

Cardiac rehabilitation participation within 6 months of discharge in 37 136 myocardial infarction survivors: a nationwide registry study

Tone M. Norekvål ^{1,2,3*}, Marte Bale⁴, Haji Kedir Bedane⁴, Torstein Hole^{5,6}, Charlotte B. Ingul^{6,7}, and John Munkhaugen ^{8,9}

¹Department of Heart Disease, Haukeland University Hospital, Bergen Hospital Trust, Jonas Lies vei 65, 5021 Bergen, Norway; ²Department of Clinical Science, University of Bergen, Laboratory Building, Haukeland University Hospital, Jonas Lies vei 87, 5020 Bergen, Norway; ³Department of Health and Caring Sciences, Western Norway University of Applied Sciences, Innlandsveien 28, 5063 Bergen, Norway; ⁴Research and Innovation Department, Førde Hospital Trust, Svanehaugvegen 2, 6807 Førde, Norway; ⁵Medical Department, Ålesund Hospital, Møre og Romsdal Hospital Trust, Åsehaugen 5, 6017 Ålesund, Norway; ⁶Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Postboks 8905, 7491 Trondheim, Norway; ⁷Faculty of Nursing and Health Sciences, Nord University, Universitetsalléen 11, 8026 Bodø, Norway; ⁸Department of Medicine, Drammen Hospital, Vestre Viken Hospital Trust, Dronninggata 41, 3004 Drammen, Norway; and ⁹Department of Behavioural Medicine, The Faculty of Medicine, University of Oslo, Sognsvannsveien 9 Domus Medica, 0372 Oslo, Norway

Received 7 July 2023; revised 12 September 2023; accepted 1 November 2023; online publish-ahead-of-print 7 November 2023

The EUROASPIRE surveys determined that a large majority of coronary artery disease (CAD) patients has unhealthy lifestyles and poor cardiovascular risk factor control.¹ Cardiac rehabilitation (CR) requires programmes delivered by interdisciplinary teams of healthcare professionals addressing all aspects of lifestyle and risk factor management. Norwegian centres did not participate in the EUROASPIRE surveys, and few national data exist on adherence to clinical practice guidelines on CAD prevention.² Further, national data on CR participation are very scarce³ and have not been reported when separating single module interventions from modern interdisciplinary multimodal CR. Therefore, the aim of this nationwide analysis was to assess CR participation among all myocardial infarction (MI) survivors diagnosed during 2018–21.

Data from the Norwegian Patient Registry (NPR) and the Norwegian Registry for Primary Health Care (KPR) were linked using the unique personal identifier number of all patients hospitalized with acute MI (ICD-10 I21) as primary diagnosis between January 2018 and December 2021. All MI survivors were followed for 182 days (six months) after discharge to observe whether they had received CR or not. All 21 hospital referral areas in Norway were grouped into the four health regions. Cardiac rehabilitation was defined as ICD-10 codes of Z50.0, Z50.80, Z50.89, or Z50.9. The percentage of CR during follow-up was calculated as the number of patients recorded to have received any one of the above codes divided by the total number of MIs adjusted for age and sex. In order to adjust for the differences in age and sex structure of the general MI population and patients who received CR between health regions, we used the age distribution of MI patients for 2020 as a standard population and standardized the percentages for age and sex using the direct method. We also calculated days to the first CR episode. We performed sensitivity analyses

stratified for the pre- and post-COVID-19 period (see [Supplementary material online, Table S1](#)). From the NPR registry, we also obtained information on educational courses (procedure code WPCK00) and guided physical exercise training (procedure code OBAB00) in the municipalities, and from KPR information on exercise training at private institutes. Statistical analyses were performed by R Studio version 2023.03.0. The study was approved by the Norwegian Directorate of Health (17/2144–57 and 21/5961–3) and evaluated by the Regional Committee for Medical and Health Research Ethics (2023/647257).

In all, 37 136 patients (mean age 70 ± 13 years, 32% women) were discharged with MI in Norway during the 4-year period (see [Supplementary material online, Table S2](#)), of which 14% ($n = 5260$) participated in CR. There was a geographic variation ranging from 4% (Northern region) to 16% (South-Eastern region) ([Figure 1A](#)). Breaking down into hospital referral areas, the variation across the country is shown in more detail ([Figure 1B](#)). We also observed a geographic variation related content of the CR provided reflected in the ICD-10 codes used (see [Supplementary material online, Figure S1](#)). The median number of days to CR was 53 (IQR = 55) with some geographic variation ([Figure 1C](#)). The 40–59-year-old patients most often received CR, but still <25% of those below 60 years participated ([Figure 2](#)). The participation rate was comparable in women and men. However, when taking all age groups into account, 16% of men participated compared to 11% of women. The participation rate dropped dramatically for both sexes after 65 years. If we also include other rehabilitative activities like lone-standing educational courses or exercise training, the total percentage of MI survivors in Norway receiving any follow-up care increased to 26% ($n = 9776$). Exercise training at

* Corresponding author. Tel: +47 55974996, Email: tone.merete.norekval@helse-bergen.no

© The Author(s) 2023. 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

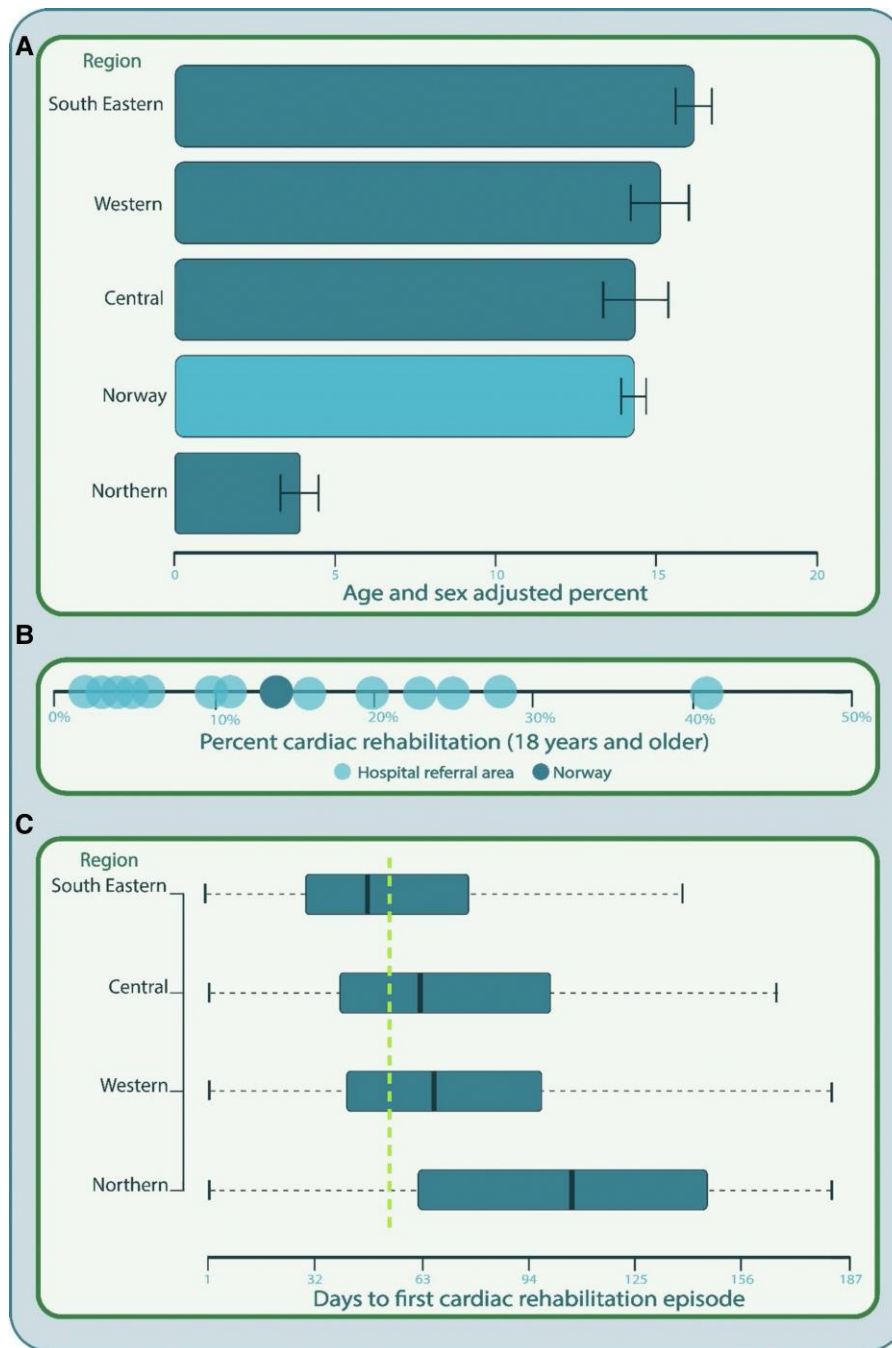


Figure 1 (A) Participation in cardiac rehabilitation across four health regions and nationally. (B) Percentage of patients in cardiac rehabilitation across the 21 hospital referral areas (C) Days to first cardiac rehabilitation episode across health regions (median at a national level marked by the dotted line).

private physiotherapy institutes was rare, and numbers were driven particularly by one geographical area ($n = 1635$, 4.4%). We found only slightly lower CR activity during and after the Covid-19 pandemic (13.7%) compared to the years before (14.6%) (see [Supplementary material online, Figure S1](#)).

There are inevitable methodological limitations. Misclassification of MI diagnoses and codes for CR may have influenced the study results. However, the quality of the ICD-10 codes in Norwegian Patient

Registry has been found to be very good.⁴ To mitigate the risk of overestimating the proportion of patients eligible for CR, we only included MI cases recorded as the primary diagnosis. We only have access to administrative and demographic data, and further investigation is needed to gain knowledge about the content of the CR programmes⁵ as well as to elucidate potential reasons for the low participation rate.

Nevertheless, these nationwide data documents that only a minority of MI survivors in Norway receive guideline recommended aftercare.

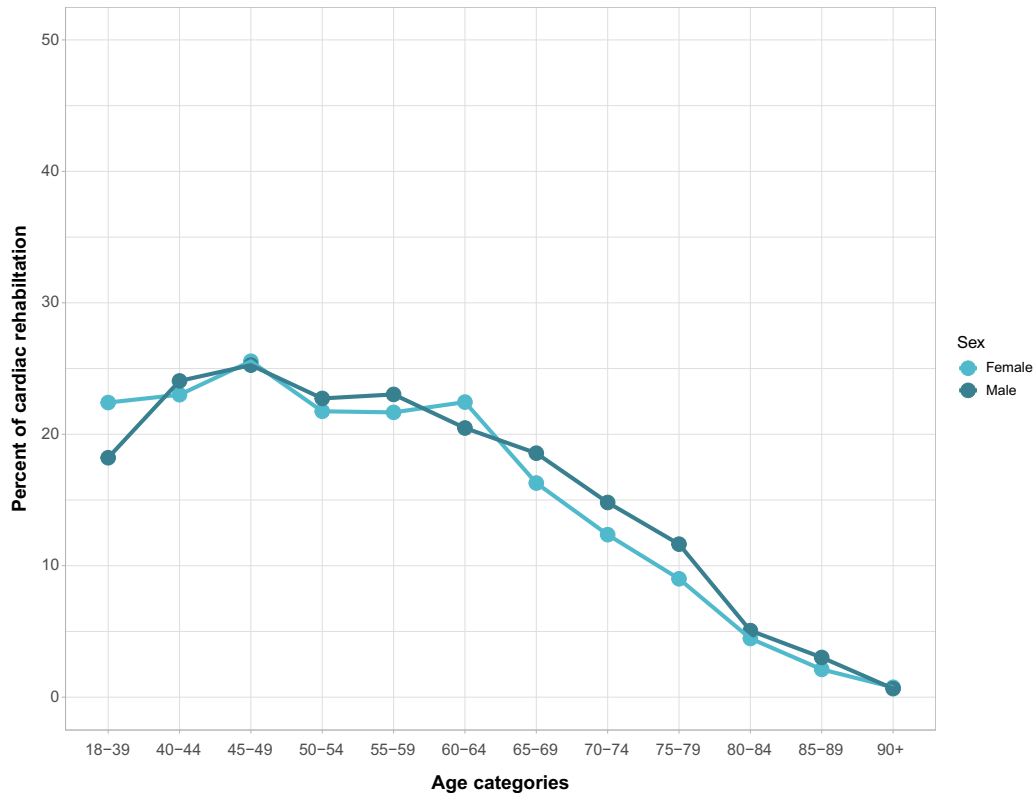


Figure 2 Percentage of cardiac rehabilitation according to sex and age categories.

This applies to both women and men, and at all ages. Time to enrolment was also too long. Geographic variations within the country were large. The results are worrying since CR is a Class IA recommendation in European guidelines,² which leaves no doubt of its efficiency when delivered by interdisciplinary teams in multimodal programmes targeting effective risk factor management. Cardiac rehabilitation is cost effective,⁶ which is yet another argument for improving the situation. Cardiac rehabilitation targeting all age groups is recommended,⁷ although tailored care may be needed, particularly for older adults.⁸ Norway has long distances and remote areas where it may be challenging to establish place-based CR. Geographic variations may be mitigated by home-based⁹ and digital¹⁰ programmes, which is also recommended in guidelines.² In summary, the participation rate in CR in Norway is very low and with great geographic variation. We need a call for action to improve the care of MI patients.

Authors' contributions

All authors contributed to the conception or design of the work. M.B. was responsible for the acquisition of data, H.K.B. performed the data analyses, and all authors contributed to interpretation of data. T.M.N., H.K.B., and J.M. drafted the manuscript. All authors gave final approval and agreed to be accountable for all aspects of the work ensuring integrity and accuracy.

Supplementary material

Supplementary material is available at *European Journal of Preventive Cardiology*.

Acknowledgements

We thank Marie Hayes for assistance in development of the figures.

Funding

We do not declare a specific grant for this research from any funding agency in public, commercial, or not-for-profit sectors.

Conflict of interest: None declared.

Data availability

The data that support the findings of this report will be available at www.helseatlas.no.

Disclaimer

Data from the Norwegian Patient Register and the Norwegian Registry for Primary Health Care have been used in this publication. The interpretation and reporting of these data are the sole responsibility of the authors, and neither endorsement by the Norwegian Directorate of Health is intended nor should be inferred.

References

1. Kotseva K, De Backer G, De Bacquer D, Rydén L, Hoes A, Grobbee D, *et al*. 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.

2. Visseren FLJ, Mach F, Smulders YM, Carballo D, Koskinas KC, Böck M, et al. 2021 ESC guidelines on cardiovascular disease prevention in clinical practice. *Eur Heart J* 2021;**42**: 3227–3337.
3. Olsen SJ, Schirmer H, Bønaa KH, Hanssen TA. Cardiac rehabilitation after percutaneous coronary intervention: results from a nationwide survey. *Eur J Cardiovasc Nurs* 2018;**17**: 273–279.
4. Varndal T, Mathiesen EB, Wilsgaard T, Njølstad I, Nyrnes A, Grimsgaard S, et al. Validating acute myocardial infarction diagnoses in national health registers for use as endpoint in research: the Tromsø study. *Clin Epidemiol* 2021;**13**:675–682.
5. Peersen KP, Munkhaugen J, Olsen SJ, Otterstad JE, Sverre E. Post-myocardial infarction rehabilitation and secondary prevention in hospitals. *Tidsskr Nor Laegeforen* 2021;**141**:1523–1526.
6. Dibben GO, Faulkner J, Oldridge N, Rees K, Thompson DR, Zwisler A-D, et al. Exercise-based cardiac rehabilitation for coronary heart disease: a meta-analysis. *Eur Heart J* 2023;**44**:452–469.
7. Ambrosetti M, Abreu A, Corrà U, Davos CH, Hansen D, Frederix I, et al. Secondary prevention through comprehensive cardiovascular rehabilitation: from knowledge to implementation. 2020 update. A position paper from the Secondary Prevention and Rehabilitation Section of the European Association of Preventive Cardiology. *Eur J Prev Cardiol* 2021;**28**:460–495.
8. Norekvål TM, Allore HG. Cardiac rehabilitation in older adults: is it just lifestyle? *Heart* 2020;**106**:1035–1037.
9. Thomas RJ, Beatty AL, Beckie TM, Forman DE, Franklin BA, Keteyian SJ, et al. Home-based cardiac rehabilitation: a scientific statement from the American Association of Cardiovascular and Pulmonary Rehabilitation, the American Heart Association, and the American College of cardiology. *J Am Coll Cardiol* 2019;**74**: 133–153.
10. Tromp J, Jindal D, Redfern J, Bhatt A, Séverin T, Banerjee A, et al. World Heart Federation Roadmap for digital health in cardiology. *Glob Heart* 2022;**17**: 61.