

Effect of Low Perceived Social Support on Health Outcomes in Young Patients With Acute Myocardial Infarction: Results From the Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients (VIRGO) Study

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Background—Social support is an important predictor of health outcomes after acute myocardial infarction (AMI), but social support varies by sex and age. Differences in social support could account for sex differences in outcomes of young patients with AMI.

Methods and Results—Data from the Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients (VIRGO) study, an observational study of AMI patients aged ≤ 55 years in the United States and Spain, were used for this study. Patients were categorized as having low versus moderate/high perceived social support using the ENRICHD Social Support Inventory. Outcomes included health status (Short Form-12 physical and mental component scores), depressive symptoms (Patient Health Questionnaire), and angina-related quality of life (Seattle Angina Questionnaire) evaluated at baseline and 12 months. Among 3432 patients, 21.2% were classified as having low social support. Men and women had comparable levels of social support at baseline. On average, patients with low social support reported lower functional status and quality of life and more depressive symptoms at baseline and 12 months post-AMI. After multivariable adjustment, including baseline health status, low social support was associated with lower mental functioning, lower quality of life, and more depressive symptoms at 12 months (all $P < 0.001$). The relationship between low social support and worse physical functioning was nonsignificant after adjustment ($P = 0.6$). No interactions were observed between social support, sex, or country.

Conclusion—Lower social support is associated with worse health status and more depressive symptoms 12 months after AMI in both young men and women. Sex did not modify the effect of social support. (*J Am Heart Assoc.* 2014;3:e001252 doi: 10.1161/JAHA.114.001252)

Key Words: myocardial infarction • prognosis • sex

Social support is an important predictor of prognosis after acute myocardial infarction (AMI) in older populations, with numerous studies finding that patients with low

perceived social support have worse outcomes after AMI, including higher mortality,^{1–4} more cardiac events,^{5,6} and reduced health status.^{7–9} In fact, social support has been shown to be equivalent to many classic risk factors predicting prognosis after AMI,¹⁰ highlighting its utility as both a tool for risk stratification and a potential target for interventions to improve post-AMI outcomes.

Although the literature on social support and cardiovascular (CV) outcomes is abundant, most has been conducted in populations of predominately older men. Relatively little is known about the role of social support in younger patients, particularly women. Compared with elderly patients, young patients with AMI are in an entirely different stage of life, with different social connections and support structures. Research in the general population has shown that whereas older individuals are more likely to rely on their immediate family for help, young people tend to include fewer family members and more friends and coworkers in their support networks.^{11–13} In addition, young people may experience more stress from work, raising a family, or social obligations, which may compromise their established support structures.¹⁴ In fact, studies have

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consistently shown that younger people require larger social networks than older people to maintain a sense of well-being.¹⁵ Collectively, these observations suggest that the quantity and function of social support varies across the lifespan, which may limit the generalizability of findings in older AMI populations.

Additionally, young women with AMI may represent a group at particularly high risk of low social support. Although population-based studies have found that both receiving and giving support decline as age increases,^{13,16,17} reports in the cardiac literature have generally shown lower levels of social support in young patients after AMI.^{3,7} However, in all of these studies, the average age of patients was still >60 years. Almost nothing is known about the magnitude of social support in younger patients (<55 years old) and whether the associations found in older populations translate to their younger counterparts. Important gender differences in social support have also been noted at the time of AMI. Whereas studies in the general population report larger and more-varied social networks in women than men,^{18,19} nearly all studies in cardiac populations have noted lower support in women across the age spectrum.^{20,21} Researchers have hypothesized that these gender differences may be the result of women's roles as the primary caretakers, prompting them to minimize the impact of their disease in order to avoid burdening others.²⁰ In addition, women may receive less information about their cardiac disease and experience a lack of belief in their heart problems from providers.²⁰ Thus, young women may be at increased risk of low social support both at the time of AMI and during the course of recovery, which may place them at higher risk of adverse outcomes.

The Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients (VIRGO) study provides a unique opportunity to examine social support in young women with AMI. This prospective, multicenter study contains detailed information on patients' sociodemographic and psychosocial characteristics as well as data on mental health, depressive symptomatology, and quality of life during follow-up. Whereas previous studies have focused primarily on mortality and physical functioning, VIRGO allows for the investigation of both the physical and mental health consequences of low social support after AMI. We sought to characterize gender differences in the distribution of social support after AMI in young patients and the association of low social support with short-term health outcomes, including health status, depression, and disease-specific quality of life.

Methods

Patient Population

VIRGO is a prospective, observational study designed to examine presentation, treatment, and outcomes of young

patients with AMI. The methods of this study have been described previously.²² In brief, between August 2008 and May 2012, patients 18 to 55 years of age were recruited into the VIRGO study from 103 U.S. and 24 Spanish hospitals. Of the 5585 patients eligible for the VIRGO study in the United States, Spain, and Australia, 3752 were enrolled. Given the small number of patients enrolled in Australia, we limited the analyses to only patients enrolled in the United States and Spain (n=3501). The diagnosis of AMI was confirmed by the presence of elevated cardiac enzymes (troponin or creatine kinase) and supporting evidence of myocardial ischemia, including at least one of the following: symptoms of ischemia; ECG changes suggestive of new ischemia; or other evidence of myocardial necrosis on imaging. Patients transferred from other institutions >24 hours after symptom onset and patients with elevated cardiac markers as a complication of elective coronary revascularization were not eligible for inclusion. We also excluded patients with missing social support data (ENRICH Social Support Instrument; ESSI) at baseline (n=69, 2% of patients). Patients missing ESSI data were less likely to be white (63.8% vs. 78.8%; $P=0.003$) and more likely to report financial instability (48.1% vs. 32.5%; $P=0.018$). No differences in gender, age, or baseline or 12-month health status were observed between those with and without recorded ESSI scores. The final study cohort included 3432 patients.

Information on patient demographics, clinical presentation, and treatment was collected by medical chart abstraction and standardized in-person interviews administered by trained personnel during the index AMI admission. Study outcomes (mortality and health status) were assessed through follow-up telephone interviews at 1 and 12 months administered by the Yale Follow-Up Center in the United States and by ANAGRAM in Spain. Institutional review board approval was obtained at each participating center, and all patients provided written informed consent.

Variable Definitions

Perceived social support was measured during the index hospitalization using the ESSI. This scale is a reliable and valid assessment of social support in cardiac populations^{23,24} and has been used by several studies to evaluate social support after AMI.^{2,3,7,8} The full-length ESSI is a 7-item self-report survey that assesses 4 domains of social support: emotional, instrumental, informational, and appraisal. For this particular study, we examined marital status and instrumental support separately from perceived social support and thus omitted them from the overall ESSI assessment (items 4 and 7). The remaining 5 items (1, 2, 3, 5, and 6) were summed to create a total score ranging from 5 to 25, with higher scores indicating greater perceived social support. This 5-item scale has been

previously validated and is highly correlated with the full-length 7-item scale.²³ It has also been used in previous studies of patients with coronary artery disease (CAD).^{7,25,26} Using standard criteria, we defined low social support as a score ≤ 3 on at least 2 items and a total score of ≤ 18 .

Outcomes after AMI included mortality, health status, quality of life, and depressive symptoms at 1 and 12 months. Health status was evaluated using the Short Form-12 (SF-12) physical and mental component scores (PCS and MCS) administered during the index hospitalization and at 1 and 12 months post-AMI. The SF-12 has been demonstrated to be both a valid and reliable instrument and is the most widely used generic health status instrument to quantify patients' mental and physical functional status.²⁷ Scores for the PCS and MCS range from 0 to 100, with lower numbers indicating poorer health status. On both, a score of 50 reflects the population mean and 10 points reflects 1 standard deviation from the mean. Disease-specific quality of life was evaluated using the Seattle Angina Questionnaire (SAQ-QoL), a 19-item self-administered questionnaire that measures 5 dimensions of CAD.²⁸ This measure has been shown to be both valid and reliable in patients with AMI and has been used extensively in cardiovascular research.^{29,30} For this study, we focused on the quality-of-life component, which ranges from 0 to 100, with lower numbers indicating poorer quality of life. Finally, depressive symptoms were assessed using the 9-item Patient Health Questionnaire (PHQ-9).^{31,32} Scores range from 0 to 27; higher scores represent greater depressive symptomatology, and a score of ≥ 10 is suggestive of moderate depressive symptoms.³¹

Statistical Analyses

We compared ESSI scores and the percentage of patients with low social support at baseline between men and women using Wilcoxon's rank-sum tests and chi-squared tests overall and by country. Baseline characteristics of patients with low social support were compared with those with moderate or high social support using chi-squared tests for categorical variables and Wilcoxon's rank-sum tests for continuous variables. Unadjusted associations between low social support and 1- and 12-month outcomes after AMI were evaluated visually by plotting mean health status over time and statistically by using chi-squared tests for mortality and Student *t* tests for SF-12, SAQ-QoL, and PHQ-9 scores.

To assess the independent relationship between low social support and 12-month outcomes, we used linear regression to evaluate differences in 12-month SF-12, SAQ-QoL, and PHQ-9 scores between social support groups while adjusting for patient characteristics. Given the low mortality rate in our sample (2% overall), we did not evaluate mortality in multivariable models. Potential covariates for multivariable analyses were selected using a combination of clinical and

statistical judgment. These included patient demographic data (gender, age, race, marital status, living alone, education, employment, financial solvency [defined as the ability to make ends meet each month], and insurance status), medical history (hypertension, diabetes, previous coronary disease, smoking status, alcohol abuse, and depression), clinical presentation (GRACE [Global Registry of Acute Coronary Events] score, presence of ST-elevation AMI), and treatment (reperfusion therapy and cardiac rehabilitation referral). Baseline scores for the health status measure being analyzed were included in the model in order to examine the effect of social support on 12-month health status independent of differences in baseline scores. A backwards elimination strategy was used to identify the most parsimonious model for each outcome. Specifically, we evaluated all available variables for those that we thought could be associated with both social support and health outcomes based on previous reports, face validity, and clinical judgment. Nineteen candidate variables were identified, which we included in the initial model and then removed sequentially from least to most significant. Changes in the likelihood ratio and other parameter estimates were evaluated, and variables were retained if they were significant ($P < 0.05$) in the model or with likelihood ratio testing. Because social support status was the primary variable of interest, baseline and 12-month social support were retained in all models regardless of significance. In addition, we tested interactions between gender and low social support in each of the adjusted models.

Finally, given the observed differences in ESSI scores between Spanish and U.S. patients at baseline, we repeated all analyses stratified by country to determine whether the relationship between low social support and 12-month health status differed for Spanish and U.S. patients. In addition, we formally evaluated the interaction between country and low social support in each of the adjusted models.

Missing covariate data were minimal, with 14.5% of patients missing any covariate data (12.9% missing 1 covariate and 1.6% missing > 1 covariate). Missing covariates were imputed using a multiple imputation approach in SAS (SAS Institute Inc., Cary, NC), which allowed incorporation of all patients into multivariable models.

At 12 months, 799 (23.3%) participants were missing information on at least 1 health status measure, of whom 716 patients were missing all 4 scores. To examine whether missing data affected our results, we performed a sensitivity analysis by imputing missing health status measures. The multiple imputation models contained all variables used in the multivariable model in addition to other variables that provided information for the imputation (eg, 1-month health status scores to impute 12-month scores). Deceased patients ($n=83$) were excluded from the sensitivity analyses. All statistical analyses were conducted with SAS 9.2.

Results

Of the 3432 patients included in this study, 728 (21.2%) were classified as having low social support using the 5-item ESSI. Fewer Spanish patients were classified as having low social support than U.S. patients (17.6% vs. 22%; $P=0.031$). No gender differences in the distribution of ESSI scores or percentage of patients with low social support were observed in the overall cohort; however, Spanish men were less likely than Spanish women to be classified as having low social support (Table 1). Because there were no observed differences in social support between men and women overall, we chose to model the entire cohort as a whole rather than stratifying by gender. Patients with low social support were more likely to be single, to live alone, and to be unemployed, as compared with patients with moderate/high social support (Table 2). In addition, they were more likely to have cardiovascular risk (CVR) factors, including hypertension, diabetes, and depression, and to smoke or abuse alcohol. No differences in clinical presentation or rates of revascularization were observed between social support levels.

During the initial hospitalization, patients with low social support reported lower functional status and quality-of-life scores and more depressive symptomatology, on average, than patients with moderate/high social support (Table 3). The 1- and 12-month scores presented in Table 3 are adjusted for baseline health status. Therefore, differences between social support groups represent the absolute differences in 1- or 12-month health status that remain after adjustment for differences in baseline health status. These differences in physical and mental health status persisted at 1 and 12 months after AMI. Although mean health status, quality of life, and depression scores improved in all patients over the 12 months of follow-up regardless of social support status, patients with low social support reported poorer health

status, lower quality of life, and more depressive symptoms at all time points than their counterparts with moderate/high support (Figure). Crude mortality at 1 and 12 months was very low in this cohort of young patients ($\approx 2\%$ overall) and did not differ by social support status.

In risk-adjusted models, patients with low social support continued to have lower mean mental functioning scores, lower quality of life, and more depressive symptoms at 12 months (all $P<0.01$). In contrast, mean physical functioning scores were comparable between groups ($P=0.6$; Table 4). No interactions between female gender and low social support were observed in any of the models (all $P>0.1$).

Given differences in baseline social support between the United States and Spain, we examined interactions between country and low social support and repeated analyses stratified by country to determine whether health outcomes in Spanish patients with low social support were different from those of U.S. patients. Interactions between country and social support were nonsignificant in all models (all $P>0.1$). In the United States, low social support was associated with lower functional status and quality-of-life scores and more depressive symptoms at baseline, but in Spain, only mental health status and depressive symptoms differed by social support at baseline (Table 3). After adjustment for demographic and clinical factors, low social support was not significantly associated with 12-month SF-12 MCS, PHQ-9, or SAQ-QoL scores in the Spanish cohort; however, the magnitude and directionality of these adjusted associations were similar for Spanish and U.S. patients (Table 5). In contrast, the relationship between low social support and the SF-12 PCS differed between countries. In the United States, 12-month SF-12 PCS scores were similar between social support groups after adjustment for patient characteristics ($P=0.9$), whereas in Spain, low social support predicted significantly lower physical functioning at 12 months even after multivar-

Table 1. Baseline Differences in Social Support by Gender

	Overall	Men	Women	P Value
Overall	N=3432	N=1129	N=2303	
ESSI, median (IQR)	23 (20, 25)	23 (20, 25)	23 (20, 25)	0.5597
Low social support, N (%)	728 (21.2)	236 (20.9)	492 (21.4)	0.7568
United States	N=2926	N=957	N=1969	
ESSI, median (IQR)	23 (19, 25)	23 (19, 25)	23 (19, 25)	0.7993
Low social support, N (%)	639 (22)	214 (22)	425 (22)	0.6332
Spain	N=506	N=172	N=334	
ESSI, median (IQR)	24 (20, 25)	25 (21, 25)	23 (20, 25)	0.0344
Low social support, N (%)	89 (17.6)	22 (12.8)	67 (20.1)	0.0419

ESSI indicates ENRICH Social Support Inventory; IQR, interquartile range.

Table 2. Baseline Characteristics of VIRGO Population by Social Support Category

	Low Social Support (n=728), n (%)	Moderate/High Social Support (n=2704), n (%)	P Value
Demographics			
Age (y), median (IQR)	48 (44, 52)	48 (43, 52)	0.1762
Nonwhite race	169 (23.3)	559 (20.7)	0.1322
Socioeconomic			
Single marital status	423 (58.3)	1004 (37.3)	<0.0001
Live alone	144 (19.8)	286 (10.6)	<0.0001
High school graduate	364 (51.1)	1434 (54.0)	0.1794
Unemployed	334 (46.0)	963 (35.8)	<0.0001
Insufficient finances to make ends meet	337 (46.7)	769 (28.7)	<0.0001
Cardiovascular risk			
Hypertension	487 (66.9)	1682 (62.2)	0.0198
Diabetes mellitus	277 (38.1)	914 (33.8)	0.0326
Previous cardiovascular disease	266 (36.5)	911 (33.7)	0.1508
Depression (PHQ-9 \geq 10)	358 (51.4)	746 (28.4)	<0.0001
Smoking history			0.0009
Never smoker	177 (24.3)	774 (28.6)	
Past smoker	107 (14.7)	490 (18.1)	
Current smoker	444 (61.0)	1439 (53.2)	
Alcohol abuse*	68 (9.4)	156 (5.8)	0.0005
Clinical presentation			
Time to presentation >6 hours	301 (41.6)	1132 (42.0)	0.8354
GRACE score, mean (SD)	75.8 (19.2)	74.3 (18.4)	0.0675
ST-segment elevation AMI	364 (50.0)	1414 (52.3)	0.2718
LVEF <40% post-AMI	73 (10.5)	289 (11.1)	0.6530
Treatment			
Reperfusion in-hospital			0.3435
None	275 (40.9)	1062 (42.2)	
Fibrinolytic therapy	34 (5.1)	157 (6.2)	
PCI	364 (54.1)	1297 (51.6)	
Cardiac rehabilitation referral	304 (41.8)	1197 (44.3)	0.2257

AMI indicates acute myocardial infarction; GRACE, Global Registry of Acute Coronary Events; IQR, interquartile range; LVEF, left ventricular ejection fraction; PCI, percutaneous coronary intervention; PHQ, Patient Health Questionnaire; VIRGO, Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients.

*Previous enrollment in alcohol treatment program.

able adjustment ($P=0.005$). Sensitivity analyses performed with the imputed data showed nearly identical results for all health outcomes, when compared with analyses using patients with complete outcome data (Tables 6 and 7).

Discussion

In this study of young women and men with AMI, patients with low social support presented with poorer mental health functioning and more depressive symptoms at the time of AMI

than patients with moderate/high social support. These differences across social support groups persisted at 12 months following AMI, which resulted in poorer 12-month mental health and quality-of-life outcomes in patients with low social support. No differences in physical functioning at 12 months were observed by social support in the overall population after adjustment for patient demographics. Although female gender was independently associated with lower health status, quality of life, and more depressive symptoms at 12 months, the association between social

Table 3. Unadjusted Association of Social Support With 1- and 12-Month Outcomes

	Overall			United States			Spain		
	Low Social Support	Moderate/High Social Support	P Value	Low Social Support	Moderate/High Social Support	P Value	Low Social Support	Moderate/High Social Support	P Value
Mortality									
1-month mortality, n (%)	5 (0.7)	12 (0.5)	0.4012	4 (0.6)	12 (0.5)	0.7508	1 (1.1)	0 (0)	0.1759
12-month mortality, n (%)	19 (2.7)	48 (1.8)	0.1456	18 (2.9)	44 (2.0)	0.1632	1 (1.1)	4 (1.0)	0.8868
Physical functional status (SF-12 PCS)									
Baseline, mean (SD)	42.4 (12.3)	44.2 (12.0)	0.0004	41.3 (12.0)	43.4 (12.1)	0.0001	50.3 (11.3)	48.8 (10.5)	0.2488
1 month, mean (SE)*	40.6 (0.4)	42.0 (0.2)	0.0017	40.2 (0.4)	41.6 (0.2)	0.0085	43.0 (1.1)	45.0 (0.5)	0.1080
12 months, mean (SE)*	42.9 (0.5)	44.8 (0.2)	0.0003	43.0 (0.5)	44.4 (0.3)	0.0119	42.3 (1.2)	46.8 (0.5)	0.0006
Mental functional status (SF-12 MCS)									
Baseline, mean (SD)	38.9 (12.3)	47.1 (12.1)	<0.0001	39.0 (12.4)	47.3 (11.8)	<0.0001	38.4 (12.0)	46.4 (13.1)	<0.0001
1 month, mean (SE)*	47.8 (0.4)	50.0 (0.2)	<0.0001	47.9 (0.4)	50.2 (0.2)	<0.0001	47.6 (1.3)	49.5 (0.6)	0.2225
12 months, mean (SE)*	48.2 (0.5)	50.8 (0.2)	<0.0001	48.4 (0.5)	50.9 (0.2)	<0.0001	46.8 (1.6)	49.8 (0.7)	0.0841
Depressive symptomatology (PHQ-9)									
Baseline, mean (SD)	10.8 (6.9)	6.9 (6.0)	<0.0001	11.0 (7.0)	7.0 (6.0)	<0.0001	9.6 (6.2)	6.8 (5.9)	0.0001
1 month, mean (SE)*	5.9 (0.2)	5.0 (0.1)	<0.0001	6.0 (0.2)	4.9 (0.1)	<0.0001	5.9 (0.5)	5.3 (0.2)	0.3270
12 months, mean (SE)*	5.6 (0.2)	4.6 (0.1)	<0.0001	5.4 (0.2)	4.3 (0.1)	<0.0001	6.8 (0.7)	5.8 (0.3)	0.1752
Disease-related quality of life (SAQ-QoL)									
Baseline, mean (SD)	52.7 (24.9)	57.7 (23.6)	<0.0001	52.7 (25.9)	58.8 (24.5)	<0.0001	52.0 (16.8)	51.4 (16.7)	0.7836
1 month, mean (SE)*	63.9 (0.9)	69.1 (0.5)	<0.0001	65.3 (1.0)	71.2 (0.5)	<0.0001	53.7 (2.3)	57.6 (1.0)	0.1196
12 months, mean (SE)*	67.8 (0.9)	73.3 (0.5)	<0.0001	69.3 (1.0)	75.2 (0.5)	<0.0001	57.1 (2.5)	63.2 (1.1)	0.0263

MCS indicates mental component score; PCS, physical component score; PHQ, Patient Health Questionnaire; SAQ-QoL, Seattle Angina Questionnaire quality of life; SF-12, Short Form-12. *Adjusted for baseline scores.

support and health outcomes did not differ by gender. Collectively, our results suggest that young patients with low social support have poorer mental health functioning and more depressive symptoms at the time of AMI, which may place them at higher risk of poorer mental health outcomes over the year following the AMI. However, social support does not explain the differences in young women's poorer baseline or 12-month health status, as compared to men.

It is important to note that although there were significant differences in mental functioning, depressive symptoms, and quality of life between patients with low and moderate/high social support, the absolute magnitude of these differences was relatively small. There are no published criteria for comparing health status scores between 2 distinct populations as we have done in this study; however, there are established values for assessing clinically important differences within patients over time. In general, a change of ≥ 5 to 15 points on either the SF-12 physical or mental component scores, ≥ 5 to 10 on the SAQ, and ≥ 5 on the PHQ-9 are considered clinically meaningful changes within a single patient indicating improvement or worsening of health status. Although these criteria are

not directly applicable to our study, they suggest that the differences in health status between social support groups observed in our study are small and may not be clinically meaningful. Nevertheless, the comparisons reported in this study are overall mean differences and thus there is a wide distribution around these means, with some patients having markedly worse health status, particularly in the low social support group. Additionally, our findings were consistent across all mental health assessments and all time points. These observations suggest that regardless of the absolute magnitude of the difference in scores, patients with low social support appear to be at increased risk of poorer mental health status outcomes after AMI.

These findings are consistent with studies in older populations that have examined the role of social support on health outcomes in cardiac populations.^{7,8,25,33,34} Using data from the Prospective Registry Evaluating Myocardial Infarction: Events and Recovery (PREMIER) cohort study of patients with AMI, Leifheit-Limson et al. showed that patients with low social support had lower mental functioning and more depressive symptoms at 12 months than patients with

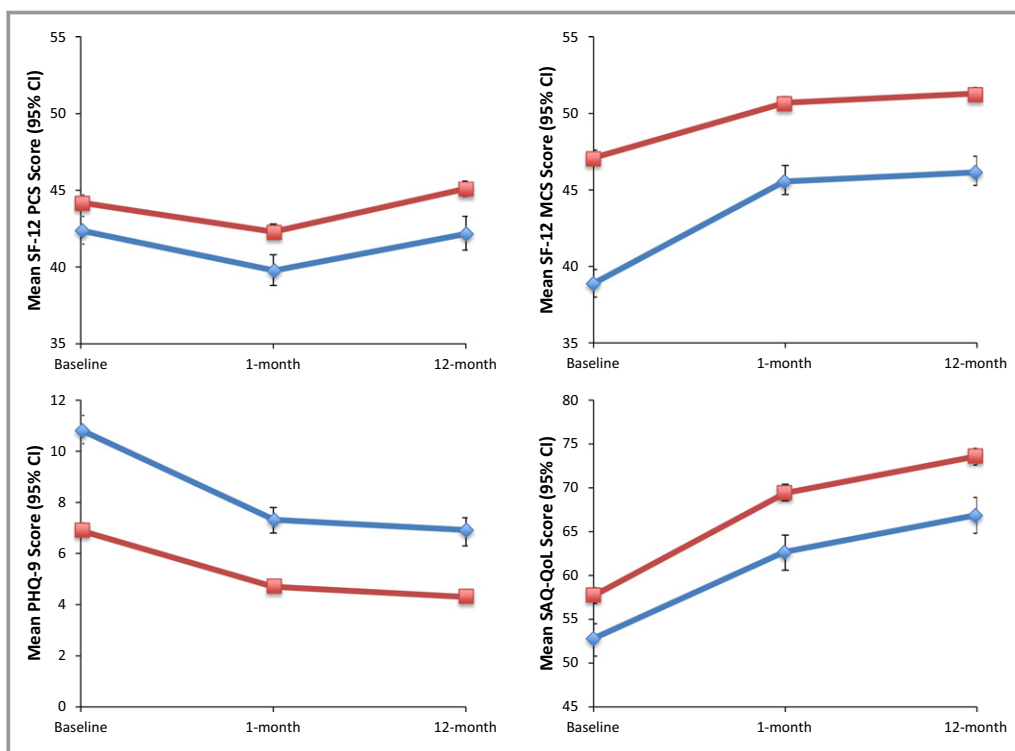


Figure. Mean health status, quality of life, and depression score trajectories at baseline and 1 and 12 months after AMI in patients with low social support (blue lines) and medium/high social support (red lines). These values represent crude baseline and 1- and 12-month scores and are not adjusted for baseline health status. AMI indicates acute myocardial infarction; CI, confidence interval; MCS, mental component scores; PCS, physical component scores; PHQ, Patient Health Questionnaire; QoL, quality of life; SAQ, Seattle Angina Questionnaire; SF-12, Short Form-12.

high social support, but physical functioning was similar across social support levels.⁷ Similarly, Barry et al. found that among patients undergoing coronary artery bypass grafting, increased instrumental support was associated with larger increases in mental health, but not physical functioning, at 6 months.²⁵ As with our study, both Leifheit-Limson et al. and

Barry et al. found differences in mental, but not physical, functioning by social support after adjustment for other patient characteristics.

Unlike previous studies, however, we found no gender differences in social support at baseline or in the effect of social support on health outcomes among U.S. patients.

Table 4. Adjusted 12-Month Health Status Measurements by Social Support Status*

Health Status Measurement	Low Social Support (N=728)	Moderate/High Social Support (N=2704)	Difference in Health Status Between Moderate/High and Low Social Support Groups at 12 Months, Mean (SE)	P Value
SF-12 PCS, mean±SE [†]	44.38±0.48	44.64±0.23	-0.26 (0.54)	0.6340
SF-12 MCS, mean±SE [‡]	48.45±0.45	50.78±0.22	-2.33 (0.51)	<0.0001
PHQ-9 score, mean±SE [§]	5.58±0.23	4.60±0.11	0.98 (0.25)	0.0001
SAQ score, mean±SE	69.79±0.94	73.18±0.46	-3.39 (1.06)	0.0014

MCS indicates mental component score; PCS, physical component score; PHQ, Patient Health Questionnaire; SAQ, Seattle Angina Questionnaire; SF-12, Short Form-12.
 *Multivariable linear regression models were used to calculate adjusted 12-month health status measurements. Data are reported as mean 12-month health status measurements adjusted for patient demographic and clinical characteristics as well as baseline health status. A backwards elimination strategy was used to retain only variables that were significant in each model.
[†]Adjusted for gender, marital status, education, employment, insufficient finances, diabetes, history of coronary artery disease, smoking, GRACE score, and cardiac rehabilitation referral.
[‡]Adjusted for gender, insufficient finances, nationality, history of coronary artery disease, and depression.
[§]Adjusted for gender, marital status, education, employment, insufficient finances, nationality, history of coronary artery disease, and reperfusion therapy.
^{||}Adjusted for age, gender, marital status, education, employment, insufficient finances, nationality, history of coronary artery disease, depression, smoking, and cardiac rehabilitation referral.

Table 5. Adjusted 12-Month Health Status Measurements by Social Support Status in Spanish Patients Only*

Health Status Measurement	Low Social Support (N=89)	Moderate/High Social Support (N=417)	Difference (Moderate/High vs. Low Social Support), Mean (95% CI)	P Value
SF-12 PCS, mean±SE [†]	42.49±1.34	46.67±0.55	-4.18 (-7.05, -1.30)	0.0047
SF-12 MCS, mean±SE [‡]	48.03±1.61	49.73±0.67	-1.70 (-5.16, 1.76)	0.3371
PHQ-9 score, mean±SE [§]	6.44±0.69	5.94±0.29	0.50 (-0.97, 1.97)	0.5069
SAQ score, mean±SE	59.04±2.52	63.13±1.07	-4.09 (-9.49, 1.32)	0.1393

MCS indicates mental component scores; PCS, physical component score; PHQ, Patient Health Questionnaire; SAQ, Seattle Angina Questionnaire; SF-12, Short Form-12.

*Multivariable linear regression models were used to calculate adjusted 12-month health status measurements. Data are reported as mean 12-month health status measurements adjusted for patient demographic and clinical characteristics as well as baseline health status. A backwards elimination strategy was used to retain only variables that were significant in each model.

[†]Adjusted for gender, marital status, education, employment, insufficient finances, diabetes, history of coronary artery disease, smoking, GRACE score, and cardiac rehabilitation referral.

[‡]Adjusted for gender, insufficient finances, nationality, history of coronary artery disease, and depression.

[§]Adjusted for gender, marital status, education, employment, insufficient finances, nationality, history of coronary artery disease, and reperfusion therapy.

^{||}Adjusted for age, gender, marital status, education, employment, insufficient finances, nationality, history of coronary artery disease, depression, smoking, and cardiac rehabilitation referral.

Studies in older populations have generally reported lower levels of social support in women, compared to men, at the time of AMI.²⁰ However, the young women and men in our study had nearly identical distributions of ESSI scores at the time of AMI, which were largely clustered at the high end of the social support spectrum. This observation suggests that gender differences in social support may be less pronounced among younger patients, as compared to older patients.

Several studies have also noted significant social support and gender interactions, whereby the relationship between social support and post-cardiac outcomes is stronger for women than for men.^{7,35-37} However, in our study of younger AMI patients, we did not observe any interactions between gender and social support for any of the health status measures. There are several potential explanations for this observation.

First, it is possible that the similar, narrow distributions of social support scores for men and women in our study precluded us from finding a differential effect by gender. Alternatively, because younger patients have lower social support needs relative to older patients, gender differences in the relationship between low social support and health outcomes after AMI are less pronounced. Finally, it is possible that gender acts as an effect modifier for only certain types of social support. Studies in older populations have suggested that tangible and informational support from family and friends generally increases with advancing age, but emotional support does not.¹³ Whereas older individuals tend to receive more instrumental support, younger persons generally have higher levels of emotional support.³⁸ Thus, we can hypothesize that interactions between gender and social support may only occur with certain subtypes of support.

Table 6. Unadjusted Association of Social Support With 12-Month Outcomes (Mean±SE) With Missing Values Imputed*

	Overall			United States			Spain		
	Low Social Support (N=709)	Moderate/High Social Support (N=2656)	P Value	Low Social Support (N=621)	Moderate/High Social Support (N=2243)	P Value	Low Social Support (N=88)	Moderate/High Social Support (N=413)	P Value
Physical functional status (SF-12 PCS)	42.4±0.5	44.5±0.2	0.0002	42.4±0.5	44.1±0.3	0.0035	43.0±1.2	46.7±0.5	0.0040
Mental functional status (SF-12 MCS)	47.9±0.4	50.5±0.2	<0.0001	48.0±0.4	50.7±0.2	<0.0001	47.1±1.4	49.9±0.6	0.0716
Depressive symptomatology (PHQ-9)	5.8±0.2	4.8±0.1	<0.0001	5.7±0.2	4.6±0.1	0.0002	6.9±0.6	5.9±0.3	0.1186
Disease-related quality of life (SAQ-QoL)	67.1±1.0	72.7±0.5	<0.0001	68.4±1.0	74.5±0.5	<0.0001	57.6±2.5	63.1±1.1	0.0389

MCS indicates mental component score; PCS, physical component score; PHQ, Patient Health Questionnaire; SAQ-QoL, Seattle Angina Questionnaire quality of life; SF-12, Short Form-12.

*Twelve-month health status scores are adjusted for baseline health status.

Table 7. Adjusted 12-Month Health Status Measurements by Social Support Status With Missing Values Imputed*

Health Status Measurement	Low Social Support (N=639)	Moderate/High Social Support (N=2287)	Difference (Moderate/High vs Low Social Support), Mean (95% CI)	P Value
SF-12 PCS, mean±SE	43.94±0.48	44.22±0.22	-0.28 (-1.38, 0.81)	0.6093
SF-12 MCS, mean±SE	48.15±0.44	50.56±0.22	-2.41 (-3.42, -1.40)	<0.0001
PHQ-9 score, mean±SE	5.80±0.22	4.80±0.10	1.00 (0.49, 1.50)	0.0001
SAQ score, mean±SE	69.28±1.02	72.49±0.46	-3.21 (-5.48, -0.94)	0.0060

CI indicates confidence interval; MCS, mental component score; PCS, physical component score; PHQ, Patient Health Questionnaire; SAQ, Seattle Angina Questionnaire; SF-12, Short Form-12.

*All values reported have been adjusted for baseline health status scores.

Although we did not observe differences in social support by gender, we did find interesting differences between the United States and Spain. Among U.S. patients, low social support was associated with poorer mental health and disease-related quality of life; however, it was not associated with physical functioning at 12 months post-AMI. The reverse was true in the Spanish cohort; low social support was associated with worse physical, but not mental, health status. It is important to note, however, that although low social support was not significantly associated with mental health, depression, and disease-related quality of life in the Spanish cohort, the magnitude and directionality of these associations were similar in Spanish and U.S. patients, suggesting that we may have been underpowered to detect an effect within the Spanish cohort. These country-specific results likely stem from differences in household structures and family ties between the United States and Spain. The sociology literature has long recognized differences between Europe and the United States with regard to family ties.³⁹ Compared with families in the United States, Spanish families are characterized by lower divorce rates and larger household sizes because children tend to leave home at an older age.^{40,41} In addition, there are strong cultural norms relevant to family

responsibilities and obligations in Spain that make coresidency of older people with children more common.^{39,42,43} In fact, we noticed marked differences between the United States and Spain in marital status and living arrangements among patients with low social support. Compared with Spain, a greater percentage of patients with low social support in the United States were single (60.9% vs. 39.5%) and lived alone (20.7% vs. 13.6%). This suggests that social support structures likely differ between the 2 countries, which may affect the relationship between social support and health outcomes. Further research is needed to elucidate why these international differences exist and how to develop country-specific interventions that address them.

Although the mechanisms by which low social support negatively affects patient outcomes remain unclear, numerous psychological, behavioral, and physiological theories have been proposed.^{2,44} These range from poor self-care and negative health behaviors to increased financial strain and elevated stress responses. Indeed, we found that patients with low social support had a higher prevalence of all CVR factors and more financial instability than patients with moderate/high social support; however, the effect of social support on health status persisted after adjustment for these

Table 8. Adjusted Difference in Health Status Between Low and Moderate/High Social Support at 12 Months*

Health Status Measurement	Including Depressed Patients		Excluding Depressed Patients	
	Difference in Health Status Between Social Support Groups, Mean (SE)	P Value	Difference in Health Status Between Social Support Groups, Mean (SE)	P Value
SF-12 PCS, mean±SE [†]	-0.26 (0.54)	0.6340	-0.05 (0.69)	0.941
SF-12 MCS, mean±SE [‡]	-2.33 (0.51)	<0.0001	-2.58 (0.63)	<0.001
PHQ-9 score, mean±SE [§]	0.98 (0.25)	0.0001	0.82 (0.30)	0.006
SAQ score, mean±SE	-3.39 (1.06)	0.0014	-3.87 (1.33)	0.004

MCS indicates mental component score; PCS, physical component score; PHQ, Patient Health Questionnaire; SAQ, Seattle Angina Questionnaire; SF-12, Short Form-12.

*Multivariable linear regression models were used to calculate adjusted 12-month health status measurements. Data are reported as mean 12-month health status measurements adjusted for patient demographic and clinical characteristics as well as baseline health status using the same models as presented in Table 4.

[†]Adjusted for gender, marital status, education, employment, insufficient finances, diabetes, history of coronary artery disease, smoking, GRACE score, and cardiac rehabilitation referral.

[‡]Adjusted for gender, insufficient finances, nationality, history of coronary artery disease, and depression.

[§]Adjusted for gender, marital status, education, employment, insufficient finances, nationality, history of coronary artery disease, and reperfusion therapy.

^{||}Adjusted for age, gender, marital status, education, employment, insufficient finances, nationality, history of coronary artery disease, depression, smoking, and cardiac rehabilitation referral.

factors. Depression also plays an intimate role in the relationship between social support and outcomes after AMI. In our sample, patients with low social support had higher rates of depression and more depressive symptoms at all time points during follow-up, and depression was strongly associated with poorer functional status at 12 months. Although we hypothesized that low social support leads to poorer mental health and quality of life after AMI, the reverse may also be true. It is possible that poorer mental health may lead to lower social support through depression and social isolation, or that depression augments or modifies the effect of social support on health outcomes.⁴⁵ However, we found that the association between social support and poorer 12-month health status persisted even when the analyses were limited to patients without depression at baseline (Table 8). Finally, it is worth commenting on the absence of an association between social support and clinical presentation or treatment. In our study, we found no difference in time to presentation, severity of AMI, reperfusion rates, or receipt of quality measures in-hospital. This suggests that much of the association between low social support and negative health outcomes occurs outside of the index hospitalization, either before admission or during follow-up.

Our study has several limitations that should be considered when interpreting these results. First, we examined only perceived social support. Although perceived support may be subject to different interpretations by patients, previous studies have hypothesized that perceived support is more beneficial for those who receive support in times of stress, including illnesses such as AMI.^{46,47} Nevertheless, received support may play an important role during follow-up in determining long-term health outcomes after AMI. Second, we evaluated a summary estimate of social support, rather than evaluating individual components of social support, such as emotional, instrumental, or informational support. Thus, we were unable to assess whether patient outcomes varied by type of social support. Third, we used social support measured only at the index hospitalization and thus were unable to characterize changes in social support during follow-up. Results from PREMIER showed that changes in social support during early AMI recovery were not uncommon and were also important for predicting outcomes in elderly patients.⁴⁸ Given the differences in patient ages between the VIRGO and PREMIER studies, however, it is unclear whether changes in social support after AMI are as common in young patients. Fourth, there was a shift in the interview mode from in-person interviews at baseline to telephone interviews during follow-up. Although this change in interview mode may have influenced patient responses to questions, trained interviewers administered all interviews, and interview modes were consistent across all patients at each time point. Any changes in patients response resulting from interview mode should be

the same for all patients regardless of social support status. Finally, it is possible that patients with low social support tended to report poorer health status as a result of a response shift rather than a causal association between these characteristics. These response shifts may occur if patients with low social support have different internal standards or conceptualization of health status than patients with moderate/high social support. Nevertheless, these scores still reflect patient perception of self-health and quality of life, which are important outcomes in their own right. Regardless of whether differences in these patient-reported outcomes translate into objective differences in health by social support, these differences still warrant attention from physicians to improve mental health and quality of life in patients with low social support.

In summary, we found that among young patients with AMI, those with low social support had poorer mental health status, quality of life, and more depressive symptoms 12 months after the event. This effect was independent of other demographic and clinical factors and comparable for men and women. These findings are most relevant for risk stratification and identifying patients who could benefit from additional support posthospitalization. Future studies should aim to understand the mechanisms underlying the relationship between low social support and poorer mental health outcomes after AMI and to evaluate potential interventions for reducing this risk. Given the low mortality rate in young patients with AMI, it is important to focus on outcomes such as health status, depression, and quality of life when designing interventions for patients with low social support.

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