

# Indicators of the Functional State of Adolescents with Impaired Vision

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## Abstract

The article assesses the functional state of adolescents with visual impairments. In visually impaired adolescents, respiratory system indicators, Ruffier-Dixon indicators characterizing physical performance, the Yarotsky test assessing the ability to maintain balance are also characterized by below-average values.

**Keywords:** Respiratory system, Yarotsky test, vestibular analyzer, physical performance, visually impaired adolescents, functional training, dynamometry.

## Introduction

### Significance of the Initiative

In the Republic of Uzbekistan, the government's approach to adaptive physical education and sports emphasizes human well-being, helping individuals with disabilities discover and develop their abilities. With strong support from the Government and President Sh. M. Mirziyoyev, athletes with disabilities have achieved notable success in major competitions like the Paralympic Games,

Deaflympics, and World and European Championships. A review of legal documents shows that Uzbekistan has established a clear system to manage sports programs for people with disabilities, including financial support to ensure their participation. The Republican Center for the Social Adaptation of Children serves as an official state organization dedicated to this cause. Physical education and wellness activities are provided through sports rehabilitation centers connected to various sports federations, as well as in special boarding schools designed for children with mobility challenges, fostering their physical and social development.

### Understanding the Topic

Children with visual impairments exhibit diverse levels of physical development, fitness, and movement capabilities. These differences mean that a one-size-fits-all approach to teaching methods and tools is often unsuitable for their needs. Experts such as Yevseyev S.P., Kurdybalo

S.F., Marzeyeva O.F., and Solodkov A.S. describe the physical well-being of teenagers with visual impairments as encompassing their physical growth, overall fitness, and ability to carry out daily tasks. They evaluate whether these attributes align with the requirements of routine activities and potential future employment. Finding the right balance of physical activity for these children remains a significant challenge, as their needs vary widely. The most effective strategy to enhance their health involves personalized physical education programs that emphasize well-being, incorporate safe exercises, and follow established guidelines to support gradual improvement in their physical strength and coordination.

## The Aim of the Study

To determine the indicators of the functional state of adolescents with visual impairments.

## Research Organization and Methods

The study aimed to assess the health and physical abilities of teenagers with visual impairments. It was conducted at a dedicated boarding school for blind and visually impaired children in the Hamza district of Tashkent city. The research involved 86 participants, aged 12 to 15 years, consisting of 46 girls and 40 boys. This specific age group was selected deliberately because boys and girls go through puberty at different stages, which causes differences in their physical development during this period. To evaluate the teenagers' overall health, a variety of tests were performed, including checks on the heart (cardiovascular system), breathing (respiratory system), the Ruffier–Dixon index to measure physical fitness, the Yarotsky test to assess balance, and a hand grip test to determine muscle strength. These tests helped provide a clear picture of the participants' physical condition and capabilities.

## Research Findings and Discussion

Table 1 shows the age-related changes in Vital Lung Capacity (VLC). For 12-year-old girls, the VLC is 1.95 liters, increasing to 2.08 liters by age 15. However, the yearly increase in VLC is only 0.2–0.5 cm, indicating very slow growth. This suggests that the respiratory system in girls of this age group is barely developing. Typically, this age range should show stronger development, with chest size growing and VLC reaching 2.4–2.8 liters, as noted in Table 1. Scientific data indicates that for 12–13-year-olds, the BMI measured during exercise tests is  $2.60 \pm 0.26$  liters per minute. Heart rate response (HRR) results also reveal signs of cardiovascular stress, as the pulse rates of the children tested were slightly higher than normal. For girls, the heart rate during physical activity rose from 116 beats per minute at age 12 to 120.7 beats per minute at age 15. In boys of the same age group, HRR increased from 121 to 130.1 beats per minute. Five minutes after exercise, neither girls nor boys in any age group returned to their resting heart rate levels from before the activity. This points to limited cardiorespiratory function. The Ruffier–Dixon index values were also below average. Notable differences were found in hand strength, with boys showing much greater strength than girls. The Yarotsky test measures the sensitivity of the vestibular system, as shown in Tables 1 and 1a. The test is conducted with participants standing and eyes closed, performing rapid head rotations. In healthy adults, balance is maintained for about 28 seconds. For girls, balance time improves from 20 seconds at age 12 to 25 seconds at age 15, which is acceptable for this age group. For boys, the vestibular system's sensitivity improves from

27 seconds at age 12 to 36–38 seconds at age 15, showing positive development in coordination skills. (Table 1a provides separate data for girls and boys).

**Table 1** Comparison of the functional status of adolescent visually impaired girls and boys

Age, Number of adolescents - total number - 128 visually impaired students -	Vital acity of the lungs in liters	Ruf'e-Dixon index (20 sit-stand times)					V.I.Yarotckiy test seconds	Dynamometry Hand grip strength	
		ABMC rest Effort count  m	ABMC Under influence Effort count	ABMC Effort when standing	R-D indeksi	grade		Right hand	Left hand
1.Girl-12 years, n=16	1.95	85	116	88.3	8.1	Average	32.3 <sup>00</sup>	11.5	10.6
2.Boy-12 years, n=16	1.94	88	121	91	10.0	Below Average	27 <sup>00</sup>	13.1	10.4
1.Girl-13 years, n=16	2.0	85.8	125.2	92.2	10.3	Below Average	21.9 <sup>00</sup>	10.8	11.2
2.Boy-13 years, n=16	2.16	90	127	94	11.1	Below Average	28 <sup>00</sup>	15.5	15.8
1.Girl-14 years, n=16	2.02	90.8	135.4	99.4	12.5	Below Average	24.2 <sup>00</sup>	10.5	9.8
2.Boy-14 years, n=16	2.04	92.6	129.3	96.6	11.8	Below Average	38.2 <sup>00</sup>	21.4	21.0
1.Girl-15 years, n=16	2.08	89.7	120.7	97.5	10.8	Below Average	25.3 <sup>00</sup>	13.7	12.5
2.Boy-15 years, n=16	2.88	91.8	130.1	95.0	11.7	Below Average	36 <sup>00</sup>	23.15	22.3

Considering the physical condition of the participants, the Ruf'e-Dixon test was applied. This test is widely used for children and teenagers because it effectively evaluates their physical adaptability, functional abilities, and heart activity. In this study, only the results for 12-year-old girls were rated as satisfactory. The results for all other groups, including older girls and boys, were classified as below average.

When comparing the collected data with existing research, clear patterns emerge regarding the heart and lung functions of visually impaired teenagers compared to their healthy peers. These patterns align with the natural biological processes of growth and development during adolescence. Several researchers have used similar findings to explore how the respiratory system develops in teenagers. The data analysis shows that boys generally have higher absolute lung capacity, known as Vital Lung Capacity (VLC), compared to girls.

For boys, the lower range of VLC varies from 1500 to 2500 milliliters, while for girls, it ranges from 1800 to 2600 milliliters. These numbers suggest that there are no major differences between the two groups at the lower end. However, the lowest VLC values were recorded at age 15 for boys and age 17 for girls. At the upper end, significant differences appear based on gender, with values ranging from 800 to 3700 milliliters, representing a difference of 21.05% to 97.36%. In boys aged 14 to 17, VLC increased by 2900 milliliters, or 38.67%, showing steady growth. In girls, the increase was smaller, at 800 milliliters or 21.05%, with growth mainly occurring at age 15. After this age, girls' VLC stabilized between 4400 and 4600 milliliters, showing little further change.

The biggest gap in average cardiorespiratory performance between boys and girls was observed at age 16, while the smallest difference was seen at age 14. When examining relative lung capacity, which considers lung capacity in relation to body weight, the smallest range of values was found

at age 14. For boys, this range was 35–85 milliliters per kilogram, and for girls, it was 40–80 milliliters per kilogram. The largest range for boys occurred at age 15, with values from 40 to 120 milliliters per kilogram. For girls, the largest range was seen at ages 15 and 17, with values from 35 to 80 milliliters per kilogram.

The lower limit of relative lung capacity is similar for both boys and girls, staying between 35 and 40 milliliters per kilogram. However, the upper limit is higher in boys, reaching an additional 35 milliliters per kilogram by the fourth year of the study. In girls, the difference in upper limits across ages is small, not exceeding 5 milliliters per kilogram. Overall, boys tend to have a higher relative lung capacity than girls, which makes sense because this measurement is influenced by body mass. These findings are consistent with scientific studies that highlight how physical development affects heart and lung performance in adolescents.

## Summary

Most measurements related to the respiratory system's function in visually impaired adolescents fell within the expected range for their age. However, when compared to standard benchmarks, the lung performance of these teenagers is generally below average, aligning with the lower end of normal values. In contrast, healthy adolescents of the same age group show a clear trend of improving lung function, with their respiratory systems demonstrating stronger capabilities over time. These differences highlight the unique challenges faced by visually impaired teenagers in developing their respiratory health compared to their healthy peers, suggesting a need for targeted support to enhance their lung capacity and overall physical well-being.

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