TURKISH JOURNAL OF SCIENTIFIC RESEARCH

Volume I Issue III ISSN:2148-5135



THE ROLE OF SPORT IN A HEALTHY LIFESTYLE: AN ANATOMICAL AND PHYSIOLOGICAL PERSPECTIVE

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ARTICLE INFO:

Received:08.11.2026
Revised: 09.11.2026
Accepted:10.11.2026

KEY WORDS:

sport, physical activity, cardiovascular system, respiratory system, skeletal muscles, bone health, metabolism, sedentary behaviour, preventive medicine.

ABSTRACT

Regular physical activity is an important component of a healthy lifestyle and contributes to the functional capacity of several body systems. This article discusses the anatomical and physiological responses associated with exercise, focusing on the cardiovascular and respiratory systems, skeletal muscles, bones, metabolism and psychological well-being. It also considers the possible consequences of prolonged sedentary behaviour, particularly among university students, and the role of physical activity in preventive medicine. The article is a narrative review based on scientific literature and international recommendations, complemented by the author's reflections on the importance of sport in everyday life. No independent experiments or clinical observations were conducted.

1. INTRODUCTION

A healthy lifestyle is one of the fundamental conditions for maintaining human health, improving quality of life and reducing the risk of chronic diseases. It includes regular physical activity, balanced nutrition, adequate sleep and the avoidance of harmful habits. Sport is a practical way to increase movement and stimulate adaptive responses in the human body. From an anatomical and physiological perspective, these responses involve coordinated changes in the heart, blood vessels, lungs, skeletal muscles, bones and nervous system.

In modern society, many educational and occupational activities require people to remain seated for long periods. University students, for example, may spend much of the day attending lectures, reading, using computers and preparing assignments. Although these activities require

sustained mental effort, they can reduce opportunities for movement. Prolonged sedentary behaviour is associated with adverse health outcomes, particularly when it replaces regular physical activity. Short movement breaks and an active daily routine can therefore be important components of health promotion.

The World Health Organization recommends that adults perform 150–300 minutes of moderate-intensity aerobic physical activity or 75–150 minutes of vigorous-intensity activity per week, together with muscle-strengthening activities involving major muscle groups on at least two days per week [1]. These recommendations should be adapted to individual abilities and health conditions.

The aim of this article is to examine the role of sport in maintaining a healthy lifestyle, with particular attention to its anatomical and physiological effects on the human body. It also discusses sedentary behaviour, student health and the responsibilities of future healthcare professionals in promoting safe physical activity.

2. MATERIALS AND METHODS

This article was prepared as a narrative review of established physiology and anatomy textbooks, public-health recommendations and scientific literature concerning physical activity and preventive medicine. The discussion focuses on the cardiovascular, respiratory, musculoskeletal, metabolic and nervous systems. No independent experiments, surveys or clinical observations were performed. The author's reflections are presented as interpretation and practical discussion, while physiological explanations are framed in accordance with published scientific knowledge.

3. EFFECTS OF SPORT ON THE CARDIOVASCULAR SYSTEM

The heart can be compared to a continuously operating pump that maintains blood circulation throughout the body. Its primary function is to move blood through the pulmonary and systemic circulations, allowing oxygen and nutrients to reach tissues and supporting the removal of carbon dioxide and metabolic waste products. The heart is therefore central to the maintenance of cellular activity. The comparison with a household water pump helps illustrate this role: if the pump stops, the system can no longer deliver fluid where it is needed. Unlike a mechanical pump, however, the heart is a living muscular organ regulated by nervous, hormonal and local mechanisms.

Even during ordinary activities such as walking, climbing stairs or doing household tasks, the cardiovascular system adjusts to the body's changing needs. When exercise begins, working skeletal muscles require more oxygen and energy. In response, heart rate and the force of cardiac contraction generally increase, and blood flow is redistributed towards active tissues. These responses increase oxygen delivery in accordance with the metabolic demands of exercise.

Regular exercise can produce long-term adaptations in the myocardium. In people who undertake consistent endurance training, the heart may develop a greater capacity to fill and eject blood. Depending on the type, intensity and duration of training, physiological cardiac remodelling may include changes in left ventricular dimensions and wall thickness. Such

adaptations are not necessarily signs of disease; they may represent a normal response to repeated physical demands. Nevertheless, not every increase in heart size is beneficial, and physiological adaptation must be distinguished from pathological enlargement.

One important adaptation is an increase in stroke volume, the amount of blood ejected by a ventricle during one contraction. When stroke volume increases, the heart may maintain an appropriate cardiac output with fewer beats per minute at rest. This helps explain why some well-trained people have a lower resting heart rate. A lower resting pulse can be a normal training adaptation, although heart rate is also influenced by age, medication, health status and other factors.

In my view, the ability to pump a greater volume of blood with each beat is one of the most interesting benefits of regular exercise. I would compare it to two machines performing the same task: one needs to repeat its action many times, while the other completes the task more efficiently with each cycle. The comparison is not exact, because the heart does not simply wear itself out by beating more often. However, it helps explain cardiovascular efficiency. An increase in stroke volume, together with adaptations in the muscles and circulation, can contribute to improved exercise capacity and endurance.

People who are regularly active often develop better cardiorespiratory fitness and can perform everyday physical tasks with less relative effort. A person who rarely exercises may experience a higher heart rate and greater breathlessness during the same activity because the task represents a larger challenge relative to their fitness level. This does not mean that every sedentary person's heart is weak or that breathlessness on stairs is necessarily caused by cardiac dysfunction. Breathlessness can have many causes, including low fitness, respiratory conditions, anaemia and cardiovascular disease; persistent or severe symptoms require medical assessment.

Physical activity also supports vascular function. Repeated increases in blood flow during exercise create physiological forces on the vascular endothelium, the thin layer of cells lining blood vessels. Regular activity can support endothelial function and contribute to healthier regulation of vascular tone and blood pressure. Exercise is associated with a lower risk of cardiovascular disease, although it cannot eliminate all risk factors. Genetics, age, smoking, diet and existing disease also influence cardiovascular health.

I strongly believe that developing healthy movement habits during youth can be valuable for health in later life. Regular activity can help maintain cardiorespiratory fitness, muscle strength and healthy routines. These benefits may support independence and everyday functioning with ageing. Exercise in youth cannot guarantee that a person will never develop hypertension, myocardial infarction or heart failure, but physical activity across the lifespan can reduce several modifiable risk factors.

4. EFFECTS OF SPORT ON THE RESPIRATORY SYSTEM

The main function of the lungs is to provide gas exchange between the external environment and the blood. Oxygen from inhaled air passes across the thin alveolar–capillary membrane into

pulmonary capillary blood, while carbon dioxide moves in the opposite direction and is removed during exhalation. Oxygen is transported to tissues, where it is used in cellular energy production. Carbon dioxide, produced by metabolism, is carried by the blood to the lungs. The respiratory and cardiovascular systems therefore work together to maintain the body's internal environment.

The lungs can be described as the body's gas-exchange station. This comparison illustrates the continuous entry of fresh air and removal of carbon-dioxide-rich air. However, the lungs are not simply a filter: gas exchange occurs by diffusion across the alveolar–capillary membrane, and its effectiveness depends on ventilation, pulmonary blood flow and the matching of these processes.

During running or other vigorous activity, working skeletal muscles require more energy and use oxygen at a higher rate. They also produce more carbon dioxide. Pulmonary ventilation therefore increases: breathing usually becomes faster and deeper. Respiratory centres in the brainstem coordinate the activity of the diaphragm and other respiratory muscles. Chemoreceptors respond to changes in carbon dioxide, hydrogen-ion concentration and oxygen, while signals from exercising muscles and joints also contribute to the adjustment in breathing.

The diaphragm is the principal muscle of quiet inspiration. It is a dome-shaped sheet of skeletal muscle separating the thoracic and abdominal cavities. When it contracts, its central portion moves downwards and the thoracic cavity expands. This lowers intrathoracic pressure and helps draw air into the lungs. During quiet expiration, the diaphragm relaxes and returns towards its dome-shaped position as the lungs and chest wall recoil. During intense exercise, intercostal and accessory respiratory muscles assist ventilation.

Regular physical training can improve the endurance and coordination of respiratory muscles. However, ordinary aerobic exercise does not necessarily cause a large increase in adult lung size, alveolar number or vital capacity. Improvements in endurance are explained to a considerable extent by adaptations in the heart, blood vessels and skeletal muscles, as well as improved oxygen extraction and use by working tissues. Specific respiratory muscle training may produce more targeted changes in respiratory muscle strength.

A trained person may sustain a given running pace with less perceived effort and better coordination of breathing. This does not mean that alveoli automatically exchange gases several times faster or that the brain's respiratory centre becomes insensitive to carbon dioxide. Rather, improved overall fitness means that the same task represents a lower relative workload. Pacing, movement efficiency and tolerance of exertion also contribute.

In my opinion, the respiratory system clearly demonstrates that physical activity is a whole-body process. The lungs bring oxygen into the body, the heart transports it, and the muscles use it to produce energy. Endurance depends on the coordinated function of ventilation, circulation and muscular metabolism.

5. SMOKING, PHYSICAL INACTIVITY AND RESPIRATORY HEALTH

Smoking harms the respiratory system through exposure to irritating and toxic substances. Tobacco smoke damages the airway lining, impairs the function of cilia that normally help move

mucus and trapped particles out of the respiratory tract, and promotes chronic inflammation. Long-term exposure can contribute to chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema. In emphysema, destruction of alveolar walls reduces the surface area available for gas exchange and decreases the elastic recoil of the lungs.

Physical inactivity has a different effect. It should not automatically be described as causing the lower parts of the lungs to stop participating in ventilation or as producing a specific increase in anatomical dead space. However, inactivity reduces cardiorespiratory fitness and may weaken general muscular conditioning. Consequently, everyday activities can feel more demanding, and a person may become breathless at a lower level of exertion than someone with better fitness.

From a preventive-medicine perspective, avoiding tobacco smoke and maintaining regular, individually appropriate physical activity are practical ways to support respiratory and general health. Exercise cannot reverse all smoking-related structural damage, but stopping smoking and following appropriate medical advice can reduce further harm.

6. SKELETAL MUSCLES AND BONES

Skeletal muscles produce movement, maintain posture and generate heat. Their contractions depend on interactions between actin and myosin filaments within muscle fibres. These interactions require energy supplied by adenosine triphosphate (ATP). During resistance exercise, muscles experience mechanical tension and other signals that stimulate adaptation. With appropriate training, nutrition and recovery, muscle protein synthesis increases and muscle fibres may become larger. This increase in fibre size is known as hypertrophy; ordinary training-related growth is explained mainly by enlargement of existing fibres rather than a routine increase in their number.

Exercise can improve muscle strength, endurance and coordination. Depending on the type of training, adaptations may include changes in mitochondrial function, capillary supply and the ability to use oxygen. Adequate recovery is important because training creates a temporary stress that the body must adapt to. Muscle soreness can occur after unfamiliar or intense activity, particularly after eccentric exercise, but severe or persistent pain should not be regarded as a necessary sign of progress.

Bones are living tissues that respond to mechanical loading. Weight-bearing and resistance activities provide stimuli that can help maintain or improve bone strength. In contrast, prolonged inactivity or immobilisation can contribute to loss of bone mass and muscle strength. Movement also helps maintain joint mobility. Articular cartilage has no direct blood supply; the exchange of nutrients through joint fluid is supported partly by normal joint movement.

Morning exercise or gentle movement after waking can help a person transition into daily activity, increase alertness and reduce stiffness. It does not need to be intense: stretching, mobility exercises or a short walk may be sufficient for many people. The most useful routine is one that can be performed safely and consistently.

7. SPORT, METABOLISM AND GLUCOSE REGULATION

Skeletal muscles are major sites of glucose use. During muscular contraction, glucose uptake by muscle cells can increase through pathways that are partly independent of insulin. Regular physical activity can also improve insulin sensitivity, meaning that the body may respond more effectively to insulin. These effects are relevant to the prevention and management of type 2 diabetes.

Exercise increases energy expenditure and can support the regulation of body composition when combined with appropriate nutrition and sufficient recovery. The metabolic response depends on exercise intensity, duration, frequency and the person's health status. Physical activity should therefore be viewed as one component of a broader lifestyle approach rather than as a substitute for medical treatment when treatment is needed.

8. SPORT, THE BRAIN AND PSYCHOLOGICAL WELL-BEING

Physical activity can influence mood and psychological well-being through several interacting mechanisms. Exercise affects the regulation of stress responses and the activity of neurotransmitter systems involved in mood and motivation. Some people experience reduced tension and improved mood after physical activity. Hormonal responses vary: cortisol and adrenaline can rise temporarily during vigorous exercise, while regular activity may support healthier long-term stress regulation. It is therefore too simplistic to state that exercise always lowers stress hormones immediately.

Exercise is also associated with benefits for aspects of cognitive function, including attention, memory and executive function. One mechanism under investigation is brain-derived neurotrophic factor (BDNF), a protein involved in neuronal maintenance and synaptic plasticity. Physical activity may influence BDNF signalling, although the size and duration of cognitive benefits vary across individuals and studies. Exercise should be described as supporting brain health rather than guaranteeing the formation of new neurons or a dramatic improvement in memory.

After exercise, a person may feel more alert or positive because of changes in arousal, mood, circulation and other physiological processes. In my opinion, this is particularly relevant to students: a short period of movement between study sessions may provide a useful change from prolonged sitting and help make the daily routine more balanced.

9. PROLONGED SITTING, STUDENT HEALTH AND THE AUTHOR'S DISCUSSION

Studying for long periods requires concentration and sustained mental effort. However, when academic work is performed while sitting for many hours, muscular activity decreases. The muscles of the lower limbs remain relatively inactive, and the leg-muscle pump, which assists venous blood return towards the heart, is used less frequently. Some people may experience stiffness, discomfort or temporary tingling, particularly when posture places pressure on nerves or blood vessels. Prolonged sitting should not be described as inevitably slowing the heart rate;

heart rate is influenced by many factors. The central concern is reduced movement and energy expenditure.

In my opinion, students should not consider physical activity a waste of study time. Short walks, gentle stretching or other suitable exercises between study sessions can help interrupt sedentary behaviour and make the daily routine more balanced. Physical activity may support attention and learning through improvements in general fitness, mood and sleep quality. Cerebral blood flow is regulated by the body, so it is more accurate to explain the cognitive benefits of exercise through several interacting mechanisms rather than simply claiming that blood always reaches the brain faster.

As a future healthcare professional, I regard sport not merely as entertainment but as an important part of preventive healthcare. Physical activity cannot replace necessary medicines or clinical treatment, but it can complement medical care and help preserve functional capacity. A doctor should understand both the benefits and the limitations of exercise and should avoid giving identical recommendations to every patient.

I believe that promoting a culture of physical activity requires more than telling people to exercise. Communities need safe public spaces, accessible sports facilities, walking routes and cycling infrastructure. Educational institutions can support students by providing opportunities for movement and encouraging active breaks during long study periods. Public-health communication should explain the benefits of activity in clear and practical language.

If I were advising a patient, I would recommend choosing an activity appropriate to their age, physical abilities and medical condition, then increasing it gradually. Brisk walking, cycling, swimming or suitable strengthening exercises may be options depending on the individual. A balanced plan should also include adequate sleep and nutrition. People with chronic diseases, significant symptoms or concerns about exercise should seek individual medical advice before starting a demanding programme.

I believe that physical activity should be accessible and realistic for the whole population, not only for athletes or medical students. Future doctors can contribute by applying evidence-based recommendations in their own lives and by helping patients find safe ways to move more.

10. CONCLUSION

Sport and regular physical activity support the function of several interconnected systems of the human body. Appropriate exercise can improve cardiovascular fitness, strengthen muscles, support bone health, contribute to metabolic regulation and benefit psychological well-being. These effects help explain why physical activity is an important element of preventive medicine.

At the same time, exercise should be individualised. Its type, intensity and duration must take account of age, fitness, health status and personal circumstances. For university students, interrupting prolonged sitting and developing sustainable movement habits can be practical first steps. In my view, a society that values regular physical activity invests not only in physical fitness but also in long-term health and quality of life.

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