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Home-based cardiac rehabilitation after myocardial infarction in the long-term rehabilitation period: Evidence base and prospects for development

Abstract

Relevance. Myocardial infarction is accompanied by long-term functional, clinical, and psycho-emotional consequences, whereas insufficient accessibility of traditional centre-based cardiac rehabilitation programmes determines the need for evidence-based home-based, hybrid, and telerehabilitation models capable of supporting safe physical activity, self-management, and secondary prevention in the long-term rehabilitation period.

Aim. To summarise the current evidence base on home-based cardiac rehabilitation after myocardial infarction and determine its effectiveness, safety, and prospects for use in the long-term rehabilitation period.

Materials and methods. The study was prepared as an analytical narrative review with elements of a systematised search. Systematic reviews, meta-analyses, randomised controlled trials, cohort studies, scientific statements of professional societies, and clinical guidelines on exercise-based cardiac rehabilitation, home-based cardiac rehabilitation, cardiac telerehabilitation, mobile health technologies (mHealth), the maintenance phase, adherence to home-based physical exercises, kinesiophobia, psychological distress, and long-term self-management in patients after myocardial infarction were analysed.

Results. Current evidences indicate that home-based cardiac rehabilitation can achieve outcomes comparable to those of centre-based cardiac rehabilitation programmes in clinically stable patients at low or moderate risk following myocardial infarction. The safety of the home-based model depends on appropriate patient selection, risk stratification, individualised exercise prescription, self-management training, regular professional feedback, and symptom-response algorithms – that is, structured rules for stopping or modifying physical exercise, contacting a specialist, or seeking emergency care when clinical signs of exercise intolerance appear.

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Telerehabilitation and mobile digital health technologies can improve accessibility, support self-management, and facilitate the monitoring of symptoms and physical activity. However, they should complement rather than replace a clinically structured cardiac rehabilitation programme. The greatest gap remains the long-term rehabilitation period, in which the maintenance of movement behaviour, adherence, psychological adaptation, overcoming kinesiophobia, self-efficacy, and social support become decisive.

Conclusions. Home-based cardiac rehabilitation after myocardial infarction is a promising secondary prevention model for selected clinically stable patients, but its long-term effectiveness requires structured professional supervision, risk stratification, psychological-behavioural support, telerehabilitation or analogue self-management tools, and standardised assessment of functional, clinical, and behavioural outcomes.

Keywords: physical therapy; secondary prevention; adherence; risk factors; cardiovascular diseases.

INTRODUCTION

Myocardial infarction remains one of the key clinical forms of ischaemic heart disease, causing a considerable burden of mortality, recurrent cardiovascular events, hospitalisations, disability, and long-term decline in functioning. Current global epidemiological data indicate that cardiovascular diseases continue to occupy a leading place among the causes of years of life lost, and ischaemic heart disease remains one of the most important components of this burden. As G.A. Roth *et al.* [1] noted, after completion of acute treatment, a patient after myocardial infarction does not automatically return to the previous level of functioning, since detraining, restrictions in everyday activity, fear of physical exertion, the need to control risk factors, and the necessity of long-term adherence to secondary prevention persist. Exercise-based cardiac rehabilitation is one of the most substantiated components of post-infarction recovery, as it combines physical training, risk-factor control, patient education, psychosocial support, and the formation of self-management skills.

In the contemporary understanding, cardiac rehabilitation is not an isolated set of exercises but, as M. Ambrosetti *et al.* [2] and R.S. Taylor *et al.* [3] emphasised, a multicomponent model of secondary prevention directed towards reducing residual cardiovascular risk, improving functional capacity, increasing quality of life, and returning the patient to active participation in everyday life. Accordingly, the availability of a rehabilitation programme alone is insufficient. Its accessibility, continuity, personalisation, and capacity to support behavioural change after completion of the early stage of recovery also become relevant. Despite the proven clinical importance of cardiac rehabilitation, its actual use remains insufficient in many countries. Low coverage of patients by cardiac rehabilitation programmes is connected not only with an insufficient number of centres but also with low referral rates, geographical distance, transport barriers, cost, employment, family responsibilities, comorbidities, and insufficient patient awareness. For this reason, international initiatives of the last decade have focused not only on the evidence base of cardiac rehabilitation but also on strategies for increasing its accessibility and patient participation, specifically through automated referral, flexible formats, home-based models, and self-management [4-5]. Research on the structure and accessibility of cardiac rehabilitation by M. Supervia *et al.* [6] and K. Turk-Adawi *et al.* [7] showed that programme provision differs considerably between countries and regions, while access to rehabilitation care is especially limited in healthcare systems with an insufficient number of specialised centres or uneven territorial distribution of services. These data are directly relevant to post-myocardial infarction rehabilitation, as patients requiring long-term professional support often face the greatest barriers to participation in centre-based cardiac rehabilitation programmes. These barriers include older age, multimorbidity, reduced mobility, residence in remote areas, and limited social support.

In response to these limitations, home-based, hybrid, and telerehabilitation models of cardiac rehabilitation are actively being developed. Home-based cardiac rehabilitation should be considered not as unsupervised independent exercise, but rather as a structured programme that includes preliminary clinical and functional assessment, individualised physical exercise, self-management training, symptom control, professional feedback, and periodic reassessment of outcomes. As S.T. McDonagh *et al.* [8] stated, telerehabilitation and digital technologies acquire particular importance, as they partly compensate for the lack of face-to-face contact and support the monitoring of physical activity, symptoms, heart rate, blood pressure, and adherence to the programme. However, the digitalisation of cardiac rehabilitation should not be equated with an automatic increase in its effectiveness. Mobile applications, wearable devices, video consultations, and electronic diaries are only support tools, the effectiveness of which depends on integration into a clinically structured programme, availability of professional feedback, the patient's digital literacy, and the presence of symptom-response algorithms. A systematic review of digital interventions in cardiac rehabilitation by S. Wongvibulsin *et al.* [9] stressed the potential of such solutions to improve accessibility and maintain physical activity, while indicating the need for standardisation, assessment of acceptability, and consideration of the digital divide. The long-term rehabilitation period remains the most problematic, because the main task is not only recovery after the acute event but also

maintenance of the achieved level of functional capacity, physical activity, self-management, and secondary prevention. After completion of centre-based cardiac rehabilitation, the patient often loses regular contact with specialists, which increases the risk of returning to sedentary behaviour, reduced adherence, and loss of the results achieved. In this context, not only the parameters of physical exercise become important, but also the patient's ability for self-management, symptom recognition, maintenance of motivation, and adaptation of physical activity to the real-life environment [3, 10].

Thus, the relevance of the study is determined by the combination of three interrelated problems: the high burden of the consequences of myocardial infarction, insufficient coverage of patients by traditional centre-based cardiac rehabilitation programmes, and the need for long-term supervision models capable of maintaining physical activity, adherence, and self-management Thus, the relevance of the study is determined by the combination of three interrelated problems: the high burden of the consequences of myocardial infarction, insufficient coverage of patients by traditional centre-based cardiac rehabilitation programmes, and the need for long-term supervision models capable of maintaining physical activity, adherence, and self-management after completion of the early stage of recovery. The unresolved issue is the determination of the conditions under which home-based cardiac rehabilitation after myocardial infarction can be not only an accessible alternative to a centre-based programme but also a safe, structured, and long-term effective physical therapy model integrated with telerehabilitation, digital or analogue self-management tools, and periodic professional reassessment. The study aimed to evaluate current scientific data on home-based cardiac rehabilitation after myocardial infarction, determine its impact on patient recovery and safety, and assess the possibilities for its integration into a long-term rehabilitation programme. This goal required the following analytical tasks: to characterise exercise-based cardiac rehabilitation as an evidence-based standard of secondary prevention after myocardial infarction (MI); to determine the content, key components, and limits of use of home-based cardiac rehabilitation; to compare different cardiac rehabilitation models and identify the main gaps in the evidence base concerning the long-term rehabilitation period after MI.

MATERIALS AND METHODS

The object of the study was home-based cardiac rehabilitation of patients after myocardial infarction in the long-term rehabilitation period. The subject was the evidence base on the effectiveness, safety, organisational conditions, telerehabilitation support, and psychological-behavioural factors of home-based cardiac rehabilitation after myocardial infarction. The theoretical basis of the study consisted of the works by G.O. Dibben *et al.* [11] and T.M. Brown *et al.* [12] on the multicomponent structure of contemporary cardiac rehabilitation, and by R.J. Thomas *et al.* [13] on the definition and principles of home-based cardiac rehabilitation. These publications formed the conceptual framework of the analysis: evidence-based cardiac rehabilitation – home-based cardiac rehabilitation – long-term maintenance of activity – psychological-behavioural barriers – digital or analogue support. The selected format of an analytical narrative review with elements of a systematised search corresponds to the purpose of the study. It provides a conceptual synthesis of the current evidence base and identifies key directions for the development of home-based cardiac rehabilitation after myocardial infarction, rather than quantitatively summarising all available studies. The search for sources was performed in the electronic databases PubMed, Cochrane Library, Scopus, Web of Science, PEDro, and Google Scholar. The review focused mainly on publications from 2019 to 2025, as they reflect the current state of the evidence base on home-based cardiac rehabilitation, telerehabilitation, mobile digital health technologies (mHealth), and long-term supervision models. Earlier sources could be considered only if they had conceptual importance for defining basic approaches to cardiac rehabilitation or the methodology for its assessment.

The following keywords and their combinations were used during the search: "home-based cardiac rehabilitation", "centre-based cardiac rehabilitation", "centre-based cardiac rehabilitation", "hybrid cardiac rehabilitation", "myocardial infarction", "exercise-based cardiac rehabilitation", "cardiac telerehabilitation", "mHealth cardiac rehabilitation", "maintenance phase", "long-term rehabilitation", "long-term adherence", "exercise adherence", "kinesiophobia", "psychological distress", "post-myocardial infarction psychological distress", "exercise self-efficacy", and "cost-effectiveness". The Boolean operators AND and OR were used to refine the results, along with manual screening of reference lists in key systematic reviews, meta-analyses, and scientific statements. Source selection was performed using the PRISMA approach. At the identification stage, 330 records were selected, including 312 through the electronic databases PubMed, Cochrane Library, Scopus, Web of Science, PEDro, and Google Scholar, and 18 through manual screening of reference lists of relevant systematic reviews, meta-analyses, and scientific statements After the removal of 96 duplicates, 234 records remained for title and abstract screening. Of these, 176 were excluded because they did not meet the eligibility criteria with respect to the study topic, target population, or intervention. Full-text assessment was performed for 58 sources; after excluding publications due to non-compliance with the inclusion criteria, absence of a home-based or remote component, insufficient coverage of the long-term period, absence of physical

therapy, or duplication of content, 25 sources were included in the final analytical synthesis.

RESULTS AND DISCUSSION

Exercise-based cardiac rehabilitation is one of the key components of contemporary management of patients after myocardial infarction. Its importance extends beyond restoring exercise capacity, as it is considered a component of comprehensive secondary prevention aimed at minimising the risk of recurrent cardiovascular events, reducing hospitalisations, improving functional status and quality of life, and supporting a safe return to everyday activities. For this reason, cardiac rehabilitation after MI should be interpreted as an evidence-based standard of long-term patient management, instead of an additional stage of post-hospital recovery [11]. Participation of patients with ischaemic heart disease in exercise-based cardiac rehabilitation programmes is associated with reduced cardiovascular mortality, recurrent cardiac events, and hospitalisations, and improved quality of life. These data have fundamental importance for post-infarction rehabilitation because they prove that structured physical training is not only a means of functional recovery but also an instrument for influencing clinically meaningful consequences of the disease. Accordingly, the contemporary scientific discussion shifts from the question "is cardiac rehabilitation effective?" to the question "how can its accessibility, safety, personalisation, and long-term implementation be ensured?" [11]. After MI, the patient often faces detraining, reduced aerobic capacity, limitations in everyday physical activity, fear of exertion, psycho-emotional instability, and difficulties returning to usual social and professional functioning. Exercise-based cardiac rehabilitation is directed towards overcoming these consequences through gradual, controlled, and individualised increases in physical exercise. The clinical value of such a programme lies not only in improving functional capacity, as reflected by measures such as peak oxygen uptake (VO_2peak) and Six-Minute Walk Test (6MWT) distance, but also in promoting safe exercise behaviours that patients can maintain after completing the early structured phase of rehabilitation. Cardiac rehabilitation should not be considered as an isolated block of physical training. The guidelines of the American Heart Association and the American Association of Cardiovascular and Pulmonary Rehabilitation define cardiac rehabilitation as a multicomponent programme that includes patient assessment, individual exercise prescription, physical-activity counselling, control of blood pressure, lipid profile, glycaemia, and body weight, correction of behavioural risk factors, psychosocial support, patient education, and evaluation of programme quality [12]. Physical training within the structure of exercise-based cardiac rehabilitation should be dosed, progressive, and adapted to the patient's clinical condition, level of functional capacity, concomitant pathology, medication therapy, and individual risk of complications. A typical programme includes a combination of aerobic exercise, strength exercises, flexibility training, and a gradual increase in everyday movement activity. However, the effectiveness of such a programme is determined not only by the parameters of intensity, frequency, and duration of sessions but also by regular performance, quality of self-management, timely adjustment of exercise load, and the patient's ability to integrate physical activity into everyday life [12].

Its multidisciplinary character is one of its key features. The rehabilitation process should involve a physician, physical therapist, nurse, psychologist, and, when necessary – a dietitian and other specialists. Such a team model provides not only for exercise prescription but also assessment of barriers to performance, setting realistic goals, symptom control, teaching the patient the principles of self-observation, and support for adherence to secondary prevention. For patients after MI, this has particular importance, as the risk of recurrent events is closely connected with behavioural factors, insufficient physical activity, low adherence to treatment, and psychosocial difficulties [12]. Exercise-based cardiac rehabilitation affects several levels of recovery simultaneously. At the physiological level, it improves cardiorespiratory endurance, muscle function, control of metabolic risk factors, and general exercise tolerance. At the functional level, it helps the patient increase the amount of everyday activity, improve tolerance to daily loads, and reduce dependence on external assistance. At the behavioural level, it forms skills of self-management, prevention, safe dosing of exercise, symptom recognition, and maintenance of physical activity as a stable component of lifestyle [11-12]. Nevertheless, recognition of exercise-based cardiac rehabilitation as the standard after MI does not eliminate the problem of its practical implementation. Even with a convincing evidence base, some patients do not participate in cardiac rehabilitation programmes or discontinue participation before a stable effect is achieved. The reasons may include logistical difficulties, remoteness of rehabilitation centres, employment, financial and transport barriers, insufficient motivation, fear of physical exertion, comorbidity, and a low level of understanding of the importance of rehabilitation [12]. Thus, the further development of post-infarction cardiac rehabilitation should be connected not only with confirmation of the effectiveness of exercise-based cardiac rehabilitation but also with the development of models that ensure its actual accessibility for different groups of patients. In this context, exercise-based cardiac rehabilitation is the evidence-based foundation for the development of home-based, hybrid, and telerehabilitation models. Home-based cardiac rehabilitation does not deny the importance of physical exercises as the central component of the programme but transfers them into the

patient's living environment, provided that preliminary assessment, risk stratification, individual exercise prescription, self-management training, and professional feedback are ensured. Therefore, further analysis of home-based cardiac rehabilitation after MI should be based on an understanding of exercise-based cardiac rehabilitation as the basic standard that requires adaptation to the long-term rehabilitation period, the patient's real living conditions, and the possibilities of the healthcare system [11-12].

Home-based cardiac rehabilitation was developed as a response to the limited coverage of patients by traditional centre-based cardiac rehabilitation programmes. Its development does not mean abandonment of the principles of exercise-based cardiac rehabilitation but involves another way of organising the rehabilitation process – mainly outside a specialised centre, in the patient's home or usual living environment. In scientific statements of the American Association of Cardiovascular and Pulmonary Rehabilitation, the American Heart Association, and the American College of Cardiology, home-based cardiac rehabilitation is defined as a structured programme implemented fully or mainly outside a centre, but involving professional assessment, individual exercise prescription, education, monitoring, risk-factor management, and regular feedback from a specialist [13]. It is fundamentally important to distinguish between home-based cardiac rehabilitation and uncontrolled independent physical exercise. Home-based cardiac rehabilitation is not simply a recommendation to "move more" or a set of general advice after inpatient rehabilitation. It is an organised model of rehabilitation care that should include clinical risk stratification, assessment of functional capacity, determination of a safe level of physical exercise, patient training in self-management, periodic contact with a physical therapist or another specialist of the multidisciplinary team, and, when necessary, psychosocial support. The presence of these components distinguishes evidence-based home-based cardiac rehabilitation from everyday physical activity without clinical supervision [12-13]. The main advantage of home-based cardiac rehabilitation is its capacity to overcome barriers that restrict patient participation in centre-based cardiac rehabilitation programmes. Such barriers include distance to the rehabilitation centre, transport difficulties, employment, the need to provide family care, financial costs, limited mobility, comorbidity, residence in a rural or remote area, and psychological factors, specifically anxiety, fear of physical exertion, and low motivation. The home-based format can increase the accessibility of rehabilitation, provide a more flexible schedule of sessions, involve the family, and transfer acquired skills directly into the patient's everyday life [13].

The evidence base on the effectiveness of home-based cardiac rehabilitation has been considerably strengthened by systematic reviews and meta-analyses comparing home-based and centre-based programmes. The updated Cochrane review devoted to comparison of home-based and centre-based cardiac rehabilitation provided no convincing evidence of a substantial difference between these models for a number of key outcomes, including mortality, cardiovascular events, functional capacity, quality of life, risk factors, and costs during follow-up of up to 12 months. This enables home-based cardiac rehabilitation to be considered an evidence-supported alternative to centre-based cardiac rehabilitation for clinically stable patients at low or moderate risk [14]. More recent comparative reviews confirm this position and indicate that home-based cardiac rehabilitation can achieve results comparable to centre-based cardiac rehabilitation in terms of functional capacity, adherence to the programme, quality of life, and control of individual cardiovascular risk factors. Specifically, the recent comparative systematic review by P. Karisa *et al.* [15] demonstrated that home-based models may have small advantages for certain indicators of functional capacity and adherence, although the clinical meaning of these differences depends on programme structure, method of monitoring, duration of supervision, and patient characteristics [15]. Thus, contemporary literature is gradually moving from evaluating home-based cardiac rehabilitation as a "reserve" model to considering it as an independent format of cardiac rehabilitation capable of scaling rehabilitation care without loss of the main clinical outcomes. Digital technologies acquire particular importance in contemporary home-based programmes. Mobile applications, wearable devices, telemonitoring, electronic diaries, video consultations, and remote feedback systems can partly compensate for the absence of constant face-to-face control. The meta-analysis by L. Li *et al.* [16] presented that such interventions can improve functional capacity and support the patient's participation in the rehabilitation process, especially when digital tools are combined with professional supervision, individualised exercise prescription, and regular symptom monitoring. Nonetheless, digital support should be considered not as a replacement for clinical reasoning but as an instrument for implementing a structured programme.

The safety of home-based cardiac rehabilitation is a key issue, especially after myocardial infarction. The systematic review by M. Stefanakis *et al.* [17] showed that the risk of adverse events during home-based cardiac rehabilitation is low if appropriate patient selection, risk stratification, preliminary training, symptom control, and clear criteria for stopping or modifying exercise are provided. This means that the safety of the home-based model is determined not by the place where exercises are performed, but by the quality of the clinical protocol, initial assessment, instruction,

monitoring, and availability of professional feedback. Cohort studies also support the possibility of wider use of home-based cardiac rehabilitation in real clinical practice. In the study by C. Nkonde-Price *et al.* [18], patients who participated in home-based and centre-based cardiac rehabilitation were compared in terms of hospitalisations, adherence to medication therapy, and control of risk factors. In this demographically diverse cohort, participation in home-based cardiac rehabilitation was associated with fewer hospitalisations over 12 months compared to centre-based cardiac rehabilitation, which highlights the potential of the home-based model not only to increase accessibility but also to support clinically meaningful outcomes in real practice. However, the cohort design of the study requires cautious interpretation of causal inferences. Despite its considerable advantages, home-based cardiac rehabilitation also has important limitations. It is most suitable for clinically stable patients after MI at low or moderate risk who have undergone initial clinical assessment, have a clear individual physical therapy plan, are capable of self-management, and can maintain contact with a specialist. By contrast, patients with unstable angina, decompensated heart failure, uncontrolled arrhythmias, pronounced symptoms during minimal exertion, severe comorbid conditions, or high risk of complications require more intensive face-to-face supervision, at least at the initial stage. For such groups, centre-based cardiac rehabilitation or a hybrid model with a gradual transition to a home-based format after stabilisation may be more appropriate [13, 17].

A separate limitation of home-based cardiac rehabilitation is the dependence of its effectiveness on behavioural and social factors. In home conditions, the patient has more freedom but less external control. This may reduce adherence to the programme, especially in the presence of kinesiophobia, anxiety, depressive symptoms, low self-efficacy, weak family support, or insufficient understanding of rehabilitation goals. Therefore, a home-based programme should not be limited to the transfer of a set of exercises; it should contain elements of motivational counselling, education, gradual formation of confidence in the safety of movement, family involvement, and regular feedback [12-13]. Another important limitation is the digital divide. Although mobile digital health technologies and telerehabilitation substantially expand the possibilities of home-based cardiac rehabilitation, not all patients have sufficient access to technical devices, stable internet, or skills in using digital platforms. This is especially relevant for older patients, persons with a lower level of education, residents of remote areas, and patients with cognitive or sensory limitations. In such cases, digital tools should be supplemented with analogue means: printed instructions, self-management diaries, telephone consultations, family involvement, and periodic face-to-face visits [13, 16]. Thus, home-based cardiac rehabilitation after MI is an evidence-based model that can provide results at the same level a as centre-based cardiac rehabilitation in stable patients at low or moderate risk. Its strengths are accessibility, flexibility, integration into everyday life, the possibility of family involvement, and the use of digital technologies. However, its effectiveness and safety depend on correct patient selection, risk stratification, individualisation of physical exercise, quality of self-management, psychological support, a digital or analogue feedback system, and professional supervision. Therefore, within long-term post-infarction management, home-based cardiac rehabilitation should be considered not as a universal model for all patients but as a structured format of rehabilitation that requires adaptation to clinical risk, functional capacity, psychological profile, and the patient's real living environment [13, 18]. A synthesis of the current evidence indicates that cardiac rehabilitation following myocardial infarction should not be viewed simply as a choice between centre-based rehabilitation and home-based exercise. Rather, these approaches represent a continuum of care models that differ in the level of professional supervision, accessibility, support for self-management, and suitability for different patient groups. A comparative characteristic of the main models of cardiac rehabilitation after myocardial infarction is presented in Table 1.

Table 1. Comparative characteristics of cardiac rehabilitation models after myocardial infarction

Organisational characteristic	Main advantages	Main limitations	Most appropriate use
Centre-based cardiac rehabilitation model			
The programme is performed in a specialised institution under direct supervision of specialists from a multidisciplinary team.	Face-to-face monitoring of the patient's condition, possibility of functional testing, rapid adjustment of exercise load, control of exercise technique, and higher safety for patients at increased risk.	Lower accessibility due to transport, geographical, time, financial, and organisational barriers; need for regular visits to the centre; limited patient coverage.	Patients after myocardial infarction with high or uncertain clinical risk, complex comorbidity, low ability for self-management, or need for initial face-to-face supervision.

Table 1. *Continued*

Organisational characteristic	Main advantages	Main limitations	Most appropriate use
Home-based cardiac rehabilitation model			
A structured programme is performed mainly in the home environment after initial assessment, risk stratification, individualised exercise prescription, and self-management training.	Higher accessibility, flexible schedule of sessions, integration of physical activity into everyday life, possibility of family involvement, and reduction of logistical barriers.	Requires sufficient clinical stability, ability for self-management, skills in responding to symptoms, and regular professional feedback.	Clinically stable patients at low or moderate risk who are able to follow instructions, keep self-management records, and maintain contact with a specialist.
Hybrid cardiac rehabilitation model			
Combines face-to-face visits, initial assessment, or control consultations with subsequent home-based performance of the programme and remote supervision.	Balance between the safety of face-to-face control and the accessibility of the home-based format; possibility of gradual transition from intensive supervision to self-management.	Requires coordination between face-to-face and remote stages, a clear patient pathway, definition of contact frequency, and criteria for transition between formats.	Patients at moderate risk, persons with unstable adherence, partial digital readiness, moderate kinesiophobia, or need for periodic face-to-face control.
Home-based cardiac rehabilitation model with telerehabilitation support			
The home-based programme is supplemented by video consultations, telephone support, electronic or paper diaries, mobile digital health technologies, wearable devices, or remote monitoring.	Supports self-management, regular feedback, monitoring of physical activity and symptoms; may increase adherence and accessibility in the long-term period.	Depends on digital literacy, technical accessibility, data confidentiality, quality of professional response, and availability of alternatives for patients without digital skills.	Patients who need long-term supervision after the inpatient stage of rehabilitation, especially when territorial or transport barriers are present, provided that professional control is maintained.

Source: compiled by the authors

The data in Table 1 indicate that comparison of different models of cardiac rehabilitation after myocardial infarction has fundamental importance for determining the optimal format of care in the long-term rehabilitation period. Contemporary literature most often considers three organisational models: centre-based cardiac rehabilitation, home-based cardiac rehabilitation, and hybrid cardiac rehabilitation. They should not be contrasted as mutually exclusive options since each model has its own clinical indications, advantages, limitations, and requirements for professional supervision. Telerehabilitation and mobile digital health technologies can supplement the home-based cardiac rehabilitation model with structure, control, and clinical manageability [12-13]. Centre-based cardiac rehabilitation has historically remained the basic model for organising cardiac rehabilitation. Its main advantage is direct face-to-face control by specialists, the possibility of functional testing, rapid adjustment of exercise load, observation of exercise technique, and involvement of a multidisciplinary team. This format is especially important for patients with higher clinical risk, comorbidity, low ability for self-management, or a need for more intensive observation. However, the centre-based rehabilitation model is the one most often limited by transport, time, geographical, financial, and organisational barriers, which reduces actual patient participation in cardiac rehabilitation programmes [11, 13]. Home-based cardiac rehabilitation emerged as a response to the limitations of the centre-based cardiac rehabilitation model. Its advantage lies in transferring the rehabilitation process to the patient's home or usual living environment, which increases accessibility, schedule flexibility, the possibility of family involvement, and integration of physical activity into everyday life. For stable patients at low or moderate risk, home-based cardiac rehabilitation is not inferior to centre-based cardiac rehabilitation in key outcomes, including functional capacity, quality of life, risk factors, and costs during follow-up of up to 12 months [14]. Nevertheless, home-based cardiac rehabilitation is not simple independent performance of exercises at home. Its evidence-based effectiveness presupposes a structured programme: preliminary assessment, risk stratification, individualised exercise prescription, self-management training, symptom monitoring, professional feedback, and clear safety criteria. Without these components, the home-based model loses clinical manageability and may turn into non-specific recommendations on physical activity [13, 17].

Hybrid cardiac rehabilitation combines the advantages of both approaches: initial face-to-face assessment, education, and primary adjustment of exercise load with subsequent home-based performance of the programme and remote or periodic face-to-face supervision. This format is particularly promising for patients at moderate risk, persons with a partial need for face-to-face control, patients with unstable adherence, moderate

kinesiophobia, or different levels of digital literacy. The hybrid model also has advantages for the long-term period, as it enables the intensity of professional control to be gradually reduced without complete termination of feedback [12]. Telerehabilitation and mobile digital health technologies have a separate role in the comparison of models. In home-based and hybrid models, they can provide monitoring of symptoms, heart rate, physical activity, adherence to the programme, and regular professional feedback. However, digital tools do not eliminate the need for a clinical protocol, risk stratification, and specialist participation. Their effectiveness depends on the patient's digital literacy, the quality of professional supervision, and the presence of symptom-response algorithms [16, 19, 20]. Comparison of the three models indicates that centre-based cardiac rehabilitation retains leading importance for patients who need intensive face-to-face control and multidisciplinary supervision. Home-based cardiac rehabilitation is an evidence-supported alternative for clinically stable patients at low or moderate risk, especially when logistical, geographical, or time barriers are present. Hybrid cardiac rehabilitation occupies an intermediate position and is promising for patients who need initial face-to-face assessment but can subsequently perform the programme at home with remote or periodic face-to-face supervision [14, 16, 20]. Thus, the choice of a cardiac rehabilitation model after MI should be determined not only by the accessibility of a centre or the availability of digital technologies, but primarily by clinical risk, functional capacity, psychological profile, ability for self-management, and the need for professional feedback. In the long-term rehabilitation period, the most promising approach is not the opposition of centre-based, home-based, and hybrid cardiac rehabilitation models, but their rational combination according to the patient's condition, rehabilitation goals, and the intensity of supervision required.

Telerehabilitation and mobile digital health technologies are key instruments that enable home-based cardiac rehabilitation to be transformed from a format of independent implementation of recommendations into a structured, controlled, and clinically managed model of care. In patients after myocardial infarction, these technologies have particular importance, as long-term recovery requires not only exercise prescription but also regular monitoring of symptoms, maintenance of adherence, adjustment of exercise load, self-management training, and timely contact with a specialist. Thus, digital support in home-based cardiac rehabilitation should be considered not as a technical addition but as an organisational mechanism for ensuring continuity of the rehabilitation process [12-13]. In the cardiological context, telerehabilitation should be understood as remote provision or support of rehabilitation care using telecommunication technologies. Such a format may include video consultations, telephone contact, transmission of self-management data, remote education, electronic diaries, reminders, professional feedback, and, where possible, monitoring of physiological indicators. Unlike a standard home-based programme, in which the patient mainly performs prescribed exercises independently, telerehabilitation preserves professional control and brings the home-based model closer to centre-based cardiac rehabilitation in terms of the supervision level, but without the need for regular physical attendance at a rehabilitation centre [13, 19]. The systematic review and meta-analysis by W. Zhong *et al.* [19], devoted to the long-term effects of cardiac telerehabilitation in patients with ischaemic heart disease, showed that telerehabilitation programmes can be effective for improving cardiorespiratory fitness and quality of life during long-term follow-up. The authors reported a positive effect of telerehabilitation on peak oxygen consumption and quality of life, while the completion rate of telerehabilitation interventions remained high. However, a stable long-term effect on control of cardiovascular risk factors, anxiety, or depressive symptoms was not convincingly demonstrated, which indicates the need to strengthen behavioural and psychosocial components in digitally supported programmes [19]. The practical importance of these data lies in the fact that telerehabilitation can partly compensate for one of the main weaknesses of home-based cardiac rehabilitation – the limitation of direct face-to-face professional control. Remote contact with a specialist allows for the assessment of exercise tolerance, detection of overload symptoms, correction of exercise intensity, maintenance of motivation, and gradual formation of safe independent training skills in the patient. It is especially important that the telerehabilitation format can be used in the long-term rehabilitation period, when the frequency of face-to-face contacts with the medical system decreases and the risk of losing achieved functional results increases [19-20].

A separate direction is represented by electronic health technologies and mobile digital health technologies oriented towards the maintenance phase of cardiac rehabilitation. The systematic review and meta-analysis by M. Heimer *et al.* [20] was specifically directed towards assessing electronic health technologies in the maintenance phase, where the main task is not functional recovery to the initial level but maintenance of physical activity, exercise tolerance, quality of life, self-management, and behavioural changes. The authors underlined that electronic health technologies can contribute to increased physical activity, improved exercise tolerance and quality of life, and improvement in individual indicators of cardiovascular risk compared with usual care. However, data on the impact on morbidity, mortality, and hard clinical endpoints remain limited [20]. For home-based cardiac rehabilitation after myocardial infarction, this has fundamental importance because it shifts the emphasis from

short-term performance of exercises to maintenance of behavioural changes in the long-term period. The most clinically meaningful components of electronic health technologies are behavioural self-management, goal setting, regular feedback, reminders, visualisation of progress, and professional reinforcement of activity. These components can prevent a gradual decline in physical activity after completion of the intensive phase of rehabilitation, when the patient is no longer under constant supervision [20]. Mobile digital health technologies are the most flexible and potentially scalable segment of digitally supported home-based cardiac rehabilitation. They include smartphone applications, wearable devices, heart-rate monitors, fitness trackers, electronic diaries, SMS reminders, chat communication with a specialist, and remote transmission of indicators of physical activity, heart rate, blood pressure, symptoms, and subjective exercise tolerance. The meta-analysis by L. Li *et al.* [16] was concentrated specifically on the effectiveness of home-based cardiac rehabilitation interventions delivered through mobile digital health technologies. Such interventions can increase rehabilitation accessibility, improve the regularity of the patient's contact with the programme, and create conditions for more objective self-management compared with traditional paper diaries. The clinical value of mobile digital health technologies lies not in the mere fact of using an application or wearable device, but in the feedback these instruments create between the patient and the specialist. The patient receives an opportunity to see personal progress, record symptoms, monitor heart rate, mark completed exercises, and receive reminders. The physical therapist or another member of the multidisciplinary team, in turn, can assess adherence, exercise tolerance, the need to adjust intensity, and detect signs of deterioration in a timely manner. Thus, mobile digital health technologies transfer the home-based programme from the passive format of "the patient has received recommendations" to the dynamic format of "the patient performs the programme under remote supervision" [12, 16].

In the long-term rehabilitation period, digital components that support behavioural stability are especially important. Such components include personalised physical-activity goals, regular feedback, automated reminders, visualisation of progress, brief educational modules, remote consultations, messages on achievement of intermediate goals, and the possibility of quick contact with a specialist when symptoms appear. These elements should be combined with the clinical logic of exercise dosing and should not function as isolated technological services. Without a clearly defined rehabilitation protocol, digital tools may increase the volume of data but do not guarantee improved clinical outcomes [16, 20]. Remote cardiac rehabilitation after myocardial infarction may also include an educational component implemented through e-learning platforms. The review by D. Trache *et al.* [21] emphasised the importance of combining remote learning, monitoring of cardiovascular risk factors, control of physical activity, and maintenance of adherence after a heart attack. Such an approach allows both monitoring of exercise performance and support for the broader process of secondary prevention, which includes lifestyle modification, blood pressure control, nutritional correction, smoking cessation, medication adherence, and patient self-management. Firstly, digital models depend on access to a smartphone, stable internet, wearable devices, or other technical means. Secondly, older patients and persons with a lower level of education or cognitive or sensory limitations may have difficulties using applications and platforms. Thirdly, some patients do not trust digital tools or are not ready to interpret indicators independently. Fourthly, issues arise concerning confidentiality of medical data, responsibility for responding to warning signals, and standardisation of remote monitoring algorithms [12, 20].

For this reason, digital support for home-based cardiac rehabilitation should not have a universal character. For patients with sufficient digital literacy, the use of smartphone applications, wearable devices, electronic diaries, and video consultations may be appropriate. For patients with a lower level of digital literacy, analogue instruments should be provided: telephone support, printed instructions, paper self-management diaries, periodic face-to-face contacts, and family assistance. This approach prevents a situation in which digitalisation increases rehabilitation accessibility for some patients but creates additional barriers for others [13, 16]. The optimal structure of digitally supported home-based cardiac rehabilitation after myocardial infarction should include several mandatory elements. The first is initial clinical and functional assessment and risk stratification, without which a remote format may be unsafe. The second is individual exercise prescription with clear parameters of frequency, intensity, duration, and type of exercise. The third is patient training in self-management: assessment of symptoms, heart rate, level of dyspnoea, fatigue, and signs requiring exercise to be stopped. The fourth is regular remote feedback. The fifth is psychological-behavioural support directed towards overcoming fear of movement, maintaining motivation, and forming self-efficacy [12, 16, 20]. Thus, telerehabilitation and mobile digital health technologies in home-based cardiac rehabilitation after myocardial infarction perform three interrelated functions: they increase accessibility of rehabilitation care, provide remote professional supervision, and support long-term adherence to physical activity. Available systematic reviews indicate a positive effect of telerehabilitation, electronic health technologies, and mobile digital health technologies on functional capacity, physical activity, and quality of life. However, they also emphasise the limited data on long-term clinical endpoints,

psychological outcomes, protocol standardisation, and the effectiveness of digital models in different patient groups. Therefore, the most substantiated approach is not isolated digitalisation of home-based cardiac rehabilitation but the integration of telerehabilitation and mobile digital technologies into a structured clinical programme with risk assessment, professional supervision, psychological support, and adaptation to the patient's capabilities.

The long-term rehabilitation period after myocardial infarction remains one of the least developed areas of the evidence base on home-based cardiac rehabilitation. Available systematic reviews and meta-analyses quite convincingly confirm the effectiveness of home-based programmes in the short and medium term, but the vast majority of studies assess outcomes within several weeks, 3-6 months, or up to 12 months after the start of the intervention. Over this follow-up period, home-based cardiac rehabilitation provides outcomes comparable to those of centre-based cardiac rehabilitation with respect to functional capacity, quality of life, programme adherence, and control of selected cardiovascular risk factors. However, preservation of these outcomes after completion of the structured programme, especially beyond 12 months, remains less extensively evaluated and methodologically heterogeneous [14-15]. The long-term rehabilitation period cannot be considered as a simple continuation of the acute or post-acute phase of cardiac rehabilitation. While the main tasks at the initial stages are safe mobilisation, restoration of basic exercise tolerance, symptom control, and patient education, in the maintenance phase, the main task becomes preservation of the already achieved functional level, prevention of return to sedentary behaviour, maintenance of adherence to physical activity, and integration of secondary prevention recommendations into everyday life. Thus, long-term cardiac rehabilitation requires not only repetition of the training protocol but also a separate behavioural, educational, and organisational strategy [12, 20].

A critical moment in post-infarction recovery is the transition from a controlled rehabilitation environment to independent implementation of recommendations. During a structured programme, the patient has external control, regular contact with a specialist, a clear schedule of sessions, control of exercise tolerance, and constant motivational reinforcement. After completion of the programme, the frequency of professional contact decreases, and responsibility for maintaining activity is transferred to the patient. In home conditions, this creates a risk of gradual reduction in physical activity, irregular performance of exercises, avoidance of exertion because of fear of symptoms, loss of self-management, and return to the previous sedentary lifestyle [13, 22]. The systematic review by H. Graham *et al.* [21], devoted to interventions for maintaining or increasing physical activity after completion of phase II cardiac rehabilitation, showed that the maintenance phase remains one of the most difficult stages of the rehabilitation process. The authors emphasised that existing programmes differ considerably in duration, intensity of contact with a specialist, behavioural components, forms of self-management, and criteria for outcome assessment. Such heterogeneity complicates comparison of studies and does not allow a single standardised protocol for long-term maintenance of physical activity after cardiac rehabilitation to be formed.

A separate problem is the limited data on hard clinical endpoints in the long-term period. Short- and medium-term outcomes are most commonly assessed using peak oxygen uptake (VO_2peak), Six-Minute Walk Test (6MWT) distance, quality of life, physical activity levels, and programme adherence. By contrast, the long-term effect of home-based cardiac rehabilitation on recurrent myocardial infarction, cardiovascular mortality, repeated hospitalisations, stability of risk-factor control, and healthcare system costs requires further evaluation. This does not deny the effectiveness of the home-based model, but it indicates the need for longer, better standardised, and methodologically stronger studies [14, 20]. The problem of adherence to the programme has particular importance in the long-term period. For patients following myocardial infarction, performing exercise at home requires not only an understanding of the benefits of physical activity but also established exercise habits, confidence in exercising safely, the ability to regulate exercise intensity independently, and readiness to continue the programme with reduced professional supervision. For this reason, short-term improvement in functional indicators does not always mean long-term change in movement behaviour. If the programme does not contain mechanisms for maintaining motivation, self-management, feedback, and social support, the achieved effect may gradually be lost [20, 22]. In this aspect, electronic health technologies and mobile digital health technologies have clear potential, but they do not eliminate the problem automatically. The systematic review and meta-analysis by M. Heimer *et al.* [20], devoted to electronic health technologies for cardiac rehabilitation in the maintenance phase, showed that digital interventions can contribute to increased physical activity, improved exercise capacity, quality of life, and individual indicators of cardiovascular risk compared with usual care. However, the authors indicate that available studies remain heterogeneous in design, technological platforms, duration of follow-up, intensity of professional feedback, and method of assessing behavioural outcomes [20]. Thus, digital technologies in the maintenance phase should be considered not as an independent replacement for a rehabilitation programme but as an instrument for maintaining long-term behavioural change. The most clinically meaningful elements are not applications, wearable devices, or electronic diaries themselves, but

the functions they provide: self-management, setting individual goals, regular feedback, reminders, visualisation of progress, remote adjustment of exercise load, and rapid contact with a specialist if symptoms appear. Without professional supervision, digital tools can record activity but cannot always support stable adherence and correct interpretation by the patient of their own condition [16, 20].

Data on cardiac telerehabilitation also confirm the prospects of remote supervision in the long-term period but also demonstrate the incompleteness of the evidence base. The systematic review and meta-analysis by W. Zhong *et al.* [19] demonstrated a positive effect of cardiac telerehabilitation on long-term functional indicators and quality of life in patients with ischaemic heart disease. However, the effect on control of risk factors, psychological outcomes, and hard clinical endpoints remains less clear. This means that telerehabilitation has high potential as a mechanism for supporting home-based cardiac rehabilitation but requires integration with the behavioural, psychological, and clinical components of the programme [19]. For home-based cardiac rehabilitation after myocardial infarction, the long-term period is especially vulnerable due to the combination of several factors: reduced frequency of contact with the medical system, the patient's return to usual everyday and professional loads, fluctuations in motivation, fear of a recurrent cardiac event, comorbidity, uneven family support, and different levels of digital literacy. In patients with low self-efficacy or kinesiophobia, the home environment may fail to support activity and, conversely, may increase avoidance of physical exercise. Therefore, the maintenance phase requires no less, and in some cases greater, individualisation than the early period of cardiac rehabilitation [12-13, 22]. From a methodological position, the main problem of contemporary studies is the heterogeneity of definitions of the long-term period. In different works, the maintenance phase may be interpreted as the period after completion of phase II cardiac rehabilitation, as follow-up beyond 6 months, beyond 12 months, or as an undefined stage of independent activity maintenance. Differences in definitions mean that results are difficult to compare with each other, while conclusions about the effectiveness of long-term interventions remain less certain. For future research, it is advisable to distinguish clearly between the early, post-acute, and long-term stages, and to indicate the duration of active intervention, duration of follow-up, and intensity of professional supervision [20-21].

Another gap is insufficient standardisation of outcomes assessed in long-term programmes. In addition to traditional functional indicators, it is advisable to measure systematically the level of everyday physical activity, sedentary behaviour, adherence to independent exercises, self-efficacy, kinesiophobia, anxiety, depressive symptoms, health-related quality of life, repeated hospitalisations, and use of medical resources. Without such a multidimensional approach, the long-term effectiveness of home-based cardiac rehabilitation may be assessed incompletely: a programme may improve peak oxygen consumption in the short term but fail to ensure sustained behavioural change or reduced risk of recurrent events [12, 20]. In practical terms, this means that home-based cardiac rehabilitation after myocardial infarction should be designed from the outset as a long-term model rather than a brief instruction after discharge. Its structure should provide for initial clinical and functional assessment, individual exercise prescription, periodic reassessment of goals, self-management training, symptom-response algorithms, psychological screening, gradual reduction in the intensity of professional supervision without complete cessation of contact, and instruments for maintaining motivation after completion of the active phase. This approach shifts the focus from short-term performance of a set of exercises to the formation of stable movement behaviour [13, 22].

Long-term care following myocardial infarction should also be considered within the broader framework of secondary prevention and the long-term management of chronic coronary syndromes. Long-term management of the patient after myocardial infarction should also be considered in the broader context of secondary prevention and management of chronic coronary syndromes. After the acute event, the patient moves to long-term control of residual cardiovascular risk, including lifestyle modification, physical activity, control of blood pressure, lipids, glycaemia, body weight, medication adherence, and structured rules for stopping or modifying physical exercise, contacting a specialist, or seeking emergency care when clinical signs of exercise intolerance appear. Therefore, home-based cardiac rehabilitation in the long-term period should be integrated not only into an exercise programme but also into the general strategy of secondary prevention after myocardial infarction [23-24]. Thus, the long-term rehabilitation period is the main gap in the current evidence base on home-based cardiac rehabilitation after myocardial infarction. Available data confirm the effectiveness of home-based programmes in the short and medium term, but leave open the issues of sustained maintenance of physical activity, long-term adherence, impact on recurrent events, optimal duration of supervision, the role of psychological components, and standardisation of digital support. Accordingly, the further development of home-based cardiac rehabilitation should be directed towards the creation of long-term, personalised, and structured programmes that combine clinical and functional stratification, behavioural support, telerehabilitation, mobile digital health technologies, family involvement, and periodic professional control [16, 19-21].

Psychological and behavioural barriers are another reason why home-based cardiac rehabilitation that

is effective in content may fail to ensure a stable result in the long-term period. Psychological distress, kinesiophobia, low self-efficacy, weak social support, insufficient digital literacy, and unstable motivation directly affect the start of the programme, regularity of exercise performance, self-management, and maintenance of movement behaviour. Therefore, home-based cardiac rehabilitation after myocardial infarction should be not only clinically and functionally individualised but also psychologically and behaviourally supported. The integration of psychological screening, behavioural support, family involvement, mobile digital health technologies, and professional feedback creates the prerequisites for effective long-term supervision of the patient after myocardial infarction [22, 25]. Thus, home-based cardiac rehabilitation after myocardial infarction is a promising, evidence-supported, and potentially scalable model of secondary prevention. However, its long-term effectiveness depends not only on prescribing physical exercises at home, but on the comprehensive organisation of the programme: risk stratification, professional supervision, psychological-behavioural support, telerehabilitation, adapted digital or analogue instruments, and standardised assessment of outcomes. Therefore, the optimal development of cardiac rehabilitation after MI lies not in replacing the centre-based cardiac rehabilitation model with a home-based one, but in the rational combination of centre-based, home-based, and hybrid formats according to clinical risk, functional status, psychological profile, and the needs of long-term patient management [23-24].

The results obtained are consistent with the data of the randomised study by R. Bravo-Escobar *et al.* [26], in which home-based cardiac rehabilitation with mixed supervision in patients with ischaemic heart disease at moderate risk showed effectiveness and safety when preliminary selection and controlled supervision were provided. A common conclusion is that the home-based format cannot be considered as uncontrolled independent exercise, it should include initial assessment, individualisation of exercise load, self-management, and professional contact. The difference of the present study lies in its focus specifically on the long-term period after myocardial infarction, where maintenance of adherence, long-term behavioural change, and prevention of loss of achieved functional outcomes become key. The conclusion on the appropriateness of telerehabilitation supervision partly coincides with the findings of R. Hwang *et al.* [27], who indicated that home-based telerehabilitation for patients with chronic heart failure may produce functional outcomes similar to those of a centre-based programme. Although the population of that study differs from post-infarction patients, its results support the general idea that a remote format can be clinically acceptable when proper monitoring is provided. The present study complements these data by stressing the need for symptom-response algorithms, risk stratification, and a combination of digital and analogue tools for patients with different levels of digital literacy.

The data of E. Piotrowicz *et al.* [28] on hybrid telerehabilitation in patients with heart failure demonstrate that remotely supported programmes can improve functional indicators but do not always convincingly affect hard clinical endpoints. This corresponds to the conclusion obtained that telerehabilitation is not a self-sufficient substitute for a clinically structured programme. It should be considered as an instrument for supporting physical activity, self-management, and feedback, rather than as a separate technological intervention. The results of the international INTERASPIRE survey presented by K. Kotseva *et al.* [29] confirm that, even in the presence of an evidence base, cardiac rehabilitation remains underused in different healthcare systems. This coincides with the above-described emphasis on accessibility as one of the main reasons for the development of home-based and hybrid models. However, this paper specifies that increasing accessibility should be accompanied not by simplification of the programme but by preservation of clinical manageability. The analysis by B. Jug *et al.* [30] of outpatient and residential cardiac rehabilitation after myocardial infarction in Slovenia indicates the importance of the organisational model, routing, and regional accessibility for patient participation and clinical outcomes. Unlike that publication, the present study does not analyse a national registry, but complements available data with a conceptual justification of the home-based format for the long-term period. Its contribution lies in the integration of three components that are often considered separately: evidence-based effectiveness of home-based cardiac rehabilitation, telerehabilitation support, and psychological-behavioural conditions for long-term adherence after myocardial infarction.

CONCLUSIONS

1. Exercise-based cardiac rehabilitation is an evidence-based component of secondary prevention following myocardial infarction. Its clinical value extends beyond improving exercise capacity to reducing cardiovascular mortality, recurrent cardiovascular events, and hospitalisations, while also improving health-related quality of life. Accordingly, post-myocardial infarction cardiac rehabilitation should be regarded as a standard component of long-term patient care rather than as an optional post-discharge intervention.

2. Home-based cardiac rehabilitation is an evidence-supported alternative to centre-based cardiac rehabilitation for clinically stable patients at low or moderate risk after myocardial infarction. Current systematic reviews and comparative studies indicate that home-based programmes can provide results not inferior in effectiveness to centre-based programmes in terms of functional capacity, quality of life, adherence to the programme, and control of individual cardiovascular

risk factors. However, these conclusions should not be automatically applied to all patients after MI without prior risk stratification.

3. The safety and effectiveness of home-based cardiac rehabilitation depend not on the place where exercises are performed itself, but on the quality of clinical organisation of the programme. Mandatory conditions are initial clinical and functional assessment, risk stratification, individualised exercise prescription, self-management training, symptom monitoring, clear criteria for stopping or modifying exercises, and regular professional feedback. For patients at high risk or with an unstable clinical condition, centre-based cardiac rehabilitation or hybrid cardiac rehabilitation may be more appropriate.

4. The greatest gap in the current evidence base remains the long-term rehabilitation period, specifically the maintenance phase. Most studies assess outcomes over 3-12 months, whereas questions of sustained maintenance of physical activity, long-term adherence, preservation of functional outcomes, impact on repeated hospitalisations, recurrent myocardial infarction, and cardiovascular mortality beyond 12-24 months remain insufficiently evaluated. In this period, not only the parameters of physical exercise but also self-management, behavioural support, periodic reassessment of goals, and long-term professional supervision become decisive.

5. Telerehabilitation, electronic technologies, and mobile health technologies can improve the accessibility of home-based cardiac rehabilitation by supporting self-management, monitoring, and adherence to the programme. However, their effectiveness depends on integration into clinically structured rehabilitation, professional supervision, and adaptation to the patient's digital literacy.

6. Psychological and behavioural factors are an integral component of home-based cardiac rehabilitation after myocardial infarction. Psychological distress, kinesiophobia, low self-efficacy, and insufficient social support may reduce adherence to the programme, so an effective model should include psychological screening, behavioural support, motivational counselling, family involvement, and regular professional feedback.

Prospects for further research. Further research on home-based cardiac rehabilitation after myocardial infarction should be directed towards long-term randomised studies, standardisation of programmes and outcome indicators, assessment of safety and psychological and behavioural consequences, and comparison of different supervision formats and their economic feasibility.

Limitations of the study. The study is an analytical narrative review with elements of a systematised search and did not involve a formal systematic review or meta-analysis. The conclusions are based on secondary analysis of home-based, hybrid, and telerehabilitation programmes that are heterogeneous in structure, duration, intensity of supervision, and effectiveness indicators. In addition, most studies include patients at low or moderate risk and short- and medium-term outcomes, whereas long-term effectiveness, safety for high-risk patients, and economic feasibility remain insufficiently evaluated. Therefore, the conclusions presented should be considered as a synthesis of the current evidence base requiring further verification in long-term randomised studies.

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CONFLICT OF INTEREST

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Домашня кардіореабілітація після інфаркту міокарда в довготривалому реабілітаційному періоді: доказова база та перспективи розвитку

Анотація
Актуальність. Інфаркт міокарда супроводжується тривалими функціональними, клінічними та психоемоційними наслідками, тоді як недостатня доступність традиційних програм кардіореабілітації у центрі зумовлює потребу в доказово обґрунтованих домашніх, гібридних і телереабілітаційних моделях, здатних підтримувати безпечну фізичну активність, самоконтроль і вторинну профілактику в довготривалому реабілітаційному періоді.
Мета. Узагальнити сучасну доказову базу щодо домашньої кардіореабілітації після інфаркту міокарда, визначити її ефективність, безпечність та перспективи застосування в довготривалому реабілітаційному періоді.
Матеріали та методи. Стаття виконана у форматі аналітичного наративного огляду з елементами систематизованого пошуку. Проаналізовано систематичні огляди, метааналізи, рандомізовані контрольовані дослідження, когортні дослідження, наукові заяви професійних товариств і клінічні настанови, присвячені кардіореабілітації на основі фізичних вправ, домашній кардіореабілітації, кардіотелереабілітації, мобільним технологіям охорони здоров'я (mHealth), фазі підтримки, прихильності до домашніх фізичних вправ, кінезіофобії, психологічному дистресу та довготривалому самокеруванню пацієнтів після інфаркту міокарда.

Результати. Сучасні дані свідчать, що домашня кардіореабілітація може забезпечувати результати, що не поступаються програмам, які проводяться в лікувально-профілактичних та реабілітаційних закладах, у клінічно стабільних пацієнтів низького або помірного ризику після інфаркту міокарда. Безпечність домашньої моделі залежить від належного відбору пацієнтів, стратифікації ризику, індивідуалізованого призначення фізичного навантаження, навчання самоконтролю, регулярного професійного зворотнього зв'язку, алгоритмів реагування на симптоми – тобто структурованих правил припинення або модифікації фізичного навантаження, контакту з фахівцем чи звернення по невідкладну допомогу при появі клінічних ознак непереносимості навантаження. Телереабілітація та мобільні цифрові технології охорони здоров'я можуть підвищувати доступність, підтримувати самоконтроль, полегшувати моніторинг симптомів і фізичної активності, однак не є самодостатньою заміною клінічно структурованої програми. Найбільшою прогалиною залишається довготривалий реабілітаційний період, у якому вирішальними стають підтримання рухової поведінки, прихильність, психологічна адаптація, подолання кінезіофобії, самоефективність і соціальна підтримка.

Висновки. Домашня кардіореабілітація після інфаркту міокарда є перспективною моделлю вторинної профілактики для відібраних клінічно стабільних пацієнтів, проте її довготривала ефективність потребує структурованого професійного супроводу, стратифікації ризику, психологічно-поведінкової підтримки, телереабілітації або аналогових інструментів самоконтролю та стандартизованої оцінки функціональних, клінічних і поведінкових результатів.

Ключові слова: фізична терапія; вторинна профілактика; прихильність; фактори ризику; серцево-судинні захворювання.