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ORIGINAL RESEARCH

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Return to Work and Risk of Subsequent Detachment From Employment After Myocardial Infarction: Insights From Danish Nationwide Registries

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***Background*—**Limited data are available on return to work and subsequent detachment from employment after admission for myocardial infarction (MI).

***Methods and Results*—**Using individual-level linkage of data from nationwide registries, we identified patients of working age (30–65 years) discharged after first-time MI in the period 1997 to 2012, who were employed before admission. To assess the cumulative incidence of return to work and detachment from employment, the Aalen Johansen estimator was used. Incidences were compared with population controls matched on age and sex. Logistic regression was applied to estimate odds ratios for associations between detachment from employment and age, sex, comorbidities, income, and education level. Of 39 296 patients of working age discharged after first-time MI, 22 394 (56.9%) were employed before admission. Within 1 year 91.1% (95% confidence interval [CI], 90.7%–91.5%) of subjects had returned to work, but 1 year after their return 24.2% (95% CI, 23.6%–24.8%) were detached from employment and received social benefits. Detachment rates were highest in patients aged 60 to 65 and 30 to 39 years, and significantly higher in patients with MI compared with population controls. Predictors of detachment were heart failure (odds ratio 1.20 [95% CI, 1.08–1.34]), diabetes mellitus (odds ratio 1.13 [95% CI, 1.01–1.25]), and depression (odds ratio 1.77 [95% CI, 1.55–2.01]). High education level and high income favored continued employment.

***Conclusions*—**Despite that most patients returned to work after first-time MI, about 1 in 4 was detached from employment after 1 year. Several factors including age and lower socioeconomic status were associated with risk of detachment from employment.
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Key Words: employment • epidemiology • myocardial infarction • outcome • prognosis • quality of life • work

Through decades, prognosis after myocardial infarction (MI) has improved as new treatment regimens for acute management, primary and secondary prevention have evolved.[1–3] Although fewer post-MI complications, such as recurrent MI, heart failure, and death, are important benchmarks for the quality of care, returning to work and being able to remain employed are similarly important markers of functional status, which are associated with individual self-esteem and societal costs. For example, evidence has indicated that quality of life is poorer in unemployed subjects and the risk of depression is greater among these individuals.[4–6] While previous studies have focused on return to work after MI, with return rates from 57% to 90% within 1 year, continuation of employment following return to work remains unclear.[7–12] Also, a single study of patients who underwent percutaneous coronary intervention (PCI) suggested that return to work is an insufficient measure of the actual employment status, because a considerable number of subjects become detached from employment relatively quickly (ie, 76% of patients returned to work after PCI, but

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Accompanying Tables S1 and Figure S1 through S4 are available at http://jaha.ahajournals.org/content/6/10/e006486/DC1/embed/inline-supplementary-material-1.pdf

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Clinical Perspective

What Is New?

- This nationwide study reports on detachment from employment after return to work in patients with myocardial infarction.
- Of 20 415 patients who returned to work, 4938 (24.2%) were detached from employment within 1 year and supported by social benefits.
- Important risk factors of detachment from employment were younger age (30–39 years) and low socioeconomic status.

What Are the Clinical Implications?

- The findings in this study suggest that a rehabilitation strategy with focus on employment maintenance is warranted.

only 60% had no recurrent sick-leave during 1 year of follow-up).[13]

An improved understanding of return to work and the subsequent detachment from employment after MI can contribute to the development of strategies to promote return and maintenance of work and thereby increase patient's quality of life and reduce societal costs. Therefore, we investigated return to work and subsequent detachment from employment after MI in a nationwide cohort during a 16-year period and assessed risk factors associated with not returning to work and/or subsequent detachment from employment.

Methods

Study Design and Study Population

The study was a nationwide retrospective cohort study comprising patients aged 30 to 65 years with a first-time primary discharge diagnosis of MI (International Classification of Diseases 10th revision code I21) in the period between January 1, 1997 and December 31, 2012. Patients with a previous discharge diagnosis of MI were excluded. Only patients who were employed for at least 3 consecutive weeks in a 5-week period before the day of admission with MI were included. The patients were included 30 days after admission.

Data Sources

In Denmark, all 5.6 million citizens are covered by publicly financed national health insurance, guaranteeing free access to healthcare services at all times. All residents hold a unique and permanent personal identification number that allows linkage between the administrative registers. The Danish Civil Registration System holds information on birth, sex, and death status. The Danish National Patient Registry holds information on all admissions since 1978.[14] All admissions to hospitals and out of hospital contacts are registered by 1 primary diagnosis, and supplementary secondary diagnoses if appropriate, according to the International Classification of Diseases. The MI diagnosis has previously been validated in this registry with a sensitivity of 97%.[15] Surgical and interventional procedures are registered in the Nordic Medical Statistics Committees Classification of Surgical Procedures.

The DREAM database was used to identify patients who received social benefits and employment was defined as being self-supportive, which has been validated with a positive predictive value of 98.2%.[16] All residents in Denmark who are not working (eg, unemployed, on sick leave, on maternity leave, or eligible for early retirement or disability pension because of severe impairments) are entitled to government-financed social benefits. Since 1991, all social benefits are registered on a weekly basis in the DREAM database, making this database suitable for studies of employment history and follow-up.[16]

Redemption of drug prescriptions was identified using the Danish Register of Medicinal Product Statistics that holds information on all prescriptions dispensed from pharmacies in Denmark since 1995, and the registry classifies each drug according to the Anatomic Therapeutical Chemical classification. The Danish healthcare system provides partial reimbursement of drug expenses, which ensures a high validity of the registry.[17] Information on education level and personal income was available on an annual basis and was provided by Statistics Denmark, and we indexed income on that of 2009.[18,19]

Study Outcomes

The study outcomes were return to work within 1 year after admission with first-time MI and detachment from employment following return to work, respectively.

Covariates

In the multivariable model, the covariates were selected before analysis and we included those that were considered most relevant based on current literature (ie, sex, age, living alone, baseline income and educational level, comorbidities [heart failure, arrhythmia, diabetes mellitus, cerebrovascular disease, chronic kidney disease, chronic obstructive pulmonary disease, and depression]), invasive coronary procedures (coronary angiography, PCI, and coronary artery bypass grafting), and time period of index admission.[20–23] We examined the comorbidity status based on discharge- and

Table 1. Baseline Characteristics of the Post-MI Population

Variable	Overall	No Return	Return	*P* Value*
N	22 394	1979	20 415	
Men, %	18 120 (80.9)	1480 (74.8)	16 640 (81.5)	<0.001
Women, %	4274 (19.1)	499 (25.2)	3775 (18.5)	<0.001
Age (median [IQR])	55 [49, 59]	55 [50, 60]	55 [49, 59]	0.072
Age groups, %				
30 to 39 y	915 (4.1)	82 (4.1)	833 (4.1)	0.659
40 to 49 y	5052 (22.6)	374 (18.9)	4678 (22.9)	<0.001
50 to 59 y	10 888 (48.6)	1024 (51.7)	9864 (48.3)	Reference
60 to 65 y	5539 (24.7)	499 (25.2)	5040 (24.7)	0.408
Living alone	4497 (20.1)	459 (23.2)	4038 (19.8)	<0.001
Heart failure, %	1990 (8.9)	377 (19.1)	1613 (7.9)	<0.001
Arrhythmia	1632 (7.3)	250 (12.6)	1382 (6.8)	<0.001
Diabetes mellitus, %	2087 (9.3)	275 (13.9)	1812 (8.9)	<0.001
Cerebrovascular disease, %	569 (2.5)	95 (4.8)	474 (2.3)	<0.001
Chronic kidney disease, %	262 (1.2)	45 (2.3)	217 (1.1)	<0.001
COPD, %	388 (1.7)	55 (2.8)	333 (1.6)	<0.001
Depression, %	1034 (4.6)	112 (5.7)	922 (4.5)	0.021
CAG, %	16 278 (72.7)	1480 (74.8)	14 798 (72.5)	0.028
PCI, %	12 379 (55.3)	1087 (54.9)	11 292 (55.3)	0.742
CABG, %	1245 (5.6)	174 (8.8)	1071 (5.2)	<0.001
Education level, %				<0.001
Basic school	6817 (30.4)	720 (36.4)	6097 (29.9)	Reference
High school	622 (2.8)	51 (2.6)	571 (2.8)	<0.001
Vocational	10 096 (45.1)	874 (44.2)	9222 (45.2)	0.065
Short/medium	3368 (15.0)	227 (11.5)	3141 (15.4)	<0.001
Long/higher education	1040 (4.6)	52 (2.6)	988 (4.8)	<0.001
Unknown	451 (2.0)	55 (2.8)	396 (1.9)	0.277
Income, %				<0.001
First quartile	5598 (25.0)	671 (33.9)	4927 (24.1)	Reference
Second quartile	5599 (25.0)	544 (27.5)	5055 (24.8)	<0.001
Third quartile	5599 (25.0)	437 (22.1)	5162 (25.3)	<0.001
Fourth quartile	5598 (25.0)	327 (16.5)	5271 (25.8)	<0.001
Period				
1997 to 2000	5717 (25.5)	455 (23.0)	5262 (25.8)	Reference
2001 to 2004	5992 (26.8)	522 (26.4)	5470 (26.8)	0.141
2005 to 2008	5571 (24.9)	579 (29.3)	4992 (24.5)	<0.001
2009 to 2012	5114 (22.8)	423 (21.4)	4691 (23.0)	0.552

CABG indicates coronary artery bypass grafting; CAG, coronary angiography; COPD, chronic obstructive pulmonary disease; IQR, interquartile range; MI, myocardial infarction; PCI, percutaneous coronary intervention.
**P* value from logistic regression models.

outpatient diagnoses 5 years before the date of inclusion. Use of medication was investigated 6 months before date of inclusion. Diabetes mellitus and depression were either defined from International Classification of Diseases codes from the National Patient Registry or use of antidiabetic medication or antidepressant, respectively. International

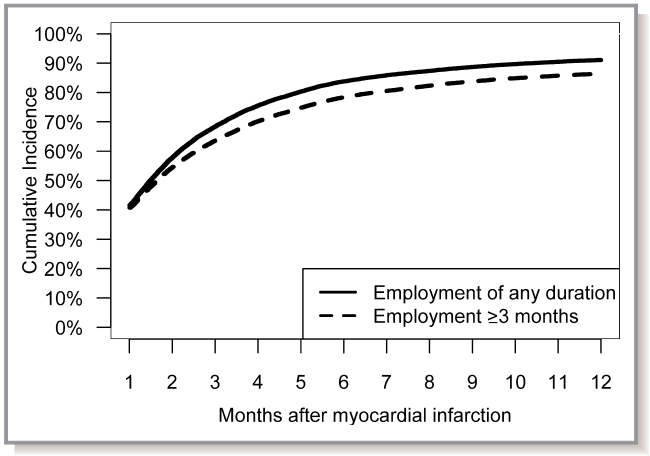

Figure 1. Cumulative incidence of patients who returned to work in the period 1 year after admission with myocardial infarction.

Classification of Diseases- and Anatomic Therapeutical Chemical-codes used in the study are found in Table S1.

Statistical Analysis

Return to work

Patients were included 30 days after admission. To assess the cumulative incidence rates of return to work, the Aalen-Johansen estimator with competing risk of death was used.[24] Return to work was defined as being self-supportive for at least 1 week, and in a sensitivity analysis, patients who returned to work and maintained employment for at least 3 months were considered. Logistic regression was applied to estimate the odds ratios (ORs) with 95% confidence intervals (CIs) for risk factors associated with not returning to work, and patients who died during follow-up were considered as not returning to work in this model. Estimates for age and sex were adjusted for comorbidities (heart failure, arrhythmia, diabetes mellitus, cerebrovascular disease, chronic kidney disease, chronic obstructive pulmonary disease, and depression), living alone, invasive coronary procedures (modeled as a categorical variable with 4 levels: no procedure, coronary angiography, PCI, coronary artery bypass grafting), education level, income, and time periods of index admission. Other estimates in the same figure were adjusted for the same variables, but because of interaction between age and numerous of the other variables, age was modeled as a restricted cubic spline, and furthermore income was stratified on sex because of interactions between these variables. Also, this analysis was repeated with return to work considered as maintenance of employment for at least 3 months.

Detachment from employment

In analyses of detachment from employment, only patients who returned to work were included. Information on age, comorbidity, medication, invasive procedures, living alone, education, and income were updated until the date of return to work. Detachment from employment was assessed by cumulative incidence using Aalen-Johansen estimator with competing risk of death, and detachment was defined as receiving social benefits for at least 1 or 3 months, respectively. Additionally, the analyses were stratified by age, using the age intervals 30 to 39, 40 to 49, 50 to 59, and 60 to 65 years. Logistic regression was applied to estimate ORs and 95% CIs for risk factors associated with detachment from employment. The logistic regression model presenting risk factors associated with detachment was based on detachment periods of at least 1 month and the model was adjusted in the same manner as the one for return to work as the same interactions were found. In the logistic regression models, patients who were unable to complete follow-up because of death were considered as detached from employment. This method was feasible because of the very low mortality of patients in the study.

The rate of detachment for post-MI patients was compared with 1:5 matched controls from the employed general Danish population. The controls had no prior history of MI and were matched by year of birth and sex. To test for differences in detachment, Aalen-Johansen estimator rates between patients with MI and the matched population, Fine-Gray models were applied.[25] The percentages of patients receiving different social benefits (sick leave, disability pensions, subsidized jobs, unemployment benefits, early retirements, pensions, student grants, and parental leave) at the time of detachment were calculated and compared with controls using conditional logistic regression with age and sex stratas.

Data management and statistical analyses were performed using SAS (version 9.4 for Windows, SAS Institute, Cary, NC) and R (version 3.2.3 for Windows, R Foundation for Statistical Computing).

Ethics

This study was approved by the Danish Data Protection Agency (local reference No. 2007-58-0015/GEH-2014-014 I-suite 02732). Informed consent and ethical approval is not required for retrospective registry-based studies in Denmark.

Results

Patients and Characteristics

Of 39 296 patients of working age (30–65 years), 22 394 (56.9%) patients were employed before admission with first-time MI (Figure S1). In the study population, a total of 18 120 (80.9%) were men and the median age was 55 (interquartile

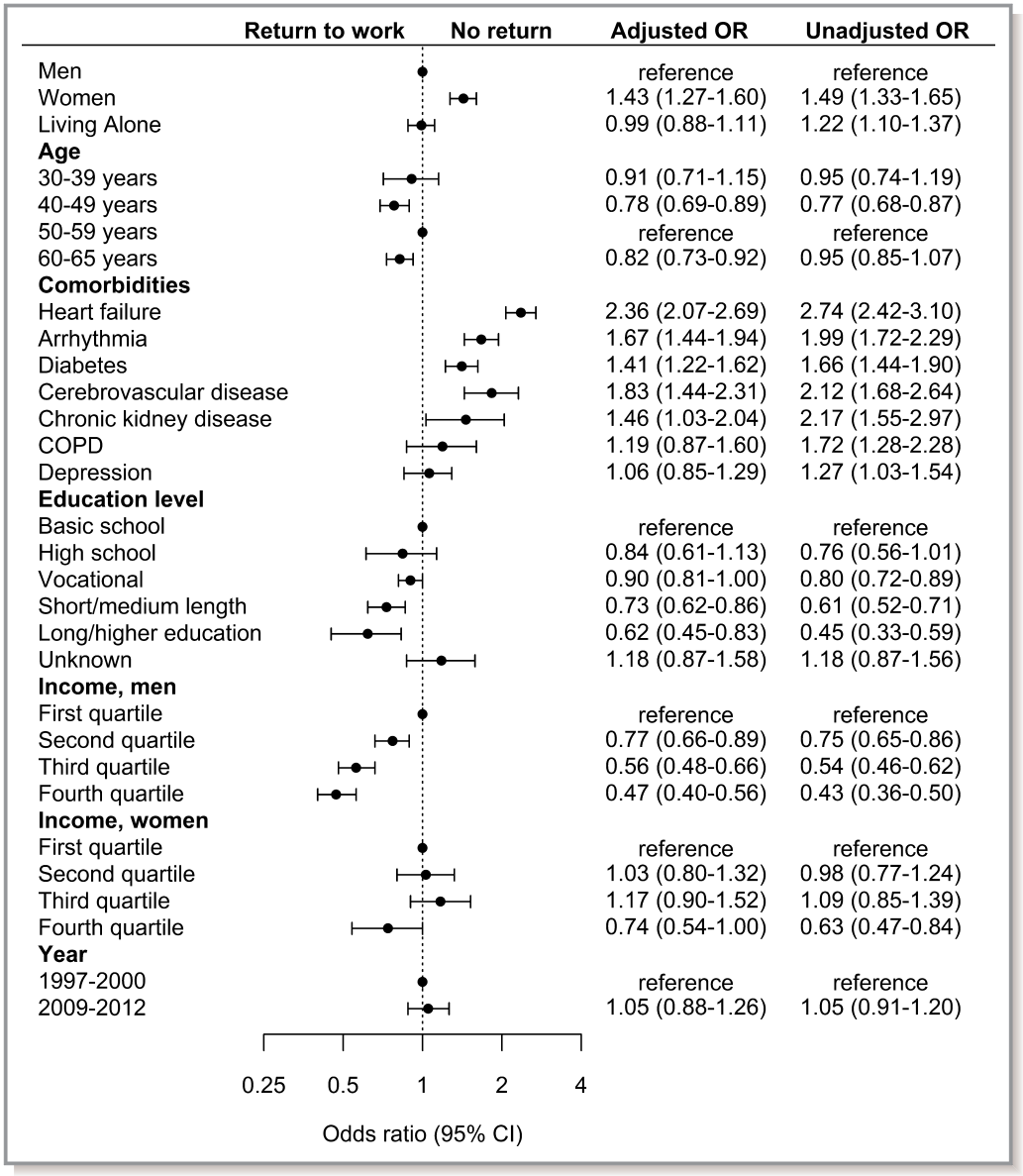

Figure 2. Risk factors associated with not returning to work. The odds ratios (ORs) with 95% confidence intervals (CIs) are displayed on a logarithmic scale. Estimates for age and sex were adjusted for comorbidities (heart failure, arrhythmia, diabetes mellitus, cerebrovascular disease, chronic kidney disease, chronic obstructive pulmonary disease [COPD], and depression), education level, income, time periods, and invasive coronary procedures. Other estimates in the figure were adjusted for age modeled as a restricted cubic spline, sex-based income, comorbidities, education level, time periods, and invasive coronary procedures.

range 49–59) years (Table 1). The most prevalent comorbidities were heart failure (8.9%), arrhythmia (7.3%), and diabetes mellitus (9.3%).

Return to Work

Within 1 month, 9329 (41.7% [95% CI, 41.0%–42.3%]) of the post-MI patients had returned to work and after 1 year this number was 20 415 (91.1% [95% CI, 90.7%–91.5%]), whereas 92 (0.4% [95% CI, 0.3–0.5]) died (Figure 1). When 3 months of employment was considered, 19 369 (86.4% [95% CI, 86.0%–86.9%]) returned to work.

Risk factors associated with not returning to work were female sex (OR 1.43 [95% CI, 1.27–1.60]), heart failure (OR 2.36 [95% CI, 2.07–2.69]), arrhythmia (OR 1.67 [95% CI, 1.44–1.94]), cerebrovascular disease (OR 1.83 [95% CI, 1.44–2.31]), and chronic kidney disease (OR 1.46 [95% CI, 1.03–2.04], Figure 2). Conversely, predictors that favored return to work were high education level, and high income favored return to work for men, but not for women

Table 2. Characteristics at Time of Return to Work of Post-MI Patients Who Were Not Detached Versus Detached From Employment

Variable	Not Detached	Detached	*P* Value*
N	15 246	5169	
Men, %	12 551 (82.3)	4089 (79.1)	Reference
Women, %	2695 (17.7)	1080 (20.9)	<0.001
Age (median [IQR])	55 [49, 59]	57 [51, 61]	<0.001
Age groups, %			
30 to 39 y	575 (3.8)	222 (4.3)	<0.001
40 to 49 y	3647 (23.9)	916 (17.7)	<0.001
50 to 59 y	7604 (49.9)	2146 (41.5)	Reference
60 to 65 y	3420 (22.4)	1885 (36.5)	<0.001
Living alone	2913 (19.1)	1121 (21.7)	<0.001
Heart failure, %	1227 (8.0)	560 (10.8)	<0.001
Arrhythmia	1061 (7.0)	464 (9.0)	<0.001
Diabetes mellitus, %	1311 (8.6)	563 (10.9)	<0.001
Cerebrovascular disease, %	320 (2.1)	181 (3.5)	<0.001
Chronic kidney disease, %	127 (0.8)	101 (2.0)	<0.001
COPD, %	224 (1.5)	131 (2.5)	<0.001
Depression, %	687 (4.5)	419 (8.1)	<0.001
CAG, %	11 574 (75.9)	3924 (75.9)	0.999
PCI, %	8822 (57.9)	2986 (57.8)	0.903
CABG, %	1101 (7.2)	390 (7.5)	0.440
Education level, %			
Basic school	4347 (28.5)	1744 (33.7)	Reference
High school	453 (3.0)	116 (2.2)	<0.001
Vocational	6881 (45.1)	2342 (45.3)	<0.001
Short/medium length	2456 (16.1)	695 (13.4)	<0.001
Long/higher education	817 (5.4)	170 (3.3)	<0.001
Unknown	292 (1.9)	102 (2.0)	0.234
Income, %			
First quartile	4950 (32.5)	2312 (44.7)	Reference
Second quartile	4440 (29.1)	1527 (29.5)	<0.001
Third quartile	3199 (21.0)	823 (15.9)	<0.001
Fourth quartile	2657 (17.4)	507 (9.8)	<0.001
Y, %			
1997 to 2000	4000 (26.2)	1262 (24.4)	Reference
2001 to 2004	4061 (26.6)	1409 (27.3)	0.033
2005 to 2008	3726 (24.4)	1266 (24.5)	0.106
2009 to 2012	3459 (22.7)	1232 (23.8)	0.009

CABG indicates coronary artery bypass grafting; CAG, coronary angiography; COPD, chronic obstructive pulmonary disease; IQR, interquartile range; MI, myocardial infarction; PCI, percutaneous coronary intervention.
**P* value from logistic regression models.

(Figure 2). When return to work was defined as at least 3 months of employment, age 60 to 65 years was no longer associated with return to work, while depression and MI during calendar years 2009 to 2012 compared with 1997 to 2000 were associated with not returning to work (Figure S2).

Detachment From Employment

Of 20 415 patients who had returned to work, 5169 (25.3%) were detached from employment within 1 year (Table 2), of which 4938 (24.2% [95% CI, 23.6%–24.8%]) received social benefits and 231 (1.1% [95% CI, 1.0%–1.3%]) had died (Figure 3). Age-stratified analyses showed that detachment was most pronounced in patients aged 60 to 65 years, followed by patients aged 30 to 39 years (Figure 4). The post-MI patients had a higher comorbidity burden and lower education level than the population controls (Table 3), and the rate of detachment was significantly higher in post-MI patients (all $P<0.001$; Figure 5).

In adjusted analyses, patients aged 40 to 49 years had a lower risk of detachment than all the other age groups (Figure 6). The youngest age group (30–39 years) had a higher risk of detachment (OR 1.26 [95% CI, 1.06–1.48]) as did patients aged 60 to 65 years (OR 1.84 [95% CI, 1.71–1.99]) compared with patients aged 50 to 59 years. Other predictors for detachment were heart failure (OR 1.20 [95% CI, 1.08–1.34]), diabetes mellitus (OR 1.13 [95% CI, 1.01–1.25]), arrhythmia (OR 1.17 [95% CI, 1.04–1.32]), cerebrovascular disease (OR 1.37 [95% CI, 1.13–1.66], chronic kidney disease (OR 2.04 [95% CI, 1.55–2.68]), and depression (OR 1.77 [95% CI, 1.55–2.01]). Also, a high education level and high income favored maintenance of employment (Figure 6).

Among post-MI patients, 74.6% were still employed 1 year after employment, while this number was 91.4% for controls (Table 4). At the time of detachment, 10.9% of post-MI patients received sick leave benefits and 5.7% received unemployment benefits versus 2.4% and 1.4% of the controls, respectively. Detachment because of early retirement and pension was higher in post-MI patients (4.6% and 1.8%, respectively) than in controls (2.7% and 1.2%, both $P<0.01$).

Discussion

In this nationwide register-based study, we found that 91.1% of the patients employed before admission with first-time MI returned to work within 1 year. Despite this high reemployment rate, 24.2% of the post-MI patients were detached from employment and received social benefits within 1 year after return to work. Detachment was associated with being in the youngest (30–39 years) or oldest (60–65 years) age group, heart failure, arrhythmia, and depression, respectively, while high income and high education level favored maintenance of employment. The rate of detachment for post-MI patients was almost 3-fold higher than the population controls. These findings suggest that post-MI patients with these characteristics including excess comorbidities and poorer socioeconomic status should receive increased focus on cardiac rehabilitation aimed at reducing detachment from employment.

In previous studies of return to work after MI, return to work rates varied from 57% to 90%.[7–12] In ST-segment elevation MI patients, rates varied between 76% and 93%.[26,27] The potentially slightly higher return to work rates observed in our study could be caused, in part, by our register-based design that minimized loss to follow-up. Furthermore, compared with other countries, all Danish citizens have the possibility of a paid sick leave, which may contribute to resumption of work.[28] High income and high education level were predictors of both returning to work and continuous employment. This finding is in accordance with previous studies showing that white collar workers with higher salaries were more likely to return to work than blue collar workers.[12] Furthermore, individuals who are employed in low income jobs generally often have lower decision latitudes at work, which is a well-described stressor, and also a risk factor of not

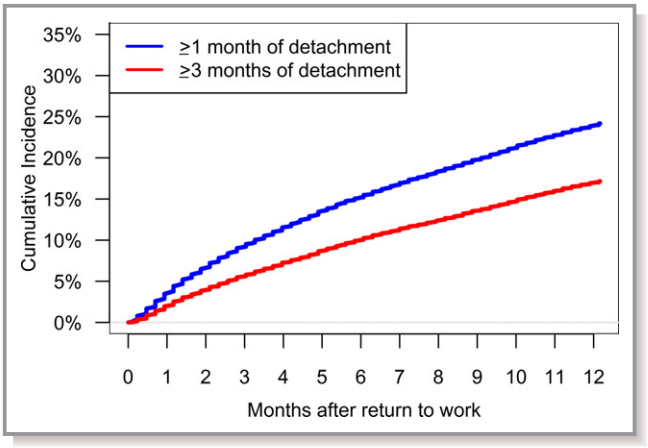

Figure 3. Cumulative incidence of patients who were detached from employment. Patients were included on the day of return to work and followed for 1 year, and detachment from employment was stratified on duration of at least 1 or 3 month, respectively.

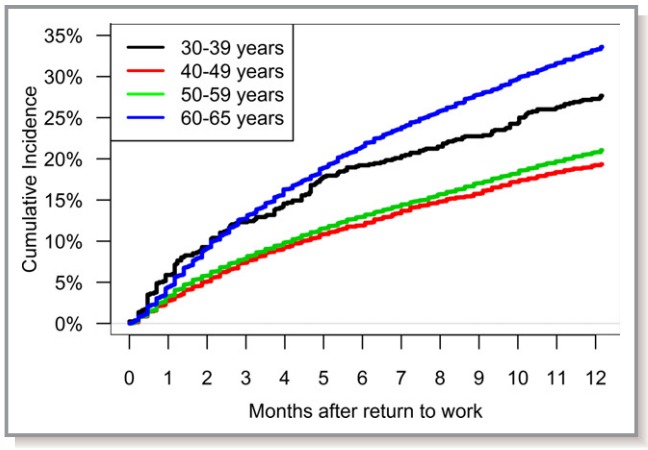

Figure 4. Cumulative incidence of detachment from employment stratified on age groups. Patients were included on the day of return to work and followed for 1 year. The figure illustrates detachment of at least 1 month duration.

Table 3. Characteristics of Population Controls and Post-MI Patients at Time of Matching

Variable	Controls	Post-MI Patients	*P* Value*
N	102 075	20 415	
Men, %	83 200 (81.5)	16 640 (81.5)	
Women, %	18 875 (18.5)	3775 (18.5)	
Age (median [IQR])	55 [49, 60]	55 [49, 60]	
Age groups, %			
30 to 39 y	3992 (3.9)	797 (3.9)	
40 to 49 y	22 816 (22.4)	4563 (22.4)	
50 to 59 y	48 733 (47.7)	9750 (47.8)	
60 to 65 y	26 534 (26.0)	5305 (26.0)	
Living alone	17 671 (17.6)	4034 (19.8)	<0.001
Heart failure, %	257 (0.3)	1787 (8.8)	<0.001
Arrhythmia	1238 (1.2)	1525 (7.5)	<0.001
Diabetes mellitus, %	2615 (2.6)	1874 (9.2)	<0.001
Cerebrovascular disease, %	789 (0.8)	501 (2.5)	<0.001
Chronic kidney disease, %	229 (0.2)	228 (1.1)	<0.001
COPD, %	404 (0.4)	355 (1.7)	<0.001
Depression, %	2237 (2.2)	1106 (5.4)	<0.001
Education level, %			
Basic school	20 632 (20.2)	6091 (29.8)	<0.001
High school	3881 (3.8)	569 (2.8)	<0.001
Vocational	40 188 (39.4)	9223 (45.2)	<0.001
Short/medium length	21 274 (20.8)	3151 (15.4)	<0.001
Long/higher education	10 705 (10.5)	987 (4.8)	<0.001
Unknown	5395 (5.3)	394 (1.9)	<0.001
Income, %			
First quartile	23 360 (22.9)	7262 (35.6)	<0.001
Second quartile	24 656 (24.2)	5967 (29.2)	<0.001
Third quartile	26 601 (26.1)	4022 (19.7)	<0.001
Fourth quartile	27 458 (26.9)	3164 (15.5)	<0.001

COPD indicates chronic obstructive pulmonary disease; IQR, interquartile range; MI, myocardial infarction.
**P* value based on conditional logistic regression using age and sex stratas.

returning to work and poor maintenance of employment.[12,29,30]

Patients aged 30 to 39 years also had a high risk of detachment from employment compared with those aged 50 to 59 years. The underlying explanations are not clear, although it is well described that younger patients with MI differ from their older counterparts, with a higher burden of smoking and high BMI, potentially indicating a poorer general lifestyle.[31,32] Furthermore, the employer's willingness to accommodate individual needs may be greater for employees who have senior positions and longer previous employment at the workplace. This result is, however, alarming because the youngest group of patients has many more potential years left on the labor market and since unemployment is an individual risk factor for poor quality of life and subsequent depression, this again entails a worsened prognosis.[4–6,33,34]

Of note, depression before MI is indicative of mental vulnerability and may reinforce, for example, augmented depression or anxiety symptoms leading to increased risk of detachment from employment as observed in the present study.

We found that women were less likely to return to work compared with men, which is in accordance with very recent findings from the United States, where this result, however,

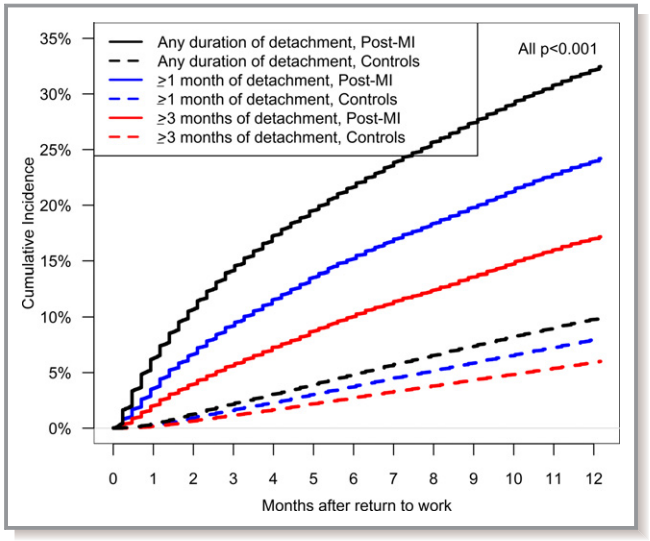

Figure 5. Cumulative incidence of detachment from employment in post–myocardial infarction (post-MI) patients compared with population controls. The detachment from employment was stratified on duration of any period, at least 1 month, and at least 3 months, respectively. The post-MI patients were included on the day of return to work, and the population controls were included on the day of statistical matching.

was not sustained after adjustments.[11] Another US report from 1992 found that single living was a risk factor for poorer outcomes after MI,[35] but this was only found in our unadjusted analyses, indicating that these patients may have a higher burden of comorbidities and lower socioeconomic status.

Heart failure was associated with not returning to work and detachment from employment, which is in accordance with previous findings.[8,10]

Remarkably, although in Denmark all citizens have access to both education and social benefits financed by the Danish welfare system, socioeconomic factors remained predictors of employment status and follow-up and these results are likely to be even more significant in countries with more societal and economic inequalities.

Clinical Implications

While our work largely confirms prior knowledge about return to work after MI, the notion that post-MI patients frequently become detached from employment shortly after re-employment is new. This observation emphasizes that return to work may not be a valid measure of successful recovery of working capacity. While rehabilitation strategies generally focus on elderly and vulnerable cases, younger and more resourceful patients (eg, patients who are employed) may not be invited or may decline or drop out from such programs.[36] Indeed, socially vulnerable patients with low socioeconomic status are less likely to enroll in these rehabilitation programs.[37] This may be reflected in our findings in that patients with lower socioeconomic status are less likely to return to work and more likely to become detached from employment. Thus, our novel findings on a nationwide level suggest that a rehabilitation strategy with focus on employment maintenance is warranted, in particular for patients aged 30 to 39 years and those of lower socioeconomic status who showed a disconcerting trend for becoming detached from employment.

Strengths and Limitations

Strengths of this current study include the following: (1) the nationwide coverage of patients, minimizing selection bias on the basis of region; (2) all citizens had free access to standardized health care without insurance requirements and the Danish welfare system with free healthcare services, partial reimbursement of medication, and paid sick leave would appear to provide favorable conditions for work resumption following MI[28,38]; (3) the nationwide register-based design enabled complete follow-up (until death, emigration, or end-of-study) and determination of comorbidities and drug treatment, which minimized selection bias, recall bias, and misclassification, respectively.

The study also had some limitations including the following: (1) it is observational, and the results represent associations and not necessarily causations; (2) important factors for both return to work and long-term outcomes such as job satisfaction, job type, health- and job-related quality of life, and physical capacity were not measured[10,12,34,39–42]; (3) other unmeasured potential confounders included, for example, smoking, drinking habits, physical activity levels, body mass index, and left ventricular ejection fraction; (4) the actual reason for not returning to work or becoming detached from employment was also unknown and is not possible to address in the registries, although we did find that these patients most often received sick leave benefits. Patients who were close to 65 years of age at time of admission may have retired because of eligibility for early retirement and pension and not because of poor functional status, but compared with the matched controls, the post-MI patients still had higher retirement rates; (5) the standard of care changed during the relatively long study period, (eg, troponins measurements changed the definition of MI in 2000/2001 and primary PCI was implemented in Denmark in 2003 after the benefits were demonstrated in a national randomized study).[43] However, excluding patients admitted during the first period (before 2001) did not change the results (Figures S3 and S4). Also, MI was evaluated as 1 entity because discrimination between MI subtypes was not valid in the registries; (6) the legislation on sick leave became more restrictive during the study period (eg, the period before the employer received reimbursement

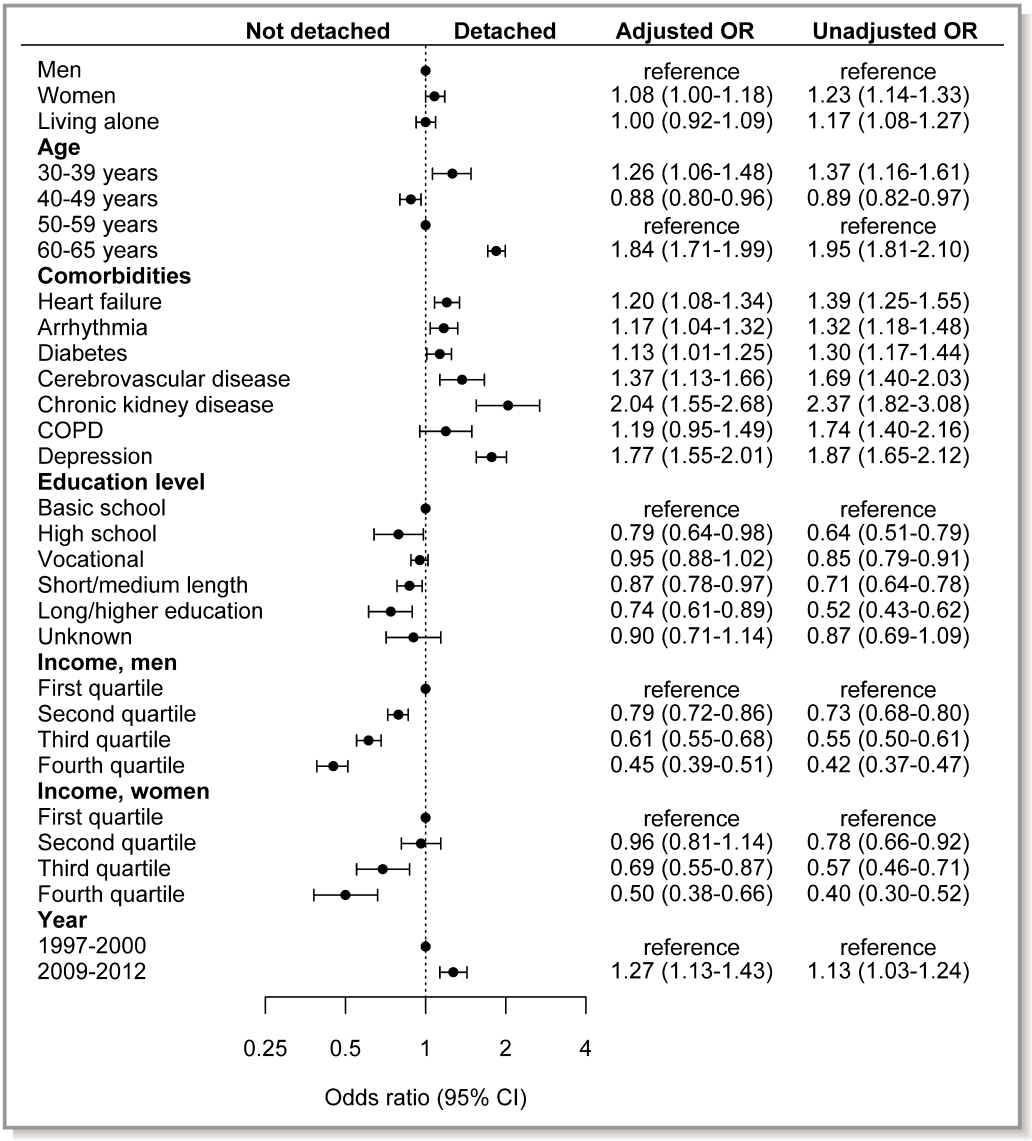

Figure 6. Forest plot of risk factors associated with detachment from employment. The estimates were based on detachment from employment of at least 1 month. The odds ratios (ORs) with 95% confidence intervals (CIs) are displayed on a logarithmic scale. Estimates for age and sex were adjusted for comorbidities (heart failure, arrhythmia, diabetes mellitus, cerebrovascular disease, chronic kidney disease, chronic obstructive pulmonary disease [COPD], and depression), education level, income, time periods, and invasive coronary procedures. Other estimates in the figure were adjusted for age modeled as a restricted cubic spline, sex-based income, comorbidities, education level, time periods, and invasive coronary procedures.

from the state because of employee's sick leave changed from 15 days to 21 days in 2008, and to 30 days in 2012). To address these changes, we investigated detachment from the workplace with duration of at least 30 days.

Conclusion

In this nationwide register-based study of patients discharged after first-time incident MI who were employed before hospital admission, we found that 91% returned to work, but that subsequently 24% of patients were detached from employment within the first year, corresponding to a 3-fold higher detachment rate compared with population controls. Younger age (30–39 years) and lower socioeconomic status were among important predictors of detachment from employment. Not being part of the workforce represents a considerable individual and societal burden, and the results may inform new strategies for maintenance of work in post-MI patients.

Table 4. Cause of Social Benefits at Time of Detachment From Employment or After 1 Year of Follow-Up in Controls and Post-MI Patients

Follow-up	Controls	Post-MI Patients	*P* Value*
Sick leave, %	2454 (2.4)	2221 (10.9)	<0.001
Disability pension, %	66 (0.1)	86 (0.4)	<0.001
Subsidized job, %	36 (0.1)	98 (0.5)	<0.001
Unemployment, %	1419 (1.4)	1168 (5.7)	<0.001
Early retirement, %	2728 (2.7)	940 (4.6)	<0.001
Pension, %	1273 (1.2)	371 (1.8)	<0.001
Parental leave and student grant, %	262 (0.3)	54 (0.3)	0.85
Emigrated, %	229 (0.2)	25 (0.1)	0.005
Dead, %	338 (0.3)	231 (1.1)	<0.001
Working, %	93 270 (91.4)	15 221 (74.6)	<0.001

MI indicates myocardial infarction.
**P* value based on conditional logistic regression using age and sex stratas.

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Disclosures

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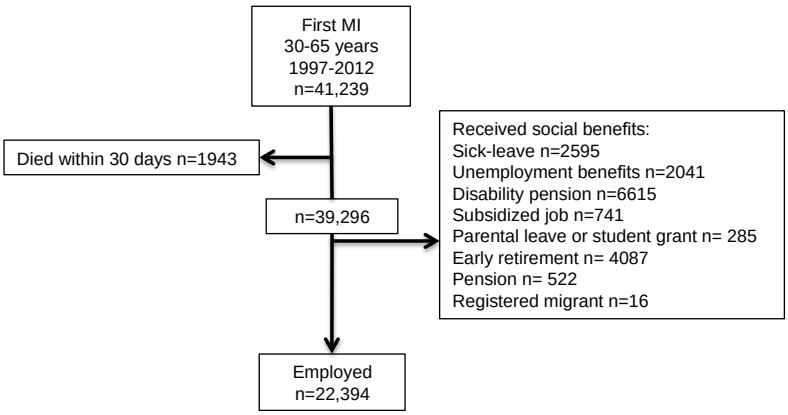
SUPPLEMENTAL MATERIAL

Table S1. Codes used to define comorbidity and medication

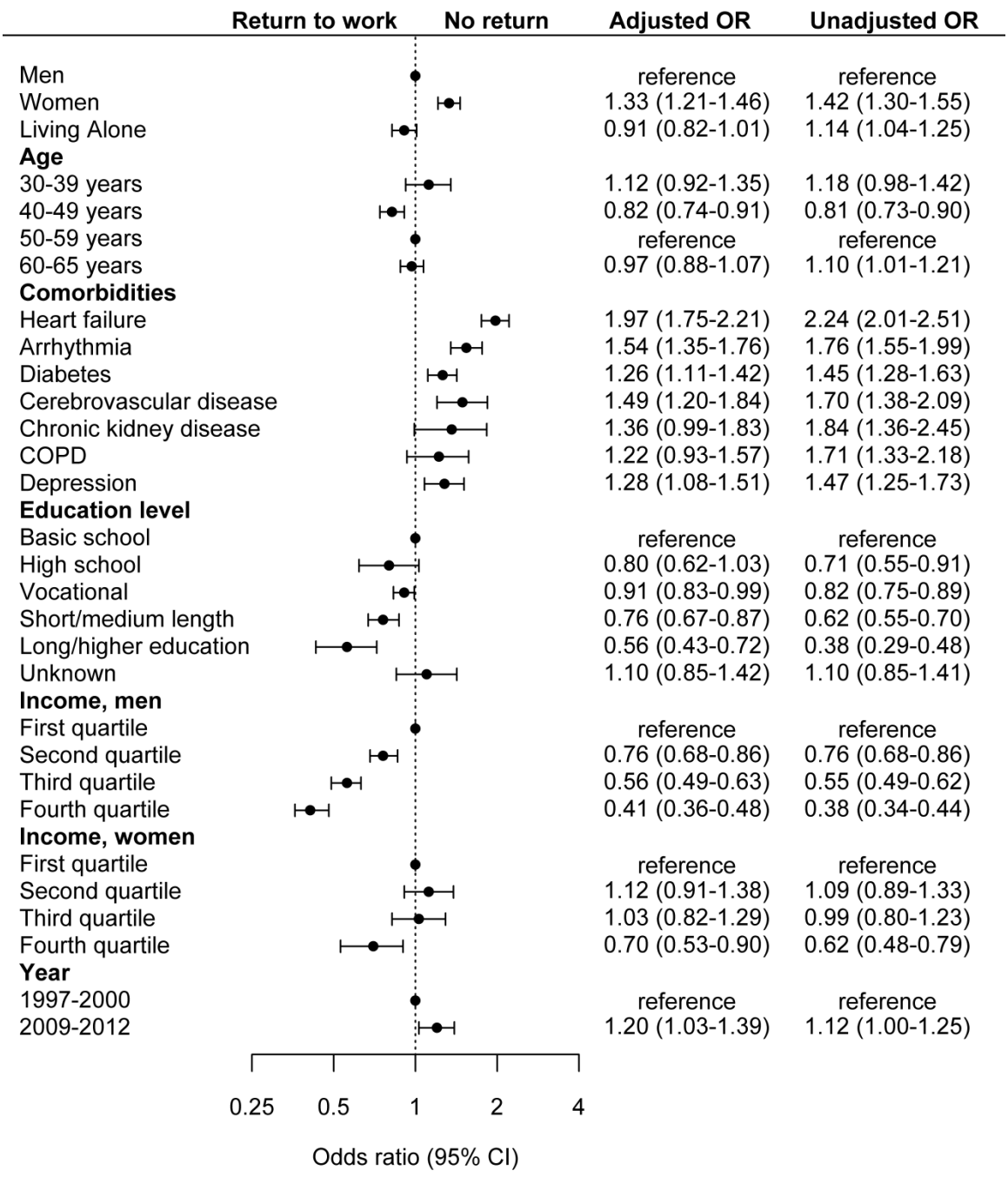
Comorbidities	Specification
Myocardial infarction	ICD8*: 410 (only to exclude prior myocardial infarction) ICD10: 121
Heart failure (including cardiomyopathy and lung edema)	ICD8: 42709-42711, 42719,42899,78249, 514,425 ICD10: I42, I50, I110, J81
Arrhythmias	ICD8: 4273-4276, 42793-42794 ICD10: Z950, I46-I49
Diabetes	ICD8: 249-250 ICD10: E10-E14 ATC †: A10
Chronic kidney disease	ICD8: 581-585 ICD10: 12-13, N03-N07, N08, N11, N14, N18, N25-N26, N28-N29, N158-N160, N162-164, N168, Z992, E102, E112, E132, E42
Chronic obstructive pulmonary disease	ICD8: 490-492 ICD10: J42, J44
Cerebrovascular disease	ICD8: 430-438 ICD10: G45-G46, H34, I60-I69
Depression	ICD8: 29609, 30049 ICD10: F32, F33 ATC: N06
*ICD; International classification of disease †ATC; Anatomical Therapeutic Chemical Classification	

Figure S1. Flowchart of study population.



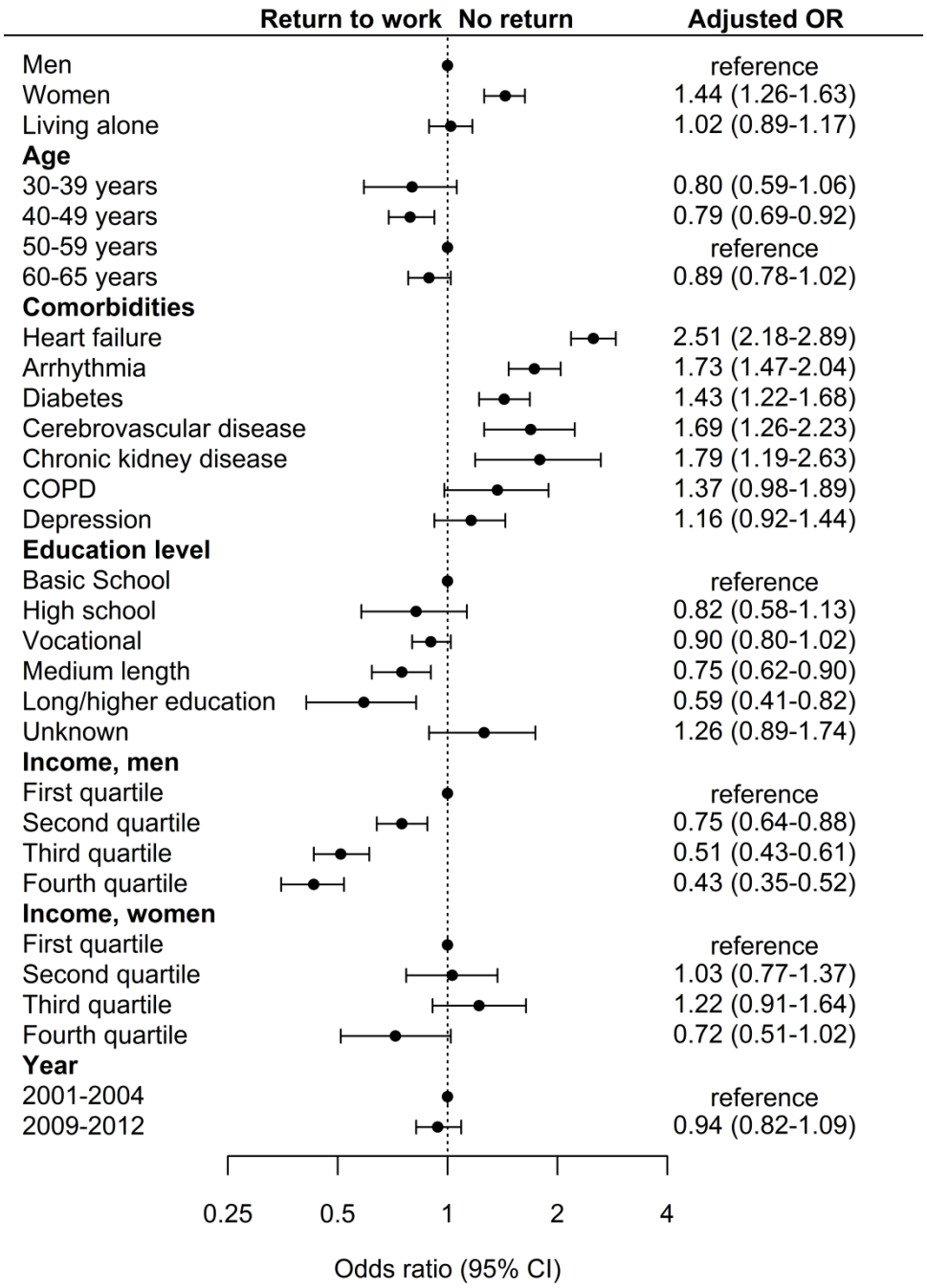
MI; myocardial infarction.

Figure S2. Risk factors associated with not returning to work when only patients who maintained employment for at least three consecutive months were considered as having returned to work.



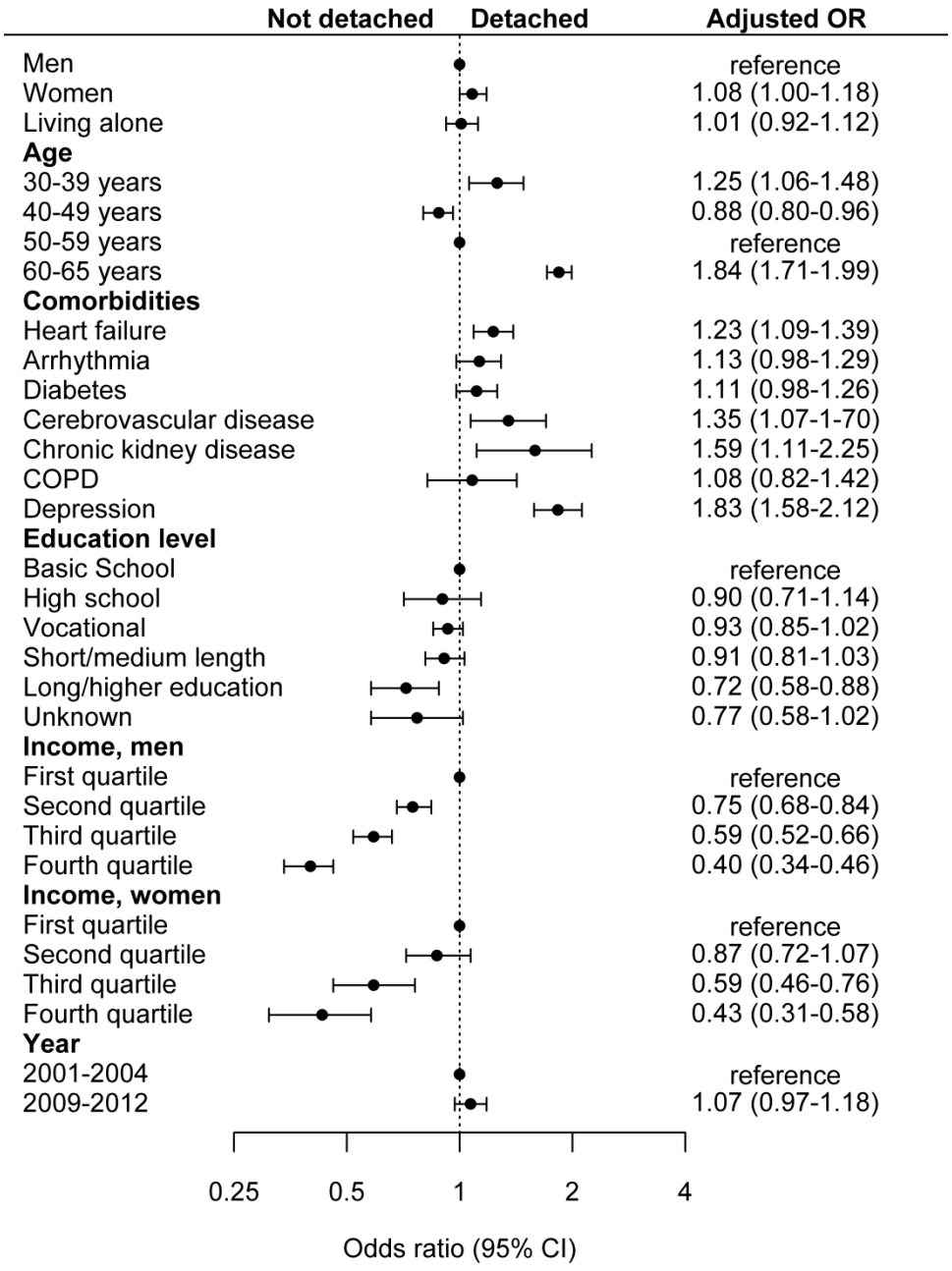
Estimates for age and sex were adjusted for comorbidities (heart failure, arrhythmia, diabetes, cerebrovascular disease, chronic kidney disease, chronic obstructive pulmonary disease [COPD], and depression), education level, income, time periods, and invasive coronary procedures. Other estimates in the figure were adjusted for age modelled as a restricted cubic spline, sex-based income, comorbidities education level, time periods, and invasive coronary procedures. OR; Odds ratio. CI; Confidence interval.

Figure S3. Risk factors associated with not returning to work where patients admitted before 2001 were excluded from the analysis.



Estimates for age and sex were adjusted for comorbidities (heart failure, arrhythmia, diabetes, cerebrovascular disease, chronic kidney disease, chronic obstructive pulmonary disease [COPD], depression), education level, income, time periods, and invasive coronary procedures. Other estimates in the figure were adjusted for age modelled as a restricted cubic spline, sex-based income, comorbidities, education level, time periods, and invasive coronary procedures. OR; Odds ratio. CI; Confidence interval.

Figure S4. Risk factors associated with detachment from employment where patients admitted before 2001 were excluded from the analysis.



The odds ratios (ORs) with 95% confidence intervals (CIs) are displayed on a logarithmic scale. The estimates were based on detachment from employment of at least one month. Estimates for age and sex were adjusted for comorbidities (heart failure, arrhythmia, diabetes, cerebrovascular disease, chronic kidney disease, chronic obstructive pulmonary disease [COPD], and depression), education level, income, time periods, and invasive coronary procedures. Other estimates in the figure were adjusted for age modelled as a restricted cubic spline, sex-based income, comorbidities, education level, time periods, and invasive coronary procedures.

Return to Work and Risk of Subsequent Detachment From Employment After Myocardial Infarction: Insights From Danish Nationwide Registries

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