FULL LENGTH ARTICLE

Correlates of memory loss and depression among myocardial infarction patients in Al-Qassim, Saudi Arabia

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Background: **After myocardial infarction (MI), patients have an elevated risk for depression, which has a negative impact on morbidity and mortality for patients. As depression and memory function are associated, we examined them in the context of one another. Our objectives were to determine the proportion of patients with either depression only, memory loss only, or both depression and memory loss and to examine the correlates with each outcome.**

Methods: **This study was a cohort of 264 patients who had myocardial infarction. Data sources included medical records and phone interviews.**

Results: **The participants' mean age was 62 þ 12.2 years and mean body mass index was 28.4 þ 5.8 kg/m^2. Of the participants, 6.4% had memory loss alone, 23.17% had depression alone, and 6.1% had combined memory loss and depression. Activity level and poor health were significantly associated with depression only ($p < 0.05$). Poor health was significantly associated with combined memory loss and depression ($p < 0.05$).**

Conclusion: **Activity level and poor health were identified as correlates of depression as well as combined memory loss and depression. Future studies should aim to improve screening for depression among post-MI patients and develop appropriate interventions to raise the level of activity.**

Keywords: Depression, Memory loss, Cardiovascular disease, Myocardial infarction, Patients

Introduction

Depression and myocardial infarction (MI) are likely to be associated 'reciprocally' with each other [1,2]. Patients have a high incidence of depression post-MI and depressive symptoms are strongly associated with morbidity and mortality of MI patients [1,3]. Both biological and lifestyle mechanisms have been proposed to explain the role of depression in the prognosis of MI patients. Biological mechanisms include but are

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not limited to hyperactivity of the hypothalamic–pituitary–adrenocortical axis and immune function whereas lifestyle mechanisms suggest that depressed patients are less likely to adhere to medication and physical rehabilitation and to quit smoking [4].

Approximately 30% of patients, who were not depressed previously, are diagnosed with depression after an MI event, indicating a post-MI increased risk of depression [4,5]. A host of patient (e.g., young age, female), psychosocial (e.g., poor coping skills, medication nonadherence, and social isolation), and disease characteristics (e.g., MI severity, previous depression, and anxiety) have been identified as risk factors for depression among MI patients [6]. Several studies have suggested that psychological disorders, including depression, should be screened and treated more systematically among MI patients [1,4,6,7].

In addition to the development of depression, memory function (and decline) might be an important health sequela in MI patients [8]. The trajectory of memory decline in post-MI patients has not yet been studied. However, there is a body of literature to suggest that traumatic, stressful life events reduce the autobiographical memory function rendering it 'overgeneral' and less specific [9–12]. Post-MI depression and memory decline are likely to go hand in hand as data indicate that an 'overgeneral' autobiographical memory may predict the course of depression [9]. Results showed that more generalized memories (i.e., fewer specific memories) were associated with higher depressive symptoms at follow-up.

Because of the interrelationship between memory function and depression and the increased risk for depression among patients following MI, we assessed both psychological conditions in a sample of MI patients. Our objectives were to determine the proportion of patients with either depression only, memory loss only, or both depression and memory loss. Furthermore, we aimed to examine the correlates with each outcome and to determine whether the correlates for each outcome were unique or shared.

Materials and methods

Study design and sample

This was a cross-sectional study of patients. We reviewed medical records of patients who were diagnosed with myocardial infarction from 2008 to 2015 and had been treated at Prince Sultan Cardiac Center (PSCC) in King Fahad Specialist Hospital located in Al-Qassim, Saudi Arabia.

Abbreviations

MI	myocardial infarction
PHQ2	Patient Health Questionnaire
CVD	cardiovascular disease
HADS	Hospital Anxiety and Depression Scale

Inclusion criteria were patient records with a diagnosis of MI during the study period 2008–2015, either male or female. Exclusion criteria were patient records of patients who were already deceased prior to 2015. The study protocol was approved by the Medical Ethical Review Committee in Qassim Region.

Data collection

The data collection was completed in two phases. During the first phase, the research assistants identified the medical records of patients that met the eligibility criteria, then extracted the relevant data (described below) and coded it into an electronic database. The phone numbers were extracted from the records and the research assistants contacted the patients via phone. Research assistants described the study's purpose and procedures. Once the patient agreed, he/she provided informed consent, verbally, to participate in the follow-up interview. Interviews took 20–30 minutes on average. There were eight research assistants involved in the data collection, each of them completed data extraction from the medical records and the follow-up interviews with the patients.

Assessment tools

The form used for data extraction from the medical records included the following: (1)

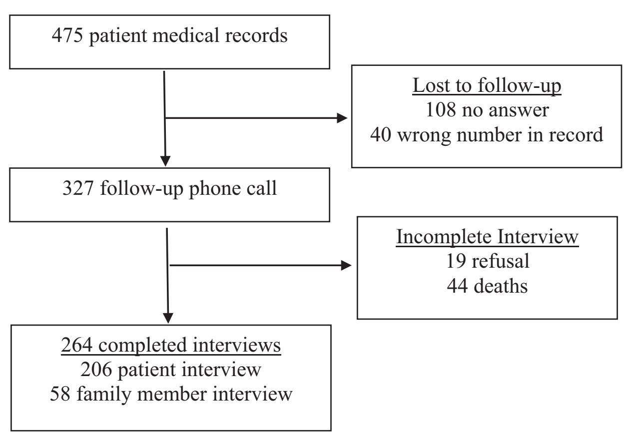

Figure 1. Flow chart for analytic sample.

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Table 1. Demographic characteristics of a sample of myocardial infarction patients in Al-Qassim, Saudi Arabia (n = 264).

Description	Total sample *n* = 264	Men *n* = 199	Women *n* = 65	*p*
Socio-demographic				
Age (y)				0.005
<60	39.0	44.2	23.1	
60–69	33.0	31.7	36.9	
≥70	28.0	24.1	40.0	
Education				0.001
None	38.6	25.1	80.0	
Primary	33.3	39.2	15.4	
Secondary or higher	28.0	35.7	4.6	
Employed				0.001
Yes	24.6	31.7	3.1	
Socioeconomic status				0.12
Poor	26.1	23.1	35.4	
Lower middle class	47.0	49.7	38.5	
Upper middle class/rich	26.9	27.1	26.2	
General activity level				0.001
Not active at all	13.6	9.5	26.2	
Somewhat active	40.9	36.7	53.8	
Active	32.6	37.7	16.9	
Very active	12.9	16.1	3.1	
General dietary habit				0.003
Not healthy at all	26.6	31.3	12.3	
Somewhat healthy	35.7	32.3	46.2	
Healthy	31.6	28.8	40.0	
Very healthy	6.1	7.6	1.5	
Self-rated health				
Poor health	50.6	55.9	34.4	0.003
Cardiac risk factors				
Body mass index (kg/m^2)				0.59
<25	27.2	26.6	29.2	
25–29.9	44.7	43.7	47.7	
≥30	28.0	29.6	23.1	
Adequate walking (≥150 min/wk)				0.002
Yes	19.3	23.6	6.2	
Cigarette smoking				0.001
Never smoker	58.7	45.2	100	
Past smoker	21.2	28.1	0	
Current smoker	20.1	26.6	0	
Medical history				
History of diabetes	55.7	50.3	72.3	0.002
History of hypertension	49.6	41.7	73.8	<0.001
History of hypercholesteremia	6.8	6.5	7.7	0.74
History of CVD event	86.4	85.4	89.2	0.44
Another MI event	17.9	18.2	17.2	0.86
Hospital visit and procedures				
D spent in hospital	4.8 (14.9)	4.9 (17.1)	4.3 (3.3)	0.77
Surgical intervention:				
No surgical intervention	13.6	12.1	18.5	0.31
PCI	81.4	83.9	73.8	
CABG	2.7	2.0	4.6	
Combined (PCI + CABG)	2.3	2.0	3.1	

CABG = coronary artery bypass graft; CVD = cardiovascular disease; MI = myocardial infarction; PCI = percutaneous coronary intervention.

demographics: sex, date of birth, area of residence, contact number, height (cm), weight (kg); (2) disease history: hypertension, hypercholesterolemia, diabetes, previous cardiovascular disease (CVD) events; and (3) MI event factors: MI type, treatment received at admission (e.g., medical or surgical), and the days spent in hospital.

The follow-up phone interview assessed the following: (1) vital status (alive, dead, or severely ill), cause of death, and date of death, if applicable; (2)

demographics: age, education, job, socioeconomic state, and self-reported height and weight; (3) personal lifestyle history: smoking, self-rated activity level, self-rated dietary habits, Quran reading (frequency/duration); and (4) lifetime disease history: hypertension, diabetes, another MI, brain stroke, heart failure, memory loss, and depression. The phone interview questionnaire was built from the validated questionnaires to the extent they were available. The Patient Health Questionnaire (PHQ2) was used to assess depression. This is a validated screening tool, which is composed of two questions that assess loss of interest and feelings of depression [13]. Memory loss was assessed with a single question: ''Have you experienced any memory loss?''. The assembled questionnaire was translated from English to Arabic and then back-translated by a different person to ensure the content accuracy. The Arabic version was used for data collection.

Statistical analysis

The variables were checked for accuracy before the analysis was undertaken. First, descriptive statistics (i.e., frequency and count) were checked for the whole sample and stratified by sex. The outcome was calculated as the proportion of patients who reported having memory loss only, depression only, or both memory loss and depression. Factors included in the multivariate model were chosen *a priori* based on the scientific literature. Nominal regression was used to model the significant correlates for the categorical outcome of memory loss only, depression only, or combined memory loss and depression. Correlates in the adjusted model included age, sex, activity level, poor health; all covariates entered the model simultaneously. Model adequacy was checked with a Hosmer–Lemeshow test. Odds ratios and the associated 95% confidence intervals (CI) for variables in the final model were reported. All tests were two-sided with an $\alpha = 0.05$ and the analyses were carried out with SPSS version 22, IBM Analytics.

Results

The original cohort included 475 patients who had an MI between 2008 and 2015. Between 2015 and 2017, 44 patients died, 19 refused to give follow-up interview, and 148 were lost to follow-up (Fig. 1), leaving 264 patients who were the focus of this current analysis.

The participants' mean age was 62 years (standard deviation = 12.2 years) and mean body mass index was 28.4 kg/m^2 (standard deviation = 5.8). The majority (73%) were overweight or obese. Twenty eight (28%) percent completed secondary education or more, 25% were employed, and 27% belonged to the upper middle class/rich (Table 1). More than half reported low activity level (54% somewhat active or not active at all) and unhealthy diet (62% somewhat healthy or not healthy at all dietary habits). Most (59%) never smoked and 51% reported having poor health. Hypertension, diabetes, and a previous CVD event were common: 50%, 56%, and 86%, respectively.

There were some notable differences in demographic characteristics and lifestyle between men and women. Women were more likely to be older, to be 'not active at all', and to have an unhealthy diet. Women were more likely to have hypertension and diabetes than men. However, men were more likely to be a smoker, be employed, and to report poor health (Table 1). Of the participants, 6.4% had memory loss alone ($n = 17$), 23.1% had depression alone ($n = 61$), and 6.1% had combined memory loss and depression ($n = 16$). There were no significant differences between men and women for depression and memory (Fig. 2).

Univariate analysis showed that active and very active participants were less likely to have either depression alone or combined memory loss than those who were not active at all ($p < 0.001$) (Fig. 3). Those with poor health were more likely to have either depression alone or combined memory loss than those with good to excellent health ($p = 0.002$) (data not shown).

In multivariate models, activity level, and poor health were significantly associated with depression only (Table 2) while controlling for age and sex. Those who were not at all or somewhat active were 2.7 times (95% CI: 1.35, 5.50) more likely to be depressed than those who were active/very active.

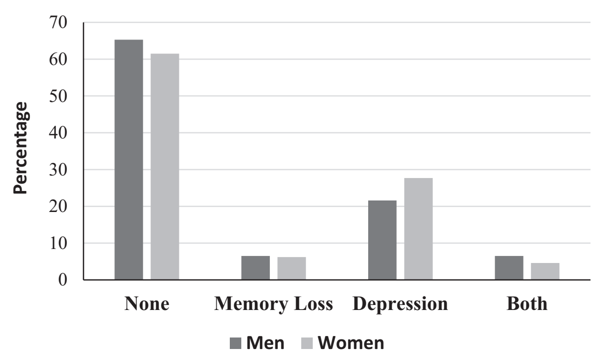

Figure 2. Sex comparison between the proportion of patients with memory loss only, depression only, or both memory loss and depression among myocardial infarction patients in Al-Qassim, Saudi Arabia (n = 264; men = 199; women = 65).

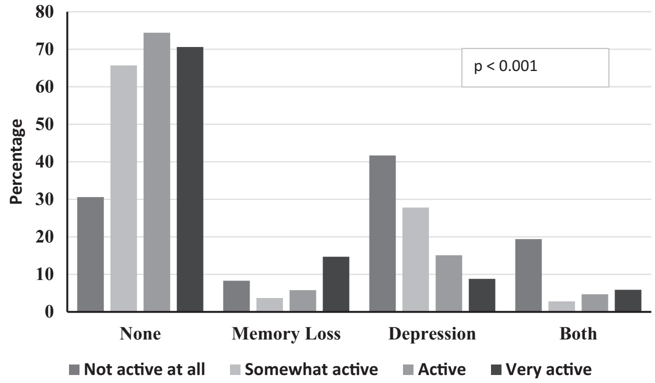

Figure 3. Comparison between level of physical activity and the proportion of patients with memory loss only, depression only, or both memory loss and depression among myocardial infarction patients in Al-Qassim, Saudi Arabia.

Table 2. Multivariate associations for the correlates with memory loss only, depression only, or both memory loss and depression among myocardial infarction patients in Al-Qassim, Saudi Arabia (n = 264).

Description	*n*	Memory loss only *n* = 17	Depression only *n* = 61	Memory loss and depression *n* = 16
Socio-demographic				
Age in y	264	0.9 (0.96, 1.04)	1.0 (0.95, 1.00)	1.0 (0.92, 1.01)
Sex				
Male	199	0.9 (0.26, 3.11)	1.0 (0.49, 2.01)	1.6 (0.42, 6.51)
Female	65	1.0	1.0	1.0
General activity level				
Not active/somewhat active	144	0.7 (0.24, 2.21)	2.7 (1.35, 5.50)	1.5 (0.47, 4.76)
Active/very active	120	1.0	1.0	1.0
Poor health				
No	128	1.0 (0.35, 3.03)	2.4 (1.30, 4.74)	6.7 (1.74, 25.71)
Yes	131	1.0	1.0	1.0

Those who reported poor health were 2.4 times (95% CI: 1.30, 4.74) more likely to be depressed than those with good to excellent health. In the models with combined memory loss and depression as the outcome, poor health was the only factor that was significantly associated with the outcome (Table 2). Those who reported poor health were 6.7 times (95% CI: 1.74, 25.71) more likely to have combined memory loss and depression than those with good to excellent health.

Discussion

This study evaluated memory loss and depression among a cohort of post-MI patients. The findings showed that 25% of the sample had depression alone and the significantly associated factors included activity level and poor health. Although 5% of the sample had combined memory loss and depression, poor health was strongly associated with this outcome. Memory loss alone was reported by 6.3% of patients but no significant correlates were identified.

This study estimated the prevalence of depression among MI patients to be near to 30%, which was similar to previous studies that reported between 20% and 40% of MI patients have depression [2,4–6,14]. There is some variation in estimates according to assessment tools and definitions of disease severity. For example, in a review of 24 studies, including 14,326 patients, major depression was identified in 19.8% using interviews but using Beck Depression Inventory score and the Hospital Anxiety and Depression Scale (HADS) depression was estimated to be 31% and 15%, respectively [14]. In an 8-year follow-up of patients, it was shown that 10% had a single episode, 19% had intermittent depression, and 11% had chronic depression [15]. Most studies of MI patients report an increased risk of depression among women [2,4].

It is not surprising that poor health was associated with depression and with memory loss.

Our results corroborate the finding of earlier studies that indicated that poor health (i.e., self-rated health) is not only associated with depression but also associated with CVD mortality [16]. Poor self-rated health was associated with >1.5 times higher risk of CVD mortality in adjusted models relative to excellent health [17]. Another longitudinal study showed that poor self-rated health and depressive symptoms at baseline predicted a higher risk of CVD mortality [15]. The conclusion of a meta-analysis that examined self-rated health and CVD mortality was that self-rated health may give additional knowledge regarding risk status of MI-patients beyond the standard CVD risk factors and disease severity measures [18]. As self-rated health plays an important role in prognosis and comorbidities such as depression, it raises the question regarding which factors improve this rating. Correlates that have been identified by earlier studies include age, employment, income, physical activity level, smoking history, alcohol use, hypertension, anxiety, and depression [5,17,19,20].

Physical activity level is known to be associated with CVD prognosis and is prescribed in the rehabilitation programs after CVD events [21,22]. In addition, higher physical activity has been shown to be associated with less depression among MI patients [5,17,19] as well as exercise capacity before and after cardiac rehabilitation programs [23–25]. Trials that have tested exercise rehabilitation among post-MI patients have shown that exercise training can reduce depressive symptoms and psychological stress as well as improve survival time [26–28]. Similar effects on depression and survival have been shown among coronary heart disease patients who adhere to cardiac rehabilitation [29–31]. As there is strong evidence that physically active patients have less depression and better prognosis [17,19,32], future studies should focus on improving adherence to the cardiac rehabilitation programs that are available.

The study strengths included having two methods for data collection and the use of validated assessment tools. However, this study had a few limitations. The outcome, depression, was assessed with the PHQ-2; this instrument is only a screening tool and cannot be used for diagnosis or monitoring of depression. It has been reported to have good sensitivity but poor specificity [13]; any patient who screens positive should be referred for diagnostic testing. The study had a nonrandom sampling method of the medical records and there were many patients that were lost to follow-up. The study results pertain to patients from central Saudi Arabia, and may not represent the population in the larger coastal cities.

A significant portion of MI patients experience depression and/or memory loss after their CVD event. Physical health (i.e., poor health) and physical activity were associated with both conditions and are correlated with one another. We conclude that screening for psychological conditions after an MI event should be improved in the healthcare system. Furthermore, cardiac rehabilitation post-MI should be improved to ensure that physical activity is taught appropriately and proper systems are established to help patients with long-term maintenance of daily activity.

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