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Effect of Living Alone on Patient Outcomes after Hospitalization for Acute Myocardial Infarction

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Abstract

Considerable attention has been devoted to the effect of social support on patient outcomes after acute myocardial infarction (AMI). However, little is known about the relation between patient living arrangements and outcomes. Thus, we used data from PREMIER, a registry of patients hospitalized with AMI at 19 US centers between 2003–04, to assess the association of living alone with post-AMI outcomes. Outcome measures included 4-year mortality, 1-year readmission, and 1-year health status, using the Seattle Angina Questionnaire (SAQ) and Short Form-12 physical health component (SF-12 PCS) scales. Patients who lived alone had higher crude 4-year mortality (21.8% vs. 14.5%, $P < 0.001$), but comparable rates of 1-year readmission (41.6% vs. 38.3%, $p = 0.79$). Living alone was associated with lower unadjusted quality of life (mean SAQ -2.40 (95% confidence interval [CI] $-4.44, -0.35$), $p = 0.02$), but had no impact on SF-12 PCS (-0.45 (95% CI $-1.65, 0.76$), $p = 0.47$) compared with patients who did not live alone. After multivariable adjustment, patients who lived alone had a comparable risk of mortality (hazard ratio [HR] 1.35, 95% CI: 0.94–1.93) and readmission (HR 0.99, 95% CI: 0.76–1.28) as patients who lived with others. Mean quality of life scores remained lower among patients who lived alone (SAQ -2.91 (95% CI $-5.56, -0.26$), $p = 0.03$). Living alone may be associated with poorer angina-related quality of life one year post-MI, but is not associated with mortality, readmission, or other health status measures after adjusting for other patient and treatment characteristics.

Keywords

Living alone; acute myocardial infarction; social support

Considerable attention has been devoted to the effect of social support and living arrangements on patient outcomes after acute myocardial infarction (AMI). While living alone has been associated with an increased risk of acute coronary syndrome in the general population, the relationship between living alone and outcomes after AMI is not well understood.¹ While some studies have found a positive association between living alone and

mortality after AMI,² others have not.³ Furthermore, no studies have examined the impact of living alone on quality of life or functional status after AMI. The purpose of this study was to characterize the relationship between living alone and outcomes after AMI including mortality, rehospitalization, and health status.

METHODS

We utilized data from the PREMIER (Prospective Registry Evaluating Myocardial Infarction: Events and Recovery), a national, prospective registry of patients hospitalized with AMI. Registry procedures and baseline data have been previously published.⁴ In brief, PREMIER enrolled 2498 MI patients from 19 US centers between January 1, 2003, and June 28, 2004. To be eligible, patients had to be aged 18 years or older, have an AMI confirmed by cardiac enzymes, and show supporting signs or symptoms of AMI in the form of prolonged ischemia or electrocardiographic ST-elevation changes. For the purpose of these analyses, patients with missing information on living alone were also excluded (N=53) as were patients who were not discharged to hospice, nursing facilities, acute care, non-acute hospitals, or had expired (N=181).

Information on patient demographics, clinical presentation, and treatment were obtained from detailed chart abstractions and baseline interviews administered during the index hospitalization. As part of the interview, patients were asked about their living arrangements at home and categorized as living alone or with others. Patients also completed the ENRICH Social Support Instrument (ESSI), a 7-item self-report survey that assesses four domains of social support: emotional, instrumental, informational, and appraisal.⁵

Outcome measures included 4-year and 1-year mortality, 1-year readmission, and 1-year changes in health status. Data on mortality was obtained through linkage of the Social Security Death Master File to patient identifiers including social security number, name, and date of birth. Changes in health status were measured using the Seattle Angina Questionnaire (SAQ) and the Short Form-12 (SF-12). The SAQ is a 19-item self-administered questionnaire that assesses several domains of coronary artery disease on a scale of 0-100, including physical limitation, angina stability, angina frequency, treatment satisfaction, and angina-related quality of life.⁶ For this study, we focused on the quality of life component as an outcome. Unlike the SAQ which measure disease-specific health status, the SF-12 evaluates general health status using physical and mental component scales (PCS and MCS).⁷ For both scales, lower numbers indicate worse health status.

We compared baseline characteristics of patients who lived alone to those living with others using χ^2 or Fisher's exact tests for categorical variables and t-tests for continuous variables. To evaluate the independent association of living alone with mortality, rehospitalization, and health status measures, we used Cox proportional hazards regression and linear regression models to adjust for patient and clinical characteristics. Covariates for multivariable analyses were selected using a combination of clinical judgment and examining the association between these factors and living alone status. They included patient demographics (age, gender, race, body mass index, marital status, employment status, living location, pet ownership, medical care payer, usual source of care, financial barriers to health care utilization), medical history (hypertension, depression, previous AMI, chronic heart failure), clinical presentation and treatment (left ventricular systolic function, creatinine, receipt of ACE inhibitor and beta blockers at discharge), ESSI score, and baseline health status scores.

RESULTS

Of the 2,264 patients with living arrangement data in our sample, 471 patients (20.8%) reported living alone. A greater percentage of patients who lived alone were female and unemployed compared with patients who lived with others (**Table 1**). Patients living alone also tended to be older, to score lower on the ESSi, and to present with lower mean quality of life and physical functioning scores. Both groups were comparable with respect to other clinical characteristics and treatment variables.

Patients who lived alone had a higher unadjusted 1-year and 4-year mortality, but similar rates of 30-day mortality and 1-year readmission as patients who lived with others (**Table 2**). Living alone was also associated with lower unadjusted quality of life adjusted for baseline scores and mental functioning but had no association with physical functioning compared with patients who did not live alone (**Table 3**).

After adjustment for patient and clinical characteristics, there were no significant differences in mortality between those living alone and those living with others (4-year mortality hazard ratio [HR] 1.35, 95% CI: 0.94-1.93) (**Table 4**). Mean quality of life scores remained slightly lower among patients who lived alone (SAQ -2.87 [95% CI -5.52, -0.22], $p=0.03$), while mean mental and physical functioning scores were comparable between the groups (SF-12 MCS -0.90 [95% CI -2.32, 0.53], $p=0.22$; SF-12 PCS 1.04 [95% CI -0.58, 2.66], $p=0.21$) (**Table 5**). Other variables associated with increased mortality and rehospitalization included being female, living in a nursing home or assisted living facility, hypertension, congestive heart failure, and presenting with an elevated creatinine level (**Table 6**). In contrast, homelessness, difficulty obtaining medical care, and receipt of depression medication or counseling were associated with worse health status measures at 1-year.

DISCUSSION

Living alone appears to be associated with poorer angina-related quality of life at one-year and a higher risk of mortality at four years post-MI. Differences in mortality were attenuated after multivariate adjustment indicating that certain patient and clinical characteristics explain some of the relationship between mortality and living alone. Nevertheless our results suggest that patients living alone may be at greater risk of adverse outcomes.

These results are consistent with a few studies that have found a positive association between living alone and worse outcomes following AMI. Data from the Multicenter Diltiazem PostInfarction Trial showed that living alone was a significant predictor of recurrent cardiac events including nonfatal infarction and cardiac death up to 4 years post-AMI.² Similarly, in a study of women after acute myocardial infarction, Norekval et al. observed a higher rate of 10- year mortality among women living alone.⁸ In contrast, Schmaltz et al. found that men, but not women, who lived alone had a higher risk of 3-year mortality than those who lived with others.⁹ While most studies examining this relationship have found a positive unadjusted association between living and mortality, some have found no differences in mortality or reported that these differences did not persist after adjustment. For example, in a population-based study of elderly patients, Berkman et al. found no difference in survival among patients living alone and those living with others; however, they did find that lack of emotional support was significantly associated with 6-month mortality.¹⁰ Similarly, in the Global Use of Strategies to Open occluded coronary arteries (GUSTO)-III trial, patients living alone had a higher crude mortality at 1 year than patients living with others, but these differences became nonsignificant after adjustment for patient age, gender, race, and region of enrollment.³ These observed inconsistencies in results may

be explained, in part, by methodological differences in patient demographics, sample size, and length of follow-up.

Several mechanisms have been proposed to explain the relationship between living alone and patient outcomes ranging from lack of medical supervision and poor adherence to neurohumoral responses associated with human contact and psychological distress.² Given that patients with AMI are at greater risk of psychological stress and depression, living alone may serve to exacerbate the link between these factors and adverse cardiovascular outcomes by limiting social support and utilization of mental health resources. In fact, patients in PREMIER who lived alone were more likely to be receiving medication or counseling for depression and to have lower ESSi social support scores as compared to patients who lived alone. Similarly, patients who live alone may be less likely to adhere to medication regimens and follow-up recommendations without the supervision and financial support of others. However, these mechanisms likely vary by age and other patient characteristics. One such characteristic that deserves mentioning is marital status. In our sample, a greater percentage of patients living alone were divorced compared with those living with others (32.1% vs. 9.1%), which may have increased patient levels of stress or further limited their access to social support. Although we controlled for marital status in our multivariable models, it is possible that we were unable to fully adjust for the effects of marital status on patient outcomes. Several studies have found that marriage is an important predictor of survival after myocardial infarction in both the short-term¹¹ and the long-term.¹² However, it is unclear whether this association is independent of other psychosocial factors including social support and living alone. For example, Wellin et al. found that marital status, marital strain, and dissatisfaction with family life were not significantly associated with mortality after first infarction after adjustment for social support.¹³ Similarly, findings from the Multicenter Diltiazem Post-Infarction Trial suggest that having a disrupted marriage is not a significant predictor of recurrent cardiac events after controlling for living alone.²

Limitations of this study include possible self-report bias on interview and survey questions and the inability to characterize changes in living arrangements during follow-up. In addition, excluding patients with missing data on living arrangements may have biased the results if the outcomes of these patients differed from those included in the sample. However, we believe this is unlikely given the small number of patients with missing data (N=53). Finally, the findings of this study may not be generalizable to other patient populations, particularly elderly or rural populations. Nevertheless, this study has several strengths including a large, multicenter sample, prospective long-term follow-up, and data on numerous patient and clinical characteristics. Our data suggest that living alone is associated with poorer quality of life post-MI and higher crude mortality, although differences in mortality may be attributable to differences in clinical characteristics.

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Table 1

Patient and clinical characteristics of sample *

Variable	Living Alone		p-value
	Yes (N=471)	No (N=1,793)	
Age (years), mean (SE)	62.7 ± 13.5	59.3 ± 12.3	<0.001
Female	200 (42.5%)	523 (29.2%)	<0.001
Race			0.004
White	321 (68.3%)	1354 (75.9%)	
Black	129 (27.4%)	344 (19.3%)	
Hispanic	12 (2.6%)	43 (2.4%)	
Asian	2 (0.4%)	5 (0.3%)	
Other	6 (1.3%)	37 (2.1%)	
Marital status			<0.001
Married	51 (11.0%)	1301 (73.0%)	
Divorced	145 (31.2%)	162 (9.1%)	
Separated	31 (6.7%)	51 (2.9%)	
Widowed	145 (31.2%)	113 (6.3%)	
Single (never married)	8 (1.8%)	126 (7.1%)	
Common Law	6 (1.3%)	23 (1.3%)	
Other	3 (0.6%)	5 (0.3%)	
Employment status			<0.001
Full time	130 (27.7%)	713 (40.1%)	
Part time	39 (8.3%)	150 (8.4%)	
Unemployed	301 (64.0%)	916 (51.5%)	
Living location			<0.001
Owned home	229 (48.8%)	1351 (76.2%)	
Owned home or apartment	199 (42.4%)	264 (14.9%)	
Relative or friend's home	19 (4.1%)	140 (7.9%)	
Nursing home or assisted living	7 (1.5%)	3 (0.2%)	
Homeless	5 (1.1%)	4 (0.2%)	
Other	10 (2.1%)	11 (0.6%)	
Pet ownership	146 (31.1%)	896 (50.1%)	<0.001
Medical care payer			<0.001
Commercial/Preferred provider organization	136 (30.2%)	789 (45.8%)	
Health maintenance organization	50 (11.1%)	225 (13.1%)	
Medicare	155 (34.4%)	334 (19.4%)	
Medicaid	32 (7.1%)	93 (5.4%)	
None/self-pay	54 (12.0%)	214 (12.4%)	
Other	24 (5.3%)	67 (3.9%)	
Usual source of care			0.002
None	57 (12.2%)	191 (10.8%)	
Private doctor's office	211 (45.0%)	869 (49.0%)	
Health maintenance organization or prepaid health plan	30 (6.4%)	139 (7.8%)	
Neighborhood clinic	27 (5.8%)	167 (9.4%)	
Hospital outpatient clinic	121 (25.8%)	358 (20.2%)	
Hospital emergency room	14 (3.0%)	21 (1.2%)	
Other	7 (1.5%)	25 (1.4%)	
Avoided getting health care due to cost	108 (23.3%)	304 (17.2%)	0.003
Body mass index (kg/m ²)			<0.001

Variable	Living Alone		p-value
	Yes (N=471)	No (N=1,793)	
< 18.5	11 (2.5%)	20 (1.2%)	
18.5-25	139 (31.7%)	351 (20.5%)	
25-30	147 (33.5%)	629 (36.7%)	
30-35	87 (19.8%)	437 (25.5%)	
35-40	41 (9.3%)	165 (9.6%)	
>40	14 (3.2%)	110 (6.4%)	
Smoker	293 (62.2%)	491 (27.4%)	0.918
Alcohol use			0.248
Never	161 (71.6%)	691 (71.3%)	
Less than monthly	34 (15.1%)	140 (14.4%)	
Monthly	15 (6.7%)	64 (6.6%)	
Weekly	6 (2.7%)	53 (5.5%)	
Daily	9 (4.0%)	21 (2.2%)	
Diabetes mellitus	139 (29.5%)	491 (27.4%)	0.359
Hypertension	321 (68.2%)	1100 (61.3%)	0.007
Hypercholesterolemia	220 (46.7%)	908 (50.6%)	0.129
Congestive heart failure	59 (12.5%)	181 (10.1%)	0.127
Peripheral arterial disease	34 (7.2%)	127 (7.1%)	0.919
Previous myocardial infarction	115 (24.4%)	360 (20.1%)	0.040
Medication or counseling for depression	78 (16.7%)	207 (11.6%)	0.004
Clinical Presentation and Treatment			
Myocardial infarction diagnosis			0.586
ST-elevation myocardial infarction	199 (42.3%)	801 (44.7%)	
Non-ST-elevation myocardial infarction	270 (57.3%)	980 (54.7%)	
Bundle-branch block/Uncertain	2 (0.4%)	12 (0.7%)	
Killip Class			<0.001
I	328 (79.0%)	1301 (86.4%)	
II	73 (17.6%)	152 (10.1%)	
III	9 (2.2%)	30 (2.0%)	
IV	5 (1.2%)	23 (1.5%)	
LVSD			0.287
Normal	239 (50.7%)	971 (54.3%)	
Mild	99 (21.0%)	390 (21.8%)	
Moderate	82 (17.4%)	263 (14.7%)	
Severe	51 (10.8%)	165 (9.2%)	
Creatinine (mg/dL), mean (SD)	1.5 ± 1.9	1.4 ± 1.5	0.048
Aspirin at arrival	447 (97.4%)	1694 (96.6%)	0.386
Beta-blocker at arrival	396 (92.7%)	1507 (91.7%)	0.469
ACE inhibitor for left ventricular systolic dysfunction at discharge	105 (89.0%)	313 (80.3%)	0.030
Beta-blocker at discharge	418 (94.6%)	1576 (91.6%)	0.036
Baseline health status and social support measures			
ESSI score, mean (SD)	20.4 (5.6%)	22.7 (4.0%)	<0.001
SAQ quality of life, mean (SD)	59.7 (24.4%)	62.5 (23.2%)	
SF-12 PCS score, mean (SD)	40.0 (12.9%)	44.0 (12.2%)	<0.001
SF-12 MCS score, mean (SD)	49.2 (12.4%)	49.7 (11.4%)	0.479

* All baseline characteristics were collected from detailed chart abstractions and baseline interviews administered within 24 to 72 hours of the index admission. Unless otherwise noted, data are reported as number (%) of patients.

Table 2

Kaplan-Meier mortality and rehospitalization *

Clinical Outcome	Living Alone (N=471)	Not Living Alone (N=1793)	p-value
30-Day mortality	6 (1.3%)	19 (1.1%)	0.697
1-Year mortality	37 (7.9%)	96 (5.4%)	0.039
4-Year mortality	102 (21.8%)	256 (14.5%)	<0.001
1-Year readmission	161 (41.6%)	606 (38.3%)	0.792

* Data on mortality were collected through linkage to the Social Security Death Master File whereas data on readmission were collected via self-report. Data are reported as number (percentage) of patients.

Table 3

Unadjusted 1-year health status measures *

Health Status Measure	Living Alone (N=471)	Not Living Alone (N=1793)	Difference (Living Alone - Not Living Alone) Mean (95% CI)	p-value
SAQ quality of life score, mean (SE)	82.1 (1.1)	84.5 (0.8)	-2.4 (-4.4, -0.4)	0.022
SF-12 PCS score, mean (SE)	44.4 (0.7)	44.8 (0.5)	-0.4 (-1.7, 0.8)	0.4676
SF-12 MCS score, mean (SE)	52.0 (0.6)	53.8 (0.4)	-1.7 (-2.8, -0.7)	0.0011

Abbreviations: SAQ, Seattle Angina Questionnaire; SE, standard error; SF-12MCS, Short-Form 12 Mental Component Score; SF-PCS, Short-Form 12 Physical Component Score.

* Health status measures included the SAQ quality of life and SF-12 PCS and MCS scores collected at baseline and at 1-year. Data are reported as mean health status measures at 1-year adjusted for baseline measures.

Table 4

Unadjusted and adjusted mortality and rehospitalization *

Clinical Outcome	Unadjusted		Adjusted		p-value
	Not Living Alone HR (Referent)	Living Alone HR (95% CI)	Not Living Alone HR (Referent)	Living Alone HR (95% CI)	
1-Year mortality	1.00	1.49 (1.02, 2.18)	1.00	0.95 (0.52, 1.74)	0.869
4-Year mortality	1.00	1.56 (1.24, 1.96)	1.00	1.35 (0.94, 1.93)	0.107
1-Year readmission	1.00	1.02 (0.86, 1.22)	1.00	0.99 (0.76, 1.28)	0.919

Abbreviations: CI, confidence interval; HR, hazard ratio.

* Cox-proportional hazards regression was used to calculate adjusted mortality and readmission. Hazard ratios were adjusted for patient demographics (age, gender, race, body mass index, marital status, employment status, living location, pet ownership, medical care payer, usual source of care, financial barriers to health care utilization), medical history (hypertension, depression, previous MI, CHF), clinical presentation and treatment (left ventricular systolic function, creatinine, receipt of ACE inhibitor and beta blockers at discharge), ESSI score, and baseline health status scores.

Table 5Adjusted 1-year health status measures^{*}

Health Status Measure	Living Alone (N=471)	Not Living Alone (N=1793)	Difference (Live Alone - Not Living Alone) Mean (95% CI)	p-value
SAQ quality of life score, mean (SE)	73.3(4.4)	76.2 (4.4)	-2.9 (-5.5, -0.2)	0.034
SF-12 PCS score, mean (SE)	38.6 (2.4)	37.5 (2.4)	1.0 (-0.6, 2.7)	0.2080
SF-12 MCS score, mean (SE)	48.0 (2.1)	48.9 (2.1)	-0.9 (-2.3, 0.5)	0.2175

^{*} Multivariate linear regression models were used to calculate adjusted mortality and readmission. Data are reported as mean health status measures adjusted for patient demographics (age, gender, race, body mass index, marital status, employment status, living location, pet ownership, medical care payer, usual source of care, financial barriers to health care utilization), medical history (hypertension, depression, previous MI, CHF), clinical presentation and treatment (left ventricular systolic function, creatinine, receipt of ACE inhibitor and beta blockers at discharge), ESSi score, and baseline health status scores.

Table 6

Demographic and clinical predictors of mortality, rehospitalization, and health status*

Clinical Outcome	Predictors of Increased Mortality, Rehospitalization, or Worse Health Status	Predictors of Decreased Mortality, Rehospitalization, or Improved Health Status
1-Year Mortality	<i>Demographic and medical history:</i> living in a nursing home or assisted living facility, hypertension, CHF <i>Clinical presentation and treatment:</i> moderate/severe LVSD, elevated creatinine	<i>Demographic and medical history:</i> obesity
4-Year Mortality	<i>Demographic and medical history:</i> increased age, female, Medicaid insurance, prior AMI, CHF <i>Clinical presentation and treatment:</i> moderate/severe LVSD, elevated creatinine	<i>Demographic and medical history:</i> full-time employment, obesity <i>Baseline health status measures:</i> increased ESSi score
1-Year Rehospitalization	<i>Demographic and medical history:</i> female, living in a nursing home or assisted living facility, hypertension, CHF <i>Clinical presentation and treatment:</i> elevated creatinine	<i>Demographic and medical history:</i> increased age, full-time employment
1-Year SAQ	<i>Demographic and medical history:</i> female, homeless or renting home, reported difficulty obtaining medical care, receipt of depression medication or counseling, prior AMI <i>Clinical presentation and treatment:</i> receipt of beta-blockers at discharge	<i>Demographic and medical history:</i> increased age, commercial or Medicare insurance <i>Baseline health status measures:</i> increased ESSi score
1-Year SF-PCS	<i>Demographic and medical history:</i> female, pet ownership, having a usual source of care, reported difficulty obtaining medical care, underweight, obesity, receipt of depression medication or counseling, prior AMI	<i>Demographic and medical history:</i> part-time employment
1-Year SF-MCS	<i>Demographic and medical history:</i> homeless, avoidance of medical care due to cost, receipt of depression medication or counseling	<i>Demographic and medical history:</i> increased age <i>Clinical presentation and treatment:</i> elevated creatinine <i>Baseline health status measures:</i> increased ESSi score

Abbreviations: AMI, acute myocardial infarction; BMI, body mass index; CHF, congestive heart failure; ESSi, LVSD, left ventricular systolic dysfunction; SAQ, Seattle Angina Questionnaire; SF-MCS, Short-Form 12 Mental Component Score; SF-PCS, Short-Form 12 Physical Component Score.