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: **2012**

ABSTRACT Population-based data on myocardial infarction rates in the Islamic Republic of Iran have not been reported on a national or provincial scale. In a cross-sectional study, data were collected on 20 750 new cases of myocardial infarction (ICD10 codes I21–22) admitted to hospitals and registered by the Iranian Myocardial Infarction Registry in 2012. The crude and age-adjusted incidence for the 31 provinces and the whole country were directly calculated per 100 000 people using the WHO standard population. Overall, males comprised 72.4% of cases and had a significantly lower mean age at incidence than women [59.6 (SD 13.3) years versus 65.4 (SD 12.6) years]. The male:female incidence ratio was 2.63. The age-standardized myocardial infarction incidence rate was 73.3 per 100 000 in the whole country (95% CI: 72.3%–74.3%) and varied significantly from 24.5 to 152.5 per 100 000 across the 31 provinces. The study provides baseline data for monitoring and managing cardiovascular diseases in the country.

Incidence de l'infarctus aigu du myocarde en République islamique d'Iran : étude à partir des données du registre national en 2012

RÉSUMÉ Les données en population sur les taux d'infarctus du myocarde en République islamique d'Iran n'ont pas été rapportées à l'échelle régionale ou nationale. Dans une étude transversale, des données ont été recueillies sur 20 750 nouveaux cas d'infarctus du myocarde (CIM-10 codes I21–22) admis dans des établissements hospitaliers et enregistrés dans le Registre iranien des infarctus du myocarde en 2012. L'incidence brute et l'incidence ajustée pour l'âge dans les 31 provinces et l'ensemble du pays ont été directement calculées pour 100 000 personnes à l'aide de la population type de l'OMS. Globalement, les hommes représentaient 72,4 % des cas et étaient nettement moins âgés en moyenne à l'incidence que les femmes (59,6 ans [ET 13,3 ans] contre 65,4 ans [ET 12,6 ans]). Le rapport d'incidence homme-femme était de 2,63. Le taux d'incidence standardisé en fonction de l'âge pour l'infarctus du myocarde était de 73,3 pour 100 000 dans l'ensemble du pays (IC à 95 % : 72,3 %–74,3 %) et variait significativement, de 24,5 à 152,5 pour 100 000, entre les 31 provinces. L'étude fournit des données initiales pour le suivi et la prise en charge des maladies cardio-vasculaires dans le pays.

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Received: 22/03/14; accepted: 08/09/14

Introduction

Despite decreases in mortality rates due to cardiovascular diseases in most developed countries, these diseases have become the most important health problem and cause of mortality in many developing countries worldwide, including the Islamic Republic of Iran (1,2). Although cardiovascular diseases were previously of greatest concern to high-income countries

(3), the age-adjusted incidence of these diseases has recently declined in these countries. Coronary heart disease is also on the rise in low- and moderate income countries (4) due to increases in life expectancy and changes in urbanization and lifestyle that have increased the prevalence of cardiovascular disease risk factors (5–7).

Cardiovascular diseases are generally manifested by myocardial infarction, and the World Health Organization (WHO) has suggested that myocardial infarction rates can be used as a proxy for cardiovascular disease rates in epidemiological studies (8). Comparison of rates of myocardial infarction in different geographical areas and communities within a country reveal important information that can be applied in evidence-based decision-making, research, prioritization and health systems planning in order to better identify myocardial infarction etiology and risk factors and to assess cardiovascular disease prevention approaches (9–11).

Reliable data to determine myocardial infarction rates are rare in developing countries. In the Islamic Republic of Iran, for example, the data required to assess myocardial infarction incidence have been mainly based on a limited number of hospitals and limited studies on small populations (12–14). According to a report by the Iranian Ministry of Health and Medical Education in 2012, cardiovascular diseases overall comprised 39% of the causes of death, and the mortality rate due to myocardial infarction was 85 per 100 000 (6). To date, no adequate estimate of myocardial infarction incidence has been reported for the whole country or in all the regions. In view of this, and reports of the varying distribution of cardiovascular disease risk factors across the different provinces (15,16), the present study was conducted to determine the incidence rate of myocardial infarction at the national and provincial level in the Islamic Republic of Iran.

Methods

Study setting

The Iranian Myocardial Infarction Registry was set up in 2009 by the Office of Cardiovascular Diseases of the Iranian Ministry of Health and Medical Education. At the end of 2011, the coverage of the Registry was complete and was usable across the whole country (6,17). The Registry covers all hospitals that are equipped with a coronary care unit in 31 provinces of the country.

Data collection

In a cross-sectional study, data were collected on 20 750 new cases of myocardial infarction recorded by the Registry in 2012. Inclusion criteria were based on the WHO and World Heart Federation definition of myocardial infarction diagnosis as per the International Classification of Diseases (ICD10) codes I21 and I22 (8). Patients with myocardial infarction history or no

definite diagnosis by the cardiologist were excluded from the study. The data collected included patients' age, sex and province of residence. The ethics committee of Shahid Beheshti University of Medical Sciences approved this study.

Data analysis

Crude incidence rates were calculated for each province and the whole country per 100 000 people for different age groups. To estimate the population denominator for the incidence, the data of the population census from the Statistical Center of Iran in 2011 were used. To adjust the rates, we used the direct standardization method and the WHO standard population (18). All continuous values were reported as means and standard deviation (SD) and categorical variables as percentages. The t-test and analysis of variance were employed to compare differences in means of continuous variables between 2 groups and among more than 2 groups. The data were analysed by Stata software, version 12. P-values

Results

Of 20 750 new cases of myocardial infarction, 15 033 (72.4%) were in males and 5717 (27.6%) in females. The male:female incidence ratio was 2.63.

Age at myocardial infarction

The mean age at myocardial infarction was 61.2 (SD 13.4) years in the whole population. The mean age in men [59.6 (SD 13.3) years] was significantly lower compared with women [65.4 (SD 12.6) years] (P = 0.001).

The mean age in different provinces by sex is shown in Table 1 . The mean age at myocardial infarction varied significantly across different provinces (P = 0.001). The lowest mean age was recorded in patients residing in Semnan province [59.1 (SD 21.9) years], followed by Tehran [60.4 (SD 13.5) years] and Lorestan [60.1 (SD 14.5) years], and these mean ages were significantly different from those in Ardabil [63.2 (SD 15.1) years] (P = 0.042). The highest mean age was in Zanjan province [64.4 (SD 12.8) years] and this was higher than in Sistan and Baluchistan [60.3 (SD 13.9) years] (P = 0.019). The mean age of men was not significantly different across the provinces. For women, the highest mean age was in Ardabil [68.4 (SD 15.0) years] and this was significantly different from the lowest age, in Hamadan [62.1 (SD 12.9) years] (P = 0.001).

Myocardial infarction incidence rate

Crude and age-standardized myocardial infarction incidence rates in the country's provinces are shown in Table 2 . The crude myocardial infarction incidence rate was 64.9 per 100 000 in the whole country. The highest crude myocardial infarction incidence rate was in North Khorasan at

126.7 per 100 000 people, followed by Yazd, Semnan, Kerman, West Azarbaijan, and Khouzestan (121.7, 119.5, 118, 108.2 and 108.1 per 100 000 respectively).

After adjustment, the crude myocardial infarction incidence rate in the whole country increased to 73.3 per 100 000 (95% CI: 72.3%–74.3%). After standardization, the highest myocardial infarction incidence was in North Khorasan (152.5 per 100 000), followed by Kerman, Khouzestan, Yazd, Semnan and West Azarbaijan (149.2, 143.7, 141.3, 132.5 and 130.8 per 100 000 respectively), and the lowest incidence was in Qom [24.5 per 100 000 (95% CI: 19.6%–29.9%)].

Figure 1 illustrates the geographical distribution of myocardial infarction incidence in the different provinces of the country.

Discussion

This is the first report on the hospital-based age-standardized incidence of myocardial infarction in the Islamic Republic of Iran. Our study showed that the incidence rate of myocardial infarction was higher than the mean national rate in more than half of the provinces. These provincial disparities in myocardial infarction incidence rates mirror a national study on noncommunicable diseases risk factors in the Islamic Republic of Iran that mapped the differences in the prevalence of cardiovascular disease risk factors across the country's provinces (19,20). The wide difference in myocardial infarction incidence rates—ranging from 24.5 per 100 000 in Qom to 152.5 per 100 000 in North Khorasan—could be due to different genetic or environmental factors, disparities in disease risk factors and different socioeconomic status distribution across the provinces as well as to varying coverage in local myocardial infarction registries (8,12,20). This needs further investigation in future studies. The especially low incidence in Qom could also be explained by inadequate registration of myocardial infarctions, and this too should be addressed in subsequent studies to obtain a more accurate estimate of myocardial infarction in this province.

In literature searches we found no studies using similar data on myocardial infarction incidence rates from the Islamic Republic of Iran. The mortality rate due to myocardial infarction has been reported as 85 per 100 000 in the Islamic Republic of Iran (6). In our study, the age-adjusted incidence of recorded cases of myocardial infarction was lower at 73.3 per 100 000. Potential reasons for this inconsistency are differences in measures, defective registration of the causes of death and cardiac arrest and/or registration of myocardial infarction instead of the correct cause of death (21,22). It should also be noted that myocardial infarction cases who died at home or outside hospital were not included in the records of myocardial infarction in our study. In the Islamic Republic of Iran the mortality rate due to acute myocardial infarction before arrival

at hospital has been reported to be 20% (23). About 20% of first myocardial infarctions were detected only on death certificates (24) and, in view of this, the estimated incidence rate of myocardial infarction in our study can be revised up to 87.9 per 100 000 people. In other words, approximately 4150 myocardial infarction cases were estimated to die before arriving in hospital. This indicates that, despite the failure to register some cases of myocardial infarction outside hospital, a low number of deaths due to myocardial infarction are estimated to be registered in the Islamic Republic of Iran and therefore our findings based on myocardial infarction cases registered in hospital seem reasonable.

The standardized incidence rate of myocardial infarction in this study is high compared with a 30-year study in Japan that reported myocardial infarction incidence rates of 7.4 and 27 per 100 000 in 1979 and 2008 respectively (25). Our results are also higher compared with age-adjusted, standardized mortality rates due to myocardial infarction in Korea in 2003 and 2007 at 30.86 and 28.5 per 100 000 respectively (26). However, the incidence rate was lower compared with a study in Finland reporting myocardial infarction incidence rates in men and women of 738.8 and 292.9 per 100 000 individuals respectively in a population of 35- to 84-year-olds (9). The rate was also lower compared with other parts of the WHO Eastern Mediterranean Region; in Kuwait the myocardial infarction incidence rate was reported to be 130.1 per 100 000 patients admitted to hospitals (27). The Gulf Registry of Acute Coronary Events reported that the highest acute coronary syndrome incidence rate in Arab countries was in Oman, where the crude and standardized incidences of myocardial infarction with ST-elevation myocardial infarction were 92.8 and 184.9 per 100 000 respectively (28). The rate of myocardial infarction we found in the Islamic Republic of Iran is lower than in Oman. Since a population-based myocardial infarction incidence rate has not been yet reported from Arab countries, and in view of the mortality rate due to acute coronary syndrome in Yemen (10%), Oman (9.6%) and other Arab countries (3.3%), the myocardial infarction incidence rate seems to be higher in the Islamic Republic of Iran than in Arab countries (except for Oman, Kuwait and Yemen) (27–29).

The incidence rate of coronary heart disease in developed countries has been reported to range from 200–500 per 100 000 in men and 60–150 per 100 000 in women (30). In one study in the United Kingdom the incidence rate of acute myocardial infarction was 0.48 per 100 000 and the rate of all coronary events was 91 per 100 000. Our rate of myocardial infarction was higher compared with that study, but lower in comparison with all coronary events (30).

The age of male and female patients (59.6 and 65.4 years respectively) and the total population (61.2 years) in our study in the Islamic Republic of Iran was lower compared with studies in Japan (25), Puerto Rico (31) and The Netherlands (10), which reported the mean ages of myocardial infarction patients as 66, 67 and 75 years respectively. On the other hand, the mean age of incidence in our study was higher compared with a study in India (57.5 years) (7). In

Kuwait, 87% of myocardial infarction patients were male and the mean age was reported to be 55 years (27), which is lower than in our study. According to registries of acute coronary events in 65 hospitals in 6 Arab countries (Yemen, Oman, Bahrain, Kuwait, Qatar and the United Arab Emirates), the mean age at incidence was 55 years (29). Our study indicates that mean age at incidence of myocardial infarction is higher in the Islamic Republic of Iran than in these Arab countries (except for Yemen, with a mean age at incidence of 61 years). The difference in mean age across different studies could be attributed to different population age distributions, differences in life expectancies and lifestyles and variations in distribution of and coping with cardiovascular disease risk factors.

In the present study, the majority of the patients were male and the male:female incidence ratio was 2.63. This ratio is similar to studies in other countries (9,27–29,32); for example, in Finland the male:female ratio was reported to be 2.52 (9). The sex ratio in the Islamic Republic of Iran was similar to that reported by the Gulf Registry of Acute Coronary Events, in which 76% of the patients were male (29).

Although the quality of hospital registry of myocardial infarction data in the Islamic Republic of Iran has been reported as acceptable (33), failure to register myocardial infarction cases who die outside hospital and/or at home was one of the limitations of the present study. We recommend that this is addressed in future research, accompanied by periodical assessments of the myocardial infarctions registry in order to determine the accuracy of the registered cases until the registry of data of myocardial infarctions becomes consistent in the country. Among the strengths of this study were that it was hospital-based, it included all the provinces of the country (based on formal provincial borders), it estimated the incidence using population denominators from the Statistical Center of Iran, as per WHO standards, it used a definite diagnosis by a cardiologist, and it was the first study on the incidence of myocardial infarction in the whole country.

Conclusion

Reports of age-adjusted incidence rates of myocardial infarction in developing countries, particularly by province or state, are rare. Without such an index, planners of health systems inevitably use alternative indices such as mortality. We report for the first time the myocardial infarction incidence rates of hospitalized patients at provincial level in the Islamic Republic of Iran. The standardized incidence rate of myocardial infarction in the whole country (73.3 per 100 000) was higher than in some Arab countries of the Eastern Mediterranean Region (except for Oman, Kuwait and Yemen). The mean age of myocardial infarction in men was significantly lower than in women. As myocardial infarction is the principal cause of death in the community, estimates of myocardial infarction incidence rate by province are valuable in health policy-making, resource allocation and prioritization and prevention and control of cardiovascular diseases. This study has paved the way for planning for and reducing disparities

among the provinces, and monitoring and managing myocardial infarctions at the micro- and macro level in the Islamic Republic of Iran. The myocardial infarction cases who died at home or outside hospital were not included in our estimates of myocardial infarction incidence. It is recommended that the Iranian Myocardial Infarction Registry officials put in place a system for registering outside-hospital deaths in order to derive the actual myocardial infarction incidence rate in our country.

Acknowledgements

We gratefully thank the personnel of the Cardiology Office (Dr Hozhabri and Mr Babrian), the personnel of the treatment deputies of the universities of medical sciences, the nurses and cardiologists in hospital coronary care units across the Islamic Republic of Iran and the officials and advisors of the Iranian Myocardial Infarction Registry Programme, particularly Dr Seyyed-Saeed Hashemi-Nazari.

Funding: This work was approved by the Management Centre of Non-Communicable Diseases and Office of Cardiovascular Diseases Prevention of the Iranian Ministry of Health and Medical Education (approval no. 305/837) and was part of a PhD thesis in Epidemiology by Ali Ahmadi at Shahid Beheshti University of Medical Sciences.

Competing interests: None declared.

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