

A 12-week cardiac telerehabilitation programme does not prevent relapse of physical activity levels

Citation for published version (APA):

Brouwers, R. W. M., Kemps, H. M. C., Herkert, C., Peek, N., & Kraal, J. J. (2022). A 12-week cardiac telerehabilitation programme does not prevent relapse of physical activity levels: long term results of the FIT@Home trial. *European Journal of Preventive Cardiology*, 29(7), e255-e257. Advance online publication. <https://doi.org/10.1093/eurjpc/zwac009>

Document license:

CC BY-NC

DOI:

[10.1093/eurjpc/zwac009](https://doi.org/10.1093/eurjpc/zwac009)

Document status and date:

Published: 25/05/2022

Document Version:

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.tue.nl/taverne

Take down policy

If you believe that this document breaches copyright please contact us at:

openaccess@tue.nl

providing details and we will investigate your claim.

A 12-week cardiac telerehabilitation programme does not prevent relapse of physical activity levels: long-term results of the FIT@Home trial

Rutger W.M. Brouwers ^{1,2*}, Hareld M.C. Kemps^{1,2,3}, Cyrille Herkert^{1,2}, Niels Peek ⁴, and Jos J. Kraal⁵

¹Department of Cardiology, Máxima Medical Center, De Run 4600, Postbus 7777, 5500 MB Veldhoven, The Netherlands; ²Vitality Center, Máxima Medical Center, De Run 4600, Postbus 7777, 5500 MB Veldhoven, The Netherlands; ³Department of Industrial Design, Eindhoven University of Technology, Atlas 3 South, PO Box 513, 5600 MB Eindhoven, The Netherlands; ⁴Centre for Health Informatics, Division of Informatics, Imaging and Data Sciences, University of Manchester, Oxford Road, M13 9P Manchester, UK; and ⁵Department of Human-Centered Design, Faculty of Industrial Design Engineering, Delft University of Technology, Landbergstraat 15, 2628 CE Delft, The Netherlands

Received 13 September 2021; revised 11 October 2021; editorial decision 28 December 2021; accepted 12 January 2022; online publish-ahead-of-print 18 January 2022

Keywords

Cardiac rehabilitation • Cardiac telerehabilitation • Coronary artery disease • Physical activity • Relapse prevention

Cardiac telerehabilitation (CTR) is a cost-effective alternative to centre-based cardiac rehabilitation (CR) for patients with coronary artery disease (CAD)¹ and as such, widespread implementation of CTR programmes is increasingly being supported. Unfortunately, physical activity levels (PAL) of patients decline after completion of CR² and many CAD patients do not adhere to physical activity guidelines.³ It is plausible that CTR is more effective than centre-based CR in sustaining long-term PAL and exercise capacity, by encouraging patients to exercise in their home environment and the development of self-management skills to remain physically active. However, follow-up periods of recent trials were too short to demonstrate these effects.^{4,5} The aim of the current study was to evaluate the long-term effectiveness of the CTR intervention applied in the FIT@Home trial⁶ on PAL, physical fitness and quality of life (QoL) after 4 years of follow-up, as compared with centre-based CR.

FIT@Home was a randomized controlled trial evaluating the clinical and cost-effectiveness of 12 weeks of CTR, applying home-based training with a heart rate monitor, web application, and weekly telephone coaching (intervention group), compared with 12 weeks of centre-based CR (control group) in 90 low-to-moderate risk patients with clinically manifest CAD (i.e. secondary prevention).⁷ Both groups were equally effective in improving their physical fitness from baseline to 1 year, whereas PAL and QoL did not change in either group.⁶ For the current study, outcome measures at 4 years of follow-up were physical fitness (peakVO₂ assessed on a cycle ergometer), PAL (assessed using tri-axial accelerometry and heart rate data), and QoL

(assessed using the MacNew questionnaire). We performed linear mixed regression analyses to assess between-group differences in responses over time and paired-sample *t*-tests to analyse within-group differences.

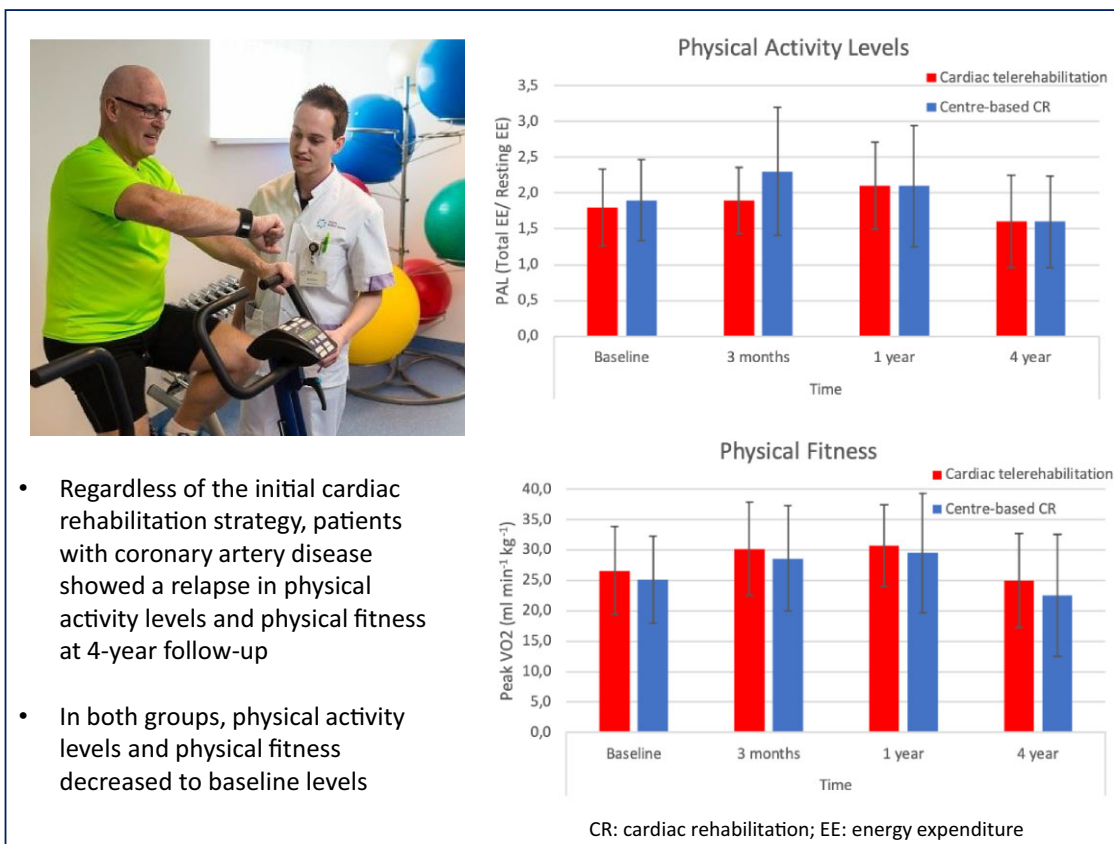
Patients were predominantly male (92.7%; similar to other CTR trials), with a mean age of 60.6 ± 8.2 years at inclusion, and 81.8% had undergone coronary revascularization before the start of CR. After 4 years, 35 patients were lost to follow-up, leaving 55 patients for analysis (27 in the intervention group and 28 in the control group). Patients lost to follow-up were similar to patients available for analysis in terms of age, sex, and prior treatment of CAD. We did not observe between-group differences in responses over time for peakVO₂ (*P* = 0.940), PAL (*P* = 0.997), and QoL (*P* = 0.839; *Figure 1*). From 1 to 4 years of follow-up, peakVO₂ declined in both groups (both *P* < 0.001; *Table 1*). Physical activity levels appeared to decrease at 4 years of follow-up as well, but due to the low number of valid PAL measurements (*n* = 15 and *n* = 12 in the intervention and control group, respectively), we were not able to detect significant changes. In both groups, PAL and peakVO₂ decreased to baseline levels. Quality of life increased in both groups compared with 1 year of follow-up (*P* = 0.005 and *P* = 0.002). With regards to depression and anxiety, only the Hospital Anxiety and Depression Score depression subscale (*Table 1*) improved between 1 and 4 years of follow-up in the control group (*P* = 0.001).

Despite an initial improvement in physical fitness and sustainment of PAL, patients showed a relapse in both of these outcome measures

* Corresponding author. Telephone: 0031 40 888 8200, Fax: 0031 40 888 8216, Email: r.brouwers@mmc.nl

© The Author(s) 2022. Published by Oxford University Press on behalf of the European Society of Cardiology.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com



- Regardless of the initial cardiac rehabilitation strategy, patients with coronary artery disease showed a relapse in physical activity levels and physical fitness at 4-year follow-up
- In both groups, physical activity levels and physical fitness decreased to baseline levels

Figure 1 Physical activity levels and physical fitness after cardiac telerehabilitation and centre-based cardiac rehabilitation. CR, cardiac rehabilitation; EE, energy expenditure; PAL, physical activity level.

Table 1 Main outcome measures at baseline, discharge (3 months) and follow-up at 1 and 4 years after cardiac telerehabilitation and centre-based cardiac rehabilitation

	Cardiac telerehabilitation				Centre-based CR			
	Baseline	Discharge	1 year	4 years	Baseline	Discharge	1 year	4 years
PAL (TEE/REE)	1.8 ± 0.5	1.9 ± 0.5	2.1 ± 0.6	1.6 ± 0.6	1.9 ± 0.6	2.3 ± 0.9	2.1 ± 0.9	1.6 ± 0.6
Peak VO ₂ (mL min ⁻¹ kg ⁻¹)	26.6 ± 7.2	30.2 ± 7.6	30.7 ± 6.7	25.0 ± 7.7 ^a	25.1 ± 7.2	28.6 ± 8.6	29.5 ± 9.9	22.5 ± 10.0 ^a
Peak workload (watt)	195.9 ± 54.8	216.2 ± 53.8	218.1 ± 54.5	197.9 ± 50.6 ^a	183.2 ± 40.2	212.0 ± 58.3	214.6 ± 62.4	197.3 ± 53.1 ^a
BMI (kg/m ²)	27.8 ± 3.6	27.3 ± 3.3	27.2 ± 3.1	27.9 ± 3.6 ^a	28.2 ± 3.5	28.2 ± 3.8	28.3 ± 3.5	28.4 ± 3.6
Waist (cm)	103.0 ± 10.1	101.5 ± 8.6	101.6 ± 9.3	101.3 ± 10.4	106.1 ± 9.4	104.7 ± 9.7	105.4 ± 10.0	105.0 ± 9.7
HRQoL total score	5.9 ± 0.7	6.1 ± 0.5	5.8 ± 0.4	6.2 ± 0.5 ^{a,b}	5.6 ± 0.8	6.1 ± 0.7	5.6 ± 0.8	6.2 ± 0.7 ^{a,b}
HADS anxiety	3.3 ± 2.4	3.3 ± 2.2	2.0 ± 1.8	3.0 ± 2.7	2.8 ± 3.1	2.5 ± 2.2	2.5 ± 2.8	2.4 ± 2.0
HADS depression	1.5 ± 1.9	2.1 ± 2.9	3.3 ± 2.6	2.0 ± 2.6	1.5 ± 1.8	1.3 ± 1.5	2.8 ± 2.3	1.0 ± 1.5 ^a
PHQ-9 score	2.7 ± 3.1	2.2 ± 3.5	2.0 ± 3.2	2.0 ± 2.6	2.5 ± 2.3	1.8 ± 2.2	2.6 ± 3.7	2.0 ± 2.2

Values reported as mean ± standard deviation.

BMI, body mass index; CR, cardiac rehabilitation; HADS, Hospital Anxiety and Depression Score (higher scores indicate higher risk of anxiety or depression); HRQoL, Health-Related Quality of Life (higher scores indicate better quality of life); PAL, physical activity level; PHQ-9, Patient Health Questionnaire 9-item score (higher scores indicate higher risk of depression); REE, resting energy expenditure; TEE, total energy expenditure.

^aSignificant difference between 1 and 4 years of follow-up ($P < 0.05$).

^bSignificant difference between baseline and 4 years of follow-up ($P < 0.05$).

at 4 years of follow-up, regardless of the initial CR strategy. It is possible that patients lost to follow-up were less motivated than patients available for analysis. In that case, an even larger relapse in physical fitness and PAL might have been observed if all patients had completed the 4 years of follow-up. The relapse in PAL is, however, consistent with findings of other studies that evaluated long-term effects of CTR in CAD patients.^{8–10} Relapse in physical fitness was observed in previous studies as well, though the extent of relapse differed and could be explained by differences in the type (CTR *instead of or in addition to* centre-based CR) and duration of the intervention (3–7 months), and variation in follow-up duration (2–6 years).^{8–10} Although our analysis at 1 year of follow-up did not demonstrate relapse, at 4-years of follow-up a relapse is clearly visible irrespective of CR strategy. This indicates that patients did not make sustainable changes in physical activity behaviour and highlights the need for long-term guidance beyond 1 year of follow-up.

Our results demonstrate that a 12-week CTR programme was not successful in preventing a decline in physical fitness and PAL over time, even in low-to-moderate risk CAD patients. This indicates that such relapse cannot be averted by the mere implementation of CTR programmes, but that future CR and CTR interventions should be thoroughly redesigned to create sustainable behavioural change and long-term adherence to a physically active lifestyle.

Funding

The FIT@Home study was performed in collaboration with Philips Research. Philips Research provided the heart rate monitors and accelerometers used during the intervention and assessment of PAL. This work was supported by ZonMw, the Netherlands Organisation for Health Research and Development (Grant number 837001003).

Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

Conflict of interest: The authors declare that there is no conflict of interest.

Acknowledgements

We would like to thank all patients who participated in the FIT@Home trial.

References

- Scherrenberg M, Falter M, Dendale P. Cost-effectiveness of cardiac telerehabilitation in coronary artery disease and heart failure patients: systematic review of randomized controlled trials. *Eur Heart J - Digit Health* 2020;**1**:20–29.
- Bock BC, Carmona-Barros RE, Esler JL, Tilkemeier PL. Program participation and physical activity maintenance after cardiac rehabilitation. *Behav Modif* 2003;**27**: 37–53.
- Kotseva K, De Backer G, De Bacquer D, Rydén L, Hoes A, Grobbee D, Maggioni A, Marques-Vidal P, Jennings C, Abreu A, Aguiar C, Badariene J, Bruthans J, Castro Conde A, Cifkova R, Crowley J, Davletov K, Deckers J, De Smedt D, De Sutter J, Dilic M, Dolzhenko M, Dzerve V, Erglis A, Frasc Z, Gaita D, Gotcheva N, Heuschmann P, Hasan-Ali H, Jankowski P, Lalic N, Lehto S, Lovic D, Mancas S, Mellbin L, Milicic D, Mirrakhimov E, Oganov R, Pogosova N, Reiner Z, Stöerck S, Tokgözoğlu L, Tsioufis C, Vulic D, Wood D; on behalf of the EUROASPIRE Investigators. Lifestyle and impact on cardiovascular risk factor control in coronary patients across 27 countries: results from the European Society of Cardiology ESC-EORP EUROASPIRE V registry. *Eur J Prev Cardiol* 2019;**26**: 824–835.
- Claes J, Buys R, Budts W, Smart N, Cornelissen VA. Longer-term effects of home-based exercise interventions on exercise capacity and physical activity in coronary artery disease patients: a systematic review and meta-analysis. *Eur J Prev Cardiol* 2017;**24**:244–256.
- Brouwers RWM, Kraal JJ, Regis M, Spee RF, Kemps HMC. Effectiveness of cardiac telerehabilitation with relapse prevention: SmartCare-CAD randomized controlled trial. *J Am Coll Cardiol* 2021;**77**:2754–2756.
- Kraal JJ, Van den Akker-Van Marle ME, Abu-Hanna A, Stut W, Peek N, Kemps HMC. Clinical and cost-effectiveness of home-based cardiac rehabilitation compared to conventional, centre-based cardiac rehabilitation: results of the FIT@Home study. *Eur J Prev Cardiol* 2017;**24**:1260–1273.
- Kraal JJ, Peek N, Van den Akker-Van, Marle ME, Kemps HMC. Effects and costs of home-based training with telemonitoring guidance in low to moderate risk patients entering cardiac rehabilitation: the FIT@Home study. *BMC Cardiovasc Disord* 2013;**13**:82.
- Smith KM, McKelvie RS, Thorpe KE, Arthur HM. Six-year follow-up of a randomised controlled trial examining hospital versus home-based exercise training after coronary artery bypass graft surgery. *Heart* 2011;**97**:1169–1174.
- Frederix I, Solmi F, Piepoli MF, Dendale P. Cardiac telerehabilitation: a novel cost-efficient care delivery strategy that can induce long-term health benefits. *Eur J Prev Cardiol* 2017;**24**:1708–1717.
- Claes J, Buys R, Avila A, Cornelis N, Goetschalckx K, Cornelissen VA. Lifelong changes in physical activity behaviour through phase II cardiac rehabilitation? Still steps to take! *Eur J Prev Cardiol* 2021;**28**:e17–e19.