Comparison of One-Year Survival After Acute Coronary Syndrome in Patients ≥75 Years of Age With Versus Without Living With Spouse

Zhu Zhaowei, MD[1,a], Peng Xiaofan, MD[1,a], Xie Hebin, MD[b], Tian Cuihong, MD[a], Xing Haoran, MD[a], Liu Qinna, MD[a], Liu Zhenzhen, MD[a], Hu Xinqun, MD[a], Fang Zhenfei, MD[a], Tang Jianjun, MD[a], Zhao Yanshu, MD[a], Yuan Hong, MD[c], Shi Chun, MD[a], Tai Shi, MD[a], Liu Qiming, MD[a], Jiang Hejun, MD[a], Lv Xiaoling, MD[a], and Zhou Shenghua, MD[a,*]

Patients with acute coronary syndrome (ACS) face high postevent mortality. This study aims to evaluate the impact of living without spouse on 1-year mortality of ACS patients. This retrospective study enrolled a total of 600 consecutive patients (≥75 years of age) with ACS hospitalized in our hospital between January 2013 and December 2016. Patients' clinical characteristics, laboratory values, hospital course, demographic characteristics, and angiographic data were collected. Patients were divided into 2 groups according to living with (n = 396) or without (n = 204) spouse. Patients living without spouse were older (79 [77,82] vs 77 [76,80], p < 0.001), more frequently female (54.9% vs 31.8%, p < 0.001), less smokers (23.5% vs 38.9%, p < 0.001), lower left ventricular ejection fraction value (52.1±10.7% vs 54.4±9.8%, p = 0.021) compared with patients living with spouse. In addition, compared to patients living with spouse, patients living without spouse were less likely to get percutaneous coronary intervention (41.2% vs 54.0%, p = 0.003) during hospitalization and had higher 1-year mortality post-ACS (22.1% vs 13.4%, p = 0.006). Multivariate logistic regression analysis showed that living without spouse remained an independent risk factor for 1-year mortality after ACS in patients ≥75 years (odds ratio 2.350, 95% confidence interval 1.245 to 4.434, p = 0.008), after adjusted with age, gender, heart rate, systolic blood pressure, left ventricular ejection fraction value at baseline, hemoglobin, white blood cell, alanine aminotransferase, albumin, creatinine, brain natriuretic peptide, type of ACS, severe heart failure at admission, percutaneous coronary intervention treatment, β blocker, diuretics application during hospital. In conclusion, living without spouse is an independent risk factor for 1-year all-cause mortality in ACS patients ≥75 years. **(Am J Cardiol 2019;123:1−6)**

Acute coronary syndrome (ACS) refers to a broad term describing a spectrum of clinical presentations including ST-segment elevation myocardial infarction (STEMI) and those with non-ST-segment elevation ACS (NSTE-ACS). ACS is a very common and life-threatening clinical event linked with high mortality and consequent economic and social care implications.[1,2] Due to increases in life expectancy worldwide,[3] patients ≥75 years of age constitute a large proportion of ACS patients. It is reported that nearly 1/3 of patients with NSTE-ACS were ≥75 years of age.[4] Based on age-related structural and functional changes of cardiovascular and noncardiovascular systems, patients ≥75 years are prone to face worse outcomes post-ACS in comparison with younger ACS patients.[5,6] Many factors are responsible for increased mortality in these ACS patients.[7] Living without spouse arises as a new concern, because increasing patients lost their spouses with aging. Previous study found that single living increased worse outcomes post heart attack or myocardial infarction regardless of age.[8,9] In the present study, we tested the hypothesis that patients ≥75 years living without spouse might be linked with worse outcomes in comparison with those living with spouse.

Methods

This retrospective single-center study enrolled 632 patients ≥75 years with ACS hospitalized in our department between January 2013 and December 2016. To ensure exhaustive data collection, only patients who were initially admitted to our center were included; those transferred from other centers were not included. The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki as reflected by

[a]Department of Cardiovascular Medicine, The Second Xiangya Hospital, Central South University, Changsha, Hunan, China; [b]Changsha Central Hospital, Changsha, Hunan, China; and [c]The Third Xiangya Hospital, Central South University, Changsha, Hunan, China. Manuscript received July 13, 2018; revised manuscript received and accepted September 13, 2018.

Funding: This work was supported in part by the National Science Foundation of China (NSFC) Projects 81600248 (Z Zhu) and 81670269 (to S Zhou), Hunan Provincial Natural Science Foundation of China Projects 2018JJ3744 (Z Zhu), the Major science and technology special project in Hunan 2016SK1001 (HY).

[1]These authors share the first authorship.

See page 5 for disclosure information.

*Corresponding author: Tel: +86 (731) 85292012; fax: +86 (731) 85292013.

E-mail address: zhoushenghua@csu.edu.cn (Z. Shenghua).

0002-9149/
https://doi.org/10.1016/j.amjcard.2018.09.032

previous approval from the human research committee of each participating institution. Informed consent for use of data was obtained from each patient.

ACS diagnosis and classifications as having either STEMI or NSTE-ACS were according to the standard definitions of the American College of Cardiology.[10,11] Severe heart failure in our study indicates heart failure with class 3 to 4 in Killip or New York Heart Association classification.

Following information was collected: risk factors for coronary artery disease, clinical characteristics, laboratory values, hospital course, demographic characteristics, medical history, and angiographic results. Follow-up outcomes were ascertained by hospital chart review, telephone contact, and clinical visit. The study population was divided into 2 groups according to living with or without spouse. The primary end point was all-cause mortality from admission till 1-year after discharge; the second endpoints included stroke, significant bleeding during 1-year follow up and unplanned readmission after discharge during the 1-year follow up.

SPSS IBM 25 was used for statistical analysis. Continuous variables were reported as mean and standard deviation or median and interquartile range according to their distribution; comparisons between groups were performed with 2-sided Student's *t* test or nonparametric test, as appropriate. Categorical variables were reported as percentage and compared with chi-square test. Multivariate logistic regression models were used to assess the relationship between risk factors and mortality. Estimates of odds ratios with their 95% confidence intervals were reported. A p value of < 0.05 was considered statistically significant.

Results

Thirty-two of 632 patients enrolled during the cohort period were excluded due to lack of relevant data, data from 600 patients were analyzed: 204 (34%) patients in the without spouse group and 396 (66%) in the with spouse group. There were 161 (26.8%) STEMI and 439 (73.2%) NSTE-ACS patients.

Baseline characteristics of each group are listed in Table 1. Body mass index, prevalence of hypertension, dyslipidemia, and diabetes were similar between the 2 groups. However, patients without spouse were older, more frequently female and the percentage of smokers was lower compared with patients with spouse.

Clinical features on admission were similar between the 2 groups (Table 2), except for the left ventricular ejection fraction (LVEF). Patients without spouse had a lower LVEF value and higher percentage of ejection fraction $< 50\%$ compared with patients with spouse.

In-hospital medication including aspirin, clopidogrel, β blocker, proton pump inhibitor, statins, angiotensin converting enzyme inhibitors or angiotensin II receptor blockers and diuretics, was similar between the 2 groups. Patients with spouse were more likely to receive percutaneous coronary intervention (PCI) treatment during hospitalization compared with those without spouse, despite similar coronary angiographic characteristics between the groups. There was also no significant difference in the length of hospital stay and in-hospital mortality (5.41% vs 5.42%) between groups (Table 3). Most in-hospital death was attributed to cardiac reason (90.4% vs 90.9% in group living with and without spouse). During 1-year follow up, a total of 98 patients died (16.3%), mortality was significantly higher in patients living without spouse than patients with spouse. Besides, the percentage of patients rehospitalized more than once was significantly higher in patients without spouse than that in patients with spouse. However, the secondary endpoints including stroke and bleeding after discharge were similar between groups (Table 3).

Table 1
Baseline characteristics of patients according to living with or without spouse

Variable	Living with spouse		p Value
	NO (n = 204)	YES (n = 396)	
Age, mean (SD), (years)	79(77,82)	77(76,80)	< 0.001
Women	112 (54.9%)	126(31.8%)	< 0.001
Smoker	48(23.5%)	154(38.9%)	< 0.001
Body mass index, mean (SD), (kg/m^2)	22.7±4.5	23.1±3.6	0.312
Hypertension	151(74.0%)	307(77.5%)	0.339
Dyslipidemia	173(84.9%)	342(86.4%)	0.641
Diabetes mellitus	59(28.9%)	131(33.1%)	0.300
Previous myocardial infarction	35(17.2%)	61(15.4%)	0.616
Previous coronary artery bypass grafting	3(1.5%)	7(1.8%)	0.770
Previous PCI	27(13.2%)	52(13.1%)	0.990
Stroke	30(14.7%)	55(13.9%)	0.843
Atrial fibrillation	23(11.3%)	43(10.9%)	0.928

Data are presented as the mean value ± SD (p values for 2-sided Student's *t* test) or median and interquartile (p values for Mann-Whitney test) or percentage of patients (p values for chi-square test).

PCI = percutaneous coronary intervention.

To investigate the possible risk factors for mortality in our study. We first investigated the risk factors of mortality with univariate analysis based on the clinical characteristics, history, blood test, and in-hospital management (Table 4). Multivariate logistic regression analysis was applied with the meaningful factors defined by univariate analysis ($p < 0.05$) after adjusted with age, gender, heart rate, systolic blood pressure, LVEF value at baseline, hemoglobin, white blood cell, alanine aminotransferase, albumin, creatinine, brain natriuretic peptide, type of ACS, severe heart failure at admission, PCI treatment, β blocker, and diuretics application during hospital. It was showed that without spouse was an independent risk factor for mortality during 1-year follow up (odds ratio [OR] 2.350, 95% confidence interval 1.245 to 4.434, p = 0.008). At the same time, male was also an independent risk factor and hemoglobin was an independent protective factor for mortality during 1-year follow up (Table 5).

Discussion

The present study describes the impact of living with or without spouse on 1-year outcomes in patients ≥ 75 years with ACS. The major finding was that patients ≥ 75 years living without spouse had a higher 1-year mortality compared with those living with spouse during follow up and

Table 2
Clinical features at admission of patients according to living with or without spouse

Variable	Living with spouse		p Value
	NO (n = 204)	YES (n = 396)	
Heart rate (beats/min)	77±17.0	76±14.3	0.254
Systolic blood pressure (mm Hg)	137±27	135±23	0.348
Diastolic blood pressure (mm Hg)	73±14	74±14	0.506
Hemoglobin (g/L)	115.2±19.5	117.5±21.7	0.208
White blood cells, median (IQR), (×1000/μl)	6.6(5.5,8.7)	6.5(5.3,8.2)	0.221
Platelet (×1000/μl)	193.8±70.4	184.1±60.5	0.083
Albumin, median (IQR), (g/L)	34.8(32.3,37.7)	35.4(32.5,37.8)	0.392
Alanine aminotransferase, median (IQR), (U/L)	18.9(12.8,35.5)	19.7(12.9,33.3)	0.811
Creatinine, median (IQR), (μmoI/L)	85.5(70.4,115.0)	91.4(72.0,121.1)	0.353
Brain natriuretic peptide, median (IQR), (pg/ml)	1440.7(389.2, 3491.6)	1006.0(345.0, 2984.3)	0.126
Creatine kinase-myocardial band, median (IQR), (IU/L)	14.5(10.9,23.7)	13.8(10.5,21.3)	0.360
Total cholesterol, (mg/dl)	152.8±37.8	151.6±38.6	0.802
Triglycerides, median (IQR), (mg/dl)	113.3(82.3,155.8)	110.6(81.4,152.2)	0.366
Low density lipoprotein cholesterol, (mg/dl)	89.9±33.9	89.1±32.4	0.863
High density lipoprotein cholesterol, (mg/dl)	41.2±13.5	41.2±10.8	0.958
Uric acid, mean (IQR), (umol\L)	355.9(285.6,425.7)	351.6(285.8,424.9)	0.766
Type of ACS			
STEMI	60(29.4%)	101(25.5%)	0.306
NSTE-ACS	143(70.1%)	293(74.0%)	0.306
LVEF(%)	52.1±10.7%	54.4±9.8%	0.021
LVEF < 50%	57(27.9%)	72(18.2%)	0.003
Severe heart failure	114(55.9%)	190(48.0%)	0.116

Data are presented as the mean value ± SD (p values for 2-sided Student's *t* test) or median and interquartile (p values for Mann-Whitney test) or percentage of patients (p values for chi-square test).

CK-MB = Creatine kinase-myocardial band.

Table 3
In-hospital management and follow up for patients living with or without spouse

Variable	Living with spouse		p Value
	No (n = 204)	Yes (n = 396)	
Medicine use			
Aspirin	169(82.8%)	336(84.8%)	0.479
Clopidogrel	175(85.8%)	352(88.9%)	0.235
Beta blocker	145(71.2%)	281(71.0%)	0.976
Statin	198(97.1%)	383(96.7%)	0.689
Proton pump inhibitor	174(85.3%)	316(79.8%)	0.190
Angiotensin-converting-enzyme inhibitors or angiotensin receptor blockers	114(55.9%)	252(63.6%)	0.065
Diuretic	105(51.5%)	171(43.2%)	0.077
Angiographic data			
Left main	16(7.8%)	24(6.1%)	0.407
1-vessel disease	23(11.3%)	61(15.4%)	0.167
2-vessel disease	3(1.5%)	12(3.0%)	0.246
3-vessel disease	41(20.1%)	87(22.0%)	0.586
Hospital PCI	84(41.2%)	214(54.0%)	0.003
Length of stay, mean (SD), (days)	10.4±5.3	10.5±5.7	0.939
In hospital mortality	11(5.42%)	21(5.41%)	0.997
Cardiac death	10(90.9%)	19(90.4%)	0.968
Follow up			
Readmission (times)			
0	138(67.6%)	288(72.7%)	0.194
1	28(13.7%)	58(14.6%)	0.760
> 1	38(18.6%)	50(12.6%)	0.049
Bleeding	17(8.3%)	33(8.3%)	0.839
Stroke	9(4.4%)	18(4.5%)	0.791
Mortality	45(22.1%)	53(13.4%)	0.006

Data are presented as the mean value ± SD (p values for 2-sided Student's *t* test) or median and interquartile (p values for Mann-Whitney test) or percentage of patients (p values for chi-square test).

living without spouse was an independent risk factor for increased mortality in patients ≥75 years with ACS. Besides, male gender was an independent risk factor and hemoglobin was an independent protective factor of 1-year mortality in these ACS patients.

More challenges arise in taking care of patients ≥75 years with ACS.[12] It is reported that 1-year mortality in ACS patients ≥ 75 years varies with different studies, ranging from 12%,[13] 15.9%[14] to 20%.[15] Our study showed a total of 16.3% mortality, which is consistent with previous studies.[16] The traditional risk factors including male gender, previous myocardial infarction, hypertension, tobacco use, diabetes mellitus, lower ejection fraction, elevated serum creatinine, in-hospital cardiac complications, no PCI or coronary artery bypass grafting, and low hemoglobin were investigated in previous studies.[17] Our results demonstrated that these factors except male gender and low hemoglobin are more or less similar between patients living with or without spouse, while living without spouse serves as an independent risk factor of increased 1-year mortality after adjustment of all other cofounders. Although the underlying reasons for the increased mortality risk of living without spouse remain largely elusive at present, our study highlights the importance of social factors on mortality in ACS patients. It is reported ACS patients without spouse even exhibited 24.4% lower physical activity than those with spouse.[18] Besides, the depression status is prevalent in ACS patients[19] and incidence of depression was higher in subjects living alone.[20] Moreover, living alone is linked with lower medicine adherence,[21] all these factors might relate to the higher mortality in patients in this cohort without spouse.

Compared with patients living with spouse, patients living without spouse were more likely to be female gender, which can be explained by the longer life expectancy of female. Gender difference might also explain why there were fewer smokers in patients living without spouse, since prevalence of smokers is less in female than in male

Table 4
Univariable analyses of the factors associated with 1-year mortality

Variable	Died (n = 98)	Survived (n = 502)	OR	95% CI	p value
Age, mean (SD), (years)	79(76,82)	78(76,80)	1.070	1.007-1.138	0.028
Men	68(69.4%)	294(58.6%)	1.588	0.998-2.529	0.051
Smoker	33(33.7%)	169(33.7%)	0.946	0.597-1.498	0.812
Body mass index, mean (SD), (kg/m^2)	22.3±4.9	23.0±3.8	0.960	0.898-1.026	0.232
Hypertension	71(72.4%)	387(77.1%)	0.781	0.479-1.275	0.323
Diabetes mellitus	27(27.6%)	163(32.5%)	0.791	0.489-1.279	0.339
Atrial fibrillation	14(14.3%)	52(10.4%)	1.434	0.760-2.706	0.266
Previous myocardial infarction	17(17.3%)	79(15.7%)	1.130	0.635-2.012	0.677
Previous PCI	11(11.2%)	68(13.5%)	0.811	0.411-1.597	0.544
Previous coronary artery bypass grafting	1(1.0%)	9(1.7%)	0.561	0.070-4.482	0.586
Previous stroke	17(17.3%)	68(13.5%)	1.331	0.743-2.384	0.336
Heart ratio, mean (SD), (beats/min)	82±17.9	75±14.5	1.028	1.015-1.042	<0.001
Systolic blood pressure, mean (SD), (mm Hg)	130.6±26.0	136.5±23.6	0.990	0.980-0.999	0.028
Diastolic blood pressure, mean (SD), (mm Hg)	73.7±18.3	73.9±13.1	0.999	0.983-1.014	0.878
Hemoglobin, mean (SD), g/L	109.6±22.3	118.2±20.5	0.982	0.973-0.992	<0.001
White blood cell, median (IQR), ($\times 1000/\mu L$)	7.5(6.1,10.1)	6.4(5.3,8.0)	1.107	1.043-1.176	0.001
Platelet, mean (SD), ($\times 1000/\mu l$)	190.5±73.2	186.8±62.3	1.001	0.998-1.004	0.605
Albumin, median (IQR), (g/L)	33.5(29.8,36.2)	35.6(32.9,38.1)	0.875	0.827-0.923	<0.001
Alanine aminotransferase, median (IQR), (U/L)	21.2(12.5,43.0)	19.4(13.1,33.0)	1.002	1.000-1.004	0.018
Creatinine, median (IQR), (μmoI/L)	108.0(81.9,153.8)	86.9(70.1,114.3)	1.005	1.002-1.008	<0.001
Brain natriuretic peptide, median (IQR), (pg/ml)	3559.0(1388.4,9454.5)	894.8(279.8,2558.0)	1.000	1.000-1.000	<0.001
Creatine kinase-myocardial band, median (IQR), (IU/L)	14.7(11.1,34.0)	13.9(10.5,20.7)	1.002	1.000-1.004	0.053
Total cholesterol, mean (SD), (mg/dl)	150.8±37.7	151.9±38.5	0.968	0.768-1.220	0.784
Triglyceride, median (IQR), (mg/dl)	105.9(79.4,149.1)	112.1(81.2,153.5)	0.917	0.718-1.173	0.491
Low density lipoprotein cholesterol, mean (SD), (mg/dl)	88.7±32.8	89.5±33.2	0.963	0.739-1.253	0.776
High density lipoprotein cholesterol, mean (SD), (mg/dl)	39.2±14.2	41.5±11.2	0.510	0.235-1.111	0.090
Type of ACS					
STEMI	41(41.8%)	120(23.9%)	2.290	1.459-3.594	<0.001
NSTE-ACS	57(58.2%)	379(75.5%)	0.440	0.280-0.691	<0.001
Left ventricular ejection fraction, mean (SD), (%)	49.4±12.1	54.3±9.6	0.957	0.935-0.979	<0.001
Uric acid, median (IQR), (umol\L)	373.3(285.7,464.9)	351.8(286.1,418.5)	1.002	1.000-1.004	0.052
Left main	5(5.1%)	35(7.0%)	0.717	0.274-1.879	0.499
3-vessel disease	14(14.3%)	114(22.7%)	0.566	0.310-1.034	0.064
Severe heart failure	67(68.4%)	237(47.2%)	2.394	1.503-3.813	<0.001
In hospital management					
Aspirin	79(80.6%)	426(84.9%)	0.732	0.419-1.279	0.273
Clopidogrel	88(89.8%)	439(87.5%)	1.243	0.613-2.518	0.546
Angiotensin-converting-enzyme inhibitors or Angiotensin receptor blockers	55(56.1%)	311(62.0%)	0.786	0.507-1.217	0.280
Beta blocker	58(59.2%)	368(73.3%)	0.528	0.337-0.827	0.005
Statin	93(94.9%)	488(97.2%)	0.457	0.157-1.329	0.151
Proton pump inhibitor	87(88.8%)	403(80.3%)	1.965	0.983-3.928	0.056
Diuretics	69(70.4%)	207(41.2%)	3.417	2.127-5.489	<0.001
Hospital PCI	34(34.7%)	264(52.6%)	0.479	0.305-0.752	0.001
Without spouse	45(45.9%)	159(31.7%)	1.832	1.180-2.843	0.007

Data are presented as the mean value ± SD (p values for 2-sided Student's *t* test) or median and interquartile (p values for Mann-Whitney test) or percentage of patients (p values for chi-square test).

population in China.[22] It is to note that patients living without spouse were less likely to get in-hospital PCI treatment. This may be attributed to the less economic support from family[23] and patients have to pay the medical cost themselves since medical insurance usually did not cover for all the clinical cost in China. However, in-hospital PCI did not serve as a protective factor for 1-year mortality in ACS patients ≥75 years and after adjustment of in-hospital PCI, living without spouse is still an independent risk factor of increased mortality in this patient cohort.

Intimate relationships are a central element of psychosocial risk for coronary artery disease.[24] It is known that the quality of spousal relationships is closely related to physical health outcomes.[25] The role of psychosocial factors in cardiovascular disease becomes an area of research interest now. Although previous studies indicated living without spouse was associated with significantly increased mortality or prognosis following myocardial infarction,[8,9] or could predict 30-day hospital readmission after coronary artery bypass graft surgery.[26] Few researches focused on this factor in ACS patients ≥75 years, who have a much higher possibility to lose his or her spouse and are more dependent on the support from spouse in late-life. Our study showed as high as 34% patients have to live alone and they faced with an increased mortality after

Table 5
Multivariable analyses of the factors associated with 1-year mortality

	Odds ratio	95% confidence interval	p Value
Male	2.139	1.065-4.296	0.033
Age	1.007	0.924-1.096	0.881
Heart rate	1.012	0.991-1.033	0.258
Systolic blood pressure	0.997	0.984-1.009	0.582
NSTE-ACS	0.769	0.372-1.588	0.477
LVEF	0.986	0.954-1.019	0.396
Beta blocker	0.670	0.355-1.265	0.217
Diuretics	1.417	0.648-3.098	0.383
Hospital PCI	0.707	0.369-1.353	0.295
Severe heart failure	1.741	0.882-3.436	0.110
Hemoglobin	0.974	0.959-0.989	0.001
White blood cell	1.036	0.972-1.105	0.281
Alanine aminotransferase	1.001	0.999-1.003	0.170
Creatinine	1.001	0.998-1.005	0.470
Albumin	0.984	0.910-1.064	0.681
High brain natriuretic peptide	1.010	0.464-2.194	0.981
Without spouse	2.350	1.245-4.434	0.008

OR = odds ratio, CI= confidence interval, High Brain natriuretic peptide means $\geq$ 1800 pg/ml.

ACS. That means they have the urgent need to get suitable social and psychosocial support form society. Besides, compared with patients living with spouse, incidence of rehospitalization was higher in patients living without spouse. Factors related to increased mortality like depression, lower physical activity,[18] and medicine adherence[21] might all contribute to the increased rehospitalization of patients living without spouse.

Our study has several limitations. First, our data was retrospectively collected and reflected the experiences of a single tertiary center. Second, our study may also suffer from selection bias. Indeed, patients who were only initially admitted to our center were included. Third, based on the limit samples, we set a strict standard to select potential variables ($p < 0.05$) for multivariate logistic analysis, which may cause missing some effective factors.

In conclusion, ACS patients $\geq$75 years face increased 1-year mortality risk, network should be established to care these patients more intensively in an effort to reduce the mortality and rehospitalization for these patients.

Disclosures

The authors have no conflicts of interest to disclose.

1. Chan MY, Du X, Eccleston D, Ma C, Mohanan PP, Ogita M, Shyu KG, Yan BP, Jeong YH. Acute coronary syndrome in the Asia-Pacific region. *Int J Cardiol* 2016;202:861–869.
2. Saunderson CE, Brogan RA, Simms AD, Sutton G, Batin PD, Gale CP. Acute coronary syndrome management in older adults: guidelines, temporal changes and challenges. *Age and ageing* 2014;43:450–455.
3. Christensen K, Doblhammer G, Rau R, Vaupel JW. Ageing populations: the challenges ahead. *Lancet* 2009;374:1196–1208.
4. Angeli F, Cavallini C, Verdecchia P, Morici N, Del Pinto M, Petronio AS, Antonicelli R, Murena E, Bossi I, De Servi S, Savonitto S. A risk score for predicting 1-year mortality in patients >/=75 years of age presenting with non-ST-elevation acute coronary syndrome. *Am J Cardiol* 2015;116:208–213.
5. Dai X, Busby-Whitehead J, Alexander KP. Acute coronary syndrome in the older adults. *J Geriatr Cardiol* 2016;13:101–108.
6. Writing Group M, Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, Das SR, de Ferranti S, Despres JP, Fullerton HJ, Howard VJ, Huffman MD, Isasi CR, Jimenez MC, Judd SE, Kissela BM, Lichtman JH, Lisabeth LD, Liu S, Mackey RH, Magid DJ, McGuire DK, Mohler ER 3rd, Moy CS, Muntner P, Mussolino ME, Nasir K, Neumar RW, Nichol G, Palaniappan L, Pandey DK, Reeves MJ, Rodriguez CJ, Rosamond W, Sorlie PD, Stein J, Towfighi A, Turan TN, Virani SS, Woo D, Yeh RW, Turner MB. American Heart Association Statistics C. Stroke Statistics S. Heart disease and stroke statistics-2016 update: a report from the American Heart Association. *Circulation* 2016;133:e38–360.
7. Veerasamy M, Edwards R, Ford G, Kirkwood T, Newton J, Jones D, Kunadian V. Acute coronary syndrome among older patients: a review. *Cardiol Rev* 2015;23:26–32.
8. Lammintausta A, Airaksinen JK, Immonen-Raiha P, Torppa J, Kesaniemi AY, Ketonen M, Koukkunen H, Karja-Koskenkari P, Lehto S, Salomaa V, Group FS. Prognosis of acute coronary events is worse in patients living alone: the FINAMI myocardial infarction register. *Eur J Prev Cardiol* 2014;21:989–996.
9. Schmaltz HN, Southern D, Ghali WA, Jelinski SE, Parsons GA, King KM, Maxwell CJ. Living alone, patient sex and mortality after acute myocardial infarction. *J Gen Intern Med* 2007;22:572–578.
10. Amsterdam EA, Wenger NK, Brindis RG, Casey DE Jr., Ganiats TG, Holmes DR Jr., Jaffe AS, Jneid H, Kelly RF, Kontos MC, Levine GN, Liebson PR, Mukherjee D, Peterson ED, Sabatine MS, Smalling RW, Zieman SJ. 2014 AHA/ACC guideline for the management of patients with non-ST-elevation acute coronary syndromes: a report of the American College of Cardiology/American Heart Association task force on practice guidelines. *J Am Coll Cardiol* 2014;64:e139–e228.
11. O'Gara PT, Kushner FG, Ascheim DD, Casey DE Jr., Chung MK, de Lemos JA, Ettinger SM, Fang JC, Fesmire FM, Franklin BA, Granger CB, Krumholz HM, Linderbaum JA, Morrow DA, Newby LK, Ornato JP, Ou N, Radford MJ, Tamis-Holland JE, Tommaso CL, Tracy CM, Woo YJ, Zhao DX, Anderson JL, Jacobs AK, Halperin JL, Albert NM, Brindis RG, Creager MA, DeMets D, Guyton RA, Hochman JS, Kovacs RJ, Kushner FG, Ohman EM, Stevenson WG, Yancy CW. American College of Cardiology Foundation/American Heart Association Task Force on Practice G. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association task force on practice guidelines. *Circulation* 2013;127:e362–e425.
12. Engberding N, Wenger NK. Acute coronary syndromes in the elderly. *F1000Res* 2017;6:1791.
13. Santos IS, Goulart AC, Brandao RM, Santos RC, Bittencourt MS, Sitnik D, Pereira AC, Pastore CA, Samesima N, Lotufo PA, Bensenor IM. One-year mortality after an acute coronary event and its clinical predictors: the ERICO study. *Arq Bras Cardiol* 2015;105:53–64.
14. Savonitto S, Morici N, Cavallini C, Antonicelli R, Petronio AS, Murena E, Olivari Z, Steffenino G, Bonechi F, Mafrici A, Toso A, Piscione F, Bolognese L, De Servi S. One-year mortality in elderly adults with non-ST-elevation acute coronary syndrome: effect of diabetic status and admission hyperglycemia. *J Am Geriatr Soc* 2014;62:1297–1303.
15. Puymirat E, Aissaoui N, Cayla G, Lafont A, Riant E, Mennuni M, Saint-Jean O, Blanchard D, Jourdain P, Elbaz M, Henry P, Bataille V, Drouet E, Mulak G, Schiele F, Ferrieres J, Simon T, Danchin N. Investigators F-M. Changes in one-year mortality in elderly patients admitted with acute myocardial infarction in relation with early management. *Am J Med* 2017;130:555–563.
16. Kashima K, Ikeda D, Tanaka H, Yamashita E, Nagayoshi S, Yoshishige Y, Tanoue K, Nagano S, Nuruki N, Yoshinaga M, Sonoda M. Mid-term mortality of very elderly patients with acute myocardial infarction with or without coronary intervention. *J Cardiol* 2010;55:397–403.
17. Pocock S, Bueno H, Licour M, Medina J, Zhang L, Annemans L, Danchin N, Huo Y, Van de Werf F. Predictors of one-year mortality at hospital discharge after acute coronary syndromes: a new risk score from the EPICOR (long-tErm follow uP of antithrombotic management patterns In acute CORonary syndrome patients) study. *Eur Heart J Acute Cardiovasc Care* 2015;4:509–517.

18. Green P, Newman JD, Shaffer JA, Davidson KW, Maurer MS, Schwartz JE. Relation of patients living without a partner or spouse to being physically active after acute coronary syndromes (from the PULSE accelerometry substudy). *Am J Cardiol* 2013;111:1264–1269.
19. Osler M, Martensson S, Wium-Andersen IK, Prescott E, Andersen PK, Jorgensen TS, Carlsen K, Wium-Andersen MK, Jorgensen MB. Depression after first hospital admission for acute coronary syndrome: a study of time of onset and impact on survival. *Am J Epidemiol* 2016;183:218–226.
20. Fukunaga R, Abe Y, Nakagawa Y, Koyama A, Fujise N, Ikeda M. Living alone is associated with depression among the elderly in a rural community in Japan. *Psychogeriatrics* 2012;12:179–185.
21. Wu JR, Lennie TA, Chung ML, Frazier SK, Dekker RL, Biddle MJ, Moser DK. Medication adherence mediates the relationship between marital status and cardiac event-free survival in patients with heart failure. *Heart Lung* 2012;41:107–114.
22. Liu S, Zhang M, Yang L, Li Y, Wang L, Huang Z, Wang L, Chen Z, Zhou M. Prevalence and patterns of tobacco smoking among Chinese adult men and women: findings of the 2010 national smoking survey. *J Epidemiol Community Health* 2017;71:154–161.
23. Demey D, Berrington A, Evandrou M, Falkingham J. Pathways into living alone in mid-life: diversity and policy implications. *Adv Life Course Res* 2013;18:161–174.
24. Smith TW, Baucom BRW. Intimate relationships, individual adjustment, and coronary heart disease: Implications of overlapping associations in psychosocial risk. *Am Psychol* 2017;72:578–589.
25. Uchino BN, Smith TW, Berg CA. Spousal relationship quality and cardiovascular risk: dyadic perceptions of relationship ambivalence are associated with coronary-artery calcification. *Psychol Sci* 2014;25:1037–1042.
26. Murphy BM, Elliott PC, Le Grande MR, Higgins RO, Ernest CS, Goble AJ, Tatoulis J, Worcester MU. Living alone predicts 30-day hospital readmission after coronary artery bypass graft surgery. *Eur J Cardiovasc Prev Rehabil* 2008;15:210–215.