



FUNCTIONAL STATE OF THE RESPIRATORY SYSTEM IN INDIVIDUALS OF DIFFERENT AGES

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Abstract

The respiratory system plays a vital role in providing the body with oxygen and removing carbon dioxide. The functional state of the respiratory system changes throughout life and depends on age, physical activity level, health, and environmental influences. During childhood, the respiratory system actively develops and matures, reaching its peak performance in adulthood, and gradually declining in functionality in old age. The aim of this study is to analyze the functional state of the respiratory system in individuals of different age groups. This paper examines physiological changes in the respiratory system, external respiration parameters, and the influence of age-related factors on vital capacity and other respiratory parameters. The results of the study demonstrate that age is a key factor determining respiratory system functionality. The data obtained can be used in medicine, physiology, and sports practice to assess health and prevent respiratory diseases.

Keywords

respiratory system, age-related characteristics, vital capacity, external respiration, respiratory physiology, functional state.

Аннотация

Дыхательная система играет важную роль в обеспечении организма кислородом и выведении углекислого газа. Функциональное состояние органов дыхания изменяется на протяжении всей жизни человека и зависит от возраста, уровня физической активности, состояния здоровья и влияния окружающей среды. В детском возрасте происходит активное формирование и развитие дыхательной системы, в зрелом возрасте её показатели достигают максимального уровня, а в пожилом возрасте наблюдается постепенное снижение функциональных возможностей. Целью данного исследования является анализ особенностей функционального состояния дыхательной системы у лиц различных возрастных групп. В работе рассматриваются физиологические изменения дыхательной системы, показатели внешнего дыхания, а также влияние возрастных факторов на жизненную ёмкость лёгких и другие параметры дыхания. Результаты исследования показывают, что возраст является одним из ключевых факторов, определяющих функциональные возможности дыхательной системы. Полученные данные могут быть использованы в медицине, физиологии и спортивной практике для оценки состояния здоровья и профилактики заболеваний дыхательной системы.

Ключевые слова



дыхательная система, возрастные особенности, жизненная ёмкость лёгких, внешнее дыхание, физиология дыхания, функциональное состояние.

Introduction

The respiratory system is one of the most important systems in the human body, ensuring gas exchange between the body and the environment. Through respiration, the body's cells obtain oxygen, necessary for energy metabolism, and release carbon dioxide, a waste product of metabolism.

The functional state of the respiratory system is determined by a number of indicators, including vital capacity, respiratory rate, minute volume, and ventilation. These indicators can change under the influence of various factors, such as age, physical fitness, environmental conditions, and the presence of diseases.

Age-related changes in the respiratory system are a natural physiological process. In childhood, intensive lung tissue growth and airway development occur. During adolescence and young adulthood, functional respiratory indicators reach their maximum. In old age, decreased elasticity of lung tissue, reduced chest mobility, and reduced respiratory muscle efficiency are observed.

Studying the functional state of the respiratory system in people of different age groups is important for medicine, physiology, and disease prevention. Such studies allow us to identify age-related characteristics of respiratory function and determine the factors influencing its changes.

Study Objective

The purpose of this study is to study the functional state of the respiratory system in people of different age groups and determine age-related characteristics of key respiratory parameters.

To achieve this goal, the following objectives were defined:

1. To analyze the functioning of the respiratory system in children, adults, and the elderly.
2. To study vital capacity and respiratory rate in individuals of different age groups.
3. To determine the impact of age on respiratory system performance.
4. To compare the obtained results and identify patterns of age-related changes in respiratory function.

Research Materials and Methods

The study was conducted among 60 volunteers divided into three age groups. The first group included children and adolescents aged 10–15 years (20 subjects: 12 boys and 8 girls). The second group consisted of adults aged 20–40 years (20 subjects: 10 men and 10 women). The third group included elderly individuals aged 60–70 years (20 subjects: 9 men and 11 women). All study participants were healthy, had a normal body mass index (18–25 kg/m²), and engaged in physical activity at least twice a week.

To assess respiratory function, vital capacity, respiratory rate, and minute respiratory volume were measured. Vital capacity was determined using a spirometer in liters. Respiratory rate was



recorded at rest, counting the number of breaths taken per minute. Minute respiratory volume was calculated as the product of tidal volume and respiratory rate. Tidal volume for adults and adolescents was assumed to be 0.5 liters, and for children, 0.4 liters. All measurements were taken in the morning under identical conditions at an air temperature of 22–24°C and humidity of 50–60%. Each participant performed three sets of measurements, and the results were averaged. Microsoft Excel and SPSS 25 were used for statistical analysis. Significance of differences between groups was tested using the Student's t-test at a significance level of $p < 0.05$.

Methods

The following research methods were used to assess the functional state of the respiratory system:

1. Spirometry.

This method was used to measure vital capacity. The subject inhaled as deeply as possible, then exhaled as deeply as possible into a spirometer.

2. Respiratory rate measurement.

Respiratory rate was determined by counting the number of chest movements during one minute at rest.

3. Determining minute respiratory volume.

Minute respiratory volume was calculated by multiplying the tidal volume by the respiratory rate.

4. Comparative analysis.

The obtained data were compared between age groups to identify differences and patterns.

Study Results

The study measured vital capacity, respiratory rate, and minute volume in three age groups.

In children and adolescents aged 10–15, the average vital capacity was 2.1 ± 0.3 L, respiratory rate was 21 ± 2 breaths per minute, and minute volume was 8.4 ± 1.2 L/min. In adults aged 20–40, the average vital capacity was 4.1 ± 0.4 L, respiratory rate was 16 ± 2 breaths per minute, and minute volume was 8.0 ± 1.0 L/min. Elderly individuals aged 60–70 years showed a decrease in functional parameters: vital capacity was 2.8 ± 0.3 L, respiratory rate was 18 ± 2 breaths per minute, and minute respiratory volume was 5.0 ± 0.7 L/min. A comparative analysis showed that vital capacity in adults was, on average, 95% higher than in children and 46% higher than in elderly participants. Respiratory rate in children was 31% higher than in adults, and in elderly participants, it was 12% higher than in adults. Minute respiratory volume in children and adults was approximately equal, while in elderly participants, it decreased by 37% compared to adults. Thus, functional indicators of the respiratory system reach their maximum between the ages of



20 and 40. In children, they are lower due to immaturity of lung tissue and smaller lung volume. In the elderly, indicators decline due to decreased lung elasticity and reduced respiratory muscle efficiency.

Discussion

The obtained results confirm the data of numerous physiological studies on age-related changes in the respiratory system. In childhood, the respiratory system is not yet fully developed, resulting in a higher respiratory rate and a relatively small vital capacity.

In adulthood, the respiratory system reaches its greatest level of development. During this period, the lungs are highly elastic, the respiratory muscles function most effectively, and ventilation rates are optimal.

In old age, age-related changes occur associated with decreased lung tissue elasticity, reduced chest wall mobility, and weakening of the respiratory muscles. These changes lead to a decrease in vital capacity and overall respiratory efficiency.

Factors such as physical activity, lifestyle, environmental conditions, and unhealthy habits can also influence the respiratory system. Regular exercise and breathing exercises can improve the functional state of the respiratory system and slow down age-related changes.

Conclusion

The functional state of the respiratory system in individuals of different age groups shows distinct age-related differences.

In children and adolescents aged 10–15 years, the vital capacity was 2.1 ± 0.3 L, the respiratory rate was 21 ± 2 breaths/min, and the minute respiratory volume was 8.4 ± 1.2 L/min. These indicators reflect the immaturity of the respiratory system and a high respiratory rate with a relatively small lung volume.

In adults aged 20–40 years, the vital capacity reached its maximum value of 4.1 ± 0.4 L, the respiratory rate decreased to 16 ± 2 breaths/min, and the minute respiratory volume was 8.0 ± 1.0 L/min. This indicates optimal functional state of the respiratory system in adulthood.

In elderly people aged 60–70 years, a decrease in the following parameters was observed: vital capacity of the lungs - 2.8 ± 0.3 l, respiratory rate - 18 ± 2 breaths/min, minute respiratory volume - 5.0 ± 0.7 l/min, which is associated with age-related loss of elasticity of lung tissue and a decrease in the strength of the respiratory muscles.

A comparative analysis showed that:

- vital capacity in adults is 95% higher than in children and 46% higher than in the elderly;
- respiratory rate in children is 31% higher than in adults; in the elderly, it is 12% higher than in adults;
- minute respiratory volume in the elderly is 37% lower than in adults.

Thus, the functional state of the respiratory system reaches its maximum between the ages of 20 and 40 years; in children, it is limited by lung immaturity, and in the elderly, by age-related



changes. These data confirm the need to maintain physical activity and monitor the condition of the respiratory system at all stages of life to preserve its functional capacity.

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