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Current Status of Myocardial Infarction and Risk Factors for Associated Mortality in Iran: A Review

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Abstract

Introduction: Cardiovascular diseases are considered an important priority in health systems worldwide, including Iran. This study was conducted to determine the current status of myocardial infarction (MI) and risk factors for associated mortality in Iran in 2012.

Methods: This study is a review article. The articles published between 2010 and the beginning of 2016 were included in the analysis. Initially, the keywords "Epidemiologic/myocardial infarction/ Mortality/analysis" [Mesh] AND "Epidemiologic/Risk Factor/ Iran" were selected in valid databases. Then, reliable databases were searched for relevant publications. Being relevant, containing viewpoints, and recommending statistical guidelines as well as approval of at least two of the three examiners of articles were determined as the inclusion criteria into the study.

Results: Only one study at national scale has been recently conducted in Iran. The main findings of this study were: The mean (standard deviation [SD]) age of the patients was 61.2 ± 13.4 years. The mean age at MI incidence was significantly lower in men (59.6 ± 13.3) compared to women 65 ± 12.6. The mean age at MI incidence was significantly different by place or the province of residence. MI incidence was clustering in six provinces (North Khorasan, Yazd, Kerman, Semnan, Golestan and Mazandaran). Female gender, smoking, low education and illiteracy, development of type 2 diabetes, ventricular tachycardia, ST segment elevation myocardial infarction, **right bundle branch block**, lack of thrombolytic therapy and percutaneous coronary intervention (PCI), and chest pain resistant to treatment are the most important determinants of death due to MI in Iran. In Iran, frequency of PCI use seems to be lower than other countries. Infrequent use of this treatment and less administration of thrombolytic drugs could explain higher mortality rate in Iran.

Conclusion: This study sought to report the overall status of MI and associated risk factors in Iran. The findings of the present study could help to plan in health system, monitor, and improve the patients' healthcare.

Keywords: Myocardial infarction; Stroke; Hospital mortality

Introduction

Cardiovascular diseases are considered one of important priorities in health system worldwide, including Iran. The burden of these diseases is increasing in low-, moderate-, and high-income countries. High prevalence and incidence of myocardial infarction (MI) as the most important cardiovascular disease and reason for death has no geographical, spatial, gender, and social limit [1,2].

Mortality rate per 100,000 population due to these diseases is 265 worldwide, 224 in Eastern Mediterranean, and 171 in Iran [2,3]. By 2020, cardiovascular disease-associated mortalities will increase by 15% in developed countries, 77% in China, and 106% in other Asian countries. Finland and Japan have the highest and lowest MI incidence rate in the world, respectively [3-5].

More than 1/3 of mortalities in Iran are due to cardiovascular diseases. Therefore, it is a serious challenge facing the country's healthcare [6-9].

A limited number of studies have addressed the factors associated with in-hospital mortality [10].

The decrease in mortalities due to MI is mainly related to decreased fatality of the disease and in fact the enhanced healthcare and appropriate treatments. The MI-related healthcare has a main role in fatality and mortality. Epidemiological pattern of MI is various in different communities [2,10].

Population-based MI incidence rate has been rarely reported in developing countries. No comprehensive and population-based work has been yet conducted in Iran to determine epidemiologic pattern of MI and particularly the effective factors on the patients' mortality [11,12]. MI and the associated mortality could be largely prevented. For prevention, the first step is to determine and explain their epidemiology to plan for and improve the process of healthcare and treatment. This review article is aimed to report important risk factors for MI and epidemiological indices by the published articles.

Methods

This study is a review article. Only the Iranian articles published between 2010 and the beginning of 2016 were included in the study.

Initially, the keywords "Epidemiologic/myocardial infarction/Mortality/ analysis" [Mesh] AND "Epidemiologic/ Risk Factor/ Iran" were selected in valid and reliable database. Then, reliable databases were searched for relevant publications. Being relevant, containing viewpoints, and recommending statistical guidelines as well as approval of at least two of the three examiners of articles were determined as the inclusion criteria into the study. In addition to the articles published by other authors, all the articles authored by the first author of this review article and obtained from the studies in which the data of Iranian Myocardial Infarction Registry (IMIR) were used were also included. Therefore the IMIR will be introduced and the methods adopted to analyze its data will be briefly explained in the following section. IMIR is present in all hospitals equipped with a cardiac care unit in 31 provinces of Iran. Inclusion criteria were based on World Health Organization (WHO) and World Heart Federation (WHF) definition of MI by International Classification of Diseases (ICD: I22, I21) [6,17]. The patients with MI history or non definite diagnosis made by cardiologist were excluded from the study. The data on age, gender, and the province of residence were collected.

Results

The findings are presented in two sections: The first section is related to the published articles summarized in table 1 and the second section addresses the data of 20750 MI patients obtained from IMIR as follows:

15033 (72.4%) patients were male. The mean (SD) age of the patients was 61.2 ± 13.4 years. The mean age at MI incidence was significantly lower in men (59.6 ± 13.3 years) than women (65 ± 12.6 years) (P=0.001). The mean age at MI incidence was significantly different by place or the province of residence (P=0.001). The age of over 84 years, being female, educational level, smoking, lack of thrombolytic therapy, type 2 diabetes, chest pain prior to arriving in hospital, right bundle branch block (RBBB), ventricular tachycardia (VT), percutaneous coronary intervention (PCI), lateral MIs, and ST-segment elevation myocardial infarction (STEMI) were present. Individual risk factors had independent effects on the hospital mortality due to MI. Variables in the province level had no significant effect on the outcome of MI. Enhancing access to and quality of treatment especially in the individuals at MI risk could reduce the mortality due to MI. MI incidence was clustering in six provinces (North Khorasan, Yazd, Kerman, Semnan, Golestan and Mazandaran). In-hospital case fatality rate (CFR) was 12.1% (n=2511). Women/men rate ratio of fatality was 1.36 (95% CI: 1.2-1.4). In-hospital CFR was 8.36 (7.81-8.94) in women and 6.12 (5.83-6.43) in men. Hazard ratio of mortality for STEMI, chest pain resistant to treatment, and RBBB was respectively 2.88, 2.55, and 2.06. Use of PCI was reported to decrease the risk of death in patients (hazard ratio: 0.68). 83.7% of the patients with STEMI died.

Discussion

In this study, epidemiological status of MI incidence and the risk factors for associated mortality were reported for the first time in Iran through a review study. The age of over 84 years, being female, educational level, smoking, lack of thrombolytic therapy, type 2 diabetes, chest pain prior to arriving in hospital, RBBB, VT, PCI, lateral MIs, and STEMI were increase Mortality rate of MI patents in Iran. The results of this review article could offer an appropriate opportunity to management, evidence-based decision making, and planning for the prevention and control of MI and associated mortality in Iran. Although cardiovascular diseases have been decreasing in developed and high-income countries, this trend is on rise in developing and moderate- and low-income countries, such as Iran [3,13-15]. According to the Iranian Mortality Registry, the mortality rate due to cardiovascular diseases and MI was reported respectively 171 and 85 per 100,000 population. In our study, mortality rate due to MI was 6.74. The mortality rate in Iran is lower compared to those of Eastern Mediterranean and worldwide [11]. The main reason for this difference

seems to be the ways of accessing and receiving healthcare, variety of risk factors worldwide, and Iran's young population. To compare the determinants of in-hospital mortality risk with those investigated in other studies, to the best of our knowledge no similar study in Iran's neighboring countries has been yet conducted. In our study, a difference in the age at MI incidence was noted between men and women, which is consistent with other studies. The age over 84 years was yielded as the risk factor for death, in agreement with the works in other countries, such as Japan and Korea [4,16-18].

The incidence rate in our study was higher compared to Japan and Korea and lower compared to Finland and Australia. In-hospital mortality rate was higher in women compared to men in Japan. In-hospital mortality rate was lower in the patients in Iran compared to Japan [3,4]. In Korea, 19.2% of MI patients had diabetes, 67.3% were smoker, and 61.2% had STEMI. In our study, the prevalence of diabetes was 22.2%, which is higher compared to Japan. In our study, hypertension association with in-hospital mortality was significant (P=0.011, OR=1.11) in univarite analysis, but it was non significant in multivariate analysis. In Japan, hypertension was significantly associated with the patients' mortality [18].

In a study, age, being female, lack of thrombolytic therapy, and STEMI were the most determinants of survival and mortality in the MI patients, which is similar to our study. Hypertension, type 2diabetes, and smoking were obtained as respectively 49%, 53%, and 30% in multiple regressions and were not significant as risk factor for death [19]. In a study, 73% of the patients were male and their mean age 61.8 years, which is similar to our study. History of coronary artery bypass grafting, PCI, and diabetes were reported respectively 4.4%, 12.5%, and 25.3% in the patients; these rates were obtained respectively 2.6, 3.2, and 22.2% in our study, which are lower compared to that study [20]. In our study, in-hospital mortality rate due to MI was 12%, which is lower compared to 23.3% reported by another study [11]. In a study in India, the mean age of the patients was reported 57.5 years, which is lower compared to Iran. In India, 30.4% of the patients had type 2 diabetes and 37.7% hypertension, and 40% were smoker; the corresponding figures in our study were respectively 22.2%, 35.5%, and 26.2%. In India, despite the high prevalence of risk factors, the death percentage was 6.7%, which is lower compared to our study. In our study, 83% of the patients were hospitalized for less than six days. In India, this figure was obtained 57.3%. The difference in mortality percentage between our study and the study in India could be due to difference in patterns of and access to treatment as well as approaches to offering healthcare services [21-23]. In-hospital mortality due to MI in the USA was higher in blacks compared to whites and higher in the individuals over 70 years compared to other ages. This rate was reported 10-70% [24-28]. The difference in incidence rate, mortality, and the factors associated with in-hospital mortality, and the mean age could be due to old population of some countries, like the USA and Japan, the difference in life expectancy and lifestyle, the difference in distribution of and coping with cardiovascular diseases risk factors, and the approach to offering healthcare. Failure to follow up the patients for 28 days, to include MI death cases outside hospital and home and to calculate the patients' survival time were some of the limitations of the present study, which should be addressed in the future studies.

Conclusion

STEMI and age over 84 years are likely to contribute mostly to in-hospital mortality in the patients with MI. The findings of the present study could be useful in planning in health system, monitoring, and improving the patients' care and treatment. The individual variables had a determining effect on the mortality due to MI. So, individual interventions in healthcare centers, clinics, and community at large for lifestyle changes contribute importantly to preventing and controlling mortality. Less importantly, the

Reference No.	Sample size/study population	Study type/ analysis	Incidence rate/ subjects	Mortality rate	Risk factors for MI 1	Other major results
[1]	20750	Prospective analysis	Out of 20,750 patients with MI, 4612 (22.3%) had type 2 diabetes	MI CFR 2 was 13.22% (95% CI 3: 12.29–14.19) and 11.78% (95% CI: 11.28–12.27), respectively, in those with or without diabetes	Age, gender, education, ischemic heart disease symptoms, smoking, dyslipidemia, hypertension, heart failure, and family history of cardiovascular diseases, AF 4; VT 5; RBBB 6; LBBB 7; STEMI 8; PCI 9; CABG 10.	The hospital mortality from MI following use of PCI, thrombolytic therapy, and CABG was, respectively, 7.28%, 13.23%, and 15.74% in diabetes patients and 4.72%, 15.57%, and 11.4% in non diabetes patients.
[2]	20750	Prospective, hospital-based	-	Illiterate: 8.11:7.7 – 8.5; elementary education: 6.11: 5.6-6.6; secondary education: 4.85: 4.4-5.3; academic education: 5.81: 4.9-6.8	Being woman, chest pain prior to arriving in hospital, lack of thrombolytic therapy, RBBB, VT, smoking and STEMI	A disparity was noted in post-MI mortality incidence in different educational levels in Iran. HR 11 of death was higher in illiterate patients than in the patients with academic education.
[6]	1691 patients with HF 12 (case group) and 6464 individuals without HF (control group)	Cohort analysis and a nested case-control	95% CI of HF was 8.1: 95% CI: 7.7-8.5 in study population (per 100 person-years)	Case:18.2 Control:12.1	Age, gender, smoking, hypertension, type 2 diabetes, high cholesterol, cardiovascular surgery, LBBB, RBBB, AF, VT	Different distribution of HF in different regions of Iran. The study suggested that identifying the risk factors for HF could play a major role in developing efficient programs to reduce the rate of mortality due to HF.
[8]	20750	Cross-sectional	73.3 per 100,000, (95% CI, 72.3-74.3)	-	Age, gender and province of residence	MI incidence of all provinces was 24.5-152.5 per 100,000 population.
[13]	20750, (15033 men and 5717 women)	Hospital-based, cross-sectional	-	Male: 7.98% Female:4.12%	Age, gender, education, place of residence, and individual, clinical, and laboratory risk factors such as the time at MI incidence, duration of hospitalization, type 2 diabetes, hypertension, smoking, dyslipidemia, type of diagnosis, treatment, the place of MI, and pain pattern	STEMI incidence was 2.8 times higher in men than women.
[14]	613	Hospital-based, cross-sectional study	Male: 375 (per 100,000 population) Female: 111 (per 100,000 population)	Male:53.9, Female:47.7	Age, gender	-
[16]	6504	Cohort-population-based	220 per 100,000 person-years in men and 104 per 100,000 person-years in women	-	Age, gender, waist circumference, central BMI 13, obesity, Overweight triglycerides, hypertriglyceridemia LDL-c 14, HDL-c 15, fasting plasma glucose, diabetes mellitus, SBP 16, DBP 17, hypertension, ever smoking	-
[24]	918	Descriptive	-	10.4% in women, 8.7% in men	Hypertension, Diabetes, dyslipidemia, smoking, positive family history, FBS 18, cholesterol, triglyceride, SBP, DBP	FBS, cholesterol and DBP were significantly higher in women. Mean age and The prevalence of diabetes and hypertension were higher in women with AMI.
[26]	20750	Ecological	-	-	Temperature, humidity, hypertension, smoking, BMI	-

[27]	20750	Prospective, population-based cohort		6.74 (95% CI, 6.4–7) per 100 person-years; 6.12 (95% CI, 5.83–6.43) and 8.36 (95% CI, 7.81–9.94) in men and women, respectively	Age, gender, educational level, place of residence, and individual, clinical, and laboratory risk factors , such as the date at MI incidence, duration of hospitalization, type 2 diabetes, hypertension, and smoking	STEMI, lack of thrombolytic therapy, age of over 84 years, and VT had the greatest effect on in-hospital mortality in MI patients.
[28]	20750	Nationwide, hospital-based, prospective	-	In-hospital mortality rate was 12.1%	type 2 diabetes, hypertension, smoking, history of heart disease, CABG, PCI, dyslipidemia, ischemic pain pattern	
[29]	20750	Prospective hospital-based study	-	31, 23.7, 20.2, 19.1, and 18.4/100,000 population in Ardebil, North Khorasan , Yazd, West Azarbaijan, and Khouzestan, respectively	Age, gender, region	This study supports the hypothesis of random pattern of mortality due to MI in Iran.
[30]	20750	Cross-sectional	-	2.07 (95% CI: 1.5–2.8) for RBBB, 1.5 (95% CI: 1.3–1.7) for STEMI	Demographic data, clinical and behavioral risk factors at the individual level and environmental data	Individual risk factors had independent effects on the in-hospital mortality due to MI. Variables in the province level had no significant effect on the outcome of MI.
[31]	611	Cross-sectional	-	-	The individual characteristics including age, history of MI in the immediate family, hypertension, and diabetes, the air quality indicators and environmental variables	-

Table 1: Summary of study findings on risk factors for myocardial infarction in Iran

[1] Myocardial infarction; [2] case fatality rate; [3] confidence interval; [4] atrial fibrillation; [5] ventricular tachycardia; [6] right bundle branch block; [7] left bundle branch block; [8] ST segment elevation myocardial infarction; [9] percutaneous coronary intervention; [10] coronary artery bypass grafting; [11] hazard ratio; [12] heart failure; [13] body mass index; [14] low density lipoprotein cholesterol; [15] high density lipoprotein cholesterol; [16] systolic blood pressure; [17] diastolic blood pressure; [18] fasting blood sugar.

variables related to the living environment such as temperature, relative humidity, and precipitation may determine the mortality in patients. Variables at the province level had no significant effect on the outcome of MI. Implementing educational strategies, motivating people to refer physicians early, and increasing access to treatment especially for the individuals at MI risk could reduce the mortality due to MI.

Conflicts of interest

None.

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References

1. Ahmadi A, Soori H, Sajjadi H (2015) Modeling of in hospital mortality determinants in myocardial infarction patients, with and without type 2 diabetes, undergoing pharmaco-invasive strategy: the first national report using two approaches in Iran. Journal of Diabetes Res Clin Pract 108: 216-220.

2. Ahmadi A, Khaledifar A, Sajjadi H, Soori H (2014) Relationship between risk factors and in-hospital mortality due to myocardial infarction by educational level: a national prospective study in Iran. Int J Equity Health 13: 116.

3. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD, et al. (2014) Executive summary: heart disease and stroke statistics--2014 update: a report from the American Heart Association. Circulation129:399-410.

4. Gaziano TA, Bitton A, Anand S, Abrahams-Gessel S, Murphy A (2010) Growing epidemic of coronary heart disease in low- and middle-income countries. Currt probl cardiol 35: 72-115.

5. Xavier D, Pais P, Devereaux PJ, Xie C, Prabhakaran D, et al. (2008) Treatment and outcomes of acute coronary syndromes in India (CREATE): a prospective analysis of registry data. Lancet 371: 1435-42.

6. Ahmadi A, Soori H, Mobasheri M, Etemad K, Khaledifar A (2014) Heart Failure, the Outcomes, Predictive and Related Factors in Iran. J Mazandaran Univ Med Sci 24: 180-188.

7. Jeemon P, Reddy KS (2010) Social determinants of cardiovascular disease outcomes in Indians. Indian J Med Res 132: 617-22.

8. Jhun HJ, Kim H, Cho SI (2011) Time trend and age-period-cohort effects on acute myocardial infarction mortality in Korean adults from 1988 to 2007. J Korean Med Sci 26: 637-41.

9.   AhmadiA, Soori H, Mehrabi Y, Etemad K, Samavat T, et al. (2015) Incidence of acute myocardial infarction in Islamic Republic of Iran: a study using national registry data in 2012. East Mediterr Health J 21:5-12.

10.   Havulinna AS, Paakkonen R, Karvonen M, Salomaa V (2008) Geographic patterns of incidence of ischemic stroke and acute myocardial infarction in Finland during 1991-2003. Ann epidemiol 18:206-13.

11.   Takii T, Yasuda S, Takahashi J, Ito K, Shiba N, et al. (2010) Trends in acute myocardial infarction incidence and mortality over 30 years in Japan: report from the MIYAGI-AMI Registry Study. Circ J 74:93-100.

12.   Jolobe OM (2006) Incidence of recognized and unrecognized myocardial infarction in men and women aged 55 and older: the Rotterdam Study. Eur Heart J 27:1383-4.

13.   Ahmadi A, Soori H, Sajjadi H, Nasri H, Mehrabi Y, et al. (2015) Current status of the clinical epidemiology of myocardial infarction in men and women: A national cross-sectional study in Iran. Int J Prev Med 6: 14.

14.   Shafiee E NI, Asadi M, Haery nejad M, Veisizadeh B, et al. (2004) Myocardial infarction event rate in Bushehr Port : WHO MONICA Project. ISMJ 6: 144-50.

15.   Fakhrzadeh H, Bandarian F, Adibi H, Samavat T, Malekafzali H, et al. (2008) Coronary heart disease and associated risk factors in Qazvin: a population-based study. East Mediterr Health J 14:33-41.

16.   Talaei M, Sarrafzadegan N, Sadeghi M, Oveisgharan S, Marshall T, et al. (2013) Incidence of cardiovasculardiseases in an Iranian population: The Isfahan cohort study. Arch Iran Med 16:138-144.

17.   MI Registery (2009) Tehran, Iran: Cardiovascular office, Minnistry of Health and Medical Education 2009.

18.   Ahmadi A, Mobasheri M, Hashemi-Nazari SS, Baradaran A, MolaviChoobini Z (2014) Prevalence of hypertension and type 2 diabetes mellitus in patients with colorectal cancer and their median survival time: A cohort study. J Res Med Sci 19: 850-4.

19.   Pedigo A, Seaver W, Odoi A (2011) Identifying Unique Neighborhood Characteristics to Guide Health Planning for Stroke and Heart Attack: Fuzzy Cluster and Discriminant Analyses Approaches. PLoS ONE 6.

20.   Zevallos JC, Yarzebski J, Banchs H, González-Sánchez JA, Mattei H (2012) Gender Disparities in Puerto Ricans Hospitalized with an Initial Acute Myocardial Infarction: A Populationbased Perspective. P R Health Sci J 31:192-8.

21.   El-Menyar A, Zubaid M, Rashed W, Almahmeed W, Al-Lawati J et al. (2009) Comparison of Men and Women With Acute Coronary Syndrome in Six Middle Eastern Countries. Am J Cardiol 104: 1018 –1022.

22.   Donyavi T, Naieni K, Nedjat S, Vahdaninia M, Najafi M, et al. (2011) Socioeconomic status and mortality after acute myocardial infarction: a study from Iran. Int J Equity Health 10: 9-17.

23.   Kazemy T, Sharifzadeh GhR (2007) Sex differences in acute myocardial infarction:birjand, eastern iran. ARYA Atherosclerosis J 3: 42-44.

24.   Shahraz S BA, Bahari A, Nadery Y, Farzadfar F, Beyranvand MR, et al. (2012) The completeness of medical records to assess quality of hospital care: the case of acute myocardial infarction in a district-level general hospital in Iran. Arch Iran Med 15: 592-5.

25.   Ahmadi A, Soori H, Mehrabi M, Etemad K (2015) Spatial analysis of myocardial infarction in iran: national report from the Iranian myocardial infarction registry. J Res Med Sci 20: 434-439.

26.   Ahmadi A, Soori H, Mehrabi Y, Etemad K, Khaledifar A (2015) Epidemiologic pattern of myocardial infarction and modeling risk factors relevant to in-hospital mortality: the first results from Iranian Myocardial Infarction Registry. Kardiol Pol 73: 451-457.

27.   Ahmadi A, Soori H, Khaledifar A (2015) In-hospital case fatality rate and Cox proportional-hazards model for risk factors ofmortality due to myocardial infarction in Iran hospitals: a national study. Int Cardiovasc Res J 9: 159-163.

28.   Ahmadi A, Soori H, Etemad K, Mehrabi Y, Hojabri S (2015) Geographical Pattern of In-hospital Mortality due to Myocardial Infarction in Iran. J Mazandaran Univ Med Sci 25: 1-9.

29.   Ahmadi A, Soori H, Mehrabi Y, Etemad K, Sajjadi H, Sadeghi M (2015) Predictive factors of hospital mortality due to myocardial infarction: A multilevel analysis of Iran's national data. I Int J Prev Med 6: 112.

30.   Ahmadi A, Golshahi J, Khaledi-Far A, Soori H, Mehrabi Y, et al. (2015) The pattern of in-hospital mortality of myocardial infarction and associated factors in Iran: A national study. Journal of Isfahan Medical School 32: 2174-2183.

31.   Sadeghi M, Ahmadi A, Baradaran A, Masoudipoor N, Frouzandeh S (2015) Modeling of the relationship between the environmental air pollution, clinical risk factors, and hospital mortality due to myocardial infarction in Isfahan, Iran. J Res Med Sci 20: 757-62.