THE IMPORTANCE OF CARDIAC REHABILITATION FOR PATIENTS WITH SURGICALLY CORRECTED VALVULOPATHIES

Radu-Valentin CHIȚĂ[1*], Mariana CORDUN[1], Mircea BRATU[1], Cozeta-Anca MINCULESCU[1], Mario DI CARLO[2]

[1] National University of Physical Education and Sport, Faculty of Physiotherapy, Bucharest, Romania
[2] University of Ferrara, Ferrara, Italy
*Corresponding author: radu.valentin.chita@gmail.com

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Abstract. *In the specialized literature, valvulopathies are defined as functional or organic conditions affecting one or more heart valves, disrupting their ability to open or close properly and affecting the heart's overall function. During surgery, the diseased heart valve is replaced with a prosthesis using extracorporeal circulation. Currently, the most commonly used prostheses are biological and mechanical. Physiotherapy plays a crucial role in the rehabilitation of patients with surgically corrected valvulopathies, primarily due to its beneficial effects on the respiratory and cardiovascular systems, which help ensure functional independence. In the late 1970s, Dr. Nanette Wenger proposed the first cardiac rehabilitation program. This program recommended, for the first time, early mobilization of the patient, aiming to transition the patient from a supine position to sitting and eventually to moving within 14 days. The purpose of this study is to present and implement a cardiac rehabilitation program, as well as to analyse its effects based on the results obtained from monitoring and evaluating selected patients. The conclusions of this study validate the research hypothesis that the application of a cardiac rehabilitation program leads to an increase in effort capacity (and, consequently, the quality of life), in patients with valvulopathies surgically corrected by minimally invasive techniques.*

Keywords: *valvulopathy, physiotherapy, cardiac rehabilitation program.*

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Introduction

Cardiovascular disease refers to a group of conditions affecting the heart and blood vessels, including cerebrovascular disease, coronary heart disease, rheumatic heart disease, and other related disorders. According to the World Health Organization (2021), they are the leading cause of death worldwide, claiming approximately 17.9 million lives each year. At the same time, according to the World Health Organization, more than four out of five deaths caused by vascular diseases are due to heart attacks and strokes, and a third of these deaths occur prematurely in people under 70 years old (World Health Organization, 2021).

Cardiovascular diseases cause more than 4 million deaths each year in Europe, accounting for 45% of all deaths. Coronary heart disease and cerebrovascular disease were the most common causes of death from cardiovascular disease, accounting for 1.8 million and 1.0

million deaths, respectively (Townsend et al., 2016). Cardiovascular disease accounted for 31.5% of all deaths and 45% of all deaths from non-communicable diseases in the 2013 report, more than twice that from cancer, as well as more than all communicable disorders, maternal, neonatal and nutrition combined (Townsend et al., 2016).

Ischemic heart disease was the leading cause of death in Romania in 2018, accounting for over 19% of all fatalities, according to the 2022 country profile by the Observatory on Health Systems and Policies. The mortality rate from ischemic heart disease in Romania was more than double the EU average. Additionally, deaths from cerebrovascular accidents, the second leading cause of death, made up 16% of all deaths, despite significant improvements since 2000. (OECD/European Observatory on Health Systems and Policies, 2022).

Valvulopathies refer to pathological valvular conditions, isolated or within other diseases, affecting one or more heart valves, leading to changes in the structure and dysfunction of the valvular apparatus.

A significant current public health concern is the increase in atherosclerotic valvular lesions compared to rheumatic ones. This shift is largely due to the use of echocardiography in diagnosing patients with valvular diseases.

According to Benjamin et al. (2019) although rheumatic heart disease is uncommon in high-income countries such as the United States, it remains an important cause of morbidity and mortality in low- and middle-income countries. In 2015, 33.4 million people were estimated to be living with rheumatic heart disease around the world, with sub-Saharan Africa, South Asia, and Oceania having the highest concentration of disability-adjusted life-years attributable to rheumatic heart disease.

According to Iung et al. (2019), the EURObservational Research Program Valvular Heart Disease II Survey reinforces the findings of the 2001 Euro Heart Survey on valvulopathies, demonstrating the predominance of aortic stenosis and degenerative mitral stenosis, the high frequency of elderly patients with valvulopathies, and the inherent burden of comorbidities.

In the specialized literature, valvulopathies are defined as functional or organic diseases that affect one or more heart valves, disrupting their ability to open or close properly and affecting the overall functioning of the heart.

Physiotherapy, through the effects induced on the systems that make up the human body, especially on the respiratory and cardiovascular systems, is the primary therapeutic intervention for rehabilitating patients with surgically corrected valvulopathies to ensure functional independence.

Rehabilitation addresses the impact of a health condition on a person's daily life by optimizing their functioning and reducing disability. It expands the focus of health beyond preventive and curative care to ensure that people with health conditions can remain as independent as possible and engage in education, work and meaningful life roles (World Health Organization, 2022).

Based on the 2019 Global Burden of Disease study, Cieza et al. (2020) state that an estimated 2.4 billion people live with conditions that could benefit from rehabilitation and this number has increased by about two thirds during the past three decades and reflects the enormous and growing need for rehabilitation.

The first cardiac rehabilitation program was proposed in the late 1970s by Dr. Nanette Wenger, who recommended early patient mobilization for the first time. According to Wenger

(1986), the objectives of this 14-day cardiac rehabilitation program included transitioning the patient from a supine to a sitting position and encouraging movement under medical supervision.

According to Seo et al. (2017), inpatient cardiac rehabilitation has been routinely conducted after cardiac surgery in several countries, with various outcomes reported. However, there is inadequate data on the status of inpatient cardiac rehabilitation in Korea.

Data from the study by Sumide et al. (2009) suggest that exercise intolerance in patients with surgically corrected valvulopathies is linked to decreased muscle strength. Further studies are needed to evaluate whether increasing lower limb muscle strength through resistance training could effectively improve effort capacity.

Price et al. (2016) believes that aerobic training programs, supplemented with resistance exercises, are recommended and considered safe for patients following cardiac rehabilitation programs. Based on research evidence, this approach may also lead to superior patient outcomes and should be considered when developing an international consensus for exercise prescription in cardiac rehabilitation.

Any definition of the quality of life includes a reference to a person's physical condition, but this should not be evaluated solely based on bodily functions measured with standardized parameters. It should also be correlated with the degree of satisfaction perceived in relation to this level of functionality.

In the biopsychosocial model developed by Engel (1977), it is stated that understanding a person's medical condition requires considering not only biological factors but also psychological and social factors. According to Irtelli and Durbano (2020), this definition shifts the focus from objectively definable functionality to the dimension of subjectivity, and assessing both aspects can provide a reliable measure of quality of life.

The *aim* of this study is to analyse the effects of applying a cardiac rehabilitation program based on the results obtained from monitoring and evaluating selected patients.

Through this study, we aim to verify the following hypothesis: the application of the cardiac rehabilitation program leads to an increase in effort capacity in patients with valvulopathies surgically corrected by minimally invasive techniques.

Methodology

Participants

The study was conducted between September 2022 and February 2023 at a centre of excellence in cardiovascular surgery in Bucharest. This hospital specializes in performing complex surgical interventions and providing integrated post-operative medical services. It has the advantage of having a physiotherapy room equipped with equipment and apparatus for the rehabilitation of patients with surgically corrected valvulopathies, through minimally invasive techniques.

Additionally, the necessary equipment is available to perform and monitor the tests included in the cardiac rehabilitation program for these patients with surgically corrected valvulopathies.

Ten subjects were included in the study based on the following criteria:

The inclusion criteria used were:

- Valvulopathies surgically corrected by minimally invasive techniques (aortic stenosis - AoS or mitral insufficiency - MiI);
- Good general condition;
- Age: 55 – 65 years;
- Consent to participate in the study.

The exclusion criteria used were:

- Complex interventions with surgically corrected valvulopathies and coronary bypass;
- Age < 55 years old or > 65 years old.

Table 1. *Data about study participants*

Item no.	Age (years)	Gender	Height (cm)	Weight (kg)
1	55	M	171	88
2	64	F	156	70
3	58	M	168	78
4	55	F	158	90
5	55	F	163	45
6	56	M	180	104
7	65	F	162	79
8	56	F	162	90
9	65	M	176	79
10	60	M	180	93

Procedure

The cardiac rehabilitation program includes the following stages:

- **Initial stage** – *Evaluation of effort capacity at the time of patient admission*

From the perspective of a cardiac patient rehabilitation, this stage serves an evaluative role. Based on the tests included in the program, it allows for the determination of the patient's initial level of effort capacity. In this study, to estimate and evaluate the initial level of preoperative effort capacity, we calculated and monitored the following parameters:

- Heart rate (HR), using a pulse oximeter;
- Blood pressure (BP), systolic and diastolic, with a digital blood pressure monitor at the beginning and end of the assessment;
- Oxygen saturation (SpO_2), using a pulse oximeter;
- Maximum oxygen consumption (VO_2max), using an Apple Watch series 8.

The cardiac rehabilitation program becomes a training program similar to the sports training program, representing a systematic and continuously graded pedagogical process of adaptation of the human body to physical and mental efforts.

The cardiac physiotherapy program consists of the following stages, as shown in Table 2.

Table 2. *Stages of the cardiac physiotherapy program*

Stages	Duration (days)	Activities
Stage I	▪ days 1-2	- starts 24 hours after the patient is transferred to the ward; - breathing exercises; - passive mobilizations of the upper and lower limbs.
	▪ days 3-4	- breathing exercises - deep inhale and exhale; - exercises with minimum resistance performed from the supine position; - the patient is moved from supine to a sitting position for a short period of time; - minimal resistance exercise with increased dwell time;
Stage II	▪ days 5-6	- continuation of the exercises from the days 3-4; - exercises to maintain joint mobility with the patient sitting on a chair with a backrest; - walk through the room and to the bathroom with attendant.
	▪ days 7-8-9	- continuation of the days exercises 5-6; - breathing exercises with positive expiratory pressure (PEP) therapy devices; - walk through the room and to the bathroom with attendant; - progressive walking on the corridor 50-150 m (assisted).
Stage III	▪ days 10-11	- continuation of the days exercises 7-9; - exercises to preserve joint mobility with the patient sitting or standing; - progressive walking on the corridor 50-200 m (assisted).
	▪ days 12-13-14	- continuation of the days exercises 10-11; - moving alone along the corridor with increasing distance; - moving in the corridor up and down a flight of stairs, preferably starting with the first descent (assisted).

- **Final stage** – *Final functional assessment*

In the final stage, we measured the monitored functional parameters and performed the 6-minute walk test (6MWT), the obtained values determine the level of the patient's effort capacity after the cardiac rehabilitation program and before hospital discharge.

Results

In the following we will present, analyse, and interpret the data obtained from the dynamic measurements (initial and final assessments) to confirm or refute the study hypothesis and to develop conclusions regarding the therapeutic intervention for subjects with surgically corrected valvulopathies.

During the study, the following assessments were conducted:

- During the initial phase, an assessment of the patient's effort capacity at the time of admission took place;
- In the final phase the assessment of the patient's effort capacity at the time of discharge.

Analysis and interpretation of the results - The 6-minute walk test (6MWT)

In the 6-Minute Walk Test (6MWT), patients were asked to walk along a 20-meter hallway, marked by two cones, with the distance travelled measured over a period of six minutes. The 6-minute walk test served as both an initial and final assessment, as well as a criterion for hospital discharge.

The preliminary analysis of the data revealed that, for the results obtained by the study participants in the 6-minute walk test, no marginal values were identified in either the initial or final assessments.

The main indicators of descriptive statistics were calculated for the group of participants in this research (N=10) based on the results obtained in the evaluation test—both at the initial and final testing stages.

We present, in Table 3, the values of the main statistical indicators: mean (m), median – score in the middle of the distribution, which divides the data into two equal halves, mode (the value that appears with the highest frequency in a data string), the standard deviation (S) - also called the mean square deviation, represents the deviation/dispersion of the values from the mean, the coefficient of variability (Cv) - provides information on the degree of homogeneity of the group results, the skewness index and the kurtosis index, for the study group that included 10 participants, in the case of the results obtained during the initial assessment at the 6-minute walk test, a test that evaluates the effort capacity.

Table 3. *Descriptive statistics – results of the 6-minute walk test initial assessment*

6-minute walk test (6MWT)	
Main statistical indicators	Initial test results (m)
N	10
Mean	282,6
Median	289,5
Mode	-
S	43,8
Cv	0,15
Skewness	-0,24
Kurtosis	-1,43

We can highlight the following important aspects:

- The arithmetic mean of the study group is m = 282.6; the median is 289.5; standard deviation (S = 43.8); the coefficient of variability (Cv) is 0.15, which means that the homogeneity of the results of the group was ensured; the skewness (-0.24) and kurtosis (-1.43) indices fall within the range of ±1.96, indicating that the research data in this case are normally distributed (Hahs-Vaughn et al., 2020).

Table 4. *Descriptive statistics – results of the 6-minute walk test final assessment*

6-minute walk test (6MWT)	
Main statistical indicators	Final test results (m)
N	10
Mean	398,2
Median	412,5
Mode	-
S	59,3
Cv	0,14
Skewness	-0,24
Kurtosis	-1,47

We present in table 4. the values of the main indicators of the descriptive statistics, in the case of the evaluation sample – the 6-minute walking test, for the results recorded by the participants in the final evaluation. It can be seen that:

- At the end of the present research, the participants obtained an average result of 398.2 meters; the median is represented by the value 412.5 meters; the standard deviation is 59.3; the coefficient of variability is 0.14, which means that the homogeneity of the results was ensured; the indices of skewness (-0.24) and kurtosis (-1.47) are in the accepted range (±1.96) which means that the distribution is symmetrical and the research data is normally distributed.

The results of the research participants from the initial assessment of the 6-minute walk test, which measures an individual's effort capacity, were compared with the final results obtained after the therapeutic intervention. To determine if there were significant statistical differences between the two assessment points, the Wilcoxon test for two dependent samples was employed. (Predoiu, 2020).

Table 5. *Results of the 6-minute walk test - initial test values vs. final test values*

Wilcoxon test	Initial assessment vs. final assessment
	6-minute walk test (6MWT)
Wilcoxon	0
Z	-2,803
p	0,00
r	0,88

The statistical analysis of the data, illustrated in Table 5, comparing the results obtained by the study participants during the initial assessment with the results from the final assessment, in the case of the 6-minute walk test, highlights the following relevant aspects:

- There are significant differences ($p < 0.01$) between the results recorded at the initial assessment (median = 289.5) and those obtained in the case of the final assessment (median = 412.5), by the 10 participants of research for the applied test;
- The effect size is r = 0.88, in the case of the evaluation of the functional capacity by performing the 6-minute walk test, which, according to the specialized literature (Sheskin, 2011), means that the effect of the therapeutic intervention is a very strong one on the results of the participants, which improved significantly after the cardiac rehabilitation program.

Measurement of functional parameters

The main functional parameters of the body were measured: heart rate (HR), systolic and diastolic blood pressure (BP), oxygen saturation (SpO_2) and maximum oxygen consumption (VO_2max), in the case of the 10 research participants, both at the time of their admission (initial assessment) and at the time of their discharge (final assessment).

The preliminary analysis of the data was conducted to identify any potential extreme (marginal) values. The results of this analysis did not reveal the presence of any excessive values in either the initial (hospitalization) or final (hospital discharge) assessments concerning the functional parameters studied.

The next step was the calculation of the main indicators of descriptive statistics: arithmetic mean (m), median, mode, standard deviation (S), coefficient of variability (Cv), skewness index and kurtosis index, for the study group that included 10 participants, in the case of measuring: heart rate (HR), systolic and diastolic blood pressure (BP), oxygen saturation (SpO_2), as well as maximum oxygen consumption (VO_2max), at the initial time of the research (hospitalization).

Table 6. *Descriptive statistics – results of functional parameters initial assessment*

Indicators	**Initial assessment results (hospitalization)**				
	Heart rate (HR)	Blood pressure (BP)		Oxygen saturation (SpO_2)	Maximum oxygen consumption (VO_2max)
		systolic	diastole		
N	10	10	10	10	10
Mean	79,7	126	74,7	92,2	33
Median	75,5	125	70	92	34,5
Mode	-	130; 120	70	92	25; 37; 40
S	13,7	21,8	14,7	1,31	5,84
Cv	0,17	0,17	0,19	0,01	0,17
Skewness	0,29	-0,07	0,13	-0,08	-0,25
Kurtosis	-1,60	-0,54	-0,19	-0,75	-1,64

Table 6 presents the values of the main indicators of descriptive statistics for the results of the initial assessment (at the time of hospitalization) concerning the following functional parameters of the body:

- Looking at heart rate, the arithmetic mean of the study group is m = 79.7; the median is 75.5; standard deviation (S = 13.7); the coefficient of variability is 0.17, which means that the homogeneity of the results was ensured; skewness (0.29) and kurtosis (-1.60) indices indicate that the normality of data distribution was ensured;

- Regarding the measurement of systolic blood pressure, the participants registered at the time of admission, on average, a result of 126; median = 125; the distribution is bimodal, being two values that are repeated in the case of patient results: 130 and 120; standard deviation S = 21.8; the coefficient of variability = 0.17, indicating that the group is homogeneous in terms of results regarding systolic blood pressure; indices of skewness = -0.07 and kurtosis = -0.54 attest that the normality of the data distribution is ensured;
- Regarding the diastolic blood pressure measurement, the arithmetic mean is 74.7, the mode and the median have the same value (70), the standard deviation is 14.7; the coefficient of variability is 0.19, the group being thus homogeneous (taking into account the results of this index); skewness = 0.13, kurtosis = -0.19, which proves that the research data in this case was normally distributed;
- Looking at the oxygen saturation level, the arithmetic mean is 92.2, the mode and the median have the same value (92), the standard deviation is S = 1.31; the coefficient of variability is 0.01, the group showing a similar level (homogeneous group); skewness = -0.08, kurtosis =-0.75 indicating that the distribution is symmetric, mesokurtic (group values are normally distributed);
- In relation to the maximum volume of oxygen, the average of the results of the group is 33; median = 34.5; the distribution is multimodal, the repeated values being 25, 37 and 40; S = 5.84; the coefficient of variability is 0.17, which means that the group is homogeneous; skewness index is -0.25, kurtosis is -1.64, indicating that the group data is normally distributed.

Table 7. *Descriptive statistics – functional parameters results final assessment*

Indicators	**Final assessment results (hospital discharge)**				
	Heart rate (HR)	Blood pressure (BP) systolic	diastole	Oxygen saturation (SpO_2)	Maximum oxygen consumption (VO_2max)
N	10	10	10	10	10
Mean	68,8	110,5	67,1	98,6	37,5
Median	67,5	109,5	68,5	98,5	37,5
Mode	68	120; 110; 108	70	98	41; 37; 42
S	7,31	6,13	6,41	1,31	4,08
Cv	0,10	0,05	0,09	0,00	0,10
Skewness	0,95	0,28	0,63	0,11	-0,43
Kurtosis	-0,06	0,14	0,19	-0,62	-1,24

Table 7 lists the values of the main indicators of the descriptive statistics, in the case of the results of the final evaluation (at the time of discharge), regarding the functional parameters:

- Regarding heart rate, the arithmetic mean of the group of patients is m = 68.8; the median is 67.5; standard deviation (S = 7.31); the coefficient of homogeneity is 0.10, meaning that the results are homogeneous; skewness (0.95) and kurtosis (-0.06) indices show that the survey data are normally distributed for this functional index;
- Related to the measurement of systolic blood pressure, the participants registered on average a result of 110.5 at the time of discharge; median = 109.5; the distribution is multimodal, being three values that are repeated in the case of patient results: 120, 110

and 108; standard deviation S = 6.13; the coefficient of variability = 0.05, indicating that the group is homogeneous in terms of results regarding systolic blood pressure; skewness = 0.28 and kurtosis = 0.14 indices underline that the normality of data distribution is ensured;

- Regarding the diastolic blood pressure, the arithmetic mean is 67.1; the median value is 68.5; most of the patients had a value of 70; the standard deviation is 6.41; the coefficient of variability is 0.09, the investigated group of patients being homogeneous in terms of the results of this index; skewness = 0.63, and kurtosis = 0.19, the data being normally distributed;
- Regarding the level of oxygen saturation, the arithmetic mean is 98.6; the median value is 98.5; most patients recorded the value 98; the standard deviation is S = 1.31; the coefficient of variability is 0.00, the group having a similar level (the group is homogeneous); skewness = 0.11, kurtosis =-0.62 indicating that the distribution is symmetric, mesokurtic (patient values are normally distributed in this case);
- In relation to VO_2max, the average of the group results is 37.5; the median is also 37.5; the distribution is multimodal, the values that appear with the highest frequency being 41; 37; 42; the standard deviation is 4.08; the homogeneity coefficient Cv= 0.10, the group being a homogeneous one; the skewness index is -0.43, the kurtosis is -1.24 (data are normally distributed).

To determine whether there are statistically significant differences ($p < 0.05$) between the values recorded at the time of hospitalization and the values at the time of discharge for the patients included in the study regarding the main functional parameters, the non-parametric Wilcoxon test was employed.

All values measured initially were compared with those measured at the end of the cardiac rehabilitation program (hospital discharge), and the results of the Wilcoxon test will be presented for each functional index separately.

Table 8. *Heart rate results - hospitalization values vs. hospital discharge values*

Wilcoxon test	**Initial assessment vs. final assessment**
	Heart rate (HR)
Wilcoxon	3
Z	-2,497
p	0,01
r	0,78

Table 8 shows the comparison of the heart rate values obtained by the study participants, from the initial assessment (hospitalization) with those from the final evaluation (hospital discharge).

The calculation of the Wilcoxon test revealed the following important aspects:

- There are significant differences (p = 0.01), between the measured HR values at the time of admission (median = 75.5) and those at the time of discharge, after applying the treatment (median = 67.5), in the case of the 10 patients in the present study;

- The effect size indicator is r = 0.78, in the case of HR values, which means that the effect of the experimental intervention is very strong on the participants' results, which improved significantly after the cardiac rehabilitation program.

Table 9. *Systolic blood pressure results - hospitalization values vs. hospital discharge values*

Wilcoxon test	**Initial assessment vs. final assessment**
	Blood pressure (BP) Systolic
Wilcoxon	4
Z	-2,191
p	0,01
r	0,69

Table 9 shows the comparison of the systolic blood pressure values measured during the initial assessment (hospitalization) with the values measured during the final assessment (hospital discharge).

The calculation of the Wilcoxon non-parametric statistical test revealed the following relevant aspects:

- There are significant differences (p = 0.01), between the measured values of systolic BP at the time of hospitalization (median = 125) and those at the time of hospital discharge, after applying the cardiac physiotherapy program (median = 109.5), in the case of the 10 patients in the research;
- The effect size indicator is r = 0.69, in the case of systolic BP values, which means that the effect of the cardiac rehabilitation program is strong to very strong on the participants' results, which improved significantly, at the end of the research (at the time of discharge).

Table 10. *Diastolic blood pressure results - values hospitalization vs. hospital discharge values*

Wilcoxon test	**Initial assessment vs. final assessment**
	Blood pressure (BP) Diastole
Wilcoxon	13
Z	-1,478
p	0,138
r	-

In Table 10 we present the comparison made at the level of diastolic blood pressure values initially measured (hospitalization) with the values measured at the time of the final evaluation (hospital discharge).

The statistical analysis of the data revealed no significant differences (p > 0.05), between the measured diastolic BP values at the time of hospitalization and those at the time of hospital discharge.

Table 11. *Results regarding oxygen saturation - hospitalization values vs. hospital discharge values*

Wilcoxon test	**Initial assessment vs. final assessment**
	Oxygen saturation (SpO_2)
Wilcoxon	0
Z	- 2,803
p	0,00
r	0,88

Following the application of the Wilcoxon test, in Table 11 we present the results regarding the comparison between the oxygen saturation values measured at hospitalization and the values measured at hospital discharge.

Analysis of the results highlighted the following important points:

- There are statistically significant differences (p = 0.00) between the oxygen saturation values at the time of hospitalization (median = 92) and those at the time of discharge, after the application of kinetic treatment (median = 98.5), recorded by the 10 patients from the research;
- The effect size indicator is r = 0.88, in the case of SpO_2 values, which means that the effect of the therapeutic intervention is very strong on the results of the participants.

Table 12. *Results regarding maximum oxygen consumption - hospitalization values vs. hospital discharge values*

Wilcoxon test	**Initial assessment vs. final assessment**
	Maximum oxygen consumption (VO_2 max)
Wilcoxon	3,5
Z	- 2,446
p	0,01
r	0,77

Following the application of the Wilcoxon test, Table 12 presents the results regarding the comparison between the values of maximum oxygen consumption, measured at hospitalization and the values measured at hospital discharge.

The statistical analysis of the research data revealed that:

- There are statistically significant differences (p = 0.01) between the maximum oxygen consumption values measured at the time of admission of the patients (median = 34.5) and those at the final evaluation at the time of discharge, after the application of the physiotherapy cardiac program (median = 37 ,5), recorded by the study participants;
- The effect size is r = 0.77, in the case of VO_2max values, which means that the effect of the physiotherapy cardiac program is strong to very strong on the results of the patients in the study.

Discussion and Conclusions

At the international and national level, there are few studies and randomized trials that address cardiac rehabilitation programs for patients with surgically corrected valvulopathies.

According to Cieza (2019), rehabilitation includes the interventions needed when a person experiences limitations in everyday physical, mental, and social functioning due to aging or a health condition, including noncommunicable diseases, disorders, injuries, or trauma.

At both the international and national levels, there are few studies and randomized trials addressing cardiac rehabilitation programs for patients with surgically corrected valvulopathies.

Seo et al. (2017) recommended that rehabilitation programs involving physical exercises for patients during hospitalization be led by specialists, such as physiotherapists.

Within the multidisciplinary team, the physiotherapist's role is to create and monitor an individualized program of cardiac physiotherapy throughout the medical rehabilitation period of the patient with surgically corrected valvulopathies.

The cardiac rehabilitation program in this study functions as a training program similar to a sports program, representing a systematic and progressively graded pedagogical process that adapts the human body to physical and mental efforts.

According to Berney et al. (2012), physiotherapists in the intensive care unit (ICU) are primary contact practitioners who use a comprehensive multisystem assessment—including the respiratory, cardiovascular, neurological, and musculoskeletal systems—to formulate individualized treatment plans.

Mendez-Tellez and Needham (2012) re-evaluated the growing evidence supporting the feasibility and safety of early physical rehabilitation interventions for mechanically ventilated patients, highlighting their positive impact on patient outcomes.

Following the statistical analysis of the results in this study, significant differences were identified between the results recorded by the 10 participants at the time of the initial evaluation (hospitalization) and those obtained during the final evaluation (hospital discharge) concerning the 6-minute walk test. The effect size indicator for measuring effort capacity through the 6-minute walk test demonstrated that the impact of the cardiac physiotherapy program was very strong on the patients' results, confirming the program's effectiveness for the ten participants.

Furthermore, according to Bellet et al. (2012), there is strong evidence suggesting that the 6-minute walk test is sensitive to clinical changes following cardiac rehabilitation.

The cardiac rehabilitation program in this study serves as a training program similar to that of sports, representing a systematic and progressively graded pedagogical process that adapts the human body to physical and mental efforts.

In the study, Seo et al. (2017) recommended that rehabilitation programs involving physical exercises for hospitalized patients be led by specialists, such as physiotherapists.

Within the multidisciplinary team, the physiotherapist’s role is to develop and monitor an individualized cardiac physiotherapy program throughout the medical rehabilitation period for patients with surgically corrected valvulopathies.

According to Berney et al. (2012), physiotherapists in the intensive care unit (ICU) serve as primary contact practitioners and conduct a comprehensive multisystem assessment, which

includes the respiratory, cardiovascular, neurological, and musculoskeletal systems, to formulate individualized treatment plans.

Mendez-Tellez and Needham (2012) reevaluated the growing evidence demonstrating the feasibility and safety of early physical rehabilitation interventions for mechanically ventilated patients, highlighting their positive impact on patient outcomes.

Following the statistical analysis of the results from this study, significant differences were identified between the initial evaluation (hospitalization) results and those obtained during the final evaluation (hospital discharge) for the 10 participants regarding the 6-minute walk test. The effect size indicator for measuring effort capacity through the 6-minute walk test revealed that the impact of the cardiac physiotherapy program was very strong, confirming its effectiveness for all ten participants.

Furthermore, according to Bellet et al. (2012), there is strong evidence suggesting that the 6-minute walk test is sensitive to clinical changes following cardiac rehabilitation.

Regarding the main functional parameters of the body—heart rate (HR), systolic and diastolic blood pressure (BP), oxygen saturation (SpO2), and maximum oxygen consumption (VO2max)—the initial and final results of the ten research participants were compared. Statistical analysis revealed a statistically significant difference in heart rate values between the initial and final assessments. The effect size indicator for heart rate (HR) values indicated that the therapeutic intervention had a very strong effect on the participants' results, which improved significantly after the cardiac physiotherapy program.

Significant differences were also found in systolic blood pressure values between measurements taken at hospitalization and those recorded at discharge. The final evaluation showed significantly better results for systolic blood pressure, with values decreasing compared to the initial measurements.

For diastolic blood pressure values, although no statistically significant differences were observed between the two evaluation points, a notable difference was identified at the group average level: hospitalization (m = 74.7) compared to hospital discharge (m = 67.1) after the cardiac rehabilitation program.

In terms of oxygen saturation, significant differences were noted between measurements taken at hospitalization and those at discharge, highlighting a very strong effect of the cardiac rehabilitation program on participants' SpO2 values.

Regarding maximum oxygen consumption, significant differences were found between pre- and post-test measurements, with VO2max values significantly higher at the end of the study. The physical therapy program demonstrated a strong to very strong effect on the patients' results.

Overall, these findings indicate that the cardiac rehabilitation program implemented for the participants was effective, leading to significant improvements in functional parameters such as effort capacity, heart rate, systolic blood pressure, diastolic blood pressure, oxygen saturation levels, and maximum oxygen consumption. The patients showed enhanced effort capacity, achieving significantly better results compared to those recorded during the initial evaluation, when they exhibited reduced tolerance to physical exertion.

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Institutional Review Board Statement: The research was conducted according to the principles stated in the Declaration of Helsinki. Written informed consent was obtained for the patients to participate in the research. The study was approved by the Ethics Committee of the National University of Physical Education and Sport in Bucharest (ID: 51/1701/SG).

Informed Consent Statement: The participants provided their written informed consent to take part in this study.

Data Availability Statement: Data can be made available upon request to the contact author.

Conflicts of Interest: The authors declare no conflicts of interest.

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