Gender, Depression, and One-Year Prognosis After Myocardial Infarction

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Objective: The purpose of this study was to assess gender differences in the impact of depression on 1-year cardiac mortality in patients hospitalized for an acute myocardial infarction (MI). **Methods:** Secondary analysis was performed on data from two studies that used the Beck Depression Inventory (BDI) to assess depression symptoms during hospitalization: a prospective study of post-MI risk and a randomized trial of psychosocial intervention (control group only). The sample included 896 patients (283 women) who survived to discharge and received usual posthospital care. Multivariate logistic regression analysis was used to assess the risk of 1-year cardiac mortality associated with baseline BDI scores. **Results:** There were 290 patients (133 women) with BDI scores ≥10 (at least mild to moderate symptoms of depression); 8.3% of the depressed women died of cardiac causes in contrast to 2.7% of the nondepressed. For depressed men, the rate of cardiac death was 7.0% in contrast to 2.4% of the nondepressed. Increased BDI scores were significantly related to cardiac mortality for both genders [the odds ratio for women was 3.29 (95% confidence interval (CI) = 1.02–10.59); for men, the odds ratio was 3.05 (95% CI = 1.29–7.17)]. Control for other multivariate predictors of mortality in the data set (age, Killip class, the interactions of gender by non-Q wave MI, gender by left ventricular ejection fraction, and gender by smoking) did not change the impact of the BDI for either gender. **Conclusions:** Depression in hospital after MI is a significant predictor of 1-year cardiac mortality for women as well as for men, and its impact is largely independent of other post-MI risks.
Key words: depression, myocardial infarction, women, prognosis.

BDI = Beck Depression Inventory; PSSS = Perceived Social Support Scale; CI = confidence interval; EPPI = Emotions and Prognosis Post-Infarct; MCS = Marlowe-Crowne Social Desirability Scale; M-HART = Montreal Heart Attack Readjustment Trial; MI = myocardial infarction; STAI = State-Trait Anxiety Inventory.

INTRODUCTION

We previously reported that depression during hospitalization for an acute MI significantly increases the long-term risk of mortality, and that the increased risk is largely independent of cardiac disease severity (1, 2). In our sample, although women were about twice as likely as men to experience post-MI depression, there were only 49 women, too few to assess the prognostic impact of depression separately for them. The higher prevalence of depression in women, coupled with studies suggesting that women may have worse post-MI prognosis than men (3–5), has led to the speculation that gender differences in depression may be responsible for some of the difference in prognosis (6, 7). By combining data from our original study of post-MI depression with data from the control group of a recently completed trial of psychosocial intervention for post-MI patients (8), we have information on depression during hospital admission in relation to 1-year prognosis in a pooled sample of 283 women and 613 men who received usual postdischarge care. The purpose of this study is to examine whether there are gender differences in the prevalence, correlates, and 1-year prognostic importance of depression assessed during hospitalization for an acute MI. We were also interested in determining the extent to which any gender differences in depression explain any gender differences in prognosis.

METHODS

Sample

The sample includes 896 patients who completed the BDI (9) in hospital while participating in one of two separate projects: the EPPI study (1, 2) and the M-HART trial (8). EPPI was a prospective study of psychosocial risk after MI involving 222 patients, 218 of whom completed the BDI in hospital. Follow-up occurred at 6, 12, and 18 months after the MI. All patients received usual care from their physicians. M-HART was a randomized controlled trial of 1 year of psychosocial intervention for post-MI patients. There were 684 patients in the M-HART control (usual care) group, and 678 completed the BDI in hospital. The sampling procedures and data collection methods for the two studies were almost identical and are described in detail elsewhere. In brief, patients were recruited from consecutive admissions for an acute nonprocedure-related MI in 10 Montreal area hospitals between 1991 and 1994. The epidemiological risk study, EPPI, included patients admitted to the Montreal Heart Institute between July of 1991 and June of 1992. The randomized trial, M-HART, recruited patients from other Montreal area hospitals between January 1991 and September 1994. It was only after the completion of recruitment for the EPPI study that Montreal Heart

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Institute patients were asked to participate in the M-HART trial. Thus, recruitment at the Montreal Heart Institute occurred for only one of the two studies at a time. Both studies were approved by institutional review boards in participating hospitals. Selection requirements for the two studies were similar. For both, the diagnosis of MI was based on specific symptom, enzyme, and electrocardiographic criteria. Patients were excluded because of other life-threatening conditions; if they were unable to speak English or French; if they were cognitively impaired or too physically unstable to complete an in-hospital baseline interview; if they lived too far to return to the hospital for follow-up examinations; and for administrative reasons (physician refusal, participation in other research, early discharge). Overall, 63.6% of 2512 patients meeting study selection requirements (1555 men; 957 women) provided informed consent for participation in one of the two studies. In both studies, women and those aged 65 years and older were significantly more likely to refuse to participate than men and younger patients, a pattern similar to that reported in other recent studies of cardiac disease (10).

After discharge, patients in the EPPI study received usual care from their physicians, whereas M-HART patients were randomly assigned to a psychosocial intervention program or usual care. Because the results of the M-HART study showed evidence of a harmful impact of the program on prognosis in women, the present combined sample includes only those M-HART patients who were randomly assigned to usual care (control group). In addition, because of the current focus on depression, the pooled sample excludes patients who did not complete the BDI during admission (four from the EPPI study, and six from the M-HART control group).

Procedures

Patients meeting sample selection requirements were asked to participate as soon as possible after transfer from coronary care to medical wards. After explanation of the study and obtaining informed consent, study research assistants conducted baseline psychosocial interviews. These interviews assessed a variety of demographic, medical history, and psychosocial variables including age, education, daily smoking at the time of the MI, previous MI, previous treatment for hypertension, current marital status, and measures of social network (whether the patient was living alone; number of close friends). The 21-item self-report BDI (9) was used to assess symptoms of depression, and the 20-item state scale of Spielberger's STAI (11) was administered to assess anxiety. The 24-item Spielberger Anger Expression Scale including subscales for anger-in (the tendency to avoid expressing anger, even when appropriate) and anger-out (the tendency to express anger by directing it outward toward other people or objects) (12) was also used, as was the PSSS (13), a 12-item self-report measure of perceived availability of social support. The tendency to respond to interview questions with socially acceptable rather than objective responses (social desirability response set) was assessed using the 13-item version of the MCS, developed by Reynolds (14).

Medical data obtained from hospital charts included whether the index MI was a Q wave or a non-Q wave MI, Killip class (15), left ventricular ejection fraction ($N = 868$), thrombolytic treatment at the time of admission, whether the patient had a revascularization procedure (angioplasty or bypass) during the index admission, and prescription of medication for diabetes (hypoglycemics or insulin).

Initial 1-year survival status was obtained from contacts with patients or family members at 12 months postdischarge, and from Quebec Medicare data. The Commission d'accès à l'information du Québec provided study investigators with the right to access Medicare data for study participants, all of whom provided informed consent for access. All readmissions for 2 or more days shown by the Medicare data were investigated additionally to determine whether there had been a reinfarction. Data on enzyme levels, chest pain, and EKG changes were obtained from files in the hospital where each admission occurred. Information about causes and dates of death was abstracted from hospital charts, ambulance records, death and autopsy reports (when available), and supplemented by interviews with family members. Survival status was obtained for all patients at 365 days postdischarge. Causes of death were independently classified as cardiac and noncardiac by two cardiologists, who were blinded to baseline data and, in the case of the M-HART study, to treatment group. Cardiac deaths were classified additionally as secondary to arrhythmias (definite or probable), MI (definite or probable), congestive heart failure, or a cardiac procedure (coronary bypass surgery, coronary angioplasty, thrombolysis). Survived MI recurrences were defined using study eligibility criteria for MI, and were also independently rated by the study cardiologists. Disagreements in classification of deaths and MI recurrences were resolved by discussion.

Data Analysis

Data were analyzed using SPSS for Windows (version 7.5) (16). All statistical tests were two-sided. p values $\leq .05$ were considered statistically significant; those $\leq .10$ and $> .05$ were considered marginal. The baseline characteristics of women and men were compared using the χ^2 statistic for categorical variables. Continuous variables were compared using independent t tests. The primary outcome was cardiac death over 12 months after hospital discharge. Multiple logistic regression analysis and the χ^2 statistic were used to assess the odds ratio for cardiac mortality associated with gender and with depression. Logistic regression was also used to examine the relationship between other baseline variables and cardiac mortality, and between baseline variables and depression. To facilitate interpretation of interactions, continuous variables were dichotomized at clinically relevant points. As in our previous work, because there was no literature to suggest cutoff values for most of the baseline psychological variables (anxiety, anger-in, anger-out, perceived social support, and social desirability) the highest or lowest quartile was selected. The two-way interactions between gender and baseline variables, between depression and baseline variables, and between gender and depression were assessed using the likelihood ratio test. Significant interactions were examined additionally by performing separate logistic regressions for the groups involved in the interactions.

To examine the impact of depression on cardiac mortality in relation to the impact of other baseline variables, a model predictive of cardiac mortality in both women and men without including depression was built, which began by forcing in age and the significant gender by baseline interactions as well as their component main effects. Then multivariate backward stepwise analyses were performed for the remaining baseline variables to produce a model to predict cardiac mortality for both genders. The degree to which this model was improved by the addition of depression was assessed, using the likelihood ratio test.

RESULTS

Gender Comparisons on Baseline Characteristics

Table 1 shows comparisons of men and women on baseline characteristics. In terms of demographic and social factors, women were, on average, 5 years older than men, and were more likely to be unmarried and

TABLE 1. Baseline Characteristics by Gender

Variable	Women (N = 283)	Men (N = 613)	p Value
Sociodemographic characteristics			
Age			
Mean years ± SD	62.8 ± 12.0	57.8 ± 10.5	<.0001
≥65 years	50.5%	25.6%	<.0001
Education ≤7 years	37.8%	23.3%	<.0001
Unmarried	49.5%	17.6%	<.0001
Living alone	32.9%	12.2%	<.0001
Close friends	78.4%	78.8%	.91
Medical history			
Daily smoker	44.5%	48.6%	.25
History of treatment for hypertension	51.9%	27.9% (N = 612)	<.0001
Diabetes	23.3%	12.9%	<.0001
Previous MI	18.7%	25.8%	.021
Characteristics of index MI			
Thrombolysis	38.2%	45.5%	.039
Non-Q wave MI	39.0% (N = 269)	34.7% (N = 602)	.22
Killip class			
1	57.2%	75.0%	<.0001
2	14.5%	11.3%	
3	25.1%	12.2%	
4	3.2%	1.5%	
Left ventricular ejection fraction			
Mean ± SD	49.6 ± 14.1 (N = 2%)	47.3 ± 13.1 (N = 598)	.019
≤35%	18.1%	19.9%	.55
Revascularization during admission	25.4%	25.3%	.96
Psychological factors			
Symptoms of depression (BDI[a])			
Mean ± SD	11.3 ± 9.3	7.1 ± 7.1	<.0001
≥10	47.0%	25.6%	<.0001
Anxiety (STAI)			
Mean ± SD	39.5 ± 12.8 (N = 281)	34.1 ± 10.0 (N = 612)	<.0001
>43	35.9%	18.8%	<.0001
Anger-in[b]			
Mean ± SD	16.9 ± 4.4 (N = 275)	16.5 ± 4.3 (N = 598)	.31
≥20	28.4%	24.6%	.24
Anger-out[b]			
Mean ± SD	13.9 ± 4.1 (N = 275)	15.4 ± 3.9 (N = 607)	<.0001
≥18	18.9%	26.9%	.011
Perceived social support (BSSS)			
Mean ± SD	70.3 ± 12.1 (N = 279)	69.5 ± 11.7 (N = 608)	.39
≤64	23.3%	26.0%	.39
Social desirability (MCS)			
Mean ± SD	9.6 ± 2.2 (N = 282)	9.2 ± 2.4 (N = 609)	.009
>11	23.0%	18.7%	.13

[a] BDI scores ≥10 are indicative of at least mild to moderate symptoms of depression.
[b] Based on the Spielberger Anger Expression Scale.

living alone. They were also less educated than men. Despite that women were more likely to be living alone, men and women did not differ in having close friends. Although smoking was equally likely for men and women, women were more likely to have a history of treatment for hypertension, to be diabetic, and were less likely to have had a previous infarct than men. Women were less likely to be treated with thrombolysis at the time of admission. However, about the same percent of men and women had non-Q wave infarcts. A higher proportion of women had advanced Killip class. Although women had significantly higher residual left ventricular ejection fractions than men, the average difference amounted to less than 3%, and the percentage of women and men with ejection fractions ≤ 35% did not differ. Thus, it is unlikely that there was a clinically meaningful gender difference in cardiac pump function. Approximately 25% of each gender underwent revascularization procedures in hospital before discharge. Although women had sig-

nificantly higher mean anxiety scores and higher social desirability scores, anger-out scores were higher for men. Finally, the perceived adequacy of social support was about the same for the two genders. Because of women's higher social desirability scores, the gender comparisons for the other psychological variables were made a second time after controlling for social desirability. The pattern of gender differences remained unchanged.

Prevalence of Post-MI Depression

Women had significantly higher mean depression scores (11.3 ± 9.3) than men (7.1 ± 7.1; $p < .0001$). Approximately half of the women ($N = 133$) and one-quarter of the men ($N = 157$) had BDI scores ≥10, indicative of at least mild to moderate symptoms of depression [the odds ratio for depression associated with gender was 2.57 (95% CI = 1.92–3.46); $p < .00001$]. To more fully explore the degree to which gender was related to post-MI depression independently of other factors associated with gender, we performed a multivariate logistic regression analysis using gender to predict depression after controlling for the background factors which differed between men and women. The results showed that gender was significantly related to post-MI depression even after controlling for age, education, marital status, living alone, history of treatment for hypertension, diabetes, previous infarct, thrombolytic treatment, Killip class, left ventricular ejection fraction, anxiety, anger-out, and social desirability score [adjusted odds ratio for depression associated with gender was 2.00 (95% CI = 1.30−3.09); $p = .0017$]. Thus, women's higher rate of post-MI depression could not be accounted for by background differences between the genders, including differences in other psychological variables.

Baseline Characteristics in Relation to Depression

Table 2 shows the relationship between depression (BDI ≥ 10) and baseline characteristics for the overall sample for variables that did not have a significant interaction with gender, that is, for which the relationship with depression was similar for men and women. Variables with significant interactions with gender are shown in Table 3. Regardless of gender, depression was associated with previous treatment for hypertension, advanced Killip class, and impaired left ventricular ejection fraction. Thus, depressed patients of both genders tended to have somewhat more advanced cardiac disease. Depression was also associated with lower levels of education, not having close friends, lower perceived social support, higher anxiety, higher anger-out, and lower social desirability response style.

Although most variables showed the same pattern of relationship to depression in women and men, there were significant interactions between baseline variables and gender in relation to depression for three psychosocial factors: living alone ($p = .0001$), marital status ($p = .0004$) and anger-in ($p = .0014$). Inspection of the data in Table 3 reveals that, although both men and women with higher anger-in scores were more likely to be depressed than those with lower scores, the contrast was much more pronounced for men. Men with high anger-in scores had about five times the risk of being depressed as those with low anger-in scores. For women, high anger-in scores only marginally increased the risk of depression. Thus, anger-in seems to be more closely related to depression in men than in women. The interactions between gender and marital status and gender and living alone were also intriguing. Whereas for men living alone and being unmarried increased the risk of depression, for women marital status was not significantly related to depression. Women who lived alone had about half the risk of being depressed as women who lived with others.

Depression and Prognosis in Men and Women

A total of 42 patients died by 1 year, with 37 being cardiac deaths. This included 15 cardiac deaths among women and 22 among men. The causes of cardiac death for women included 7 MIs (definite or probable), 2 arrhythmic deaths (definite or probable), 5 deaths from heart failure, and 1 periprocedural death. For men there were 6 MIs, 15 arrhythmic deaths, and 1 death from heart failure. In addition, 19 women and 24 men had survived reinfarctions, and 1 woman and 4 men survived cardiac arrests. Results of the logistic regressions for cardiac death and other cardiac events in relation to gender and depression are shown in Table 4. Although there was no significant gender difference for overall cardiac deaths, women were significantly more likely to experience reinfarctions, and marginally less likely to have arrhythmic events than men. The gender difference for the combined end point of any hard event, including cardiac death, survived MI recurrences, and survived cardiac arrests, was not significant. Similarly, there was no difference between men and women in terms of revascularization after discharge. Depressed patients were significantly more likely to die of cardiac causes and to have an arrhythmic event than nondepressed patients. They were also marginally more likely to have MI recurrences, and significantly more likely to experience the combined end point of any hard cardiac event. There

TABLE 2. Relationships Between Baseline Variables and In-Hospital Depression (BDI ≥ 10) After an MI[a]

Variable	Category (*N*)	Depressed (%)	OR[b] (95% CI)	*p* Value
Sociodemographic characteristics				
Age (yr):	≥65 (300)	31.7	0.95 (0.71–1.28)	.75
	<65 (596)	32.7		
Education (yr):	≤7 (250)	38.4	1.45 (1.07–1.97)	.017
	>7 (646)	30.0		
Unmarried (significant interaction with gender see Table 3)				
Living alone (significant interaction with gender see Table 3)				
Close friends:	Yes (705)	30.4	0.66 (0.47–0.92)	.014
	No (191)	39.8		
Medical history				
Daily smoker:	Yes (424)	34.4	1.20 (0.90–1.58)	.21
	No (472)	30.5		
History of treatment for hypertension:	Yes (318)	37.4	1.42 (1.06–1.90)	.017
	No (577)	29.6		
Diabetes:	Yes (145)	38.6	1.39 (0.96–2.01)	.080
	No (751)	31.2		
Previous MI:	Yes (211)	33.6	1.08 (0.78–1.50)	.65
	No (685)	32.0		
Characteristics of index MI				
Thrombolysis:	Yes (387)	30.5	0.86 (0.65–1.14)	.30
	No (509)	33.8		
Type of MI:	Non-Q wave (314)	34.7	1.21 (0.90–1.62)	.20
	Q wave (557)	30.5		
Killip class:	≥2 (274)	40.1	1.65 (1.22–2.22)	.0010
	1 (622)	28.9		
Left ventricular ejection fraction:	≤35% (168)	39.3	1.48 (1.04–2.10)	.028
	>35% (700)	30.4		
Revascularized during admission:	Yes (227)	32.6	1.01 (0.74–1.40)	.93
	No (669)	32.3		
Psychological characteristics				
Anxiety (STAI):	>43 (216)	72.7	11.09 (7.78–15.82)	<.00001
	≤43 (677)	19.4		
Anger-in[c]: (significant interaction with gender see Table 3)				
Anger-out[c]:	≥18 (215)	38.6	1.48 (1.07–2.04)	.017
	<18 (667)	29.8		
Perceived social support (PSSS):	≤64 (223)	41.7	1.77 (1.29–2.43)	.0004
	>64 (664)	28.8		
Social desirability (MCS):	>11 (179)	12.3	0.23 (0.15–0.37)	<.00001
	≤11 (712)	37.5		

[a] Includes baseline variables without significant gender interactions. Variables with significant gender interactions in relation to depression appear in Table 3.
[b] OR = odds ratio.
[c] Based on the Spielberger Anger Expression Scale.

was no difference in revascularization between depressed and nondepressed patients. It is also of interest that, as suggested in our previous work (17), the impact of depression tended to be more marked for cardiac deaths (particularly arrhythmic deaths) than for MI recurrences. Consequently, when MI recurrences and arrhythmic events were added together to form the variable "any hard cardiac event," the depression-related risk for the combined outcome was less marked than the risk for the primary outcome, cardiac mortality.

None of the interactions between gender and depression were significant. Therefore, to assess the degree to which any gender differences in prognosis were accounted for by gender differences in depression, we also performed logistic regressions for the relationship between gender and each cardiac event after controlling for depression. These analyses revealed that for all of the cardiac events, the relationship between gender and outcome was less marked after control for depression. However, the only outcome variable for which there was a significant gender difference (MI recurrences) remained significant after taking depression into account, suggesting that, at least in the current data set, depression does not account for gender differences in prognosis (see Table 4).

TABLE 3. Gender by Baseline Variable Interactions for In-Hospital Depression (BDI ≥ 10) After an MI

Variable	Variable category	Depression		OR[a] for Depression Associated With Variable			
		Women	Men	Women		Men	
		% (*N*)	% (*N*)	OR (95% CI)	*p* Value	OR (95% CI)	*p* Value
Unmarried	Unmarried	42.1 (140)	38.9 (108)	0.68 (0.42–1.09)	.11	2.16 (1.39–3.35)	.0006
	Married	51.7 (143)	22.8 (505)				
Living alone:	Yes	37.6 (93)	41.3 (75)	0.57 (0.34–0.94)	.028	2.30 (1.40–3.80)	.0011
	No	51.6 (190)	23.4 (538)				
Anger-in:[b]	≥20	56.4 (78)	50.3 (147)	1.67 (0.98–2.83)	.057	5.00 (3.33–7.51)	<.00001
	<20	43.7 (197)	16.9 (451)				

[a] OR = odds ratio.
[b] Based on the Spielberger Anger Expression Scale.

As mentioned previously, there was no evidence of an interaction of gender and depression for any outcome, including the primary outcome, cardiac death ($p = .92$). For women, the 1-year odds ratio for cardiac death associated with depression was 3.29 (95% CI = 1.02–10.59), and for men it was 3.05 (95% CI = 1.29–7.17). The same pattern also occurred when the BDI score was analyzed as a continuous variable. The odds ratio for cardiac mortality associated with a 1-point increase in the BDI score was 1.03 (95% CI = 0.98–1.08) for women and 1.06 (95% CI 1.02–1.10) for men. Figure 1 includes the percent cardiac mortality for women and men in relation to the level of their in-hospital BDI score, which reflects increasing severity of depressive symptoms. There is a nearly linear increase in risk of cardiac mortality with increasing BDI scores for both genders. The exception to this linear increase is for women with BDI scores ≥19, for whom the risk, although higher than that for women who were not depressed at all, was less than the risk for women with scores between 15 to 18. However, although women classified as depressed (BDI scores ≥10) did not differ in age from nondepressed women, the women with very high scores (≥19) were, on average, 4 years younger than women with scores < 19 ($p = .025$). Thus, their lower age may partially explain their lower mortality.

Other Baseline Factors Related to Cardiac Mortality

Table 5 presents data on the relationship between baseline factors (other than depression) and cardiac mortality over the first post-MI year for those variables with a similar impact for men and women. The data for baseline variables with different impacts for men and women (significant gender by variable interactions) are shown in Table 6. Men and women shared most standard risk factors for 1-year cardiac mortality, including older age, diabetes, previous MI, and advanced Killip class. Patients who were revascularized during the index admission had a very low risk of cardiac mortality. In fact, only one woman and two men who underwent bypass or angioplasty in hospital soon after the MI died during the year. None of the psychological variables other than depression was significantly related to cardiac mortality. However, there were three significant gender differences in factors related to 1-year cardiac mortality: non-Q wave MI ($p = .012$), left ventricular ejection fraction ($p = .011$), and smoking ($p = .050$). There was also a marginally significant interaction of gender by anxiety ($p = .057$). Although non-Q wave MI and low left ventricular ejection fraction were related to significantly increased risk in men, there was little evidence of increased risk for women. Examination of the risks associated with smoking for men and women revealed the surprising finding that women who smoked at the time of admission had approximately one-fifth the risk of cardiac

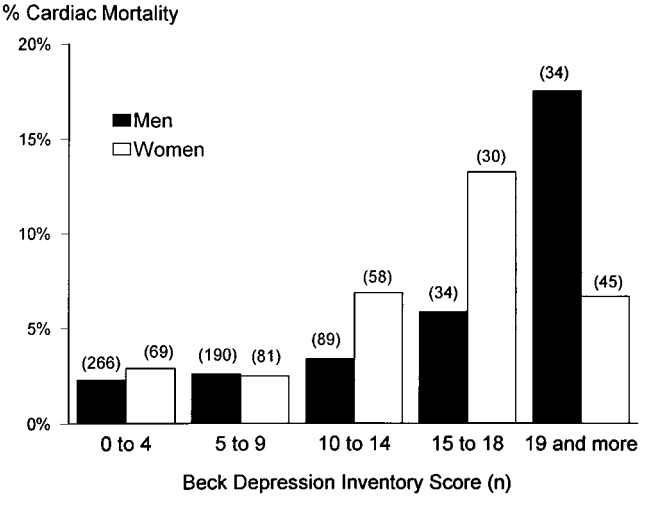

Fig. 1. One-year cardiac mortality in relation to the Beck Depression Inventory score and gender.

TABLE 4. Cardiac Events During the Year Postdischarge in Relation to Gender and Depression (BDI ≥ 10)[a]

	Gender Differences					Depression Differences			
Event	Category (*N*)	With Event (%)	OR[b] (95% CI)	*p*	OR Adjusted for Depression (95% CI)	*p*	Category (*N*)	With Event (%)	OR (95% CI)	*p*
Cardiac death	Women (283)	5.3	1.50 (0.77–2.94)	.23	1.16 (0.58–2.33)	.67	Depressed (290)	7.6	3.23 (1.65–6.33)	.0006
	Men (613)	3.6					Not depressed (606)	2.5		
Arrhythmic event	Women (283)	1.1	0.34 (0.10–1.14)	.080	Not calculable[c]		Depressed (290)	4.5	3.11 (1.32–7.37)	.0099
	Men (613)	3.1					Not depressed (606)	1.5		
MI recurrence	Women (283)	9.2	1.97 (1.14–3.39)	.015	1.82 (1.04–3.19)	.036	Depressed (290)	8.3	1.62 (0.93–2.80)	.086
	Men (613)	4.9					Not depressed (606)	5.3		
Any hard event[d]	Women (283)	11.3	1.47 (0.92–2.35)	.11	1.28 (0.79–2.07)	.32	Depressed (290)	13.1	1.97 (1.25–3.13)	.0038
	Men (613)	8.0					Not depressed (606)	7.1		
Revascularization	Women (283)	15.2	1.35 (0.90–2.02)	.15	0.43 (0.94–2.17)	.10	Depressed (290)	11.4	0.82 (0.53–1.26)	.37
	Men (613)	11.7					Not depressed (606)	13.5		

[a] *p* Values for all gender by depression interactions <.40.
[b] OR = odds ratio.
[c] None of the nondepressed women had an arrhythmic event.
[d] Cardiac death, survived MI recurrence, or survived cardiac arrest.

mortality as nonsmokers, whereas smoking was not related to mortality for men. Additional examination revealed that women who smoked at the time of their MI were on average 11 years younger than nonsmoking women, were significantly less likely to have had a previous MI, and less likely to be hypertensive and diabetic than nonsmoking women. In other words, women who were still smoking at the time of their MI tended to be younger and healthier than other women. After controlling for these factors, smoking was no longer significantly related to cardiac mortality in women ($p = .38$).

The marginally significant interaction of gender and anxiety showed that men in the upper quartile of anxiety experienced an increased risk of 1-year cardiac mortality, but that anxiety had little impact on women. Because women were more likely than men to have high anxiety scores, the analysis for women was also done using the cutoff point for the upper quartile of anxiety in women (STAI ≥ 49). However, the impact of anxiety on cardiac mortality in women remained nonsignificant [odds ratio was 0.74 (95% CI = 0.20–2.71); $p = .65$].

The Independent Relationship Between Depression and Cardiac Mortality

To assess the strength of the relationship between depression and cardiac mortality after taking into account other predictive factors, stepwise procedures were used to build a combined model to predict cardiac mortality in both women and in men without the inclusion of depression. The final model included age, Killip class, the interaction of gender and left ventricular ejection fraction, the interaction of gender and non-Q wave MI, and the interaction of gender and smoking. Overall, this model had a Hosmer and Lemeshow Goodness of Fit χ^2 value of 8.79 (8 *df*; $p = .36$). The addition of depression significantly improved the model ($p = .0008$; Goodness of Fit $\chi^2 = 5.15$; $p = .74$), and the interaction of gender by depression remained nonsignificant ($p = .30$), supporting the interpretation that the impact of depression is independent of measures of disease severity for both genders. The final model including depression is shown in Table 7.

Referral to Psychiatric Care

Physician contact data from the Régie de l'assurance maladie du Québec (the government office that pays for physician care) was available for 890 of the 896 patients. There were 108 individuals (12.1%) seen at least once by a psychiatrist either in hospital or during the first year postdischarge. Forty-six were first seen during their admission and the remainder were seen

TABLE 5. Relationships Between Baseline Variables and One-Year Cardiac Mortality After an MI[a]

Variable	Category (*N*)	Cardiac Mortality (%)	OR[b] (95% CI)	*p* Value
Sociodemographic factors				
Age (yr):	≥65 (300)	6.0	1.94 (1.00–3.75)	.049
	<65 (596)	3.2		
Education (yr):	≤7 (250)	5.6	1.61 (0.81–3.18)	.17
	>7 (646)	3.6		
Unmarried:	Unmarried (248)	4.4	1.11 (0.54–2.28)	.78
	Married (648)	4.0		
Living alone:	Yes (168)	3.6	0.83 (0.34–2.03)	.69
	No (728)	4.3		
Close friends:	Yes (705)	4.3	1.17 (0.51–2.70)	.71
	No (191)	3.7		
Medical history				
Daily smoker (significant interaction with gender, see Table 6)				
History of treatment for hypertension:	Yes (318)	6.3	2.21 (1.14–4.28)	.019
	No (577)	2.9		
Diabetic:	Yes (145)	8.3	2.62 (1.28–5.24)	.0081
	No (751)	3.3		
Previous MI:	Yes (211)	8.5	3.27 (1.68–6.35)	.0005
	No (685)	2.8		
Characteristics of index MI				
Thrombolysis:	Yes (387)	2.8	0.54 (0.27–1.11)	.10
	No (509)	5.1		
Non-Q wave MI (significant interaction with gender, see Table 6)				
Killip class:	≥2 (274)	8.4	3.98 (2.01–7.85)	.0001
	1 (622)	2.3		
Left ventricular ejection fraction (significant interaction with gender, see Table 6)				
Revascularized during index admission:	Yes (227)	1.3	0.25 (0.076–0.82)	.023
	No (669)	5.1		
Psychological factors				
Symptoms of depression (BDI):	≥10 (290)	7.6	3.23 (1.65–6.33)	.0006
	<10 (606)	2.5		
Anxiety (STAI) (marginally significant interaction with gender, see Table 6)				
Anger-in:[c]	≥20 (225)	4.9	1.28 (0.62–2.65)	.50
	<20 (648)	3.9		
Anger-out:[c]	≥18 (215)	3.3	0.74 (0.32–1.72)	.48
	<18 (667)	4.3		
Perceived social support (PSSS):	≤64 (223)	4.5	1.25 (0.59–2.66)	.56
	>64 (664)	3.6		
Social desirability (MCS):	>11 (179)	3.9	0.93 (0.40–2.14)	.86
	≤11 (712)	4.2		

[a] Includes baseline variables without significant gender interactions. Variables with significant gender interactions in relation to cardiac mortality are shown in Table 6.
[b] OR = odds ratio.
[c] Based on the Spielberger Anger Expression Scale.

after discharge. Although patients with high BDI scores in hospital were more than twice as likely to see a psychiatrist than were patients with BDI scores < 10 [odds ratio was 2.58 (95% CI = 1.72–3.89)], most patients with high BDI scores never saw a psychiatrist. Only 18.2% of the men with high BDI scores and 21.2% of the women had any contact with a psychiatrist. Among the patients who completed interviews during the year after discharge (839) only 36 reported a prescription for antidepressants, and none of these were for tricyclics. There was no relationship between psychiatric contact and mortality or reported antidepressant use and mortality for either gender.

DISCUSSION

Our results indicate that depression after MI is a risk factor for cardiac mortality over the subsequent year in

TABLE 6. Gender by Baseline Variable Interactions for One-Year Cardiac Mortality After an MI

Variable	Variable Category	Cardiac Mortality		OR[a] for Cardiac Mortality Associated With Variable			
		Women	Men	Women		Men	
		% (*N*)	% (*N*)	OR (95% CI)	*p* Value	OR (95% CI)	*p* Value
Non-Q wave MI at index:	Non-Q wave	4.8 (105)	7.7 (209)	0.86 (0.28–2.64)	.79	5.35 (2.06–13.88)	.0006
	Q wave	5.5 (164)	1.5 (393)				
Left ventricular ejection fraction:	≤35%	6.1 (49)	12.6 (119)	1.38 (0.36–5.20)	.64	11.37 (4.31–30.00)	<.00001
	>35%	4.5 (221)	1.3 (479)				
Daily smoker:	Yes	1.6 (126)	3.4 (298)	0.18 (0.04–0.81)	.025	0.88 (0.37–2.06)	.76
	No	8.3 (157)	3.8 (315)				
Anxiety (STAI):	>43	4.0 (101)	7.0 (115)	0.63 (0.20–2.04)	.45	2.58 (1.06–6.30)	.038
	≤43	6.1 (180)	2.8 (497)				

[a] OR = odds ratio.

TABLE 7. Multivariate Baseline Predictors of One-Year Cardiac Mortality

	OR[a] Adjusted for Other Variables in Multivariate Model	95% CI	*p* Value
Age (per year increase)	1.04	0.99–1.08	.071
Killip class > 2	2.17	0.96–4.92	.063
Non-Q wave MI[b]			
Women	0.75	0.21–2.70	.66
Men	0.25	0.088–0.69	.0077
Left ventricular ejection fraction ≤ 35%[c]			
Women	0.73	0.15–3.44	.69
Men	7.97	2.80–22.71	.0001
Daily smoking[d]			
Women	0.44	0.077–2.49	.35
Men	1.83	0.65–5.11	.25
Depression (BDI ≥ 10)	3.66	1.68–7.99	.0011

[a] OR = odds ratio.
[b] *p* Value for interaction of gender by non-Q wave MI after control for other variables in the model = .16.
[c] *p* Value for interaction of gender by left ventricular ejection fraction after control for other variables in the model = .014.
[d] *p* Value for interaction of gender by smoking after control for other variables in the model = .048.

both women and men, and that its impact remains after controlling for other measures of cardiac risk. Although women were twice as likely to report post-MI symptoms of depression as men, the doubling in rate of depression in women did not result in a significantly higher mortality rate in women. Of the variety of cardiac outcomes examined, only MI recurrences were more common in women than men. However, it was primarily cardiac deaths, particularly arrhythmic events, not MI recurrences that were linked to depression, and the gender difference in MI recurrences remained after control for depression. Arrhythmic events were marginally more common in men than in women, but all of the arrhythmic events in women occurred in women with increased BDI scores. As intriguing as this contrast is, only 3 women had arrhythmic events in contrast to 19 men, making definite conclusions impossible. We can only speculate regarding the relative importance of depression in arrhythmic versus thrombotic events. Classification of causes of death always involves a subjective component (18), and the apparent difference may, in fact, be an artifact of the limited power in our data set. As in other recent studies of hospital survivors, death rates were much lower for both genders than reported in most earlier research (19, 20). With the observed overall cardiac mortality rate of only approximately 5%, almost 5000 patients would have been needed to reliably detect a statistically significant gender difference in mortality of the size found in this study. An even larger sample would have been needed to examine arrhythmic events. The clinical meaningfulness of such small differences in outcome between women and men is unclear. Finally, in the context of recent successful changes in post-MI medical management, the role of previously important prognostic factors, such as gender, may also have changed (19). It is also relevant to emphasize that patients in our sample had to survive long enough to complete baseline measures of psychological status. Those who died in the early postinfarct period were not interviewed. Thus, we were unable to examine the relationship of depression to in-hospital mortality, the outcome for which gender differences have been most strongly documented in the past (4, 7).

In their recent review of the literature concerned with gender differences in mortality after MI, Vaccarino et al. (7) reported that despite the large amount of variability among the more than 20 studies examined, women MI patients tended to be older, and were more likely than men to have a history of hypertension, congestive heart failure, and diabetes. They experienced more complications at the time of the MI

including congestive heart failure and cardiogenic shock, but there was also evidence of greater preservation of left ventricular function in women. Men, however, were more likely to have had a previous infarct, to smoke, and to have arrhythmic complications. With the exception of smoking (women and men in the current sample were about equally likely to have smoked before the index MI), these differences closely parallel our results. Our data also indicate that, as in the few studies that have assessed social factors (7, 21), women, partially because of their older age, are more likely to be unmarried and living alone, and to have less education than men. The current data now add to this pattern by documenting gender-related differences in psychological factors. We found that women report more depression and anxiety symptoms than men, and that men tend to report more anger directed outward. The observation that anxiety increased the risk of cardiac mortality for men and not for women was of only marginal statistical significance, but may be of some clinical importance, and deserves additional study. However, depression was the only psychological factor with a significant survival impact over the first post-MI year for both genders. This may indicate that depression is more important than other psychological factors, or it may reflect the fact that depression was better measured than anxiety and anger.

It is also worth noting that the approximate doubling in rates of post-MI depression associated with female gender is similar to the ratio reported in many epidemiological studies of psychiatric disorder in the general community (22, 23). Although some authors have speculated that women are more willing to report depressive symptoms than men (24), and others have suggested that there is a gender difference in tendencies to ruminate about interpersonal interactions that leads women to be more easily depressed (25), the reasons for the higher rates of depression among women remain controversial. However, our finding of similar increases in mortality risk associated with increased BDI scores in women and men suggests that mild to moderate symptoms of depression have an intrinsic clinical value for both genders. Patients reporting this level of symptoms deserve closer psychiatric evaluation, regardless of gender.

Not only did depression have a similar degree of impact for women and men, but also the baseline factors related to depression were almost identical for the two genders. Both men and women who were depressed were significantly more likely to have a history of hypertension, advanced Killip class, and impaired ventricular function, and marginally more likely to be diabetic. Although statistically significant, the differences in disease severity between the depressed and nondepressed were relatively small, and the impact of depression remained after control for measures of disease severity.

We found two interrelated gender differences in the correlates of depression. Men who lived alone and who were unmarried were significantly more likely to be depressed than others. This suggests that depression may be a mechanism explaining previously reported links between social isolation with mortality in cardiac patients (21, 26), at least among men. However, among women, the unmarried and those living alone were less likely to be depressed. Interestingly, a recent Swedish study that examined gender differences in the characteristics of patients hospitalized for depression found that a greater percentage of women were married than men, and conversely that there were more men who had lived alone before admission (27). The authors suggest that for men marriage provides a special degree of closeness that is not available in other relationships, but that for women the same degree of closeness and support can be obtained from a variety of sources, so that living alone confers no special risk for them.

Our research has several limitations. First, it involved secondary analysis of data sets from two separate studies, neither of which was designed in advance to examine gender differences in prognostic factors. Although the mortality rate was lower in the M-HART control group (3.4%) than in the EPPI study (6.4%; $p = .054$), and a greater proportion of women were included in M-HART (34.8% vs. 21.6%; $p < .0003$), there was no evidence that the rates of elevated BDI scores (32.7% vs. 31.2%; $p = 0.67$) or the predictors of depression or mortality differed between the studies. The second limitation is that women and older patients were significantly more likely to refuse to participate than men and younger individuals. Thus, results cannot be generalized beyond the type of patient who is willing to participate in psychological screening interviews during hospitalization. Thirdly, it must be remembered that the BDI assesses the severity of depressive symptomatology, not the diagnosis of major depression. Although the BDI seems to be a good instrument to screen patients at increased risk of cardiac mortality, it is premature to say that 50% of women and 25% of men who experience MIs also experience a clinically significant depression. Unfortunately, although a measure of depression based on psychiatric criteria (the Diagnostic Interview Schedule; Ref. 28) was included in the EPPI study, it was not part of the M-HART trial. Thus, we cannot evaluate the sensitivity and specificity of different cutoff points of the BDI score for predicting major depression in women in

contrast to men. We also do not know how many of the patients with increased BDI scores might have responded to antidepressant or psychotherapeutic treatment. Finally, although the current analyses include a substantial number of women and men who experienced MIs, the absolute number of cardiac deaths was relatively small, limiting our ability to control statistically for multiple variables and higher level interactions.

As the evidence accumulates that depressed post-MI patients are at increased risk for cardiac events, the need to provide effective and safe treatment strategies becomes more and more imperative. However, the risk of poor prognosis is not the only reason to want to be able to treat post-MI depression. In fact, with current cardiac treatment regimens, the prognosis after MI is quite good, even for depressed patients. We need to remember that beyond its impact on prognosis, depression results in considerable suffering for patients and families. This fact in and of itself justifies continued research into safe and efficacious treatments for post-MI depression for both women and men.

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ANNOUNCEMENT

Scientific Publishing Workshop

The American Psychosomatic Society will be offering a Scientific Publishing Workshop at the annual meeting in Vancouver, Canada. March 17–20, 1999. The workshop will be held on Wednesday the 17th from 2:00 to 5:00 pm. followed by the evening opening reception.

The workshop will be hosted by former journal Editors-in-Chief, including past editors of ***Psychosomatic Medicine***, *Health Psychology,* and *Psychophysiology*. The general theme will be "everything you always wanted to ask an editor but were afraid to." Issues to be covered include selecting the appropriate journals for your manuscripts, interpreting reviewer comments, and sculpting response letters. The workshop is designed primarily for younger colleagues and international attendees, but all are welcome to attend. Editors will give brief presentations based on their experiences and the cumulative wisdom derived from many years of editing. Attendees will also participate in small groups where particular questions and issues could be addressed. Attendees may bring copies of manuscripts or correspondence for review. There is no additional registration fee for this workshop.