

The history of “Exercise Is Medicine” in ancient civilizations

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Tipton CM. The history of “Exercise Is Medicine” in ancient civilizations. *Adv Physiol Educ* 38: 109–117, 2014; doi:10.1152/advan.00136.2013.—In 2007, the American College of Sports Medicine, with endorsement from the American Medical Association and the Office of the Surgeon General, launched a global initiative to mobilize physicians, healthcare professionals and providers, and educators to promote exercise in their practice or activities to prevent, reduce, manage, or treat diseases that impact health and the quality of life in humans. Emerging from this initiative, termed Exercise Is Medicine, has been an extensively documented position stand by the American College of Sports Medicine that recommended healthy adults perform 150 min of moderate dynamic exercise per week. The purpose of this article is to demonstrate the foundation for this global initiative and its exercise prescription for health and disease prevention has roots that began in antiquity more than two millennia ago. Individuals and concepts to remember are that Susruta of India was the first “recorded” physician to prescribe moderate daily exercise, Hippocrates of Greece was the first “recorded” physician to provide a written exercise prescription for a patient suffering from consumption, and the global influence of Galen from Rome combined with his recommendation on the use of exercise for patients in the management of disease prevailed until the 16th century. Historically intertwined with these concepts was exercise being advocated by select physicians to minimize the health problems associated with obesity, diabetes, and inactivity.

antiquity of Exercise Is Medicine; ancient exercise prescriptions; contributions of Susruta, Hippocrates, and Galen to Exercise Is Medicine

ON NOVEMBER 5TH, 2007, the American College of Sports Medicine (ACSM), with support and endorsement from the American Medical Association and Office of the Surgeon General, launched a global initiative with the intent to mobilize physicians, healthcare professionals and providers, and educators to incorporate exercise in their practices or activities with humans to prevent, reduce, manage, or treat chronic diseases that impact health and the quality of life (7, 41). Of the chronic diseases, few have more importance or interest to the exercise science community than physical inactivity, which Blair has termed as the “biggest” public health problem of the 21st century (14). Since the formulation of the Exercise Is Medicine (EIM) initiative, ACSM has formed 11 new committees to implement the global initiative (63), published a documented position stand containing 407 references, and provided a universal recommendation that healthy adults secure 150 min of moderate dynamic physical activity per week (20). In addition, during this same time interval, PubMed listed, as of January 30, 2014, a total of 56,691 citations under the heading of EIM (41).

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However, the concept of EIM is not a 21st century original, as McKenzie, 95 yr ago, suggested such a relationship (39) and, in 1968, Peter Karpovich (31, p. 66) wrote:

... there is growing evidence on the preventive value of exercise, and it is possible that, in the not too distance future, physical education will become a part of medicine.

The intent of this article is to demonstrate that the foundation of EIM has roots from antiquity [antiquity ends with the death of Galen in 210 Common Era (CE) (3)] and to recognize physicians and philosophers who have contributed to EIM concepts. A secondary intent is to complete the historical record on the contributions from ancient civilizations to the emergence and acceptance of EIM. It must be acknowledged that aspects pertaining to exercise physiology have been previously discussed in historical articles (57, 58); however, their specific emphasis to and relevance for EIM are new and regarded as original contributions.

Before evaluating ancient information, readers must recognize that humans emerging from the caves of the Neolithic Age and migrating to the banks of the Indus, Nile, Tigrus, Euphrates, and Yellow Rivers, which preceded the establishment of Greek and Roman societies, possessed great fear and trepidation concerning the ravages of disease, which they attributed to spirits, demons, curses, and/or supernatural forces (57). Consequently, these ancient humans believed that these “evil spirits” had to be controlled, appeased, or driven away before recovery from disease could occur and health be restored. However, of the river civilizations, only those involving the Indus Valley and associated with the banks of the Yellow River made contributions to EIM (57).

Contributions From the Indus River Civilization

Archeological excavations conducted in the Indus Valley of India less than a century ago revealed the existence of an ancient civilization that was in existence as early as 3300 Before CE (BCE) (48). The excavations demonstrated the existence of a myriad of human diseases and structures that revealed a major concern for sanitation and public health. Around 2000 BCE, the Indus Valley was invaded by Aryans (Indo-Europeans) who established the Hindu culture and subsequently wrote their sacred texts and formulated the tridosa (tridhatu) doctrine or the Indian humoral theory (32, 57). The relevance and importance of one of the sacred texts and its 1,028 hymns [the Rig-Veda (1500 BCE) (64)] to EIM are that 1) disease and health were the result of actions by their gods and 2) ancient Hindus were aware of the existence and importance of humors before the establishment of city-states in Greece (57). In addition, the acceptance of the tridosa doctrine (1500–800 BCE) provided explanations for the meaning of life and death and the relationship between health and disease (32). The essence of the doctrine was that the human body contained three dosas (humors) known as vayu, pitta, and

kapha, with each having designated physiological functions (32). An important effect of the tridosha doctrine was that it removed the supernatural and importance of demons from the relationship between health and disease while establishing a foundation for the practice of medicine in ancient India. Implicit with the tridosha doctrine was 1) dosas controlled all functions of the body, 2) disease occurred when a dosa was dearranged or not in equilibrium with other dosas, and 3) health prevailed when the dosas were in equilibrium (57).

It is documented that during 600 BCE a physician named Susruta (Sushruta; Fig. 1) was a strong advocate of the tridosha doctrine who incorporated its concepts in his teaching of medicine and surgery at a university in Benares, India (24). Unknown is whether he considered exercise as a vital sign (49); however, it is known he was the first recorded physician to prescribe exercise for his patients and to indicate that "it should be taken every day" but taken "only to half extent of his capacity" as otherwise "it may prove fatal" (11, p. 486). In addition, before prescribing exercise, it was essential for the physician to consider the age, strength, physique, exercise terrain, and diet of the patient (11). Susruta advocated exercise because it made the body stout, strong, firm, compact, and light, enhanced the growth of limbs and muscles, improved digestion and complexion, prevented laziness (inactivity?), and reduced senility (11) while being "absolutely conducive to a better preservation of health" (10, p. 185).

Although Susruta stated that "diseases fly from the presence of a person habituated to regular physical exercise" (11, p.486), he was concerned that individuals who consumed too much food, slept too long, and remained sedentary while pampering their belly would become corpulent, a condition that he associated with a variety of diseases (10). Therefore, he wrote,

physical exercise should be included in the prescription for obesity (10, p. 137), ostensibly because activity contributed to the reduction of the kapha dosa (11, 46). Susruta regarded diabetes as a curable disease of the urinary tract (prameha) for which he prescribed diet and exercise. However, exercise was not prescribed for the noncurable form of diabetes known as mahu-meha (12). As noted above, Susruta was of the opinion that participation in excessive exercise, interpreted to mean strenuous or heavy physical activity, would cause multiple diseases and potentially lead to death (46). Consequently, he discouraged patients from active participation (Table 1).

Several centuries later, documents of the physician Caraka [Charaka (250–100 BCE)] made major contributions to the foundations of Ayurveda medicine (51, 52). Similar to Susruta, he believed that disruption of dosas caused diseases, whereas restoration of an equilibrium between them would enhance recovery and promote health (51). He advocated daily exercise because it alleviated dosas, especially kapha (51, p. 152), while endorsing the view of Susruta that training would have beneficial effects on the body. Although he prescribed moderate exercise for most diseases, strenuous exercise was advocated to "cure" diabetes (prameha; Table 1) (52, p. 312).

Contributions From the Yellow River Civilization

According to medical historians such as Gordon (23) and Lyons and Petrucelli (36), breathing exercises, regarded as medical gymnastics (16), were being practiced in China as early as 2600 BCE. During the era of the Yellow Emperor (1050–256 BCE), these exercises were used for subjects experiencing chills, fevers, or complete paralysis (60, p. 148). In addition, massage with exercise of the extremities was also being recommended. During this same time period, the yin-yang doctrine was prevalent, with yang being identified with life and health, whereas disease and death were associated with yin (60).

In the East Han Dynasty (25 BCE–250 CE), a Chinese physician and surgeon named Hua T’O (Fig. 2) prescribed exercise for his patients and followers because of its yang effect. He stated that (65, p. 54):

The body needs exercise only it must not be to the point of exhaustion for exercise expels the bad air in the system promotes free circulation of the blood and prevent sickness.

Hua T’O advocated activities (labeled as frolic exercises) that simulated the actions of deers, tigers, bears, cranes, and monkeys that not only supported his previous statements but also strengthened legs, provided a sense of lightness, enhanced appetite, delayed aging, removed disease, and promoted health (65). Like his counterparts in other civilizations, he had the belief that excessive exercise would lead to disease states (Table 1).

Contributions to EIM From Greece and Nearby Regions and an Overview

According to Lyons and Petrucelli (36), the history of Greek medicine can be classified into the following periods with the approximate starting dates:

Cretan-Mycenean	3000 BCE
Mythological	1500 BCE
Pre-Hippocratic (Philosopher-Scientist Era)	650 BCE
Hippocratic	460 BCE
Post-Hippocratic	370 BCE

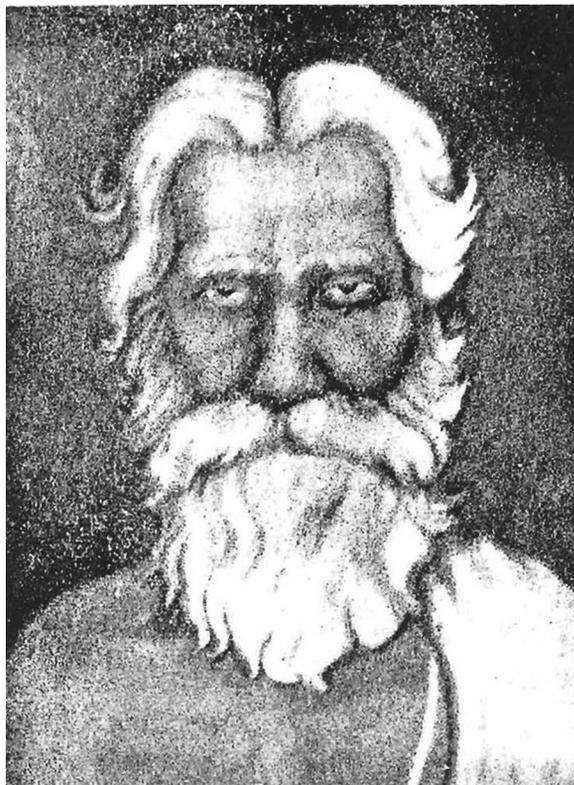


Fig. 1. Susruta [600 Before Common Era (BCE)] of India. He was the first physician to prescribe moderate daily exercise to his patients. [Image from Tipton (58).]

Table 1. Concepts from ancient civilizations or cultures that contributed to the emergence of Exercise Is Medicine

Civilization or Culture	Indus Civilization		Yellow River Civilization		Greece and its City-States		Roman Empire
	1500-800 BCE	700-100 BCE	2500-1100 BCE	1000-200 BCE	1250-550 BCE	550-258 BCE	
<i>Individuals of historical importance</i>	No evidence	Susruta, Caraka	No evidence	Hua T'O	Pythagoras; no one from Sparta	Herodotus, Hippocrates, Diocles, and Erasistratus	Celsus, Archagathus, Aesclepiades, and Galen
<i>Select ancient concepts that impacted the "Exercise Is Medicine" movement</i>	No evidence	No evidence	Yes	Yes	No evidence	No evidence	No evidence
Breathing exercises used to promote health	No evidence	No evidence	Suggestive evidence	Yes	No evidence	No evidence	No evidence
Exercise was advocated for its yang effect	No evidence	Yes	No evidence	No evidence	No evidence	Yes	Yes, because Galen usually followed Hippocratic practices and beliefs
Physicians consider a patient's age, physical status, dietary habits, health status, etc. before prescribing exercise	No evidence	Yes	No evidence	No evidence	In Sparta, exercise was to be strenuous	Yes	Yes
Exercise should be performed daily and in moderation	No evidence	Yes	No evidence	No evidence for daily exercise; yes for purposes of moderation	No evidence	Yes	Possible
Evidence for written exercise prescriptions	No evidence	No evidence	No evidence	No evidence	No evidence	Yes	Uncertain about Galen's views
Believed strenuous exercise would result in disease and potential death	No evidence	Yes, but Caraka felt that strenuous exercise would cure diabetes	No evidence	Yes	No evidence	Yes	Uncertain about Galen's views
Prescribed exercise for obese subjects	No evidence	Yes	No evidence	No evidence	No evidence	Yes	Suggestive evidence
Inactivity was associated with the onset of disease	No evidence	Yes	No evidence	No evidence	No evidence	Suggestive evidence	No evidence
Prescribed exercise for diseases besides obesity and diabetes	No evidence	Yes	No evidence	No evidence	No evidence	Yes	Yes
Era an example of the "exercise paradox"	No evidence	Yes	No evidence	Yes	Yes, unlikely in Sparta	Unlikely in Athens; likely in rural areas	Uncertain in Rome; likely in rural areas
Training was advocated or prescribed for its effects on growth and development, strength/endurance of muscles, improved digestion, cardiovascular system changes, elevated temperature, reduced fatigue, and enhanced physical appearance	No evidence	Yes for most effects because they promoted health	No evidence	Yes for some effects because they promoted health while preventing effects associated with the aging process	Yes for most regions but uncertain in Sparta because the negative mental health effects were equal to the physical benefits on health	Yes for most effects because they promoted health	Yes for most effects because they promoted health

BCE, Before Common Era (CE).



Fig. 2. Hua T'O [100 Common Era (CE)] of China. He was an ancient surgeon who prescribed moderate exercise for its yang effect (enhanced health). He advocated exercises that mimicked the actions of deer, tigers, bears, monkeys, and birds that have been termed "animal frolics." [Image from Wong and Wu (65).]

It is a difficult task to integrate this specific information with archeological and historical evidence indicating ancient Greece as the site of the Minoan civilization (3000–1000 BCE), the Mycenaean civilization (1550–1050 BCE), a Classical Period (500–400 BCE) (57), and the establishment of numerous city-states (800–384 BCE) (44). However, to maintain a focus on the relationship between exercise and medicine, the subsequent topic headings will be followed.

Contributions from the Mycenaean Era and insights from Homer. During the latter part of the Minoan civilization, a single individual performed the functions of a priest-physician (44); however, during the early years of the Mycenaean Era, both "professions" attributed disease and illness to a punishment from one or more deities while seeking healing, recovery, and health from others (57). Specifically, Zeus was supreme and ruled Olympia, Athena was a daughter of Zeus who had select healing powers, Apollo was a son of Zeus who inflicted illness and death to men; Artemis was a daughter of Zeus who inflicted illness and death to women, and the demigod Asclepius became the physician god of healing. Asclepius' first daughter was named Hygeia and later became the goddess of health, whereas his second daughter was known as Panacea and became responsible for healing (57). The practice of medicine during this time was labeled by Gordon as religious medicine (23), whereas Singer referred to it as Homer's medicine (55).

According to Singer (55) and Elliott (17), physicians were held in "high esteem," with the profession being organized into

practitioners (healers) and surgeons. Of the two, the practitioners were the most respected (17). As mentioned in the *Illiad* by Homer, both were active in the Trojan war (fall of Troy: 1174 BCE), with Machaon and Podalirius (sons of Asclepius) serving as physicians (57). It should be noted that Machaon has been termed as the "father of surgery" (36), and the anatomic nomenclature used by Homer was similar to one mentioned by Hippocrates centuries later (23).

At the time of Homer (750 BCE), the practice of physical culture (exercise) was regarded by the citizens of Greece as a national duty, with gymnasiums being established for this purpose (17). Indeed, gymnasiums were available and in use long before members of the Asclepiades [guild of lay physicians (3)] practiced in temples (17). Homer revealed in his poems an admiration for the Greek athlete (17) and their propensity to schedule athletic completion as mentioned in the funeral games for Patroclus, in which warriors competed in chariot racing, boxing, wrestling, discus, spear throwing, and archery contests (57).

Finally, most historians agree that the end of the Mycenaean civilization occurred soon after the fall of Troy in 1174 BCE (43).

Contributions from the city-state of Sparta. The zenith of Sparta's influence was between 800 and 600 BCE, when an oligarchic form of government was in existence that suppressed sedition, required obedience to the state, and expected men to become warriors and women to be mothers of warriors, with all citizens being prepared for war at any time (40). Unlike other city-states, eugenics was practiced; birth was honored if healthy women produced warriors, as was death if a woman died in childbirth or a man died in combat. On the other hand, graves were left unmarked if either a woman or man died from other causes (43). If, for any reason, a male was judged to be unhealthy, unfit, or undesirable (handicapped, deformed, etc.) to become a future warrior, his life was terminated or he was left to die at the apothete (pit) of Mount Taygetus (23, 40). It is unclear from the text of Pomeroy whether the same fate occurred with female babies who were judged to be unfit mothers of warriors (43). At the age of seven, a Spartan male was "educated" to become a physically fit warrior who devoted the majority of his time performing endurance and strenuous exercises or participating in combative athletics or games (29, 40, 57). Not surprisingly, Aristophanes claimed that the Spartan citizen was "addicted to exercise" (37).

Included early within the education of a Spartan man was never to show fear when exposed to the dark and to learn to tolerate pain and injury without expressing emotions; they were expected to lie and steal but not to get caught and, if caught and flogged, not to cry (44). Although a Spartan warrior would never kill an enemy in flight or one who admitted defeat (44), it is unlikely he expressed any sympathy, empathy, or compassion for a wounded enemy. Furthermore, there is no historical evidence that Spartan citizens expressed any of these emotions or "feelings" toward injured athletes or nonathletes.

Spartan females were educated to be mothers of warriors, which necessitated consuming a "healthy" diet and regular participation in physical fitness activities and athletic events (including wrestling) (57). However, compared with other women, she was, according to Pomeroy, the most liberated of all women in Greece (43). This social status occurred because

1) other regions had a low regard for women and considered them as only chattels for men (44); 2) Spartan men were away from home for long periods because of military obligations, leaving women more responsibilities, which included managing, controlling, and owning property; 3) Spartan women had the opportunity to increase the wealth of the family by selling woven items; and 4) Sparta did not follow the Grecian practice of marriage at the age of 12 yr old, and thus a married Spartan woman was older and more mature when she assumed the responsibilities of the home. In addition, Pomeroy questions the validity of reports stating that nude females exercised with nude males solely for the purpose of being selected as a future mate (43).

Although Sparta demonstrated the value of a healthy and physically fit population for conditions of war, their culture exhibited little, if any, characteristics for the establishment of EIM. Hence, it is concluded that Sparta warranted no recognition for EIM becoming a national movement.

Contributions from the Philosopher-Scientist Era. One characteristic of the Minoan civilization was the formation of an extensive maritime fleet that established trade relationships with regions located within the Mediterranean and Aegean Seas (36). One result was the establishment of a port at Miletaus (situated on the Aegean west coast of Asia Minor) because it subsequently contained a school of philosophy that was founded by Thales (639–544 BCE). His disciples included Anaximander (611–547 BCE), Anaximenes (610–545 BCE), and Pythagoras (570–490 BCE). The first two individuals made no significant contributions to EIM; however, this was not the case for Pythagoras (Fig. 3). A former athlete, Pythagoras was the first individual or medical philosopher from ancient Greece to advocate daily exercise for health reasons. Besides being an excellent mathematician and astronomer, he established a school in Croton, Italy, to teach science and philosophy in accord with the mystical religious teachings of Orpheus (17, 23). His school was described as a “philosophical medical center” that served as a location for a religious cult in which he advised his followers to adhere to a regimen of diet, exercise, music, and meditation (61). He did not believe or teach that gods were responsible for disease; rather, disease and bodily ailments occurred because of a lack of harmony between the elements, qualities, and tendencies of the body. To restore harmony and to achieve a healthy state, a daily regimen was required, which included long walks, running, wrestling, discus throwing, and boxing (61).

Contributions from the Classical Period, the city-state of Athens, and the Post-Hippocratic Era. This time period includes the introduction and establishment of a democratic state, the subsequent defeat of the Persian army, the presence of the Golden Age of Greece, and Athens becoming the most important city-state of Greece (23, 36, 54, 55).

Herodotus (500 BCE), a former teacher of Hippocrates (54), was a physician who practiced dietetic medicine who later became recognized for his emphasis on the therapeutic effects of exercise (34). However, he became criticized by both Hippocrates and Plato for prescribing exercises they believed were too strenuous for his patients. Since he recently has been designated as the “father of sports medicine” (22), it is possible he devoted the majority of his time recommending exercise to aid recovery from athletic and gymnastic injuries.

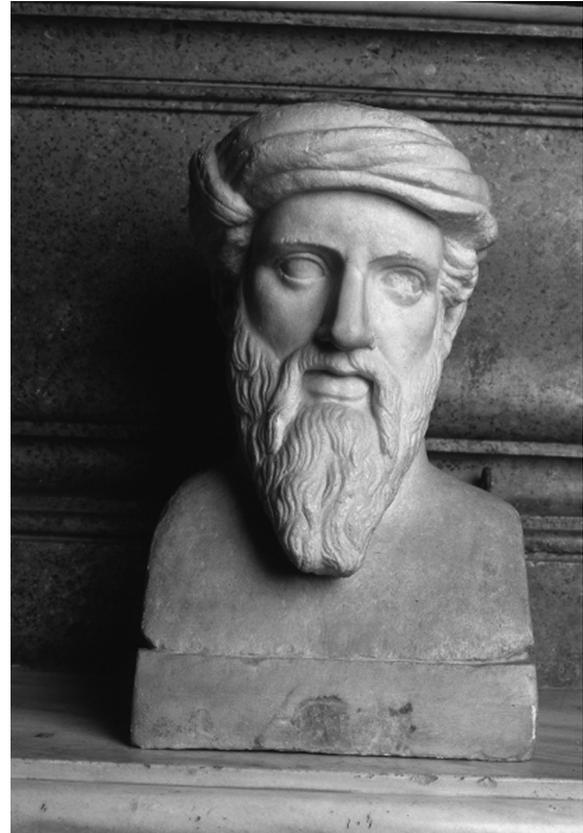


Fig. 3. Pythagoras (570–490 BCE) of Samos. He was a philosopher who established a school at Crotona whose followers were advised to exercise daily for health purposes. [Image supplied by and used with permission of Musei Capitolini (45).]

Sallis, the pioneer of the EIM movement, and Berryman, the exercise science historian, are commended for informing EIM advocates that Hippocrates (460–370 BCE; Fig. 4) wrote that “eating alone will not keep a man well, he must also take exercise” (7, 49). Hippocrates also stated that “. . . food and exercise, while possessing opposite qualities, yet work together to produce health” (26, p. 229). Although Hippocrates was not the first physician to prescribe exercise for patients, he was the first recorded physician to provide a written exercise prescription for a patient suffering from consumption. Specifically, in *Diseases III* and internal affections, Hippocrates provided a detailed written exercise prescription of walking for a patient with consumption (28). Thus, it is surprising that EIM advocates do not use this historical fact for physicians when promoting the clinical attributes of exercise.

Aristotle (384–322 BCE), regarded by Singer as the primary originator of the Greek humoral theory (55), proposed when an imbalance occurred between the four humors [phlegm, yellow bile, black bile, and blood (42)], disease and bodily disorders would follow. Hippocrates was a “strong supporter” of the humoral theory and likely the most prominent physician in Greece to include its tenets when prescribing a regimen that would reestablish an equilibrium between the humors that aided recovery and promoted health. In *Regimen II*, Hippocrates prescribed moderate exercise because it warmed, thinned, and purged away the humor (27). Furthermore, he believed idleness (inactivity), excessive exercise, and over-

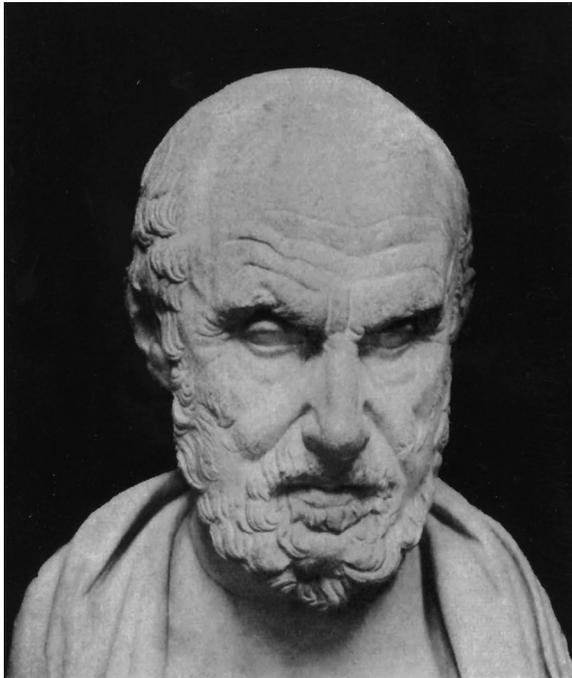


Fig. 4. Hippocrates (460–370 BCE) of Cos. He was the father of scientific medicine, who was the first physician to provide a written exercise prescription for a patient with the disease of consumption. [Image from Singer (55).]

powering food consumption (compared with exercise) could lead to disease. His discussion in *Regimen I*, on how food can overpower exercise, has 2014 EIM overtones. Thus, it is surprising that the current crusade against obesity has not invoked Hippocratic views in its efforts. In addition to reducing corpulence or “excess flesh,” Hippocrates believed that training would increase stature, bone mass, muscle mass, tone, and endurance, digestion, temperature regulation, and tolerance against fatigue (57).

Hippocrates deserves recognition for providing the centrality of exercise in EIM for the following statement in *Acute Diseases* (25, p. 62):

I say then, that this question [regimen] is a most excellent one and allied to many others, some of the most vital importance in the art [medicine], for that it can contribute much to the recovery of the sick, and to the preservation of health in case of those gymnastic[athletic] exercises, and is useful to whatever one wish to apply it.

One of Hippocrates’ disciples was the physician Diocles [375–300 BCE (1)], who believed that diseases were caused by an imbalance of humors and by the constituents of air while adhering to Hippocratic views concerning health (56). Although he wrote extensively on diseases, there are no writings that indicated exercise was included as a prescription for their treatment. On the other hand, he was an ardent supporter of daily moderate exercise for younger and older individuals. Not surprisingly, he also felt Herodicus’ exercise prescriptions were too strenuous for his patients (57). Diocles believed that diet, exercise, and baths were essential for healthful living and advised children to visit the gymnasium twice daily for its exercise benefits, whereas older individuals were encouraged to take moderate walks to aid digestion while avoiding long

and rapid walks because of the dangers of indigestion and stomach disorders (1, 59).

Similar to other medical historians, Rothschild labeled the physician Erasistratus in nearby Sicily (310–250 BCE) as the “father of physiology” for his physiological discoveries (47). Although Erasistratus’ views on the function of the body and causes of disease were markedly different from those of Susruta and Hippocrates, he prescribed a regimen that included moderate exercise, gymnastic activities, dieting, bathing, and limited medication (44).

Contributions From the Roman Empire and an Overview

Scarborough, writing on the history of Roman medicine, indicated ancient tribes in the hills of Rome around 950 BCE worshiped spirits that existed in animate and inanimate objects (50). Subsequently, they redirected their worship to gods and goddesses from Greece and used ceremonies to be free of disease, which they believed originated from the displeasure of the gods (50). They also designated health as being the domain and responsibility of Aesculapius (Asclepius) (17).

Although ancient Romans rapidly accepted the gods and goddesses of Greece, this was not the situation for medicine. According to Elliott (17), Pliny the Elder stated that while “The Roman people for more than 600 years were not without medicine, they were without physicians.” In most homes, the head of the household served as their physician, whereas in others it was slaves or foreigners. Elliott (17) mentioned that the first regular physician in Rome was Archagathus from Peloponesia, who began his practice in 219 BCE. The second physician from Greece was the Aselepiades (128–56 BCE) of Bithynia. Like Archagathus, Aselepiades prescribed exercise (walking) for patients suffering from consumption, dropsy, and hemiplegia (50, 57).

The physician Celsus (258 BCE–50 CE), also known as the “Latin Hippocrates” (23), was a recorder of Roman medicine and the author of *De Medicina*. He mentioned that in the 400 yr since Hippocrates, medicine had become a triad of emphasis between dietetics, pharmacology, and surgery, with dietetics becoming a composite of food and fluid consumption, exercise, bathing, and relaxation (15). During the era of Celsus, exercise was considered to be reading aloud, drill, walking, and running, but never to the degree of sweating or to the level of fatigue experienced by athletes (15). Both Baas (3) and Celsus stated humoral shifts and climatic changes as the primary causes of disease.

The most important physician of the Roman Empire for global medicine and the EIM initiative was a former physician of gladiators named Claudius Galenus or Galen (129–210 CE; Fig. 5). He is recognized because his influence on the use of exercise in the practice of medicine in Arabic and European countries lasted ~1,400 yr, or until the end of the Middle Ages (6, 62). His contributions to EIM have been mentioned in recent publications by Berryman (7, 8) and Sallis (49).

Galen was an admirer of Hippocrates and accepted the principle of humoral imbalance being the cause of disease. He also believed multiple factors contributed to disease and indicated there were nine different humoral mixtures or combinations that served as precursors for health disorders (53, p. 234). Factors that also could impact health and disease were 1) things consumed, 2) things being eliminated from the body, 3) things



Fig. 5. Claudius Galenus (129–210 CE) or Galen of Pergamon. He was a physician whose concepts influenced the practice of medicine, and especially the use of exercise in the practice of medicine, until the 16th century. He was renowned for his use of exercise to treat patients suffering from a variety of diseases. [Image from Longet (35).]

done as exercise, walking, riding, massage, sleep, etc., and 4) things happening from without (5, p. 14 and 15).

Emerging from deliberations on the relationships between health and disease, Galen developed his “medical theory,” which was formulated on the concept of “natural conditions” (53) or the “naturals” (4, 6, 7). As described by both Siegel (53) and Berryman (4, 6, 7), the theory included natural conditions (*kata physin*, healthy, and physiology¹), and non-natural conditions (*para physin*, diseased, and pathological¹). Identified with the non-natural conditions were 1) air, 2) motion and rest, 3) sleeping and waking, 4) that which was taken in, 5) that which was secreted, and 6) emotions and passions (4).

Germane to EIM and implicit within the medical theory were that natural conditions were responsible for either the occurrence of disease or the preservation of health and were dependent upon the ability of the body to maintain a “normal balance” between the constituents, especially between the non-naturals (4). To Galen, work and exercise were equivalent

terms, whereas motion had to be vigorous and cause labored breathing if it was to be designated as exercise. He classified exercise as being slow, swift, atony, vigorous, gentle, and violent; select examples are as follows: running was swift, lifting a heavy weight was vigorous, and continuous jumping was violent. However, if exercise was to be prescribed for health reasons, it was to be moderate (57). Of the exercises being mentioned, Galen’s favorite exercise comprised games in which a small ball was used. His views concerning the small ball were as follows (19, p. 302):

The form of exercise deserving our attention is therefore that which has the capacity to provide health of the body, harmony of the part, and virtue in the soul, and these things are true of the exercise with the small ball.

Galen believed that training would cause “thinning” of the body, harden and strengthen muscles, increase flesh (mass?), and elevate blood volume while achieving “good condition” of the wrestler or heroes like Hercules and Achilles in Homer’s epics (18, 19). Relevant to the EIM movement and consistent with the practice of select ancient physicians was Galen prescribing exercise for weakened patients or for those afflicted with disorders or diseases associated with arthritis, depression, dropsy, epilepsy, gout, tuberculosis, and vertigo (18, 19, 34, 38).

Concluding Remarks

The 21st century efforts of ACSM and the American Medical Association to maximize physical and mental health in American citizens by advocating more exercise in their daily lives have roots that began in antiquity. It is also likely true for the admirable goal of Dr. Robert Sallis (49) to have practicing physicians consider exercise as a vital sign when interacting with their patients. Although previous health educators defined health as “freedom from disease,” we know from medical historians that in ancient populations, this goal or hope was everpresent in their actions. Therefore, as medicine and therapy have progressed, we should not be surprised that ancient theories, doctrines, dogmas, or practices have emerged to explain the causes or consequences of disease. However, what is somewhat unexpected is that ancient physicians in agrarian societies prescribed moderate daily exercise to enhance health.²

Medical and exercise practitioners should realize >2.5 millennia ago, Susruta from the Indus Valley civilization was the first recorded physician to prescribe moderate daily exercise for this reason. They should also acknowledge Hippocrates being the first recorded physician to provide a written exercise prescription for a patient with a disease (consumption). Finally, because of the influence of Galen, exercise was advocated for health reasons and to minimize the consequences of disease until the beginning of the 16th century.

As shown in Table 1, the antiquity roots of EIM effectively demonstrate that ancient physicians and philosophers believed that regular exercise (training) would produce physiological changes that enhanced health. It is noteworthy that ancient physicians were against prescribing strenuous or excessive

¹ Physiology and pathological were terms used by Berryman.

² Defined as the “exercise paradox” in a 2010 American Physiological Society symposium by C. M. Tipton and J. W. Berryman.

exercise because they believed it would lead to illness, disease, or death. An exception was Caraka from India, who stated that strenuous exercise was necessary to "cure" diabetes.

The most significant and relevant antiquity roots were those pertaining to disease. A century or more before the non-naturals of Galen were proposed, physicians from India and Greece recognized that within the triad of inactivity, obesity, and diabetes, each had the potential to become a disease. It is of historical interest that ancient physicians in these locations included exercise in regimens that were prescribed to manage, minimize, or treat the effects of these diseases. As previously emphasized, it was during Galen's era that exercise was prescribed for multiple diseases.

Any attempt by historians to acknowledge Sparta's militaristic emphasis on fitness for men or its liberal treatment of women as contributions to EIM missions should be challenged, because any society that endorses eugenics, ignores the fears of children, is indifferent to the pain and suffering of its citizens, supports the death of disfigured, deformed, and unfit babies, or lacks the sympathy and compassion indicated in the modern oath of Hippocrates (33) warrants no recognition.

Finally, advocates of EIM should realize they have given credibility to the adage "what is old is new again."

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AUTHOR CONTRIBUTIONS

Author contributions: C.M.T. conception and design of research; C.M.T. analyzed data; C.M.T. interpreted results of experiments; C.M.T. prepared figures; C.M.T. drafted manuscript; C.M.T. edited and revised manuscript; C.M.T. approved final version of manuscript.

REFERENCES

- Allbutt TC. *Greek Medicine in Rome*. New York: Benjamin Bloom, 1921.
- Amoit JM. *Memoires concernant l'histoire les sciences, les arts, les moeurs, les usages etc, des Chinois, par les missionnaires de Pekin*. Paris: Saint-Jean-de-Beauvais vis-a'-vis le College, 1779, vol. 4, p. 451–452.
- Baas JH. *Outlines of the History of Medicine and the Medical Profession*. Huntington, NY: Krieger, 1971.
- Berryman JW. The tradition of "six things non-natural": exercise and medicine. From Hippocrates through ante-bellum America. *Exerc Sport Sci Rev* 17: 515–559, 1989.
- Berryman JW. Exercise and the medial tradition from Hippocrates through antebellum America. In: *Sport and Exercise Science*, edited by Berryman JW, Park RJ. Chicago: Univ. of Illinois Press, 1992, p. 14–15.
- Berryman JW. Ancient and early influences. In: *People and Ideas: Exercise Physiology*, edited by Tipton CM. Oxford: Oxford Univ. Press, 2003, p. 1–38.
- Berryman JW. Exercise is medicine: a historical perspective. *Curr Sport Med Rep* 9: 195–201, 2010.
- Berryman JW. The art of medicine, motion and rest: Galen on exercise and Health. *Lancet* 380: 210–211, 2010.
- Bhatia SL. *A History of Medicine With Special Reference to the Orient*. New Delhi: Office of the Medical Council of India, 1977.
- Bhishagrata KK. *The Sushruta Samhita*. Varnasi, India: Chowkhamba Sanskrit Series Series Office, 1963, vol. 1.
- Bhishagrata KK. *The Sushruta Samhita*. Varnasi, India: Chowkhamba Sanskrit Series Series Office, 1963, vol. 2.
- Bhishagrata KK. *The Sushruta Samhita*. Varnasi, India: Chowkhamba Sanskrit Series Series Office, 1963, vol. 3.
- Biers WR. *The Archaeology of Greece: an Introduction*. Ithaca, NY: Cornell Univ. Press, 1980.
- Blair SN. Physical inactivity: the biggest public health problem of the 21st century. *Br J Sports Med* 43: 1–2, 2009.
- Celsus DA. *De Medicina*, translated by Spenser WG. Cambridge, MA: Harvard Univ. Press, 1935, books, I–IV.
- Chancerel PG. *Historique de les Gymnastique Medicale. These pour le Doctorat en Medecine*. Paris: Faculte' de Medecine, 1864, p. 1–73.
- Elliott JS. *History of Greek and Roman Medicine*. Boston, MA: Milford House, 1971.
- Galen. *Galen' Hygiene (De Sanitate Trendera)*, translated by Green RM. New York: Oxford Unive. Press, 1997.
- Galen. *Galen: Selected Works*, translated by Singer PN. New York: Oxford Univ. Press, 1997.
- Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lee IM, Nieman DC, Swain DP. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Med Sci Sports Exerc* 43: 1334–1359, 2011.
- Garrison FH. *An Introduction to the History of Medicine* (2nd ed.). Philadelphia, PA: Saunders, 1922.
- Georgoulis AD, Kiapidou IS, Velogianni L, Sterigiou N, Boland A. Herodicus, the father of sports medicine. *Knee Surg Sports Traumatol Arthrosc* 15: 315–318, 1997.
- Gordon BL. *Medicine Throughout Antiquity*. Philadelphia, PA: Davis, 1949.
- Hauben DJ. Sushruta Samhita (Sushruta's collection) (800–600 BC?). *Acta Chir Plast* 28: 65–68, 1984.
- Hippocrates. *The Genuine Works of Hippocrates*, translated by Adams F. Baltimore, MD: Williams & Wilkins, 1939.
- Hippocrates. *Hippocrates*, translated by Jones WHS. London: William Heinemann, 1923, vol. 1.
- Hippocrates. *Hippocrates*, translated by Jones WHS. London: William Heinemann, 1923, vol. 4.
- Hippocrates. *Hippocrates*, translated by Potter P. Cambridge, MA: Harvard Univ. Press, 1988, vol. 6.
- Hooker JT. *Ancient Spartans*. London: Dent, 1980.
- Jackson R. *Doctors and Diseases in the Roman Empire*. Norman, OK: Univ. of Oklahoma Press, 1988.
- Karpovich PV. Exercise in medicine: a review. *Arch Phys Med Rehabil* 49: 66–76, 1968.
- Kutambiah P. *Ancient Indian Medicine-Orient*. Mdras: Longmans, 1962.
- Lasagna L. *Medicine Net.Com. Definition of Hippocratic Oath. A Modern Version of the Hippocratic Oath* (online). <http://www.medterms.com/script/main/art.asp?articlekey=20909> [10 March 2014].
- Light S. *Therapeutic Exercise* (2nd ed.). New Haven, CT: Elizabeth Light, 1965.
- Longet FA. *Anatomie et Physiologie du Systeme Nerveux de l'Homme et des Animaux Vertebres*. Paris: Fortin, Masson et Cie, 1842, vol. 2.
- Lyons AS, Perrucelli RJ II. *Medicine: an Illustrated History*. New York: Harry N. Abrams, 1987.
- Martin JE. The Spartan character. *Sparta* 5: 24–26, 2009.
- McArdle WD, Katch FI, Katch VL. In the beginning: origins of exercise physiology from ancient Greece to America in the 1880s. In: *Exercise Physiology: Energy, Nutrition and Human Performance* (6th ed). Philadelphia, PA: Lippincott, Williams & Wilkins, 2005, p. xviii–xxxiii.
- McKenzie RT. *Exercise in Education and Medicine*. Philadelphia, PA: Saunders, 1909.
- Mitchell H. *Sparta*. Westport, CT: Greenwood, 1985.
- National Center for Biotechnology Information. *PubMed. Results for search terms "exercise + is + medicine"* (online). <http://www.ncbi.nlm.nih.gov/pubmed/?term=exercise+is+medicine> [30 January 2014].
- Nutton V. *Ancient Medicine*. London: Routledge, 2004.
- Pomeroy SB. *Goddesses, Whores, Wives, and Slaves*. New York: Shocken Books, 1975.
- Prioreschi P. *A History of Medicine* (2nd ed.). Omaha, NE: Horatius, 1988, vol. 3.

45. **Pythagoras** (sculpture). *Herm Depicting Pythagoras*. Image courtesy of Musei Capitolini and used with permission. <http://museicapitolini.org> [9 April 2014].
46. **Ray P, Gupa H, Roy M.** *Susruta Samhita*. New Delhi: Indian National Science Academy, 1980.
47. **Rothschuh KE.** *History of Physiology*. Huntington, NY: Krieger, 1973.
48. **Roy SB.** *Mohenjodaro*. New Delhi: Institute of Chronology, 1982.
49. **Sallis RE.** Exercise is medicine and physicians need to prescribe it! *Br J Sports Med* 43: 3–4, 2009.
50. **Scarborough J.** *Roman Medicine*. Ithaca, NY: Cornell Univ. Press, 1969.
51. **Sharma RK, Dash VB.** *Agnivesa's Caraka Samhita*. Varanasi, India: Chowkhamba Sanskrit Series Office, 1977, vol. 1.
52. **Sharma RK, Dash VB.** *Agnivesa's Caraka Samhita*. Varanasi, India: Chowkhamba Sanskrit Series Office, 1988, vol. 3.
53. **Siegel RE.** *Galen on Psychology, Psychopathology, and Function and Diseases of the Nervous System*. Basel: Karger, 1973.
54. **Sigerist HE.** *A history of Medicine*. New York: Oxford Univ. Press, 1961, vol. 2.
55. **Singer C.** *Greek Biology & Greek Medicine*. Oxford: Clarendon, 1922.
56. **Temkin O.** *Hippocrates in a World of Pagans and Christians*. Baltimore, MD: Johns Hopkins Univ. Press, 1991.
57. **Tipton CM.** Historical perspective: the antiquity of exercise, exercise physiology and the exercise prescription for health. *World Rev Nutr Diet* 98: 198–245, 2008.
58. **Tipton CM.** Susruta of India, an unrecognized contributor to the history of exercise physiology. *J Appl Physiol* 104: 1553–1556, 2008.
59. **Van der Eijk PJ.** *Diocles of Carystus*. Leiden: Koninklijke Brill, 2001, vol. I.
60. **Veith I.** *Huang Ti Nei Ching Su Wen (The Yellow Emperor's Classic of Internal Medicine)*. Berkeley, CA: Univ. of California Press, 2002.
61. **Vogel CJ.** *Pythagoras and Early Pythagoreanism*. Assen, The Netherlands: Royal Van Gorcum & Company, 1966.
62. **West JB.** Pulmonary blood flow and gas exchange. In: *Respiratory Physiology: People and Ideas*, edited by West JB. New York: Am. Physiol. Soc., 1996, p. 40–169.
63. **Whitehead JR.** *Leadership Manual 2012–2013*. Indianapolis, IN: American College of Sports Medicine, 2012, p. 40–46.
64. **Wilson HH.** *Rig-Veda Samhita*. New Delhi: Cosmo, 1977, vol. I.
65. **Wong KC, Wu L.** *History of Chinese Medicine* (2nd ed.). Shanghai: National Quarantine Service, 1936.

