



Online Intensive Cardiac Rehabilitation Program for Japanese Patients With Coronary Artery Disease

— A Pilot Study Protocol —

Neiko Ozasa, MD, PhD; Kazuhisa Kaneda, MD; Koichi Washida, RN, MHSc;
Yoko Umeda Shiozaki, CEP, CPP, MPP; Saeko Imai, RD, PhD; Kaoru Kitta, RD;
Yuki Higuchi, RD; Sawako Yoshiuchi, RD; Toshiko Yoshida, RN, PHN, PhD;
Kenji Nakatsuma, MD, PhD; Takeshi Kimura, MD, PhD, MPH; Koh Ono, MD, PhD

Background: A comprehensive cardiac rehabilitation (CR) program is recommended for coronary artery disease (CAD). However, many facilities do not have established programs for dietary guidance and patient education, resulting in an exercise-based CR program and limited efficacy for secondary prevention.

Methods and Results: A pilot study will be conducted to develop an online Japanese-style intensive cardiac rehabilitation (J-ICR) program for Japanese patients with CAD and will examine adherence, safety, and efficacy. Twenty-four patients diagnosed with stable CAD will be randomly assigned in a 1:1 ratio to either an early or late-phase group. The program will comprise the following four parts: exercise sessions; dietary education centered on “the Japan diet”; mindfulness; and group support, with a frequency of 3 h per session, once a week for 12 weeks (a total of 36 h). The primary endpoint will be program feasibility, determined by examining its adherence. Physical examination and function, stress-coping skills, risk of classic CAD (e.g., lipid profile, glucose tolerance, and blood pressure), and dietary changes will be assessed as secondary endpoints.

Conclusions: The online J-ICR program is designed as a comprehensive CR program for Japanese patients with CAD. If this program shows high adherence and an improvement in CAD risk factors, its secondary prevention effect should be verified with appropriately powered randomized trials at multiple centers.

Key Words: Exercise; Group support; Intensive cardiac telerehabilitation; Mindfulness; The Japan diet

Cardiovascular diseases and their risk factors such as obesity, diabetes, and hypertension are rapidly increasing in Japan owing to lifestyle changes, such as diet westernization and a decrease in exercise habits.¹ Cardiac rehabilitation (CR) is a lifestyle modification program aimed at preventing the worsening or recurrence of cardiovascular diseases. For patients with coronary artery disease (CAD), such as myocardial infarction and angina pectoris, a comprehensive CR program that includes exercise training, dietary guidance, medication guidance, patient education for self-management, psychological counseling, and return-to-work guidance, is recommended. However,

in clinical practice in Japan, exercise training accounts for 40–50 min of a 1-h CR session, and many facilities do not have well-developed programs for dietary guidance and patient education, resulting in exercise-based CR.

In the USA, a leading country in CR, a program involving 3 1-h sessions per week for 12 weeks (a total of 36 h) has traditionally been conducted. However, this conventional program does not affect total mortality, myocardial infarction, or revascularization, although a reduction in cardiac death and rehospitalization prevention have been reported.² In contrast, intensive CR (ICR) with a comprehensive patient-education program has been covered by insurance

Received July 2, 2024; accepted July 2, 2024; J-STAGE Advance Publication released online August 27, 2024 Time for primary review: 1 day

Department of Primary Care and Emergency Medicine (N.O.), Department of Cardiovascular Medicine (K. Kaneda, K.W., K.N., K.O.), Kyoto University Graduate School of Medicine, Kyoto; Department of Cardiology, Kansai Heart Center, Takanohara Central Hospital, Nara (N.O.); Rehabilitation Unit, Kyoto University Hospital, Kyoto (Y.U.S.); Department of Food and Nutrition, Kyoto Women's University, Kyoto (S.I., K. Kitta, Y.H.); Health Science Center, Kansai Medical University Hospital, Osaka (S.Y.); Graduate School of Nursing Science, St. Luke's International University, Tokyo (T.Y.); and Division of Cardiology, Hirakata Kohsai Hospital, Osaka (T.K.), Japan

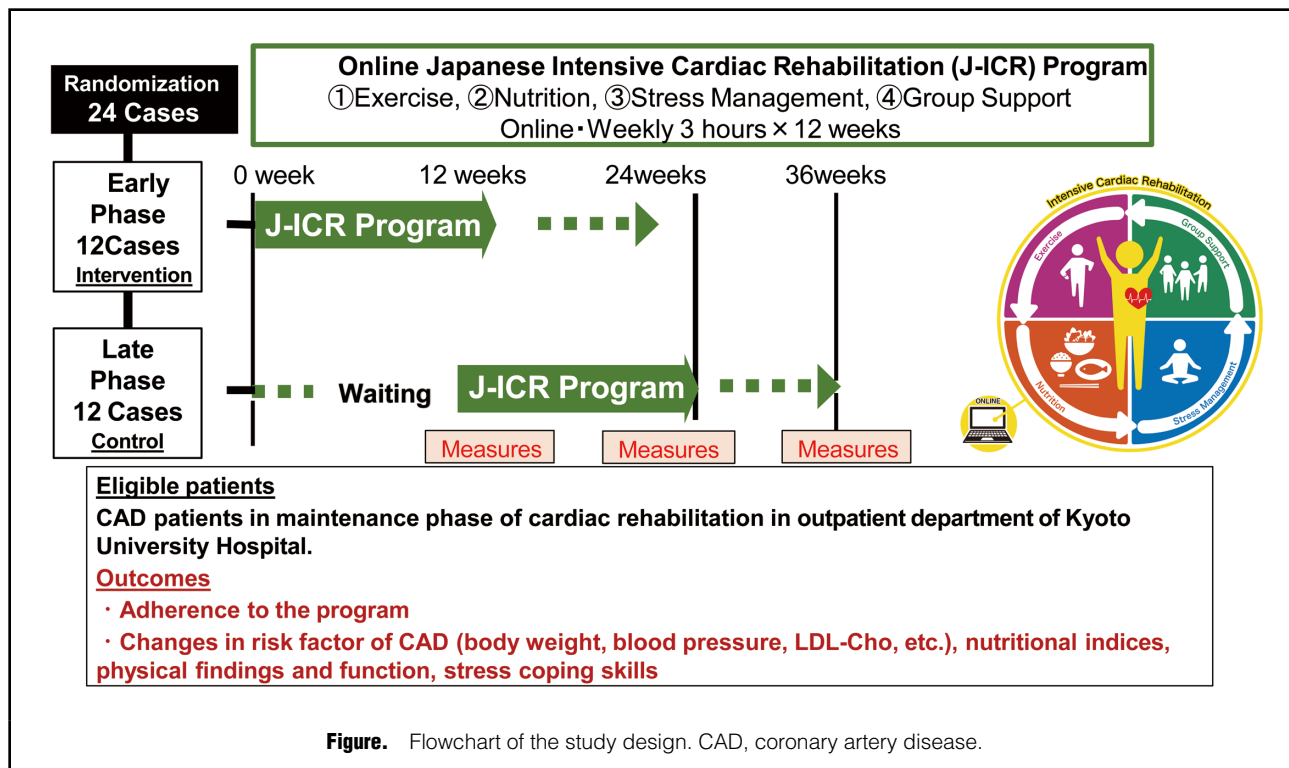
K.O. is a member of *Circulation Reports*' Editorial Team.

Mailing address: Neiko Ozasa, MD, PhD, Department of Primary Care and Emergency Medicine, Kyoto University Graduate School of Medicine, 54 Shogoin Kawahara-cho, Sakyo-ku, Kyoto 606-8507, Japan. email: nei126@kuhp.kyoto-u.ac.jp

All rights are reserved to the Japanese Circulation Society. For permissions, please email: cr@j-circ.or.jp

ISSN-2434-0790





in the USA since 2011, and is reported to have a great treatment effect. It comprises 4-h sessions two times weekly for 9 weeks (a total of 72 h); each session includes 1 h each of exercise training, dietary guidance, mindfulness, and group support.³ It has been introduced in Japanese guidelines as the latest CR program that provides a more comprehensive intervention.⁴ Coronary risk factors, including lipid profiles, weight, emotional depression, and blood pressure, significantly improved at 12 weeks and 1 year in a large demonstration project of ICR involving approximately 3,000 patients across 24 USA hospitals and clinics.⁵ In another demonstration project involving 333 patients eligible for revascularization surgery, approximately 80% could safely avoid surgery.⁶

Specific features of the USA ICR include the following: exercise instruction centered on aerobic exercise; dietary instruction centered on a raw, plant-based, whole-food diet; mindfulness and yoga for stress management instruction; and group support involving a small group of patients and a medical professional. The importance of aerobic exercise in preventing and treating cardiovascular disease is well established, and exercise therapy as a non-pharmacological treatment is recommended by the American Heart Association (AHA). The AHA has recently recommended a dietary pattern with an emphasis on fruit and vegetables, whole grain foods, healthy protein sources (e.g., fish, seafood, legumes and nuts, low-fat/fat-free dairy, poultry, and, if desired, lean meat), and plant oils.⁷ Mindfulness is a scientifically validated and systematized stress-management approach to stabilize the mind and autonomic nervous system and improve adherence to lifestyle modification.⁸ Group support was developed in the 1970s in the USA to help patients with cancer cope and adapt by expressing and managing illness-

related emotions, increasing social support, strengthening relationships with family and healthcare providers, and improving symptom control.⁹ It has been introduced to treat patients with various chronic diseases and has been found to reduce psychological distress and improve quality of life.¹⁰

As it is difficult to introduce the original USA ICR program in Japan, where diet and lifestyle greatly differ from that in the USA, we have developed a novel ICR program – “the Japanese intensive cardiac rehabilitation (J-ICR)” program – which is compatible with Japanese patients with cardiovascular disease. It was developed as an online program to adapt to the current situation of CR in Japan, including the patient burden on time spent in the hospital and infection control in rehabilitation rooms.¹¹ As a preliminary pilot study to determine the feasibility of the online J-ICR program, we will examine its adherence, safety, and changes in coronary risk factors, dietary habits and stress-coping skills in a small group of patients with CAD in the maintenance phase of the CR program.

Methods

Design

This is a physician-initiated, open-label, randomized controlled study focusing on the online J-ICR. Between September and October 2023, 24 patients were recruited for this study at the outpatient clinic of the Department of Cardiology, Kyoto University Hospital. The online ICR program was implemented in November 2023 and was expected to be terminated in April 2024 (Figure).

This study was registered with the University Hospital Medical Information Network (UMIN identifier: UMIN000051365).

Table 1. Overview of Study Activities

	Pre-program survey items (pre-start survey)	End-of-program/end-of-waiting survey items (exit survey)	6 months after program completion (6-months post-intervention survey)
	From obtaining research consent to 0 weeks; 4–5 h	12 weeks + 2 weeks post-intervention; approximately 3 h	24 weeks + 2 weeks after intervention; approximately 3 h
Demographic variables	X		
Medications and treatments	X	X	X
Physical examination (WC, grip strength)*	X	X	X
Early morning home BP and pulse rate averaged over 1 week	X	X	X
Bioimpedance analysis (Inbody)**	X	X	X
Laboratory data***	X	X	X
Physiological examination (ECG, UCG, CPX)	X		
Lifestyle factors	X	X	X
Stress coping ability	X	X	X
Program adherence		X	X
Participants' evaluation of the program		X	
Adverse events			→

*Grip strength is measured using a digital grip strength meter (Grip D, Takei Kiki Kogyo Co., Ltd) two times on each side in the sitting position with the elbow joint in extension, calculating the maximum value. **Body composition is measured using bioimpedance analysis (InBody 770, Cerritos, CA, USA): body fat mass, body fat percentage, skeletal muscle mass, phase angle, and extracellular water/total body water. ***Blood samples (fasting, 10 mL): white blood cell count, white blood cell fraction, hemoglobin level, hematocrit, creatinine level, estimated glomerular filtration rate, urea nitrogen level, albumin level, total protein level, aspartate aminotransferase level, alanine aminotransferase level, uric acid level, sodium level, potassium level, chloride level, calcium level, magnesium, phosphorus level, blood glucose level, hemoglobin A1c level (National Glycohemoglobin Standardization Program, diabetes, or suspected diabetes), total cholesterol level, low-density lipoprotein cholesterol level, high-density lipoprotein cholesterol level, triglyceride level, B-type natriuretic peptide level, and high-sensitivity C-reactive protein level; urinalysis: sodium, creatinine, and albumin levels. BP, blood pressure; CPX, cardiopulmonary exercise test; ECG, electrocardiogram; UCG, ultrasonic cardiogram; WC, waist circumference.

Ethics Approval

The Medical Ethics Committees of the Kyoto University Graduate School of Medicine and Faculty of Medicine and Kyoto University Hospital approved this study (Institutional Study No. C1633).

Patients

Patients diagnosed with CAD who were undergoing revascularization or receiving drug treatment, including anti-thrombotic drugs, but whose condition had been stable for at least 3 months with outpatient treatment and with no plans to change treatment (i.e., patients in the maintenance phase of CR) were registered. The detailed inclusion and exclusion criteria are listed in **Supplementary Table 1**. Patients who meet the eligibility criteria will be informed about the online ICR program by their physicians or researchers and asked if they want to participate. Twenty-four eligible patients will be randomized in a 1:1 ratio to either the early (immediately administered the program; n=12) or late-phase (administered the pre-intervention examination after a 12-week waiting period; n=12) groups by block randomization, consisting of 8 blocks, using Research Electronic Data Capture (REDCap),¹² which is a secure, web-based platform to support research data capture. All therapeutic decisions (e.g., medication and revascularization) will be deferred to the referring physician.

The J-ICR Program

This J-ICR program will provide online instructions through Zoom (Zoom Video Communications Inc., San

Jose, CA, USA). It will comprise four parts: exercise training; dietary education; mindfulness; and group support, with 3 h sessions once a week for 12 weeks (a total of 36 h). Each component is detailed below.

Exercise Training: 40 min per Session Exercise prescription and instruction will be based on the cardiopulmonary exercise test (CPX) results and real-time exercise instructions (i.e., aerobic exercise, strength training, and multi-component exercise) by physicians and instructors.

Dietary Education: 40 min per Session The J-ICR focuses on “the Japan diet”, centering on rice. It emphasizes unprocessed and vegetarian foods, has a higher proportion of carbohydrates relative to total energy intake, has a lower proportion of fat (especially saturated fat), and limits meat and processed foods.¹³ The themes of each dietary session are listed in **Supplementary Table 2**.

Stress Management: 40 min per Session In this study, we will construct an original program using mindfulness-based stress reduction: a program systematized by Dr. Jon Kabat-Zinn at the University of Massachusetts Medical School (USA).¹⁴ The themes of each mindfulness session are presented in **Supplementary Table 3**.

Group Support: 40 min per Session The sessions will be informal, and the facilitators will coordinate the development of mutually supportive relationships so that patients feel comfortable discussing their feelings and thoughts with each other.

Measurements

In this study, all measurements, surveys, and evaluations

Table 2. Study Outcomes

2-1. Definition of primary endpoints Program adherence
2-2. Definition of secondary endpoints Nutritional indices, physical findings and function, stress coping skills (mindfulness), classic risk of coronary artery disease (lipid abnormalities, glucose intolerance, and hypertension) Participants' evaluation of the program

will be conducted during randomization, before the start of the program, at the end of the program, and 3 months after the program. **Table 1** provides a summary of the research activities and measurement details. Furthermore, to evaluate the J-ICR program for quality improvement, the participants will provide evaluations of the J-ICR online program.

Physical Fitness Tests

Exercise capacity was measured before the beginning of the program via the CPX using a symptom-limited bicycle ergometer with a 10–20 W ramp protocol. Peak oxygen consumption, aerobic threshold, 12-lead electrocardiogram, heart rate, and blood pressure during exercise were evaluated.

Home Blood Pressure and Daily Physical Activity

Morning, fasting, resting blood pressure, along with pulse rate (patient measured), will be assessed every day using a brachial sphygmomanometer (Omron HCR-7101; Omron Healthcare Co. Ltd, Kyoto, Japan) and averaged over 1 week. The amount of exercise performed at home will be measured using a Fitbit Inspire 2™ (FBI2; FitBit® Inc., San Francisco, CA, USA).

Patient-Reported Outcome Measures: Visual Analog Scale for the Overall Program

Four questionnaires assessing daily exercise, diet, mindfulness, and group support will be used, with scores ranging from not satisfied (0) to fully satisfied (10).

Dietary Assessments

The Food Frequency Questionnaire (FFQ) and FFQ Kenpakusha FFQ-NEXT will be used to assess the Healthy Eating Index-2015.^{15,16}

Psychological Assessment

Sense of Coherence Scale-13 will be used to assess coping capacity.¹⁷ The Japanese version of the Mindful Attention Awareness Scale published in 2015 will be used to assess mindful attention awareness.¹⁸

Study Outcomes

The primary endpoint will be program feasibility, assessed by examining program adherence, such as domestic participation and implementation rates. Physical function, stress-coping skills, mindfulness, body composition, and typical CAD risks (e.g., lipid profile, glucose tolerance, and blood pressure) will be assessed as secondary endpoints. The HEI-2015,^{15,16} which has been widely reported to be associated with CAD in the USA, will be used as a nutritional index to examine dietary changes (see **Table 2** for an overview of the study outcomes).

Safety Assessment

The program includes exercise instructions, with CPX performed before program commencement to check exercise safety and the optimal intensity for each patient. The program will also be conducted while ensuring that the heart rate does not exceed the optimal range. Heart rate will be assessed using the FB-I2 and self-reported before, during, and after exercise.

In preparation for liability for compensation in the event of health-related harm due to study participation, the patient will be covered by the Clinical Research and Physician-Initiated Clinical Trials Insurance.

Ethical Considerations

The investigators will provide patients with written information about the study's purpose and content. After confirming that individuals fully understand the research, their free and voluntary consent to participate will be obtained. This study will be performed in accordance with the Declaration of Helsinki and the Ethical Guidelines for Medical and Health Research Involving Human Subjects in Japan.

Discussion

This is a physician-initiated, open-label, randomized controlled pilot study designed to evaluate the feasibility, adherence, safety, and improvement of CAD risk factors of the J-ICR in a small number of cases.

In the next stage, hybrid J-ICR models, including components from both center and home-based CR, will be required.¹⁹ Ultimately, the future optimal model of care would be person-centered, where the J-ICR delivery mode depends on the preferences of each patient while considering the medical risk stratification and related need for direct supervision and monitoring. Such models may allow patients to start with a supervised center-based ICR program that may be supplemented with home-based sessions, or that switches entirely to home after a given period. It is expected that the J-ICR program will be covered by insurance in Japan in the near future and widely used as a sustainable secondary prevention program.

Conclusions

The online J-ICR program is designed as a comprehensive CR program for Japanese patients with CAD. As this is a pilot study to explore the feasibility of the online J-ICR, its secondary prevention effect should be verified with appropriately powered randomized trials at multiple centers.

Acknowledgments

We express our sincere gratitude to Harue Suzuki, Doctor of Medicine, the President of the Plantician Project in Japan, for her guidance in plant-based whole-food cooking.

Sources of Funding

This research was partially supported by an FY2023 research grant from the Japanese Association for Cardiac Rehabilitation Research (Assignment No. 203230700044) and a Grant-in-Aid for Scientific Research from the Japan Society for the Promotion of Science (Assignment No. JP 21K19669). The funders had no involvement in the study design, data collection, analysis, interpretation, manuscript writing, or decision to submit the manuscript for publication.

Disclosures

K.O. is a member of *Circulation Reports'* Editorial Team. The authors declare that there are no conflicts of interest.

Conflicts of interest were reviewed by the Kyoto University Clinical Research Conflict of Interest Review Committee in accordance with the Kyoto University Conflict of Interest Policy and Kyoto University Conflict of Interest Management Regulations.

Data Availability

As this is a study protocol, no raw data would be available at the time of manuscript submission.

References

- Kanaoka K, Soeda T, Terasaki S, Nishioka Y, Myojin T, Kubo S, et al. Current status and effect of outpatient cardiac rehabilitation after percutaneous coronary intervention in Japan. *Circ Rep* 2021; **3**: 122–130, doi:10.1253/circrep.CR-20-0143.
- Anderson L, Oldridge N, Thompson DR, Zwisler AD, Rees K, Martin N, et al. Exercise-based cardiac rehabilitation for coronary heart disease: Cochrane Systematic Review and Cochrane Systematic Review and Meta-Analysis. *J Am Coll Cardiol* 2016; **67**: CD001800, doi:10.1002/14651858.CD001800.pub3.
- Freeman AM, Taub PR, Lo HC, Ornish D. Intensive cardiac rehabilitation: An underutilized resource. *Curr Cardiol Rep* 2019; **21**: 19, doi:10.1007/s11886-019-1104-1.
- Makita S, Yasu T, Akashi YJ, Adachi H, Izawa H, Ishihara S, et al. Corrigendum: JCS/JACR 2021 Guideline on rehabilitation in patients with cardiovascular disease. *Circ J* 2023; **87**: 937, doi:10.1253/circj.CJ-66-0214.
- Silberman A, Banthia R, Estay IS, Kemp C, Studley J, Hareras D, et al. The effectiveness and efficacy of an intensive cardiac rehabilitation program in 24 sites. *Am J Health Promot* 2010; **24**: 260–266, doi:10.4278/ajhp.24.4.arb.
- Ornish D. Avoiding revascularization with lifestyle changes: The Multicenter Lifestyle Demonstration Project. *Am J Cardiol* 1998; **82**: 72T–76T, doi:10.1016/s0002-9149(98)00744-9.
- Lichtenstein AH, Appel LJ, Vadiveloo M, Hu FB, Kris-Etherton PM, Rebholz CM, et al. Dietary guidance to improve cardiovascular health: A scientific statement from the American Heart Association. *Circulation* 2021; **144**: e472–e487, doi:10.1161/CIR.000000000001031.
- Olex S, Newberg A, Figueredo VM. Meditation: Should a cardiologist care? *Int J Cardiol* 2013; **168**: 1805–1810, doi:10.1016/j.ijcard.2013.06.086.
- Goodwin PJ, Leszcz M, Ennis M, Koopmans J, Vincent L, Guthrie H, et al. The effect of group psychosocial support on survival in metastatic breast cancer. *N Engl J Med* 2001; **345**: 1719–1726, doi:10.1056/NEJMoa011871.
- Hosaka T, Tokuda Y, Sugiyama Y. Effects of a structured psychiatric intervention on cancer patients' emotions and coping styles. *Int J Clin Oncol* 2000; **5**: 188–191, doi:10.1007/PL00012036.
- Kida K, Nishitani-Yokoyama M, Kono Y, Kamiya K, Kishi T, Node K, et al. Second nationwide survey of Japanese cardiac rehabilitation training facilities during the coronavirus disease 2019 (COVID-19) outbreak. *Circ Rep* 2022; **4**: 469–473, doi:10.1253/circrep.CR-22-0086.
- Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, et al.; REDCap Consortium. The REDCap consortium: Building an international community of software platform partners. *J Biomed Inform* 2019; **95**: 103208, doi:10.1016/j.jbi.2019.103208.
- Kinoshita M, Yokote K, Arai H, Iida M, Ishigaki Y, Ishibashi S, et al. Japan Atherosclerosis Society (JAS) Guidelines for Prevention of Atherosclerotic Cardiovascular Diseases 2017. *J Atheroscler Thromb* 2018; **25**: 846–984, doi:10.5551/jat.GL2017.
- Kabat-Zinn J. Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness. Dell Publishing; New York: 1990.
- Yokoyama Y, Takachi R, Ishihara J, Ishii Y, Sasazuki S, Sawada N, et al. Validity of short and long self-administered food frequency questionnaires in ranking dietary intake in middle-aged and elderly Japanese in the Japan Public Health Center-Based Prospective Study for the Next Generation (JPHC-NEXT) protocol area. *J Epidemiol* 2016; **26**: 420–432, doi:10.2188/jea.JE20150064.
- Krebs-Smith SM, Pannucci TE, Subar AF, Kirkpatrick SI, Lerman JL, Tooze JA, et al. Update of the Healthy Eating Index: HEI-2015. *J Acad Nutr Diet* 2018; **118**: 1591–1602, doi:10.1016/j.jand.2018.05.021.
- Muroi K, Ishitsuka M, Hori D, Doki S, Ikeda T, Takahashi T, et al. A high sense of coherence can mitigate suicidal ideation associated with insomnia. *Health Psychol Rep* 2023; **11**: 309–320, doi:10.5114/hpr/163068.
- Osman A, Lamis DA, Bagge CL, Freedenthal S, Barnes SM. The Mindful Attention Awareness Scale: Further examination of dimensionality, reliability, and concurrent validity estimates. *J Pers Assess* 2016; **98**: 189–199, doi:10.1080/00223891.2015.1095761.
- Taylor RS, Afzal J, Dalal HM. The promise and challenge of telerehabilitation in cardiac rehabilitation. *Eur J Prev Cardiol* 2022; **29**: 1015–1016, doi:10.1093/eurjpc/zwab138.

Supplementary Files

Please find supplementary file(s):
<https://doi.org/10.1253/circrep.CR-24-0054>