Susretu of India, an unrecognized contributor to the history of exercise physiology

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Tipton CM. Susretu of India, an unrecognized contributor to the history of exercise physiology. J Appl Physiol 104: 1553–1556, 2008. First published March 20, 2008; doi:10.1152/japplphysiol.00925.2007.—When considering the history of exercise physiology, authors begin with Hippocrates and the “Golden Age” of Greece before mentioning Galen and the contributions from Rome. However, this approach has omitted the information from the ancient civilizations of India which flourished before and during the emergence of Mycenaean cultures. Specifically ignored have been 1) the tridosa doctrine (humoral theory), which as early as 1500 B.C., emphasized that disease occurred because of a displacement of one or more of the three humors, with health being achieved when the humors were in equilibrium and 2) the perspective of Susretu (Sushrata, an Indian physician) who was a 600 B.C. physician who included exercise in his prescriptions to prevent and treat diseases. Susretu not only advocated exercise to maintain equilibrium among the humors, notably kapha, he promoted exercise to minimize the consequences of obesity and diabetes. To be effective, exercise had to be daily and moderate in intensity and never excessive or to exceed the half-maximum limit for exhaustion, because disease or even death could ensue. It is concluded that Susretu’s concepts pertaining to chronic exercise and to the health benefits of exercise were “remarkably modern” and that future authors on the history of exercise physiology should include contributions from ancient India.

ancient history; health; humors, antiquity

Like physiology (40), the history of exercise physiology begins with contributions from ancient Greece and Rome (2, 29, 45). Unfortunately, this approach ignores the information from ancient India and the tenets of Susretu (Sushrata, an Indian physician) concerning exercise physiology and exercise influences on human health and disease. The purpose of this Historical Perspective is to acquaint the exercise physiology community with India’s and Susretu’s contributions while indicating similarities to present day concepts.

Background Information on Ancient India and the Existence of Susretu

Archaeological excavations during the 1920s in the Indus Valley pertaining to Mohenjo-Daro (in Sind of now west Pakistan) and Harappa (in Punjab of India) revealed the existence of an ancient Indus civilization that noted historians and archeologists (15, 25, 32, 43) believe existed millennia earlier than a carbon dated value of 3300 B.C. (41). These findings support the view that these cities existed during the pre-Susretu era (32) (4000–900 B.C.) while being contemporary with civilizations in Egypt, Mesopotamia, and China (1). Excavation results and evaluations of skeletal remains indicated Hindus living in these regions were focused on matters of personal hygiene, public health, and sanitation and had experienced arteriosclerosis, osteomyelitis, cancer, metal poisoning, and infectious diseases (10). The excavations also included statues with positions that suggested the inhabitants were familiar with the practice of yoga. With the Aryan invasion of ∼2000 B.C. (42), the Indus Civilization ended but the interest in health and the concern for disease remained.

The oldest literature in the world is found in the 1,028 sacred hymns of the Rgveda (Rig-Veda) (50–56). Written in Sanskrit, it includes a history of the Aryans, a view of prehistoric times, requests for benevolence and blessings from various mythological gods and goddesses, and divine remedies for disease and disorders. Within select hymns was the belief that disease occurred because of evil spirits that originated from either a god or goddess or from a living or deceased enemy (53). When health was mentioned, it was not related to disease or recovery from disease, rather it was a condition that reflected the pleasure or displeasure of the gods (56). It is known that a hymn in the Rgveda makes reference to the existence of the three humors (50, p. 95) that influence health. The dates cited for the Rgveda range from 4000 B.C to 2500 B.C to 1500 B.C., with the latter date being most frequently mentioned by historians (21). When the era of the Vedas or the Vedic Period is discussed, a range of dates is also listed with 3000 B.C to 1000 B.C being frequently recorded (19).

Of the sacred texts of India, the Atharvaveda (Atharva-Veda) contains the most detailed information dealing with medicine, health, and disease (15, 16, 48, 49). It includes 20 books by multiple authors with 731 hymns and considered by the Sanskrit scholar Macdonell (26, p. 185) to be a “a heterogenous collection of spells” directed against diseases, demons, foes, wizards, noxious animals, and oppressors of Brahmins. Although all authorities agree it appeared after the Rgveda, uncertainty reigns as to the date of origination with 1000 B.C. being selected by the majority of authors. As in the Rgveda, diseases were associated with supernatural forces and as a punishment for evil deeds or for sins against the gods by individuals, their parents, or by their enemies.

During the late Vedic period (circa 1500–800 B.C.) the tridosa doctrine (also known as the trihautu doctrine and considered to be the Indian humoral theory) was formulated and developed (3, 23). This doctrine was introduced to help explain the meaning of life, death, health, and disease while describing how the elements of water, fire, air, earth, and ether contributed to the formation of the human body. Interacting within the body were nutrient particles that were derived from the wind, sun, and moon that became transformed into air, bile, and phlegm and were regarded by Susretu as dosas (humors)

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and identified as vayu, pitta (pittam), and kapha (kaphah), respectively (12, 23, 38). However, Susruta considered blood to be a fourth humor that was capable of influencing interactions between the other humors (38).

According to the tridosa doctrine or the Indian humoral theory, vayu, pitta, and kapha humors controlled and regulated all functions of the body (38). When they were in equilibrium, health was present, but if one or more humors were displaced or deranged, health was impaired and illness and death could occur (23, 38). In addition to disease, conditions that could alter the equilibria between the humors were climatic changes, select foods, fatigue, psychic changes, poisons, sedentary living, and exercise (6, 38).

Susruta’s existence is shrouded in mythology and controversy. One version has Dhanwantri, the physician to the gods and reputed Vedic father of medicine, coming to earth to minister to the misery and disease of mankind while extolling them in the science of life (21). He subsequently migrates to Benares (Varanasi) and meets Susruta as the son of Saint Vishvamitra, a disciple of Dhanwantri, and instructs him on the science of life and the surgery of medicine. Later, Susruta writings were compiled into a Samhita. Another version has Susruta being trained by Divodasa, a physician king of Varanasai (1, 4). However, this version creates more confusion because select authorities consider Divodasa and Dhanwantri to be the same entity.

Regardless, Susruta was a physician who taught surgery and medicine at the university in Benares (19). With ancient India, there is certainty in the existence of their sacred texts and of the samhitas associated with Atreya, the world’s oldest record of medical practice (15, 43). However, uncertainty prevails concerning their dates and whether the samhita attributed to Susruta was from a historical figure or from different physicians using a prominent name to give credence to their views (12, 22). When dates are listed for him, they include 1000 B.C. (21, 32), 800–600 B.C. (37), 600 B.C. (27), 600–200 B.C. (1), 200 B.C. (15), 1–100 A.D. (33), and 500 A.D. (14). Partial resolution of these uncertainties has been achieved by findings that 1) several Vedic hymns were dedicated to him (21, 2) his description of the human skeleton was very similar to the one described in the Atreya samhita (21), 3) his comments on the skeleton were nearly identical to the words included in the creation of man within Hymn X of the Atharvaveda (17, p. 1–4), and 4) a critical analysis of the ancient Bower Manuscript by Hoernle demonstrated Susruta was a historical figure during 600 B.C. (20). After commenting on what he considered to be “absurd and amusing theories” that denied the existence of Susruta, Professor N. H. Keswani of Anatomy at the All-India Institute of Medical Sciences in New Delhi wrote (4, p. 7), “Considering all the evidence available today, one comes to the conclusion that the lowest limit of Sushruta’s death is fixed as the sixth and seventh Century B.C., this being the date of the Satapatha Brahmana, while nothing can be said about the upper limit.” Therefore, 600 B.C. has been selected for the era of Susruta.

**SUSRUTA AND HIS CONCEPTS PERTAINING TO EXERCISE PHYSIOLOGY**

He defined exercise as a “sense of weariness from bodily labour and it should be taken every day” (5, p. 485). When he described exercise he was referring to movements associated with walking, running, jumping, swimming, diving, or riding and participating in sports such as archery, wrestling, and javelin throws (5). When prescribed (he was the first physician to prescribe exercise), exercise should be moderate in nature or to an intensity that will cause labored breathing. However, before exercise was to be prescribed, the age, strength, physique, and diet of the individual was to be considered as well as the season of the year and the terrain of the area (5).

Susruta advocated moderate exercise for ancient Indians because it improved the growth of limbs; enhanced muscle stoutness (mass), strength, endurance, tautness (tone), and development; reduced corpulence; increased digestion; increased the resistance against fatigue; elevated temperatures and thirst while improving appearances and complexions. Moderate exercise was also advocated because it “gives the desirable mental qualities of alertness, retentive memory, and keen intelligence” (5, p. 40).

**SUSRUTA AND HIS CONCEPTS PERTAINING TO EXERCISE, HEALTH, AND DISEASE**

Susruta believed medical practice should direct as much effort to the prevention of disease as it devoted to curative remedial procedure and included physical exercise within his recommended hygienic practices. He felt regular moderate exercise provided resistance to disease(s) and “against physical decay” and stated “Diseases fly from the presence of a person, habituated to regular physical exercise . . .” (5, p. 486). He strongly opposed excessive exercises, which was interpreted to mean continued heavy or maximal exercise (46), because it would cause diseases and disorders such as consumption, thirst, phthisis, asthma, cachexia, hemorrhaging, vomiting, coughing, and fever (5). It is of interest that the concept of excessive exercise being responsible for a disease state has similarities to a current concept that repeated bouts of strenuous exercise will suppress the immune system leading to transient disorders of the upper respiratory tract (34). Moreover, professional societies who advocate exercise for health reasons should incorporate this cautionary concern in their 21st century pronouncements.

Susruta was a strong advocate for the tridosa doctrine and for the concepts that 1) disease occurred when the humors were not in equilibrium and 2) health was present when the displaced humors had returned to resting levels. He was convinced a sedentary lifestyle that included physical inactivity, sleeping through the day, and consuming excessive food and fluids would sufficiently elevate the kapha humor to a level that could disrupt humoral equilibrium resulting in a disease state and potential death. Consequently, he included exercise in his recommendations to prevent the occurrence of kapha diseases (5, 22, 38).

Frequently discussed by historians is whether the tridosa doctrine of India influenced the humoral theory of Greece attributed to Hippocrates (460–370 B.C.). Although Alexander the Great conquered Greece in 326 B.C. after the death of Hippocrates and had Greek physicians within his Army, the possibility exists but the issue remains unresolved (15, 43).
Susruta considered obesity to be a disease that was caused by an increase in the humor vayu because of an elevation in lymph chyle. Obesity was attributed to a sedentary lifestyle which included “pampering his belly”; sleeping during the day, and being adverse to taking “any sort of physical exercise” (5, p. 135–136). As with other diseases, death could result if his recommendations were not followed. Treatment consisted of removing the fat that was obstructing the internal channels and by preventing the growth of abnormal fat, which was accomplished by providing assorted medications and by prescribing “physical exercise” (5, p. 137).

Diabetes was regarded by Susruta as a disease of the urinary tract (prameha) and as an incurable condition (mahu-meha). When diagnosed as prameha, its causes were either congenital or the result of an injudicious diet, with obesity being a major characteristic of the disease (6). Treatment included dietary changes and participation in an exercise program that included long walks, engaging in sports such as wrestling, and riding on a horse or an elephant (5, p. 377).

Susruta’s sixth century B.C. concept that sedentary living could cause obesity, diabetes, disease, and death has similarities to the 20th century concept of the Sedentary Death Syndrome of Professor Frank Booth (9, 24) in that both identified inactivity with disease and both included physical activity within their prevention regimens (7, 8).

WHY HAVE EXERCISE PHYSIOLOGIST OMITTED THE CONTRIBUTIONS OF SUSRUTA?

Susruta’s contributions to medicine have been extensively acknowledged by historians on the history of medicine (15, 35, 36, 43) and by authors of articles pertaining to urology, plastic surgery, and ophthalmology (11, 19, 37). When the History of Physiology (40) was published, Rothschuh began with the contributions from Greece. However, in the United States, exercise physiology did not evolve from physiology; rather, it began in the classrooms and laboratories of physical educators during the late decades of the 19th century. Even so, physical education historians have been careful to note the contributions from Persia, India, and China before discussing those from Greece and Rome (18, 39, 47). Insights can be gleaned from the publication in 1553 of the first text devoted to exercise physiology entitled the Book of Bodily Exercise (33) by the Spanish physician Cristobal Mendez (1500–1541) in that only Greek and Roman concepts were used to discuss the four treatises emphasized within the book. Sixteen years later (1569), the Italian physician Girolamo Mercuriale (Hieronymus Mercurialis, 1550–1606 B.C.) published in Latin the first text devoted to sports medicine in which sections were devoted to exercise and its physiological concepts; but, only those that had originated from Greece and Rome with the most coming from Galen (31). Several hundred years later in England, or in 1807, John Sinclair discussed aspects of chronic exercise (training) for humans and animals (45). Like others, he followed Mendez’s approach by using observations and concepts from individuals who lived in ancient Greece and Rome (Herodicus, Asclepiades, Celsus, Galen) plus those from the 17th century as Sir Francis Bacon and Byran Robinson (45). Since the time of Sinclair there have been ~40 first edition texts published in North America devoted to the science of exercise physiology. Of those that contain ancient historical information, all begin with the contributions from Greece and Rome.

CONCLUSION

Unlike their history of medicine counterparts, authors on the history of exercise physiology have omitted the achievements from ancient India. In doing so, they have missed the contributions of a 600 B.C. physician named Susruta (Sushruta; Fig. 1) who was an ardent advocate of the tridosha doctrine (humoral theory), which stated disease was a resultant when one or more of the three bodily humors (dosas) was displaced and that health occurred when they were in equilibrium. The antiquity of the tridosha doctrine is that it was included within the oldest of the sacred books of India (The Rig-Veda, circa 1500 B.C.) while its importance to exercise physiology was established by Susruta’s belief that exercise could help prevent the diseases caused by the elevation in the kapha humor because of lifestyles that included inactivity and excessive consumption of food and fluid. His idea that inactivity could lead to a disease state has similarities to the 20th century concept of the Sedentary Death Syndrome. He was the first physician to prescribe exercise (moderate) for health reasons and preceded Greek physicians in discouraging individuals from performing “excessive exercise” because of the propensity for health disorders. Susruta regarded diabetes and obesity as diseases and included moderate exercise within his treatment regimens. When he described the physiological effects of chronic exercise, they had marked similarities to those currently listed in elementary exercise physiology textbooks.

The collective conclusion is that Susruta was remarkably modern with his ancient concepts.
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