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ORIGINAL INVESTIGATIONS

Sex Differences in Cardiac Risk Factors, Perceived Risk, and Health Care Provider Discussion of Risk and Risk Modification Among Young Patients With Acute Myocardial Infarction

The VIRGO Study

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ABSTRACT

BACKGROUND Differences between sexes in cardiac risk factors, perceptions of cardiac risk, and health care provider discussions about risk among young patients with acute myocardial infarction (AMI) are not well studied.

OBJECTIVES This study compared cardiac risk factor prevalence, risk perceptions, and health care provider feedback on heart disease and risk modification between young women and men hospitalized with AMI.

METHODS We studied 3,501 AMI patients age 18 to 55 years enrolled in the VIRGO (Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients) study in U.S. and Spanish hospitals between August 2008 and January 2012, comparing the prevalence of 5 cardiac risk factors by sex. Modified Poisson regression was used to assess sex differences in self-perceived heart disease risk and self-reported provider discussions of risk and modification.

RESULTS Nearly all patients (98%) had ≥1 risk factor, and 64% had ≥3. Only 53% of patients considered themselves at risk for heart disease, and even fewer reported being told they were at risk (46%) or that their health care provider had discussed heart disease and risk modification (49%). Women were less likely than men to be told they were at risk (relative risk: 0.89; 95% confidence interval: 0.84 to 0.96) or to have a provider discuss risk modification (relative risk: 0.84; 95% confidence interval: 0.79 to 0.89). There was no difference between women and men for self-perceived risk.

CONCLUSIONS Despite having significant cardiac risk factors, only one-half of young AMI patients believed they were at risk for heart disease before their event. Even fewer discussed their risks or risk modification with their health care providers; this issue was more pronounced among women. (J Am Coll Cardiol 2015;66:1949–57) © 2015 by the American College of Cardiology Foundation.

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ABBREVIATIONS AND ACRONYMS

AMI = acute myocardial infarction

CAD = coronary artery disease

CI = confidence interval

RR = relative risk

STEMI = ST-segment elevation myocardial infarction

Heart disease is the leading cause of death and a major contributor to disability among women worldwide. Although often considered a disease of older age, more than 15,000 deaths each year among women ≤55 years of age in the United States can be attributed to heart disease (1,2). Moreover, young women with acute myocardial infarction (AMI) have excess mortality compared with similarly aged men (3–8). Sex differences in risk factors such as diabetes mellitus, dyslipidemia, hypertension, obesity, and cigarette smoking may contribute to poorer outcomes for young women, but research is limited in young patients with AMI (9,10). A recent study found that multiple cardiac risk factors are highly prevalent in patients with AMI, and secondary prevention efforts are less common among younger patients (11). Prevention of heart disease and recurrent cardiac events requires that patients be aware of their risk factors, be educated about their risk, and perhaps most importantly, perceive themselves to be at risk (12). Patients must also receive guidance on ways to modify their risk. Although numerous guidelines emphasize the importance of risk assessment and patient education for improving the quality of preventive care among women (13), both women and their physicians underestimate the cardiovascular risk for women, particularly young women (14–17). We sought to compare the prevalence of 5 potentially modifiable risk factors by sex in a cohort of young patients hospitalized with AMI. We also assessed sex differences in patient perceptions of risk before the index AMI and discussions of heart disease risk and risk modification with health care providers.

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METHODS

STUDY POPULATION. Patients hospitalized with AMI, age 18 to 55 years, were recruited between August 2008 and January 2012 from 103 U.S. and 24 Spanish hospitals using a 2:1 female-to-male enrollment design to participate in the VIRGO (Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients) study. The methods of VIRGO have been described previously (18). In brief, eligible patients had elevated cardiac biomarkers (troponin I or T or creatine kinase-myocardial band), with at least 1 biomarker >99th percentile of the upper reference limit at the recruiting center within 24 h of admission (>97% of patients had qualifying troponin levels). Additional evidence of acute myocardial ischemia was required, including either symptoms of ischemia or electrocardiogram changes indicative of new ischemia (new ST-T changes, new or presumably new left bundle branch block, or the development of pathological Q waves). Patients must have presented directly to the enrolling site or been transferred within the first 24 h of presentation. Patients who were incarcerated, did not speak English or Spanish, were unable to provide informed consent or be contacted for follow-up, developed elevated cardiac markers because of elective coronary revascularization, or had an AMI as the result of physical trauma were not eligible.

Of the 5,422 patients eligible for the VIRGO study, 3,501 were ultimately enrolled, including 2,985 in the United States and 516 in Spain. Institutional review board approval was obtained at each participating institution, and patients provided informed consent for their study participation.

DATA COLLECTION AND VARIABLES. Baseline patient data were collected by medical chart abstraction and standardized in-person patient interviews administered by trained personnel during the index AMI admission. Sociodemographic factors included age, sex, self-identified race (white, black, other), Hispanic ethnicity, marital status, completed education (< high school [1 to 11 years], high school graduate [12 years], > high school [13+ years]), and full- or part-time employment. Access-to-care factors included lack of insurance, having a primary care clinician, having a usual place for health care, and visiting a heart specialist in the past year. Medical history data included prior AMI, revascularization procedure (percutaneous coronary intervention or coronary artery bypass graft surgery), angina, congestive heart failure, chronic kidney disease (estimated glomerular filtration rate ≤60 ml/min/1.73 m^2), chronic lung disease, and family history of coronary

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artery disease (CAD). Clinical characteristics at presentation were also noted, including final AMI diagnosis and ejection fraction <40%.

Information on 5 potentially modifiable risk factors was ascertained from the medical record and the patient interview. Diabetes mellitus was defined as glucose >200 mg/dl, hemoglobin A1c ≥6.5%, documented history of diabetes mellitus in the medical record, self-reported history of diabetes mellitus, or use of a glucose-lowering medication on arrival (e.g., insulin or an oral antidiabetic agent) (19). Dyslipidemia was defined as total serum cholestero ≥200 mg/dl, low-density lipoprotein cholesterol ≥130 mg/dl, high-density lipoprotein cholesterol <40 mg/dl, documented history of dyslipidemia in the medical record, self-reported history of dyslipidemia, or use of a lipid-control medication on arrival (e.g., statin, fibrate, or niacin) (20). Hypertension was defined as a documented history of hypertension in the medical record or self-reported hypertension. Obesity was defined as a body mass index ≥30 kg/m^2 (21). Patients reporting a history of smoking within the past 30 days were considered current smokers.

During the baseline interview, patients were asked about their perceptions of risk and discussions of heart disease risk and risk modification with their health care providers before the index AMI event. Specific questions included the following. 1) "Prior to your recent hospital stay, did you consider yourself at risk for heart disease or a heart problem?" 2) "Prior to your recent hospital stay, did any of your health care providers ever tell you that you were at risk for heart disease or a heart problem?" 3) "Did a doctor ever talk to you about heart disease and talk about things that you could do to take care of your heart?" Possible responses for each question were "yes," "no," or "don't know." Because <2% of patients reported "don't know" for these questions and there were no differences by sex, we recoded this response as missing.

STATISTICAL ANALYSIS. Sociodemographic characteristics, health care access, medical history, clinical characteristics at presentation, prevalence of individual risk factors, perceived risk for heart disease, and health care provider discussion of risk or risk modification before the index admission were compared by sex and country by use of chi-square or Fisher exact tests for categorical variables and Wilcoxon rank sum tests for continuous variables. The cumulative number of risk factors was determined for each patient (possible range from 0 to 5) and also compared by sex and country as described above.

Modified Poisson regression models with robust error variance (22) were used to calculate relative risks (RRs) directly for the associations of sex with perceived risk for heart disease and health care provider discussion of risk or risk modification. Multivariable models adjusted for country, self-reported race, education, lack of insurance, marital status, presence of a primary care clinician, usual place for care, family history of CAD, visiting a heart specialist within the past year, and documented, potentially modifiable cardiac risk factors (diabetes mellitus, dyslipidemia, hypertension, obesity, and smoking). The RRs were calculated for the overall cohort and among subgroups defined by documented cardiac risk factors before the index event and family history of CAD. Recognizing the potential importance of a personal history of CAD (i.e., prior AMI event or revascularization procedure) in patients' perceptions of risk and providers' discussions of risk and risk modification, we repeated analyses in models stratified by personal history of CAD, as well as in models stratified by whether the patient had visited a heart specialist within the past year. We formally tested interactions between these variables and sex. We used a similar strategy to assess country as a modifier, repeating analyses separately for U.S. and Spanish patients and testing the interaction between country and sex.

Missing data were minimal for our study, with 10% of patients missing data for any of the model variables (2.4% were missing data for >1 variable) and no single variable missing for >5% of patients. All statistical analyses were conducted with SAS version 9.3 (SAS Institute, Cary, North Carolina), with 2-tailed tests for statistical significance and $\alpha = 0.05$.

RESULTS

PATIENT CHARACTERISTICS. The VIRGO study enrolled 2,349 women and 1,152 men hospitalized with AMI. Patients ranged in age from 18 to 55 years, had a median age of 48 years, and were predominantly white (78%). Women were more likely than men to be nonwhite, unmarried, and unemployed and to have less than a high school education (**Table 1**). Although women were more likely to have a primary care clinician and usual place for care, women and men were equally as likely to have visited a heart specialist in the past year. Approximately 19% of patients had a previous AMI or revascularization procedure, and comorbidities were common. Women were more likely than men to have a history of congestive heart failure, chronic kidney disease, and chronic lung disease; men were more likely to have

TABLE 1 Patient Characteristics by Sex and Country

	Overall			United States			Spain		
	Women (n = 2,349)	Men (n = 1,152)	p Value	Women (n = 2,009)	Men (n = 976)	p Value	Women (n = 340)	Men (n = 176)	p Value
Sociodemographic characteristics									
Age, yrs	48 (44-52)	48 (43-52)	0.266	48 (44-52)	48 (44-52)	0.286	47 (42-51)	47.5 (42-51)	0.774
Race			<0.001			<0.001			0.663
White	75.9	83.5		72.9	81.6		93.8	94.3	
Black	18.6	9.8		21.3	11.0		2.7	3.4	
Other	5.5	6.7		5.8	7.5		3.5	2.3	
Hispanic	7.6	8.0	0.660	7.7	8.4	0.477	7.1	5.7	0.555
Married/cohabitating	55.3	64.2	<0.001	52.6	62.3	<0.001	71.2	74.9	0.386
Completed education			0.010			0.004			0.457
< High school	21.8	17.9		15.9	11.9		59.2	54.4	
High school graduate	25.0	28.4		27.3	31.5		10.4	9.5	
> High school	53.2	53.7		56.8	56.6		30.4	36.1	
Working full- or part-time	56.4	73.4	<0.001	56.3	72.0	<0.001	56.9	81.1	<0.001
Health care access									
No health insurance	18.7	21.4	0.063	21.6	24.9	0.042	1.5	1.2	0.774
Currently has a primary care clinician	74.5	66.1	<0.001	74.9	66.7	<0.001	71.7	62.6	0.036
Usual place for care: none/ED	7.6	12.8	<0.001	8.2	13.4	<0.001	3.7	9.4	0.009
Previously seen by heart specialist	32.7	32.2	0.776	34.7	34.3	0.827	20.8	20.5	0.924
Medical history									
Prior MI	14.8	16.9	0.105	16.3	18.9	0.086	5.9	6.3	0.868
Prior PCI or CABG	14.6	18.0	0.010	16.4	20.4	0.008	3.8	4.5	0.694
Angina	27.5	26.1	0.373	27.4	26.2	0.490	28.3	25.6	0.507
Congestive heart failure	5.0	2.1	<0.001	5.8	2.5	<0.001	0.3	0.0	1.000
Family history of CAD	76.0	73.5	0.120	77.6	76.7	0.559	66.4	56.5	0.031
Chronic kidney disease	11.6	7.8	0.001	12.7	8.6	0.001	5.0	3.4	0.406
COPD	12.6	5.5	<0.001	14.2	6.4	<0.001	3.2	0.6	0.067
Clinical characteristics at presentation									
Final diagnosis: STEMI	47.9	59.5	<0.001	45.9	57.7	<0.001	60.0	69.3	0.038
Ejection fraction <40%	10.6	11.2	0.593	10.9	11.6	0.589	9.0	9.3	0.906

Values are median (interquartile range) or %.

CABG = coronary artery bypass graft; CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease; ED = emergency department; MI = myocardial infarction; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction.

previously undergone revascularization and to present with an ST-segment elevation myocardial infarction (STEMI). Sex differences in employment, having a primary care clinician or usual place for care, and STEMI diagnosis persisted across countries. Differences in race, marital status, education, insurance, revascularization, and comorbidities were observed only for U.S. patients. Among patients in Spain, women were more likely than men to report a family history of CAD. Patients within the United States versus those in Spain were more racially diverse, less likely to be married or insured, and more likely to have comorbid conditions and a history of AMI or revascularization. STEMI was more common in Spanish than U.S. patients.

RISK FACTORS. Nearly all women (97%) and men (99%) had at least 1 of the 5 potentially modifiable risk factors assessed in this study, and 65% of women and 63% of men had 3 or more. The most common risk factor was dyslipidemia (86%), followed by hypertension (63%), current smoking (60%), obesity (49%), and diabetes mellitus (35%). With the exception of smoking, all risk factors were more prevalent among patients in the United States than among those in Spain (Table 2). Across countries, women were more likely than men to have diabetes mellitus (relationship only statistically significant among U.S. patients), but they were less likely to have dyslipidemia. Women in the United States were also more likely to be obese than their male counterparts. Hypertension and smoking were prevalent but did not differ markedly by sex in either country.

RISK PERCEPTIONS AND DISCUSSIONS WITH PROVIDERS. Approximately one-half of women and

TABLE 2 Modifiable Risk Factors by Sex and Country

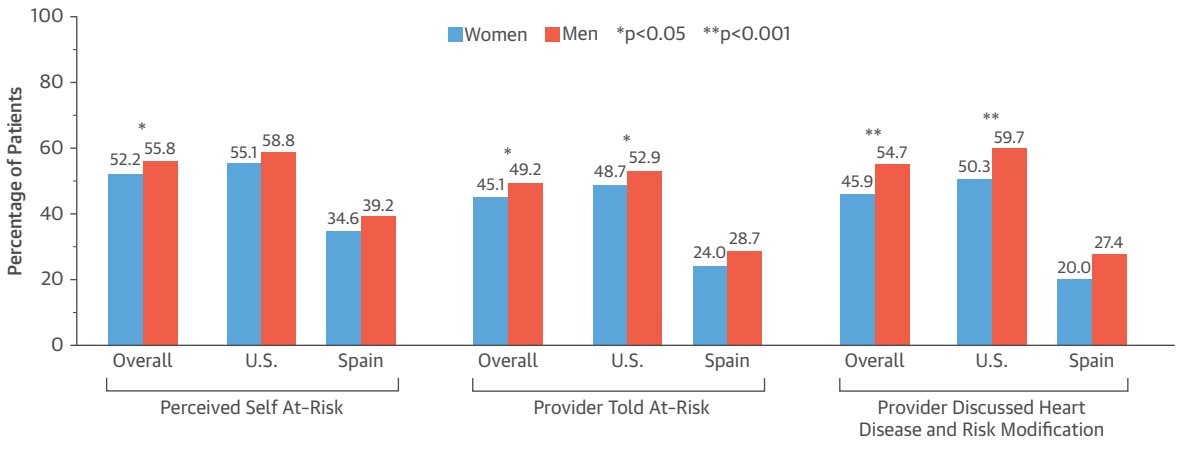
	Overall			United States			Spain		
	Women (n = 2,349)	Men (n = 1,152)	p Value	Women n = 2,009	Men (n = 976)	p Value	Women (n = 340)	Men (n = 176)	p Value
Diabetes	38.8	26.7	<0.001	39.9	26.7	<0.001	32.4	26.7	0.186
Dyslipidemia	82.6	92.1	<0.001	83.7	92.9	<0.001	76.5	87.5	0.003
Hypertension	63.8	62.3	0.391	67.1	64.7	0.176	44.1	49.4	0.251
Obesity	51.0	44.6	<0.001	55.3	47.7	<0.001	25.2	27.2	0.635
Smoking	59.7	59.3	0.811	57.7	56.6	0.578	71.8	74.3	0.543
Total number of risk factors			<0.001			<0.001			0.286
0	3.0	1.2		3.1	1.1		2.6	1.7	
1	11.2	10.2		10.2	10.1		17.1	10.2	
2	20.5	26.1		18.6	24.5		32.1	35.2	
3	28.4	33.9		28.2	34.2		29.7	31.8	
4	26.1	22.3		28.2	23.3		13.2	17.0	
5	10.9	6.3		11.8	6.8		5.3	4.0	

Values are %.

men in the United States reported that before their index AMI event, they considered themselves at risk for heart disease (56%), were told by a health care professional that they were at risk (50%), or had a health care provider talk to them about heart disease and ways to modify their risk (53%). The proportion of Spanish patients was even lower, with only 36% reporting prior perceived risk for heart disease, 26% reporting a health care professional had told them they were at risk, and 22% reporting that a health care provider had talked to them about heart disease and ways to modify risk. In the United States and Spain, a smaller proportion of women than men reported prior self-perceived risk or discussions about risk or risk modification with their health care providers, although the relationships were only statistically significant for discussions of risk or risk modification among U.S. patients (Figure 1).

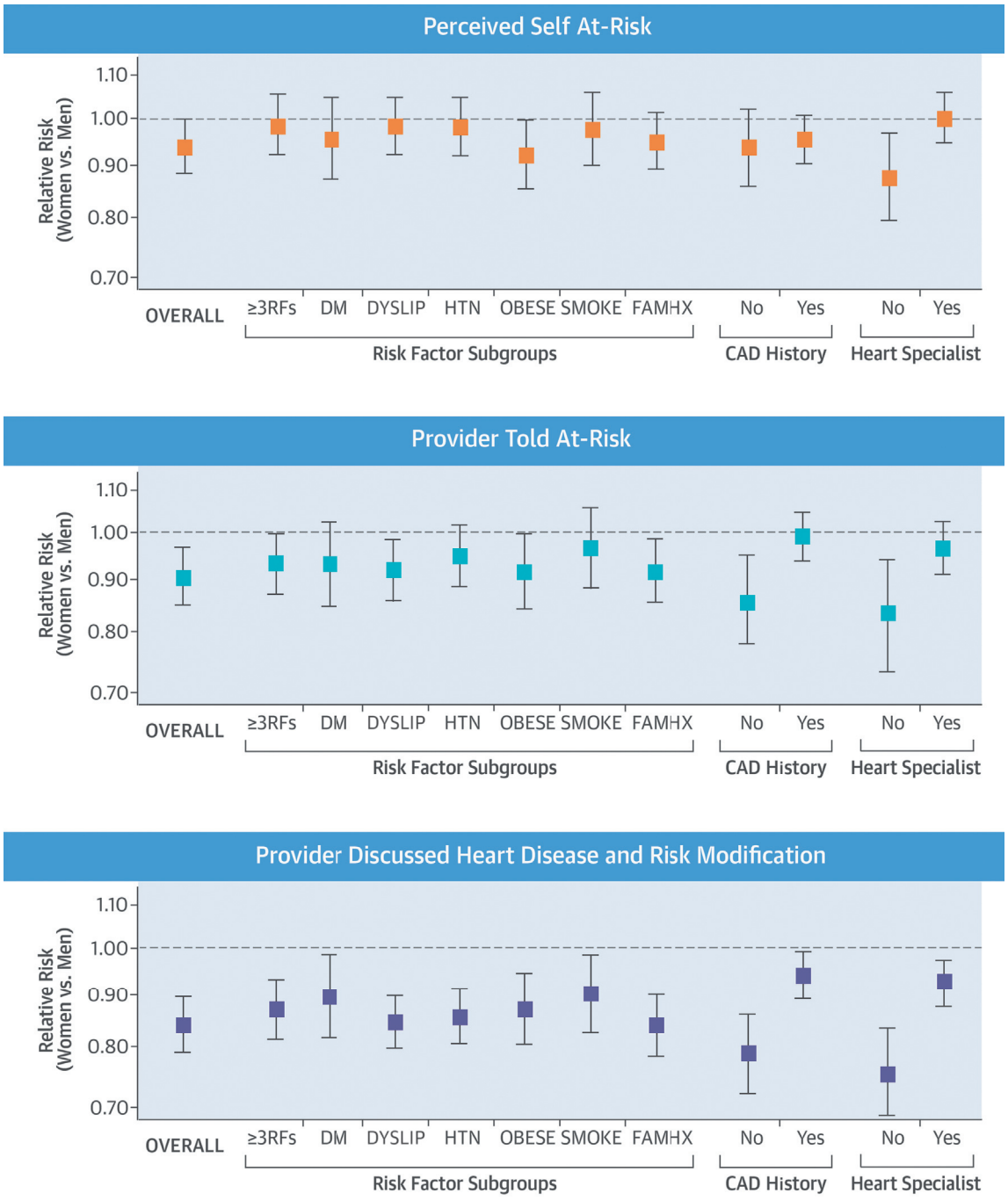
In risk-adjusted models that included both U.S. and Spanish patients, women were 11% less likely than men to report being told they were at risk for heart disease (RR: 0.89; 95% confidence interval [CI]: 0.84 to 0.96) and 16% less likely than men to report having a health care provider discuss heart disease

FIGURE 1 Perceptions and Discussions of Risk by Sex and Country



Percentage of women and men reporting that before their index acute myocardial infarction event, they considered themselves at risk for heart disease, were told by a health care professional that they were at risk, or had a health care provider talk to them about heart disease and ways to modify their risk. p Values for comparisons by sex within the overall, U.S., and Spanish cohorts were calculated with chi-square tests.

CENTRAL ILLUSTRATION **Risk Perceptions and Discussions Before AMI: Risk-Adjusted Associations of Sex (Women vs. Men) With Perceptions and Discussions of Risk**



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Adjusted relative risks and 95% confidence intervals for women versus men were calculated for the overall cohort, among subgroups of patients defined by documented modifiable risk factors (diabetes, dyslipidemia, hypertension, obesity, current smoking) and family history of coronary artery disease, among those with and without a personal history of coronary artery disease (i.e., prior acute myocardial infarction or revascularization procedure), and among those who did and did not visit a heart specialist in the past year. ≥3RFs = patient has at least 3 of the 5 potentially modifiable risk factors; CAD = coronary artery disease; DM = diabetes history documented in the medical chart or glucose-lowering medication on arrival; DYSLIP = dyslipidemia history documented in the medical record or lipid-control medication on arrival; FAMHX = family history of coronary artery disease; HTN = hypertension history documented in the medical chart; OBESE = body mass index ≥30 kg/m^2; SMOKE = current smoking within the past 30 days.

and ways to modify risk (RR: 0.84; 95% CI: 0.79 to 0.89) before their index AMI event (**Central Illustration**). The association of sex with prior perceived risk of heart disease was not statistically significant (RR: 0.94; 95% CI: 0.89 to 1.00). These relationships remained fairly consistent across patient subgroups defined by 5 documented modifiable risk factors (diabetes mellitus, dyslipidemia, hypertension, obesity, and current smoking) and by family history of CAD. A personal history of CAD moderated the relationships between sex and provider discussions of risk (p for interaction = 0.067) and risk modification (p for interaction = 0.002). Women without a history of CAD were 15% less likely than men without a CAD history to report being told they were at risk (RR: 0.85; 95% CI: 0.77 to 0.95), but there was no significant sex difference among patients with a documented history of CAD (RR: 0.98; 95% CI: 0.92 to 1.03). Regarding provider discussion of heart disease and ways to modify risk, women without a history of CAD were 21% less likely than men to report such discussions (RR: 0.79; 95% CI: 0.72 to 0.87). Among those with a documented history of CAD, women were 6% less likely than men to report discussions (RR: 0.94; 95% CI: 0.89 to 0.99). There was an interaction between sex and being seen by a heart specialist in the past year for each of the 3 risk perception/discussion variables (p for interaction was 0.016 for perceived risk of heart disease, 0.072 for provider discussion of risk, and 0.002 for provider discussion of heart disease and risk modification). Among those who had not seen a heart specialist in the past year, women were significantly less likely than men to perceive themselves to be at risk (RR: 0.88; 95% CI: 0.79 to 0.97), report being told they were at risk (RR: 0.83; 95% CI: 0.73 to 0.93), and report having a provider discuss heart disease and risk modification (RR: 0.76; 95% CI: 0.68 to 0.85). Among those who had seen a heart specialist, sex was significantly associated with discussion of heart disease and risk modification (RR: 0.92; 95% CI: 0.87 to 0.97 for women vs. men). Interactions between sex and country were nonsignificant in all models (all p > 0.2); however, the relationships appeared somewhat stronger among Spanish versus U.S. patients (Online Table 1).

DISCUSSION

In this multicenter study of young women and men hospitalized with AMI in the United States and Spain, the burden of traditional cardiac risk factors was high, with nearly all patients presenting with at least 1 modifiable risk factor and nearly two-thirds presenting with 3 or more. Despite women having a similar or possibly greater risk factor burden than men, they were 11% less likely to report that their health care providers had told them they were at risk for heart disease before the index AMI event and 16% less likely to report having had a provider talk with them about heart disease and ways to modify risk. This inequity largely persisted across cardiac risk factors, was more pronounced among patients without a history of CAD and among those who had not visited a heart specialist in the year before the index AMI, and was observed for patients in both the United States and Spain.

Only 53% of the young patients in our study reported that they believed they were at risk for heart disease before their AMI hospitalizations. Even more striking were the lower reported rates of provider feedback on and discussion of heart disease risk (46%) and risk factor management (49%) among these patients with documented risk factors, particularly young women. Whether these findings reflect actual practice patterns, a lack of effective communication about heart disease risk and risk modification, or potentially a perceived reduced risk because of young age (23) is unclear. Regardless, the findings underscore the importance of improved risk identification, clinical management, and patient education for adults age ≤55 years, with an emphasis on women.

Although heart disease awareness among women has increased in recent decades, it remains suboptimal (24). The 2012 American Heart Association National Women's Survey revealed that only 56% of women respondents cited heart disease as the leading cause of death in women, and only 48% of women considered themselves very well or well informed about heart disease in women. Although awareness has improved from a 1997 survey, no further improvements have occurred since 2009. In 2012, only 21% of respondents reported that their doctors ever discussed their risk for heart disease, and this proportion varied by age, with only 6% of women age 25 to 34 years reporting such a discussion, 16% of those age 35 to 44 years, 23% of those age 45 to 64 years, and 33% of those age 65 years or older. Although approximately 45% of the young women in our study reported that their health care providers discussed heart disease risk and modification, this is not reassuring given our cohort is composed of patients with premature heart disease who have a high prevalence of traditional cardiac risk factors and a family history of CAD. Building on the findings of these previous studies, we found that young women were significantly less likely than young men to

report discussions of heart disease risk and risk modification before their AMI hospitalizations. This sex difference persisted after taking into account sociodemographic characteristics, health care access, medical history, and the presence of traditional risk factors for heart disease. Moreover, the relationship was evident across multiple subgroups of patients with documented risk factors, including those with diabetes mellitus, a factor known to confer a particularly high risk for heart disease and fatal cardiac events (13,25,26), and those presenting with at least 3 of 5 potentially modifiable risk factors.

Diabetes mellitus, dyslipidemia, hypertension, obesity, and cigarette smoking are well-established risk factors for heart disease development and prognosis. Our findings are consistent with those of previous studies reporting a high percentage of patients hospitalized with AMI presenting with at least 1 of these traditional, and potentially modifiable, risk factors for heart disease (11,27-30). Few studies, however, provide sufficient data to assess sex differences in these risk factors among a young population of patients with AMI (11,29,31-34). Similar to prior studies that included younger patients with AMI in the United States (11,31,34), Sweden (33), and Canada (32), we found that young women in both the United States and Spain were more likely to present with diabetes mellitus than young men. As in prior U.S. studies (11,31,34), young women in the United States were also more likely to be obese, and young men in both the United States and Spain were more likely to have dyslipidemia. In contrast to prior studies, we did not observe a sex difference in hypertension (11,31-34) or current smoking status (31,33), which may in part reflect differences in risk factor definitions. Regardless, rates of these risk factors were high, with 60% of our cohort being current smokers and 63% being hypertensive. Collectively, these results highlight the unfavorable risk factor profiles of young patients with AMI. Our study extends these findings by including patients from both the United States and Spain and by assessing whether these traditional and potentially modifiable cardiac risk factors impact sex differences in patients' perceptions of risk and recollection of heart disease counseling by their health care providers.

STUDY LIMITATIONS. There are several issues to consider when interpreting our results. Only patients hospitalized with AMI who survived and provided consent were enrolled in the VIRGO study. Risk factor information was obtained via medical chart review and may be limited by the availability of documented information on the presence and clinical management of risk factors. Information was supplemented with direct patient interview about risk factors, but it may be subject to recall bias and awareness of risk factor status. We relied on self-report of risk discussions with providers, and these may not reflect actual practice patterns; although it is possible more discussions of risk and risk modification may have occurred, the lack of patient recall suggests that they were not effective. Finally, our results may not be generalizable to patients with AMI seen at nonparticipating hospitals. However, VIRGO is one of the largest cohorts of women and men age ≤55 years hospitalized with AMI, and the composition of our cohort and prevalence of comorbidities and risk factors are consistent with other studies of younger patients with AMI (34).

CONCLUSIONS

Although both young men and women had a high risk factor burden, young women were less likely than men to be informed about heart disease. Our results highlight opportunities to improve patient knowledge and perceptions of heart disease risk. Optimization of the delivery of health information to younger patients, particularly those with multiple cardiac risk factors, represents an important practice target for health care providers and may potentially reduce the morbidity and mortality associated with heart disease and acute cardiac events.

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PERSPECTIVES

COMPETENCY IN SYSTEMS-BASED PRACTICE: Young men and women with cardiovascular risk factors often do not receive counseling on their risk of cardiac events or ways to modify risk. Physicians should take greater advantage of opportunities to improve risk awareness.

TRANSLATIONAL OUTLOOK: More effort is needed to identify effective ways to alert young people to cardiovascular risk factors and their modification to reduce morbidity and mortality.

REFERENCES

1. Mozaffarian D, Benjamin EJ, Go AS, et al. Heart disease and stroke statistics–2015 update: a report from the American Heart Association [published correction appears in Circulation 2015;131:e535]. Circulation 2015;131:e29–322.

2. National Center for Health Statistics. Health, United States, 2012: With Special Feature on Emergency Care. Hyattsville, MD: National Center for Health Statistics, 2012.

3. Vaccarino V, Parsons L, Every NR, Barron HV, Krumholz HM, for the National Registry of Myocardial Infarction 2 Participants. Sex-based differences in early mortality after myocardial infarction. N Engl J Med 1999;341:217–25.

4. Champney KP, Frederick PD, Bueno H, et al. The joint contribution of sex, age and type of myocardial infarction on hospital mortality following acute myocardial infarction. Heart 2009;95:895–9.

5. Rosengren A, Spetz CL, Köster M, Hammar N, Alfredsson L, Rosén M. Sex differences in survival after myocardial infarction in Sweden; data from the Swedish National Acute Myocardial Infarction Register. Eur Heart J 2001;22:314–22.

6. Mahon NG, McKenna CJ, Codd MB, O'Rorke C, McCann HA, Sugrue DD. Gender differences in the management and outcome of acute myocardial infarction in unselected patients in the thrombolytic era. Am J Cardiol 2000;85:921–6.

7. Koek HL, de Bruin A, Gast F, et al. Short- and long-term prognosis after acute myocardial infarction in men versus women. Am J Cardiol 2006;98:993–9.

8. Vaccarino V, Krumholz HM, Yarzebski J, Gore JM, Goldberg RJ. Sex differences in 2-year mortality after hospital discharge for myocardial infarction. Ann Intern Med 2001;134:173–81.

9. Lloyd-Jones DM, Dyer AR, Wang R, Daviglus ML, Greenland P. Risk factor burden in middle age and lifetime risks for cardiovascular and non-cardiovascular death (Chicago Heart Association Detection Project in Industry). Am J Cardiol 2007;99:535–40.

10. Yusuf HR, Giles WH, Croft JB, Anda RF, Casper ML. Impact of multiple risk factor profiles on determining cardiovascular disease risk. Prev Med 1998;27:1–9.

11. Leifheit-Limson EC, Spertus JA, Reid KJ, et al. Prevalence of traditional cardiac risk factors and secondary prevention among patients hospitalized for acute myocardial infarction (AMI): variation by age, sex, and race. J Womens Health 2013;22:659–66.

12. Rosenstock IM. Historical origins of the health belief model. Health Educ Behav 1974;2:328–33.

13. Mosca L, Benjamin EJ, Berra K, et al. Effectiveness-based guidelines for the prevention of cardiovascular disease in women–2011 update: a guideline from the American Heart Association [published correction appears in J Am Coll Cardiol 2012;59:1663]. J Am Coll Cardiol 2011;57:1404–23.

14. Mosca L, Linfante AH, Benjamin EJ, et al. National study of physician awareness and adherence to cardiovascular disease prevention guidelines. Circulation 2005;111:499–510.

15. Mochari-Greenberger H, Miller KL, Mosca L. Racial/ethnic and age differences in women's awareness of heart disease. J Womens Health 2012;21:476–80.

16. Lehto HR, Lehto S, Havulinna AS, Jousilahti P, Salomaa V. Gender differences in the prevalence, causes and treatment of high cardiovascular risk: findings from the FINRISK Survey. Eur J Prev Cardiol 2012;19:1153–60.

17. Hart PL. Women's perceptions of coronary heart disease: an integrative review. J Cardiovasc Nurs 2005;20:170–6.

18. Lichtman JH, Lorenze NP, D'Onofrio G, et al. Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients (VIRGO) study design. Circ Cardiovasc Qual Outcomes 2010;3:684–93.

19. American Diabetes Association. Standards of medical care in diabetes–2011. Diabetes Care 2011;34 Suppl 1:S11–61.

20. National Cholesterol Education Program, NHLBI. Third report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. Circulation 2002;106:3143–421.

21. National Institutes of Health. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: the evidence report [published correction appears in Obes Res 1998;6:464]. Obes Res 1998;6 Suppl 2:51S–209S.

22. Zou G. A modified Poisson regression approach to prospective studies with binary data. Am J Epidemiol 2004;159:702–6.

23. Lichtman JH, Leifheit-Limson EC, Watanabe E, et al. Symptom recognition and healthcare experiences of young women with acute myocardial infarction. Circ Cardiovasc Qual Outcomes 2015;8 2 Suppl 1:S31–8.

24. Mosca L, Hammond G, Mochari-Greenberger H, Towfighi A, Albert MA. Fifteen-year trends in awareness of heart disease in women: results of a 2012 American Heart Association national survey. Circulation 2013;127:1254–63.

25. Huxley R, Barzi F, Woodward M. Excess risk of fatal coronary heart disease associated with diabetes in men and women: meta-analysis of 37 prospective cohort studies. BMJ 2006;332:73–8.

26. Haffner SM, Lehto S, Rönnemaa T, Pyörälä K, Laakso M. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. N Engl J Med 1998;339:229–34.

27. Canto JG, Kiefe CI, Rogers WJ, et al., for the NRMI Investigators. Number of coronary heart disease risk factors and mortality in patients with first myocardial infarction. JAMA 2011;306:2120–7.

28. Gerber Y, Weston SA, Killian JM, Jacobsen SJ, Roger VL. Sex and classic risk factors after myocardial infarction: a community study. Am Heart J 2006;152:461–8.

29. Greenland P, Knoll MD, Stamler J, et al. Major risk factors as antecedents of fatal and nonfatal coronary heart disease events. JAMA 2003;290:891–7.

30. Roe MT, Halabi AR, Mehta RH, et al. Documented traditional cardiovascular risk factors and mortality in non-ST-segment elevation myocardial infarction. Am Heart J 2007;153:507–14.

31. Canto JG, Kiefe CI, Rogers WJ, et al., for the NRMI Investigators. Atherosclerotic risk factors and their association with hospital mortality among patients with first myocardial infarction (from the National Registry of Myocardial Infarction). Am J Cardiol 2012;110:1256–61.

32. Egiziano G, Akhtari S, Pilote L, Daskalopoulou SS, for the GENESIS (GENdEr and Sex Determinants of Cardiovascular Disease) Investigators. Sex differences in young patients with acute myocardial infarction. Diabet Med 2013;30:e108–14.

33. Lawesson SS, Stenestrand U, Lagerqvist B, Wallentin L, Swahn E. Gender perspective on risk factors, coronary lesions and long-term outcome in young patients with ST-elevation myocardial infarction. Heart 2010;96:453–9.

34. Gupta A, Wang Y, Spertus JA, et al. Trends in acute myocardial infarction in young patients and differences by sex and race, 2001 to 2010. J Am Coll Cardiol 2014;64:337–45.

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APPENDIX For a supplemental table, please see the online version of this article.