

The Role of Exercise in Hippocratic Medicine

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Abstract The crucial role of exercise in mental and physical health is a research field with growing interest in recent years. Scientific disciplines such as medicine, psychology and coaching, search the benefits of participation in training programs. Hippocrates has a separate thesis among the pioneers who recorded the benefits of equilibrated diet and exercise. This research aims to specify and assay the role of exercise in Hippocratic Medicine. After a review of literature, the Hippocratic writings “Regimen in Health - Περί διαίτης”, were identified and analyzed as the texts which containing the thesis of exercise in Hippocratic Medicine.

Keywords: *physical activity, health, medicine, Hippocrates*

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1. Introduction

The need for prevention and treatment occurred since there existence of human being. Search of treatment either with science – medicine, or sometimes by non-scientific way – magic, found from ancient times. Hippocrates due to the methodology followed and focal point of his medicine that should be practiced as a scientific discipline based on natural sciences, diagnosing and preventing diseases as well as threatening them [1]. For his contribution to classic medicine Hippocrates is widely recognized as the founder of Greek and global medicine. Purpose of this study is to identify and analyze in depth, the texts that Hippocrates refers to the role of exercise on the human health and robustness.

2. Methodology

The present study was focused on the Hippocratic books “REGIMEN IN HEALTH”.

3. Results

A series of scientific studies substantiate the research hypothesis that exercise helps, prevent, and treat, physical and mental illnesses. The role of exercise is so important to the public health, that the American College of Sports Medicine (ACSM), with support from the American Medical Association and Office of the Surgeon General, launched an initiative with the aim to mobilize physicians,

healthcare professionals and providers, and educators to incorporate exercise in their practices with humans to manage, or treat chronic diseases that impact health and the quality of human life [2]. Blair considers physical inactivity as the biggest public health problem of the 21st century [3]. PubMed listed, as January, of 2014, a total of 56,691 citations under the heading of Exercise Is Medicine (EIM) [2].

According to Adlard and Cotman voluntary exercise protects against stress-induced decreases in brain-derived neurotrophic factor protein expression [4]. Greenwood et alii [5] write: “Humans who exercise are less likely to suffer from stress-related mood disorders”. Villareal et alii [6] suggest that a combination of weight loss and exercise provides greater improvement in physical function than either intervention alone. The research hypothesis that exercise is directly related to the individual's health is not a novelty. During the study of global bibliography it is concluded that the ancient Greek doctor Hippocrates was the first who recognized the beneficial effects of exercise. In particular via his writings “REGIMEN IN HEALTH” the great physician of antiquity stated:

A) The correlation between Regimen, Age and Exercise.

B) Characteristics-Properties of Exercises.

A) The correlation between Regimen, Age and Exercise.

Hippocrates is the first physician in world history who categorises the human's regimen according to age criteria: <<As for age, such persons are most healthy in childhood, next come youths, while the least healthy are the very old and the elderly; such constitutions age rapidly ... and their exercise should be directed more to the outside of the body than to the inner parts.>> [7]. Translation by E. J. James. 1931. THE LOEB CLASSICAL LIBRARY. HARVARD UNIVERSITY PRESS [7].

According to his writings children are the most healthy, next are youths, and the last healthy are the average people. Children ought to adopt a regimen that warms and dries, their exercise should be oriented to the outside of the human body than to the inner parts [7]. Probably Hippocrates means that children should develop their musculoskeletal system, the orthosomia in order to have healthy and strong bodies, to prepare harmoniously for the youthful age. Then refers to Adolescents: "As for age, the youngest are the most unhealthy. Their bodies grow quickly, ... and these persons profit more if their exercise be directed to the internal parts of the body." [7]. Translation by E. J. James. 1931.

The ancient doctor characterizes the youngest as the most unhealthy because their bodies grow fast, and are subject to catarrhs. Hippocrates believes that their regimen should include dry and cool food. According to the great physician, physical education must orient to the inner parts of the body [7]. Apparently refers to organism's internal systems such as the cardiovascular, digestive system and the various organs, such as heart, liver, spleen, stomach. Then writes: "the most healthy are the aged. It is the same with those nearest these ages. Regimen should be such as cools and moistens, with such exercises as warm and dissolve least and produce the most thorough cooling. Such natures have long life and a healthy old age." [7]. Translation by E. J. James. 1931.

Hippocrates considers the adults healthy and regimen should be cool and moistens and exercises have to result the thorough cooling. In this way they will live more and healthier. In fact according to a study [8] published in "PLOS Medicine" (impact factor of 2014, 14.429) trainees live longer than non-trainees: "More leisure time physical activity was associated with longer life expectancy across a range of activity levels and BMI groups." For this age Hippocrates prefers cool and moist, not warm and dry regimen probably considers that physical health will be served by such foods.

At the age of forty people are not healthy: "At the age of forty (more or less) they are unhealthy; ... Exercise should be mild at first, gradually increasing, gently warming and not taking too much from the available strength. In this way then ought one to judge of the nature of the original constitution of a man." [7]. Translation by E. J. James. 1931. According to Hippocrates their regimen should be warm and moist. Exercise should be harmonically increased and gently warmed not to strength so much the human body.

Hippocrates correctly suggests arise the intensity of the exercise gradually; in this way he adopts the philosophy of the modern training where the athletes have to warm their body, to do exercise via harmonically encumbrment. Additionally in relation to the theme of the exercises of the training program in another part of his work he writes: "exercises should be as far as possible natural and there should be plenty of them; violent exercise should be sparingly used, and only when necessary;" [7]. Translation by E. J. James. 1931.

Hippocrates writes that the exercises should be as natural as possible and they must be varied with rare use of violent and only when necessary. The great doctor has knowledge of training; he recommends the natural exercises and the variety of the training program through

enrichment of it. By the term violent Hippocrates means the exercises with maximum intensity, where properly urges the infrequent use in training, because according to recent studies the athlete's body is exhausted and he becomes more prone to injury and performance decreases with probable and the appearance of overtraining syndrome.

According to Kreher [9] Overtraining syndrome (OTS) appears to be a maladapted response to excessive exercise without adequate rest, resulting in perturbations of multiple body systems (neurologic, endocrinologic, and immunologic) coupled with mood changes. MacKinnon writes [10]: "Overtraining syndrome is a neuroendocrine disorder characterized by poor performance in competition, inability to maintain training loads, persistent fatigue, reduced catecholamine excretion, frequent illness, disturbed sleep and alterations in mood state." MacKinnon believes that Overtraining is a process of excessive exercise training that may, if left unchecked, lead to a condition termed 'overtraining syndrome' [10].

B) Characteristics-Properties of Exercises.

Then Hippocrates refers to the properties of exercises: "I will now discuss the properties of exercises. Some exercises are natural and some violent. Natural exercises are those of sight, hearing, voice and thought ... Exercises of the voice, whether speech, reading or singing, all these move the soul. And as it moves it grows warm and dry, and consumes the moisture." [11]. Translation by E. J. James. 1931.

Hippocrates separates exercises "πόνους" to natural and violent. Natural are those of sight "ὄψις πόνους", hearing "ἀκοῆς", voice "φωνῆς" and thought "μερίμνης". During the exercise of sight the soul "ἡ ψυχὴ" is moved and warmed, it dries and empties the moisture out. Through hearing the noise "διὰ δὲ τῆς ἀκοῆς" stimulus the soul, the soul is moved and exercised. All the thoughts that making a man stimulate the soul, warm and dry the soul; The soul is exercised via the consumption of the moisture, (hearing) empties the flesh "σάρκα" and makes a man thin "καὶ λεπτύνει τὸν ἄνθρωπον".

The doctor likely refers to the impact of various stimuli coming to the attention of the individual through the auditory channels, affecting the psychology and subsequently causes weight loss by decreasing food intake. This phenomenon needs further study of how sound could contribute to fat loss through the effect on the psychology and the person's metabolism. Then refers to exercises of the voice "φωνῆς", speech, and reading or singing, stimulate the soul, as it moves it gets warm and dry, and finally consumes the moisture. Consume the moisture according to Hippocrates makes a man thin [11]. This thesis is proved today where according to scientific survey during daily activities presented energy expenditure [12].

In the next paragraph he writes: "Walking is a natural exercise, much more so than the other exercises, ... as follow" [11]. Hippocrates says that walking "περίπατος" is a natural exercise more than others. The great doctor had found that walking is the most natural form of exercise. Furthermore according to a contemporary study is beneficial, in particular Williams and Thompson write [13]: "These results from these very large, prospective,

cohorts suggest that equivalent doses of running (a vigorous exercise) and walking (a moderate exercise) are associated with equivalent reductions in the risks for new onset hypertension, hypercholesterolemia, and diabetes." Rippe et alii [14] write that: "walking has also been shown to reduce anxiety and tension and aid in weight loss. Regular walking may help improve cholesterol profile, help control hypertension, and slow the process of osteoporosis."

Then writes: "A walk after dinner dries the belly and body; it prevents the stomach becoming fat for the following reasons ... so that the belly and the flesh dry up." [11]. Translation by E. J. James. 1931. According to Hippocrates walk after dinner dries and prevents the accumulation (of lipids) round the belly. In these lines the great doctor describes for the first time in history of medicine the mechanism of digestion, όπου the nourishment is consumed by metabolism innate heat "σύμφουτου θερμού" or secreted out with the breath or by the urine, the derivatives of metabolic processes removed through the respiratory and the urinary system.

According to Hippocrates the driest part from the food is left behind so that the belly and the flesh dry up, during the process of digestion of nutrients which absorbed by the body [11]. Rightly writes that walking helps actively to prevent obesity, especially abdominal [11]. Katch indirectly confirms the opinion of Hippocrates because writes [15]: "Subjects who exercised the equivalent of walking or jogging 12 miles per week (classified as moderate physical activity) put on no visceral fat, and those who exercised the equivalent of jogging 20 miles per week (moderate-to-vigorous physical activity) lost both visceral and subcutaneous fat!"

Additionally a study which aim was to examine the relationship between objectively determined physical activity and body composition variables in middle-aged women, concludes that: "Women who walked more had lower body fat percentage (%BF). Additionally, the average BMI of women who accumulated 10,000+ steps-d-1 was in the normal range." [16] All the above studies confirm the correctness of the opinion of the great doctor about benefits of walking.

Then Hippocrates writes: "Early-morning walks too reduce [the body], and render the parts about the head light, bright and of good hearing, while they relax the bowels." [11]. Translation by E. J. James. 1931. According to father of modern Medicine, morning walks result in weight loss and render the parts about the head, light, bright and of good hearing, while they relax the stomach "κοιλίην". The great physician refers to the beneficial effects of walking where the psychology of the individual is improving and thought becomes more efficient.

Actually according to a recent research report of Stanford University: "Walking substantially enhanced creativity by two different measures. For the three alternate uses studies, 81%, 88%, and 100% of participants were more creative walking than sitting." [17]. The same authors mention: "Walking is an easy-to-implement strategy to increase appropriate novel idea generation. When there is a premium on generating new ideas in the workday, it should be beneficial to incorporate walks" [17].

Pursuant to Hippocrates: "When the bowels have been emptied, being hot they draw to themselves the moisture from the body generally, and especially from the head; when the head is emptied sight and hearing are purged, and the man becomes bright." [11]. According to the author when the process of defecation draws the moisture from the body, and especially from the head, the man becomes bright "εὐαγέα". Hippocrates observed that defecation as a result of walking helps of the individual mental clarity.

Exercise helps to have correct posture and to proper functioning of the large intestine with beneficial results in emptying. All these have positive effects in physical and mental health. The systematic exercise contributes to better absorption of nutrients and reduces the probability of cancer in large intestine. Larson-Meyer et alii [18] write: "The benefits of exercise in the prevention of chronic diseases including overweight and obesity are well documented. Regular physical activity reduces blood pressure, creates a more favorable lipid profile, and reduces risk for stroke, coronary heart disease, hypertension, and colon cancer".

According to the Global Recommendations on Physical Activity for Health released by World Health Organization: "Undertaking 150 minutes a week of moderate physical activity can reduce the risk of breast and colon cancers" [19]. Pursuant to Harvard T.H. Chan School of Public Health: "Keeping active can help people stay at a healthy weight or lose weight. It can also lower the risk of heart disease, diabetes, stroke, high blood pressure, osteoporosis, and certain cancers, as well as reduce stress and boost mood." [20].

Hippocrates writes: "Walks after gymnastics render the body pure and thin, prevent the flesh melted by exercise from collecting together, and purge it away." [11]. In this context the author refers to the beneficial effects' of post exercise recovery: "οὐκ ἔωντες τὴν σύντηξιν τῆς σαρκὸς τὴν ὑπὸ τοῦ πόνου συνίστασθαι, ἀλλ' ἀποκαθαίρουσιν" [11], wherein after walking exercise helps reduce muscle tone prevents the muscle contraction due to muscular fatigue and contributes to the removal of lactate, which produce energy and fatigue. According to a study of Sieber et McMurray [21]: "The walking recovery reduced the lactate levels to 38.5% (in six female collegiate swimmers)." Hippocrates knows the beneficial effects of post exercise recovery and that is why at another point his book he writes: "such as are fatigued by wrestling ought to run. For by taking exercise in this way they will warm, brace and refresh best the part of the body suffering from fatigue." [22]. Translation by E. J. James. 1931.

The great doctor writes: "Of running exercises, such as are not double and long, if increased gradually, have the power to heat, concoct and dissolve the flesh; they digest the power of the foods that is in the flesh, making the body slower and more (παχύ) gross than do circular runnings, but they are more beneficial to big eaters, and in winter rather than in summer. Running in a cloak has the same power, but heating more rapidly." [11]. Translation by E. J. James. 1931.

The sprinters events result in making the body more gross than do the circular runnings (endurance races, 800m etc.), but are beneficial to big eaters. Via studying

synchronous athletes of speed track events it is concluded that they have larger amount of muscle mass than those of endurance. The runners of 100 meters are heavier than Marathon runners who have low levels of body fat and less muscle mass. Consequently the thesis of Hippocrates and his empirical observation that sprinters are bulky and eat a lot, are confirmed "τοῖσι δὲ πολλὰ ἐσθίουσι" [11].

Additionally writes the running a cloak has the same power "δύναμιν", but heating more rapidly [11]. This observation is confirmed in our epoch and has application in various clothing for sports, where warming and sweating is achieved through specific training suits. According to Hippocrates exercise with clothes is beneficial to those who have excess of flesh which they wish to reduce and those who are getting on in years [11]. He refers to the beneficial effects of exercise clothing at obese and the elderly people, where through the clothing is achieved faster and easier rise in body temperature. The rising of temperature results in sweating and weight loss by reducing body fluids. This role serve sauna suit, but their use should be approached carefully for its safety and effectiveness.

Hippocrates writes: "The double course ..., it is the quickest to draw the moisture to itself." [11]. Translation by E. J. James. 1931. The double courses "διαυλοῖ" because concerned with the inner parts of the soul render the body thin and dry. Hippocrates writes running in circle "τροχοῖ" reduces and contracts the flesh and the belly most, he explains it by writing that it causes the most rapid respiration; it is the quickest (way) to draw the moisture "το υγρόν" to itself. Actually running endurance events "τροχοῖ" due to the fact that their operation requires the consumption of large amounts of energy, they resulted in significant reduction of fat in the abdomen and the body in general. Typical examples are the Marathon runners, who not only have less weight but have lower body fat percentages.

Macroscopically Hippocrates had noticed the effect of endurance racing in body weight and in the reduction of fat in the abdomen. Updated studies have confirmed the reduced weight of distance runners. Marc et alii [23] identified the most appropriate profiles and conditions to realize optimal performance for marathon runners. They found, that optimal BMI for men was 19.8 kg.m⁻², and for the 10 best performers of all time a BMI range between 17.5 and 20.7 kg.m⁻². According to a study of Sedeaud et alii [24]: "Athletes, on average were continuously lighter and smaller with distance increments."

Hippocrates then writes: "Swinging the arms, for persons of dry flesh, and when jerky, is inexpedient, as it causes sprains, in the following way. The body having been warmed, this swinging makes the skin considerably thinner, but contracts the flesh less than running in a circle, and empties the flesh of its moisture." [11]. According to the father of modern medicine moving the arms for persons of dry flesh in "ἐξάπινης" (γρήγορο) it causes sprains "σπάσματα" [11].

The ancient doctor describes the etiology mechanism of injury, probably in this text refers to tendonitis, which developed due to the continued strong and sudden strain of muscles and tendons. In the rest phase the tendon shows a waveform, which occurs when there is a dilation

of the size of 4% [25]. Between 4-8% of the expansion of the tendon induced a slippage of collagen fibers, because of the small elasticity first occurs a breakage of the connecting bridges and then themselves. At this point an inflammatory reaction is occurred. A hypothetical increase in stretching (8-10%) results in mechanical failure of the tendon, the less potent collagen fibers ruptured and tendon expels its normal structure at the molecular level [25].

Hippocrates continues writing that wrestling and rubbing give exercise more to the exterior parts of the body, warm the flesh, harden and make it to grow [11]. Wrestling with the fingers "ἀκροχειρισμὸς", the punch-ball "κωρυκομαχίη" and arm exercises "χειρονομίη" reduce and draw the flesh upward [11]. The three styles of wrestling which mentioned above mainly develop the muscles of the upper body; because these are the parts which primarily exercise, therefore as a result develop the muscular and the circulatory system of the arms and upper torso of wrestlers.

In another part of his work he refers to fatigue pains: "The fatigue pains that arise in the body are as follow. Men out of training suffer these pains after the slightest exercise, as no part of their body has been inured to any exercise; but trained bodies feel fatigue pains after unusual exercises, some even after usual exercises if they be excessive." [11]. The above text proves that Hippocrates correctly noticed that then as is the case today, the unfit suffered from pain after any kind of exercise, since their bodies and in particular their muscular system has not gradually adapted to the stress of exercise, fact that resulted in muscle fatigue and cause delayed muscle pain (Delayed Muscle Soreness).

Muscle pain may be the result of lactic acid accumulation in muscles or the result of microscopic injury at sarcomere (mechanical disruptions of the Z lines referred as "Z-disk streaming") [26]. The present study proves that in this work "Regimen" Hippocrates possesses not only medical knowledge, but also training at a depth that he separates people into trained and non trained. Also he knows that the fatigue pain in untrained can be caused by any type of exercise, in contrast with the trained where fatigue pain will be felt after excessive or unusual exercises.

4. Discussion

The ancient physician in his work "Regimen in Health" is proven connoisseur of training science. He refers to the basic principle of training expertise, the introduction of maximum intensity at certain units of the training program and not to the implementation of it to all the units [7]. The frequent repetition of the maximum intensity, it is likely to lead to over exhaustion the muscular and the energy system of an athlete and consequently at an overtraining syndrome. Hippocrates from his writings approves that despite the nonexistent scientific metrics – methods of his epoch, he seems to have a deeply knowledge of the mechanisms of the physiology and ergo physiology of the human body. According to his scientific beliefs he suggests the best regimen for each athlete according to his age (pages 3-5). For the first time globally we have the

implementation of the principle of training according to the age criteria [7].

The great physician notes that he; trying to treat correctly of human regimen he must first gain knowledge and discernment of the nature of the man [7]. If the physician ignores the controlling thing in the body he will not be able to gain the suitable treatment for his patient [7]. Additionally recognizes the need for a balanced diet and exercise: "As I have said above, it is impossible to treat of the regimen of men with such a nicety as to make the exercises exactly proportionate to the amount of food." [27]. In fact nowadays it has proven that the physical-athletic performance requires the appropriate nutrition. Hippocrates in his writings recognizes that various ages have different needs [27]. While he has study in such a degree that in accordance with the time of year (winter, spring, summer, autumn) he suggests analogous exercises program and nutrition [27].

Via this paper it is concluded that Hippocrates is the pioneer of his era, by the method of the visual observation he identified the valuable role of exercise (in health of the human) and set the foundations for modern medicine and well being movement. Hippocrates innovative spirit combined with his scientific course, contributed significantly to the foundation of medicine as a science. This fact rightly resulted to be considered as the founder of the modern medicine.

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