Circulation: Cardiovascular Quality and Outcomes

ORIGINAL ARTICLE

Adverse Change in Employment Status After Acute Myocardial Infarction

Analysis From the TRANSLATE-ACS Study

See Editorial by Dreyer and Dickson

Haider J. Warraich, MD
Lisa A. Kaltenbach, MS
Gregg C. Fonarow, MD
Eric D. Peterson, MD, MPH
Tracy Y. Wang, MD, MHS, MSc

BACKGROUND: Inability to resume employment after acute myocardial infarction (MI) has important implications for patients. We sought to assess the prevalence of and outcomes associated with adverse change in employment after MI in a national US cohort.

METHODS AND RESULTS: The TRANSLATE-ACS study (Treatment with Adenosine Diphosphate Receptor Inhibitors: Longitudinal Assessment of Treatment Patterns and Events after Acute Coronary Syndrome) assessed employment status at baseline and 1 year among 9319 patients with MI (mean age, 60.8 years; SD, 11.3; 27.3% women) enrolled at 233 US hospitals. We defined adverse change in employment as patients working at baseline but working less or not working at 1-year post-MI. In multivariable models, we assessed factors associated with adverse change in employment and its association with patient-reported depression, health status, persistence to evidence-based medications prescribed at discharge, and financial hardship affording medications. Half of the patients (51%; n=4730) were employed at the time of MI. By 1 year, 10% (n=492) of these reported an adverse change in employment, with 3% (n=143) working less and 7% (n=349) no longer working (only 27 of 349 reported retirement). Factors significantly associated with adverse change in employment included a number of unplanned readmissions, postdischarge bleeding complications, hypertension, and smoking. At 1 year, patients with an adverse change in employment were more likely to report depression (Patient Health Questionnaire 2 score >3: 27.4% versus 16.7%), lower health status (mean EuroQoL visual analogue scale: 73 [SD, 17.8] versus 78 [SD, 14.8]), and moderate-extreme financial hardship with medication costs (41.0% versus 28.4%; all $P<0.001$). There was no difference in persistence to evidence-based medications prescribed at discharge.

CONCLUSIONS: Patients who experienced an adverse change in employment after MI reported lower quality of life, increased depression, and more difficulty affording medications. These results underscore the need for interventions to address this patient-centered outcome and its health impact.

CLINICAL TRIAL REGISTRATION: URL: https://www.clinicaltrials.gov. Unique identifier: NCT01088503.

Key Words: depression ■ employment ■ medication ■ adherence ■ myocardial infarction ■ quality of life

http://circoutcomes.ahajournals.org

WHAT IS KNOWN

- Clinical outcomes of acute myocardial infarction have experienced sustained improvement during the past several decades.
- Acute myocardial infarction, historically, has had a profoundly adverse experience on patients' ability to resume full employment.

WHAT THE STUDY ADDS

- In a more contemporary national US population, adverse change in employment only affects 1 in 10 patients after acute myocardial infarction.
- Bleeding after cardiac catheterization and unplanned rehospitalization are the factors most strongly associated with adverse change in employment after acute myocardial infarction.
- Patients who experience adverse change in employment have worse health status, depression, and hardship affording medications than patients who do not experience adverse change in employment.

Cardiovascular disease is the leading cause of morbidity and mortality in the United States,[1] and acute myocardial infarction (MI) accounts for a significant proportion of the disease burden of cardiovascular disease. Advances in prevention and treatment strategies have led to significant improvement in clinical outcomes and age-adjusted mortality from MI.[2] It remains unclear, though, whether similar progress has been achieved in outcomes that are particularly patient centric, such as the ability to maintain or return to employment.

Social determinants of health are strongly linked to the risk of human disease, with employment, or the lack thereof, being one of the most significant.[3] The risk of MI increases linearly with each cumulative job loss.[3] Single-center studies performed in the early percutaneous coronary intervention (PCI) era have shown that more than a third of patients with MI are unable to return to work by 1 year.[4,5] Job loss significantly interacts with other psychosocial factors, such as depression and health status; for example, depression can be both a cause and a consequence of an adverse change in employment.[6] Employment status may also influence medication-taking behavior and affordability.[7] However, the prevalence of adverse change in employment after MI and the association between post-MI job changes and psychosocial outcomes and medication-taking behavior have not been well investigated in a large representative US cohort.

Using data from the TRANSLATE-ACS registry (Treatment with Adenosine Diphosphate Receptor Inhibitors: Longitudinal Assessment of Treatment Patterns and Events after Acute Coronary Syndrome),[8] we assessed the prevalence of adverse change in employment between baseline and 1-year post-MI in a national US cohort. We compared patient-reported depression, quality of life, medication adherence, and financial hardship affording medications between patients who experienced an adverse change in employment and those who remained working at 1 year without an adverse change.

METHODS

Study Population

TRANSLATE-ACS is a longitudinal, observational registry of patients treated for acute MI at 2333 US hospitals between April 2010 and October 2012. Details of the design and conduct of the TRANSLATE-ACS study have been previously published.[8] (Data Supplement) Patients were included in the registry if they were ≥18 years of age presenting with ST-segment–elevation myocardial infarction (STEMI) or non-STEMI, treated with PCI and a P2Y12 inhibitor, were not enrolled in another research study, and were able to provide written consent for longitudinal telephonic follow-up and data collection. Study enrollment received institutional review board approval at each participating hospital. Of the total 12 365 patients enrolled in 233 US hospitals, we excluded patients who died in-hospital (n=14), did not have baseline (n=98), and 1-year employment status recorded (n=2934), resulting in a final study population of 9319 patients for this analysis.

Data Collection and Definitions

Detailed demographic, clinical, and angiographic characteristics, in-hospital laboratory values, and adverse outcomes (as shown in Table 1) were collected for all patients using a standardized set of data elements and definitions in accordance with those used by the National Cardiovascular Data Registry CathPCI Registry.[9] Centralized telephone follow-up was conducted by trained Duke Clinical Research Institute personnel for all enrolled patients at 6 weeks and 6, 12, and 15 months after discharge. At each interview, standardized questionnaires collected interval medication changes and patient-reported outcomes using validated instruments, as described in the Outcomes section below.[10,11]

Patients were asked about their work status at the 1-year interview. Those who reported working full-time or part-time were defined as working. We defined an adverse change in employment as patients who reported working immediately before the index MI hospitalization but were either no longer working or working fewer hours 1 year later. Patients no longer working at 1 year included those who report being laid off, disabled, on sick leave, retired, or unemployed for other or nonspecified reasons.

Hospital bills were collected for all subsequent hospital visits involving at least 1 overnight stay, including inpatient or observation status admission.[12] Medical records were collected to permit independent physician adjudication of recurrent MI, coronary revascularization procedures, stroke, and bleeding events occurring within 1-year post-MI. Unplanned readmissions were defined as any bill-confirmed hospital visit

Table 1. Differences in Characteristics and Outcomes Between Patients Working and Not Working at Baseline

	Not Working (n=4589)	Working (n=4730)	*P* Value
Demographics			
Age, y, mean (SD)	65.9 (11.0)	55.8 (9.2)	<0.001
Male sex	65.0 (2984)	80.3 (3796)	<0.001
White race	87.5 (4013)	90.3 (4269)	<0.001
Black race	9.7 (446)	6.5 (308)	<0.001
Hispanic race	3.0 (139)	3.3 (156)	0.46
Uninsured	12.3 (566)	13.7 (647)	0.063
High school or beyond	84.2 (3862)	93.0 (4397)	<0.001
Married	60.9 (2795)	70.3 (3327)	<0.001
Clinical characteristics			
Prior MI	23.9 (1095)	14.5 (684)	<0.001
Prior PCI	26.4 (1211)	16.0 (757)	<0.001
Prior CABG	13.5 (618)	4.9 (233)	<0.001
Prior CVA/TIA	8.0 (369)	2.5 (118)	<0.001
Peripheral artery disease	9.1 (417)	2.8 (130)	<0.001
Prior heart failure	8.1 (372)	1.9 (89)	<0.001
AFIB/flutter	7.0 (322)	2.3 (107)	<0.001
Diabetes mellitus	30.4 (1394)	19.9 (942)	<0.001
Hypertension	74.7 (3428)	58.7 (2777)	<0.001
Chronic lung disease	13.3 (610)	4.7 (222)	<0.001
Current/recent smoker	31.9 (1462)	38.7 (1828)	<0.001
In-hospital characteristics			
ST-elevation MI	46.9 (2151)	57.2 (2705)	<0.001
Cardiac arrest during admission	2.6 (120)	3.8 (178)	0.002
Cardiogenic shock during admission	1. 8 (83)	2.1 (101)	0.287
Multivessel disease	53.7 (2463)	44.9 (2125)	<0.001
Body mass index, mean (SD)	29.9 (6.7)	30.5 (6.2)	<0.001
Creatinine clearance, mean (SD)	65.8 (28.7)	82.47 (24.6)	<0.001
Ejection fraction, mean (SD)	50.5 (11.3)	51.4 (10.8)	<0.001
Length of stay, mean (SD)	3.2 (2.3)	2.9 (1.8)	<0.001
One-year postdischarge course			
Recurrent MI	5.5 (252)	2.5 (120)	<0.001
Unplanned revascularization	10.9 (502)	8.5 (401)	<0.001
Stroke	1.0 (44)	0.3 (15)	<0.001
BARC 2+ bleed	22.8 (1046)	18.3 (865)	<0.001
No. of all-cause unplanned hospitalizations, mean (SD)	0.0 (1.2)	0.4 (0.8)	<0.001

Values presented as % (n) or mean (SD) where indicated. AFIB indicates atrial fibrillation; BARC, Bleeding Academic Research Consortium; CABG, coronary artery bypass grafting; CVA, cerebrovascular accident; MI, myocardial infarction; PCI, percutaneous coronary intervention; and TIA, transient ischemic attack.

involving at least 1 overnight stay except for hospitalizations involving an adjudicated, planned coronary revascularization within 60 days of the index PCI.

Outcomes

Outcomes of interest included depression, self-rated health status, evidence-based medication (EBM) persistence,[13] patient-reported medication adherence,[14] and financial hardship associated with medication costs.[12] Depression and self-rated health status at baseline, 6 weeks, 6 months, and 1-year post-MI were compared between patients with and without adverse change in employment. Depression was defined as a Patient Health Questionnaire (PHQ) score-2 >3,[15] and health status was measured using the EuroQoL-5 Dimensions (EQ5D) visual analog scale (VAS).[11] As previously described, persistence was defined as percentage of patients still taking the EBMs prescribed at discharge at the 1-year interview.[13] These EBMs included aspirin, P2Y12 inhibitors, statins, β-blockers, and angiotensin-converting enzyme inhibitors/angiotensin receptor blockers. Consistent with prior work, patient-reported medication adherence was a summed score based on 3 questions asked during the 1-year interview[14]; the score ranged from 0 to 3 where 0 indicates optimal adherence: (1) do you sometimes forget heart medications? yes=1, no=0; (2) how often do you have difficulty remembering to take all your heart medications? never=0, all other answers=1; and (3) do you know what to do if you run out of medication? yes=0, no=1. Patients were asked to rank on a scale of 1 to 5 the financial hardship of their monthly medication cost (1=no hardship, 2=minimal hardship, 3=moderate hardship, 4=much hardship, 5=extreme hardship). Financial hardship was defined as a score >2.

Statistical Analysis

We compared patient characteristics between patients working at baseline and not working at baseline, and then among those working at baseline, those with and without an adverse change in employment by 1 year. Categorical variables were presented as frequencies (percentages), and differences between the groups were assessed using the χ^2 test. Continuous variables are presented as mean with SD and were compared using the Wilcoxon rank-sum test. Changes in depression and EQ5D VAS over time were compared among patients who experienced adverse change in employment, patients who retained employment, and patients who were not employed or retired at baseline. We calculated *P* trends for changes in EQ5D VAS and PHQ2 >3 over time from baseline to 6 months to 1-year post-MI.

We used logistic regression to assess factors associated with adverse change in employment status at 1-year postdischarge. The variable list, adapted from prior research based on clinical judgment,[4,16–18] included the following variables: age, sex, race, Hispanic ethnicity, insurance status, education level, marital status, diabetes mellitus, hypertension, smoking, body mass index, prior MI, prior PCI, prior coronary artery bypass graft surgery, prior stroke/transient ischemic attack, peripheral arterial disease, atrial fibrillation/flutter, chronic lung disease, STEMI, multivessel disease, multivessel PCI, creatinine clearance, ejection fraction ≤40%, length of index stay, presentation or in-hospital development of heart failure signs/symptoms, cardiac arrest, cardiogenic shock, baseline PHQ2 >3, baseline EQ5D VAS, postdischarge events within 1 year (recurrent MI, unplanned revascularization, stroke, Bleeding Academic Research Consortium 2+ bleeding), and number of

all-cause unplanned rehospitalizations. We used generalized estimating equations with exchangeable correlation structure to account for within-hospital clustering. We calculated a C-index to assess how well this model discriminated between patients with and without an adverse change in employment.

We used a similar methodology to assess the association of adverse change in employment with 1-year depression, EBM persistence, medication adherence, and financial hardship affording medications. Each model adjusted for the following variables: age, sex, race, body mass index, STEMI, prior MI, diabetes mellitus, hypertension, smoker, number of unplanned rehospitalizations in first year, Bleeding Academic Research Consortium 2+ bleeding in first year, number of meds reported at 1 year (of aspirin, P2Y12 inhibitor, statin, β-blocker, angiotensin-converting enzyme inhibitors/angiotensin receptor blockers), baseline EQ5D VAS, and baseline PHQ2. Adjusting for these same variables, we assessed the association of adverse change in employment with 1-year EQ5D VAS using linear regression with generalized estimating equations.

Variables inputted into the model were missing <5%. To account for missing data, categorical variables were imputed to the mode, creatinine clearance, and ejection fraction was imputed using medians, and body mass index was imputed using sex and STEMI versus non-STEMI–specific medians. We did not impute clinical outcomes. In all instances, $P<0.05$ was considered statistically significant. All analyses were performed with SAS version 9.2 (Cary, NC).

RESULTS

In the final study population of 9319 patients, the mean age was 55.8 years (SD, 9.2) and 27.3% were women; more than half (n=4730; 51%) were working at the time of their index MI (Figure 1). Patients not working at baseline were more likely to be older, black, women, unmarried, and not have graduated high school (Table 1). They were more likely to have medical comorbidities than patients who were working. Most patients not working at baseline were retired (n=3355; 73%). Patients working at baseline were more likely to smoke and to present with STEMI or have a cardiac arrest during the index MI hospitalization.

Changes in Work Status

Among patients working at baseline, 10% (n=492) reported an adverse change in employment 1 year later, with 7% (n=349) no longer working whereas 3% (n=143) reported working less (Figure 1). Only 27 of those with an adverse change in employment reported retirement; 172 patients (49% of patients no longer working) reported involuntary job loss, such as being laid off or no longer working because of their health and disability.

Patients who experienced an adverse change in employment post-MI were more likely to be women, have diabetes mellitus, hypertension, tobacco use, and were less likely to have a drug-eluting stent placed than patients who continued working as before (Table 2). Patients with an adverse change in employment were more likely to have recurrent MI, unplanned revascularization, stroke, and Bleeding Academic Research Consortium 2+ bleeding than patients who were still working (Table 2).

In multivariable analysis, the strongest factor associated with adverse change in employment in the 1 year after discharge was the number of readmissions within the first year (odds ratio, 1.20; 95% confidence interval, 1.09–1.32 per event). Other factors significantly associated with adverse change in employment include baseline smoking status, hypertension, and postdischarge bleeding (Table 3). Notably, factors, such as sex, baseline health status, and recurrent MI, were significant in unadjusted comparisons but did not remain significantly associated with adverse change in employment in the multivariable model.

Outcomes

Patients experiencing an adverse change in employment were more likely to have depression at baseline compared with those experiencing no change (6.5% versus 4.5%; $P=0.04$); these differences widened at 6 weeks (22.4% versus 19.2%; $P=0.1$), 6 months

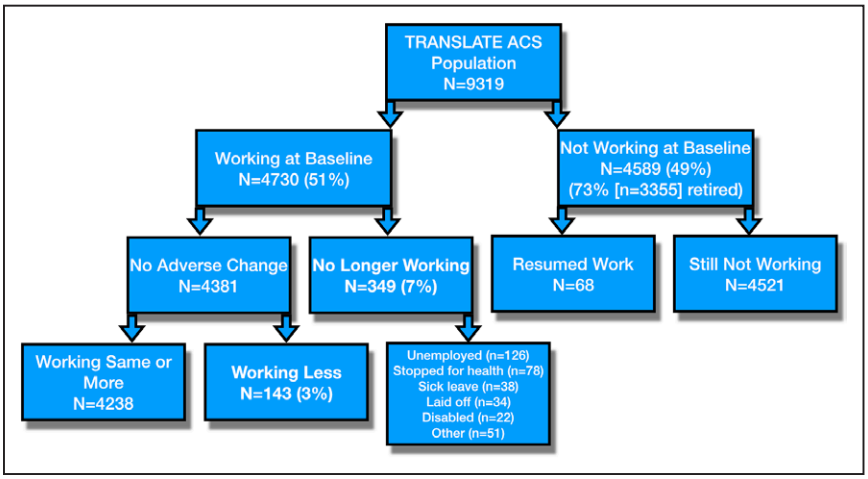


Figure 1. Distribution of patients by baseline employment status and change after myocardial infarction.
TRANSLATE-ACS indicates Treatment with Adenosine Diphosphate Receptor Inhibitors: Longitudinal Assessment of Treatment Patterns and Events after Acute Coronary Syndrome.

Table 2. Differences in Characteristics and Outcomes Between Patients With or Without Adverse Change in Employment Within 1-Year Postdischarge

	No Adverse Change (n=4238)	Adverse Change (n=492)	*P* Value
Demographics			
Age, y, mean (SD)	55.8 (9.3)	56.05.7 (8.7)	0.940
Male sex	80.9 (3427)	75.0 (369)	0.002
White race	90.4 (3832)	88.8 (437)	0.189
Black race	6.4 (269)	7.9 (39)	0.183
Hispanic race	3.3 (141)	3.1 (15)	0.735
Uninsured	13.5 (571)	15.5 (76)	0.258
High school or beyond	92.3 (3935)	93.9 (462)	0.870
Married	70.8 (2999)	66.7 (328)	0.057
Clinical characteristics			
Prior MI	14.4 (608)	15.5 (76)	0.511
Prior PCI	15.9 (672)	17.3 (85)	0.416
Prior CABG	4.9 (206)	5.5 (27)	0.543
Prior CVA/TIA	2.4 (103)	3.1 (15)	0.402
Peripheral artery disease	2.7 (113)	3.5 (17)	0.311
Prior heart failure	1.8 (76)	2.6 (13)	0.190
AFIB/flutter	2.3 (99)	1.6 (8)	0.318
Diabetes mellitus	19.4 (823)	24.2 (119)	0.012
Hypertension	57.8 (2451)	66.3 (326)	0.0003
Chronic lung disease	4.7 (200)	4.5 (22)	0.806
Current/recent smoker	38.1 (1615)	43.3 (213)	0.025
In-hospital characteristics			
ST-elevation MI	57.0 (2417)	58.5 (288)	0.523
Cardiac arrest on admission	3.8 (162)	3.3 (16)	0.510
Cardiogenic shock	2.2 (92)	1.8 (9)	0.604
Multivessel disease	44.8 (1900)	45.7 (225)	0.831
Multivessel PCI	9.8 (414)	9.2 (45)	0.652
Drug-eluting stent used	75.1 (3184)	69.9 (344)	0.010
Body mass index, mean (SD)	30.4 (6.0)	31.1 (7.1)	0.084
Creatinine clearance, mean (SD)	82.6 (24.5)	81.8 (25.8)	0.315
Ejection fraction, mean (SD)	51.4 (10.7)	50.9 (11.5)	0.652
Length of stay, d, mean (SD)	2.9 (1.8)	3.0 (1.7)	0.114
EQ5D VAS Score, mean (SD)	73.5 (17.5)	70.7 (19.7)	0.013
PHQ2 >3	4.5 (189)	6.5 (32)	0.042
One-year postdischarge course			
Recurrent MI within 1 y	2.2 (91)	5.9 (29)	<0.001
Unplanned revascularization within 1 y	7.9 (333)	13.8 (68)	<0.001
Stroke within 1 y	0.3 (11)	0.8 (4)	0.039
BARC 2+ bleed within 1 y	17.6 (745)	24.4 (120)	<0.001
No. of unplanned hospitalizations, mean (SD)	0.4 (0.8)	0.6 (1.1)	<0.001

Values presented as % (n) or mean (SD) where indicated. AFIB indicates atrial fibrillation; BARC, Bleeding Academic Research Consortium; CABG, coronary artery bypass grafting; CVA, cerebrovascular accident; EQ5D, EuroQoL-5 Dimensions; MI, myocardial infarction; PHQ, Patient Health Questionnaire; PCI, percutaneous coronary intervention; TIA, transient ischemic attack; and VAS, visual analog scale.

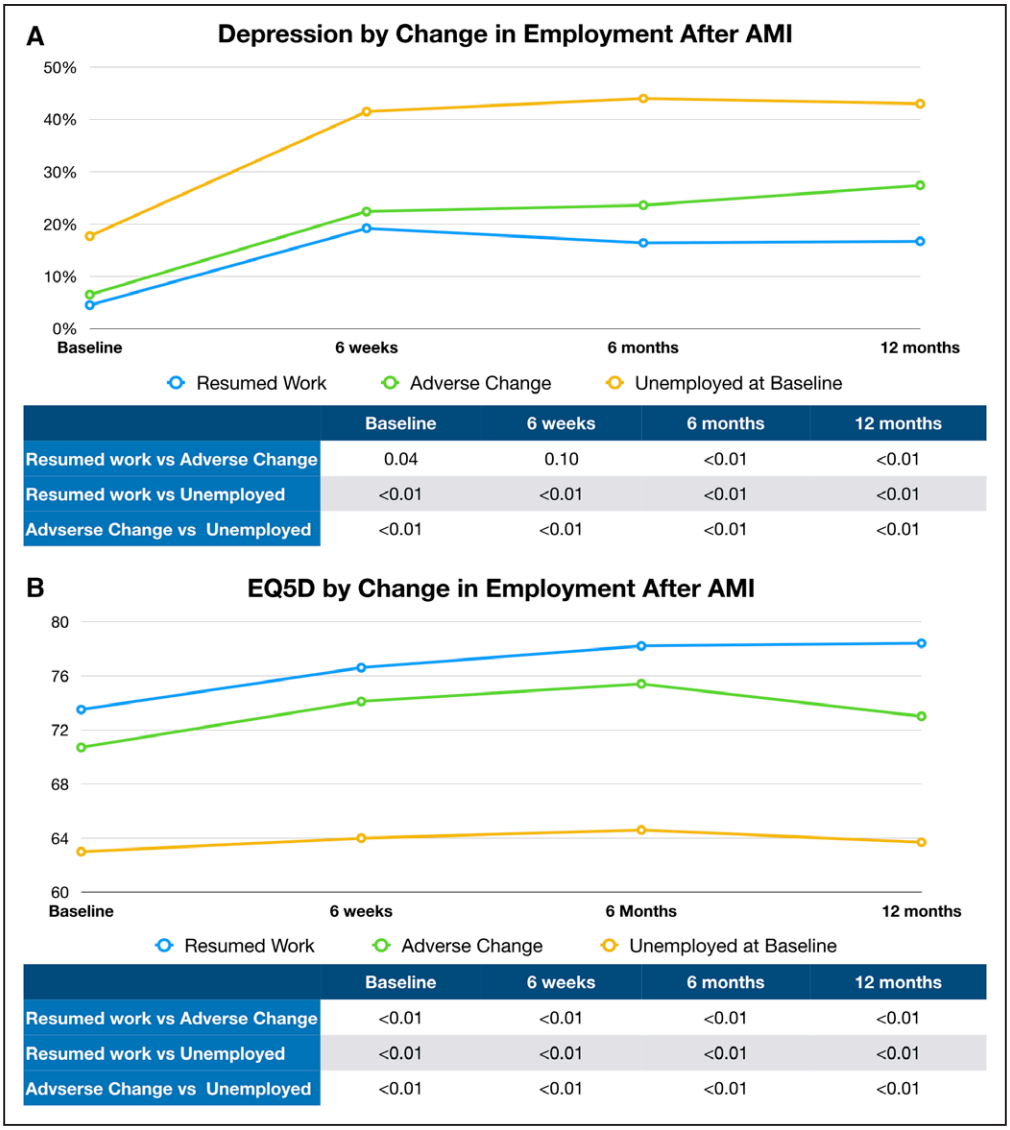
Table 3. Factors Associated With Adverse Change in Employment Status at 1 Year

	Adjusted		
Parameter	OR (95% CI)	Wald χ^2 Test Statistic	*P* Value
No. of unplanned readmissions per 1 increase	1.20 (1.09–1.32)	13.20	0.0003
BARC 2+ bleed within 1 y	1.39 (1.13–1.72)	9.34	0.0022
Hypertension	1.33 (1.08–1.65)	7.12	0.0076
Smoker	1.28 (1.04–1.57)	5.28	0.0215
Recurrent MI within 1 y	1.64 (0.99–2.71)	3.64	0.0563
Female vs male	1.23 (0.98–1.56)	3.15	0.0757
BMI per 5 increase	1.07 (0.99–1.16)	3.07	0.0798
Baseline EQ5D VAS per 10 U decrease	1.04 (0.99–1.10)	2.83	0.0927
Unplanned revascularization within 1 y	1.30 (0.95–1.79)	2.65	0.1038

Factors with $P \leq 0.1$ shown. Additional nonsignificant parameters included stroke within 1 year, EF <40%, insurance status, chronic lung disease, atrial fibrillation, STEMI vs NSTEMI, cardiac arrest, ethnicity, education, creatinine clearance, age, diabetes mellitus, marital status, cardiogenic shock, prior CABG, multivessel PCI, prior stroke/transient ischemic attack, any heart failure, peripheral arterial disease, prior MI, multivessel disease, length of stay, and prior PCI. Adjusted model C-index=0.63. BARC indicates Bleeding Academic Research Consortium; BMI, body mass index; CABG, coronary artery bypass grafting; CI, confidence interval; EF, ejection fraction; EQ5D, EuroQoL-5 Dimensions; NSTEMI, non–ST-segment–elevation myocardial infarction; OR, odds ratio; PCI, percutaneous coronary intervention; STEMI, ST-segment–elevation myocardial infarction; and VAS, visual analog scale.

(23.6% versus 16.4%; $P<0.001$), and 1 year (27.4% versus 16.7%; $P<0.001$; Figure 2A) in part because of observed improvement among patients who resumed work. The difference in depression over time was significant between patients who experienced an adverse change in employment and those who resumed work: $P<0.001$. Patients not working at baseline, not retired, and who did not resume working at 1 year had significantly higher rates of depression throughout the study period. Patients with an adverse change in employment also had lower self-rated health status (EQ5D VAS) than those not experiencing any adverse change (70.7 [SD, 19.7] versus 73.5 [SD, 17.5] at baseline, 74.1 [SD, 16.2] versus 76.7 [SD, 15.3] at 6 weeks, 75.4 [SD, 15.8] versus 78.2 [SD, 15.0] at 6 months, 73.0 [SD, 17.8] versus 78.4 [SD, 14.8] at 1 year; all $P \leq 0.01$; Figure 2B). Patients not working at baseline, not retired, and who did not resume working at 1 year had significantly poorer EQ5D VAS scores throughout the study period. Change in EQ5D VAS score over time was significant only for patients working at baseline with no adverse change within the next year ($P<0.001$); these patients experienced improvement in quality of life over time.

At 1 year, patients with adverse changes in employment were more likely to have PHQ2 score >3 suggestive of depression and lower EQ5D VAS scores suggestive of lower quality of life in both unadjusted



	Baseline	6 weeks	6 months	12 months
Resumed work vs Adverse Change	0.04	0.10	<0.01	<0.01
Resumed work vs Unemployed	<0.01	<0.01	<0.01	<0.01
Advserse Change vs Unemployed	<0.01	<0.01	<0.01	<0.01

	Baseline	6 weeks	6 months	12 months
Resumed work vs Adverse Change	<0.01	<0.01	<0.01	<0.01
Resumed work vs Unemployed	<0.01	<0.01	<0.01	<0.01
Advserse Change vs Unemployed	<0.01	<0.01	<0.01	<0.01

Figure 2. Change in (A) depression (Patient Health Questionnaire [PHQ] 2 >3) and (B) self-rated health status (EuroQoL-5 Dimensions [EQ5D] visual analog scale) after myocardial infarction among patients by employment status change. *P* values show significance of differences in PHQ2 >3 among patient groups at baseline and follow-up. AMI indicates acute myocardial infarction.

and adjusted comparisons (Table 4). No difference was noted in patient-reported medication adherence or in persistence of EBMs prescribed at discharge. However, more patients who had adverse change in employment reported moderate-extreme financial hardship with out of pocket medication costs than those without change in work status after adjustment for clinical and sociodemographic characteristics (Table 4).

DISCUSSION

This study sheds novel insights into patients' ability to return to work after MI. We found that 1 in 10 patients working at baseline had an adverse change in employment at 1 year; 7% were unable to return to work, and 3% worked less. Almost half of the job losses were described by the patient as involuntary. An adverse change in employment was associated with increased risk of depression, lower self-rated health status, and increased financial hardship associated with affording medications. These findings have important implications for patient-centered care for patients with MI.

A key finding of this analysis is the low rate of adverse change in employment after MI. Improvements in treatments for MI, in addition to causing dramatic reductions in total and age-adjusted mortality after MI, have also resulted in significant improvements in patient functionality after MI. We hypothesize that advances in MI care have also resulted in improvement in patients' ability to resume employment. In comparison with prior literature, we now

Table 4. Outcomes at 1 Year

	Unadjusted			Adjusted
	Adverse Employment Change (n=492)	No Adverse Change (n=4238)	*P* Value	HR (95% CI)
PHQ2 depression score >3	27.4%	16.7%	<0.001	1.60 (1.27 to 2.02)
EQ5D VAS	73 (17.8)	78 (14.8)	<0.001	–3.23 (–4.73 to 1.74)*
Medication adherence	68.0%	70.6%	0.226	1.15 (0.93 to 1.41)
Medication persistence				
P2Y12 inhibitors	86.1%	88.2%	0.185	0.88 (0.68 to 1.14)
Aspirin	95.3%	96.3%	0.239	0.86 (0.53 to 1.40)
Statins	86.1%	88.3%	0.178	0.87 (0.67 to 1.13)
β-Blockers	86.0%	87.0%	0.565	0.91 (0.70 to 1.17)
ACE inhibitor/ARB	78.0%	81.4%	0.116	0.80 (0.63 to 1.02)
Moderate/extreme financial hardship with medication costs	41.0%	28.4%	<0.001	1.57 (1.33 to 1.87)

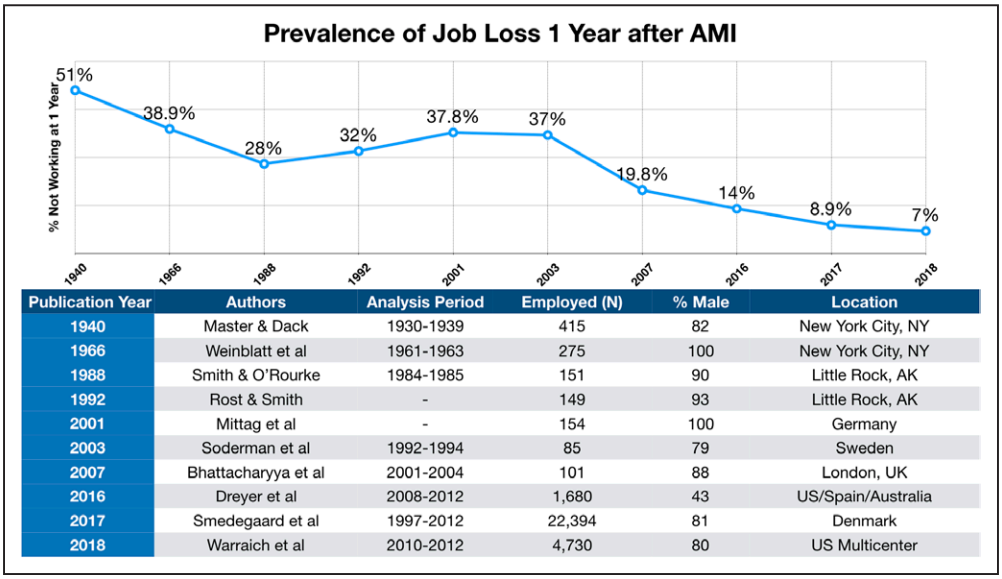
Continuous variables expressed as mean (SD). Adjusted for age, sex, race, BMI, MI type, prior MI, diabetes mellitus, hypertension, smoking, unplanned rehospitalizations in first year, BARC 2+ bleeding in first year, number of medications reported at 1 year, baseline EQ5D VAS, baseline PHQ2.

ACE indicates angiotensin-converting enzymes; ARB, angiotensin receptor blocker; BARC, Bleeding Academic Research Consortium; BMI, body mass index; CI, confidence interval; EQ5D, EuroQoL-5 Dimensions; HR, hazard ratio; MI, myocardial infarction; PHQ, Patient Health Questionnaire; and VAS, visual analog scale.

*Linear regression results expressed as estimate (95% CI).

observe a substantially lower rate of job loss within 1 year after MI.[4,5,16–22] In fact, our study demonstrates the lowest rate of adverse change in employment at 1 year among patients with MI to date (Figure 3). These findings thus represent commendable translation of clinical outcomes into patient-centered measures, representing additional crucial protection for patients from the financial hardship associated with medical care. However, this progress must not deter efforts to target patients who are at high risk for job loss with psychosocial and occupational interventions during the initial episode of care for MI. In our study, factors that were associated with the greatest chance of work loss were unplanned hospitalizations, bleeding, hypertension, and smoking status. Finally, similar to prior studies, we demonstrate that patients unemployed at baseline are at risk for poorer outcomes after MI.[3]

Depression occurs commonly after MI, and our data suggest that an adverse change in employment is associated with higher rates of depression. Rates of depression increase after MI for all patient groups, however, patients able to resume work actually demonstrate a reduction in rates of depression while those who are unable to



Publication Year	Authors	Analysis Period	Employed (N)	% Male	Location
1940	Master & Dack	1930-1939	415	82	New York City, NY
1966	Weinblatt et al	1961-1963	275	100	New York City, NY
1988	Smith & O'Rourke	1984-1985	151	90	Little Rock, AK
1992	Rost & Smith	-	149	93	Little Rock, AK
2001	Mittag et al	-	154	100	Germany
2003	Soderman et al	1992-1994	85	79	Sweden
2007	Bhattacharyya et al	2001-2004	101	88	London, UK
2016	Dreyer et al	2008-2012	1,680	43	US/Spain/Australia
2017	Smedegaard et al	1997-2012	22,394	81	Denmark
2018	Warraich et al	2010-2012	4,730	80	US Multicenter

Figure 3. Prevalence of job loss at 1 y after myocardial infarction.
Review of historical literature that reported prevalence of job loss at 12 mo after acute myocardial infarction (AMI).[4,5,16–22]

resume work see a continuously rising trend in prevalence of depression. Rates of depression in patients unable to resume work begin to approach those who are unemployed and not retired at baseline by 1 year.[3] Furthermore, patients with depression remain at high risk for losing employment even after they return to work. In a recently published nationwide study from Denmark analyzing factors associated with inability to maintain work after, despite resumption of work within a 1-year post-MI, depression was the strongest predictor of subsequent detachment from work.[22] In our analysis, however, although depression was slightly higher at baseline among patients who experienced adverse change in employment (6.5% versus 4.5%; *P*=0.04), depression was not a significant predictor of adverse change in our adjusted model.

Patients who experience an adverse change in employment also experience poorer quality of life. Self-rated health, in addition to reflecting a poor sense of physical and emotional well being, is also a sensitive marker of adverse clinical outcomes and is associated with increased mortality.[23] Although self-rated health improved steadily for patients, who resumed work (*P* trend <0.001), it did not do so for patients unemployed at baseline or who were unable to resume work (*P* trend nonsignificant). These outcomes become increasingly important given their importance to patients and improvements in clinical outcomes, such as mortality.

These associations underscore the importance of this patient-centered outcome and raise several questions. Can we predict or prevent adverse changes in employment? Our data suggest that the factor most strongly associated with job loss was unplanned readmissions. Prevention of post-MI readmission has been the focus of national quality improvement initiatives in recent years.[24] Patients who experienced a bleeding complication also had a higher likelihood of experiencing adverse change in employment. Risk scores to identify patients at high risk of bleeding have been proposed to assist in antiplatelet medication selection and long-term management.[25,26] Treating depression in patients post-MI has been known to lower depression and improve quality of life, but not cardiovascular outcomes, and it remains unknown whether behavioral or pharmacotherapeutic interventions result in an improved ability to return to work.[27]

Unemployment is known to reduce medication adherence,[28] another important factor affecting outcomes in patients after MI.[29] In our study, we examined medication taking in 2 ways: persistence assesses both clinician and patient continuation of EBMs, whereas adherence describes the patient's medication-taking behavior. Although adverse change in employment did not result in a significant difference in medication persistence or adherence in our study, we did find increased financial hardship reported among those whose work status was adversely affected. Financial hardship associated with medications has been shown in prior studies to lead to reduced long-term adherence and worse medical outcomes among post-MI patients.[30]

Our study has several limitations. The precise timing of work loss/reduction could not be analyzed. Unmeasured factors may contribute to adverse change in employment. Medication adherence was patient self-reported based on a questionnaire and may be overestimated. Although financial hardship was assessed, specific impact of adverse change in employment on household income could not be examined as ≈43% of patients declined to provide information about income level. Income levels are poorly reported in many observational studies and can be weighted toward both patients with high or low socioeconomic status.[31] Given the observational nature of this study, we cannot make inferences on causality when examining outcomes. Last, we included patients who retired (n=27) into those experiencing as adverse change in employment given that health shocks, such as MI, are associated with early retirement decisions.[32,33]

In conclusion, our study shows the lowest levels of job loss in the context of prior studies of patients with MI . However, almost half of job losses were involuntary. Patients who experience an adverse change in employment are at increased risk of depression, lower quality of life, and increased financial hardship with medication costs compared with those who continue working. Unplanned rehospitalizations and post-MI bleeding are the strongest predictors of adverse change in employment, increasing the impetus to reduce the incidence of these adverse outcomes. These results underscore the need for interventions to address this patient-centered outcome and its health impact.

ARTICLE INFORMATION

Received December 20, 2017; accepted April 20, 2018.

The Data Supplement is available at http://circoutcomes.ahajournals.org/lookup/suppl/doi:10.1161/CIRCOUTCOMES.117.004528/-/DC1.

Correspondence

Haider J. Warraich, MD, Division of Cardiology, Department of Medicine, Duke University Medical Center, 2301 Erwin Rd, 3485 Durham, NC 27710. E-mail haider.warraich@duke.edu

Affiliations

Division of Cardiology, Department of Medicine, Duke University Medical Center, Durham, NC (H.J.W., E.D.P., T.Y.W.). Duke Clinical Research Institute, Durham, NC (H.J.W., L.A.K., E.D.P., T.Y.W.). Cardiology Division, Department of Medicine, University of California Los Angeles (G.C.F.).

Sources of Funding

The TRANSLATE-ACS (Treatment With Adenosine Diphosphate Receptor Inhibitors: Longitudinal Assessment of Treatment Patterns and Events After Acute Coronary Syndrome; NCT01088503) registry was sponsored by Daiichi Sankyo, Inc and Lilly USA. The Duke Clinical Research Institute is the coordinating center for this study, which represents a collaborative effort with the American College of Cardiology. This analysis was funded, in part, by a U01HL107023 grant from the National Heart, Lung, and Blood Institute.

Disclosures

Dr Fonarow reports being a consultant to Eli Lilly, Novartis, and Janssen. Dr Peterson reports grant support from American College of Cardiology, American Heart Association, and Janssen; and consulting from Bayer, Boehringer Ingelheim, Merck, Valeant, Sanofi, Astra Zeneca, Janssen, Regeneron, and Genentech. Dr Wang reports research funding from AstraZeneca, Gilead, Lilly, The Medicines Company, National Institutes of Health, and Canyon Pharmaceuticals (all significant); educational activities or lectures (generates money for Duke) for AstraZeneca (modest); consulting (including continuing medical education) for Medco (modest); and American College of Cardiology (significant). The other authors report no conflicts.

REFERENCES

1. Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, Das SR, de Ferranti S, Després JP, Fullerton HJ, Howard VJ, Huffman MD, Isasi CR, Jiménez MC, Judd SE, Kissela BM, Lichtman JH, Lisabeth LD, Liu S, Mackey RH, Magid DJ, McGuire DK, Mohler ER 3rd, Moy CS, Muntner P, Mussolino ME, Nasir K, Neumar RW, Nichol G, Palaniappan L, Pandey DK, Reeves MJ, Rodriguez CJ, Rosamond W, Sorlie PD, Stein J, Towfighi A, Turan TN, Virani SS, Woo D, Yeh RW, Turner MB; Writing Group Members; American Heart Association Statistics Committee; Stroke Statistics Subcommittee. Heart disease and stroke statistics-2016 update: a report from the American Heart Association. *Circulation*. 2016;133:e38–e360. doi: 10.1161/CIR.0000000000000350.
2. Yeh RW, Sidney S, Chandra M, Sorel M, Selby JV, Go AS. Population trends in the incidence and outcomes of acute myocardial infarction. *N Engl J Med*. 2010;362:2155–2165. doi: 10.1056/NEJMoa0908610.
3. Dupre ME, George LK, Liu G, Peterson ED. The cumulative effect of unemployment on risks for acute myocardial infarction. *Arch Intern Med*. 2012;172:1731–1737. doi: 10.1001/2013.jamainternmed.447.
4. Mittag O, Kolenda KD, Nordman KJ, Bernien J, Maurischat C. Return to work after myocardial infarction/coronary artery bypass grafting: patients' and physicians' initial viewpoints and outcome 12 months later. *Soc Sci Med*. 2001;52:1441–1450.
5. Söderman E, Lisspers J, Sundin O. Depression as a predictor of return to work in patients with coronary artery disease. *Soc Sci Med*. 2003;56:193–202.
6. Andreeva E, Magnusson Hanson LL, Westerlund H, Theorell T, Brenner MH. Depressive symptoms as a cause and effect of job loss in men and women: evidence in the context of organisational downsizing from the Swedish Longitudinal Occupational Survey of Health. *BMC Public Health*. 2015;15:1045. doi: 10.1186/s12889-015-2377-y.
7. Kronish IM, Rieckmann N, Burg MM, Alcántara C, Davidson KW. The psychosocial context impacts medication adherence after acute coronary syndrome. *Ann Behav Med*. 2014;47:158–164. doi: 10.1007/s12160-013-9544-0.
8. Chin CT, Wang TY, Anstrom KJ, Zhu B, Maa JF, Messenger JC, Ryan KA, Davidson-Ray L, Zettler M, Effron MB, Mark DB, Peterson ED. Treatment with adenosine diphosphate receptor inhibitors-longitudinal assessment of treatment patterns and events after acute coronary syndrome (TRANSLATE-ACS) study design: expanding the paradigm of longitudinal observational research. *Am Heart J*. 2011;162:844–851. doi: 10.1016/j.ahj.2011.08.021.
9. Moussa I, Hermann A, Messenger JC, Dehmer GJ, Weaver WD, Rumsfeld JS, Masoudi FA. The NCDR CathPCI Registry: a US national perspective on care and outcomes for percutaneous coronary intervention. *Heart*. 2013;99:297–303. doi: 10.1136/heartjnl-2012-303379.
10. Morisky DE, Ang A, Krousel-Wood M, Ward HJ. Predictive validity of a medication adherence measure in an outpatient setting. *J Clin Hypertens (Greenwich)*. 2008;10:348–354.
11. Ellis JJ, Eagle KA, Kline-Rogers EM, Erickson SR. Validation of the EQ-5D in patients with a history of acute coronary syndrome. *Curr Med Res Opin*. 2005;21:1209–1216. doi: 10.1185/030079905X56349.
12. Hess CN, Wang TY, McCoy LA, Messenger JC, Effron MB, Zettler ME, Henry TD, Peterson ED, Fonarow GC. Unplanned inpatient and observation rehospitalizations after acute myocardial infarction: insights from the Treatment With Adenosine Diphosphate Receptor Inhibitors: Longitudinal Assessment of Treatment Patterns and Events After Acute Coronary Syndrome (TRANSLATE-ACS) Study. *Circulation*. 2016;133:493–501. doi: 10.1161/CIRCULATIONAHA.115.017001.
13. Mathews R, Wang TY, Honeycutt E, Henry TD, Zettler M, Chang M, Fonarow GC, Peterson ED; TRANSLATE-ACS Study Investigators. Persistence with secondary prevention medications after acute myocardial infarction: insights from the TRANSLATE-ACS study. *Am Heart J*. 2015;170:62–69. doi: 10.1016/j.ahj.2015.03.019.
14. Rymer JA, Kaltenbach LA, Anstrom KJ, Fonarow GC, Erskine N, Peterson ED, Wang TY. Hospital evaluation of health literacy and associated outcomes in patients after acute myocardial infarction. *Am Heart J*. 2018;198:97–107. doi: 10.1016/j.ahj.2017.08.024.
15. Kroenke K, Spitzer RL, Williams JB. The Patient Health Questionnaire-2: validity of a two-item depression screener. *Med Care*. 2003;41:1284–1292. doi: 10.1097/01.MLR.0000093487.78664.3C.
16. Bhattacharyya MR, Perkins-Porras L, Whitehead DL, Steptoe A. Psychological and clinical predictors of return to work after acute coronary syndrome. *Eur Heart J*. 2007;28:160–165. doi: 10.1093/eurheartj/ehl440.
17. Dreyer RP, Xu X, Zhang W, Du X, Strait KM, Bierlein M, Bucholz EM, Geda M, Fox J, D'Onofrio G, Lichtman JH, Bueno H, Spertus JA, Krumholz HM. Return to work after acute myocardial infarction: comparison between young women and men. *Circ Cardiovasc Qual Outcomes*. 2016;9(suppl 1):S45–S52. doi: 10.1161/CIRCOUTCOMES.115.002611.
18. Weinblatt E, Shapiro S, Frank CW, Sager RV. Return to work and work status following first myocardial infarction. *Am J Public Health Nations Health*. 1966;56:169–185.
19. Master AM, Dack S. Rehabilitation following acute coronary artery occlusion. *JAMA*. 1940;115:828–832.
20. Smith GR Jr, O'Rourke DF. Return to work after a first myocardial infarction. a test of multiple hypotheses. *JAMA*. 1988;259:1673–1677.
21. Rost K, Smith GR. Return to work after an initial myocardial infarction and subsequent emotional distress. *Arch Intern Med*. 1992;152:381–385.
22. Smedegaard L, Nume AK, Charlot M, Kragholm K, Gislason G, Hansen PR. Return to work and risk of subsequent detachment from employment after myocardial infarction: insights from Danish Nationwide Registries. *J Am Heart Assoc*. 2017;6:e006486. doi: 10.1161/JAHA.117.006486.
23. Miilunpalo S, Vuori I, Oja P, Pasanen M, Urponen H. Self-rated health status as a health measure: the predictive value of self-reported health status on the use of physician services and on mortality in the working-age population. *J Clin Epidemiol*. 1997;50:517–528.
24. United States Department of Health and Human Services. Centers for Medicare and Medicaid Services Readmissions Reduction Program. 2017: https://www.cms.gov/medicare/medicare-fee-for-service-payment/acuteinpatientpps/readmissions-reduction-program.html. Accessed March 1, 2018.
25. Mathews R, Peterson ED, Chen AY, Wang TY, Chin CT, Fonarow GC, Cannon CP, Rumsfeld JS, Roe MT and Alexander KP. In-hospital major bleeding during ST-elevation and non-ST-elevation myocardial infarction care: derivation and validation of a model from the ACTION Registry®-GWTG. *Am J Cardiol*. 2011;107:1136–1143. doi: 10.1016/j.amjcard.2010.12.009.
26. Yeh RW, Secemsky EA, Kereiakes DJ, Normand SL, Gershlick AH, Cohen DJ, Spertus JA, Steg PG, Cutlip DE, Rinaldi MJ, Camenzind E, Wijns W, Apruzzese PK, Song Y, Massaro JM, Mauri L; DAPT Study Investigators. Development and validation of a prediction rule for benefit and harm of dual antiplatelet therapy beyond 1 year after percutaneous coronary intervention. *JAMA*. 2016;315:1735–1749. doi: 10.1001/jama.2016.3775.
27. Cohen BE, Edmondson D, Kronish IM. State of the art review: depression, stress, anxiety, and cardiovascular disease. *Am J Hypertens*. 2015;28:1295–1302. doi: 10.1093/ajh/hpv047.
28. Lee GK, Wang HH, Liu KQ, Cheung Y, Morisky DE, Wong MC. Determinants of medication adherence to antihypertensive medications among a Chinese population using Morisky Medication Adherence Scale. *PLoS One*. 2013;8:e62775. doi: 10.1371/journal.pone.0062775.
29. Bansilal S, Castellano JM, Garrido E, Wei HG, Freeman A, Spettell C, Garcia-Alonso F, Lizano I, Arnold RJ, Rajda J, Steinberg G, Fuster V. Assessing the impact of medication adherence on long-term cardiovascular outcomes. *J Am Coll Cardiol*. 2016;68:789–801. doi: 10.1016/j.jacc.2016.06.005.
30. Choudhry NK, Avorn J, Glynn RJ, Antman EM, Schneeweiss S, Toscano M, Reisman L, Fernandes J, Spettell C, Lee JL, Levin R, Brennan T, Shrank WH; Post-Myocardial Infarction Free Rx Event and Economic Evaluation (MI FREEE) Trial. Full coverage for preventive medications after myocardial infarction. *N Engl J Med*. 2011;365:2088–2097. doi: 10.1056/NEJMsa1107913.
31. Kim S, Egerter S, Cubbin C, Takahashi ER, Braveman P. Potential implications of missing income data in population-based surveys: an example from a postpartum survey in California. *Public Health Rep*. 2007;122:753–763. doi: 10.1177/003335490712200607.
32. Topa G, Depolo M, Alcover CM. Early retirement: a meta-analysis of its antecedent and subsequent correlates. *Front Psychol*. 2017;8:2157. doi: 10.3389/fpsyg.2017.02157.
33. van Rijn RM, Robroek SJ, Brouwer S, Burdorf A. Influence of poor health on exit from paid employment: a systematic review. *Occup Environ Med*. 2014;71:295–301. doi: 10.1136/oemed-2013-101591.

Adverse Change in Employment Status After Acute Myocardial Infarction: Analysis From the TRANSLATE-ACS Study

Haider J. Warraich, Lisa A. Kaltenbach, Gregg C. Fonarow, Eric D. Peterson and Tracy Y. Wang

Circ Cardiovasc Qual Outcomes. 2018;11:
doi: 10.1161/CIRCOUTCOMES.117.004528
Circulation: Cardiovascular Quality and Outcomes is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 1941-7705. Online ISSN: 1941-7713

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract X
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found X
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported X
Objectives	3	State specific objectives, including any prespecified hypotheses X
Methods		
Study design	4	Present key elements of study design early in the paper X
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection X
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up X *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable X
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group X
Bias	9	Describe any efforts to address potential sources of bias X
Study size	10	Explain how the study size was arrived at NA
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why X
XStatistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding X
		(*b*) Describe any methods used to examine subgroups and interactions X
		(*c*) Explain how missing data were addressed X
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed X *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed X
		(b) Give reasons for non-participation at each stage X
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders X
		(b) Indicate number of participants with missing data for each variable of interest X
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount) X
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time X
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included X
		(*b*) Report category boundaries when continuous variables were categorized X
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period X
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses X
Discussion		
Key results	18	Summarise key results with reference to study objectives X
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias X
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence X
Generalisability	21	Discuss the generalisability (external validity) of the study results X
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based X

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.