ORIGINAL ARTICLES. PHYSICAL THERAPY

Assessment of the functional state and level of physical fitness of people with immunodeficiency virus with different levels of T-lymphocytes in the practice of a physical therapist

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Abstract

Purpose: to assess the functional state of patients with human immunodeficiency virus with different levels of T-lymphocytes for use in the practice of physical therapy.
Materials and methods. We examined 24 patients with human immunodeficiency virus at the stage of acquired immunodeficiency syndrome at the outpatient stage of treatment. The patients were divided into 2 groups. Group 1 included 11 patients with CD4+ T-lymphocyte levels <100 cells ml^{-1}, and group 2 included 13 patients with CD4+ T-lymphocyte levels above 150 cells ml-1 (p<0.01). The clinical and anamnestic data, the main anthropometric parameters and physiological indices, the results of carpal dynamometry, the 6-minute walk test, characterizing the functional state of people living with the human immunodeficiency virus, were studied. The results of immunological, virological and biochemical parameters were also studied.
Results. Anthropometric indicators: Group 1 – body mass index 48.9±7.4 kg m2-1, waist to hip ratio ratio 0.92±0.17 cm, leg circumference 16.6±0.8 cm; Group 2 – body mass index 23.1±2.8 kg m^{2-1}, waist to hip ratio ratio 1.14±0.11 cm, leg circumference 15.9±1.4 cm (p>0.05). Indicators of physiological indices: Reed - group 1 - 17.3±7.2%, group 2 - 18.3±11.8% (p>0.05); Hobbes - group I 70.9 ± 5.5%, group 2 - 93.6 ± 11.8% (p<0.05), Kerdo - group 1 was 26.6 ± 14.2%, group 2 - 10 .8 ± 14.7% (p<0.05). Index of functional changes group 2 - 2.44±0.2 points, group 2 - 2.59±0.3 points (p>0.05). Dynamometry indicators - group I - 17.5 ± 6.8 kg, group 2 - 28.1 ± 9.4 kg (p>0.05); strength index – group 1 35.3±-9.6%, group 2 40.5±10.4% (p>0.05); 6 min walk test in group 1 - 402.8±40.04 m, group 2 459.7±56.1 m (p<0.05). Indicators of biochemical studies were in reference values ??in patients of both groups.
Conclusions. There is a decrease in the functional state and the predominance of catabolic processes in people with human immunodeficiency virus with a significant deficiency of CD4+ T-lymphocytes.
Keywords: acquired immunodeficiency syndrome, in human immunodeficiency virus, physical therapy, functional status

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Анотація

Андрій Орфін, Марія Мазепа. Оцінка функціонального стану та рівня фізичної підготовленості людей з вірусом імунодефіциту з різним рівнем Т-лымфоцитів у практиці фізичного терапевта

Мета: дати оцінку функціонального стану хворих на вірус іммудодефіциту людини з різним рівнем Т-лімфоцитів для використання в практиці фізичної терапії.

Матеріали та методи. Обстежено 24 пацієнти із вірусом іммудодефіциту людини на стадії синдрому набутого імунодефіциту на амбулаторному етапі лікування. Пацієнти були поділені на 2 групи. У І групу увійшло 11 пацієнтів із рівнем Т-лімфоцитів CD4+ менш. ніж 100 клітин·мл$^{-1}$, а у 2 – 13 пацієнтів із рівнем Т-лімфоцитів CD4+ вище 150 клітин·мл$^{-1}$ (p<0,01). Вивчено клініко-анамнестичні дані, основні антропометричні показники та фізіологічні індекси, результати кистьової динамометрії, тести 6-хвилинної ходьби, що характеризують функціональний стан людей, що живуть з вірусом іммудодефіциту людини. Також було вивчено результати імунологічних, вірусологічних та біохімічних показників.

Результати. Антропометричні показники: І група – індекс маси тіла 48,9±7,4 кг·м2-1, індекс співвідношення обводів талії до стегна 0,92±0,17 см, коло гомілки 16,6±0,8 см; 2 група – індекс маси тіла 23,1±2,8 кг·м$^{2\ -1}$, індекс співвідношення обводів талії до стегна 1,14±0,11 см, коло гомілки 15,9±1,4 см (p>0,05). Показники фізіологічних індексів: Ріда – І група 17,3±7,2%, 2 група 18,3±11,8% (p>0,05); Гоббса – І група 70,9 ± 5,5 %, 2 група – 93,6 ± 11,8 % (p<0,05), Кердо – І група становила 26,6 ± 14,2 %, 2 група – 10 ,8±14,7% (p<0,05). Індекс функціональних змін – І група 2,44±0,2 бали, 2 група – 2,59±0,3 бали (p>0,05). Показники динамометрії – І група – 17,5±6,8 кг, 2 група 28,1±9,4 кг (p>0,05); силовий індекс – І група 35,3±9,6%, 2 група 40,5±10,4% (p>0,05); тест 6 хв ходьби – І група 402,8±40,04 м, 2 група 459,7±56,1 м (p<0,05). Показники біохімічних досліджень були у референтних значеннях у пацієнтів обох груп.

Висновки. Спостерігається зниження функціонального стану та переважання катаболічних процесів у людей із вірусом іммудодефіциту людини зі значним дефіцитом Т-лімфоцитів CD4+.

Ключові слова: синдром набутого імунодефіциту, вірус імунодефіциту людини, фізична терапія, функціональний стан

Аннотация

Андрей Орфин, Мария Мазепа. Оценка функционального состояния и уровня физической подготовленности людей с вирусом иммунодефицита с разным уровнем Т-лимфоцитов в практике физического терапевта

Цель: дать оценку функционального состояния больных вирусом иммудодефицита человека с разным уровнем Т-лимфоцитов для использования в практике физической терапии.

Материалы и методы. Обследовано 24 пациента с вирусом иммудодефицита человека на стадии синдрома приобретенного иммунодефицита на амбулаторном этапе лечения. Пациенты были разделены на 2 группы. В I группу вошло 11 пациентов с уровнем Т-лимфоцитов CD4+ ≤ 100 клеток·мл$^{-1}$, а во 2 – 13 пациентов с уровнем Т-лимфоцитов CD4+ выше 150 клеток·мл$^{-1}$ (p≤0,01). Изучены клинико-анамнестические данные, основные антропометрические показатели и физиологические индексы, результаты кистевой динамометрии, теста 6-минутной ходьбы, характеризующие функциональное состояние людей живущих с вирусом иммудодефицита человека. Также были изучены результаты иммунологических, вирусологических и биохимических показателей.

Результаты. Антропометрические показатели: I группа – индекс массы тела 48,9±7,4 кг·м2^{-1}, индекс соотношения обводов талии к бедру 0,92±0,17 см, окружность голени 16,6±0,8 см; 2 группа – индекс массы тела 23,1±2,8 кг·м$^{2-1}$, индекс соотношения обводов талии к бедру 1,14±0,11 см, окружность голени 15,9±1,4 см (p≥0,05). Показатели физиологических индексов: Рида – I группа 17,3±7,2%, 2 группа 18,3±11,8% (p≥0,05); Гоббса – I группа 70,9 ± 5,5 %, 2 группа – 93,6 ± 11,8 % (p≤0,05), Кердо – I группа составляла 26,6 ± 14,2 %, 2 группа – 10,8 ± 14,7 % (p≥0,05). Индекс функциональных изменений – I группа 2,44±0,2 балла, 2 группа – 2,59±0,3 балла (p≥0,05). Показатели динамометрии – I группа – 17,5 ± 6,8 кг, 2 группа 28,1 ± 9,4 кг (p≥0,05); силовой индекс – I группа 35,3±-9,6%, 2 группа 40,5±10,4% (p≥0,05); тест 6 мин ходьбы – I группа 402,8±40,04 м, 2 группа 459,7±56,1 м (p≤0,05). Показатели биохимических исследований были в референтных значениях у пациентов обеих групп.

Выводы. Наблюдается снижение функционального состояния и преобладание катаболических процессов у людей с вирусом иммудодефицита человека со значительным дефицитом Т-лимфоцитов CD4+.

Ключевые слова: синдром приобретенного иммунодефицита, вирус иммудодефицита человека, физическая терапия, функциональное состояние

Introduction

Physical therapy for people living with human immunodeficiency virus at the stage of acquired immunodeficiency syndrome is a necessary and effective component of the treatment process at the outpatient stage [1]. At the same time, there are many unresolved issues in the conduct of physical therapy [2]. In particular, there is no single protocol for assessing the functional status of people infected by human immunodeficiency virus and dosing exercise [3].

The main achievement of antiretroviral therapy is the reduction of human immunodeficiency virus mortality and increase in life expectancy. Every year in Ukraine number of people living with human immunodeficiency virus over the age of 50 grows. However, the aging of people living with human immunodeficiency virus is accompanied by faster than in healthy people the development of cardiovascular pathology, osteoporosis, liver and kidney dysfunction, dementia [4]. This phenomenon has given rise to the term "accelerated or premature aging of people living with human immunodeficiency virus ".

The so-called "successful aging" includes either serious illness and maintaining functional status at the appropriate level and independence in daily life [5]. Thus, it is necessary to evaluate the infected by human immunodeficiency virus functional status to influence the impact of processes and lifestyle on successful aging. Physical therapy is appointed to reduce the rate of "premature aging" and improve the quality of life of people living with human immunodeficiency virus [6].

Previous studies evaluating functional status in infected by human immunodeficiency virus individuals were explored among older people living with human immunodeficiency virus, based on participants' self-reports, had a wide age range, or included patients with comorbid conditions that limited domestic physical activity. Several studies have compared fatigue rates and objective rates of higher functional status based on domestic physical activity among people living with human immunodeficiency virus [7,8]. Given the above, an outer assessment of people living with human immunodeficiency virus functional status is an urgent task in both physical therapy and infectology.

Purpose: to study the functional status of people living with human immunodeficiency virus at the stage of acquired immunodeficiency syndrome to select adequate means and methods of physical therapy.

Materials and methods

Participants

The study involved 24 people living with human immunodeficiency virus at the acquired immunodeficiency syndrome stage in the outpatient phase of treatment. All patients were investigated by the same researcher. Selection from the general sample was performed using the program Random Numbers and Names. Criteria for inclusion in the study were signing voluntary informed consent, the absence of acute diseases that required hospitalization, severe mental and cognitive disorders, age from 18 to 60 years. The exclusion criteria were cancer, gross neurological disorders, childhood and adolescence, pregnancy, nursing mothers, and those who refused to participate in the study.

Procedure

The research is part of the research them of the Department of Physical Therapy and Occupational Therapy of Lviv State University of Physical Culture named after I. Bobersky "Improvement of approaches to physical therapy of persons who have or may experience disabilities." This study is cross-cutting and performed in compliance with the main provisions of the "Rules of ethical principles of scientific medical research with human participation", approved by the Declaration of Helsinki (1964-2013), ICH GCP (1996), EEC Directive № 609 (from 24.11. 1986), orders of the Ministry of Health of Ukraine № 690 dated 23.09.2009, № 944 dated 14.12.2009, № 616 dated 03.08.2012.

Ethical Committee or Institutional Animal Care and Use Committee Approval. Ivan Bobersky Lviv State University of Physical Culture 17/11/2021 № 10.

Clinical and anamnestic data were obtained by analyzing the patient's medical records.

Among the many indicators of people living with human immunodeficiency virus functional status, we chose the most objective, informative, and accessible for the researcher and the researcher.

We used standard methods of measurement: body weight, height, body mass index, waist and hip circumference, shins, forearms, and index of the ratio of waist circumference to hip circumference. These anthropometric indicators reflect functional status in people living with human immunodeficiency virus due to manifestations of sarcopenia and lipodystrophy.

To assess the state of energy-metabolic processes and physical therapy action potential, the following indices were determined: the Reed index (percentage of deviation of the basic metabolism from the norm) was calculated by the formula: 0.75 * (HR + (PP * 0.74)) - 72, where HR - heart rate, beats·min^{-1}; PP - pulse pressure (mm Hg). Hobbes index (state of energy-metabolic processes) was evaluated by the formula: HI = BW * 100 / ((55 + 0.8 * (GROWTH - 150)), where BW is bodyweight, kg. Kerdo index (assessment of the physical therapy capacity of people living with human immunodeficiency virus and the degree of influence of the autonomic nervous system on the cardial-vessel system): (1 - DBP/ HR) * 100, where DBP - diastolic blood pressure, mmHg, HR - heart rate, beats·min^{-1}. Index of functional changes (assessment of physical therapy potential and capabilities) according to the method of Baevsky: 0.011 * (HR) + 0.014 * (SBP) + 0.008 * (DBP) + 0.014 * (age) + 0.009 * (BW) - 0.009 (G) - 0,027, where HR - heart rate, beats·min^{-1}, SBP - systolic blood pressure, mm Hg, DBP - diastolic blood pressure, mm Hg, BW - body weight, kg, G - growth, cm.

The wrist dynamometry was performed according to the standard method; the force index was calculated: wrist dynamometry * 100% / body weight.

The ability to tolerate physical activity was determined using a 6-minute walk test. The distance traveled by the patient in 6 minutes was a criterion for assessing his functionality.

Glucose, cholesterol, total protein, alanine aminotransferase, total bilirubin, urea, and creatinine were assessed from laboratory parameters.

In all patients, viral load was determined by polymerase chain reaction and T-lymphocyte CD4+ levels by flow cytofluorimetry.

Statistical analysis

Statistical data processing was performed using the analysis package Statistica 6.0 for Windows. We determined the arithmetic mean (X) and the standard deviation (S). The significance of the difference was assessed using Mann-Whitney U-test. The level of significance for the results was expressed using p value with $p < 0.05$ being statistically significant.

Results

Patients included in the study were divided into two groups according to the level of T-lymphocytes CD4+. Thus, group I included 11 patients who had a level of T-lymphocytes CD4+ ≤ 100 cells·ml^{-1}, and group 2 - 13 people living with human immunodeficiency virus with a level of T-lymphocytes CD4+ above 150 cells·ml^{-1}. The average age of patients in group I was 40.6 years, of which 8 (72.7%) were women, and 3 (27.3%) were men. The second group included 13 people living with human immunodeficiency virus; whose average age was 40.5 years, of which 8 (61.5%) were men and 5 (38.5%) women.

All patients had stage IV clinical human immunodeficiency virus infection. Group I patients lived with human immunodeficiency virus for an average of 9.2 years, and group 2 patients for 8.7 years.

The average level of T-lymphocytes CD4+ in patients of group I was 47.6 ± 26.5 cells·ml^{-1}, 2 - 282.6 ± 112.2 cells·ml^{-1}($p \leq 0,01$). The viral load was 630433 ± 278901.3 copies·µl^{-1} in group I patients and 209543 ± 278901.3 copies·

µl^{-1} in group 2 patients ($p \leq 0,01$). In group I, 9 (81.8%) patients received ART, in the second - only 4 (30.8%) patients.

Table 1

Anthropometric indicators of the studied patients with human immunodeficiency virus

Indicator	1 group n = 11		2 group n = 13		Uemp.	U0.01	U0.05	p
	Average indicators	Rank measure	Average indicators	Rank measure				
Height (cm)	167,09 ± 7,2	156 – 180	172,2 ± 9,1	158 – 184	46,5	31,0	42,0	≥0,05
Weight (kg)	48,9 ± 7,4	38 – 60	68,5 ± 12,6	50 – 84	12,0	31,0	42,0	≤0,01
body mass index (kg·m2^{-1})	17,5 ± 1,3	14,5 – 18,9	23,1 ± 2,8	19,4 – 28,5	234,0	173,0	205,0	≥0,05
Waist circumference (cm)	59,4 ± 14,4	40,1 – 85,6	78,2 ± 9,7	67,5 – 96,5	234,4	173,0	205,0	≥0,05

Thigh circumference (cm)	64,5 ± 9,8	47,1 – 78,3	68,6 ± 6,1	56,3 – 79,1	206,5	173,0	205,0	≥0,05
Ratio of waist to hips index (cm)	0,92 ± 0,17	0,7 – 0,13	1,14 ± 0,11	0,94 – 1,34	320,0	173,0	205,0	≥0,05
Forearm circumference (cm)	14,5 ± 1,3	12,5 – 16,9	15,3 ± 1,1	13,5 – 16,9	240,0	164,0	195,0	≥0,05
Shin circumference (cm)	16,6 ± 0,8	15,2 – 17,9	15,9 ± 1,4	13,8 – 17,8	240,0	164,0	195,0	≥0,05

The average height of patients in group I was 167.09 ± 7.2 cm, 2 - 172.2 ± 9.1 cm, (p≥0,05). Bodyweight was lower in patients of group I 48.9 ± 7.4 kg against 68.5 ± 12.6 kg of group 2, (p≤0,01). Body mass index was 17.5 ± 1.3 kg·m2^{-1} and 23.1 ± 2.8 kg·m2^{-1}, (p≥0,05) in people living with human immunodeficiency virus groups I and 2, respectively. It is noteworthy that the main contours were smaller in the first group of people living with human immunodeficiency virus. Thus, waist circumference was 59.4 ± 14.4 cm, hip circumference 64.5 ± 9.8 cm, forearm circumference 14.5 ± 1.3 cm, waist to hip ratio 0.92 ± 0.17 cm. In people living with human immunodeficiency virus from group 2 waist circumference was 78.2 ± 9.7 cm, thighs 68.6 ± 6.1 cm, forearms 15.3 ± 1.1 cm; index of the ratio of waist to hips 1.14 ± 0.11 cm. The circumference of the legs was greater in patients of group I 16.6 ± 0.8 cm against 15.9 ± 1.4 cm in group 2 (p≥0,05).

Generalized data from anthropometric measurements are given in Table 2.

Table 2

Indicators of the functional state of people living with human immunodeficiency virus

Indicator	1 group	2 group	Uemp.	U0.01	U0.05	p	Norm
Reed index (%)	17,3 ± 7,2	18,3 ± 11,8	221,0	158,0	188,0	≥0,05	±10
Hobbes index (%)	70,9 ± 5,5	93,6 ± 12,8	196,5	173,0	205,0	≤ 0,05	85 – 102
Kerdo index (%)	26,6 ± 14,2	10,8 ± 14,7	260,0	173,0	205,0	≥0,05	-10 – +10
Index of functional changes (points)	2,44 ± 0,2	2,59 ± 0,3	280,0	173,0	205,0	≥0,05	2,1 – 2,6
Wrist dynamometry (kg)	17,5 ± 6,8	28,1 ± 9,4	230,5	173,0	205,0	≥0,05	15 – 50
Force index (%)	35,3 ± 9,6	40,5 ± 10,4	255,0	173,0	205,0	≥0,05	45 – 70
6 minutes walk test (m)	402,8 ± 40,04	459,7 ± 56,1	33,0	31,0	42,0	≤ 0,05	500 – 600

As can be seen from Table 2, the Reed index was similar in value in both groups, in I - 17.3 ± 7.2% and 18.3 ± 11.8% in group 2 (p≥0,05), but higher than usual. These results may indirectly indicate an increase in catabolic processes in people living with human immunodeficiency virus at the stage of acquired immunodeficiency syndrome.

The Hobbes index in group 2 was within the norm of 93.6 ± 11.8%. In group, I it was lower 70,9 ± 5,5% (p≤0,05) than in group 2 and much lower than normal. Based on the indicators of Reed index and Hobbes index, we have identified individuals who have increased energy and metabolic processes caused by catabolism [7]. These indices must be necessary when choosing physical therapy tactics. In the first stage of physical therapy, there is a slowing down of catabolic processes. The program should include measures that promote muscle growth. Such measures include nutritional support and combined exercises (anaerobic and aerobic) of low intensity.

The Kerdo index in group I people living with human immunodeficiency virus was 26.6 ± 14.2%, and in group 2 people living with human immunodeficiency virus - 10.8 ± 14.7% (p≥0,05).

The value of the Index of functional changes in the amount of group I was 2.44 ± 0.2 points in part, group 2 - 2.59 ± 0.2 points (p≥0,05).

Dynamometry readings in group I 17.5 ± 6.8 and 28.1 kg ± 9.4 kg in group 2 were (p≥0,05). The force index was 35.3 ± 9.6% for group I people living with human immunodeficiency virus and 40.5 ±

10.4% for group 2 people living with human immunodeficiency virus (p≥0,05).

The results of the 6 min walk were lower than normal in patients of both groups: in patients of group I - 402.8 ± 40.04 m and 459.7 ± 56.1 m in patients of group 2 (p≤0,05). Summary results of the functional status assessment are presented in table 3.

Table 3

Biochemical parameters in patients with human immunodeficiency virus

Indicator	1 group n = 11	2 group n = 13	Uemp..	U0.01	U0.05	p
	Average indicators	Average indicators				
Hemoglobin g·l^{-1}	112,9 ± 20,7	128,6 ± 20,4	41,0	31,0	42,0	≤ 0,05
Erythrocyte sedimentation rate mm·hour^{-1}	33,6 ± 12,8	23,5 ± 21,2	48,0	31,0	42,0	≥0,05
Alanine aminotransferase Units·liter^{-1}	41,8 ± 25,5	41,3 ± 33,7	120,0	71,0	89,0	≥0,05
Total bilirubin mrmol·l^{-1}	14,3 ± 3,3	13,0 ± 4,2	266,0	166,0	197,0	≥0,05
Urea mmol·l^{-1}	5,7 ± 2,1	6,9 ± 8,0	264.5	124.0	150.0	≥0,05
Creatinine mmol·l^{-1}	84,7 ± 19,9	125,6 ± 159,3	201,0	102,0	125,0	≥0,05
Cholesterol mrmol·l^{-1}	4,5 ± 0,9	4,4 ± 0,6	284,5	164,0	195,0	≥0,05
Glucose mrmol·l^{-1}	4,9 ± 1,2	5,7 ± 2,6	286,5	164,0	195,0	≥0,05
Total protein g·l^{-1}	63,3 ± 9,9	69,1 ± 9,5	230,5	166,0	197,0	≥0,05

From the data in table 3, it is seen that the average hemoglobin in patients in group I was 112.9 ± 20.7 g·l^{-1} (from 75 g·l^{-1} to 150 g·l^{-1}); in patients of group 2 the average level of hemoglobin was 128.6 ± 20.4 g·l^{-1} (from 86 g·l^{-1} to 162 g·l^{-1}), (p≤0,05).

The erythrocyte sedimentation rate in group I people living with human immunodeficiency virus was 33.6 ± 12.8 mm·hour^{-1}, in group 2 people living with human immunodeficiency virus - 23.5 ± 21.2 mm·hour^{-1}, (p≥0,05).

Mean bilirubin levels were in the reference values in both groups, reaching 14.3 ± 3.3 mrmol·l^{-1} in group I people living with human immunodeficiency virus and 13.0 ± 4.2 mrmol·l^{-1} in group 2 people living with human immunodeficiency virus (p≥0,05). The average alanine aminotransferase level was close in two groups and was at the upper limit of normal: in patients of group I 41.8 ± 25.5 U·l^{-1} and patients of group 2 - 41.3 ± 33.7 U·l^{-1} (p≥0,05).

In group, I people living with human immunodeficiency virus, the average blood urea level was 5.7 ± 2.1 mrmol·l^{-1}, creatinine - 84.7 ± 19.9 mrmol·l^{-1} (p≥0,05). In patients of group 2, these values were 6.9 ± 8.0 mrmol·l^{-1} for urea and 125.6 ± 159.3 mrmol·l^{-1} for creatinine (p≥0,05).

Total cholesterol and glucose were in the reference values in patients of both groups. In people living with human immunodeficiency virus in group I cholesterol is 4.5 ± 0.9 mrmol·l^{-1}, glucose is 4.9 ± 1.2 mrmol·l^{-1}, in people living with human immunodeficiency virus in group 2 cholesterol is 4.4 ± 0.6 mrmol·l^{-1} (p≥0,05) and glucose is 5.7 ± 2.6 mrmol·l^{-1}. Total protein in patients of group I was 63.3 ± 9.9 g·l^{-1}, in the second group - 69.1 ± 9.5 g·l^{-1} (p≥0,05). Table 3 shows the indicators of general and biochemical blood tests of the studied patients.

Discussion

In this study, we examined the indicators of people living with human immunodeficiency virus at the stage of acquired immunodeficiency syndrome in the Lviv region (Ukraine). The age range of study participants in group I was 33 - 61 years, in group 2 32 - 59 years so, it is consistent with the statistical indicators for Ukraine [4]. Among people living with human immunodeficiency virus included in the study, the average T-lymphocytes CD4+ in the first group reached 47.6 ± 26.5 cells·ml^{-1}, and in the second group - 282.6 ± 112.2 cells·ml^{-1}(p≤0,01), which indicates significant immune dysfunction. In

contrast to ours, many studies have examined functional status in people living with human immunodeficiency virus with T lymphocyte CD4+ counts greater than 500 cells·ml^{-1} [7,9].

We found that the mean body mass index was 17.5 ± 1.3 kg·m2^{-1} and 23.1 ± 2.8 kg·m2^{-1} ($p \geq 0,05$), which is similar to the results of researchers from Kenya 20.5 [10]. To assess the redistribution of adipose tissue and the degree of depletion, body contours were determined. This is due to the negative impact of ART on the distribution of fat in the body of people living with human immunodeficiency virus and the presence of dysmetabolic syndrome [11]. The decrease in waist circumference may be caused by poor nutritional support [12], which in our case requires further study.

According to the results of the Reed index in people living with human immunodeficiency virus, accelerated metabolism is observed: 17.3 ± 7.2% and 18.3 ± 1.8% in groups I and 2, respectively ($p \geq 0,05$). The same changes in metabolism were found in related studies [13,14]. We found changes in energy and metabolic processes in people living with human immunodeficiency virus by calculating the Hobbes index in patients of group I - 70.9 ± 5.5%, and in group 2 this figure was within normal limits ($p \leq 0,05$). Such results may indicate significant catabolic processes due to severe T-helper insufficiency. However, only a few researchers have studied the intensity of catabolic processes in people living with human immunodeficiency virus with low T-lymphocytes CD4+. Their results show an increase in catabolism in people living with human immunodeficiency virus with acquired immunodeficiency syndrome who do not receive antiretroviral therapy [15]. However, in people living with human immunodeficiency virus with a sufficient level of CD4+ T-lymphocytes, there is an accumulation and redistribution of mercury, which may be due to side effects of ART and slowing of metabolic processes [13,15].

The autonomic nervous system's effect on the cardiovascular system in people living with human immunodeficiency virus was studied by calculating the Reed index. Positive Reed index in group I, which goes beyond the reference range, significantly impacts the sympathetic nervous system. It may also indicate catabolic processes in the body of people living with human immunodeficiency virus. In group 2, the result is observed within normal limits, but with a tendency to the predominance of the sympathetic nervous system. Studies [16] have found chronic stress in people living with human immunodeficiency virus, indicating a predominance of the sympathetic nervous system.

We found that despite functional impairments, people living with human immunodeficiency virus has sufficient physical therapy capacity. This is indicated by the indicators index of functional changes in I (2.44 ± 0.2%) and 2 (2.59 ± 0.3%) groups ($p \geq 0,05$), which were within normal limits. The index of functional changes suggests that people living with human immunodeficiency virus in the acquired immunodeficiency syndrome stage has a good rehabilitation potential, in particular for the use of therapeutic exercises [6,8].

Wrist dynamometry and force index also testify to the good prospects of physical therapy in people living with human immunodeficiency virus. We found that these indicators correspond to the norm in the two groups of people living with human immunodeficiency virus. Similar results were found in other researchers [17]. Despite the preserved physical therapy mechanisms in people living with human immunodeficiency virus, we found a decrease in exercise tolerance, which was achieved using 6 minutes walking test. As in other studies [18], we found a decrease in the results of this test in both groups I and 2.

Difficulties in performing physical therapy in people living with human immunodeficiency virus are also due to the manifestations of chronic inflammation of low intensity, which in our study was manifested by accelerated erythrocyte sedimentation rate. In group I 33.6 ± 12.8 mm·hour^{-1} and in group 2 - 23.5 ± 21.2 mm·hour^{-1} ($p \geq 0,05$). This type of inflammation in people living with human immunodeficiency virus has been repeatedly mentioned in other studies [13].

The ability to tolerate therapeutic exercises of people living with human immunodeficiency virus is demonstrated by normal indicators of liver enzymes, bilirubin, urea, and creatinine. However, the level of total protein may indicate the need for nutritional support in people living with human immunodeficiency virus performing therapeutic exercises. The need for dietary correction is reported by other researchers [12].

Conclusions

Anthropometric parameters, laboratory parameters, and the results of immunological studies in people living with human immunodeficiency virus at the stage of acquired immunodeficiency syndrome indicate a decrease in functional status and the predominance of catabolic processes. For a comprehensive assessment of the functional status, it is advisable to study the state of the respiratory and

cardiovascular systems, physical therapy in general and therapeutic exercises, in particular, should be aimed at reducing the manifestations of catabolism, and in the best case, the stimulation of anabolic processes in the body of people living with human immunodeficiency virus at the stage of acquired immunodeficiency syndrome.

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Conflict of interest

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