



Incidence, Age-Specific, and Regional Distribution of Myocardial Infarction in Zanjan Province, Iran, during 2014-2019

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Abstract

Background: Myocardial Infarction (MI) is one of the most important cardiovascular diseases and the leading cause of 39% of deaths in Iran. Due to the different geographical diversity in Zanjan province, Iran.

Objectives: This study aimed to investigate the incidence, age-specific, and regional distribution of myocardial infarction in Zanjan province, Iran.

Methods: This cross-sectional study was conducted at Zanjan University of Medical Sciences (ZUMS), Zanjan, Iran, in 2020. Data were collected from nine hospital information systems. The incidence rate, age-specific, and regional distribution of MI were calculated for each county. Chi-square test, independent sample t-test, and binary logistic regression methods were used to investigate significant relationships between variables. All statistical analyses were performed using RStudio and R software.

Results: In total, 3,723 MI patients were hospitalized in ZUMS hospitals during 2014-2019. The overall incidence rate of MI was 348 cases (95% CI, 337-359) per 100,000 population. Moreover, the prevalence of this condition was higher in males compared to females and at age 80 and over. The incidence rates of MI increased by 84% from 49 cases (95% CI: 47-55) in 2014 to 90 cases (95% CI: 88-99) in 2019 (P<0001). Moreover, the highest incidence rate of MI was observed in Khorramdareh and Ijrood counties.

Conclusion: This study provided an overview of the current status of MI incidence in Zanjan province, Iran. The highest incidence of MI was observed in males and at the southeast of the studied area. This study can help health authorities and policymakers prioritize resource allocation and employ prevention programs to reduce the incidence rate of MI.

Keywords: Incidence rate, Myocardial infarction, Regional and time distribution, Zanjan

1. Background

Despite the reduction of mortality rate in recent years, Myocardial Infarction (MI) is one of the most important cardiovascular diseases (CVD) that is responsible for 35 percent of deaths in the world and 39 percent of mortalities in Iran (1). MI is an acute disease commonly known as a heart attack that needs immediate medical interventions (2). Previous studies reported a significant relationship between the incidence rate of MI (IRMI) and age, gender, geographical, and socioeconomic factors (1, 3-5). The incidence of MI was 73.3 cases per 100,000 person-year in Iran, and the male: female incidence ratio was obtained at 2.63 (3,6). Various IRMI per 100,000 persons in different countries was reported at 62.6 cases in Japan (7), 738 cases in males and 292 cases in females in Finland (8), 154 cases in males and 66 cases in females in England (9), 196 cases in females and 357 cases in males in Denmark (10), and 200-500 cases in males and 60-150 cases in females in developed countries (11). According to Ahmadi's study in 2012, IRMI varied from 20 to 121 cases per 100,000 person-year across different provinces of Iran (6). Furthermore, the highest and the lowest

incidence of MI was observed in North Khorasan (152.5 cases per 100,000 population) and Qom (24.5 cases per 100,000 population) provinces of Iran. IRMI was 40 cases per 100,000 persons in Zanjan province in the northwest of Iran (6).

The incidence of MI has a significant influence on the quality of life and imposes considerable costs on family and community (12). Although the incidence of CVD is high among people living in the developed countries where a sedentary lifestyle is common (12), more than 80% of deaths from CVD occur in low and middle-income countries (13). The vast majority of these deaths could be prevented by defining risk factors, high-risk groups, high-risk areas, and applied prevention programs (1,5,10,14).

Moreover, MI risk factors were divided into two categories of modifiable and non-modifiable factors. The most common modifiable factors include hypertension, diabetes mellitus, sedentary lifestyle, alcohol consumption, and smoking. However, age, gender, ethnicity, and family history of CVD are non-modifiable factors (14).

There are no reliable data to define the distribution pattern of MI incidence among various groups or areas in Iran. Consequently, determining the high-risk

groups is the first step in MI prevention programs. The comparison of IRMI across different regions and groups reveals useful information that can be used in evidence-based decision making, investigation, prioritization of resource allocation, and health systems to better understand the epidemiology of MI and reduce IRMI at high-risk areas. Zanjan province is one of the 31 provinces of Iran located in the northwest of this country with an area of 21,773 km² and a population of 1,057,461 people in the year 2016. Due to different geographical diversity in this area, this study aimed to investigate the incidence rate, age-specific, and regional distribution of MI in Zanjan province of Iran, during 2014-2019.

2. Objectives

This study aimed to investigate the incidence, age-specific, and regional distribution of myocardial infarction in Zanjan province, Iran.

3. Methods

This cross-sectional study was conducted at Zanjan University of Medical Sciences (ZUMS) in the year 2020. The study data were collected from nine hospital information systems and included patients' age, gender, length of stay (LOS), and residential address. Patients with an ICD-10 discharge diagnosis code I21-I22 were selected as the study sample. The study sample included all patients who were admitted, hospitalized, or died due to MI at ZUMS hospitals during 2014-2019. The population of Zanjan province counties was obtained from Iran's national census in 2011 and 2016. The IRMI per 100,000 persons for each county was calculated by dividing the number of MI cases to each county population multiplied by 100,000 with a 95% confidence interval (CI). Univariate chi-square test

was used to examine the statistically significant relationship between the distribution of MI incidence with that of counties, hospitals, and years. A statistically significant difference between the mean age and the mean LOS of male and female patients was examined through the independent sample t-test. The binary logistic regression method was used to investigate the significant relationship between the probability of MI incidence among patients admitted at ZUMS hospitals and different age groups, based on gender and geographical areas. Data analysis was performed for males, females, and different geographical regions, separately. For all statistical tests in this study, the level of significant was considered 95%.

All statistical analyses were performed using "Tidyverse", "Stringr", "epiR", "gridExtra", "directlabels", "openxlsx", "caret", and "ggplot2" packages at RStudio and R software. The study protocol was approved by the Ethics Committee of ZUMS (IR.SSU.MEDICINE.REC.1396.311).

4. Results

In total, 3723 (0.06%) MI cases out of 68,843 CVD hospitalized patients were admitted at ZUMS hospitals during 2014-2019, and 5,238 (7.6%) cases were excluded due to duplicated data or residency in other provinces. Moreover, the majority (70%) of admitted cases were male. The overall incidence rate of MI was 348 cases (95% CI: 337-359) per 100,000 people in Zanjan province, Iran, and was higher in males (n=484; 95% CI: 465-503) compared to females (n=211; 95% CI: 199-223) per 100,000 person (P<0.0001; Table 1). It should be noted that 26.3% of all MI incidents occurred to patients in the age range of 30-44 years; however, the highest IRMI was observed among those aged 80 years and older (n=3268; 95% CI, 2997-3558 per 100,000 people) (Table 3). The

Table 1. Incidence of MI by counties in Zanjan province, Iran from 2014 to 2019

Characteristic	Population N (%)	Total N (%)	Female N (%)	Male N (%)	Per 100,000 (95% CI)	AGE (Year) Mean±SD	LOS (Hour) Mean±SD	P-Value
Total	1,069,533 (100)	3723 (100)	1145 (30)	2675 (70)	348 (337, 359)	64.65±14.1	122.7±197.5	-
Sex	Women 531,557 (49.7)	1,120 (30)	1,120(100)	0 (0)	211 (199, 223)	67.3±14.2	127.8±219.6	P<0.0001
	Men 537,976 (50.3)	2,603 (70)	0 (0)	2603(100)	484 (465, 503)	62±14	117.7±175.5	
County (Location)	Abhar (the Southeast) 150,431 (14.07)	360 (9.7)	114(31.7)	246 (68.3)	239 (215,265)	63.6±13.5	106.5±136	P<0.0001
	Ijrood (the West) 38142 (3.57)	190 (5.1)	57 (30.0)	133 (70.0)	498 (430,574)	68.8±12	86.7±97.2	
	Khodabandeh (the South) 171319 (16.02)	595 (16.0)	221 (37.1)	374 (62.9)	347 (320,376)	60.8±17.6	121.9±280.4	
	Khorramdareh (the Southeast) 68699 (6.43)	347 (9.3)	115 (33.1)	232 (66.9)	505 (453,561)	64.9±13.3	107.1±169.7	
	Mahnesan (the Northwest) 40722 (3.81)	117 (3.1)	39 (33.3)	78 (66.7)	287 (238,344)	64.3±12.4	194.4±334.6	
	Soltanieh (the East) 30631 (2.84)	86 (2.3)	29 (33.7)	57 (66.3)	281 (225,347)	68±12.7	121.9±100.1	
	Tarom (the Northeast) 47983 (4.49)	142 (3.8)	54 (38.0)	88 (62.0)	296 (249,349)	64.7±12.7	119.5±116.2	
	Zanjan (the North) 521606 (48.77)	1886 (50.7)	491 (26.0)	1395 (74.0)	362 (345,378)	63.3±13.7	124.4±166.6	

N: Number, SD: Standard deviation, CI: Confidence interval, %: Percent

Table 2. incidence of MI by years in Zanjan province, Iran from 2014-2019

Years (2014-2019)	Population N (%)	Total N (%)	Females N (%)	Males N (%)	Per 100,000 (95% CI)	AGE (Year) Mean±SD	LOS (h) Mean±SD	P-Value
2014-2015	1,059,884	521(14.0)	147(28.2)	374(71.8)	49(45,54)	62.9±14.2	124.5±121.1	P<0.0001
2015-2016	1,070,886	652(17.5)	188(28.8)	464(71.2)	61 (56,66)	63.7±13.5	137.7±187.3	
2016-2017	1,057,461	798(21.4)	230(28.8)	568(71.2)	75 (70,81)	64.3±13.8	126.7±189.2	
2017-2018	1,072,939	769(20.7)	227(29.5)	542(70.5)	72 (67,77)	63.8±13.9	126.2±279.2	
2018-2019	1,086,497	983(26.4)	328(33.4)	655(66.6)	90 (85,96)	63±15.4	98.2±121.8	

N: Number, SD: Standard deviation, CI: Confidence interval, %: Percent

Table 3. Age specific-distribution of MI patients in Zanjan province, Iran, from 2014 to 2019

Age group	Population N (%)	Total N (%)	Females N (%)	Males N (%)	Per 100,000 (95% CI)	AGE (Year) Mean±SD	LOS (h) Mean±SD	P-Value
0-4	97161 (9.1)	5 (0.134)	2 (40)	3 (60)	5 (2,12)	1.4±1.9	90.9±77.1	P<0.0001
05-14	159227 (14.9)	8 (0.215)	4 (50)	4 (50)	5 (2,10)	10.6±2.1	38.5±39.6	
15-29	277901 (26)	59 (1.585)	23 (38.983)	36 (61.017)	21 (16,27)	23.5±4.3	139.9±762.3	
30-44	280964 (26.3)	234 (6.285)	32 (13.675)	202 (86.325)	83 (73,95)	39.5±3.9	102±175.9	
45-59	152545 (14.3)	1121 (30.11)	215 (19.179)	906 (80.821)	735 (692,779)	53.1±4.2	111.4±152.1	
60-69	53626 (5)	952 (25.571)	318 (33.403)	634 (66.597)	1775 (1664,1892)	64.4±2.8	120±132.3	
70-79	31797 (3)	811 (21.784)	301 (37.115)	510 (62.885)	2551 (2378,2732)	74.2±2.8	122.7±170.4	
80+	16309 (1.5)	533 (14.316)	225 (42.214)	308 (57.786)	3268 (2997,3558)	84.2±3.8	146±223.4	

N: Number, SD: standard deviation, CI: Confidence interval, %: Percent

mean±SD age ($P=0.02$) and the mean±SD LOS of patients ($P=0.03$) were higher in females than in males (67.3 ± 14.2 years vs. 62 ± 14 years and 127.8 ± 219.6 h vs. 117.7 ± 175.5 h, respectively).

The distribution pattern of MI was different in various counties of Zanjan province ($P<0.0001$). A higher IRMI was observed in Khorramdareh (the southeast of Zanjan province) and Ijrood (the east of Zanjan province) counties ($n=505$; 95% CI: 453-561 and $n=498$; 95% CI: 430-574 per 100,000 people, respectively), while the lowest IRMI ($n=239$; 95% CI: 215-265 per 100,000 people) was occurred in Abhar County (the southeast of Zanjan province). The IRMI in Zanjan County (the north of Zanjan province), as the center of the province, was 362 cases (95% CI: 345-378) per 100,000 population which ranked it the third high-risk area for MI incidence in the studied area. The highest mean±SD age (68.8 ± 12 years) of patients was observed in Ijrood County (the west of Zanjan province). Mahneshan County (the northwest of Zanjan province) had the highest mean±SD LOS in the studied area (194.4 ± 334.6 h).

In total, 54.3% of patients were hospitalized in Ayatollah Mousavi Hospital in Zanjan County. However, no patient was admitted in Emdadi and Razi Hospitals in Abhar and Mahneshan counties, respectively ($P<0.0001$). Moreover, the majority of patients in all hospitals were males. The mean LOS±SD of patients with MI was different among various hospitals and the highest mean±SD of LOS was estimated at 133.8 ± 151.4 h and was observed in

Ayatollah Mousavi Hospital ($P<0.0001$).

The IRMI was different in different years in the studied area ($P<0.0001$). The IRMI increased by 84% from 49 cases (95% CI: 47-55) in 2014 to 90 cases (95% CI: 88-99) in 2019 in Zanjan province, Iran, while the population density of the province increased only 2% during this time (from 1,059,884 in 2014 to 1,086,497 person in 2019). The mean age (approximately 63 years) of patients remained constant during 2014-2019, while the mean±SD LOS decreased by 21% from 124.5 ± 121.1 h in 2014 to 98.2 ± 121.8 h in 2019. Each year IRMI was significantly greater in males (approximately 70%) compared to females (30%) (Table 2).

Based on the findings, IRMI was different in different age groups in the studied area and a statistically significant increase was observed in the incidence of MI in cases aged 45 years and older ($P<0.0001$). It should be noted that, 92% of all hospitalized patients aged 45 years and older, while only 8% of them were younger than 45 years. Moreover, 30.1% of MI incidence occurred in the 45-59 years age group; however, the highest IRMI was observed at persons aged 80 years and older ($n=3268$; 95% CI: 2997-3558 per 100,000 persons). It was also revealed that the mean±SD LOS increased with age. It was increased by 61% from 90.9 ± 77.1 h in the 0-4 years age group to 146 ± 223.4 h in the over 80 age group. The lowest IRMI was observed at 0-4 and 05-14 years age groups with 5 cases per 100,000 persons (Table 3).

The trend of IRMI had an ascending order across all regions during 2014-2019. It is worth mentioning that Abhar, Khodabandeh, and Khorramdareh counties of Znanj province, Iran, experienced a greater increase of MI incidence from 16 to 108 cases (580%), from 22 to 143 cases (650%), and from 28 to 122 cases (335%), respectively during the study period (Figure 1-a). The incidence of MI increased among both males and females in most areas during 2014-2019 (Figure 1-a). The highest RIMI was observed at age 80 and over in Khorramdareh County (5.3~5 cases overall, 6.3~6 cases in males, and 4.1~4 cases in females per 100 people). The lowest IRMI was observed at 0-4, 5-14, and 15-29 years age groups which were different from 0 to 0.1 case per 100,000 people across different regions (Figure 1-b).

The mean LOS decreased in all counties of Zanjan province of Iran except in Ijrood County which showed an increase from 75 h in 2014 to 117 h in 2019 (Figure 1-c).

Figure 2 presents the probability of MI across different age groups based on gender and geographical location of patients who were admitted at ZUMS hospitals in Zanjan province, Iran. It shows that the probability of MI incidence was directly correlated with increases in the age in both males and females; however, it was higher in males compared to females. The 70-79 years age group was defined as the high-risk age group for MI incidence at both genders in the studies areas. The highest probability of MI incidence was observed in the southeast of Zanjan province, Iran (Figure 2).

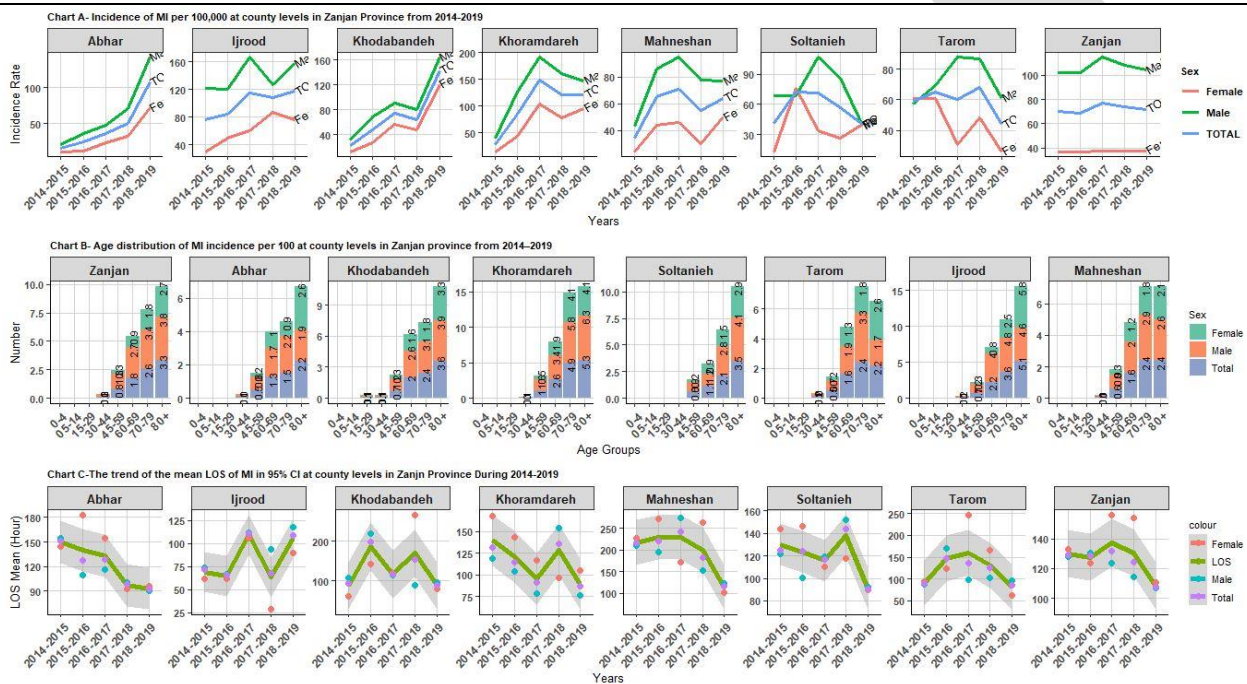


Figure 1. Incidence rate, age distribution, and the mean LOS of MI at county levels in Zanjan province, Iran during 2014-2019

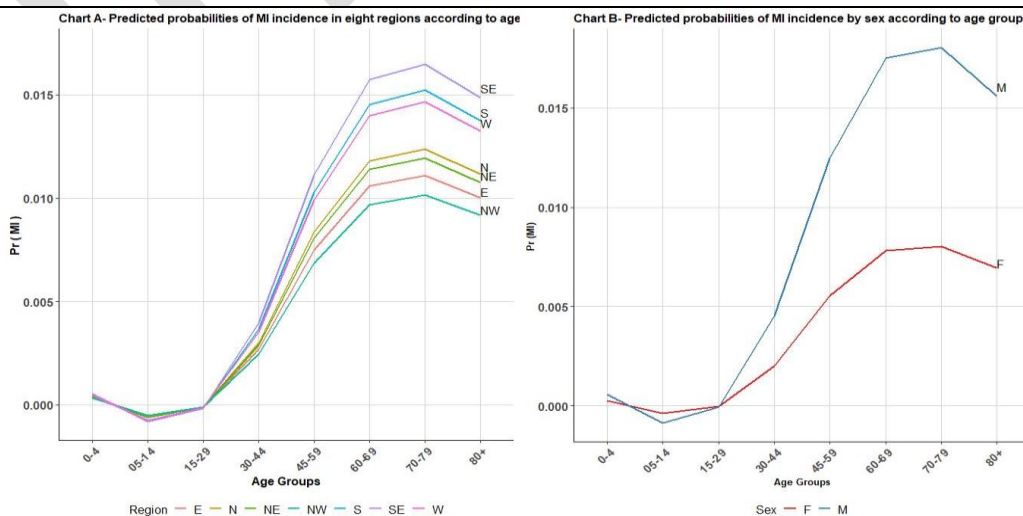


Figure 2. Probability of MI incidence across different age groups based on gender and geographical location of patients in Zanjan province, Iran Abbreviations of Figure 2: E: East, N: North, NE: Northeast, NW: Northwest, S: South, SE: Southeast, W: West, F: Female, M: Male, Pr: Probability.

5. Discussion

To the best of the authors' knowledge, this was the first study conducted to examine the incidence rate, age-specific, and regional distribution of MI in Zanjan province, Iran. CVD and MI are the first causes of mortality in Iran and Zanjan province of Iran and are a great burden on patients' families and the health sector. It should be noted that early diagnosis of MI is very important for the timely implementation of a lifesaving treatment since the risk of death increases from 3% to 5% per half hour after the onset of MI (15-16). Moreover, upon the patients' arrival to the hospital, early and immediate treatment is necessary to reduce the extent of myocardial damage and the probability of death (15). Therefore, the necessity of conducting this research is quite clear due to the high prevalence of MI in Iran and the lack of financial, equipment, and human resources. The result of this study can help health authorities and policymakers to determine the high-risk groups and areas. It is a crucial step to prioritize resource allocation and applied prevention programs to reduce IRMI.

The overall incidence rate of MI was 348 cases (95% CI: 337-359) per 1,000,000 people in the studied area during 2014-2019, and the highest IRMI was 90 cases per 100,000 person-year in 2019. In contrast, the result of the study conducted by Ahmadi revealed that IRMI was 40 cases per 100,000 person-year in 2012 in Zanjan province, Iran. The IRMI ranged from 39 to 108 cases per 100,000 person-year in provinces neighboring Zanjan province. The IRMI was 108, 38, 97, and 96 cases in Ardabil (the north) (17), Tabriz (the west) (18), Qazvin (the east) (19), and Gilan (the northeast) provinces (6) per 100,000 person-year, respectively. It is worth mentioning that the IRMI was higher in Kerman, North Khorasan, Semnan (3), and Yazd provinces (20) from the those obtained in the present study (149, 152, 132, and 783 cases per 100,000 person-year, respectively).

The IRMI was higher in Zanjan province compared to the average IRMI in the country (90 cases versus 73.3 cases per 100,000 person-year) (3), and higher than average IRMI in developed countries, such as Japan (21) and United States (22). The IRMI in 20 states of the United States was reported between 22.2 and 39.7 cases per 100,000 person-year at age 35 years (23) which was consistent with the results of the present study. Based on the results of the study conducted by Havulinna in Finland, IRMI was reported to be 738.8 and 292.9 cases in males and females respectively, per 100,000 person-year at the age range of 35 to 84 years, which was higher compared to the obtained results in the present study (8).

Previous studies have reported that the incidence of MI can vary across different geographical areas based on the established risk factors,

environmental factors, and socio-economic backgrounds (1,10,18,20). This result was consistent with those of the present study; although, further studies are needed to determine the main risk factors of MI in the studied area. The current study only reported the incidence rate, age-specific, and regional distributions of MI in Zanjan province, Iran, during 2014-2019. However, the IRMI was not homogenous among different regions of Zanjan province, Iran. The highest incidence rate of MI was observed in Khorramdareh County (the southeast) with 505 cases (95% CI: 453-561) per 100,000 persons and the lowest incidence rate was observed in Abhar County (the southeast) with 239 cases (95% CI: 215-265) per 100,000 people.

The incidence of MI increased by 84% from 49 cases (95% CI: 45-54) per 100,000 person-year in 2014 to 90 cases (95% CI: 85-96) per 100,000 person-year in 2019 in Zanjan province, Iran. Previous studies reported an ascending trend in patients with MI and a descending trend in LOS in hospitals in Iran between the years 1992 and 2004 (3,24), which was consistent with the results of studies performed in developing countries and those of the present study as well. However, a steady decreasing trend in the number of MI patients was observed in developed countries including Japan (21), Korea (25), European countries (26), and the United States (22) in recent years. Part of this reduction can be attributed to the implementation of global prevention programs, the use of effective drugs, and timely CVD interventions. National-scale studies in Europe and cross-sectional studies in the United States showed a concurrent statistically significant reduction in MI incidence along with smoking cessation (27). In addition, hospitalization rates declined from 1999 to 2008 in Taiwan due to the control of risk factors by medical and educational systems with an emphasis on MI prevention (4).

The incidence of MI was more prevalent in males compared to females in Iran (3). The ratio of MI incidence was 70:72 to 28:30 in males compared to females in Iran, which was consistent with the results of the present study (3,28). The ratio of MI incidence in males and females was 70 to 30, 78 to 22, 73 to 28, 65.5 to 34.5, 70 to 30, and 56 to 44 in Japan (21), Korea (25), the United State (23), Taiwan (4), Switzerland (29), and Oman, respectively (30). These data showed a high incidence rate of MI in males, compared to females in the world which was consistent with the results of the current study.

The mean±SD age of patients was estimated at 64.65±14.1 in this study, which was consistent with the reported mean age of MI in Iran (58-64 years) (24). The mean age at MI incidence was significantly different in different provinces of Iran (6). According to the study conducted by Ahmadi in 2015, the lowest mean age of MI was observed at Semnan (59.1 years),

Tehran (60.4 years), and Lorestan (60.1 years) provinces of Iran which were lower than those obtained in the current study (6). The mean age of MI patients in the present study was lower than those reported in Taiwan (75.13 years) (4), Massachusetts (69.14 years), Switzerland (67.6 years) (29), Japan (66 years) (21), and Korea (65 years) (25). According to the reports provided for acute coronary events, the mean age of MI was obtained at 55 years in 65 hospitals in six Arab countries (Yemen, Oman, Bahrain, Kuwait, Qatar, and the United Arab Emirates) (31), which was lower than that in the present study. Variation of mean age at different studies might be due to differences in the study population, life expectancy, lifestyle, and environmental or geographical risk factors.

The difference in MI incidence distribution was statistically significant among various age groups ($P < 0.0001$). The incidence of MI had significantly increased after age 45 and 30.11% of patients were in the 45-59 years age group, while only 8% of patients were in the 0-44 years age group. The highest incidence rate of MI was observed at patients aged 80 years and older with 3,268 cases (95% CI: 2997-3558) per 100,000 persons. Various studies reported a prevalence rate of 5 to 15% for MI incidence at an early age in Iran (3,24). In the same line, only 10% of MI patients were younger than 45 years in the United States (23) which was consistent with the results of this study. In contrast, IRMI is very common in adults (45 years and older) and aging is an important factor in MI incidence (32). However, future studies should identify age-related risk factors and their potential role in the development of MI to determine public health interventions in high-risk groups, including adults.

The result of this study showed that the probability of MI incidence was higher at the age range of 70-79 years in males at the southeast of the studied area, while the results of the age-specific analysis showed that IRMI was higher in individuals aged 80 and older at Zanjan province, Iran. These discrepancies might be due to the fact that the binary logistic regression method adopted in the present study was conducted on data collected from patients who were admitted at ZUMS hospitals during 2014-2019. However, the same results might have been obtained if the binary logistic regression method was conducted on the whole population of Zanjan province, Iran.

There are some conflicting reports on the effects of residential area factors on IRMI. Although, the results of some studies showed that there was no statistically significant difference between urban and rural areas (20), a direct and strong correlation was observed between IRMI and the socio-economic status of MI patients (33-34). The results of a study conducted by Donyavi in Iran showed that IRMI was much lower in the areas with high socioeconomic status (35). Therefore, socio-cultural differences,

behavioral and lifestyle differences, and various environmental and geographical risk factors can play an important role in IRMI in communities.

Based on the evidence, MI is a major public health challenge in the world and Iran, including Zanjan province, Iran. Many factors can affect the development of CVD. The most common risk factors for the incidence of MI include hypertension (52.3%), smoking (31.3%), dyslipidemia (28.0%), and family history of coronary heart disease (28.0%) (14,36). However, efforts to change diets, physical activity patterns and other aspects of lifestyle, consumption of fruits, vegetables, nuts, legumes, whole grains, and healthy oils, and avoidance of smoking are commonly recommended approaches to reduce the MI risk.

6. Conclusion

This study provides an overview of the current status of MI incidence in Zanjan province, Iran. MI is a major public health problem in Zanjan province, Iran. A high prevalence of MI was observed in the study area during 2014-2019, which was higher in males aged 45 years and older. Based on the results in this study, males and patients residing in the southeast of Zanjan province, Iran, had the highest chance of developing MI among patients who were admitted at ZUMS hospitals. It is a warning to health authorities and policymakers to identify the major risk factors and determine the possible causes of MI incidence in these areas and groups. Eventually, it should be noted that MI is one of the most important cardiovascular diseases leading to death. World Health Organization has set a target to achieve a 25% global reduction in cardiovascular mortality rate by the year 2025, adopting the slogan "25 by 25". Therefore, the results of this study can help health authorities and policymakers to prioritize the allocation of health resources and applied prevention programs to high-risk groups and areas to reduce the incidence of MI in Zanjan province, Iran.

Regarding the limitations of the present study, one can refer to the fact that information of the MI patients in this study was restricted to those patients hospitalized in Zanjan University of Medical Sciences hospitals from 2014 to 2019. However, this study did not include the information of MI patients hospitalized at two social security administration hospitals; therefore, the study population may not represent all MI patients in Zanjan province, Iran. Moreover, the IRMI has been calculated using Iran's national census that is gathered every five years in Iran. Therefore, only census data of 2011 and 2016 was utilized in this study due to the lack of annual population census.

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Footnotes

Ethical Approval: The study protocol was approved by the Ethics Committee of ZUMS (IR.ZUMS.REC.1398.056).

Consent for Publication: Not applicable.

Availability of Data and Material: The datasets are available with the corresponding author upon reasonable request.

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Authors Contributions: M.S designed the study, drafted the manuscript, conducted the statistical analysis, and was the project leader. M.S. and A.J. acquired the data from hospitals. M.S and R.S conducted the literature review. K.K, A.J, and R.S revised the manuscript critically and offered the relevant suggestions to improve the manuscript quality. All authors contributed to the preparation of the final version of the manuscript and approved it.

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