

ABSTRACT

Dissertation by Kymbat Samatkyzy Trusheva on the topic:

“The development and clinical evaluation of a modular cardiac rehabilitation program for post-myocardial infarction patients, both with and without stenting”,

submitted for the degree of Doctor of Philosophy (PhD) in the educational program 8D10110 – “Medicine”.

Relevance of the research topic:

Cardiovascular diseases (CVDs) are the leading cause of mortality and morbidity worldwide, accounting for approximately one-third of all annual deaths (World Health Organization, 2025; Voutilainen A. et al., 2022; AACVPR, 2020). According to the latest data from the Ministry of Health of the Republic of Kazakhstan for 2020, cardiovascular diseases remain the leading cause of death in our country. In 2014, this rate was 168.98 cases per 100,000 population, and in 2020, it reached 192.76 cases, showing an upward trend.

Cardiac rehabilitation (CR) is an interdisciplinary, systems-based approach that has proven effective in secondary prevention. A meta-analysis of 63 randomized trials showed that cardiac rehabilitation after myocardial infarction reduces the incidence of recurrent myocardial infarction by 17% and mortality by 47% (Clark A.M. et al., 2005).

Based on cardiovascular mortality results, it is clear that a modern exercise-based approach to improving the quality of life of patients after myocardial infarction is safe and effective; it prevents secondary morbidity and mortality. Furthermore, exercise-based rehabilitation reduces the number of hospitalizations after myocardial infarction and is cost-effective and efficient. However, despite sufficient evidence of its positive effects, cardiac rehabilitation has not yet been fully implemented. Unfortunately, only one program recommended by practicing physicians is currently registered, and information on the general characteristics, course, and specific recommendations for its implementation is insufficient (Cowie A. et al., 2019). From a scientific perspective, it is important to explore new methods of cardiac rehabilitation in patients after myocardial infarction and to clarify the need for new programs incorporating new cardiac rehabilitation technologies to maximize the comprehensive benefits of cardiac rehabilitation. Therefore, the use of a program with specific measures and behavioral methods, as well as a course, necessitates research in the field of cardiac rehabilitation.

Aim of the study:

Development of a modular cardiac rehabilitation program and clinical study of the effectiveness of cardiac rehabilitation in stented and non-stented patients after myocardial infarction.

Objectives of the study:

1. Development of a modular cardiac rehabilitation program for stented and non-stented patients after myocardial infarction in the second and third stages of cardiac rehabilitation.

2. Determination of the clinical condition and physical load tolerance of stented and non-stented patients after myocardial infarction participating in the modular cardiac rehabilitation program and monitoring in dynamics.

3. Study of the effect of the modular cardiac rehabilitation program on the psycho-emotional state and drug compliance in patients after myocardial infarction.

4. Assessment of the quality of life after the modular cardiac rehabilitation program in stented and non-stented patients after myocardial infarction.

Research Methods:

The study was conducted at the CardioMed LLC clinic in Shymkent. General scientific (comparative, observational, analysis, and summary) and specific scientific (clinical, instrumental, laboratory, and statistical) research methods were used. During the cardiac rehabilitation period, demographic, anthropometric, clinical, and instrumental examinations were conducted. Quality of life, psycho-emotional state, and adherence to therapy were assessed using questionnaires. The questionnaire was administered in four stages: before cardiac rehabilitation, after cardiac rehabilitation, and after 3 and 6 months. Statistical analysis of the obtained data was performed using Microsoft Excel and the R 4.4.2 statistical computing program (R Foundation for Statistical Computing, Vienna, Austria). Differences were considered statistically significant at $p < 0.05$.

Study Object: 220 patients after myocardial infarction with and without coronary artery stenting.

Subject: Clinical efficacy of a modular program in stented and non-stented patients after myocardial infarction, specifically clinical and laboratory parameters, physical endurance parameters, quality of life, psychoemotional state, and compliance with drug therapy.

Key Provisions Submitted for Defense:

1. The developed modular program is an effective, scientifically sound, and patient-centered cardiac rehabilitation program for patients after myocardial infarction with and without stenting.

2. The modular cardiac rehabilitation program improves exercise tolerance (metabolic equivalent, maximum oxygen consumption, exercise duration), as well as psychoemotional state and treatment adherence in patients after myocardial infarction with and without stenting.

3. A modular cardiac rehabilitation program has a positive impact on the quality of life of patients who have had a myocardial infarction, as measured by the Seattle Cardiac Rehabilitation Questionnaire at 3 and 6 months.

Description of the main study findings:

According to the exercise capacity data, the duration of physical activity performed by patients in the modular program increased by approximately 110 seconds before discharge, by 658 seconds after 3 months, and by 732 seconds after 6 months, indicating an increase in patients' physical activity. However, although METs and VO₂ max did not increase immediately after discharge, METs increased by 1.4 and VO₂ max by 4.2 ml/kg/min after 3 and 6 months compared with baseline, clearly demonstrating an improvement in exercise capacity. The mean 6-minute walk distance (6MW) on admission was 240.5 (23) m, and at discharge, 6MW

reached 280 (40) m, an increase of 16% ($p < 0.05$). However, after 3 months the result increased by 32.5% and amounted to 318.5 (57.5) meters, and after 6 months it reached 350 (68.8) meters, which is 45.8%, which indicates a clear positive dynamic.

When assessing the impact of the cardiac rehabilitation program on psychological status using the HADS scale, no changes were found in anxiety and depression before discharge from the hospital at the initial stage, only anxiety decreased by 42.1% after 3 months and by 50% after 6 months. Meanwhile, the depression index decreased by 45.6% after 3 months and by 49% after 6 months. It was noted that the level of high adherence to medication intake increased by 21% after 3 months and by 36.1% after 6 months compared to the period of admission to cardiac rehabilitation. The average level decreased by 11.3% after 3 months and increased by 5.3% after 6 months compared to the initial stage. However, low adherence decreased by 22% after 3 months and by 38.9% after 6 months compared to the time of admission to the hospital. When comparing the results of the 3-month follow-up with the 6-month follow-up, the high degree of adherence increased by 12.9%, the average degree of adherence increased by 19.1%, and the low degree of adherence decreased by 50%.

Examining the impact of the modular program on quality of life, it was found that the angina stability index (AS) increased from 50 to 75 points, indicating stability of angina attacks in patients. The frequency of angina (AF) increased by 30%, while the number of angina attacks decreased. In terms of physical limitations, PL increased by 31% after 3 and 6 months compared to baseline. Satisfaction with treatment (TS) did not change significantly at discharge from the hospital or after 3 months. Only after 6 months did the score increase by 21%, indicating patient satisfaction. Regarding the disease perception scale, DP showed positive dynamics only after 3 and 6 months. The total score increased by 25%.

Scientific Novelty:

1. A scientifically based modular cardiac rehabilitation program for patients after myocardial infarction has been developed for the first time.
2. For the first time in the Republic of Kazakhstan, the clinical condition, physical endurance, psych-emotional state, and adherence to drug therapy of patients participating in a modular cardiac rehabilitation program were studied. In the physical activity module, which includes low- and moderate-intensity exercises, optimal parameters such as metabolic equivalent, maximum oxygen consumption, and exercise duration were studied.
3. The impact of the modular rehabilitation program on the quality of life of patients after myocardial infarction, based on the Seattle Heart Questionnaire, is described.

Practical significance of the results:

1. The modular cardiac rehabilitation program includes modules for initial assessment, physical exercise, psycho-emotional state correction, drug therapy, and education, and has a positive impact on the clinical condition, quality of life, treatment adherence, and psycho-emotional state of each patient.

2. The proposed modular cardiac rehabilitation program can be used by cardiologists, rehabilitation specialists, and nursing staff when conducting rehabilitation interventions for patients who have suffered a myocardial infarction.

3. The modular cardiac rehabilitation program is adapted for practical use, is simple, and affordable, allowing it to be used in cardiac rehabilitation departments, rehabilitation centers, and clinics.

Personal contribution of the doctoral student:

The author's contribution includes substantiating the research topic, goals, and objectives, independently planning the study design, conducting clinical and functional examinations of patients, searching for data in the literature, analyzing the obtained data, statistically processing the data in an electronic database, and analyzing the results of the study, interpreting, formulating conclusions, and providing practical recommendations.

Conclusions:

1. As a result of the conducted research, a modular program was developed, including modules adapted to the conditions of patients with stented and non-stented coronary arteries after myocardial infarction in the second and third stages of cardiac rehabilitation.

2. As part of the modular CR program, after 6 months, patients after myocardial infarction showed positive dynamics in exercise tolerance, metabolic equivalent (MET) by 1.5 times, maximum oxygen consumption by 1.3 times, and exercise duration by 6.5 times.

3. Positive dynamics in psychoemotional state indicators were noted: anxiety decreased by 50% and depression by 49% after 6 months. Adherence to medication therapy did not significantly increase after 3 months, but decreased by 38.9% in patients with low compliance after 6 months, while it increased by 36.1% in patients with high compliance.

4. Patients who participated in the modular CR program demonstrated improved quality of life, measured using the Seattle Angina Questionnaire (SAQ): angina stability, physical limitations, and treatment satisfaction after 3 and 6 months.

Approbation of the dissertation results:

The main provisions and data from this dissertation were presented at the following conferences and scientific seminars:

10th International Scientific and Practical Conference "Global Science and Innovation 2020: Central Asia", Nur-Sultan, Kazakhstan, August 17, 2020.

3rd International Conference "Chronic Heart Failure", Turkestan, Kazakhstan, October 2021.

International Conference "ESC Acute Cardiovascular Care 2022", Marseille, France, March 18, 2022.

The extended scientific seminar of the Department of Internal Medicine of the International Kazakh-Turkish University named after Khoja Ahmet Yasawi was discussed (Protocol No. 6 dated May 5, 2025).

Publications:

Eleven scientific papers have been published on the topic of the dissertation, including: - 1 article in a journal included in the international Scopus and Web of

Science Core Collection (Clarivate Analytics) databases; - 4 articles in journals recommended by the Scientific and Technical Committee of the Ministry of Science and Technology of the Republic of Kazakhstan; - 4 abstracts in the proceedings of an international scientific and practical conference; - 2 Author's Certificate.

Dissertation Volume and Structure:

The dissertation is presented on 105 pages of typed text and consists of an introduction, a literature review, a description of the research materials and methods, original research results, conclusions, and a list of references. The work is illustrated with 21 figures and includes 43 tables and 6 appendices. The bibliography comprises 157 sources.