



# Myocardial Infarction in Iran: Epidemiology, Management, and Prognosis

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## Abstract

**Background:** Cardiovascular diseases, specifically acute myocardial infarction (AMI), are the leading cause of death worldwide. In this review, we explain the characteristics of AMI in Iran.

**Methods:** We searched PubMed, Google, and Google Scholar for articles containing myocardial infarction, STEMI, and MI<sup>+</sup> Iran in English and Persian words.

**Results:** The age-standardized incidence rate of MI was 73.3 per 100 000. The mean±SD age of patients was 61.20±13.40 years. In-hospital mortality of patients with AMI in the IMIR was 12.1%. Concerning AMI complications reported in the IMIR, 5.8% of patients experienced ventricular tachycardia, and 2.5% experienced ventricular fibrillation. The 1-year mortality rate in the IPACE2 study was 4.3%.

**Conclusion:** Only a few national studies are available in Iran regarding patients with AMI. A federal surveillance program continuously monitoring and tracking coronary events is essential to improve the general population's health.

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**Keywords:** Myocardial infarction; ST-elevation myocardial infarction; Iran

## Introduction

Cardiovascular diseases, including ischemic heart disease, stroke, heart failure, and peripheral arterial disease, constitute the leading cause of mortality and are a significant contributor to reduced quality of life the world over.<sup>1</sup> In 2019, cardiovascular diseases were the underlying cause of 9.6 million deaths among men and 8.9 million deaths among women, approximately one-third of all deaths globally.<sup>2</sup>

As a subtype of ischemic heart disease, acute myocardial infarction (AMI) is the most common cause of death.<sup>3</sup> From the epidemiological point of view, the incidence of MI in a population can be used as a proxy for the prevalence of coronary artery disease in that population.<sup>4</sup>

In this review, we explain the characteristics of AMI in Iran, a country with a population of about 75 million people in 2011.<sup>5</sup> We searched PubMed, Google, and Google Scholar for articles containing myocardial infarction, STEMI, and

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MI<sup>†</sup> Iran in English and Persian.

The age-standardized incidence rate of MI was reported at 73.3 per 100 000 in the whole country (95% confidence interval [CI], 72.30% to 74.30%) based on the Iranian Myocardial Infarction Registry (IMIR) in 2012, which varied from 24.5 to 152.5 per 100 000 across 31 provinces.<sup>6</sup>

The prevalence of hypertension in patients with coronary artery disease was reported 44.0% (95% CI, 38.00% to 49.00%): 67.0% in women (95% CI, 53.00% to 82.00%) and 42.0% in men (95% CI, 39.00% to 46.00%). The highest prevalence of hypertension was in patients with AMI (50.0%; 95% CI, 8.00% to 93.00%).<sup>7</sup> Additionally, in a large population study on 20 750 patients with MI, 35.5% had hypertension, 26.2% were smokers, 17.8% had dyslipidemia, and 22.2% had type 2 diabetes mellitus.<sup>8</sup> A summary of the reported risk factors in patients with AMI based on different studies is presented in Table 1.

The mean±SD age of patients was 61.20±13.40 years,<sup>6</sup> with the mean age at MI incidence being significantly lower in men than in women.<sup>6,9-11</sup> A summary of the reported mean age in patients with AMI according to different studies is shown in Table 1. Most patients with AMI were illiterate (46.3%) or had only primary school education (23.8%) in a large study in 2012.<sup>8</sup> The geographical distribution of MI studies from 1994 through 2018 is illustrated in Figure 1.

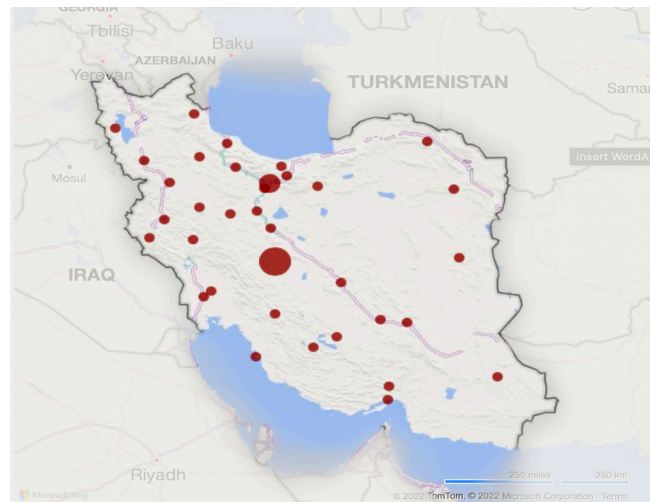


Figure 1. The image depicts the geographical distribution of Iranian studies on acute myocardial infarction.

Chest pain was the most common manifestation of patients with AMI.<sup>10,12-17</sup> Small studies covered different periods across the country, from symptom onset to medical contact or arrival at the hospital. Only a minority of patients with AMI (35.7%) arrived at the hospital during the first hour of symptom onset, 7.9% 24 hours after symptom onset in Bandar Abbas,<sup>12</sup> and 69.0% 2 hours after symptom onset in Kashan.<sup>15</sup> In other articles, the mean (±SD) pre-hospital delay was 7.40 (±16.25) hours in Gilan,<sup>14</sup> 127.00 (±174.00)

Table 1. Iranian studies on acute myocardial infarction according to location, years, mean age, sex, and risk factors\*

Author	Origin of the Population	Year	Type of Study	N	Mean age (year±SD)	Male	Diabetes mellitus	Dyslipidemia	Hypertension	Smoker
Ahmadi <sup>8</sup>	31 Provinces	2012-2013	Cross-sectional	20750	61.20±13.40	72.4	22.2	17.8	35.5	26.2
Hosseini <sup>30</sup>	1 hospital in Tehran	2003-2007	Retrospective	2028 <sup>†</sup>	60.60±12.50	75.0	32.3	46.7	42.8	33.2
Sezavar <sup>17</sup>	5 hospitals in Tehran and Shiraz	2017	Prospective, observational	162 <sup>†</sup>	61.00±12.00	75.0	20.0	39.0	65.0	15.0
Nozari <sup>21</sup>	1 hospital in Tehran	2015-2019	Observational	2823 <sup>†</sup>	59.60±11.60	79.5	40.5	53.3	46.6	NA
Kassaian <sup>18</sup>	11 hospitals in Tehran, Mashhad, Tabriz, Isfahan, and Shiraz	2011-2012	Prospective	463 <sup>†</sup>	58.80±11.30	80.1	25.9	34.9	39.5	51.9
Safi <sup>29</sup>	1 hospital in Tehran	2001-2005	Cross-sectional	180	56.00±2.10	80.0	19.4	43.9	29.4	50.6
Ghaffari <sup>27</sup>	NA	1993-2012	Cross-sectional, descriptive, analytical	600	60.03±11.61	73.3	15.7	11.3	39.3	43.5
Beyranvand <sup>26</sup>	1 hospital in Tehran	2003-2004	Cohort	132	59.20±13.10	76.5	21.2	NA	28	32.6
Donyavi <sup>35</sup>	1 hospital in Tehran	2005-2006	Retrospective	1283	62.40±12.30	74.0	35.1	53.2	45.2	67.6
Poorhosseini <sup>16</sup>	1 hospital in Tehran	2016-2018	Cross-sectional	2103 <sup>†</sup>	59.49±11.79	76.4	31.2	41.8	40.5	35.1
Saadatagah <sup>33</sup>	1 hospital in Tehran	2006-2017	Retrospective	8295 <sup>†</sup>	60.40±12.50	77.5	30.1	39.3	43.4	42.7

\*Data are presented as n (%).

†ST-elevation myocardial infarction patients

minutes in Kashan,<sup>13</sup> 265.60 minutes (among patients with acute coronary syndromes),<sup>18</sup> 149.00 ( $\pm$ 120.00) minutes in Isfahan,<sup>19</sup> and 146.00 $\pm$ 20.00 minutes in Tehran among patients transferred in Emergency Medical System (EMS) ambulances.<sup>20</sup> The median time of hospital arrival, according to various articles, was 279 (interquartile range [IQR], 120 to 630) minutes,<sup>16</sup> 258 (IQR, 108 to 574) minutes,<sup>21</sup> 3 (min-max: 0.5148) hours,<sup>22</sup> and 244 (IQR, 109 to 565) minutes<sup>23</sup> in Tehran.

According to several studies, prehospital delays were correlated with educational level. Patients with a higher level of education had a lower rate of prehospital delays<sup>12,16</sup> and vice versa.<sup>13,14</sup> The most common causes of delays were unawareness of coronary artery disease<sup>12</sup> and waiting for improvement.<sup>15</sup>

A minority of patients with MI came to the hospital in EMS ambulances: 23.5% (n=227) in Bandar Abbas,<sup>12</sup> 17.3% (n=162) in Rasht,<sup>14</sup> 25.4% (n=248)<sup>13</sup> and 10.0% (n=200) in Kashan,<sup>15</sup> and 9.3% (n=2103),<sup>16</sup> 18.5% (n=2823),<sup>21</sup> and 12.7% (n=1493)<sup>23</sup> in Tehran.

In Tehran, among 513 patients with STEMI transported by the EMS, the mean time from the onset of symptoms to calling EMS was 61.00 $\pm$ 19.00 minutes, and the mean transportation time from the patient's place to the hospital was 34.00 $\pm$ 12.00 minutes.<sup>20</sup>

AMI is classified as STEMI or non-STEMI based on the presence or absence of ST-segment elevation on the electrocardiogram.<sup>24</sup> The ratio of STEMI among patients with AMI was 75.8%<sup>25</sup> and 79.5%.<sup>26</sup> The ratio among patients with coronary syndromes was 52.0%<sup>17</sup> and 25.7%.<sup>18</sup>

The frequency of thrombolytic therapy among patients with AMI rose over time: 1.0% between 1993 and 1999, 13.0% between 1993 and 2003, 26.5% between 2003 and 2012,<sup>27</sup> and 52.0% between 2000 and 2009.<sup>11</sup> In addition, the frequency of thrombolytic therapy among patients with STEMI was 58.1% between 2003 and 2004,<sup>26</sup> 52.7% between 2009 and 2011,<sup>22</sup> 46.3% between 2011 and 2012,<sup>18</sup> and 73.3% between 2012 and 2013.<sup>25</sup>

Streptokinase was the main thrombolytic drug in the past.<sup>10,18,22,26,27</sup> Nonetheless, in recent years, it has been replaced with reteplase (Retelies, OSVAH Pharmaceutical CO, Tehran).

According to various articles, the median door-to-needle time was 30 (range: 6-330) minutes<sup>22</sup> and 44 minutes,<sup>20</sup> with a mean ( $\pm$ SD) time of 45.60 ( $\pm$ 41.10) minutes<sup>18</sup> and 64.00 ( $\pm$ 74.00) minutes.<sup>19</sup>

Primary percutaneous coronary intervention (PPCI) has increased rapidly in recent years. Many hospitals (n=31) are involved in a national program called "247", which means the capability of doing PPCI over 24 hours, 7 days a week.<sup>28</sup>

The door-to-balloon time was reported in a few studies. The median door-to-balloon time was 30 (range: 60-300) minutes,<sup>22, 53</sup> minutes in the Iranian Project for Assessment of Coronary Events 2 (IPACE2) study,<sup>18</sup> and 55 (IQR, 40

to 92) minutes in a study on 2823 patients. Further, a door-to-balloon time of 90 minutes or less was noted in most patients (74.0%).<sup>21</sup> In a study on 180 patients, the door-to-balloon time was less than 90 minutes in only 39.0%.<sup>29</sup> On the other hand, the median door-to-device time was 64 (41-100) minutes in a study on 11 563 patients who underwent PPCI in 247 centers. Additionally, 68.0% of the patients had a door-to-device time of 90 minutes or less.<sup>28</sup> The in-hospital mortality rate of patients with AMI in the IMIR was 12.1%: 11.0% in males and 15.0% in females. Furthermore, the female/male fatality ratio was 1.36 (95% CI, 1.20 to 1.40), and the mortality rate was 13.3% in patients with STEMI and 8.1% in those with non-STEMI.<sup>8,25</sup> In a study using data from the Cardiovascular Disease Registry of Tehran Heart Center from 2003 through 2007, in-hospital mortality was 5.8% in 2028 patients with STEMI.<sup>30</sup>

The fatality rate of patients with AMI has decreased over time, as shown in the Isfahan Registry, including 12 900 patients admitted with their first AMI during 10 years from 2000 through 2009. The registry showed a 28-day case fatality rate reduction, from 11.2% to 7.9%: from 9.2% to 6.7% in men and from 16.1% to 10.9% in women, indicating a 29.4% reduction in the case fatality rate: 27.1% in men and 32.2% in women.<sup>31</sup>

Among patients who underwent PPCI, the mortality rate was 6.6%.<sup>29</sup> In a study on patients older than 75, the in-hospital mortality rate was 17.0%: 2.4% in patients without cardiogenic shocks and 83.0% in those with cardiogenic shocks.<sup>32</sup> In other studies, in-hospital mortality rates were 18.5%,<sup>28</sup> 5.4%,<sup>33</sup> and 15.1%<sup>34</sup> (Table 2).

The complications of AMI have not been reported thoroughly. In the IMIR, ventricular tachycardia occurred in 1198 patients (5.8%) and ventricular fibrillation in 511 (2.5%). The frequencies of ventricular tachycardia and ventricular fibrillation were significantly higher in deceased patients (10.5% vs 5.1% and 5.5% vs 2.0%, respectively; P=0.001).<sup>25</sup>

The duration of hospitalization showed a significant reduction, as shown in a multicenter study over 20 years from 1993 through 2012, from a mean duration of 11.36 $\pm$ 6.48 days to 6.35 $\pm$ 3.56 days.<sup>27</sup>

Data regarding long-term mortality are scarce. According to various articles, short-term (28 d) survival rates were 91.5% (93.0% in males and 86.8% in females)<sup>9</sup> and 90.9% (92.5% in males and 86.7% in females).<sup>10</sup> Most deaths occurred during the first week after the events.<sup>9</sup>

One-year mortality of 132 patients with AMI (20.0% non-STEMI) stood at 6.1% and readmission rates at 14.3%.<sup>26</sup> The 1-year mortality rate in the IPACE2 study was 4.3% (71.4% cardiac causes).<sup>18</sup> The 2-year mortality rate in 664 out of 1283 patients with AMI who could be followed up was 24.7% in a study on 139 patients with AMI in 2002.<sup>35</sup>

Ghadimi et al<sup>34</sup> reported 1-, 6-, and 12-month cumulative mortality rates of 17.3%, 20.1%, and 21.6%, respectively



Table 2. Iranian studies on acute myocardial infarction according to location, years, treatment, and mortality

Study	Year	N	Origin of the Population	Thrombolytic	Primary PCI	Door-to-Needle time (mean±SD) (min)	Door-to-Balloon Time (mean±SD) (min)	In-hospital Mortality	1 M Mortality
Abdolazim <sup>9</sup>	1999-2009	14426	Isfahan	NA	NA	NA	NA	6.7 (7 D Mortality)	8.5
Mohammadian <sup>10</sup>	2000-2009	12900	Isfahan	NA	NA	NA	NA	NA	9.3
Ghadimi <sup>33</sup>	2002-2003	139	Tehran	35.9	6.4	NA	NA	15.1	17.3
Hosseini <sup>30</sup>	2003-2007	2028	Tehran	NA	NA	NA	NA	5.8	NA
Saadatagah <sup>33</sup>	2006-2017	8295	Tehran	36.6	28.0	31.00±15.00	70.00±25.00	5.4	NA
Alishahi Tabriz <sup>20</sup>	2007-2010	513	Tehran	100	NA	44	NA	NA	NA
Donyavi <sup>35</sup>	2008	664	Tehran	NA	NA	NA	NA	NA	NA
Kassaian <sup>18</sup>	2011-2012	463	5 Major cities	46.3	17.3	45.60±41.10	82.80±112.50	NA	NA
Ahmadi <sup>25</sup>	2012	20750	31 provinces of Iran	NA	NA	NA	NA	12.1	NA
Nozari <sup>21</sup>	2020	2823	Tehran	0	100	NA	Median: 55 (IQR 40-92)	1.6	NA
Abdi <sup>28</sup>	2021	11563	31 Centers 24/7 Program	NA	100	NA	Median: 64 (41-100)	NA	NA

(Table 2).

In a small study, the rates of adherence to prescribed  $\beta$ -blockers, ASA, angiotensin-converting enzyme inhibitors, and statins 1 year after discharge were 74.2%, 98.5%, 71.2%, and 67.4%, respectively.<sup>26</sup>

## Conclusion

Few extensive national studies have been conducted on patients with AMI in Iran. Having a national program for gathering data on patients with AMI throughout the country will help to overcome this shortage.

A national surveillance program that continuously monitors and tracks coronary events is essential to improve the general population's health. In addition, such a program may be used as an indicator of the effectiveness of community-based interventions by showing the outcome of intervention programs on the population.

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