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## Gender Differences in Calls to 9-1-1 During an Acute Coronary Syndrome

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### Abstract

Calling 9-1-1 during an acute coronary syndrome (ACS) decreases time to treatment and may improve prognosis. Women may have more atypical ACS symptoms compared to men, but few data are available on differences in gender and ACS symptoms in calling 9-1-1. We conducted patient interviews and structured chart reviews to determine gender differences in calling 9-1-1. Calls to 9-1-1 were assessed by self-report and validated by medical chart review. Of the 476 patients studied, 292 (61%) patients were diagnosed with unstable angina (UAP) and 184 (39%) patients were diagnosed with a myocardial infarction (MI). Overall, only 23% of patients called 9-1-1. A similar percentage of women and men with UAP called 9-1-1 (15% and 13%, respectively,  $P = 0.59$ ). In contrast, women with MI were significantly more likely to call 9-1-1 than men (57% vs. 28%,  $P < 0.001$ ). After adjustment for sociodemographic factors, health insurance status, history of MI, left ventricular ejection fraction, GRACE score and ACS symptoms, women were 1.79 times more likely to call 9-1-1 during an MI than men (prevalence ratio 1.79; 95% C.I. 1.22 – 2.64,  $P < 0.01$ ). In conclusion, the findings in the current study suggest that initiatives to increase calls to 9-1-1 are needed for both women and men.

### Keywords

Acute Coronary Syndrome; Gender; Emergency Services

## INTRODUCTION

Prior studies on differences in the proportion of men and women having acute coronary syndrome (ACS) who call 9-1-1 have produced inconsistent results. While some studies have found no difference in calls to 9-1-1 between women and men with ACS,<sup>1,2</sup> other studies restricted to patients with a myocardial infarction (MI) found that women call 9-1-1 more often than men.<sup>3,4</sup> However, there are few data that have described gender differences

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in calls to 9-1-1 by ACS type or by specific ACS symptom experienced. Differences in the presenting characteristics and pathobiology of patients with MI vs. unstable angina pectoris (UAP) may influence patterns of 9-1-1 calling.<sup>5</sup> Therefore, we analyzed data from an ongoing, observational cohort of ACS patients to determine gender differences in calls to 9-1-1, and investigated whether clinical characteristics, ACS type or ACS symptoms modified these differences.

## METHODS

Patients from the Prescription Use, Lifestyle, Stress Evaluation (PULSE) study at Columbia University Medical Center comprise the study population. PULSE is an ongoing, observational, single-site, prospective cohort study of the prognostic risk conferred by depressive symptoms and clinical depressive disorders at the time of an ACS. Patients with UAP, ST-elevation myocardial infarction (STEMI) or non-ST elevation myocardial infarction (NSTEMI) by published ACC/AHA definitions<sup>6</sup> were included and were recruited from Columbia University Medical Center within one week of hospitalization of their ACS. Between February 1, 2009 and June 30, 2010, 500 patients were recruited; 24 (5%) were excluded from these analyses because of missing data on calls to 9-1-1. The current analysis includes 476 English or Spanish speaking patients, 18 years of age who either presented to the emergency department at Columbia University Medical Center or were transferred from nearby hospitals. The Institutional Review Board of Columbia University Medical Center approved this study, and all participants provided informed consent.

Calling 9-1-1 was self-reported during an in-hospital interview within 7 days of admission, and was verified by review of 100 randomly selected medical records. During the interview, patients were asked whether they a) called 9-1-1, b) went to the Emergency Department, or c) called or went to a physician's office at ACS onset. No other information on calling 9-1-1 was collected. Demographic, psychosocial and clinical factors were assessed within 7 days of enrollment. Age, gender, ethnicity (Hispanic or Latino vs. other), English fluency, marital status, high school education, health insurance over the prior two years and insurance with Medicaid/Medicare were assessed during a study interview. ACS symptom assessment was restricted to two typical (chest pain, arm/jaw pain) and three atypical symptoms (dyspnea, nausea/vomiting, syncope), as these five symptom clusters have been identified as independent predictors of hospital mortality;<sup>7</sup> time course of ACS symptoms was assessed and dichotomized as constant or intermittent for analysis. ACS severity was determined using the Global Registry of Acute Coronary Events (GRACE) risk score. The GRACE score includes age and clinical parameters at presentation (heart rate, systolic blood pressure, serum creatinine, congestive heart failure, and the presence of cardiac arrest, ST-segment elevation, and cardiac enzymes/markers) and provides an estimate of mortality within 6 months of an ACS.<sup>8</sup> The Beck Depression Inventory was used to assess depressive symptoms; a score  $\geq 10$  was used to identify clinically significant depression, as this score has been independently associated with poor cardiovascular prognosis.<sup>9</sup> History of prior MI and left ventricular ejection fraction (LVEF) during admission was abstracted from the medical chart.

Prior studies have documented potential differences in prognosis and presentation for patients with MI vs. UAP.<sup>10,11</sup> Therefore gender differences in calls to 9-1-1 were first examined by ACS type. As rates of 9-1-1 calling in this study were markedly different for patients with MI versus UAP, all analyses were stratified by ACS type. Patient characteristics were calculated separately for women and men. The percentage of study patients calling 9-1-1 was calculated by characteristics including age, race, ethnicity, native English speaker, marital status, completion of high school, LVEF, GRACE score, history of MI, insured over past two years, Medicare/Medicaid insurance, depressive symptoms,

nausea/vomiting, syncope, constant symptoms, chest pain, arm/jaw pain and dyspnea, with the statistical significance of differences determined by t-tests for continuous variables and chi-square tests for categorical variables. Binomial regression was used to calculate prevalence ratios of calling 9-1-1 for women compared to men. Prevalence ratios are recommended instead of odds ratios for cross sectional studies with common outcomes.<sup>12</sup> An initial model was unadjusted (Model 1). Subsequent models included progressive adjustment for age, race/ethnicity, public health insurance status, health insurance status within the past 2 years, high school education and marital status (Model 2); Model 2 variables and history of an MI (Model 3); Model 3 variables and ACS symptoms (nausea/vomiting, syncope and constant vs. inconstant, Model 4); Model 4 variables and LVEF/GRACE (Model 5). Variables were selected for adjustment if significant at the  $P < 0.10$  level on calls to 9-1-1 in the unadjusted model, or if identified in prior studies as potential determinants of calls to 9-1-1 (GRACE score, marital status, insurance status).<sup>13</sup> Among patients with an MI, subgroup analyses were performed to examine the consistency of the relationship between gender and calls to 9-1-1. Multiplicative interaction was assessed using the full population and including main effects and interaction terms (e.g., race \* sex). Data on covariates was missing for 100 (21%) of participants. We used multiple imputation with chained equations and 5 data sets to account for the missing data.<sup>14,15</sup> [ENREF 18](#) The association between gender and 9-1-1 calling was similar using a complete case analysis (data not presented). All analyses were conducted using Stata 11 (Stata Incorporated, College Station, TX).

## RESULTS

Statistically significant differences in baseline characteristics were present between women and men with UAP and between women and men with MI (Table 1). There were also significant differences in calls to 9-1-1 by baseline characteristics among patients with UAP vs. MI (Table 2).

The overall percentage of calls to 9-1-1 was low, and was similar between women and men with UAP (Figure 1). In contrast, among patients with an MI, women were significantly more likely to call 9-1-1 than men.

There was no difference in calls to 9-1-1 for women and men with UAP before (Model 1) or after progressive adjustment for sociodemographic factors (Model 2); history of MI (Model 3); ACS symptoms (Model 4); and LVEF and GRACE score (Model 5, Table 3). In contrast, women with an MI were more likely than men to call 9-1-1, and this difference remained statistically significant in a fully adjusted model (Model 5, Table 3). Among those with an MI, the association between gender and 9-1-1 calling was present for all sub-groups except age (Figure 2). There was an interaction of age on the association between sex and calling 9-1-1 (interaction  $P$ -value  $< 0.05$ ).

## DISCUSSION

The principal findings of this investigation are that (1) less than 25% of ACS patients call 9-1-1, (2) women with an MI are more than twice as likely as men to call 9-1-1 whereas (3) the proportion of women and men calling 9-1-1 was similar for UAP.

Similar to some of our findings, studies from the National Registry of Myocardial Infarction (NRMI) have also found that women with MI were more likely than men to call 9-1-1.<sup>3,4</sup> The current study extends data from NRMI to a contemporary cohort, demonstrating that while reported ACS symptoms may differ between women and men, ACS symptoms in this study did not explain gender differences in calls to 9-1-1. Moreover, by examining

differences in calls to 9-1-1 by ACS type, the current study clarifies 9-1-1 calling among patients with different ACS presentations.<sup>2,16</sup> The gender differences observed for patients with MI did not extend to UAP. As both UAP and MI warrant urgent medical evaluation,<sup>5</sup> this finding indicates a specific need to increase 9-1-1 calling among all patients with an ACS.

Consistent with prior studies, we found a trend suggesting women were more likely than men to present with atypical symptoms at the time of ACS.<sup>17–20</sup> Despite the higher prevalence of atypical symptoms among women in the current study, ACS symptom type (typical vs. atypical) did not explain gender differences in calls to 9-1-1 in the current study.

Patients with sociodemographic characteristics associated with poor health outcomes were more likely to call 9-1-1 during an ACS than patients with fewer high-risk characteristics. However, sociodemographic factors did not explain the association between gender and calls to 9-1-1 during an MI observed in this study. Women were also more likely than men to report depressive symptoms. Similar to prior findings,<sup>21</sup> however, we did not observe an association between depressive symptoms and calls to 9-1-1.

We also observed a significant interaction between age and gender on calls to 9-1-1 for patients with an MI. Women less than 65 years of age were significantly more likely than men in the current study to call 9-1-1. However, there was no significant difference on calls to 9-1-1 between women and men over age 65 years. Compared to women over age 65, younger women may be less likely to view MI symptoms as part of aging or to misattribute MI symptoms to those of other comorbidities.<sup>22</sup> This may lead to greater 9-1-1 calling by younger compared to older women.

There are limitations to the current study. This was a relatively small, single-center study in an urban environment, which may limit the generalizability of our findings. We did not assess whether witnesses called 9-1-1 or acted on behalf of patients enrolled in this study, or whether men were more likely than women to self-transport to the emergency department. More comprehensive description of the actions taken by patients and their families at ACS onset is warranted in future studies.

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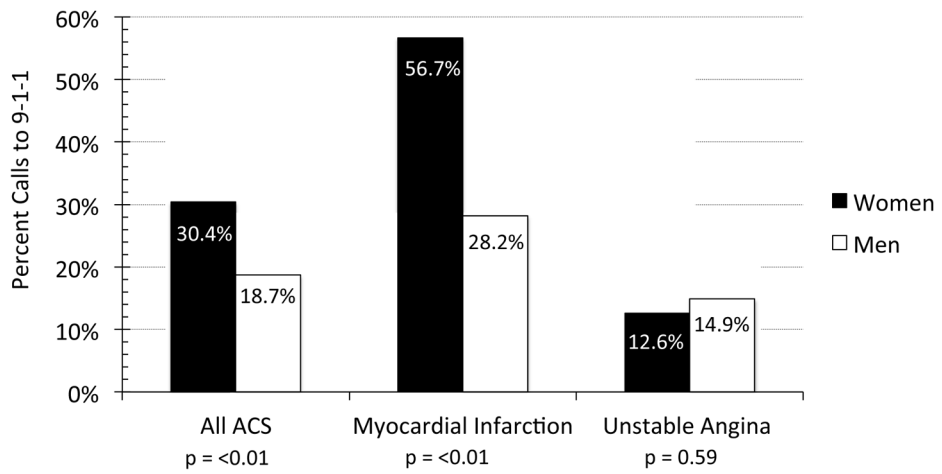
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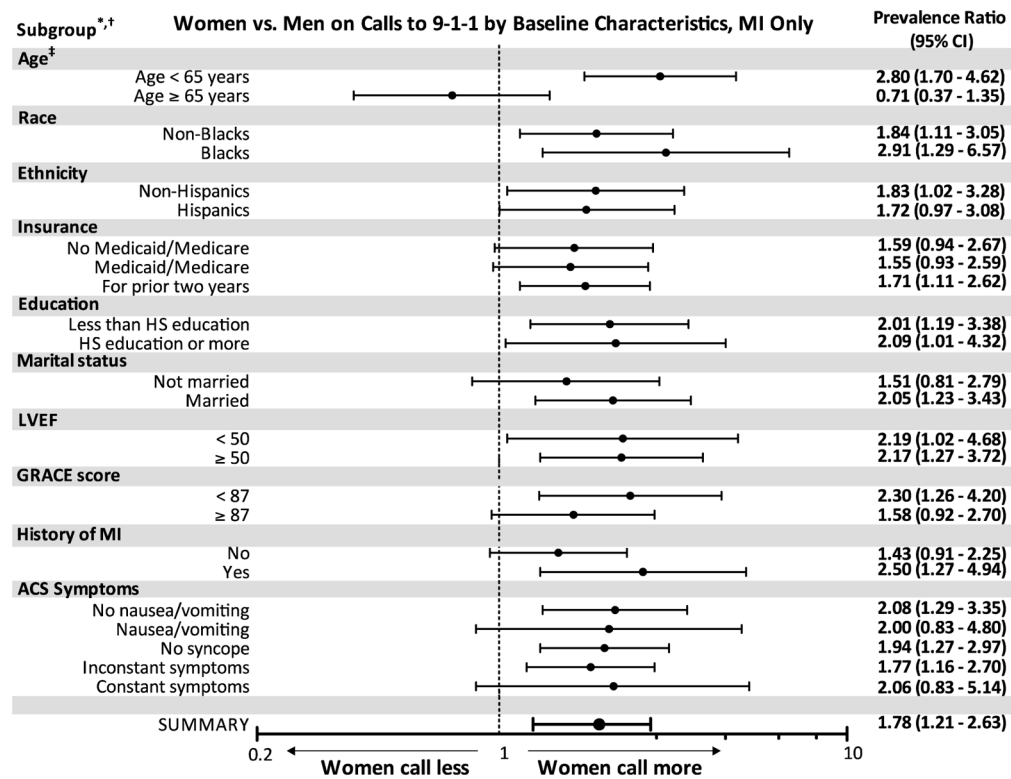
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**Figure 1.**  
Women vs. Men on Calls to 9-1-1  
Abbreviations: ACS, Acute Coronary Syndrome  
P values reported for difference between women and men on calls to 9-1-1



**Figure 2.** Women vs. Men on Calls to 9-1-1 by Baseline Characteristics, MI only  
 Abbreviations: MI, myocardial infarction. HS, high school. ACS, acute coronary syndrome. LVEF, left ventricular ejection fraction. GRACE, Global Registry of Acute Coronary Events  
 \* Includes adjustment for age, race/ethnicity, education, health insurance for prior two years, Medicaid/Medicare, marital status, GRACE score, LVEF, ACS type and MI history (Model 5 covariates in Table 3)  
 † Subgroups estimates for syncope and no insurance for prior two years not provided because of too few events.  
 ‡ Interaction  $P < 0.05$



Table 1

Patient Characteristics by acute coronary syndrome type and gender.

Variable	Unstable Angina Pectoris			Myocardial Infarction		
	Women (n=101)	Men (n=191)	p-value	Women (n=60)	Men (n=124)	p value
Age (years)	65.9 (11.8)	63.1 (10.9)	0.184	64.3 (11.3)	61.3 (11.6)	0.101
Black	24%	12%	0.010	28%	18%	0.099
Hispanic	30%	25%	0.347	50%	32%	0.020
Native English speaker	73%	72%	0.888	53%	65%	0.127
Married	51%	73%	<0.001	37%	64%	<0.001
At least high school education	72%	84%	0.014	60%	81%	0.003
Left ventricular ejection fraction	55% (9)	51% (10)	<0.001	47% (13)	47% (12)	0.789
GRACE score	87.6 (25.1)	85.3 (24.4)	0.463	100.3 (33.5)	92.6 (30.3)	0.117
STEMI	NA	NA	NA	27%	32%	0.440
History of myocardial infarction	29%	31%	0.669	32%	23%	0.163
Insured over past two years	91%	90%	0.888	92%	89%	0.634
Medicaid/Medicare insurance	62%	56%	0.378	65%	52%	0.099
Current Depression <sup>*</sup>	28%	11%	<0.001	26%	12%	0.016
Nausea/vomiting	23%	9%	0.001	31%	16%	0.025
Syncope	11%	9%	0.575	12%	11%	0.909
Constant Symptoms	26%	25%	0.851	65%	51%	0.069
Chest pain	90%	85%	0.237	78%	81%	0.714
Arm/jaw pain	41%	27%	0.020	42%	42%	0.955
Dyspnea	60%	50%	0.099	43%	39%	0.549

STEMI, ST-Elevation myocardial infarction. GRACE, Global Registry of Acute Coronary Events. Numbers in parentheses are standard deviation.

<sup>\*</sup> P value comparing differences across gender for unstable angina and myocardial infarction using Chi-square for categorical data and analysis of variance for continuous data

<sup>†</sup> Depression by Beck Depression Inventory score 10.

**Table 2**

Percent calling 9-1-1 by patient characteristics and acute coronary syndrome type

Variable	Unstable Angina Pectoris (n=292)	P value*	Myocardial Infarction (n=184)	P value*
Age (years)				
< 65	13%	0.79	36%	0.61
>=65	14%		40%	
Race				
Not black	13%	0.74	34%	0.045
Black	15%		51%	
Ethnicity				
Not Hispanic	11%	0.026	32%	0.034
Hispanic	21%		47%	
Native English speaker				
No	21%	0.014	44%	0.147
Yes	10%		33%	
Marital status				
Not Married	18%	0.111	38%	0.870
Married	11%		37%	
Completed high school				
No	28%	<0.001	50%	0.052
Yes	10%		34%	
Left ventricular ejection fraction				
< 50%	13%	0.506	40%	0.643
50%	16%		36%	
GRACE score				
< 87	14%	0.955	40%	0.643
87	13%		36%	
History of myocardial infarction				
No	9%	<0.001	35%	0.281
Yes	24%		45%	
Insured over past 2 years				
No	15%	0.889	44%	0.504
Yes	14%		36%	
Medicare/Medicaid Insurance				
No	7%	0.003	30%	0.134
Yes	19%		41%	
Depressive symptoms				

Variable	Unstable Angina Pectoris (n=292)	P value*	Myocardial Infarction (n=184)	P value*
No	13%	0.586	37%	0.352
Yes	16%		46%	
Syncope				
No	11%	0.009	35%	0.125
Yes	29%		52%	
Constant symptoms				
No	7%	0.001	24%	<0.001
Yes	32%		48%	
Chest pain				
No	8%	0.282	43%	0.419
Yes	14%		36%	
Arm/jaw pain				
No	13%	0.560	39%	0.617
Yes	15%		35%	
Dyspnea				
No	13%	0.722	35%	0.313
Yes	14%		42%	

GRACE, Global Registry of Acute Coronary Events

\* P value for differences in percentage calls to 9-1-1 across ACS type using Chi-square

† Depression by Beck Depression Inventory score 10

**Table 3**  
Multivariate regression model comparing women to men on calls to 9-1-1 during an Acute Coronary Syndrome

Model	Covariate adjustment	Unstable Angina Pectoris		Myocardial Infarction	
		Prevalence Ratio (95% CI)	p value	Prevalence Ratio (95% CI)	p value
1:	Unadjusted	1.18 (0.65–2.15)	0.585	2.01 (1.40–2.87)	<0.001
2:	Model 1 + sociodemographic factors <sup>*</sup>	0.96 (0.53–1.71)	0.879	1.93(1.33–2.81)	0.001
3:	Model 2 + history of MI	0.89 (0.50–1.59)	0.696	1.93 (1.33–2.80)	0.001
4:	Model 3 + symptoms <sup>†</sup>	0.92 (0.51–1.65)	0.770	1.80 (1.22–2.65)	0.003
5:	Model 4 + LVEF/GRACE	0.97 (0.51–1.84)	0.919	1.78 (1.21–2.63)	0.004

LVEF, left ventricular ejection fraction. GRACE, Global Registry of Acute Coronary Events

<sup>\*</sup> Age (continuous), race/ethnicity, Medicaid/Medicare, insurance over the prior 2 years, education and marital status.

<sup>†</sup> Symptoms include nausea/vomiting, syncope, and symptom presentation (constant vs. inconstant).