Short Communication

Medical Principles and Practice

Med Princ Pract 2012;21:93–96
DOI: 10.1159/000332573

Received: January 13, 2011
Accepted: May 11, 2011
Published online: October 21, 2011

Sex-Specific Time Trends in Very Elderly Patients (Aged ≥80 Years) Hospitalized with Myocardial Infarction

Bruce Ovbiagele

Vascular Neurology Program, University of California, La Jolla, San Diego, Calif., USA

Key Words
Elderly · Oldest old · Acute myocardial infarction · Acute myocardial ischemia · Time trends

Abstract
Objective: To assess sex-related time trends in the proportion of very elderly patients (age ≥80) hospitalized with myocardial infarction (MI). ***Subjects and Methods:*** Data were obtained from all states in the USA that contributed to the Nationwide Inpatient Sample. All patients admitted to hospital between 1997 and 2006 with a primary discharge diagnosis of MI, identified by the *International Classification of Diseases, Ninth Revision* procedure codes were included. Percentages of MI hospitalizations comprising men and women aged ≥80 were evaluated. ***Results:*** Overall, between 1997 and 2006, the absolute number of MI hospitalizations decreased from 732,170 to 674,988, but the percentage of very elderly men rose in a roughly linear pattern by 2.84% from 14.2% in 1997 to 17.1% in 2006 (95% CI 1.9–3.8%, $p < 0.001$) while among very elderly women, the percentages increased linearly by 4.95% from 31.0% in 1997 to 35.95% in 2006 (95% CI 3.6–6.3%, $p < 0.001$). Comparing women to men, the rise was 1.74 times larger (95% CI 1.26–2.23, $p = 0.03$). ***Conclusions:*** Over the last decade, the percentage of very elderly women hospitalized with MI in the United States rose at almost twice the rate of similarly aged men. These trends may be expected to exponentially worsen given the aging global population.

Introduction

The world population is rapidly aging. For instance, by 2050 the proportion of very elderly individuals in the United States will represent approximately a two-fold increase from 2010 [1]. This projected change in population age structure has already begun, and it is believed that women may be at more of a disadvantage than men since the magnitude of age-related increases in prevalence of leading medical conditions like coronary heart disease is greater in women [2]. Compounding these issues, the very elderly are relatively understudied with regard to cardiovascular disease, and practice findings suggest that the very old and women generally receive lower-quality cardiovascular care than their younger or male counterparts [2]. Since myocardial infarction (MI) occupies a central role in the assessment of the burden of heart disease, this study aimed to assess nationwide sex-specific trends in the percentage of persons hospitalized with MI who were aged ≥80 years over the last decade.

Subjects and Methods

Data were obtained from the Nationwide Inpatient Sample (NIS), developed as part of the Healthcare Cost and Utilization Project (HCUP), a Federal-State-Industry partnership sponsored by the Agency for Healthcare Research and Quality (AHRQ). NIS is designed to approximate a stratified 20% sample of all non-Federal, short-term, general and specialty hospitals serving adults

KARGER

Fax +41 61 306 12 34
E-Mail karger@karger.ch
www.karger.com

1011–7571/12/0211–0093$38.00/0

Accessible online at:
www.karger.com/mpp

Bruce Ovbiagele, MD, MSc
Vascular Neurology Program, University of California, San Diego
9500 Gilman Drive
La Jolla, CA 92093 (USA)
Tel. +1 858 552 8585, E-Mail ovibes@ucsd.edu

Table 1. Descriptive summary table: percent of MI hospitalizations by sex among persons aged ≥80 years in the United States between 1997 and 2006

Variable	Description	Year 1997				Year 2006			
		sample frequency n	weighted frequency n	weighted frequency %	SE	sample frequency n	weighted frequency n	weighted frequency %	SE
Sex	Male	12,830	62,986	41.26	0.37	14,095	69,213	41.70	0.35
	Female	18,172	89,660	58.74	0.37	19,662	96,763	58.30	0.35
Race	White	23,036	112,462	90.35	0.74	21,572	106,167	84.68	1.13
	Black	1,136	5,649	4.54	0.43	1,456	7,054	5.63	0.47
	Hispanic	866	4,089	3.29	0.59	1,486	7,066	5.64	0.91
	Other	496	2,276	1.83	0.22	1,062	5,082	4.05	0.48
Primary	Medicare	28,228	138,500	90.79	0.52	31,576	155,382	93.74	0.40
Payer	Medicaid	261	1,288	0.84	0.12	253	1,228	0.74	0.08
	Private	2,224	11,274	7.39	0.48	1,535	7,440	4.49	0.37
	Other	274	1,492	0.98	0.18	349	1,703	1.03	0.10
Hospital region	North East	7,191	36,072	23.63	1.24	7,650	40,327	24.30	1.52
	Mid-West	7,476	37,451	24.53	1.10	7,901	40,287	24.27	1.30
	South	11,615	56,814	37.21	1.40	12,610	58,897	35.49	1.55
	West	4,724	22,329	14.63	0.78	5,596	26,464	15.94	0.94
Hospital location	Rural	5,513	27,853	18.27	0.78	4,711	23,936	14.47	0.83
	Urban	25,445	124,580	81.73	0.78	28,930	141,514	85.53	0.83
Hospital teaching status	Nonteaching	21,863	106,021	69.55	1.36	19,373	93,739	56.66	1.69
	Teaching	9,095	46,412	30.45	1.36	14,268	71,711	43.34	1.69
Admission source	Emergency	21,264	104,581	70.93	1.23	23,575	115,758	69.90	1.41
	Another health facility	3,664	18,162	12.32		4,878	24,040	14.52	1.03
	Routine	4,932	24,690	16.75	1.03	5,232	25,814	15.59	1.00
		Q1	Median	Q3		Q1	Median	Q3	
Age, years		82	84	88		82	85	89	

in the United States. The sampling strategy selects hospitals within states that have State Inpatient Databases (SID) according to defined strata based on ownership, bed size, teaching status, urban/rural location and region. All discharges from sampled hospitals for the calendar year are then selected for inclusion into NIS. To allow extrapolation for national estimates, both hospital and discharge weights are provided. Detailed information on the design of the NIS is available at http://www.hcup-us.ahrq.gov. From 1997 to 2006, NIS captured discharge level information on primary and secondary diagnoses and procedures, discharge vital status and demographics on several million discharges per year from hospitals in 22 (1997) to 38 (2006) states. Data elements that could directly or indirectly identify individuals were excluded; we thus considered all discharges to be independent. The unit of analysis was the discharge rather than the individual. A unique hospital identifier allows for linkage of discharge data to an NIS data set with hospital characteristics.

To analyze MI hospitalization percentages, we identified all discharges for which an ICD9-CM code of 410.xx (acute myocardial infarction) was listed as the primary diagnosis. This approach has been utilized by other studies and was taken to specifically focus on patients who presented with acute myocardial ischemia and not those patients who had MI secondary to surgery, hypotension or other events after hospitalization [3]. Total number of MI was obtained by summing across codes. The 95% confidence intervals (95% CI) were approximated using Monte Carlo simulation strategy. For patients who had more than one reported code of 410.xx, only the first reported code was used. All patients with a diagnosis of MI were included regardless of whether they were alive or dead at the time of discharge.

Statistical Analyses

The percentage of MI hospitalizations among men and women in the sample were computed over the 10-year study period (1997–2006). Age standardization was subsequently performed using the 2000 standard US population. Race was not adjusted for given the large amount of missing data on this variable (25%). We tested for significant trends in hospitalization percentage over years us-

Table 2. Percent of MI hospitalizations by sex among persons aged ≥80 years in the United States between 1997 and 2006

Year	Total MI hospitalizations, weighted number	MI hospitalizations in persons aged ≥80 years, %	SE, %
Men			
1997	443,023	14.22	0.32
1998	451,492	15.14	0.32
1999	435,200	16.26	0.32
2000	454,443	16.28	0.32
2001	456,177	17.33	0.35
2002	450,877	17.01	0.35
2003	443,407	17.26	0.33
2004	411,375	17.71	0.35
2005	392,398	18.44	0.41
2006	405,867	17.05	0.34
Women			
1997	289,147	31.01	0.47
1998	301,320	32.48	0.47
1999	295,072	34.46	0.44
2000	313,949	34.66	0.45
2001	317,675	35.81	0.49
2002	313,228	35.44	0.51
2003	306,981	35.93	0.48
2004	283,454	36.16	0.48
2005	269,760	37.20	0.58
2006	269,121	35.96	0.50

ing linear logistic regression. To test for curvilinear trends, we included year as a continuous variable together with the quadratic term to the regression models. The p values for assessing sex differences in hospitalizations across the 10-year study period were computed using contrasts (Z-tests) under the regression model. All data analyses were conducted using SAS (version 9.1; SAS Institute Inc, Cary, N.C., USA). Statistical hypotheses were tested with $p < 0.05$ as the level of statistical significance.

Results

The descriptive summary statistics are given in table 1. For simplicity, these descriptive tables only show the results for the years 1997 and 2006. These results are generally comparable across variables, but it can be noted that over the decade the median age went up by 1 year from 84 to 85 years, and there was an almost 6% point drop in those persons categorized as being of White race.

Overall, the absolute number of MI hospitalizations generally decreased from 732,170 to 674,988, but the percentage of the MI hospitalizations in the very elderly rose over the study period (table 2). The corresponding plot of percentage MI hospitalizations by year in the very elderly is shown in figure 1. The proportion increased significantly in a roughly linear fashion in both sexes across the decade. The proportion of very elderly men rose from 14.2% in 1997 to 17.05% in 2006, a 2.84% increase (linear trend: $p < 0.01$). The proportion of very elderly women also increased from 31.01% in 1997 to 35.95% in 2006, representing a 4.95% boost in frequency (linear trend: $p < 0.001$). The percent change across the decade was significantly greater in females than in males overall (ratio = 1.74, approximate 95% CI 1.26–2.23, p = 0.03).

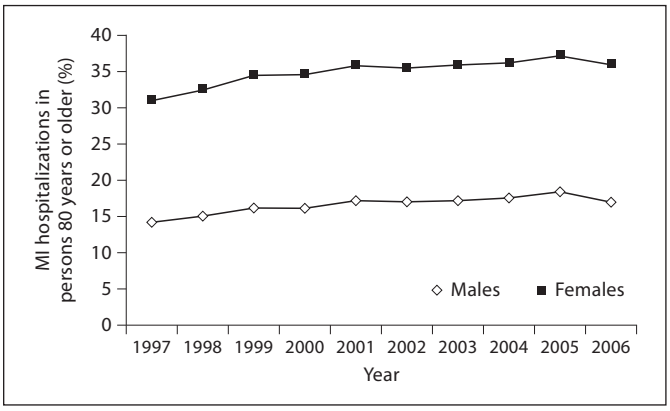

Fig. 1. Percent hospitalizations with MI by sex among persons aged ≥80 years in the United States between 1997 and 2006.

Discussion

Overall, this analysis found that across the last decade there was a modest yet significant increase in the proportion of hospitalized patients aged 80 years and above, in the United States. Of note, the increase in the proportion of very elderly women among the patients hospitalized with MI was about twice as large as that of very elderly men hospitalized with MI. At first glance, the approximately 3% rise for very elderly men and 5% rise for very elderly women over the 10-year period, although statistically significant, may not seem impressive. However, when put in the context of what appears to be diminishing absolute numbers of MI hospitalization in the overall population, established disparities in cardiovascular care unfavorable to women [4], the relentless aging of the US population [5], known poorer clinical outcomes after MI in the very elderly [2] and a recognized underutilization of proven vascular risk reduction treatments in the very-elderly age group [6], the findings could be of growing public health importance.

It is unlikely that these findings are due to better recognition of cardiovascular symptoms and risk factors by patients, or better detection of cardiovascular disease by providers [7] since conceivably any boost in recognition or diagnosis would also have applied to other patients, and yet, as noted, overall MI hospitalization numbers decreased. A more likely explanation would be that with superior medicines and their more timely and widespread use [8], relatively younger patients are now much older when they experience their first or recurrent MI, thereby postponing MI hospitalization well into their golden years [9]. Similarly, the comparatively greater longevity and delayed incidence of first MI in women versus men [5] may be contributing to the steeper rise in the proportion of the former hospitalized with MI. It is also possible that the undertreatment of cardiovascular risk factors observed among relatively younger women compared to men might also play a role in this disparate increase [4].

These findings underscore the need for healthcare providers and policy makers to prepare for a continued and probable exponential rise in the proportion MI hospitalization among the very elderly and women in years to come, and to identify ways to optimize clinical outcomes in these relatively underinvestigated and undertreated demographic groups [6]. Intensification of efforts at screening for and treating vascular risk factors may be warranted [6]. Furthermore, researchers and research-funding agencies may also need to boost research in this population to ensure that treatments being instituted actually carry a favorable risk-benefit ratio and that the more aggressive proven treatments applied to younger patients are not simply being blindly extended to this age group with uncertain or dire consequences.

This study has limitations. Initial MI hospitalizations could not be distinguished from recurrent ones, and although we included all MI-pertinent diagnostic codes, MI diagnoses were not validated using standardized criteria. Also, these data are not necessarily applicable to other countries, especially since regional variability in MI characteristics are known to occur [10]. The study was strengthened by hospital-based MI diagnoses and nationwide scope, and unlike many community-based studies was not limited by upper age limits, or inclusion of persons of only one race or sex.

Conclusion

From 1997 to 2006, the proportion of individuals hospitalized with MI in the United States who were very elderly women, rose at almost twice the rate of similarly aged men. These trends are probably similar in many developed nations and will likely exacerbate in years to come given the aging global population, necessitating enhanced efforts in vascular risk factor management among the very elderly, especially women.

Acknowledgements

B.O. received support from the University of California, Los Angeles, Resource Centers for Minority Aging Research Center for Health Improvement of Minority Elderly (RCMAR/CHIME) under NIH/NIA Grant P30-AG021684.

References

1 US Census Bureau; US population projections: 2010 to 2050. Washington, US Department of Commerce; 2008. Available at: http://www.census.gov/population/www/projections/summarytables.html (accessed December 27, 2010).
2 Yazdanyar A, Newman AB: The burden of cardiovascular disease in the elderly: morbidity, mortality, and costs. Clin Geriatr Med 2009;25:563–577, vii.
3 Vaccarino V, Parsons L, Peterson ED, Rogers WJ, Kiefe CI, Canto J: Sex differences in mortality after acute myocardial infarction: changes from 1994 to 2006. Arch Intern Med 2009;169:1767–1774.
4 Mosca L, Merz NB, Blumenthal RS, Cziraky MJ, Fabunmi RP, Sarawate C, Watson KE, Willey VJ, Stanek EJ: Opportunity for intervention to achieve American Heart Association guidelines for optimal lipid levels in high-risk women in a managed care setting. Circulation 2005;111:488–493.
5 Lloyd-Jones D, Adams RJ, Brown TM, et al: Heart Disease and Stroke Statistics – 2010 Update. A Report from the American Heart Association. Circulation 2010;121:948–954.
6 Kriekard P, Gharacholou SM, Peterson ED: Primary and secondary prevention of cardiovascular disease in older adults: a status report. Clin Geriatr Med 2009;25:745–755, x.
7 Parikh NI, Gona P, Larson MG, Fox CS, Benjamin EJ, Murabito JM, O'Donnell CJ, Vasan RS, Levy D: Long-term trends in myocardial infarction incidence and case fatality in the National Heart, Lung, and Blood Institute's Framingham Heart study. Circulation 2009; 119:1203–1210.
8 Fonarow GC, French WJ, Frederick PD: Trends in the use of lipid-lowering medications at discharge in patients with acute myocardial infarction: 1998 to 2006. Am Heart J 2009;157:185–194.
9 Krumholz HM, Wang Y, Chen J, et al: Reduction in acute myocardial infarction mortality in the United States: risk-standardized mortality rates from 1995–2006. JAMA 2009;302:767–773.
10 Thalib L, Zubaid M, Rashed W, Almahmeed W, Al-Lawati J, Sulaiman K, Al-Motalleb A, Amin H, Al-Suwaidi J, Alhahbib KF: Regional variability in hospital mortality in patients hospitalized with ST-segment elevation myocardial infarction: findings from the Gulf Registry of Acute Coronary Events. Med Princ Pract 2011;20:225–230.