

BMJ Open Does socially differentiated cardiac rehabilitation affect the use of healthcare services after myocardial infarction? A 10-year follow-up study

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ABSTRACT

Objective To examine the long-term effect of a socially differentiated cardiac rehabilitation (CR) intervention tailored to reduce social inequalities in health regarding use of healthcare services in general practice and hospital among socially vulnerable patients admitted with first-episode myocardial infarction (MI).

Design A prospective cohort study with 10 years' follow-up.

Setting Department of cardiology at a university hospital in Denmark between 2000 and 2004.

Participants Patients <70 years admitted with first-episode MI categorised as socially vulnerable (n=208) or non-socially vulnerable (n=171) based on educational level and social network.

Intervention A socially differentiated CR intervention. The intervention consisted of standard CR and expanded CR with focus on cross-sectional collaboration.

Main outcome measures Participation in annual chronic care consultations in general practice, contacts to general practice, all-cause hospitalisations and cardiovascular readmissions.

Results At 2-year and 5-year follow-up, socially vulnerable patients receiving expanded CR participated significantly more in annual chronic care consultations (p=0.02 and p<0.01) but at 10-year follow-up, there were no significant differences in annual chronic care consultations (p=0.13). At 10-year follow-up, socially vulnerable patients receiving standard CR had significantly more contacts to general practice (p=0.03). At 10-year follow-up, there were no significant differences in the proportion of socially vulnerable patients receiving expanded CR in the mean number of all-cause hospitalisations and cardiovascular readmissions (p>0.05).

Conclusions The present study found no persistent association between the socially differentiated CR intervention and use of healthcare services in general practice and hospital in patients admitted with first-episode MI during a 10-year follow-up.

INTRODUCTION

The '2016 European Guidelines on cardiovascular disease prevention in clinical practice' define cardiovascular disease (CVD)

Strengths and limitations of this study

- No previous studies have examined the association between a socially differentiated cardiac rehabilitation intervention and the long-term use of healthcare services in a cohort of socially vulnerable patients admitted with first-episode MI during a 10-year follow-up period.
- The use of highly valid register-based data provides for a complete follow-up of all yearly survivors at 2-year, 5-year and 10-year follow-up.
- The general practitioners succeeded in maintaining a regular contact with all patients regardless of social status in the long-term secondary cardiovascular disease prevention.
- The study found no persistent or long-term association between the socially differentiated cardiac rehabilitation intervention and the use of healthcare services in general practice and hospital among socially vulnerable patients.
- The study was conducted with a non-randomised design which must be considered as a methodological limitation.

prevention as a coordinated set of actions at population or individual level aiming at eliminating or minimising the impact of CVD and related disabilities. The guidelines emphasise that the general practitioner (GP) plays a key role in initiating, coordinating and providing long-term follow-up including preventive care and chronic disease monitoring in patients diagnosed with CVD.¹

In a recent Cochrane publication including six Cochrane reviews, cardiac rehabilitation (CR) was found to be effective in secondary CVD prevention. The reviews included 148 randomised, controlled trials (RCT) and 98 093 patients with CVD. Patients participating in exercise-based CR improved their health-related quality of life and decreased

their risk of hospital admission compared with patients not participating in CR.²

Whereas CR decreased the risk of hospital admission, readmission and in-patient days,²⁻⁴ low socioeconomic status defined as low educational level and living alone was associated with a higher probability of readmission and emergency department use in patients already diagnosed with CVD.⁵⁻¹⁰ However, a Danish study found that patients with a low educational level and patients living alone had a lower rate of hospital contacts during the first 6 months after being admitted with first-episode myocardial infarction (MI).¹¹

A CR intervention focusing on reducing social inequalities in health was carried out in Denmark between 2000 and 2004. A group of socially vulnerable patients received an expanded CR intervention and was compared with a group of socially vulnerable patients receiving standard CR. The intervention group showed significant results regarding adherence to secondary prevention guidelines at 1-year follow-up.¹² However, no long-term effects were seen regarding mortality and morbidity at 10-year follow-up.¹³

The aim of the present study was to examine the long-term effect of a socially differentiated CR intervention tailored to reduce social inequalities in health on the use of healthcare services in general practice and hospitals among socially vulnerable patients admitted with first-episode MI.

METHODS

The methods, including a presentation of the study population and the intervention of the study, and the 10-year follow-up on mortality and morbidity has been presented in a previous *BMJ Open* publication.¹³ We briefly describe the methods below.

Study design

The study was conducted between 2000 and 2004 and carried out as a prospective register-based cohort study. The setting was the department of cardiology at a university hospital in Denmark. Baseline was defined as the date of admission with first-episode MI. Follow-up was performed exactly 2, 5 and 10 years after baseline. The Danish healthcare system is tax-funded and free of charge for all Danish citizens.

Patient population

The 379 study participants were all patients <70 years old admitted with first-episode MI who participated in standard or expanded CR. Participation in standard CR was defined as attendance for at least one consultation with a cardiologist and attendance for at least three consultations with a cardiac nurse. Participation in expanded CR was defined as attendance for at least one consultation with a cardiologist and attendance for at least four consultations with a cardiac nurse. Patients were categorised as socially vulnerable if they had a lower educational

level (education classified 1-4 in The Danish Educational Nomenclature if age <55 years and 1-3 if age >55 years) and/or if they lived alone. According to these criteria, 78 patients admitted between 2000 and 2002 and 130 patients admitted between 2002 and 2004 were categorised as socially vulnerable. Patients were excluded from the study if they had severe comorbidities such as dementia or mental conditions or if they had a serious alcohol abuse.^{12 13}

Exposure

All 130 socially vulnerable patients admitted between 2002 and 2004 received an expanded CR intervention in addition to standard CR based on current guidelines at the time. During the acute treatment from admission to discharge (phase I CR), the intervention was identical to standard CR. From discharge until return to vocational activities (phase II CR), expanded CR lasted 2 weeks longer and included one extra consultation with a nurse. The patients played an active role in defining an individual rehabilitation plan, which was shared with their GP. Phase II lasted up to 12 weeks. In the long-term secondary prevention (phase III CR) which is a life-long effort, the patients receiving the intervention were referred to a preventive consultation in general practice and to rehabilitation activities in primary care and The Danish Heart Association. Furthermore, the patients in the intervention group had a telephone follow-up consultation 2 months after completing phase II CR.

All 78 socially vulnerable patients admitted between 2000 and 2002 received standard CR and served as controls. All 171 non-socially vulnerable patients in the study population (55 admitted between 2000 and 2002 and 116 admitted between 2002 and 2004) also received standard CR.^{12 13}

Study outcomes

The outcome measure of the study was use of healthcare services. In the present study, the healthcare services of interest were participation in annual chronic care consultations in general practice, contacts to general practice, all-cause hospitalisations and cardiovascular readmissions.

Data sources

Data were collected from Danish registers using civil registration (CPR) numbers of the patients. A CPR-number is a unique 10-digit identification number given to all citizens with a residence permit in Denmark. The first six digits indicate the citizen's birthday and the last four digits is a combination of digits to distinguish between citizens born in the same year and on the same day. Each CPR-number is unique and will follow the citizen forever. The CPR-number is used in all Danish registers and ensures complete linkage and accurate follow-up when using register-based data.¹⁴ Data on participation in annual chronic care consultations in general practice and contacts to general practice were

retrieved from The Danish National Health Service Register.¹⁵ In Denmark, general practice is the corner stone of primary healthcare. GPs are similar to family physicians and act as gatekeepers in referring patients to medical specialists as well as in- and out-patient hospital examinations and treatment.¹⁶ General practice in Denmark has the medical responsibility for secondary CVD prevention. Patients are invited to an annual chronic care consultations in general practice where medication, treatment goals, lifestyle, mental well-being, compliance and motivation are assessed and discussed. Participation in annual chronic care consultations in general practice was measured dichotomously (yes/no) for every year in the follow-up period. Number of contacts to general practice was assessed for every year in the follow-up period. A 'contact' was defined as any kind of contact involving the clinic of the GP, including telephone and email consultations, home visits and services provided by other healthcare professionals in the clinic. Data on all-cause hospitalisations and cardiovascular readmissions were retrieved from The Danish National Hospital Register.¹⁷ The International Classification of Diseases 10 was used to define 'cardiovascular readmission'. All-cause hospitalisations and cardiovascular readmissions were measured as number of hospital stays for every year in the follow-up period.

Statistics

Baseline characteristics of the study population were described using either frequencies and percentages or means and SD within groups. Use of healthcare services was compared between socially vulnerable patients receiving expanded CR in addition to standard CR and socially vulnerable patients receiving standard CR only. An additional comparison was made between non-socially vulnerable patients who all received standard CR to evaluate potential differences between the two calendar periods. All data were based on yearly survivors. Participation in annual chronic care consultations in general practice was assessed as a dichotomous outcome for each year of follow-up and reported as proportion of patients participating with 95% CI. These proportions were compared by calculating ratios and using chi-squared tests. Contacts to general practice were compared using mean number of contacts during each year of follow-up and compared by calculating the difference in mean number of contacts with 95% CI and using t-tests. All-cause hospitalisations and cardiovascular readmissions were shown as mean number of admissions during each year of follow-up and compared by calculating the difference in mean number of admissions with 95% CI and using t-tests. All data management and analyses were performed using Stata/MP V.14.2, and p values below 0.05 were considered statistically significant.

Patient and public involvement

Patients and the public were not involved in the design, the conduct or the reporting of the research in the present study.

RESULTS

Baseline characteristics

Table 1 shows baseline characteristics of the study population. The mean age in the study population was 57 years and three out of four were males. In accordance with the criteria of defining the study population as socially vulnerable or not, the socially vulnerable patients had a lower educational level and were more likely to live alone. Patients diagnosed with comorbidities varied from 49% to 64%. Socially vulnerable patients admitted between 2000 and 2002 had a higher body mass index and were more likely to be smokers than the rest of the study population.

Use of healthcare services in general practice

Participation in annual chronic care consultations

In general, the proportion of patients participating in the annual chronic care consultations in general practice increased over the 10-year follow-up. There was a tendency for the patients enrolled between 2000 and 2002 to participate to a lesser extent in the annual chronic care consultations than the patients enrolled between 2002 and 2004 regardless of social status. At the end of the 10-year follow-up period, approximately 40% of the study population participated in the annual chronic care consultations (figure 1). At 2-year (p value=0.02) and 5-year (p value=0.00) follow-up, socially vulnerable patients receiving expanded CR participated significantly more often in the annual chronic care consultations than socially vulnerable patients receiving standard CR. At 10-year follow-up, no significant differences were seen among the socially vulnerable patients (p value=0.13) (table 2). The same tendencies were found among the non-socially vulnerable patients for all the results (figure 1).

Contacts to general practice

The mean number of contacts to general practice remained stable (15–25 contacts per year) during the 10-year follow-up period regardless of social status (figure 1). At 10-year follow-up, socially vulnerable patients receiving standard CR had a significantly higher mean number of contacts to general practice (p value=0.03) than socially vulnerable patients receiving expanded CR (table 2). No significant differences were found among the non-socially vulnerable patients (figure 1). No significant differences in mean number of contacts to general practice were seen between socially vulnerable patients receiving expanded CR and socially vulnerable patients receiving standard CR at 2-year (p value=0.60) and 5-year follow-up (p value=0.21).

Table 1 Baseline characteristics of 379 patients admitted with first-episode myocardial infarction receiving socially differentiated cardiac rehabilitation

	Socially vulnerable participants		Non-socially vulnerable participants	
	Rehabilitation type N time period		Rehabilitation type N time period	
	Standard rehabilitation N=78 2000–2002	Expanded rehabilitation N=130 2002–2004	Standard rehabilitation N=55 2000–2002	Standard rehabilitation N=116 2002–2004
Age at admission, years	56 (8.15)	55 (8.53)	60 (7.56)	57 (8.50)
Gender, male	57 (73)	93 (71)	42 (76)	94 (81)
Educational level, DUN	3.18 (1.19)	3.26 (1.39)	4.80 (1.08)	4.75 (1.19)
Living alone	27 (35)	51 (39)	0	0
Other diseases	39 (50)	82 (64)	27 (49)	68 (59)
Diabetes mellitus	10 (13)	16 (12)	6 (11)	10 (9)
Hyperlipidaemia	20 (26)	37 (28)	13 (24)	44 (38)
Hypertension	18 (23)	28 (22)	11 (20)	23 (20)
Body mass index	27.26 (4.35)	26.26 (4.08)	26.37 (3.99)	26.54 (3.12)
Current smoker	59 (76)	83 (64)	34 (62)	60 (52)

Patients are divided into groups based on social vulnerability and time of admission. Data are given as numbers (percentage) or as means (standard deviation).

DUN, Danish Educational Nomenclature.

Use of healthcare services in hospital

All-cause hospitalisations

The mean number of all-cause hospitalisations declined during the 10-year follow-up in all groups. During the first years of follow-up, socially vulnerable patients experienced more admissions but at 10-year follow-up the mean number of admissions regardless of social status

equalised (figure 2). No significant differences in the mean number of hospital admissions were seen between socially vulnerable patients receiving expanded CR and socially vulnerable patients receiving standard CR at 2-year (p value=0.46), 5-year (p value=0.30) or 10-year (p value=0.81) follow-up (table 2). No significant

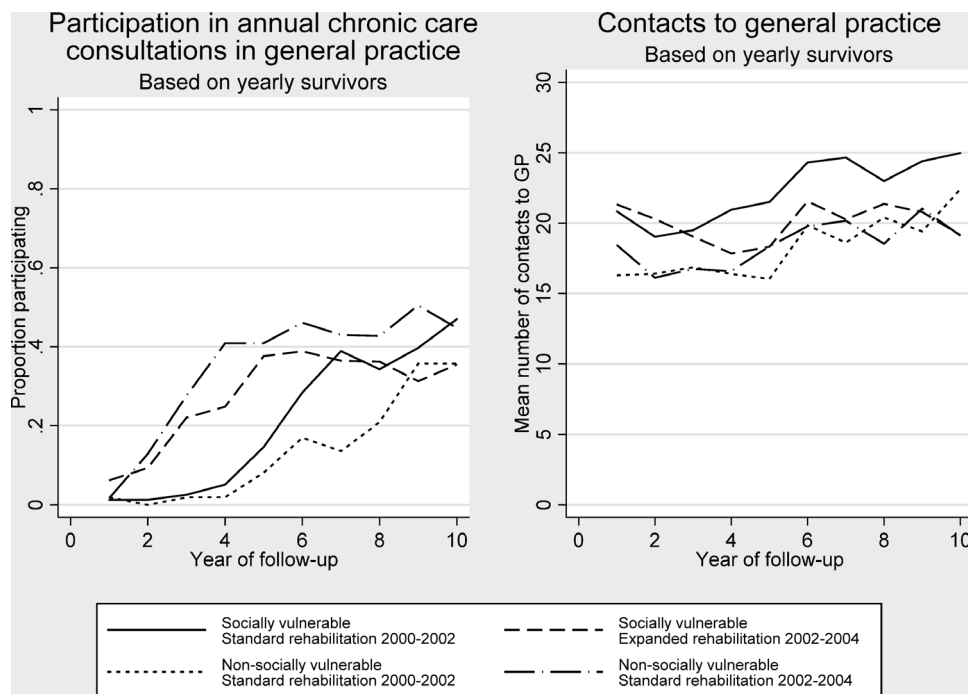


Figure 1 Use of healthcare services in general practice among 379 patients receiving socially differentiated cardiac rehabilitation after first-episode myocardial infarction admission by groups of social vulnerability and calendar period. Proportions and means are based on yearly survivors each year of follow-up. GP, general practitioner.

Table 2 Assessment of use of healthcare services among socially vulnerable patients admitted from 2000–2002 (N=78) and 2002–2004 (N=130) at Aarhus University Hospital, Denmark with first-episode myocardial infarction who participated in socially differentiated cardiac rehabilitation (CR) and who were evaluated at 2-year, 5-year and 10-year follow-up

	Year of follow-up	Socially vulnerable patients				Ratio* Difference**	P value
		Standard CR		Expanded CR			
		Proportion* Mean**	N	Proportion* Mean**	N		
Participation in annual chronic care consultations in general practice	2	0.01*	78	0.09*	128	7.3* (1.0;55.2)	0.02
	5	0.15*	75	0.38*	125	2.6* (1.4;4.6)	0
	10	0.47*	66	0.36*	107	0.8* (0.5;1.1)	0.13
Number of contacts to general practice	2	19.0**	78	20.3**	128	1.3** (-3.6;6.1)	0.6
	5	21.5**	75	18.3**	125	-3.2** (-8.1;1.8)	0.21
	10	25.0**	66	19.2**	107	-5.8** (-11.0;-0.6)	0.03
Number of all-cause hospitalisations	2	0.8**	78	0.6**	128	-0.2** (-0.6; 0.3)	0.46
	5	0.7**	75	0.5**	125	-0.2** (-0.6; 0.2)	0.3
	10	0.5**	66	0.4**	107	-0.1** (-0.3;0.2)	0.81
Number of cardiac readmissions	2	0.3**	78	0.2**	128	-0.1** (-0.29;0.07)	0.24
	5	0.1**	75	0.2**	125	0.1** (-0.1;0.2)	0.43
	10	0.1**	66	0.1**	107	0.0** (-0.1;0.1)	0.98

Values are based on yearly survivors and on available data from registers.

Data are given as proportions and ratios or as means and differences**.

differences were found among the non-socially vulnerable patients (figure 2).

Cardiovascular readmissions

No significant differences in the mean number of cardiac readmissions were seen between socially

vulnerable patients receiving expanded CR and socially vulnerable patients receiving standard CR at 2-year (p value=0.24), 5-year (p value=0.43) or 10-year (p value=0.98) follow-up (table 2). No significant

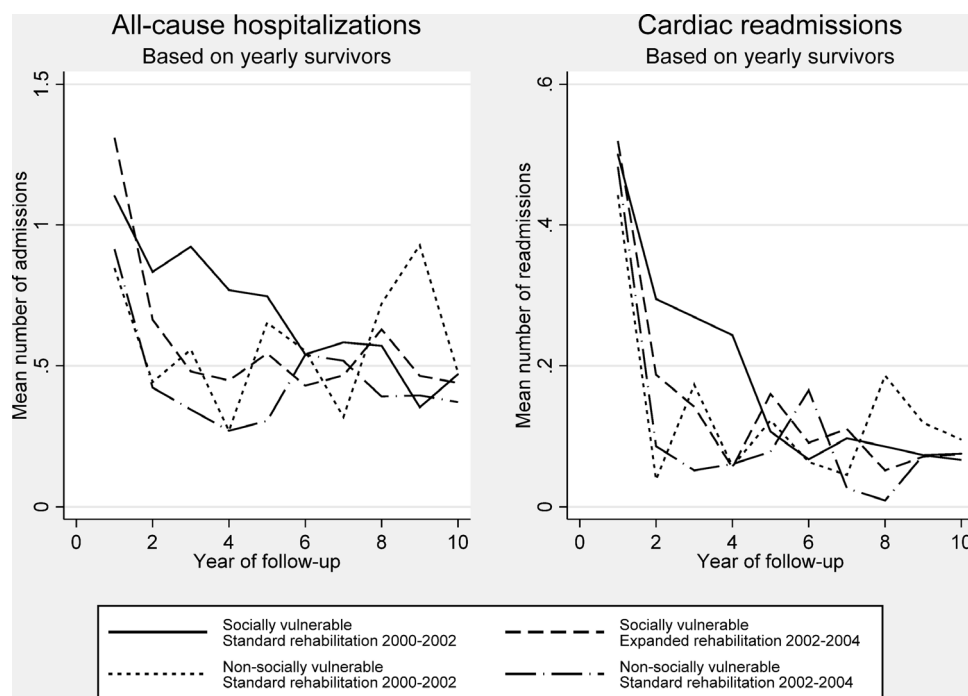


Figure 2 Use of healthcare services in hospital among 379 patients receiving socially differentiated cardiac rehabilitation after first-episode myocardial infarction admission by groups of social vulnerability and calendar period. Means are based on yearly survivors each year of follow-up.



differences were found among the non-socially vulnerable patients (figure 2).

DISCUSSION

Study findings

In this prospective cohort study, we examined the long-term effects of a socially differentiated CR intervention in relation to use of healthcare services. At 10-year follow-up, there were no significant differences in the proportion of socially vulnerable patients receiving expanded CR and participating in annual chronic care consultations compared with socially vulnerable patients receiving standard CR. The same associations were seen for the mean number of all-cause hospitalisations and cardiovascular readmissions. At 10-year follow-up, socially vulnerable patients receiving standard CR had significantly more contacts to general practice compared with socially vulnerable patients receiving expanded CR.

Comparison with other studies

To our knowledge, no previous studies have examined the long-term effect of a socially differentiated CR intervention in relation to the MI patients' use of healthcare services at 2-year, 5-year and 10-year follow-up. In 2016, Fors *et al*⁵ investigated the effect of person-centred care (PCC) following MI with focus on the patients' educational level in Sweden.⁵ A cohort of 199 patients <75 years received either usual care and PCC or usual care only. Patients receiving PCC played an active role in designing the rehabilitation plan in corporation with the PCC team and general practice. All patients were followed for 6 months and evaluated using a composite score consisting of self-efficacy, return to work, re-hospitalisation and mortality. Patients with low education receiving the PCC intervention had a significantly higher composite score than patients with a low education receiving usual care (p value 0.04).⁵ Another Swedish randomised controlled trial (RCT) study of 131 patients by Andersson *et al* from 2010 compared a 5-year intensive lifestyle programme including stress management among younger women in comparison to standard care.⁴ Patients in the intervention group had significantly fewer emergency visits and number of inpatient days compared with the group receiving standard care.⁴ The healthcare structures in Sweden and Denmark are comparable. The study population and intervention in Fors *et al*⁵ is also quite comparable to the study population in the present study. Fors *et al*⁵ managed to create an intervention that resulted in a significantly better outcome for patients with a low educational level. An explanation for this could be that the results were collected at the end of the intervention where patients were still receiving the intervention.⁵ The intervention in Andersson *et al*⁴ lasted for 5 years and showed significant results in relation to emergency visits and number of in-patient days at follow-up at the end of the study. This indicates the importance of a consistent long-term secondary intervention. Even though no major

significant long-term effects of socially differentiated CR intervention was seen in this study, it is worth mentioning that the present study found that the mean number of all contacts to general practice remained stable and no major differences between the socially and non-socially vulnerable patients were seen during the 10-year follow-up period. This could indicate that general practice has succeeded in maintaining a regular contact with patients regardless of the patients' social status. Compared with the present study, the study population in Andersson *et al*⁴ was younger and consisted only of women. Moreover, the intervention was not socially differentiated, and it is unclear if the patients improving significantly were equally divided between socially vulnerable and non-socially vulnerable patients.⁴ Additionally, the results were collected at the end of the 5-year intervention where patients were still part of the intervention; this was also the case in Fors *et al*^{4,5}

Strengths and limitations of the study

One of the strengths of the present study is the use of highly valid register-based data as well as the follow-up period of 10 years. Register-based data provide a complete follow-up of all yearly survivors in the follow-up year in question. Risk of selection bias in relation to all-cause mortality when using data on yearly survivors is low, as it previously has been established that all-cause mortality in the study population was not associated with the exposure.¹³ However, potential risk of selection bias due to the fact that only socially vulnerable patients who participated in CR and who gave written, informed consent was included must be considered.

As the present study is designed as a prospective cohort study and not as a randomised controlled trial, the risk of confounding must be considered. The homogeneous study population indicates a small likelihood of confounding (table 1). However, the risk of residual confounding cannot be ruled out. Potential confounding could have been handled by using adjusted statistical analyses.

Prospective data collection has been conducted using registers. Thus, no risk of information bias can be expected as data do not depend on the memory of the study participants. In relation to the register-based data extraction, specific codes were applied in agreement with experts within general practice and cardiology when defining participation in annual chronic care consultations and cardiovascular readmissions. This provided a consistent data extraction and thus a low risk of information bias.

The study was conducted as a non-blinded study. Given the nature of the intervention it was not possible to blind the health professionals from which patients who received the intervention and which patients who received standard CR. However, as the patients receiving standard CR were studied from 2000 to 2002 and the patients receiving expanded CR were studied from 2002 to 2004 it is not likely that the intervention could have affected the control group. Follow-up data were extracted from

national Danish registers and it is not likely to assume that the non-blinded design has effected these outcomes.

The proportion of patients participating in the annual chronic care consultations increased during follow-up. Also, the part of the study population admitted between 2002 and 2004 participated more than the study population admitted between 2000 and 2002. During the noughties, annual chronic care consultations were put on the agenda in Denmark and were given priority. The increase in the proportion of patients participating and also the significant differences between the socially vulnerable patients receiving expanded CR and the socially vulnerable patients receiving standard CR could be explained by this and the fact that patients from non-parallel time periods were compared, thus constituting a study weakness.

The long-term follow-up showed that the GPs were able to maintain a regular contact with all patients regardless of social status in the long-term secondary CVD prevention. Also, it was seen that socially vulnerable patients who received expanded CR had significantly fewer contacts to general practice at 10-year follow-up and participated significantly more in annual chronic care consultations at 2-year and 5-year follow-up. It could be speculated that the socially vulnerable patients who received expanded CR and who had a significantly more stable pattern of participation in annual chronic care consultations were more well-regulated and thus they did not need to contact the GP as often. Also, it must be considered if the socially vulnerable patients who received standard CR to a greater extent suffered from comorbidities and therefore had significantly more contacts to general practice.

The non-persistent non-significant long-term implications of the socially differentiated CR intervention must be addressed. When performing a 10-year follow-up any effect of the intervention could be suspected to have been washed out over time. It could be speculated that if the intervention had continued in phase III CR the long-term effect would have been significant.

The original study performed from 2000 to 2004 was based on clinical and real-life experiences from the health professionals employed at the cardiac ward which was the study setting. Thus, no power calculation was performed at the time. Before performing the ten10-year follow-up in this study no power calculation was performed due to the fact that power calculations performed after an intervention are pointless as they should have been addressed when planning the project.

Future research

Future research should focus on exploring if the pattern for participation in annual chronic care consultations and the pattern for contacts to general practice is due to comorbidities or a close control from the GP.

CONCLUSION

The present study found no persistent or long-term association between the socially differentiated CR intervention

and use of healthcare services in general practice and hospital in patients admitted with first-episode MI during a 10-year follow-up. At 10-year follow-up, socially vulnerable patients receiving standard CR had significantly more contacts to general practice compared with socially vulnerable patients receiving expanded CR. At 2-year and 5-year follow-up, socially vulnerable patients receiving expanded CR participated significantly more in annual chronic care consultations compared with socially vulnerable patients receiving standard CR.

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CONTRIBUTORSHIP STATEMENT All authors contributed to the conception and design of the work. All authors contributed to acquisition, analysis and interpretation of data. KH and BC drafted the manuscript. LKM, KMN, FBL, MBJ, MLL and CVN critically revised the manuscript. All authors approved the final version and agree to be accountable for all aspects of work ensuring integrity and accuracy.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The Danish Data Protection Agency approved the study (Case number: 1-16-02-684-14). No ethical approval was required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information.

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REFERENCES

- 1 Piepoli MF, Hoes AW, Agewall S, *et al.* 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts) Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). *Eur Heart J* 2016;37:2315–81.
- 2 Anderson LJ, Taylor RS. Cardiac rehabilitation for people with heart disease: an overview of Cochrane systematic reviews. *Int J Cardiol* 2014;177:348–61.
- 3 Kachur S, Chongthammakun V, Lavie CJ, *et al.* Impact of cardiac rehabilitation and exercise training programs in coronary heart disease. *Prog Cardiovasc Dis* 2017;60:103–14.
- 4 Andersson A, Sundel KL, Undén A-L, *et al.* A five-year rehabilitation programme for younger women after a coronary event reduces the need for hospital care. *Scand J Public Health* 2010;38:566–73.



- 5 Fors A, Gyllensten H, Swedberg K, *et al.* Effectiveness of person-centred care after acute coronary syndrome in relation to educational level: subgroup analysis of a two-armed randomised controlled trial. *Int J Cardiol* 2016;221:957–62.
- 6 Khawaja FJ, Shah ND, Lennon RJ, *et al.* Factors associated with 30-day readmission rates after percutaneous coronary intervention. *Arch Intern Med* 2012;172:112–7.
- 7 Murphy BM, Elliott PC, Le Grande MR, *et al.* Living alone predicts 30-day Hospital readmission after coronary artery bypass graft surgery. *Eur J Cardiovasc Prev Rehabil* 2008;15:210–5.
- 8 Roe-Prior P. Sociodemographic variables predicting poor post-discharge outcomes for hospitalized elders with heart failure. *Medsurg Nurs* 2007;16:317–21.
- 9 Howie-Esquivel J, Spicer JG. Association of partner status and disposition with rehospitalization in heart failure patients. *Am J Crit Care* 2012;21:e65–73.
- 10 Schwarz KA, Elman CS. Identification of factors predictive of hospital readmissions for patients with heart failure. *Heart Lung* 2003;32:88–99.
- 11 Nielsen TJ, Vestergaard M, Fenger-Grøn M, *et al.* Healthcare contacts after myocardial infarction according to mental health and socioeconomic position: a population-based cohort study. *PLoS One* 2015;10:1–13.
- 12 Nielsen KM, Meillier LK, Larsen ML. Extended cardiac rehabilitation for socially vulnerable patients improves attendance and outcome. *Dan Med J* 2013;60:A4591.
- 13 Hald K, Nielsen KM, Nielsen CV, *et al.* Expanded cardiac rehabilitation in socially vulnerable patients with myocardial infarction: a 10-year follow-up study focusing on mortality and non-fatal events. *BMJ Open* 2018;8:1–8.
- 14 Pedersen CB. The Danish civil registration system. *Scand J Public Health* 2011;39:22–5.
- 15 Andersen JS, Olivarius NDF, Krasnik A. The Danish National health service register. *Scand J Public Health* 2011;39:34–7.
- 16 Pedersen KM, Andersen JS, Søndergaard J. General practice and primary health care in Denmark. *J Am Board Fam Med* 2012;25 Suppl 1:S34–8.
- 17 Andersen TF, Madsen M, Jørgensen J, *et al.* The Danish national Hospital register. A valuable source of data for modern health sciences. *Dan Med Bull* 1999;46:263–8.