ARCHIVES OF THE TURKISH SOCIETY OF CARDIOLOGY

Official journal of the TURKISH SOCIETY OF CARDIOLOGY

The Relationship Between Coronary Artery Angiographic Characteristics, Occupational Factors, and Return to Work

Koroner Arter Anjiyografik Özelliklerinin Mesleki Faktörler ve İşe Dönüş İle İlişkisi

ABSTRACT

Objective: Coronary artery disease is one of the most common causes of disability and work loss among working-age individuals. Since the ability to return to work after cardiovascular events depends on several factors, identifying these factors can be helpful in treatment planning and effective rehabilitation. In this study, we aimed to assess the employment status and related factors one year after angiography in patients with stable angina and acute coronary syndrome and to investigate the impact of occupational factors on angiographic characteristics.

Methods: This retrospective study included 447 patients with coronary artery disease who underwent angiography between February 2020 and March 2021 at a teaching hospital. Data regarding employment status and other related variables, including the Job Content Questionnaire, were collected through medical record reviews and telephone interviews one year after hospital discharge. The participants' occupational factors and return-to-work status were then compared.

Results: One year after angiography, the rate of returning to work was 70%. Of these, 86.3% had resumed their previous job. Factors associated with a reduced return to work included major coronary artery involvement, a history of hypertension, lower ejection fraction, and increased hospitalization days. Occupational risk factors such as low income, longer working hours, and high job demand also decreased the likelihood of returning to employment.

Conclusion: Various clinical and socioeconomic factors can predict the probability of returning to work after angiography in patients with coronary artery disease. Considering these factors could be useful in formulating clinical guidelines to improve employment outcomes for these patients.

Keywords: Angiography, coronary artery disease, employment status, return to work

ÖZET

Amaç: Koroner arter hastalığı, çalışma çağındaki bireylerde en sık görülen sakatlık ve iş kaybı nedenlerinden biridir. Kardiyovasküler olaylardan sonra işe dönebilme yeteneği çeşitli faktörlere bağlı olduğundan, bu faktörlerin belirlenmesi tedavi planlamasında ve etkili rehabilitasyonda yardımcı olabilir. Bu çalışmada stabil anjina ve akut koroner sendromu olan hastalarda anjiyografiden bir yıl sonra çalışma durumu ve ilişkili faktörleri değerlendirmeyi ve mesleki faktörlerin anjiyografik özellikler üzerindeki etkisini araştırmayı amaçladık.

Yöntem: Bu retrospektif çalışma, Şubat 2020-Mart 2021 tarihleri arasında bir eğitim hastanesinde koroner arter hastalığı nedeniyle anjiyografi yapılan 447 çalışan hasta üzerinde gerçekleştirildi. İstihdam durumuna ve iş içeriği anketi dahil olmak üzere diğer ilgili değişkenlere ilişkin veriler, hastaneden taburcu olduktan bir yıl sonra tıbbi kayıtların incelenmesi ve telefon görüşmeleri yoluyla toplandı. Daha sonra katılımcılar arasında mesleki faktörler ve işe dönüş durumları karşılaştırıldı.

Bulgular: Anjiyografiden bir yıl sonra işe dönüş oranı %70 idi. Bunlardan %86,3'ü önceki işine devam etmişti. Büyük koroner arterlerin tutulumu, hipertansiyon öyküsü, daha düşük ejeksiyon fraksiyonu ve daha fazla hastanede kalış günü, işe dönüşün azalmasıyla ilişkilendirildi. Düşük gelir, daha uzun çalışma saatleri ve yüksek iş talebi gibi mesleki risk faktörleri de işe geri dönme olasılığını azalttı.

Sonuç: Koroner arter hastalığı olan hastalarda anjiyografi sonrası işe dönme olasılığını çeşitli klinik ve sosyoekonomik faktörler öngörebilmektedir. Bu faktörlere dikkat edilmesi, bu hastalarda istihdam sonuçlarını iyileştirmek için klinik kılavuzların formüle edilmesinde faydalı olabilir.

Anahtar Kelimeler: Anjiyografi, koroner arter hastalığı, çalışma durumu, işe dönüş

ORIGINAL ARTICLE
KLİNİK ÇALIŞMA

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Received: December 23, 2023
Accepted: March 18, 2024

Cite this article as: Rezaei F, Mohammadi S, Amirfarhangi A, Hosseininejad M. The relationship between coronary artery angiographic characteristics, occupational factors, and return to work. *Turk Kardiyol Dern Ars.* 2024;52(6):420-428.

DOI:10.5543/tkda.2024.86918

Coronary Artery Disease (CAD) is a serious and increasingly prevalent condition worldwide. The prevalence of this disease is very high in all countries, making it one of the leading causes of death.[1] Treatments for CAD include medical and invasive interventions such as percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG). However, the chronic nature of CAD and the possibility of recurrent episodes present significant challenges.

In 2013, CAD was recognized as one of the major causes of mortality worldwide, responsible for over 17 million deaths. With the rapid growth of this disease, it is predicted that by 2030, the mortality rate due to CAD will exceed 23 million.[1] Studies have estimated a significant distribution of heart disease among the workforce.[2,3] Due to the high prevalence and significant mortality among the workforce, CAD has received much attention recently, and studies have been conducted regarding the changes in employment conditions for these patients.

All individuals in the working age group, besides being susceptible to various incidents like other members of society, are exposed to numerous risks and injuries due to various occupational encounters.[4,5] Therefore, it seems that in addition to dealing with the challenges of the disease, the workforce affected by CAD also faces work-related challenges.[6] Single-center studies conducted in the post-PCI period have shown that more than one-third of patients suffering from acute myocardial infarction are unable to return to work within one year.[6,7] Some studies have analyzed employment status after coronary artery interventions such as myocardial infarction treatment, CABG, and angioplasty, with findings indicating a return-to-work rate of 50 to 80% within the first 12 months post-intervention.[7-12]

The probable employment status for these patients includes full-time employment continuation, part-time employment, unemployment, or retirement with disability benefits.

Identifying and assessing the employment status of patients with heart disease, particularly after interventional treatments, can be a step forward in planning corrective and supportive measures for their return to work.

Thus far, few studies have explored the relationship between coronary artery angiographic characteristics, return to work, and occupational factors. In this study, we aimed to assess the employment status and related factors one year after angiography in patients with stable angina and acute coronary syndrome (ACS), and to investigate the impact of occupational factors on angiographic characteristics.

ABBREVIATIONS

ACS	Acute coronary syndrome
AF	Atrial fibrillation
CAD	Coronary Artery Disease
CCS class	Canadian Cardiovascular Society class
CKD	Chronic kidney disease
COPD	Chronic obstructive pulmonary disease
EF	Ejection fraction
HTN	Hypertension
JCQ	Job Content Questionnaire
PCI	Percutaneous coronary intervention

Materials and Methods

In this retrospective cohort study, we observed all patients aged 18 to 70 years who underwent angiography for stable angina or ACS from February 2020 to March 2021. Exclusion criteria included patient dissatisfaction with participating in the study, unemployment at the time of admission, and missing information in the medical files that could not be completed via telephone contact.

This study was conducted in accordance with the Helsinki Declaration, and participation was voluntary. Participants did not pay to enter the study. All patient data remained confidential. This study was reviewed and approved by the Ethics Committee of Iran University of Medical Sciences (Approval Number: IR.IUMS.FMD.REC.1401.104, Date: 28.05.2022).

The medical records of the participants were reviewed for required variables, including demographic factors such as age at admission, gender, marital status, and education, as well as disease-related factors. These included the Canadian Cardiovascular Society class (CCS class), prescribed medications at discharge, ejection fraction (EF) rate, and the presence of accompanying chronic diseases such as atrial fibrillation (AF), chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), diabetes mellitus, hypertension (HTN), and stroke. Information about occupational factors, such as days absent from work or unemployment, the first day of full-time work, monthly income, job satisfaction (scored from 1 to 10, where 1 represents the least support and 10 the most), employer support (1-10), coworker support (1-10), and insurance support (1-10), was obtained through telephone interviews. Patients participating in this study were covered by basic insurance, which includes support for the worker in cases of issues such as illness and injury related to work or job loss. We asked patients to assign a score from 1 to 10 on their level of satisfaction with insurance support for these issues.

To assess workload, individuals were questioned about physical encounters on a 5-degree scale, including never, one-fourth of the time, half of the time, three-fourths of the time, and more than three-fourths of the time. These activities included working in a seated position, kneeling, squatting, bending, working at overhead shoulder level, and carrying or lifting heavy objects. Based on these encounters, different occupations were classified into sedentary, light, medium, and heavy groups.[12,13]

Additionally, the Job Content Questionnaire (JCQ) was utilized to measure job demand, job decision-making authority, job skill discretion, job decision latitude, and job strain.[14] This questionnaire is the most extensively used tool for evaluating job content related to an increased risk of cardiovascular diseases. Each item in the JCQ was scored on a Likert scale from 1 to 4, where 1 = strongly disagree and 4 = strongly agree. The total score in each area was calculated by summing the scores of the relevant questions, and the scales were interpreted accordingly. Job strain was measured using the following formula: Job strain ratio: (demand*2)/decision-latitude. A ratio greater than one indicates the presence of job strain. This questionnaire was completed and recorded separately for each individual.

Statistical Analysis

In this study, the angiographic characteristics were initially considered as independent variables in relation to return to work and subsequently as dependent variables in relation to occupational factors. All the aforementioned disease-related, occupational, and demographic variables were compared between individuals with and without a return to work. The results for qualitative variables were expressed as frequencies and percentages. Non-normally distributed variables were expressed as medians with 25th and 75th percentiles and were compared between the two groups using the Mann-Whitney U test. Variables showing significant results in univariate analysis were further examined using logistic regression analysis to identify factors affecting the return to work. The Statistical Package for the Social Sciences software for Windows, version 24.0 (IBM Corp., Armonk, NY, USA), was used for the statistical analyses, and the statistical significance level was set at < 0.05.

It is worth mentioning that artificial intelligence (Chatbot) was used for language fluency.

Results

During the period from February 2020 to March 2021, a total of 629 individuals underwent angiography at the hospital. Of these, 182 individuals were excluded from the study for various reasons: 98 individuals were unemployed at the time of hospitalization, 56 were excluded due to non-response or incorrect phone numbers in the files, 11 were excluded due to death, and 17 due to unwillingness to participate. This left data from 447 individuals available for analysis. Out of these, 313 individuals (70%) returned to work, while 134 individuals (30%) did not. Among those who returned to work, 270 individuals (86.3%) resumed their previous job, and 43 individuals (13.7%) secured a new job. The median (interquartile range) number of sickness absence days among those who returned to work was 5 (4-5). In evaluating the relationship between return to work and quantitative variables, it was found that individuals who did not return to work were older, had longer hospital stays, worked longer hours per week, received more insurance support, and had higher job demands. Conversely, they had lower levels of employer support, coworker support, job satisfaction, job decision-making authority, job skill discretion, and job decision latitude. The relationship between return to work and a history of cardiovascular disease including heart failure (HF), ischemic heart disease (IHD), and previous CABG was significant (Table 1).

In examining the relationship between return to work and qualitative variables, it was observed that the rate of return to work was higher in women than in men (Table 2). Regarding the association between return to work and the type of involved vessel, individuals with involvement in the left main, right coronary artery (RCA), left anterior descending (LAD), and left circumflex (LCX) had significantly lower rates of return to work. There was no significant association between return to work and involvement in minor vessels (Table 3). The association between return to work and the use of statins, antiplatelets, angiotensin receptor blockers (ARBs), beta-blockers, diuretics, nitrates, and digoxin was significantly meaningful, with a lower rate of return to work observed in individuals using these medications (Supplementary Table 1).

Regression analysis further confirmed the significance of the association between return to work and factors including age, type of treatment, involvement in the RCA, LAD, income level, work hours per week, number of hospitalization days, EF, CCS class, HTN, job decision-making authority, and job demand (Table 4, Figure 1).

In investigating the impact of occupational factors on angiographic characteristics as a dependent variable, it was observed that individuals with involvement in RCA and LAD experienced longer work hours per week, lower job satisfaction, and reduced job decision latitude. Those with involvement in the LCX had more work experience but less job satisfaction and job skill discretion. The association between occupational factors and the number of involved vessels, and angiography indications such as stable angina, unstable angina, ST Elevation Myocardial Infarction (STEMI), and Non-ST Elevation Myocardial Infarction (NSTEMI), is detailed in Supplementary Table 2. The relationship between job strain ratio and cardiovascular events was also examined. In the low strain group, a higher percentage of individuals had normal angiography compared to the high strain group (35% vs. 20%). In the stable angina group, a higher percentage of individuals were in the low strain group, whereas, in cases of STEMI, non-STEMI, and unstable angina, more individuals were in the high strain group (Table 5).

Discussion

In this study, we aimed to assess the employment status and related factors one year after angiography in patients with stable angina and ACS, and to explore the impact of occupational factors on angiographic characteristics. Our findings revealed several key factors influencing the return to work, providing valuable insights into the complex interaction between medical conditions and employment outcomes.

After applying the exclusion criteria, data from 447 individuals were analyzed. Among the study population, 70% returned to work, with 86.3% returning to their previous job and 13.7% transitioning to a new job. These findings reinforce existing evidence suggesting that the majority of patients strive to regain their previous occupational roles following significant cardiovascular events. The rate of return to work after coronary events in various studies ranged from approximately 60% to 92%.[8,11,15-20]

In our examination of the association between return to work and demographic variables, older age was associated with a lower likelihood of returning to work. Studies on return to work after ACS,[14] Myocardial Infarction (MI),[15,21] and CABG[17] indicated that older age was associated with a decreased return to work. However, some studies did not find a correlation between age and return to work.[11,16,18] The absence of a relationship between age and return to work in these studies could be due to the smaller sample sizes compared to our research and variations in socio-economic factors in different societies, such as retirement age.

In our initial analysis, the rate of return to work was higher in women than in men. Upon further examination based on gender, it was found that women's job demands were lower than men's. Additionally, the number of diseased vessels was higher

Table 1. The Relationship Between Return to Work and Quantitative Variables and Underlying Diseases

Variables	Returned to work (n=313)	Not returned to work (n=134)	*P*	OR (95% CI)
	Median (Interquartile range) / Number (%)			
Age (years)	56 (50-63)	60 (55-65)	**<0.001**	
Pack Year	11.9 (5.4-23.7)	19.5 (12.1-40)	**0.009**	
Ejection Fraction (%)	50 (45-55)	40 (30-50)	**<0.001**	
Hospitalization Days	1 (1-2)	2 (1-5)	**<0.001**	
Work Experience (years)	35 (25-40)	35 (30-40)	0.092	
Off Work Days	5 (4-5)	616 (503-636)	**<0.001**	
Insurance Support (1-10)	10 (9-10)	9 (8.7-10)	**0.045**	
Manager Support (1-10)	8 (6-10)	7 (5-10)	**0.012**	
Coworker Support (1-10)	6 (5-7)	5.5 (5-7)	**<0.001**	
Job Satisfaction (1-10)	6 (5-7)	5 (5-6)	**<0.001**	
Weekly Work Hours	40 (35-45)	46.5 (44-50)	**<0.001**	
Job Skill Discretion (12-48)	34 (30-36)	30 (30-34)	**<0.001**	
Job Decision-Making Authority (12-48)	36 (32-40)	32 (28-36)	**<0.001**	
Job Demands (12-48)	27 (24-31)	30 (26-31)	**<0.001**	
Job Decision Latitude (24-96)	70 (62-74)	60 (58-72)	**<0.001**	
Cardiovascular History	119 (58.3%)	85 (41.7%)	**<0.001**	0.35 (0.23 ± 0.53)
Previous PCI	48 (63.2%)	28 (36.8%)	0.152	0.68 (0.40 ± 1.15)
Valvular Disease	6 (85.7%)	1 (14.3%)	0.361	2.59 (0.31 ± 21.80)
Stroke	5 (41.7%)	7 (58.3%)	**0.030**	0.29 (0.09 ± 0.94)
Myocardial Infarction	25 (58.1%)	18 (41.9%)	0.074	0.55 (0.29 ± 1.06)
Heart Failure	15 (41.7%)	21 (58.3%)	**<0.001**	0.27 (0.13 ± 0.54)
Ischemic Heart Disease	88 (59.9%)	59 (40.1%)	**0.001**	0.49 (0.32 ± 0.75)
Previous CABG	4 (26.7%)	11 (73.3%)	**<0.001**	0.14 (0.04 ± 0.46)
Diabetes Melitus	90 (67.7%)	43 (32.3%)	0.480	0.85 (0.55 ± 1.32)
Hypertension	158 (64.8%)	86 (35.2%)	**0.008**	0.56 (0.37 ± 0.86)
Hyperlipidemia	74 (76.3%)	23 (23.7%)	0.128	1.49 (0.88 ± 2.51)
Atrial Fibrillation	3 (30%)	7 (70%)	**0.005**	0.17 (0.045 ± 0.69)
Peripheral Vascular Disease	2 (50%)	2 (50%)	0.380	0.42 (0.05 ± 3.04)
Depression	4 (66.7%)	2 (33.3%)	0.857	0.85 (0.15 ± 4.72)
COPD	3 (75%)	1 (25%)	0.827	1.28 (0.13 ± 12.23)
CKD	6 (35.3%)	11 (64.7%)	**0.001**	0.21 (0.07 ± 0.60)

CABG, Coronary Artery Bypass Graft; CKD, Chronic Kidney Disease; COPD, Chronic Obstructive Pulmonary Disease; PCI, Percutaneous Coronary Intervention.

in men than in women (data not shown). Thus, the higher rate of return to work in women may be attributed to lower job demands and less severity of the disease. However, subsequent regression analysis found no differences in the rate of return to work between genders. This contrasts with Dreyer et al.'s study,[22] where women were less likely to return to work than men. However, this difference was not significant after adjusting for patient demographic characteristics and psychosocial factors. The effect of gender differences on returning to work is highly dependent on cultural and demographic factors in various societies. Hence, the development of effective interventions to facilitate patients' return to work after cardiovascular events will be facilitated by a precise understanding of the contributions of male and female characteristics.

Based on the findings of our study, the rate of return to work was higher in individuals with higher income. This observation aligns with studies by Fukuoka et al.[14] and Batt et al.[17], where higher income levels were associated with a greater rate of returning to work. Consistent with previous research, our findings suggest that efforts to retain patients in the workforce should particularly target low-income groups.

Table 2. The Relationship Between Return to Work and Demographics and Occupational Factors

Variables		Returned to work (n=313)	Not returned to work (n=134)	*P*	OR (95% CI)
		Number (%)			
Gender	Male	173 (61.3)	109 (38.7)	**<0.001**	3.52 (2.16 ± 5.75)
	Female	140 (84.8)	25 (15.2)		
Marital Status	Single	43 (76.8)	13 (23.2)	0.232	1.48 (0.76 ± 2.85)
	Married	270 (69.1)	121 (30.9)		
Smoking Status	Yes	96 (70.6)	40 (29.4)	0.861	1.04 (0.66 ± 1.61)
	No	217 (69.8)	94 (30.2)		
Body Mass Index	Underweight	4 (57.1)	3 (42.9)	0.408	--------
	Normal	137 (68.2)	64 (31.8)		
	Overweight	122 (69.7)	53 (30.3)		
	Obese	50 (78.1)	14 (21.9)		
Education Level	Low	181 (66.3)	92 (33.6)	0.102	-------
	Moderate	101 (75.3)	33 (24.6)		
	High	31 (77.5)	9 (22.5)		
Income Level	Very Low	123 (39.3)	63 (47)	**0.026**	------
	Low	129 (68.3)	60 (31.7)		
	Moderate	58 (85.3)	10 (14.7)		
	High	3 (75)	1 (25)		
Physical Activity	Yes	184 (79.7)	47 (20.3)	**<0.001**	2.64 (1.73 ± 4.01)
	No	129 (59.7)	87 (40.3)		
Shift Work	Yes	34 (70.8)	14 (29.2)	0.897	1.04 (0.54 ± 2.01)
	No	279 (69.9)	120 (30.1)		
Work Demand	Sedentary	71 (64)	40 (36)	**0.006**	--------
	Light	174 (77.3)	51 (22.7)		
	Medium	62 (60.2)	41 (39.8)		
	Heavy	6 (75)	2 (25)		

In our study, longer working hours per week were associated with a lesser rate of returning to work, whereas Fukuoka's[14] study found that longer working hours were associated with a quicker return to work. The relationship between return to work after coronary events and weekly working hours has not been extensively explored in other studies, and given the discrepancy with Fukuoka's findings, this issue requires further investigation.

Our research also indicated that individuals who returned to work less frequently had higher job demands. Some studies have found that physically demanding jobs delay or prevent return to work.[8,15] Additionally, having white-collar occupations has been found to be effective in early return to work in some studies.[16] In contrast, Mirmohammadi et al.'s[18] article indicated that return to work was not related to work demand.

We found that a longer hospital stay was associated with a lower rate of returning to work. Similar findings were reported in the Worcester study, where a longer hospital stay was linked to the elevated return to work.[8] Given that longer hospital stays indicate slower recovery, this association is likely related to the severity of the disease. In our study, lower EF and more involved vessels were associated with longer hospital stays (data not shown). However, other studies have not found a relationship between return to work and the length of hospital stay.[15,16]

Lower EF rates were associated with a lower rate of returning to work in our study. While some studies reported results consistent with our findings,[11,18] others did not find an association between EF and return to work.[15,16]

Regarding the relationship between return to work and angiography indications (stable angina, unstable angina, STEMI, and NSTEMI), our initial analysis found that the return to work rate was higher in patients with stable angina and lower in NSTEMI patients than other groups (79.4% and 59.6%, respectively). However, this difference was not statistically significant after applying regression analysis to adjust for confounding factors. Few studies have examined the involvement of major coronary arteries. In our study, involvement of major coronary arteries (RCA and LAD) was identified as an important determinant in return to work.

Table 3. The Relationship Between Return to Work, Angiographic Characteristics, and Functional Class

Variables		Returned to work (n = 313)	Not returned to work (n = 134)	*P*	OR (95% CI)
		Number (%)			
RCA	Yes	94 (55)	77 (45)	**<0.001**	0.31 (0.20 ± 0.48)
	No	219 (79.3)	57 (20.7)		
Left Main	Yes	17 (45.9)	20 (54.1)	**0.001**	0.32 (0.16 ± 0.64)
	No	296 (72.2)	114 (27.8)		
LAD	Yes	152 (58.2)	109 (41.8)	**<0.001**	0.21 (0.13 ± 0.25)
	No	161 (86.6)	25 (13.4)		
LCX	Yes	86 (57.7)	63 (42.3)	**<0.001**	0.42 (0.28 ± 0.65)
	No	227 (76.2)	71 (23.8)		
Ramus	Yes	8 (57.1)	6 (42.9)	0.285	0.56 (0.19 ± 1.64)
	No	305 (70.4)	128 (29.6)		
Obtus Marginalis	Yes	50 (61.7)	31 (38.3)	0.072	0.63 (0.38 ± 1.04)
	No	263 (71.9)	103 (28.1)		
Diagonal	Yes	36 (60)	24 (40)	0.069	0.59 (0.34 ± 1.04)
	No	277 (71.6)	110 (28.4)		
PLV	Yes	8 (50)	8 (50)	0.075	0.41 (0.15 ± 1.12)
	No	305 (70.8)	126 (29.2)		
PDA	Yes	15 (83.3)	3 (16.7)	0.208	2.19 (0.62 ± 7.72)
	No	298 (69.5)	131 (30.5)		
Angiography Indication	Stable Angina	158 (79.4)	41 (20.6)	**0.002**	----------
	STEMI	43 (64.2)	24 (35.8)		
	NSTEMI	29 (59.2)	20 (40.8)		
	Unstable Angina	83 (62.9)	49 (37.1)		
Number of Vessels Involvement	0	128 (90.8)	13 (9.2)	**<0.001**	-------
	1	54 (70.1)	23 (29.9)		
	2	80 (61.1)	51 (38.9)		
	3	51 (52)	47 (48)		
Type of Treatment	Medical	152 (82.6)	32 (17.4)	**<0.001**	--------
	PCI	129 (63.2)	75 (36.8)		
	CABG	32 (54.2)	27 (45.8)		
First CCS Class	1	19 (82.6)	4 (17.4)	0.102	---------
	2	145 (74)	51 (26)		
	3	135 (66.2)	69 (33.8)		
	4	14 (58.3)	10 (41.7)		
Current CCS Class	1	211 (80.5)	51 (19.5)	**<0.001**	----------
	2	88 (64.2)	49 (35.8)		
	3	13 (28.3)	33 (71.7)		
	4	1 (50)	1 (50)		

CABG, Coronary Artery Bypass Graft; CCS, Canadian Cardiovascular Society; LAD, Left Anterior Descending; LCX, Left Circumflex; NSTEMI, Non-ST Elevation Myocardial Infarction; PDA, Posterior Descending Artery; PLV, Posterior Left Ventricle; RCA, Right Coronary Artery; STEMI, ST Elevation Myocardial Infarction.

Table 4. Regression Analysis of the Relationship Between Return to Work and Study Variables

Variables	*P*	OR	95% CI	
			Lower	Upper
Age	**<0.001**	1.096	1.049	1.146
Gender (Male)	0.142	2.098	0.754	5.837
Pack Year	0.166	0.984	0.961	1.007
Ejection Fraction on Admission	**0.002**	0.950	0.920	0.981
Antiplatelet	0.265	0.689	0.358	1.327
Atorvastatin	0.775	0.788	0.154	4.031
Beta Blocker	0.607	0.842	0.436	1.623
Nitroglycerine	0.536	0.760	0.318	1.814
Digoxin	0.280	0.172	0.007	4.188
Diuretics	0.268	1.712	0.661	4.437
RCA Involvement	**0.014**	0.362	0.161	0.813
Left Main Involvement	0.733	0.840	0.309	2.285
LAD Involvement	**0.009**	0.246	0.086	0.704
LCX Involvement	0.699	0.851	0.375	1.930
Number of Vessels Disease (3)	0.624	1.181	0.607	2.300
Angiography Indication (Unstable Angina)	0.912	0.984	0.741	1.307
Type of Treatment (CABG)	**0.018**	0.421	0.222	0.799
Current CCS Class (4)	0.059	1.592	0.982	2.581
Hypertension	**0.019**	0.452	0.233	0.878
Atrial Fibrillation	0.348	0.252	0.014	4.467
Chronic Kidney Disease	0.897	0.911	0.223	3.726
Income Level	**<0.001**	0.414	0.271	0.633
Physical Activity	0.122	1.687	0.869	3.274
Cardiovascular History	0.463	1.289	0.655	2.536
Insurance Support	0.364	0.940	0.823	1.074
Manager Support	0.283	0.913	0.772	1.078
Co-worker Support	0.911	1.019	0.739	1.403
Job Satisfaction	0.327	0.821	0.553	1.219
Job Skill Discretion	0.374	0.965	0.892	1.044
Job Decision Making Authority	**0.012**	0.926	0.872	0.983
Job Demands	**0.009**	0.885	0.807	0.970
Weekly Work Hours	**0.000**	1.150	1.094	1.209
Hospitalization Days	**0.041**	1.168	1.006	1.355

CABG, Coronary Artery Bypass Graft; CCS, Canadian Cardiovascular Society; LAD, Left Anterior Descending; LCX, Left Circumflex; RCA, Right Coronary Artery.

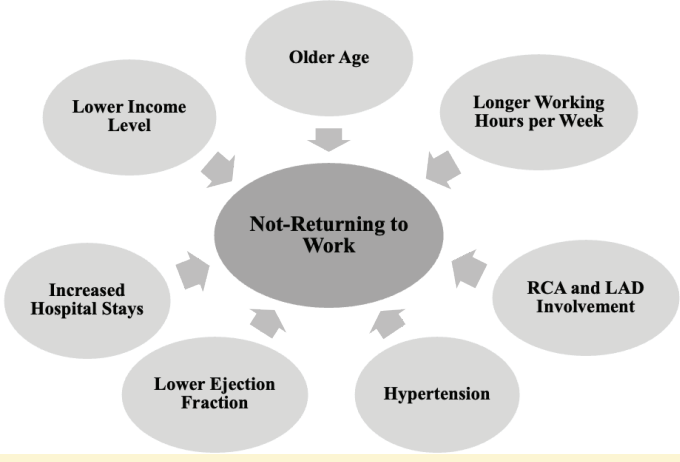

Figure 1. The main determinants of not returning to work. LAD, Left Anterior Descending; RCA, Right Coronary Artery.

Patients with involvement of these arteries had a lower rate of returning to work, underscoring the importance of the extent and severity of CAD in determining a patient's ability to return to professional life. This suggests that interventions aimed at reducing coronary artery involvement can have a positive impact on post-treatment employment outcomes. In Karl's study,[15] there was no significant difference in the extent of coronary artery involvement between the return-to-work and non-return-to-work groups. In the mentioned study, which examined return to work status after STEMI treated by direct PCI, the severity of coronary artery disease (two or more vessel disease) in the group without return to work was slightly higher than those in the return to work group (40% vs. 28%, respectively), but the difference was not statistically significant. Unlike our study, Karl et al. did not investigate the involvement of each major coronary artery separately; their research focused only on patients with MI who underwent PCI.

Table 5. The Relationship Between Job Strain and Angiographic Characteristics

Angiographic Characteristics		Low Strain Number (%)	High Strain Number (%)	*P*	OR (95% CI)
RCA Involvement	Yes	115 (34.3)	56 (50)	**0.003**	0.523 (0.339 ± 0.807)
	No	220 (65.7)	56 (50)		
LAD Involvement	Yes	184 (54.9)	77 (68.8)	**0.010**	0.554 (0.352 ± 0.872)
	No	151 (45.1)	35 (31.3)		
LCX Involvement	Yes	105 (31.3)	44 (39.3)	0.123	0.706 (0.453 ± 1.100)
	No	230 (68.7)	68 (60.7)		
Number of Vessels Involvement	0	118 (35.2)	23 (20.5)	**0.030**	--------
	1	55 (16.4)	22 (19.6)		
	2	95 (28.4)	36 (32.1)		
	3	67 (20)	31 (27.7)		
Angiography Indication	Stable Angina	163 (48.7)	36 (32.1)	**0.001**	---------
	STEMI	39 (11.6)	28 (25)		
	NSTEMI	35 (10.4)	14 (12.5)		
	Unstable Angina	98 (29.3)	34 (30.4)		

LAD, Left Anterior Descending; LCX, Left Circumflex; NSTEMI, Non-ST Elevation Myocardial Infarction; RCA, Right Coronary Artery; STEMI, ST Elevation Myocardial Infarction.

Patients with HTN in our study were significantly less likely to return to work. Similarly, Dreyer et al.[22] found that the absence of HTN predicts a higher rate of return to work. Another study indicated that comorbidities, excluding diabetes, also predicted non-return to work.[8] However, Mariarita et al.[16] did not find a relationship between blood pressure and return to work. In their study, the relationship between current blood pressure (not HTN) and the timing of return to work status was investigated. Therefore, given the difference in medication compliance and blood pressure control, the inconsistency of our findings with this study can be justified.

Additionally, our study demonstrated that a history of cardiovascular diseases was associated with a reduced rate of returning to work. Results from different studies in this regard vary; some identify a history of heart disease as a predictive factor for non-return to work,[17] while others suggest that the absence of a history of CAD increases the rate of returning to work.[22] In Bhattacharyya et al.'s study,[11] a history of heart disease was not related to the patient's return to work.

Regarding the association between return to work and JCQ indices, our study found that a lower rate of return to work was associated with lower job decision-making authority and higher job demand. Similarly, Fukuoka et al.[14] identified that a group with low job control and high job demand was an independent predictor of delayed return to work.

Regarding the impact of occupational factors on angiographic characteristics, we found a significant association between major coronary artery involvement (RCA, LAD, and LCX) and occupational factors such as higher work experience, longer work hours per week, and lower job satisfaction. Also, there was a significant relationship between the indication of angiography and the number of vessels involved with occupational factors including work experience, job satisfaction, and working hours per week. However, these results may not be extrapolated to the general population due to the scarcity of similar studies and variations in socio-demographic factors across different populations. More related studies in the future are required.

The relationship between job strain ratio and cardiovascular events was investigated, revealing that the high-strain group had a higher percentage of individuals with involvement of one, two, or three vessels. Conversely, in the low-strain group, a higher percentage of individuals had normal angiography compared to the high-strain group.

Strengths and Weaknesses: Our single-center observational data may have uncertain generalizability in regions with cultural and socio-economic diversity. Additionally, factors such as undocumented cardiovascular events prior to angiography, details about the technical success of revascularization, and compliance with regular medication use were not examined in this study and could be considered confounding factors.

The strength of our study lies in its consideration of multiple variables such as occupational characteristics using the JCQ questionnaire, demographic variables, and angiographic findings, all of which are effective in understanding return to work. Furthermore, unlike most studies that focus on the association between return to work and one or two specific cardiovascular events, our study examined return to work across a variety of cardiovascular events.

Recommendations: Future prospective multicenter cohort studies with larger sample sizes are recommended to examine the relationship between return to work and various factors.

Conclusion

In our study, 70% of employed patients undergoing angiography for stable angina or ACS returned to their jobs. Our findings indicate that multiple clinical, occupational, and socio-economic factors can predict success in returning to work after angiography.

These findings could be useful in formulating clinical guidelines to improve employment outcomes in patients with CAD. Additionally, we found a significant association between major coronary artery involvement and occupational factors such as higher work experience, longer work hours per week, and lower job satisfaction.

Ethics Committee Approval: This study was reviewed and approved by the Ethics Committee of Iran University of Medical Sciences (Approval Number: IR.IUMS.FMD.REC.1401.104, Date: 28.05.2022).

Informed consent: Participation was voluntary.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – F.R., S.M., A.A.; Design – S.M., M.H.; Supervision – S.M., A.A.; Resource – A.A.; Materials – A.A.; Data Collection and/or Processing – F.R., M.H.; Analysis and/or Interpretation – F.R., M.H.; Literature Review – F.R., M.H.; Writing – F.R., M.H.; Critical Review – S.M., M.H.

Use of AI for Writing Assistance: Artificial intelligence (Chatbot) was used for language fluency.

Conflict of Interest: The authors have no conflicts of interest to declare.

Funding: The authors declared that this study received no financial support.

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Supplementary Table 1. Association between Return to Work and Medication Use

Variables		Returned to work (n = 313)	Not returned to work (n = 134)	*P*	OR (95% CI)
		Number (%)			
Atorvastatin	Yes	270 (68)	127 (32)	**0.009**	0.34 (0.15±0.79)
	No	43 (86)	7 (14)		
Antiplatelet therapy	Single	125 (74.9)	42 (25.1)	**<0.001**	--------
	Dual	156 (63.2)	91 (36.8)		
	No	32 (97)	1 (3)		
Angiotensin receptor blocker	Yes	134 (66)	69 (34)	0.09	0.70 (0.47±1.05)
	No	179 (73.4)	65 (26.6)		
Beta blocker	Yes	156 (65.5)	82 (34.5)	**0.02**	0.63 (0.41±0.95)
	No	157 (75.1)	52 (24.9)		
Diuretic	Yes	39 (53.4)	34 (46.6)	**0.001**	0.41 (0.25±0.70)
	No	274 (73.3)	100 (26.7)		
Nitroglycerine	Yes	33 (56.9)	25 (43.1)	**0.019**	0.51 (0.29±0.90)
	No	280 (72)	109 (28)		
Digoxin	Yes	2 (28.6)	5 (71.4)	**0.016**	0.16 (0.03±0.86)
	No	311 (70.7)	129 (29.3)		
Captopril	Yes	51 (76.1)	16 (23.9)	0.237	1.43 (0.78±2.62)
	No	262 (68.9)	118 (31.1)		
Rivaroxaban	Yes	13 (59.1)	9 (40.9)	0.251	0.60 (0.25±1.44)
	No	300 (70.6)	125 (29.4)		
Insulin	Yes	3 (42.9)	4 (57.1)	0.114	0.31 (0.06±1.42)
	No	310 (70.5)	130 (29.5)		
Oral glucose lowering agents	Yes	93 (29.7)	43 (32.1)	0.654	0.895 (0.57±1.38)
	No	220 (70.3)	91 (67.9)		
Pantoprazole	Yes	73 (59.8)	49 (40.2)	**0.004**	0.52 (0.34±0.81)
	No	240 (73.8)	85 (26.2)		

Supplementary Table 2. Relationship between Occupational Factors and Angiographic Characteristics

	RCA involvement	LAD involvement	LCX involvement	Number of vessels disease	Angiography Indication
Occupational factors			*P*		
Work experience	0.095	**0.001**	0.104	**0.001**	**0.000**
Manager support	0.507	0.130	0.165	0.779	0.204
Co-worker support	0.539	0.142	0.090	0.567	**0.021**
Job satisfaction	**0.023**	**0.041**	**0.002**	**0.022**	**0.000**
Weekly work hours	**0.013**	**0.007**	0.160	**0.005**	**0.000**
Job Skill Discretion	**0.001**	0.146	**0.037**	**0.032**	0.249
Job Decision Making Authority	0.063	**0.006**	0.260	0.069	0.113
Job Demands	0.487	0.064	0.067	0.191	**0.004**
Job Decision Latitude	**0.006**	**0.004**	0.087	**0.015**	0.149
Income level	0.834	0.751	0.518	0.945	0.065
Work demands	0.499	0.155	0.073	0.435	0.126
Shift work	0.458	0.750	0.517	0.906	**0.001**

LAD, Left Anterior Descending; LCX, Left Circumflex; RCA, Right Coronary Artery.