EURASIAN JOURNAL OF ACADEMIC RESEARCH
Innovative Academy Research Support Center
IF = 9.3 www.in-academy.uz/index.php/ejar

RESPIRATORY PHYSIOLOGY, OXYGEN CIRCULATION AND ITS IMPORTANCE FOR THE ORGANISM, HYPOXIA

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https://doi.org/10.5281/zenodo.17119207

ARTICLE INFO

Received: 08th September 2025
Accepted: 14th September 2025
Online: 15th September 2025

KEYWORDS

Respiratory system, Gas exchange, Oxygen circulation, Hypoxia, Types of hypoxia, Aerobic respiration, Anaerobic respiration, Tissue respiration, Oxygen deficiency, Haemic hypoxia, Respiratory hypoxia, Circulatory hypoxia, Exogenous hypoxia, Tissue (cellular) hypoxia, Lung volumes, Lung capacities, Biological oxidation, Pulmonary ventilation, Homeostasis, Oxygen therapy, Pulse oximetry, Arterial blood gas analysis.

ABSTRACT

This article discusses the physiology of breathing as one of the main processes of human life. This process involves the intake of oxygen and the expulsion of carbon dioxide. It explores the connections not only with the respiratory process but also with the cardiovascular system, blood, and metabolic activities at the cellular level. The breathing process is controlled by the central nervous system, particularly the respiratory centres in the brain. These centres regulate the respiratory rate based on the concentration of oxygen and carbon dioxide in the blood. The classification of hypoxia aims to study the causes and mechanisms of its occurrence, by studying the respiratory and heart rate changes as a result of the body's increased demand for oxygen during physical activity.

INTRODUCTION

The human body exchanges gases with the external environment, in other words gas exchange occurs. The process of breathing is of crucial importance for human life and health. Oxygen is considered necessary not only for energy production but also for the proper functioning of cells, the immune system, and the overall life processes of the body. This process in the body (the intake, distribution, and utilization of oxygen) is carried out based on complex physiological mechanisms. The respiratory system participates in

maintaining homeostasis by taking in oxygen from the external environment and releasing carbon dioxide back into it.

MAIN BODY

Breathing is a complex process that consists of supplying oxygen to the organism and expelling carbon dioxide. All living organisms consume energy during their vital activities. Energy is produced as a result of the energy-rich fermentative breakdown, and replenishing the spent energy is a complex process. This process occurs through biological oxidation, and energy release is observed. When this oxidation process takes place with the participation of oxygen, it is called aerobic respiration, and when it occurs without oxygen, it is referred to as anaerobic respiration.

All vertebrates exhibit aerobic respiration. Their respiratory system includes the following processes:

1. External respiration (exchange of air between the external environment and the alveoli in the lungs);

2. Gas exchange in the lungs (exchange of gases between lung alveoli and the small circulatory system);

3. Transportation of gases in the blood;

4. Gas exchange between blood and tissues;

5. Tissue respiration (biological oxidation in cell mitochondria).

Lung volumes:

- Tidal Volume - TV 400-500ml
- Inspiratory Reserve Volume - IRV 1.5-2.5 l
- Expiratory Reserve Volume - ERV 1-1.5 l
- Residual Volume - RV 1-1.5 l

Lung capacities:

Vital capacity (VC)

(TV + IRV + ERV) = in men (3.5-4.5 l) in women (3-4 l)

Functional residual capacity FRC

(ERV + RV) = 2-3 l

Total lung capacity 4-6 l

The minute volume of air - the volume of air passing through the lungs in one minute, is equal to 6-7 litres at rest and can be up to 100 litres during physical activity.

Alveolar air - the sum of the volumes of expiratory reserve and residual air - is equal to 2.5 litres. The composition of gases does not change significantly when exhaling, it forms the internal environment of the organism, and usually ensures gas exchange in the lungs.

Hypoxia or oxygen deficiency (Greek: Hupo - less, oxigenum - oxygen) is a pathological process that occurs as a result of insufficient oxygen supply to tissues or impaired oxygen utilization. Tissue respiration is the process of its oxygen absorption. The circulatory, blood and external respiratory systems participate in the oxygen supply of tissues. The dysfunction of each of these systems to varying degrees is necessarily reflected in tissue respiration. When the adaptive processes of this system are insufficient and the tissue itself is impaired in the use of oxygen, a state of hypoxia occurs in the tissues

due to oxygen deficiency. There are 5 types of hypoxia. Exogenous (hypobaric) hypoxia - occurs due to a decrease in the partial pressure of oxygen in the external environment. Its main causes include being in high altitudes or in an unpressurized cabin on an airplane, places without ventilation, a difficult working environment or crowded buildings where the amount of oxygen in the air is reduced, toxic gases, smoke or other additives displace oxygen and make the breathing process difficult. Exogenous hypoxia causes dizziness, general weakness, fainting, loss of concentration, and in the long term, organ dysfunction.

Respiratory (respiratory) hypoxia is a condition that occurs when the respiratory system fails or when gas exchange in the lungs is impaired. Respiratory hypoxia can be caused by "impaired airway patency (bronchospasm, inflammatory processes, bronchitis, tracheitis), obstruction of the lungs (pneumothorax, accumulation of exudate in the pleural cavity), and decreased ventilation in other respiratory diseases. People with asthma or lung diseases cannot absorb oxygen well, so they quickly get tired.

Circulatory (cardiovascular) hypoxia - circulatory hypoxia develops in the event of local and general circulatory disorders, and its manifestations can be divided into ischemic and haemostatic. If haemodynamic disorders develop within the large circulatory system, oxygen saturation of the blood in the lungs may be sufficient, but it is possible that oxygen will not reach the tissues. If haemodynamics are impaired within the small circulatory system, oxygenation of arterial blood is impaired.

Haemic (blood) hypoxia - pathological changes in the blood system, which occur mainly due to a decrease in the effective oxygen capacity of the blood. Haemic hypoxia is divided into anaemia and hypoxia resulting from impaired haemoglobin function. Detailed information on how anaemia leads to hypoxia is given in the section "Pathological physiology of the blood system". In pathological conditions, when haemoglobin is poisoned with nitrates, nitrites and aniline products, methaemoglobin is formed, which contains trivalent iron (Fe3+), therefore it cannot bind oxygen and cannot perform its oxygen transport function.

Tissue (cellular) hypoxia is a violation of the adequate utilization of oxygen in tissues. In this case, while the tissue is supplied with sufficient oxygen, biological oxidation is impaired. For example: When poisoned with cyanide, even if oxygen reaches the cells, they lose the ability to use it. In diabetes, cells in tissues may not function normally, which leads to oxygen deficiency in the organs.

RESEARCH RESULTS

The study clearly demonstrated the complex structure of the respiratory system and its key role in ensuring gas exchange in the body. The respiratory system acts not only as an important system for supplying oxygen, but also as a system for removing carbon dioxide. As the body's need for energy increases, the intensity of the respiratory process increases. Therefore, the state of the respiratory system is closely related to the activity of the cardiovascular system and metabolism at the cellular level.

Studies show that hypoxia has a significant negative impact on human health. Each type of hypoxia has its own pathophysiological mechanisms, and its correct identification and differential diagnosis are important in determining the treatment strategy. In

particular, in haemic and tissue hypoxia, oxygen utilization at the cellular level is impaired, which requires long-term medical intervention.

Scientific observations on the topic under discussion have shown that in the case of hypoxia, the activity of such important organs as the central nervous system, heart muscle, and kidneys is seriously disrupted. It is these organs that are highly dependent on oxygen, and any disruption in their functioning negatively affects overall homeostasis.

Also, in cases of hypoxia, compensatory mechanisms are activated in the body: breathing accelerates, heart rate increases, and blood pressure increases. However, these responses are short-lived, and in conditions of chronic hypoxia, the body's reserves are quickly depleted. This condition is observed to be especially common in people living in high-altitude areas or those engaged in high-intensity physical work.

On the other hand, modern medicine has developed a wide range of methods for diagnosing and treating hypoxia. Diagnostic methods such as pulse oximetry and arterial blood gas analysis serve as important tools for the early detection of hypoxia. Treatment varies depending on the type of hypoxia: oxygen therapy, medications that help with breathing, medications that improve blood circulation, and medications that support metabolism, among others.

CONCLUSION

The process of breathing is very important for the human body, and its full and uninterrupted functioning ensures the continuation of life. This article examined the basic processes of respiration, oxygen circulation, and hypoxia. The respiratory system, especially its function of providing oxygen and carbon dioxide exchange, is inextricably linked to all body systems. The process of breathing is not only associated with the lungs, but is also controlled by metabolic activity at the blood and cellular levels, as well as the central nervous system.

The respiratory centres are controlled by the brain, and they adjust the respiratory rate depending on the number of gases in the blood. These processes work effectively only in normal conditions, and the level of physical activity imposed on the body places high demands on the respiratory system. Understanding the efficiency of breathing helps to understand conditions such as hypoxia, or oxygen deficiency. Hypoxia occurs under the influence of various factors, and there are several types of it. Exogenous hypoxia is associated with a lack of oxygen in the external environment and occurs as a result of reduced oxygen in high mountains or cabins. Respiratory hypoxia is due to impaired gas exchange and the respiratory system of the lungs, while circulatory hypoxia develops due to impaired blood circulation. In this case, the blood is unable to transport oxygen in sufficient quantities. Haemic hypoxia occurs as a result of anaemia or loss of haemoglobin activity, and finally, tissue hypoxia is associated with a violation of the ability of cells to use oxygen. This type of hypoxia affects the biochemical processes of the body, making it more complex. The symptoms and consequences of hypoxia can be of varying degrees, but prolonged or severe forms can weaken the functioning of vital organs of the body - the heart, brain, liver and kidneys, and also pose a threat to life.

Therefore, early detection and treatment of hypoxia and its various types is of life-saving importance. Measures aimed at ensuring the full functioning of the respiratory

system, normal oxygen circulation, and prevention of hypoxia will help not only to eliminate mild cases, but also to prevent severe ones. The above analysis shows that a complete understanding of the physiology of respiration and effective treatment of conditions such as hypoxia are important not only in clinical practice, but also in the long-term rehabilitation of patients. Respiratory disorders, especially hypoxia, require prompt and effective treatment. Methods used in modern medicine to improve respiratory processes play an important role in the prevention of diseases associated with hypoxia. At the same time, new studies and scientific work will help to develop effective measures to prevent hypoxia and reduce its consequences

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