

## Evaluation of Exercise in Canon of Medicine

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### Introduction

Regular physical activity prevents many health problems and increases quality of life. The word ‘exercise’ is derived from the Romance (Latin-origin) word “*exercitus*”, which means “drive forth”.<sup>1</sup> Exercise, beneficial for its positive effects on health from the earliest periods of the history, has different meanings in different historical periods and cultures. Sustura (BC 600), from the Indus Civilization, was the first physician to prescribe exercise for patients. Sustura recommended that his patients should do exercise every day at an intensity of about half their capacity.<sup>2</sup> Hippocrates (BC 370–460) emphasized that only eating is not sufficient for a person to maintain a healthy state, and exercise is also necessary. The most important doctor in Roman period, Galen (BC 129–120) stated that physical activity must be done at every age.<sup>3</sup> Exercise-related theories of Galen maintained their effect in Arab and European countries in the Middle Ages and gained acceptance widely during the Renaissance Period.<sup>2,3</sup>

Avicenna, the most famous in a series of Muslim physician-philosophers who preserved Greco-Roman knowledge, was born in 980 near Bukhara of Old Persia (modern day Uzbekistan) and died in 1037 age of 58 at Hamadan in Persia.<sup>4,5</sup> In his works (AC 980–1037), which have an important place in the history of medicine, the influence of doctrines of Galen and Hippocrates is seen. Avicenna gained his extant reputation thanks to “*Canon of Medicine*”, his most important work. With translation of the work into Latin in the 12th century, its influence in the Western world was seen especially between the 13th and 17th centuries and was used as a source book in many medical schools.<sup>6</sup> Comprising five volumes, this work has the characteristics of a medical encyclopedia with extensive medical information. Avicenna indicated exercise as one of three principles of protection of health, together with food and sleep. In different parts in the chapter “general diet of the physically matured” of the work, information was given about collective discourse of exercise, the various forms of exercise, its time and duration.

In this study, we aimed to compare the information presenting relationship of the exercise approaches and the exercise with health in “*Canon of Medicine*” with today’s knowledge, and to evaluate the point of view on exercise in that period.

The parts “collective discourse upon bodily exercise”, “the various forms of exercise”, “the best time for commencing

exercise, the proper duration and other rules” in the chapter “general diet of the physically matured” in the first volume of Avicenna’s work called “*Canon of Medicine*”, translated by Esin Kahya from Persian into Turkish, were examined.<sup>7</sup> The Turkish translation was also compared with the English version of “*Canon of Medicine*”.<sup>8</sup> Information in the book was compared with today’s knowledge. True, false or imperfect information was determined and interpreted.

The information about exercise and relationship of exercise with health was evaluated as mentioned by Avicenna under three titles in the book:

### Collective discourse upon bodily exercise

Avicenna started this chapter by stating that exercise, food and sleep are three basic principles of protection of health. He defined exercise as a series of voluntary movements bringing about deep and hurried respiration. He expressed that regular exercise has a protective effect against temperament and humoral disorders. Exercise, from its beginning, revives the innate heat and generates light heat and enables the body to feel lighter. It prevents accumulation of toxic residues in the body, which it accomplishes by removing poisons, irritating unnecessary substances in secretory canals and carrying forward the residues through the outlet hole. Exercise strengthens muscles and joints and increases resistance to diseases. Furthermore, it enables the residues to be removed and thus accelerates the absorption of food by tissues. It enhances and loosens the organs, dilutes secretions, and expands the holes. Avicenna stated that restriction of exercise may be a precursor of tuberculosis.

When this chapter is examined, “formation of series of movements related to deep and hurried respiration” used in the description of exercise, are physiological responses to oxygen consumption increasing as a result of physical activity. With the information that exercise is protective against temperament and humoral disorders, it was emphasized that exercise has protective effect on health. The information that exercise revives heat in the body is true obtained through observation in that period. It is known today that energy emerging in inter-metabolism of the foods turns into body temperature. It is true that exercise causes toxic substances to be removed from the body. Mechanisms stated while explaining this information are stated to be partly true as in sweat glands. Furthermore, the information that exercise strengthens the muscles is true. It states correctly that physical activity decreases in tuberculosis. Decrease in physical activity, seen in many diseases, is a sign of disease causing death, like tuberculosis, as well.

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## The various forms of exercise

This is the most comprehensive chapter related to exercise. Avicenna defined *two* types of exercises. The *first* is accidental exercises done related to daily activities. The *second* is exercises done in order to gain benefit. Second type exercise varies by *duration, intensity* and *rate*. This type of exercise may be long or short term, moderate or strenuous, slow or fast. Furthermore, exercise may be mixed-type as in every three forms. Avicenna divided types of exercises according to intensity into two types: *strenuous* and *moderate*. He showed sport activities, such as wrestling, measuring strength against someone, boxing, running, quick marching, archery, javelin throw, jumping on one foot, fencing, and fencing on horseback, as examples of strenuous exercises. He examined wrestling and measuring strength against someone under a separate title in the chapter of exercise types, and described wrestling and explained with which techniques it is performed. He showed the activity of swinging to and fro as an example of moderate exercises.

Avicenna, apart from strenuous and moderate exercises, also defined vigorous exercises. As examples of more vigorous exercises than moderate exercises, running at a certain distance, swordplay, combat with one's shadow, clapping, springing, playing with a large ball, lifting heavy stones, horseback riding, mounting on a camel, elephant and getting on horse-drawn vehicle, horse jumping and bridling the running horse were given.

It was stated that *fast exercises* are done with two people. As an example of fast exercises, changing place one after another, jumping forward-backward were given. It was stated that it is necessary to take a resting break and, in the meantime, to do some mild exercises while doing fast and vigorous exercises. Avicenna stated that it would be better to change the way of exercise instead of continuing the same exercise.

In this chapter, Avicenna stated that there are exercises for various parts of the body under the title "special exercise for each organ". He explained that, with vociferation from high-pitched and deep voice, chest and respiratory organs can be made do exercise. With this exercise, chest is expanded, and the color of skin improves. Another exercise for chest and respiratory organs is wide and long respiration. This movement activates the whole body, and opens up and purifies respiratory tracts. He stated that extremely loud voice and long shouts are injurious, and may cause injuries and harms in healthy people.

Avicenna expressed that there is an exercise type for each person. For example, gentle exercises such as swinging are more suitable for patients debilitated by fever, the ones debilitated by purgatives and the ones affected by diaphragm inflammation. Gentle swinging is somniferous, disperses flatulence, provokes the appetite, and is beneficial for forgetfulness (memory loss) and stupor. Furthermore, it is also beneficial in ascites, gouty pain and kidney diseases. Avicenna stated that unnecessary substances are removed out of the body by means of swinging. He emphasized that weak organs must be protected from intensive exercise and exercise must be gentle in feeble people. He recommended strenuous exercise for people with strong bodies. He stated that people with varicose veins should avoid moving their legs too much.

When this chapter is examined, activities done unintentionally in daily life were described wrongly as exercise and were called accidental exercises. Exercises were divided into long and short

term in terms of duration; however, no explanation was given. Although exercises are divided into moderate and strenuous in terms of intensity, he also defined the vigorous exercises. When the examples given for these exercises are examined, it is seen that classification was done with subjective observations. Since the examples given for moderate exercises contain activities not imposing excessive load on cardiopulmonary and locomotor systems, the examples given are in accordance with exercise intensity. The examples given for strenuous exercises are sport activities which impose great stress on both locomotor and cardiopulmonary systems and require overexertion. Although the examples given for vigorous exercises bear resemblance to the examples given for strenuous exercises, they were considered under a different category. Fast exercises were defined and exemplified; however, no information was given about slow exercises. The examples given for fast exercises contain successive muscular activities and springing movements. Today, these types of exercises are defined as coordination and plyometrics exercises and are applied during sport trainings. The information that it is necessary to take resting breaks and, in the meantime, to do some mild exercises while doing exercise is in accordance with modern knowledge of sport science. During aerobic type and intense exercise, breaks (intervals) are taken which are called active recovery and in which less intense activities are performed within exercise cycle.

Avicenna said that there are special exercises for different parts of the body. Today, in line with the need of a person, exercise methods such as reinforcement exercises, respiratory exercises, and cardiac exercises are resorted to for different parts of the body. Avicenna exemplified exercises applied for improving the respiratory system. Even though he expressed that vociferation from high-pitched and deep voice is a beneficial respiratory exercise, application of such a respiratory exercise does not exist in modern chest physiotherapy applications. In another example given, a deep and long inspiration-expiration was recommended. This improves respiratory functions. However, information, such as correct positioning of the person, taking passive and long expiration, and pursing during expiration, were not included, which are significant during respiratory exercises.

Avicenna stated correctly that exercise must be moderate for debilitated people. According to this statement, it is understood that he made exercises personal according to the physical and health level of a person. This approach is the basic principle of prescription of exercise today. He recommended the activity of swinging for patients with bad physical activity state because of disease. With this activity, the movements of people whose mobility decreased can be increased. However, there is no proven positive effect of swinging on sleeping sickness, appetite, flatulence, ascites, mental status, gout, or kidney diseases. The information that people with varicose veins should avoid moving their legs too much is not true. Today, exercise programs containing muscle contractions are used to treat and prevent varicose veins.

## The best time for commencing exercise, the proper duration and other rules

Avicenna explained when exercise should be done. He stated that, to be able to do exercise, there should not be immature or remaining liquids (blood, yellow bile, black bile, sputum) in abdomen and blood vessels. Furthermore, he also stated that

exercise should be done when food from the previous day has been digested in the stomach, liver and blood vessels and almost when the following supertime has come. He emphasized that exercise should be done when the stomach is empty, instead of when it is full. Before commencing exercise, the intestine and bladder should also be empty. Exercise done in hot and humid climate is better than cold and dry climate. Massage before exercise revives the innate heat and expands the holes. He explained that exercise can be done best in moderately warm room round midday in spring. The best time for exercise is towards evening in summer. Exercise should be done in early hours and in a properly heated room.

Avicenna stated that exercise can be maintained as long as hand and feet can easily move and organs continue swelling up. He stated that when these findings disappear and perspiration, instead of evaporation, starts, exercise of running should be stopped. If exercise requires holding the breath frequently, it is necessary to rub the body with oil after the exercise.

When this chapter is examined, it is recommended that exercise should be done when the stomach is completely empty. This statement is not true according to today's knowledge because it is tied to many parameters such as when and how much food should be eaten before exercise, climate, exercise intensity, duration, what time the exercise would be done. Today, it is preferred to eat a nosh, which is easily digestible and contains carbohydrates, since it improves the performance. It is recommended that especially diabetic patients do exercise two hours after the meals.

The information that exercises done in hot and humid climate are better than the ones done in cold and dry climate is not true. It is extremely difficult to do physical activities in hot and humid air, which are easily done in cool air.

Together with exercise, edema forms by accumulation of liquid in interstitial area. In the work, it was stated that exercise should be maintained as long as swelling in the organ continues; however, there is no such relationship today. Furthermore, the information that exercise should be stopped when perspiration starts is not true. Perspiration is a physiological mechanism which prevents organs from being damaged by preventing extreme increase in body temperature.

Avicenna stated that massage should be applied to the body after sports in which isometric contractions often occur, which especially require holding the breath. Massage is a method frequently used to decrease edema, pain and tension in muscles in the treatment of sports injuries. It is known today that post-exercise massage generates a mechanical stress on tissues and leads to increase in blood stream in the area of application by increasing arteriolar pressure. Therefore, we think that the information given by Avicenna about massage is true.

Regular physical activity has great importance in leading a healthy life. In recent years, with the change of modes of living, people have started to lead a physically inactive life. This has made physical inactivity a risk factor in terms of universal mortality.<sup>9</sup> Exercise, effective in prevention of diseases, protection of health and continuation of general well-being, is an important concept which medical scholars included in their works in very old periods, as in today.<sup>3</sup>

Medical doctrines of Avicenna largely affected both the Islamic world and Europe between the 11<sup>th</sup> and 17<sup>th</sup> centuries.<sup>6</sup> In the "*Canon of Medicine*", there are examples expressing the protective and healing effect of exercise on diseases, and exercise principles are seen to be systematically presented in three parts. In

the part in which general explanations about exercise were given, the protective property of exercise on temperament and humoral diseases was explained. The basis of the concepts 'temperament and humoral' stated by Avicenna is based upon Galen and Hippocrates.<sup>10</sup> Temperament is the physical conditions with hot, cold, dry or humid organs. Bodily fluids consist of four fluids: blood, yellow bile, black bile and sputum.<sup>7</sup> According to this theory, physiological or pathologic explanations of diseases and health are made with the balance of opposite elements forming temperament. An external factor may lead to disease by spoiling the equilibrium state between bodily fluids.<sup>11</sup> In the text, protective property of exercise against diseases, which occur with loss of temperament and humoral balance, was mentioned. Today, it is also known that exercise is effective in preventing many chronic diseases and reducing the risk of mortality.<sup>12,13</sup>

Just like Galen, Avicenna also stated that toxins get out of the body thanks to exercise.<sup>3</sup> Today, it is known that perspiration formed by exercise done as aerobics plays a role in getting toxic elements out of the body.<sup>14</sup>

Avicenna classified exercise by taking into account parameters such as duration, intensity and rate. In terms of intensity, exercises were defined as strenuous, moderate and vigorous; however, he did not state by which parameter he classified exercise intensity. While Hippocrates mentioned heating and weight loss effects of moderate exercises, he considered that excessive exercise may lead to disease.<sup>2</sup> Greatly influenced by the ideas of Hippocrates, Galen expressed that movements can be regarded as exercise only when they include vigorous activities. He associated the difficulty degree of exercise to its heavy effect on respiration.<sup>3</sup> Galen classified exercises as slow or swift, atony or vigorous, gentle or violent.<sup>15</sup> Significant similarity between the exercise-related classification of Avicenna and that of Galen shows that Avicenna was influenced by Galen also in the field of exercise. In modern exercise science, duration, severity and rate are taken into account in strengthening and aerobics exercise programs and alterations are made in exercise prescription when needed. Furthermore, methods such as maximum oxygen consumption, maximum heart rate percentage and heart rate reserve are used in determining exercise intensity.<sup>16</sup>

Physical activity done in hot and humid weather conditions cause central body temperature to increase faster. Contrary to today's knowledge, Avicenna stated that exercise should be done in hot and humid climate. Furthermore, he stated that exercise should be stopped as perspiration starts. Since perspiration starts earlier in hot and humid climate, there is a disharmony between these two statements.

## Conclusions

Avicenna was greatly influenced on exercise by Hippocrates and Galen as in other fields. Although there is false information about exercise, there is information, valid today, as well. The most prominent of them is personalized planning of exercise program and the protective effect of exercise. The work of Avicenna is a valuable book contributing to the historical development process of exercise.

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The authors declared no conflicts of interest with respect to the authorship and/or publication of this article

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