. Avicenna also classified sciences as

El-ilm ül-esfel	(natural sciences)
Mabad-üt-tabia	(metaphysic)
El-ilm'üll-âli	(logic)
El-ilm ül-evsat	(mathematics)

In the meantime, in India, written sources related to therapeutic exercises, so called Arthava Veda, were written around 8 centuries before Christ. Unfortunatelly, Westerners do know little about these rich cultural heritages. For example, Susruta (B.C. 600) who had lived well before Miken Civilisation left important information on the relationship between health and activity.

Bernardino Ramazzini's book De Arte Gymnastica is considered as the first comprehensive book explaining the human movements. He can be regarded as the father of work physiology[4]. Without mentioning the study of Santorio Santorius (1561-1636) who was a friend of Galileo and professor of medicine at Padua, we would lack the first research on human metabolism. He used an innovative mechanism for his research. He recorded changes in daily body temperature with the first air thermometer. He also measured pulse rates with Galileo's pulsilogium (pulsiometer). Ever inventive, Sanctorius studied digestion by constructing a wooden frame that supported a chair, bed, and work table. Suspended from the ceiling with scales, the frame recorded changes in weight. For thirty years, Sanctorius slept, ate, worked, and made love in the weighing contraption to record how much his weight changed as he ate, fasted, or excreted. He invented the term "insensible perspiration" to account for differences in body weight, because he believed that weight was gained or lost through the pores or during respiration. Often depriving himself of food and drink, Sanctorius determined that the daily change in body mass approached 1.25 kg. Santorius' book of aphorisms, De Medicina Statica Aphorismi (1614), drew worldwide attention. Although he did not explain the role of nutrition in weight gain or loss, Sanctorius nevertheless inspired later researchers in metabolism, especially during the eighteenth century.

Afterwards, a list several of other researchers can be given, although not directly worked on exercise however contributed largely on human physiology in general, like Galvani (muscular electrical potentials), Volta (1792 physiological tetanus), William Beaumont (1785-1853, Nutrition), James Lind (1716-1794, seamen's nutrition and immunity), Antoine Laurent Lavoisier (1743-1794, metabolism, nutrition and exercise physiology), Justus von Liebig (1803-1873, Proteins in exercise and strength), Claude Bernard (1813-1878, Homeostasis – metabolism during exercise), Edward Smith (1819-1874, Closed circuit spirometer), Emil du Bois Reymond (1818-96, Neuro muscular physiology), August Chaveau (1827-1917, Heat production during muscular work), Adolf Fick (1829-1901, Myotonograph), Russel Henry Chittenden (1856-1943, Low protein diet), Frederick Gowland Hopkins (1861-1947, Nobel Prize Experimental physiology) and Francis Gano Benedict (1870-1957, Metabolism and heat exchange during exercise on bicyle ergometer).

Italian physiologist Angelo Mosso (1846–1910) has a significant place in exercise physiology. At the first International Congress of Physiologists in Basel, Switzerland, the Mosso discussed his findings on muscular fatigue while demonstrating the functioning of an ergograph (work recorder). After receiving his degree in Medicine and Surgery from Turin, Italy, in 1870, Mosso was able to study and interact with renowned physiologists as Wilhelm Ludwig, Du Bois-Reymond, Hugo Kronecker, and Etienne Marey. By 1879, he was Professor of Physiology at the University in Turin, where he conducted research pertaining to blood circulation, respiration, physical education, high-altitude physiology, and muscular fatigue. Using tracings from the ergograph (concentric contractions of the flexor muscles of the middle finger that were volitionally or electrically stimulated), he was able to characterize muscle fatigue and to associate its occurrence with central or peripheral influences. He demonstrated that exercise would increase muscular strength and endurance while prolonging the occurrence of fatigue, which he postulated was a chemical process that involved the production of toxic substances such as carbonic acid. The phenomenon of contracture was described, and his collective studies led to the formulation of laws pertaining to exhaustion and to the 1891 publication of *La Fatica* (Fatigue). Besides *La Fatica,* Mosso will be remembered as a scientist with a love for physiology, a concern for the social welfare of his countrymen, and as one who sought to integrate physiological, philosophical, and psychological concepts in his experimental studies.

In the meantime, we need to have a look what is happening in North America, especially in the USA. First article on exercise physiology was published in 1855 in the USA (Byford, W.H. *On the physiology of exercise*. *Am J Med Sci*. 30:32-42, 1855). Dudley A. Sargent (1849-1924), Director of Hemenway Gymnasium at Harvard University 1879-1919, developed a system for physical examination including strength testing and anthropometric measures, designed individual exercise programs based on this data. Sargent Jump Test is still used today. Atwater and Bryant (1900) studied crew members from Harvard and Yale and found a diet of 15.6% protein, 40.7% fat, 44.2% carbos, ~4085 Kcal/day. The revival of the Modern Olympic Games in the 1890's and the formation of the International Olympic Committee (IOC) in 1894 may have stimulated some interest in exercise physiology and sports physiology.

In fact, in Europe, August Krogh (1874-1949) from Denmark, interested in science from an early age and wrote his first work with Christian Bohr who invented tonometer, collected data relevant to "Greenhouse Effect". Krogh and Bohr published a work in 1904 demonstrating that binding carbon dioxide decreases the affinity of hemoglobin for oxygen (thus promoting unloading of O2) "Bohr Effect". They demonstrated that oxygen passes from alveolus to capillary via passive diffusion in 1906. A.V. Hill and Otto Meyerhof shared 1922 Nobel Prize with their studies on "Muscle Glycolytic Metabolism"[5,6].

The first attempts to measure human gas metabolism while performing quantified physical work can be traced back to the year 1790. The developments in ergometery in the 19th and 20th centuries are well documented. Later on, Knipping and Brauer introduced the diagnosis of performance in 1929 in Germany. But the first ergospirometry apparatus that met all scientific requirements was introduced in 1950s[7].

Later on, back in the USA, The Harvard Fatigue Laboratory was established in 1927 as a part of the Business School of Harvard. Many people credit the Harvard Fatigue Laboratory (HFL) as the origin of exercise physiology in the United States. Director David Bruce Dill (DB Dill) was interested in environmental effects on exercise performance and among other things he studied the effects of altitude on exercise and thermoregulation during exercise. Dill was often a subject in his

own studies – including some unpleasant scenarios – like walking across the desert with a donkey and a dog. HFL was closed in 1947. Interest continued in exercise physiology during the second half of the 20th Century and the American Physiological Society began publishing the Journal of Applied Physiology (JAP) in 1948. This journal publishes high quality research in exercise physiology. Krebs and Lipmann won Nobel Prize 1953 with their study on Krebs Cycle and CoEnzyme A. Later on, we see the developments like; formation of The National Athletic Trainers Association (NATA) in 1950 and American College of Sports Medicine (ACSM) in 1954. ACSM started publishing Medicine and Science in Sports and Exercise in 1969. In 1955, Eisenhower established President's Council on Youth Fitness. In 1956, Hellenbrandt and Houtz defined VO2max testing. Bruno Balke introduced ACSM certification programs in 1970's. In 1980, American Association of Health, Physical Education, Recreation and Dance (AAHPERD) pushed a differentiation between youth "performance testing" vs. "fitness testing" – the latter stressing body composition, cardiorespiratory fitness and low back.

Due to greater demand on sport, science and medicine, these sectors have come to closer contact and cooperation in time and were introduced in a way as sports medicine and sport sciences.

The first world's sports medical establishment took shape in Dresden (Germany) in 1911. The first scientific meeting "First Congress for the scientific investigation of sports and physical exercises" was held in 1912 (Oberhof) and the term "sports physician=sportarzt" (Dr.A.Mallwitz) was first used in 1913. The first sports medical journal published by French Society of Sports Medicine (SMEPS) in 1922. The foundation of sports related medical societies followed these developments in sports medicine (in 1921 The Netherlands and in 1922 Switzerland). 33 physicians as delegates from 11 countries participating to the 2nd Winter Olympic Games in St.Moritz founded the "Association International Medico Sportive" (AIMS) in 1928 which then the name of the organization was changed into "Fédération Internationale de Médecine Sportive (FIMS)" in 1934. FIMS was prevalently a European organization until IOC recognized FIMS "as the designated competent international organization for biological and medical research to medicine and sport and medical care of athletes". FIMS later on was recognized by the World Health Organization (WHO) as a non-governmental organization (NGO) and by the International Council of Sports and Physical Education (ICSPE) in 1960[8,9].

Italian Sports Medicine Federation (FMSI) was founded in 1929. During the First Polish Sports Physicians' Congress (1937) in Worochta the Polish Sports Physicians Association was established, and the Finnish Society of Sports Medicine was founded in 1939. Charles University in Praha (founded in 1348 - Czech Republic) has the honour of establishing the first institute of sports medicine in a medical faculty by Dr.Jiri Kral (in 1945). Actually, long ago in Czechoslovakia, J.E.Purkyne (1850) has put forward the idea of favourable effect of body training for human health. Together with several important research topics, first wireless transmission of heart frequency and cardiological observations during sport events were all studied in this institute[10].

In addition to above mentioned countries, Scandinavian, Mediterranean and Balkan Countries have long sports medicine tradition.

After the 2nd World War, in 1958, the first School of Specialization in Sport Medicine was established in Italy, Milan by Prof. Margaria. Presently, Italy is one of the few countries in the world having a public system of health rules for sports activities. In Italy, people practising sports activities, organized by sports federations or sports promotion bodies have to undertake a periodical medical visit in order to obtain a certification of eligibity to sport. The requested screening tests and physical examinations are different according to the type of sport, and are listed in special decrees issued by the Ministry of Health which regulate on *competitive sport activity* (1982) and *not competitive sport activity* (1983), on *competitive sport activity for disabled people* (1993) and on *professional sport activity* (1995). Since 1950 it is mandatory to obtain a medical certification for eligibility to sport for all professional and amateur athletes. From 1971, the Government intended to safeguard the health of all those practicing sport activity at competitive and not competitive level with laws that, regularly updated, regulate preventive pre-participation screening in competitive and not competitive sports. Competitive athletes must undergo a yearly preventive screening protocol including a past medical history, clinical evaluation, urinalysis, EGC at rest and after step test, and pulmonary function tests. This evaluation can only be performed by physician board certified in Sports Medicine, who is legally responsible for the accuracy of this assessment, being the final judges for the eligibility to sport and its certification.

During the 9th European Congress of Sports Medicine (1997) organized under the patronage of FIMS and hosted by Portuguese Sports Medicine Society and Porto Sport Club. Participants and delegates from 40 nations formed the first council of delegates and established the European Federation of Sports Medicine Associations (EFSMA) recognized by FIMS. Presently, national associations from 39 countries are EFSMA members[11].

Sports medicine and sport sciences

This division between science and sport had two major consequences. First, even at the end of the century, at a time when sport was gaining mass popularity, there was very little scientific interest in boosting athletic performance. Second, athletes and their coaches showed little knowledge of or interest in contemporary science. Training techniques were thus explained according to "scientific" notions about the physiology of exercise that gave wide latitude to the idiosyncrasies of various practitioners. Even after 1870, as British physiologists began to catch up with their French and German counterparts, the term "scientific training" was used frequently to refer to the regimens devised by individual trainers who spoke in the most rudimentary scientific terms on the basis of personal observations. This ad hoc approach is evident in R.J. Lee's *Exercise and Training: Their Effects Upon Health* (London, 1873), which scarcely advances beyond the generalities of Sinclair dating from most of a century earlier. While maintaining that exercise is important for "the preservation of health and prevention of disease," Lee admits that physiologists had neglected training as a scientific problem. The founder of performance physiology in Germany, Nathan Zuntz, published on a whole series of topics relevant to the biology of the athlete: circulation, respiration, energy metabolism, nutrition, muscular work and altitude physiology. In 1899 his son, Leo Zuntz, published the first adequate study of the energy metabolism of the cyclist. During the 1920s the Nobel Prize-Winner muscle physiologist A.V. Hill published several essays on the connection between his research and high-performance athletics.

As it can clearly be seen, sport sciences have been in a way triggered by physiologists and physicians. This inevitably does not apply to some

other sport science disciplines like biomechanics. For example, the analysis of athletic movement was first made possible by the "chronophotography" invented by the great French physiologist Etienne-Jules Marey (1830-1904). As early as 1872, Marey's predecessor, the Anglo-American photographer Edward Muybridge, had photographed the horse in motion, and in 1879 Muybridge announced that he would toward apply this technique to "all the imaginable postures of athletes, horses, oxen, dogs and other animals in movement". Marey's chronophotography improved upon Muybridge's work by including the precise time intervals that separated these new and startling images of bodies and limbs frozen in time, thereby making human and animal motion both visible and comprehensible for the first time. In 1894, Marey stated his interest in producing instantaneous photographic images of "very strong and competent athletes," and at the 1900 Olympic Games in Paris he used chronophotography to reveal the secrets of the champions. The high-speed photographs and computer-generated stick-figures that enable biomechanics experts to assist runners and throwers today can be traced back to Marey's work. It can be pointed out that biomechanics has been initiated with the help of photographers.

Sports medicine is a discipline (a well-established profession having a long historical back ground) in health sciences whereas it can also be as regarded a scientific discipline in cooperation with sport sciences. Sport is a cultural phenomenon. Any related aspects (athlete himself or events happening) in sports are observed, measured, evaluated, analyzed and documented using techniques and methods by several scientific disciplines so-called sport(s) science(s). Coaching, as clinical medical practice, applies the information gained through studies in sport sciences. Both serve to the benefit of active people and professionals within two distinct perspectives, as one pushes the limits, the other scopes to protect the athlete's health within these limits[12].

Sports medicine education in the european countries

European Federation of Sports Medicine Associations and European Olympic Committees Medical and Scientific Commission have conducted a survey on the sports medical educational activities in European countries. The analysis of responded questionnaires has revealed the following information; 44 countries have replied the questionnaire. Presently, 24 European countries (Belarus, Bosnia&Herzegovina, Bulgaria, Czech Republic, Croatia, Finland, Georgia, The Nederland, Ireland, Italy, Latvia, Malta, Portugal, Poland, Romania, Russia, Serbia, Slovenia, Spain, San Marino, Turkey, FYR of Macedonia, United Kingdom and Ukraine) offer sports medicine specialisation. The specialisation period varies between 2 to 5 years. In general, Ministry of Health is the main authority approving specialisation in these countries. Another 13 countries (Andorra, Armenia, Austria, Azerbaican, Belgium, France, Germany, Hungary, Luxemburg, Monaco, Moldova, Slovakia and Switzerland) run subspeciality programmes. This means, in total, 37 countries carry out sports medicine education. The total number of sports medicine specialists in Europe is estimated around 30000. This shows a clear demand and interest for sports medicine education in most of the European countries.

UEMS and recognition of sports medicine in Europe

With regard to European Union (EU) countries, 15 countries (Bulgaria, Czech Republic, Finland, the Nederland, Ireland, Italy, Malta, Latvia, Portugal, Romania, Spain, Slovenia and United Kingdom) offer speciality and 7 (Austria, Belgium, France, Hungary, Slovakia, Luxembourg, Poland, and Germany) subspeciality programmes (22 in total). These figures seem to be very promising for future advancement of sports medicine scope in Europe not only with regard to elite athletes but also for the health promotion.

EUMS (European Union of Medical Specialities) Council convened in Munich on 21 and 22 October 2005 and agreed upon the creation of Multidisciplinary Joint Committee (MJC) on Sports Medicine. This important development will lead to establish a European Board of Sports Medicine in the future. Creation of Sports Medicine MJC in EUMS will also be encouraging to promote and harmonize sports medicine education in all European Countries and full recognization of sports medicine speciality by all medical authorities in member countries.

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