Association between Marital Status and In-Hospital Death in Acute Myocardial Infarction Patients in Puerto Rico

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Objective: The purpose of this study was to determine if there is an association between marital status (single, married, divorced/separated, and widowed) and in-hospital mortality in patients with acute myocardial infarction (AMI) from Puerto Rico in 2007, 2009, and 2011.

Methods: This study was a secondary data analysis of information retrieved from the Puerto Rican Cardiovascular Surveillance System obtained from the University of Puerto Rico for the residents of Puerto Rico during the study years. The sample included individuals aged 18 or older who presented with an incidental AMI. Univariate and multivariate logistic regression models were used to assess the association between marital status and in-hospital mortality after an AMI. Covariates included age, sex, social history, and comorbidities.

Results: Among the study participants, 414 were single, 1,811 were married, 153 were separated/divorced, and 472 were widowed. Widowed status was more common in the elderly population, age groups 75-84 and ≥85, than any other marital status representing 37.9% and 30.7% respectively (p-value < 0.001). The adjusted OR were 0.6 (95% confidence interval (CI) 0.3-1.4), 0.6 (95% CI 0.2-2.0), and 0.9 (95% CI 0.5-1.7) for single, divorced/separated, and widowed patients respectively when compared with married patients.

Conclusion: No noticeable association was found between marital status and in-hospital mortality in patients with incidental AMI in Puerto Rico during the years of 2007, 2009, and 2011. Further research may be required to investigate mortality rates during the time period following hospital discharge. [*P R Health Sci J 2019;38:231-236*]

Key words: Marital status, Mortality, Myocardial infarction, Puerto Rico

Heart disease has been the leading cause of death in the Puerto Rico since the late 1940s (1). The prevalence of myocardial infarction in Puerto Rico was estimated to be 4.2% in 2015 accounting for one out of 10 deaths (1, 2). Previous studies have revealed that the risk of death in married people is lower and their general health better compared with unmarried ones (3-7).

Several studies have been conducted investigating the association between marital status and health outcomes in acute myocardial infarction patients (AMI) (8-21). Whereas most previous studies assessed the impact of marital status on long-term mortality (9-11, 13-16), only a few have examined the effects on in-hospital mortality after an AMI (8, 12, 17-21). The current scientific evidence between marital status and in-hospital mortality following an AMI has been inconclusive (8, 12, 17-21). Some of them reported an increased risk for living alone (8, 17, 18, 19, 21), whereas others did not find a statistically significant association between marital status and in-hospital mortality in AMI patients (12, 20). Furthermore, some studies (8, 18, 20) only assessed 24-hour mortality rates opposed to others looking at the entire span of in-hospital length (12, 17, 19, 21).

Social support and living arrangements have revealed to be important predictors of patients' outcomes after an AMI (14, 15). However, none of the previous studies have included Hispanic populations who culturally have a well-developed social support network.

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The purpose of this study was to determine if there is an association between marital status (single, married, divorced/separated, and widowed) and in-hospital mortality in patients with acute myocardial infarction (AMI) from Puerto Rico in 2007, 2009, and 2011. We hypothesize that married Puerto Rican patients with AMI would display lower in-hospital mortality rates compared to non-married counterparts.

Materials and Methods

The study sample consisted of residents (adults ≥ 18 years-old) living in Puerto Rico who, in 2007, 2009 and 2011, were hospitalized for a possible AMI at any one of the 21 academic or non-teaching medical centers. The multicentric nature of the study enhances the external validity of our findings as well as the comparability with other population-based studies (22, 23). Information on all hospital discharges in Puerto Rico with International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) code 410 in the principal and/or secondary diagnosis position and related acute and chronic coronary disease ICD-9 rubrics (e.g., 412 [old MI], 413 [angina pectoris], 414 [other forms of chronic CHD], and 786.5 [chest pain]) was obtained from each of the participating hospitals (all of which had emergency room capability and served non-institutionalized, non-military residents of Puerto Rico).

Once the computerized discharge diagnosis printouts were obtained from each of our 16 participating hospitals, the appropriate ICD-9-CM codes for CHD were reviewed for purposes of selection and case validation. Each participating hospital was able to provide us with a patient-specific zip code listing that allowed us initially to screen out patients hospitalized for suspected acute coronary disease but who lived in Puerto Rico. Once selected, a list of medical record numbers was given to the medical record department personnel at each of the participating hospitals. Trained nurse and physician abstractors reviewed the medical records of all of the identified patients meeting the pre-defined geographic inclusion criteria (e.g., residents of Puerto Rico). Since we were interested in documenting the incidence rates of newly diagnosed AMI, we restricted our study sample to patients hospitalized with an initial (incident) AMI that occurred in 2007, 2009 and 2011. Data of even years were excluded from the surveillance system due to two main reasons. First, the impact of measurable indicators in chronic disease conditions, particularly in heart attack incidence does not change substantially on a yearly basis, and second, it makes data collection more efficient.

Patients initially hospitalized in one hospital and then transferred to another during the same event were counted only once. Data were abstracted from the applicable emergency medical record of the transferring hospital and from the applicable medical record of the receiving hospital.

The records of any previous hospitalizations for Coronary Heart Disease (CHD) were reviewed when available and when the review of the hospital chart indicated that the present hospitalization was not the first for CHD, regardless of whether the patient was hospitalized in different hospitals for separate events. We excluded patients with electrocardiogram (ECG) changes indicative of prior AMI (old Q-waves on ECG) or with a documented history of AMI. We excluded patients who developed AMI resulting from an interventional or surgical procedure. In this study, each case was validated using the widely accepted diagnostic definition developed by the World Health Organization (WHO), which requires that at least 2 of 3 criteria be present for the confirmation of AMI. This schema uses information from the patient's clinical history that is suggestive of AMI, serum enzyme elevations, and serial ECG findings of AMI. These criteria have been utilized in a number of clinical and epidemiological investigations, e.g., the Worcester Heart Attack Study and the World Health Organization Multinational Monitoring of Trends and Determinants in Cardiovascular Disease (MONICA) Project (22-24). An autopsy confirmation of recent onset MI satisfied the study inclusion criteria, irrespective of the other diagnostic criteria. Patients who developed AMI resulting from an interventional procedure or surgery, other than for the treatment of an acute coronary event, were excluded from the study.

Demographic and clinical data and complete medical histories were abstracted from hospital medical records into a standardized case-report form by trained nurse and physician abstractors. These data included each patient's marital status, age, sex, municipality of residence, coronary risk factors (e.g., diabetes, hypertension, smoking), comorbidities (e.g., history of angina, stroke, heart failure), physiologic parameters (e.g., heart rate, blood pressure, lipid profile, serum creatinine/glucose findings), AMI-associated characteristics (e.g., ST-elevation AMI, non- ST-elevation AMI), use of cardiac medications and secondary prevention practices, and survival status at the time of hospital discharge. Information on marital status, the main exposure variable, was collected from patient records according to the patients' proper definition of his/her marital status. In those patient charts marital status was categorized into four groups (i) single; (ii) married; (iii) divorced/separated; and (iv) widowed.

All quality control measures were continuously monitored and any identified errors were discussed with each reviewer to ensure a high degree of accuracy and observer reliability so that documentation errors were minimized.

Statistical analysis

The data was analyzed using STATA 13 (College Station, Texas). Chi-square tests were applied to compare the distribution between the potential confounders and marital status, and were also applied to compare the distribution between potential confounders and in-hospital mortality. Collinearity diagnostics were performed to test for the correlations between the variables. Unadjusted and adjusted logistic regression models were used to assess the association

between the exposure and outcome variable. Odds ratios and the respective 95% confidence interval were calculated. Patients with missing information on smoking and obesity exceeds the 5 percent (18.5% and 18.6% respectively). We estimated two additional models to check for the potential bias from missing data on these variables. We assigned persons with missing data first to the highest category (worst scenery) of that variable then to the lowest (best scenery). P-value of <0.05 was considered statistically significant.

Ethical considerations

The Committee for the Protection of Human Subjects at each participating hospital approved this study.

Results

Among the study participants, 414 were single, 1,811 were married, 153 were separated or divorced, and 472 were widowed. Table 1 presents the baseline characteristics of patients diagnosed with AMI in Puerto Rico during years 2007, 2009, and 2011 with respect to marital status. Widowed patients were more likely to have hypertension compared to other marital status groups. 86.9% of widowed patients had hypertension compared to the other marital statuses which ranged from 76.6%-80.0% (p-value: 0.001). Widowed patients were also more likely to have a history of congestive heart failure; and to suffer stroke (p-value = 0.017), asthma or Chronic Obstructive Pulmonary Disease (COPD) (p-value < 0.001), history of cancer (p-value: 0.020), or atrial fibrillation (p-value: 0.019). There was no statistically significant difference in obesity among marital statuses (p-value: 0.058). The distribution of diabetes (p-value: 0.127), history of depression (p-value: 0.257) and history of renal failure (p-value: 0.080) was not statistically significantly different according to marital status.

Table 2 presents unadjusted and adjusted odds ratios for the association between marital status and in-hospital mortality of Puerto Rican patients after an incidental AMI. The odds of mortality for single and divorced/separated before and after adjustment were very similar (Table 3). The unadjusted odds ratio (OR) for widowed patients was 1.7 (95% confidence interval (CI) 1.1-2.4). After adjustment for the covariates, the OR of mortality decreased to 0.9 and became not significant (95% CI 0.5-1.7). Age <55 was associated with a decrease in mortality compared to patients between 55 and 65 years of

Table 1. Characteristics of study participants with incidental myocardial infarction according to marital status in 2007, 2009 and 2011.

	Marital status				
	Single (n=414) %	Married (n=1811) %	Divorced/ Separated (n=153) %	Widowed (n=472) %	p-value
Age (years)					< 0.001
<55	28.3	20.7	23.5	1.7	
55-64	24.4	26.2	33.3	6.6	
65-74	22.5	28.4	24.8	23.1	
75-84	15.0	18.8	15.0	37.9	
>84	9.9	5.9	3.3	30.7	
Sex					< 0.001
Female	46.4	34.2	48.4	80.1	
Male	53.6	65.8	51.6	19.9	
Health insurance					0.027
Yes	76.0	76.0	76.5	82.4	
No	24.0	24.1	23.5	17.6	
Smoking status					< 0.001
Never smoked	61.8	64.6	59.5	76.0	
Current or ex- smoker	38.2	35.4	40.5	24.0	
Obesity					0.058
Yes	34.5	33.6	34.1	26.5	
No	65.5	66.4	65.9	73.5	
Hypertension					0.001
Yes	76.6	80.0	78.4	86.9	
No	23.4	20.0	21.6	13.1	
Hyperlipidemia					0.019
Yes	30.3	31.5	22.4	25.9	
No	69.7	68.5	77.6	74.1	
Diabetes					0.127
Yes	43.7	48.9	44.1	50.5	
No	56.3	51.1	55.9	49.5	
History of stroke					0.017
Yes	5.3	4.8	4.6	8.6	
No	94.7	95.2	95.4	91.4	
History of cancer					0.020
Yes	4.2	5.4	3.3	8.4	
No	95.8	94.6	96.7	91.6	
History of asthma or COPD[a]					< 0.001
Yes	15.1	13.9	11.3	22.3	
No	84.9	86.1	88.7	77.7	
History of congestive heart failure					< 0.001
Yes	9.1	9.1	9.2	18.1	
No	91.0	90.9	90.8	81.9	
History of depression					0.257
Yes	3.5	2.8	5.2	4.1	
No	96.5	97.2	94.8	95.9	
History of renal failure					0.080
Yes	9.6	11.5	9.3	14.7	
No	90.4	88.6	90.7	85.3	
History of atrial fibrillation					0.019
Yes	4.4	5.6	3.3	8.5	
No	95.7	94.4	96.7	91.5	
Invasive procedureb					< 0.001
Yes	15.2	22.5	16.4	10.7	
No	84.8	77.5	83.6	89.3	

[a]Chronic obstructive pulmonary disease; [b]Invasive procedure was defined as patients who underwent coronary artery bypass graft, percutaneous coronary intervention, and percutaneous transluminal coronary angioplasty.

Table 2. Unadjusted and adjusted association between in-hospital mortality and marital status in acute myocardial infarction patients in Puerto Rico in 2007, 2009 and 2011.

Characteristics	Unadjusted OR[a] (95% CI[b])	Adjusted OR (95% CI)
Marital status		
Married	Ref.[c]	Ref.
Single	0.8 (0.5-1.3)	0.6 (0.3-1.4)
Divorced/Separated	0.8 (0.4-1.7)	0.6 (0.2-2.0)
Widowed	1.7 (1.1-2.4)	0.9 (0.5-1.7)
Age		
55-64	Ref.	Ref.
<55	0.2 (0.1-0.6)	0.3 (0.1-0.8)
65-74	1.6 (0.9-2.6)	1.3 (0.7-2.6)
75-84	2.8 (1.7-4.5)	1.9 (1.0-3.7)
>=85	4.2 (2.5-7.0)	1.6 (0.7-3.9)
Sex		
Male	Ref.	Ref.
Female	1.4 (1.0-1.9)	1.8 (1.1-3.0)
Insurance		
Yes	Ref.	Ref.
No	1.1 (0.7-1.5)	1.0 (0.6-1.7)
Smoking status		
Never smoked	Ref.	Ref.
Current or Prior smoker	1.2 (0.8-1.7)	1.7 (1.1-2.8)
Obesity		
No	Ref.	Ref.
Yes	0.5 (0.3-0.8)	0.6 (0.3-1.1)
Hypertension		
No	Ref.	Ref.
Yes	0.7 (0.5-0.9)	0.5 (0.3-0.9)
Hyperlipidemia		
No	Ref.	Ref.
Yes	1.0 (0.7-1.4)	1.0 (0.6-1.6)
Diabetes		
No	Ref.	Ref.
Yes	1.0 (0.8-1.4)	1.2 (0.7-1.9)
History of Stroke		
No	Ref.	Ref.
Yes	1.5 (0.8-2.6)	0.4 (0.1-1.5)
History of Cancer		
No	Ref.	Ref.
Yes	1.0 (0.5-2.0)	1.2 (0.5-2.7)
History of Asthma or COPD[d]		
No	Ref.	Ref.
Yes	1.4 (1.0-2.1)	0.9 (0.5-1.8)
History of Congestive Heart Failure		
No	Ref.	Ref.
Yes	2.3 (1.5-3.3)	1.6 (0.9-3.1)
History of Depression		
No	Ref.	Ref.
Yes	0.9 (0.4-2.2)	0.5 (0.1-3.5)
History of Renal failure		
No	Ref.	Ref.
Yes	2.2 (1.5-3.2)	2.6 (1.4-4.7)
History of Atrial fibrillation		
No	Ref.	Ref.
Yes	4.1 (2.7-6.3)	2.0 (1.0-4.1)
Invasive procedure[e]		
No	Ref.	Ref.
Yes	0.8 (0.5-1.2)	1.4 (0.8-2.4)

[a]Odds ratio; [b]Confidence interval; [c]Reference group; [d]Chronic obstructive pulmonary disease; [e]Invasive procedure was defined as patients who underwent coronary artery bypass graft, percutaneous coronary intervention, and percutaneous transluminal coronary angioplasty.

age (OR 0.3; 95% CI 0.1-0.8). A patient's insurance status or a history of obesity, hyperlipidemia, diabetes, stroke, congestive heart failure, asthma or COPD, cancer, atrial fibrillation or depression did not have a statistically significant association with mortality in our population. Patients with a history of smoking had 70% higher risk of mortality compared to non-smoking patients (OR 1.7; 95%CI 1.1-2.8). Patients with renal failure also had an increased risk of mortality (OR 2.6; 95%CI 1.4-4.7). The odds of dying in patients who underwent invasive procedure was not statistically significant compared to those who did not.

Table 3 presents a best and worst case scenario for the sensitivity analysis to examine the effect of missing data on obesity or smoking status. Results from these sensitivity analyses were similar to the adjusted analysis and our conclusion remained unchanged.

Discussion

The results of our study showed that there was no association between marital status and in-hospital mortality in patients with incidental AMI in Puerto Ricans in 2007, 2009, and 2011. Furthermore, to our understanding this is the first study conducted in a Hispanic population assessing the association between marital status and in-hospital mortality in patients who had an AMI.

Only a few studies have investigated the association between marital status and in-hospital mortality in AMI patients (8, 12, 17-21). Our findings are in line with those published by O'Shea et al. and Khafaji et al. revealing no association between being single and in-hospital mortality (12, 20). Even though the results of a multi-center trial involving over 13,000 patients with an AMI showed that living alone was associated with significantly higher 24-hour and 30-day mortality, these findings did not remain statistically significant in the adjusted regression models revealing that living alone was not an independent risk factor (20). In the 5,334 patients presenting with Acute Coronary Syndrome (ACS) in the Middle East region, being widowed, but not living alone, was associated with an increase in-hospital mortality (12). Other studies conducted in the European populations reported that unmarried status, in both gender, was also related with an increased case fatality rate after the first 24 hours, taking potential confounders into account. The risk of death was between two and three times higher in people living alone compared with married people (17-19).

One possible reason for the lack of association between married patients compared with patients who live alone and in-hospital mortality may be due to marital status having more of an influence with regards to risk of suffering an incidental MI as well as an effect on the long term survival after having an incidental MI. For instance, it was argued that most of the excess mortality appeared to occur already before the hospital admission and was not related to differences in treatment of AMI (17). When CHD manifests as an acute heart attack, survival often critically depends on reaching hospital quickly, which is likely to be an

important contributor to the greater risks of out-of-hospital CHD deaths observed in the unmarried (17, 25, 26). Living alone can dispose to a particularly strong risk for mortality, because it may translate to severe and potentially fatal delays to obtaining acute care (17, 27).

In addition, marital status seemed to have a protective effect on a long-term, as those patients may have a greater support system once discharged from the hospital reducing the risk of recurrent AMI due to improved adherence of medications and treatment (9-11, 13-16). Moreover, it has been argued whether social isolation is associated with health outcomes in CHD patients (28-31). However, the current scientific evidence is inconclusive and the methods used in these studies failed to adjust for age and other co-morbidities (20, 28-31). Moreover, there seem to be certain difficulties in defining or measuring social support (20, 30).

Table 3. Sensitivity analysis (best and worst case scenario) to examine the potential effect of bias by missing information on smoking and obesity in the adjusted[a] logistic regression models between marital status and mortality.

		Smoking[b]		Obesity[b]	
	Overall OR (95% CI)	Best case OR (95% CI)	Worst case OR (95% CI)	Best case OR (95% CI)	Worst case OR (95% CI)
Marital status					
Single	0.6 (0.3-1.4)	0.6 (0.3-1.2)	0.6 (0.3-1.2)	0.9 (0.5-1.6)	0.8 (0.5-1.6)
Married	Ref	Ref	Ref	Ref	Ref
Divorced /Separated	0.6 (0.2-2.0)	0.5 (0.1-1.6)	0.5 (0.1-1.6)	0.7 (0.2-1.9)	0.6 (0.2-1.8)
Widowed	0.9 (0.5-1.7)	1.0 (0.6-1.7)	1.0 (0.6-1.7)	0.6 (0.4-1.1)	0.6 (0.4-1.1)

[a]Adjusted for age, sex, health insurance, smoking status, obesity, hypertension, hyperlipidemia, diabetes, invasive procedure and history of stroke, cancer, asthma or COPD, congestive heart failure, depression, renal failure, and atrial fibrillation; [b]Missing information on smoking and obesity variables were 18.5% and 18.6%, respectively.

Finally, it may be hypothesized that by dividing marital status into four separate groups, the power to detect an association, if it really exists, would be too low. However, in contrast to some of the previous studies (8, 14), when marital status was stratified into two groups consisting of married or unmarried there was still no statistically significant association between marital status and in-hospital mortality in our data.

Naturally, our study had some limitations. Missing data on obesity and smoking status may have biased the results. However, when we performed a best and worst case scenario analysis, there was no change in the OR before and after adjustments compared with the initial analysis. Furthermore, the data only included patients hospitalized with AMI and not those with other manifestations of underlying CHD. In addition, only Puerto Rican patients were studied and therefore findings may not be generalizable to other racial or ethnic groups who are not Hispanic. In addition, only survivors of an AMI were considered, excluding those individuals who died before arriving to the hospital (32). Widowed patients have been shown to present to the hospital later than other marital statuses causing some misclassification bias.

Another limitation is that the analysis between marital status and prognosis of patients was focused only at one point in time, thus changes in marital status or length of marital status could not be evaluated. Also, we did not have information on other important factors such as psychological stress that may be associated with the exposure or outcome of our study. Lastly, our results might be subject to some extent of misclassification bias, since some patients who reported being single might be living with a consensual partner and having the protective effect of a legally married couple. By the same token, patients who are classified as legally married might live apart from their partners and don't actually have the protective effect expected for a legally married couple.

In conclusion, in-hospital mortality observed in our study seemed to be the same among different marital status subgroups. Studies investigating the association between marital status and the time period immediately following hospital discharge may be necessary in order evaluate whether there is an increased long-term mortality according to marital status in Puerto Rican AMI patients. Finally, as people living alone have shown to have lower general health and higher mortality compared with married people, it may be worthwhile in clinical practice to assess marital status for patients with AMI.

Resumen

Objetivo: El objetivo de este estudio fue determinar si existe una asociación entre estado civil (soltero, casado, divorciado / separado y viudo) y mortalidad hospitalaria en pacientes con infarto agudo de miocardio (IAM) de Puerto Rico en 2007, 2009 y 2011. Métodos: Este estudio fue un análisis de datos secundarios de la información obtenida del Sistema de Vigilancia Cardiovascular de Puerto Rico obtenida de la Universidad de Puerto Rico para los residentes puertorriqueños durante los años de estudio. La muestra incluyó individuos de 18 años o más que presentaron un IAM incidental. Se utilizaron modelos de regresión logística para evaluar la asociación entre el estado civil y la mortalidad hospitalaria después de un IAM. Los covariados incluidos eran edad, sexo, historia social y comorbilidades. Resultados: Entre los participantes del estudio, 414 eran solteros, 1.811 casados, 153 separados/divorciados y 472 viudos. El estado de viudez fue más frecuente en la población de edad avanzada, con edades comprendidas entre 75-84 y ≥85 años, que en cualquier otro estado civil, representando el 37,9% y el 30,7% respectivamente (p <0,001). El odds ratio (OR) ajustado fue 0,6 (intervalo de confianza del 95% (IC) 0,3-1,4), 0,6 (IC del 95%: 0,2-2,0) y 0,9 (IC del 95%: 0,5-1,7) para los pacientes solteros, divorciados / separados y viudos, comparando con los pacientes casados. Conclusión: No se encontró una asociación notable entre el estado civil y la mortalidad intrahospitalaria en pacientes con IAM incidental en Puerto Rico durante los años de 2007, 2009 y 2011.

References

1. Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health. BRFSS Prevalence & Trends Data. [CDC Web site] 2015. Available from: Url: https://www.cdc.gov/brfss/brfssprevalence/index.html. Accessed January 20, 2017.
2. Zevallos J, Yarzebski J, González J, et. al. Incidence, In-hospital Case-fatality Rates, and Management Practices in Puerto Ricans Hospitalized with Acute Myocardial Infarction. P R Health Sci J 2013;32:138-145.
3. Rendall MS, Weden MM, Favreault MM, Waldron H. The protective effect of marriage for survival: a review and update. Demography 2011;48:481–506.
4. Liu H, Umberson DJ. The Times They Are a Changin': Marital Status and Health Differentials from 1972 to 2003. J Health Soc Behav 2008;49:239–253
5. Lund R, Due P, Modvig J, Holstein BE, Damsgaard MT, Andersen PK. Cohabitation and marital status as predictors of mortality an eight year follow-up study. Soc Sci Med 2002;55:673–679.
6. Scafato E, Galluzzo L, Gandin C, et al. Marital and cohabitation status as predictors of mortality: A 10- year follow-up of an Italian elderly cohort. Soc Sci Med 2008;67:1456–1464.
7. Koskinen S, Joutsenniemi K, Martelin T, Martikainen P. Mortality differences according to living arrangements. Int J Epidemiol 2007;36: 1255–1264.
8. Chandra V, Szklo M, Goldberg R, Tonascia J. The impact of marital status on survival after an acute myocardial infarction: A population based study. Am J Epidemiol 1983;117:320–325.
9. Nielsen FE, Mard S. Single-living is associated with increased risk of long-term mortality among employed patients with acute myocardial infarction. Clin Epidemiol 2010;2:91–98.
10. Bucholz EM, Rathore SS, Gosch K, et al. Effect of living alone on patient outcomes after hospitalization for acute myocardial infarction. Am J Cardiol 2011;108:943–948.
11. Wiklund I, Oden A, Sanne H, Ulvenstam G, Wilhelmsson C, Wilhelmsen L. Prognostic importance of somatic and psychosocial variables after a first myocardial infarction. Am J Epidemiol 1988;128:786–795.
12. Hadi Khafaji HA, Al Habib K, Asaad N, et al. Marital status and outcome of patients presenting with acute coronary syndrome: an observational report. Clin Cardiol 2012;35:741–748.
13. Consuegra-Sánchez L, Melgarejo-Moreno A, Jaulent-Huertas L, et. al. Unraveling the relation between marital status and prognosis among myocardial infarction survivors: Impact of being widowed on mortality. Int J Cardiol 2015;185:141-143.
14. Quinones PA, Kirchberger I, Heier M, et al. Marital status shows a strong protective effect on long-term mortality among first acute myocardial infarction-survivors with diagnosed hyperlipidemia-findings from the MONICA/KORA myocardial infarction registry. BMC 2014;14:98.
15. Kitamura T, Sakata Y, Nakatani D, et al. Living alone and risk of cardiovascular events following discharge after acute myocardial infarction in Japan. J Cardiol 2013;62:257–262.
16. Koskenvuo M, Kaprio J, Romo M, Langinvainio H. Incidence and prognosis of ischaemic heart disease with respect to marital status and social class. A national record linkage study. J Epidemiol Community Health 1981;35:192-196.
17. Lammintausta A, Airaksinen JK, Immonen-Räihä P, et al. Prognosis of acute coronary events is worse in patients living alone: the FINAMI myocardial infarction register. Eur J Prev Cardiol 2014;21:989-996.
18. Gerward S, Tydén P, Engström G, Hedblad B. Marital status and occupation in relation to short-term case fatality after a first coronary event--a population based cohort. BMC Public Health 2010;10:235.
19. Kilpi F, Konttinen H, Silventoinen K, Martikainen P. Living arrangements as determinants of myocardial infarction incidence and survival: A prospective register study of over 300,000 Finnish men and women. Soc Sci Med 2015;133:93-100.
20. O'Shea JC, Wilcox RG, Skene AM, et al. Comparison of outcomes of patients with myocardial infarction when living alone versus those not living alone. Am J Cardiol 2002;90:1374-1377.
21. Panagiotakos DB, Pitsavos C, Kogias Y, et al. Marital status, depressive episodes, and short-term prognosis of patients with acute coronary syndrome: Greek study of acute coronary syndrome (GREECS). Neuropsychiatr Dis Treat 2008;4:425-432.
22. Goldberg RJ, Gorak EJ, Yarzebski J, et al. A communitywide perspective of sex differences and temporal trends in the incidence and survival rates after acute myocardial infarction and out-of-hospital deaths caused by coronary heart disease. Circulation 1993;87:1947-1953.
23. Tunstall-Pedoe H, Kuulasmaa K, Amouyel P, et al. Myocardial infarction and coronary deaths in the World Health Organization MONICA Project. Registration procedures, event rates, and case-fatality rates in 38 populations from 21 countries in four continents. Circulation 1994;90: 583-612.
24. Luepker RV, Apple FS, Christenson RH, et al. Case definitions for acute coronary heart disease in epidemiology and clinical research studies: a statement from the AHA Council on Epidemiology and Prevention; AHA Statistics Committee; World Heart Federation Council on Epidemiology and Prevention; the European Society of Cardiology Working Group on Epidemiology and Prevention; Centers for Disease Control and Prevention; and the National Heart, Lung, and Blood Institute. Circulation 2003;108:2543-2549.
25. Empana, J.P., Jouven, X., Lemaitre, R., et al. Marital status and risk of out-of-hospital sudden cardiac arrest in the population. Eur J Cardiovasc Prev Rehabilitation 2008;15: 577e582.
26. Sorlie PD, Coady S, Lin C, Arias E. Factors associated with out-of-hospital coronary heart disease death: the national longitudinal mortality study. Ann. Epidemiol 2004;14: 447e452.
27. Schmaltz HN, Southern D, Ghali WA, et al. Living alone, patient sex and mortality after acute myocardial infarction. J General Intern Med 2007;22:572e578.
28. Frasure-Smith N, Lesperance F, Gravel G, et al. Social support, depression, and mortality during the first year after myocardial infarction. Circulation 2000;101:1919–1924.
29. Ruberman W, Weinblatt E, Goldberg JD, Chaudhary BS. Psychosocial influences on mortality after myocardial infarction. N Engl J Med 1984;311:552–529.
30. Kaplan GA, Keil JE. Socioeconomic factors and cardiovascular disease: a review of the literature. Circulation 1993;88:1973–1998.
31. Bucher HC. Social support and prognosis following first myocardial infarction. J Gen Intern Med 1994;9:409–417.
32. Hill G, Connelly J, Hébert R, Lindsay J, Millar W Neyman's bias re-visited. J Clin Epidemiol 2003;56:293-296.