BMJ Open

To what extent is socioeconomic status associated with not taking up and dropout from cardiac rehabilitation: a population-based follow-up study

Marie Louise Svendsen ,[1] Birgitte Bitsch Gadager,[1,2] Christina M Stapelfeldt,[1,2] Maiken Bay Ravn,[1,2] Sanne Moeller Palner,[3] Thomas Maribo[1,2]

To cite: Svendsen ML, Gadager BB, Stapelfeldt CM, *et al*. To what extent is socioeconomic status associated with not taking up and dropout from cardiac rehabilitation: a population-based follow-up study. *BMJ Open* 2022;**12**:e060924. doi:10.1136/bmjopen-2022-060924

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-060924).

Received 12 January 2022
Accepted 09 June 2022

[1]DEFACTUM, Central Denmark Region, Aarhus, Denmark
[2]Centre for Rehabilitation Research, Department of Public Health, Aarhus University, Aarhus, Denmark
[3]Unit of Rehabilitation, Randers Health Centre, Randers Municipality, Randers, Denmark

Correspondence to
Dr Marie Louise Svendsen; marie.louise.svendsen@rm.dk

ABSTRACT

Objectives High socioeconomic status (SES) has been linked to high referral for cardiac rehabilitation (CR). However, the impact of SES on CR utilisation from enrolment to completion is unclear. The objective of this study was to examine whether indicators of SES are associated with not taking up and dropout from CR.

Design A population-based, follow-up study.

Setting Hospitals and primary healthcare centres in the Central Denmark Region.

Participant Patients diagnosed with ischaemic heart disease (IHD) in the hospital and referred for rehabilitation in the primary healthcare setting from 1 September 2017 to 31 August 2018 (n=2018).

Variables Four SES indicators (education, disposable family income, occupation and cohabitant status) were selected because of their established association with cardiovascular health and CR utilisation. Patients were followed up regarding no uptake of or dropout from CR in the primary healthcare setting.

Statistical methods The associations between the four SES indicators and either no uptake or dropout from CR were analysed using logistic regression with adjustment for age, sex, nationality and comorbidity.

Results Overall, 25% (n=507) of the referred patients did not take up CR and 24% (n=377) of the participators dropped out the CR. All adjusted ORs, except one (education/dropout) demonstrated that low SES compared with high are statistically significantly associated with higher odds of not taking up CR and dropout from CR. The ORs ranged from 1.52, 95% CI 1.13 to 2.04 (education/no uptake) to 2.36, 95% CI 1.60 to 3.46 (occupation/dropout).

Conclusions This study highlights that indicators of SES are important markers of CR utilisation following hospitalisation for IHD.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ A comprehensive identification of a cohort of patients hospitalised with ischaemic heart disease (International Classification of Diseases, 10th Revision classified) and a medically deemed need for rehabilitation.
⇒ Assessment of the outcomes (no uptake and dropout) pursuant to the clinical performance of standardised cardiac rehabilitation programmes in agreement with international clinical guidelines.
⇒ Independent and almost complete registration of data in separate population-based public databases and individual-level linkage of data across healthcare sectors.
⇒ Risk of confounding from sedentary lifestyle and logistic factors.

INTRODUCTION

Individuals suffering from ischaemic heart disease (IHD) are at high risk of death and medical complications, and frequently experience anxiety, depression, impaired cognition and perceived stress.[1–3] Cardiac rehabilitation (CR) is targeted toward improving functioning, health-related quality of life and well-being. Therefore, based on level A evidence, CR is strongly recommended following an acute coronary event or revascularisation.[4] Nevertheless, CR continues to be widely underused. Reported referral rates range from 22% to 73%, participation rates are <50% and dropout rates range from 12% to 82%.[5–7] Low socioeconomic status (SES) has been linked to low referral rates for CR; however, evidence on the association between SES and the uptake and completion of CR remains limited.[5 8]

Core elements of CR include physical exercise, nutrition therapy, smoking cessation, patient education and addressing psychosocial factors.[4 9] Physical exercise is the foundation of CR alongside educational and psychological support, with proven positive effects on hospital readmissions and health-related quality of life.[10] CR acts through physiological improvement in cardiac function, risk factor modification and improvements in healthy lifestyle and mood.[4 10] The proven positive effect along with the wide variability in the utilisation of CR has strengthened the

focus on determinants of CR utilisation. Proposed determinants are multifaceted and include interpersonal, clinical and logistical factors.[5] Indicators of SES, including income, education, employment, civil status and physical and social environment, have a measurable and significant association with cardiovascular health. This association may be partly mediated by inequalities in standards of care and utilisation of CR.[8 11] The initial phase of CR utilisation was investigated in a recent study examining the link between SES and the CR referral process.[8] The investigators concluded that patients with high levels of personal income and higher education may have a higher chance of being informed regarding CR, increased willingness to participate in CR, and greater rates of assignment to CR than those with low levels.[8] Furthermore, low SES has been linked to non-participation in CR; nonetheless, the impact of SES on CR utilisation from enrolment to completion of the programme is currently unclear.[5 8 12]

Objectives

The objective of this study was to examine whether indicators of SES are associated with not taking up CR and dropout from CR among patients diagnosed with IHD in the hospital and referred for rehabilitation in the primary health care setting.

METHODS

Study design

In this population-based cohort study, we included all patients (age≥18 years) diagnosed with IHD in a hospital in the Central Denmark Region from 1 September 2017 to 31 August 2018 and referred for rehabilitation. The study was performed in compliance with the Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines for cohort studies.[13]

Data collection

Individually identifiable data from five national health and social databases were linked via the unique personal identification number assigned to all Danish residents at birth or immigration.[14–19] The Danish welfare system enables extensive registration in nationwide databases of the tax-financed services within the universal healthcare, education and social welfare (eg, pension and unemployment insurance) systems.[14] Danish residents have free access to the tax-funded hospital care and CR.

Setting and participants

The study covered all hospitals and municipalities in the Central Denmark Region (population: ~1.3 million).[14] According to Danish law, hospitalised patients with a medically deemed need for rehabilitation after discharge will be referred for rehabilitation by means of a rehabilitation plan. The rehabilitation plan is mandatorily registered in the National Patient Registry.[16] In the Central Denmark Region, the primary healthcare setting provides specific CR activities through established CR programmes in agreement with international clinical guidelines.[4] The primary healthcare setting provides personalised planning of CR, a 12-week physical exercise training programme, exercise tolerance tests before and after the 12-week training, patient education, tobacco cessation, detection of anxiety and depression, nutritional counselling and evaluation at the closing CR meeting.

We identified patients with IHD and a hospital contact (outpatient) or discharge (inpatient) from 1 September 2017 to 31 August 2018 in the National Patient Register using the International Classification of Diseases, 10th Revision (ICD-10) codes.[16] Acute coronary syndrome was defined by the ICD-10 codes DI210–DI219, DI240, DI248 and DI249 as a primary or secondary diagnosis.[19] Other IHD were defined by the additional ICD-10 codes DI20–DI25 as the primary diagnosis. Patients with a referral for rehabilitation registered in the National Patient Registry were eligible for inclusion in the study.[16] Prerequisites for inclusion in the study were: (1) referral during the index hospital contact for IHD; (2) referral within 120 days after discharge during a subsequent hospital contact restricted to the primary ICD-10 codes for heart disease, observation for suspected heart disease or care involving the use of procedures for CR or unspecified rehabilitation.

One municipality in the Central Denmark Region (population: ~3720) did not offer CR, and these patients were excluded (n<5) because even if they fulfilled the inclusion criteria for this study, they were not given the opportunity to participate in an established CR programme. Furthermore, a priori n<5 patients were excluded owing to missing values on six of eight variables for SES and the covariables (data not shown). Hence, the study included 2018 patients (figure 1).

The study involved two study subpopulations and follow-up periods (figure 1). First, regarding no uptake of CR, the study population included hospitalised patients with a referral for rehabilitation (n=2018). The patients were followed up from the day of referral until the initial CR meeting in the primary healthcare setting or the end of follow-up by 90 days. Second, regarding dropout from CR, the study population included patients who participated in the initial CR meeting in the primary healthcare setting (n=1568). The patients were followed up from the day of the initial CR meeting until completion of at least one of three CR activities or the end of follow-up at 180 days.

Socioeconomic status

Different indicators of SES including education, disposable family income, occupation and cohabitant status were selected based on prior knowledge regarding their proposed mechanisms associated with cardiac health, possible mediated by disparities in care.[8 20] Most often, family income rather than personal income is identified as an indicator of SES, and this study analysed disposable family income.[20 21] The latest updated information on the four SES indicators before referral for rehabilitation was obtained from national databases with high validity

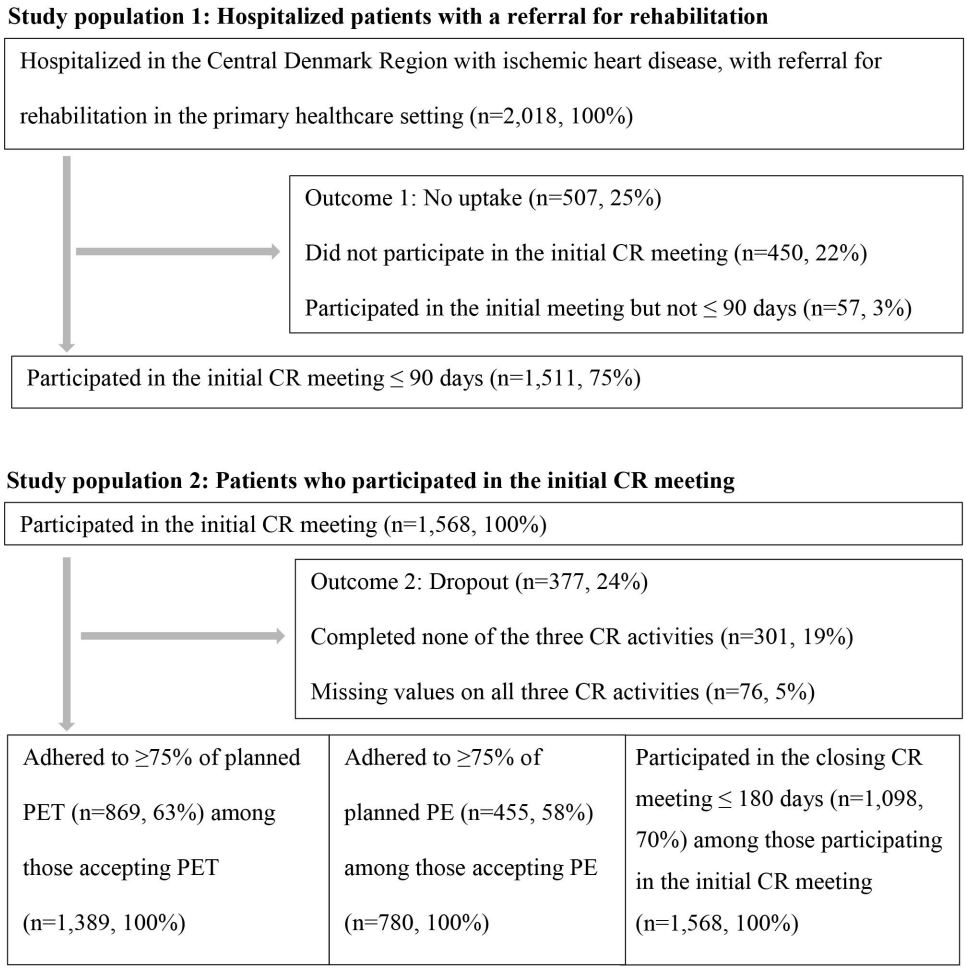

Figure 1 Patient flow from hospital until the closing meeting in the primary healthcare setting. CR, cardiac rehabilitation; PET, physical exercise training; PE, patient education.

and coverage.[15 17 18] Data on the highest attained level of education were obtained from the Population Education Register, and the educational level was classified according to the International Standard Classification of Education as follows: low (lower than primary, primary and lower secondary education); medium (upper secondary and postsecondary non-tertiary education); and high (tertiary education).[17 22] Information on disposable family income was obtained from the Income Statistics Register and categorised into three groups with an equal number of patients in each group.[18] Occupational status defines a person's primary income source and/or occupation.[23] Occupational status was categorised into employment, age-related pension including early retirement and social benefits (eg, unemployment, sick leave, social security, disability pension and education grant).[18 23] Data on cohabitant status were obtained from the civil registration system and specifies whether two adults share the same address.[15]

Outcomes

In accordance with previous studies, this study included two endpoints, namely no uptake of CR among referred patients and dropout among participants (figure 1).[5] No uptake of CR determines whether a referred patient did not participate in the initial meeting for CR in the primary healthcare setting. No uptake was classified into 'yes' (ie, did not participate within 90 days after referral) and 'no' (ie, participated within 90 days after the referral). Accordingly, patients who did not participate in the initial CR meeting (n=450) and patients who participated in the meeting >90 days after the referral (n=40) were classified as patients with no uptake. Furthermore, 67 patients participated in an initial CR meeting before referral for rehabilitation was registered in the National Patient Registry. Of those, patients with a period of ≤30 and >30 days between the CR meeting and referral were classified as patients with uptake (n=50) and patients with no uptake (n=17), respectively.

Dropout was determined using a composite measure based on the following three CR activities: (1) adherence to ≥75% of the planned sessions of physical exercise training; (2) adherence to ≥75% of the planned sessions of patient education; and (3) participation in the closing CR meeting within 180 days. Dropout was classified into yes (ie, the patient completed none of the three CR activities (n=301) or had missing values on all three (n=76)) and no (ie, the patient

completed one or more of the three CR activities). Missing values on a CR activity were classified as non-adherence with respect to physical exercise training and patient education, and as non-participation with respect to the closing CR meeting within 180 days. Among those who accepted to participate in physical exercise training (n=1389), the percentage of patients with missing values regarding adherence was 4% (n=57). Among those who accepted to participate in patient education (n=780), the percentage of missing values regarding adherence was 10% (n=79). Furthermore, among those who participated in the initial CR meeting (n=1568), the percentage of missing values regarding the closing meeting was 5% (n=76). Whether the patients were enrolled in one or more of the CR activities was decided by agreed personalised planning at the initial CR meeting.

Information on CR (including no uptake and dropout) was obtained from the Danish Cardiac Rehabilitation Database.[19] The database was developed in 2013 and data on CR in the primary healthcare setting are available since 2017.[19] Information on the number of persons who died during follow-up was obtained from the civil registration system.[15]

Covariables

Older age, female sex, non-Caucasian origin and comorbid disease are proposed risk factors for non-utilisation of CR; the selection of potential confounders was based on prior knowledge.[5] Information on all four covariables was attained at the time of or immediately before referral.[15 16] Danish nationality included a person—regardless of the place of birth—with at least one parent who is a Danish citizen or born in Denmark. Comorbidity was defined according to the Charlson Comorbidity Index and computed by identifying the specific ICD-10 conditions in the National Patient Registry up to 10 years before the referral for rehabilitation.[24]

Statistical methods

Baseline characteristics and outcomes were summarised using means, SD and percentages. Means and SDs were applied rather than percentiles to protect personal data. The individual associations between the four indicators of SES and either no uptake of CR or dropout were analysed by crude and multivariable logistic regressions, adjusting for age (continuous), sex (male/female), nationality (Danish/not Danish) and comorbidity (score: 0, low; 1–2, moderate; 3–8, high). All analyses were performed as complete-case analyses. Due to missing values regarding the educational level (no uptake: n=37; dropout: n=24), the number of patients in the individual analysis varied.

Sensitivity analyses were performed to identify any conflicting underlying associations according to the three CR activities in the composite measure of dropout (ie, physical exercise, patient education and closing CR meeting). The individual associations between the four indicators of SES and each of the three CR activities were assessed through logistic regression analyses with and without adjustment for age, sex, nationality and comorbidity. Furthermore, a sensitivity analysis was performed to evaluate the robustness of the definition of not taking up CR by recoding 'no uptake' to 'uptake' for the 17 patients who participated in the initial CR meeting >30 days before registration of the referral. Thereafter, the associations between the SES indicators and no uptake of CR (recoded) were analysed using logistic regression with and without adjustment for age, sex, nationality and comorbidity. Finally, two sensitivity analyses were performed; one for not taking up CR and one for dropout of CR, including all four SES indicators in the adjusted logistic regression analysis in addition to age, sex, nationality and comorbidity.

Patient and public involvement

Results were presented for a panel of former patients participating in CR. The panel contributed with valuable input to the discussion.

RESULTS

Participants

A total of 2018 patients diagnosed with IHD were referred for rehabilitation in the primary healthcare setting (the study population for no uptake). Of those, 78% (n=1568) participated in the initial meeting in the primary healthcare setting (the study population for dropout). Among participants, 76% (n=1191) of the patients completed at least one of the three CR activities (figure 1). The mean number of planned and completed sessions of physical exercise training was 23.8 (SD: 7.3) and 17.4 (SD: 9.1), respectively. The mean number of planned and completed sessions of patient education was 6.4 (SD: 3.4) and 4.7 (SD: 3.9), respectively. The mean number of days from the initial until the closing CR meeting was 114.1 (SD: 134.9) days. As regards physical exercise training, 89% (n=1389) of the patients accepted to participate in physical exercise training alone or in combination with the closing CR meeting and/or patient education (online supplemental table 1). Only 588 (38%) patients accepted to participate in all three CR activities (online supplemental table 1).

Baseline characteristics

Patient baseline characteristics stratified according to the indicators of SES are presented in table 1 (patients with a referral) and online supplemental table 2 (patients participating in the initial CR meeting). Patients with low SES tended to be older, female, not of Danish nationality and had higher comorbidity versus those with high SES. Expectedly, patients supported by age-related pension prior to referral were elderly. These tendencies were observed in the referred patients (table 1) and those who attended the initial CR meeting (online supplemental table 2).

No uptake

Among the 2018 patients with IHD and referral for rehabilitation, 25% (n=507) did not take up CR. Of these,

Table 1 Baseline characteristics of 2018 patients with ischaemic heart disease referred for rehabilitation

	No uptake	Characteristics					
					Charlson Comorbidity Index n (%)		
Indicators of SES	n (%)*	Age mean (SD)	Male†n (%)	Danish origin‡ n (%)	Low score 0	Moderate score 1–2	High score 3–8
Educational level							
High	86 (20.3)	64.9 (10.7)	310 (73.3)	395 (93.4)	260 (61.5)	114 (27.0)	49 (11.6)
Medium	200 (22.5)	64.4 (10.9)	706 (79.5)	845 (95.2)	489 (55.1)	274 (30.9)	125 (14.1)
Low	206 (30.8)	67.7 (12.0)	429 (64.0)	623 (93.0)	310 (46.3)	236 (35.2)	124 (18.5)
Missing data	15 (40.5)	65.2 (14.3)	21 (56.8)	24 (64.9)	20 (54.1)	12 (32.2)	5 (13.5)
Family income level							
High	109 (16.2)	61.7 (9.6)	562 (83.5)	657 (97.6)	419 (62.3)	201 (29.9)	53 (7.9)
Medium	169 (25.1)	65.9 (10.8)	506 (75.2)	634 (94.2)	355 (52.8)	222 (33.0)	96 (14.3)
Low	229 (34.1)	69.2 (12.4)	398 (59.2)	596 (88.7)	305 (45.4)	213 (31.7)	154 (22.9)
Occupational status							
Employment	128 (17.8)	56.7 (7.7)	606 (84.3)	689 (95.8)	490 (68.2)	193 (26.8)	36 (5.0)
Age-related pension	302 (28.4)	74.1 (6.5)	703 (66.2)	1025 (96.5)	482 (45.4)	355 (33.4)	225 (21.2)
Social benefit	77 (32.5)	54.6 (7.7)	157 (66.2)	173 (73.0)	107 (45.2)	88 (37.1)	42 (17.7)
Living alone							
No	303 (20.8)	65.1 (10.6)	1144 (78.7)	1354 (93.1)	805 (55.4)	456 (31.4)	193 (13.3)
Yes	204 (36.2)	66.9 (13.2)	322 (57.1)	533 (94.5)	274 (48.6)	180 (31.9)	110 (19.5)

*The inverse percentage, that adds up to 100%, represents the patients in the specific category of the SES indicator with no cardiac rehabilitation uptake.
†Sex (male/female). The inverse percentage, that adds up to 100%, represents females.
‡Nationality (Danish/not Danish). The inverse percentage, that adds up to 100%, represents persons who are not of Danish origin.
SES, socioeconomic status.

4% (n=19) died during follow-up. Low SES was statistically significantly associated with not taking up CR in the primary healthcare setting compared with high SES (table 2). Although adjustment for age, sex, nationality and comorbidity lowered the point estimates, the observed associations remained statistically significant and exhibited twofold higher odds for not taking up CR. This applied to low versus high disposable family income (OR: 2.04, 95% CI 1.54 to 2.71), patients supported by social benefits versus employment (OR: 2.10, 95% CI 1.46 to 3.02) and living alone versus cohabiting (OR: 2.02, 95% CI 1.61 to 2.53).

Dropout

In total, 24% (n=377) of the 1568 patients who participated in the initial CR meeting dropped out from CR (table 3). Fewer than five patients who dropped out died during follow-up. Social inequality in dropout showed similar tendencies to those observed for not taking up CR; the adjusted ORs ranged from 1.34 (95% CI 0.96 to 1.86; educational level) to 2.36 (95% CI 1.60 to 3.46; occupational status). The adjusted ORs indicated weaker associations between the indicators of SES and dropout versus no uptake of CR.

Sensitivity analyses

The sensitivity analyses assessing the associations between the indicators of SES and the individual three CR activities of the composite measure of dropout showed

Table 2 Associations between socioeconomic status (SES) and not taking up cardiac rehabilitation among referred patients (n=2018)

Indicators of SES	No uptake n (%)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
Educational level			
High	86 (20.3)	1 (reference)	1 (reference)
Medium	200 (22.5)	1.14 (0.86 to 1.51)	1.13 (0.85 to 1.51)
Low	206 (30.8)	1.74 (1.30 to 2.32)	1.52 (1.13 to 2.04)
Family income level			
High	109 (16.2)	1 (reference)	1 (reference)
Medium	169 (25.1)	1.74 (1.33 to 2.27)	1.51 (1.14 to 1.99)
Low	229 (34.1)	2.67 (2.06 to 3.47)	2.04 (1.54 to 2.71)
Occupational status			
Employment	128 (17.8)	1 (reference)	1 (reference)
Age-related pension	302 (28.4)	1.83 (1.45 to 2.32)	0.74 (0.52 to 1.04)
Social benefit	77 (32.5)	2.22 (1.59 to 3.10)	2.10 (1.46 to 3.02)
Living alone			
No	303 (20.8)	1 (reference)	1 (reference)
Yes	204 (36.2)	2.15 (1.74 to 2.66)	2.02 (1.61 to 2.53)

*Adjusted for age, sex, nationality and Charlson Comorbidity Index.
CI, confidence interval; OR, odds ratio; SES, socioeconomic status.

Table 3 Associations between socioeconomic status (SES) and dropout from cardiac rehabilitation (CR) among participants in the initial CR meeting (n=1568)

Indicators of SES	Dropout n (%)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
Educational level			
High	76 (21.4)	1 (reference)	1 (reference)
Medium	160 (22.5)	1.05 (0.77 to 1.43)	1.03 (0.75 to 1.40)
Low	133 (27.7)	1.38 (1.00 to 1.91)	1.34 (0.96 to 1.86)
Family income level			
High	119 (20.7)	1 (reference)	1 (reference)
Medium	108 (20.4)	0.99 (0.74 to 1.32)	1.01 (0.75 to 1.36)
Low	150 (32.4)	1.84 (1.39 to 2.44)	1.90 (1.40 to 2.58)
Occupational status			
Employment	129 (21.2)	1 (reference)	1 (reference)
Age-related pension	175 (22.1)	1.06 (0.82 to 1.37)	1.18 (0.80 to 1.74)
Social benefit	73 (43.5)	2.86 (1.99 to 4.11)	2.36 (1.60 to 3.46)
Living alone			
No	258 (21.6)	1 (reference)	1 (reference)
Yes	119 (31.9)	1.70 (1.32 to 2.20)	1.73 (1.33 to 2.27)

*Adjusted for age, sex, nationality and Charlson Comorbidity Index.
CI, confidence interval; OR, odds ratio; SES, socioeconomic status.

similar tendencies to those noted in the primary results summarised in table 3. However, patients receiving age-related pension tended to have lower odds of non-adherence to physical exercise training (adjusted OR: 0.70, 95% CI 0.48 to 1.03) and patient education (adjusted OR: 0.65, 95% CI 0.39 to 1.08) than employed patients (online supplemental table 3). Furthermore, the sensitivity analysis evaluating the robustness of the definition of not taking up CR demonstrated that recoding no uptake to uptake for the 17 patients who participated in the initial CR meeting >30 days before registration of the referral had only a minor impact on the results. However, the association between age-related pension compared with employment and lower odds of not taking up CR reached statistical significance (adjusted OR: 0.70, 95% CI 0.49 to 0.99) (online supplemental table 4). As expected, mutual adjustment for the indicators of SES changed the point estimates of each indicator towards the null, except for age-related pension and not taking up CR (adjusted OR: 0.57, 95% CI 0.38 to 0.84) (online supplemental table 5).

DISCUSSION

This study demonstrated a consistent and significant pattern of CR underutilisation in patients with low SES after hospitalisation for IHD.

Strengths and limitations

A strength of this study is the comprehensive identification of the cohort of patients with IHD and a referral to CR, as well as thorough identification of their SES and CR utilisation. Information regarding the SES indicators was almost complete and registered independently from the study hypothesis. This possibly reduced the risk of bias due to differential misclassification. Furthermore, the proportions of no uptake (25%) and dropout (24%) from CR were rather low compared with other countries implying thorough follow-up.[6] The sensitivity analyses assessing the associations between individual SES indicators and each of the three CR activities in the composite measure of dropout (ie, physical exercise, patient education and closing CR meeting) produced corresponding results, thereby suggesting the absence of selection bias between them.

The main limitation of this study is its observational design. The results may have been influenced by residual confounding; for example, the considerable proportion of persons with a nationality other than Danish among patients receiving social benefits may have affected the results towards stronger associations in case of inadequate adjustment.[25] Moreover, the present findings may have been influenced by unaccounted confounding from; for example, sedentary lifestyle and difficulties in planning the CR in relation to travel time and work which are proposed risk factors for non-utilisation of CR.[5] Unaccounted confounding may have introduced bias in opposite directions; for example, a conflicting relationship between employment status and non-utilisation of CR has been proposed.[5] Furthermore, the relatively large proportion of referred patients who did not participate in the initial CR meeting (n=450, 22%) may have induced significant differences in the baseline profiles between the referred patients and the patients who participated in CR. Considering this, we analysed these as two separate study population. Still, the baseline characteristics of the two study populations showed similar tendencies.

No uptake and dropout

As healthcare factors have been linked to CR utilisation, the low proportions of patients with no uptake of CR (25%) and dropout from CR (24%) observed in this study could be caused by several factors.[5] First, the Danish clinical guidelines highly recommend systematic referral.[26] Second, the Danish healthcare system provides tax paid CR, including transportation if necessary. Third, the primary healthcare setting is responsible for CR, thereby reducing the travel time for many patients. These healthcare factors may reduce the spatial inequality and the overall proportion of patients not taking up and dropping out from CR; nevertheless, social inequality at the individual level may still persists.

The indicators of SES

This study substantiates the evidence of social inequality in CR with respect to the specific SES indicators with established associations with cardiovascular health.[8] Other proposed mechanisms linking SES and cardiovascular health in socially disadvantaged individuals include low

health literacy, undesirable health behaviour and adverse biological and psychosocial risk factors, all of which are targets of CR.[10 11]

The results of this study are largely in line with those of a systematic review that reported the following OR ranges addressing non-participation: low income (1.47–5); low educational level (1.5–1.81); unemployment or retirement (0.48–5); and single marital status (1.30–16.73).[5] All these studies were conducted in hospital-based settings and different countries, which may explain the variation. Although dropout is less investigated in the literature, the present findings are in line with those of existing research.[5 12] Specifically, this study expands the sparse evidence that first, the SES indicators are important in the cross-sectoral referral process for CR and second, that the indicators are significant risk factors for dropout.

In this study, receiving social benefits other than age-related pension represented the strongest association with no uptake of and dropout from CR (adjusted OR: 2.10, 95% CI 1.46 to 3.02 and adjusted OR: 2.36, 95% CI 1.60 to 3.46, respectively). Among the referred patients and participants in CR, 25%–27% of those who received social benefits were not of Danish nationality. Compared with the general population, ethnic minority groups have been associated with poor referral for and participation in CR, while dropout is scarcely described.[5 27] Attention should be focused on overcoming identified barriers to CR utilisation in ethnic minority groups, such as language restriction and cultural adaption of CR.[25]

Furthermore, a recent Danish study conducted by Graversen *et al* and this study imply that low personal or family income negatively influences the CR pathway, including referral, uptake and completion of CR.[8] Also, this study proposes that living alone is negatively associated with the uptake and dropout from CR. Although the Danish welfare system and universal tax-financed healthcare system may partially counterbalance inequality in health due to economic factors and the availability of practical and social support, these associations appear to persist. This may be explained by studies proposing that the income level fosters self-esteem and social position relevant to participation in society.[20 28]

Additionally, education may be conceptualised in a life course framework. It is strongly determined by parental characteristics, is often completed in young adulthood and it may influence adult resources, such as the employment status.[20] Nonetheless, this investigation and the study conducted by Graversen *et al* demonstrate less pronounced and non-significant associations between the educational level and CR non-utilisation compared with those noted for income.[8] Education may impact health through the attainment of knowledge and skills. This possibly affects the functioning of patients, rendering them more receptive to health education messages and facilitating access to appropriate health services.[20] The sensitivity analyses yielded tentative, yet supporting results showing that low educational level may be associated with non-adherence to physical exercise training (adjusted OR: 1.39, 95% CI 1.00 to 1.92) (online supplemental table 3).

Perspectives

As socioeconomically deprived groups continue to be linked to increased disease rates and poorer outcomes, interventions targeted at improving CR utilisation among this population become necessary.[11] Such targeted efforts may involve multilevel behavioural interventions at the individual and community levels.[11] This study supports previous findings indicating the need for enhanced cross-sectoral collaboration between the referring hospital and the delivering primary healthcare centre of CR with the objective to promote CR uptake and adherence.[12 29 30] Furthermore, health professionals should communicate to patients that CR is an important part of the secondary prevention and provide comprehensive information regarding the various CR activities.[12 29 30] Future research on interventions to promote CR utilisation among patients with low SES is warranted.[7 8]

Generalisability

The annual publication of data from the Danish Cardiac Rehabilitation Database in the primary healthcare setting demonstrated comparable numbers of referred patients for CR with those obtained from this investigation based on referrals registered in the National Patient Registry (hospital-based).[31] Transfer of CR from hospitals to the primary healthcare setting was implemented on 1 January 2017 in the Central Denmark Region and systematically supported by a quality improvement database on CR including performance measures in agreement with international clinical guidelines.[19] The inclusion period in this study was advanced by 9 months to avoid the running-in period and potential variation between providers in the CR pathway. Thus, the generalisability of these findings to other settings and comparable healthcare systems is strengthened by the comprehensive identification of patients with IHD eligible for CR, as well as the completion of standardised CR programmes in accordance with international clinical guidelines for CR.[4]

CONCLUSIONS

This study demonstrates that the examined indicators of SES are important markers of the uptake of CR in the cross-sectoral referral process and dropout among participators, and augments the evidence of social inequality in the CR pathway among patients with IHD.

Acknowledgements The authors thank the Human First Group (www.human-first.org/english) for participating in the preparation and discussions of the present study.

Contributors MLS, SMP and TM contributed to the conception or design of the study. MLS, BBG, CMS, MBR and TM contributed to the acquisition, analysis or interpretation of data obtained from this investigation. MLS and BBG drafted the manuscript. CMS, MBR, SMP and TM critically reviewed the manuscript. All authors approved the final version of the manuscript and agreed to be accountable for all aspects of this work, ensuring data integrity and accuracy. TM is responsible for the overall content as guarantor.

Funding This work was supported by Public Health in the Central Denmark Region – a joint effort by the 19 municipalities and the Region [grant no. A2617].

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This project was approved by the Danish Patient Safety Authority (ID: 31-1522-28), and informed consent from the patients was not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

ORCID iD

Marie Louise Svendsen http://orcid.org/0000-0003-2291-0200

REFERENCES

1 Virani SS, Alonso A, Benjamin EJ, *et al*. Heart disease and stroke statistics-2020 update: a report from the American Heart Association. *Circulation* 2020;141:e139–596.
2 Goldberg RJ, Saczynski JS, McManus DD, *et al*. Characteristics of contemporary patients discharged from the hospital after an acute coronary syndrome. *Am J Med* 2015;128:1087–93.
3 GBD 2017 Causes of Death Collaborators. Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: a systematic analysis for the global burden of disease study 2017. *Lancet* 2018;392:1736–88.
4 Visseren FLJ, Mach F, Smulders YM, *et al*. 2021 ESC guidelines on cardiovascular disease prevention in clinical practice. *Eur J Prev Cardiol* 2022;29:5–115.
5 Resurrección DM, Moreno-Peral P, Gómez-Herranz M, *et al*. Factors associated with non-participation in and dropout from cardiac rehabilitation programmes: a systematic review of prospective cohort studies. *Eur J Cardiovasc Nurs* 2019;18:38–47.
6 Turk-Adawi KI, Grace SL. Narrative review comparing the benefits of and participation in cardiac rehabilitation in high-, middle- and low-income countries. *Heart Lung Circ* 2015;24:510–20.
7 Santiago de Araújo Pio C, Chaves GS, Davies P, *et al*. Interventions to promote patient utilisation of cardiac rehabilitation. *Cochrane Database Syst Rev* 2019;2:CD007131.
8 Graversen CB, Johansen MB, Eichhorst R, *et al*. Influence of socioeconomic status on the referral process to cardiac rehabilitation following acute coronary syndrome: a cross-sectional study. *BMJ Open* 2020;10:e036088.
9 Cowie A, Buckley J, Doherty P, *et al*. Standards and core components for cardiovascular disease prevention and rehabilitation. *Heart* 2019;105:510–5.
10 Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease: an overview of Cochrane systematic reviews. *Cochrane Database of Syst Rev* 2014;12:CD011273.
11 Schultz WM, Kelli HM, Lisko JC, *et al*. Socioeconomic status and cardiovascular outcomes: challenges and interventions. *Circulation* 2018;137:2166–78.
12 Ruano-Ravina A, Pena-Gil C, Abu-Assi E, *et al*. Participation and adherence to cardiac rehabilitation programs. A systematic review. *Int J Cardiol* 2016;223:436–43.
13 von Elm E, Altman DG, Egger M, *et al*. The strengthening the reporting of observational studies in epidemiology (STROBE) statement. *Epidemiology* 2007;18:800–4.
14 Schmidt M, Schmidt SAJ, Adelborg K, *et al*. The Danish health care system and epidemiological research: from health care contacts to database records. *Clin Epidemiol* 2019;11:563–91.
15 Pedersen CB. The Danish civil registration system. *Scand J Public Health* 2011;39:22–5.
16 Schmidt M, Schmidt SAJ, Sandegaard JL, *et al*. The Danish national patient registry: a review of content, data quality, and research potential. *Clin Epidemiol* 2015;7:449–90.
17 Jensen VM, Rasmussen AW. Danish education registers. *Scand J Public Health* 2011;39:91–4.
18 Baadsgaard M, Quitzau J. Danish registers on personal income and transfer payments. *Scand J Public Health* 2011;39:103–5.
19 Zwisler A-D, Rossau HK, Nakano A, *et al*. The Danish cardiac rehabilitation database. *Clin Epidemiol* 2016;8:451–6.
20 Galobardes B, Shaw M, Lawlor DA, *et al*. Indicators of socioeconomic position (Part 1). *J Epidemiol Community Health* 2006;60:7–12.
21 Statistics Denmark. FAMAEKVIVADISP_13. Available: https://www.dst.dk/da/Statistik/dokumentation/Times/familieindkomst/famaekvivadisp-13 [Accessed 11 Oct 2021].
22 Eurostat. ISCED-Classification. correspondence between ISCED 2011 and ISCED 1997 levels. Available: https://ec.europa.eu/eurostat/documents/1978984/6037342/Comparability_ISCED_2011_ISCED_1997.pdf [Accessed 1 Oct 2021].
23 Statistic Denmark. SOCIO13. Available: https://www.dst.dk/da/Statistik/dokumentation/Times/personindkomst/socio13 [Accessed 4 Oct 2021].
24 Thygesen SK, Christiansen CF, Christensen S, *et al*. The predictive value of ICD-10 diagnostic coding used to assess Charlson comorbidity index conditions in the population-based Danish national Registry of patients. *BMC Med Res Methodol* 2011;11:83.
25 Vanzella LM, Oh P, Pakosh M, *et al*. Barriers to cardiac rehabilitation in ethnic minority groups: a scoping review. *J Immigr Minor Health* 2021;23:824–39.
26 The Danish Health Autority. National klinisk retningslinje for hjerterehabilitering. Available: https://www.sst.dk/da/udgivelser/2015/nkr-hjerterehabilitering [Accessed 23 Nov 2021].
27 Castellanos LR, Viramontes O, Bains NK, *et al*. Disparities in cardiac rehabilitation among individuals from racial and ethnic groups and rural Communities-A systematic review. *J Racial Ethn Health Disparities* 2019;6:1–11.
28 Tromp J, Collins S. Universal healthcare but not universal access? *Eur J Prev Cardiol* 2020;27:75–8.
29 Ravn MB, Uhd M, Svendsen ML, *et al*. How to facilitate adherence to cardiac rehabilitation in primary health settings for ischaemic heart disease patients. The perspectives of health professionals. *Front Rehabilit Sci* 2022;3.
30 Ravn MB, Uhd M, Svendsen ML, *et al*. Why do patients with ischaemic heart disease drop out from cardiac rehabilitation in primary health settings. A qualitative audit of patient charts. *Front Rehabilit Sci* 2022;3.
31 DEFACTUM. Opgørelse af kommunale hjerterehabiliteringsindikatorer. Rapportering af data fra HjerteKomMidt i den midtjyske region for perioden 1. januar 2018 til 31. December 2018. *Aarhus: DEFACTUM* 2019.

Correction: *To what extend is socioeconomic status associated with not taking up and dropout from cardiac rehabilitation: a population-based follow-up study*

Svendsen ML, Gadager BB, Stapelfeldt CM, *et al*. To what extend is socioeconomic status associated with not taking up and dropout from cardiac rehabilitation: a population-based follow-up study. *BMJ Open* 2022;12:e060924. doi: 10.1136/bmjopen-2022-060924

This article was previously published with an error in the article title.

The correct title is **To what extent is socioeconomic status associated with not taking up and dropout from cardiac rehabilitation: a population-based follow-up study**

BMJ Open 2022;**12**:e060924corr1. doi:10.1136/bmjopen-2022-060924corr1