www.nclinmed.com
Novelty in Clinical Medicine. 2022; 1(1): 38-43
https://doi.org/10.22034/NCM.2022.140807

Research Article Open Access

Estimating the attributable mortality of modifying selected risk factors for myocardial infarction

Taher Ahangari [1*], **Kamran Ebrahimi** [1], **Shaker Salari Lak** [2]

[1] Department of Epidemiology, Urmia University of Medical Sciences, Urmia, Iran
[2] Department of Public Health, Islamic Azad University, Tabriz Branch, Tabriz, Iran

[*] **Corresponding author:** Taher Ahangari. Epidemiology, Urmia University of Medical Sciences, Urmia, Iran
Email: ahangari.taher@gmail.com

Received: 25 November 2021 **Revised:** 30 November 2021 **Accepted:** 28 December 2021 **e-Published:** 1 January 2022

Abstract

Background: Cardiovascular diseases are the leading cause of death due to non-communicable diseases, and myocardial infarction (MI) is one of the most common causes of death due to cardiovascular diseases worldwide.

Objectives: This study aimed to estimate the attributable mortality of certain modifying risk factors for MI in West Azerbaijan province, Iran.

Methods: The study used data from the national study of risk factors for non-communicable diseases to estimate the population attributable fraction and number of attributable deaths. Effect sizes of risk factors for MI were calculated from international cohort studies, and data on deaths due to MI by sex categories were obtained from the death registration system of West Azerbaijan province, Iran.

Results: The most significant population-attributable fraction of modifying risk factors in men was smoking (33.2%) and high blood glucose (27.8%), and in women it was high blood glucose (23.3%) and overweight and obesity (22.2%). The most prevalent cause of death due to MI in men was attributed to smoking (895 cases), and in women, it was attributed to high blood glucose (525 cases).

Conclusions: The current findings, with an emphasis on proper planning and prioritization of available resources to modify risk factors such as smoking and high blood glucose, could have a significant effect on reducing mortality from MI in West Azerbaijan province, Iran.

Keywords: Population attributable fraction, Mortality attributable, Modifying risk factors, Myocardial infarction.

Introduction

Myocardial infarction (MI) is one of the main and best-known causes of disease burden in developed and developing countries.[1] More than 20% of Iranian people over 30 years old have some signs or symptoms of cardiovascular disease, and more than 70% of them have at least one cardiovascular risk factor.[2–4] Currently, the multifaceted basis of cardiovascular disease prevention is based on the principles of identifying and controlling modifiable cardiovascular risk factors such as smoking, hyperlipidemia, hypertension, high blood glucose, overweight, and obesity. Due to limited resources for the management of cardiovascular disease in low- and middle-income countries, it is important to develop and implement cost-effective preventive programs.[5,6]

Deciding on the type of population-based interventions and prevention strategies requires access to evidence-based information. Population Attributable Fraction (PAF) is one of the important epidemiological indicators in public health that measures the effects of risk factors contributing to public health and assesses the potential impact of preventive interventions on community health.[7,8] The PAF is a proportion of disease or death incidence in the population that is attributed to a specific risk factor and can be potentially prevented if exposure to the risk factor is eliminated. The PAF index, especially in studies addressing the role of several risk factors in the development of a disease, shows the role of eliminating the

most effective risk factor in reducing disease and death.[9]

Although numerous global studies have been conducted to estimate the Population Attributable Fraction (PAF) for risk factors for cardiovascular disease, knowledge of the risk factors for these diseases is derived from the situation in developed countries, and the impact of these factors on cardiovascular risk in most parts of the world, especially in developing countries, is unknown. Due to the difference in the prevalence of risk factors in different populations, an important risk factor in one community, due to its low prevalence in other communities, may account for a low PAF. Therefore, PAF estimates for a community cannot be generalized to other communities, and PAF should be calculated for each population.[10-13]

Objectives

The aim of this study was to examine the modifiable risk factors for cardiovascular disease, including hypertension, high blood glucose, smoking, overweight, and obesity, with the aim of calculating the population attributable fraction (PAF) of myocardial infarction risk factors in West Azerbaijan province, Iran.

Methods

The study was performed on the preventable risk factors for myocardial infarction (MI) using the comparative risk assessment method in the community. Considering the possibility of accessing data related to exposure and effect size, the selected risk factors for analysis were:

Smoking: daily consumption of any tobacco substance (cigarettes, pipes, or hookahs)

Hypertension: The mean systolic/diastolic blood pressure is equal to or above 140/90 as a result of two measurements at intervals of 5 minutes or the use of antihypertensive drugs according to national guidelines.

High blood glucose: fasting blood glucose (FBS) equal to or higher than 126 mg/dL or taking medication

Overweight and obesity: Body Mass Index (BMI) is equal to or more than 25 kg/m2.

In the analysis by comparative risk assessment, the number of deaths that can be prevented is estimated. The number of deaths is reduced if the risk factor is eliminated or the previous exposure to the risk factor is decreased.

Requirements for data analysis include:

Prevalence of risk factors

The prevalence of risk factors is determined using data from the 2016 national study of Iran's noncommunicable diseases care system (NCD risk factors surveillance system) and considering World Health Organization (WHO) recommendations to obtain valid and comparable data. The study of non-communicable disease risk factors was performed to determine the level of major preventable risk factors and the trend of major preventable risk factors for non-communicable diseases by age and sex groups.

Etiological effects of risk factors

In this study, the effect size for each pair, including a risk factor and a disease, was extracted from previous studies. The effect size for smoking was derived from a study by Katanoda et al.,[14] which involved 296,000 participants in Japan. To estimate the effect size of hypertension, the study of Spanloo et al.,[15] which involved 50,000 participants, was considered. The effect size of high blood glucose was estimated using the study by Woodward et al.,[16] in the Asia-Pacific region, which involved 161,000 participants. The effect size of BMI was measured using the study by Chen et al.,[17] in Asia, which involved 835,000 participants in East Asia and 289,000 people in South Asia.

Death from disease

Data on the number of deaths by age, sex, and underlying cause were obtained from the death registration system. The number of deaths due to myocardial infarction (ICD10 code: I20-I25) in 2012 and 2013 in West Azerbaijan province was included in the study, according to the International Classification of Diseases 10th Revision.

Risk factors for death

For each disease with a causal relationship with that risk factor, a reduction in the number of deaths by disease is calculated to completely eliminate exposure to the risk factor.[18] In this method, the population-attributable fraction was calculated using the following formula:

$$PAF = \frac{P_e(RR-1)}{P_e(RR-1)+1}$$

where RR is the effect size of the risk factor and Pe is the prevalence of the risk factor in the population.

Furthermore, the fatalities attributable to each risk factor

were estimated individually by gender using the formula: AM=PAF M, where M is the number of deaths attributable to a given cause and AM is the mortality attributable to the risk factor.

Sensitivity analysis for PAF

A sensitivity analysis was done utilizing the upper and lower limits of the effect size and prevalence of risk variables to determine the uncertainty in PAF and the number of fatalities attributed to risk factors owing to sampling variability.

In this study, the PAF and deaths attributed to the risk factors were calculated using Excel software

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval was obtained.

Results

According to the results of the study, in 2012 and 2013, 4948 deaths due to myocardial infarction (MI) were registered in the death registration system in West Azerbaijan province, Iran, for people 18 years old and older. Of these, 2696 cases (54.5%) were in men. The most population-attributable fraction (PAF) for death for the risk factors in men was smoking and high blood glucose, while in women, it was high blood glucose, overweight, and obesity. In men, the most deaths from MI were attributed to smoking, high blood glucose, hypertension, being overweight, and obesity, respectively. The highest attributed mortality rates were observed in women for high blood glucose, overweight, obesity, hypertension, and smoking, respectively. The greatest number of deaths due to MI was attributed to smoking (895 cases) in men, while the greatest number of deaths due to MI was attributed to high blood glucose (525 cases) in women. The most uncertainty in men's estimates for PAF and deaths was related to smoking, while in women's estimates, it was related to high blood glucose [Tables 1 and 2].

Table-1. Population attributed fraction (PAF) and mortality attributed to preventable risk factors for death from MI in men of West Azerbaijan province in 2012–2013

Risk factor	Risk ratio * (95% CI)	Prevalence § (95% CI)	PAF (%) (Uncertainty 95%)	Death (n)	Attributed death (95% uncertainty)
Smoking	2.81 (2.28-3.46)	5.12 (5.08-5.2)	8.5 (6.1-11.3)	2252	191 (137-254)
High blood glucose	4.38 (4.63-7.31)	8.99 (7.2-10.8)	23.3 (20.7-40.5)	2252	525 (466-912)
Overweight	1.38 (1.29-1.47)	74.94 (72.2-77.6)	22.2 (17.3-26.7)	2252	500 (390-601)
Hypertension	1.85 (1.6-2.14)	27.92 (25.1-30.7)	19.2 (13.1-25.9)	2252	432 (295-583)

* Risk ratio of the results of Katanoda et al.,[14] Woodward et al.,[16] Chen et al.,[17] and Spanlow et al.,[15]

§ Prevalence estimates from the results of the national study of the non-communicable diseases care system in 2016

Table-2. Population attributed fraction (PAF) and mortality attributed to preventable risk factors for death from MI in women of West Azerbaijan province in 2012-2013

Risk factor	Risk ratio * (95% CI)	Prevalence § (95% CI)	PAF (%) (Uncertainty 95%)	Death (n)	Attributed death (95% uncertainty)
Smoking	2 (1.65-2.42)	49.8 (46.7-52.9)	33.2 (23.3-42.9)	2696	895 (628-1157)
High blood glucose	4.38 (4.63-7.31)	11.43 (9.4-13.4)	27.8 (25.4-45.8)	2696	749 (685-1235)
Overweight	1.38 (1.29-1.47)	59.96 (56.9-62.9)	18.6 (14.2-22.8)	2696	501 (383-615)
Hypertension	1.85 (1.6-2.14)	26.82 (24.1-29.5)	18.6 (12.6-25.2)	2696	501 (340-679)

* Risk ratio of the results of Katanoda et al.,[14] Woodward et al.,[16] Chen et al.,[17] and Spanlow et al.,[15]

§ Prevalence estimates from the results of the national study of the non-communicable diseases care system in 2016

Discussion

The severity of the effect of risk factors can vary significantly in the population due to differences in prevalence. This study calculates the population-attributable fraction (PAF) of risk factors for myocardial infarction (MI) in West Azerbaijan province in 2012 and 2013. However, comparing the results of PAF studies has some limitations. The use of different computational methods can lead to major changes in the PAF.[19] Additionally, the use of different population groups in terms of age, sex, and ethnicity, entering a different set of risk factors into the calculations, and different definitions and cutting points for the variables make it difficult to compare the results of these studies. Furthermore, due to significant differences in the prevalence of risk factors in different communities, the calculation of PAF should be done using a representative sample of the target community. In this study, like in other studies, smoking, high blood glucose, hypertension, and overweight were examined as major modifiable risk factors for MI.

In the present study, smoking is the primary risk factor for death in patients with MI, accounting for 33.2% of deaths in men. The burden of smoking in women was less than in men due to the decrease in the prevalence of smoking in the women's community. A similar result by Khalili et al. in Tehran city showed that smoking, with a PAF of 7%, was the main risk factor for MI.[20] The WHO in 2005 announced smoking as a major risk factor for MI in 14 different regions of the world based on age and sex.[21] In 2010 in Japan, tobacco use with a risk of 36.8%,[22] in 2006 in the United States with a risk of 30.9%,[23] and in Iran with a risk of 13.6%,[24] were reported as the first and most important risk factor for cardiovascular risk.

In the present study, the first risk factor associated with MI in women was high blood glucose (23.3%). A similar finding was reported in previous studies. In a study by Mohammadi et al. in Yazd,[25] high blood glucose was the main risk factor for heart disease (PAF=12.3%). In another study by Danaei et al.,[26] diabetes and high blood glucose were reported as a very important cause of cardiovascular disease and death, and at least 53% of all cardiac deaths were attributed to diabetes. In a study by Moran et al.,[27] in the United States, diabetes (PAF=19.8%) was the number one risk factor for cardiovascular disease.

In the current study, overweight with a PAF of 22.2% was the second most common risk factor in women. A similar finding is reported in a study by Peter et al., where overweight with a PAF of 15% in women was the second leading risk factor for acute MI.[28] Additionally, another study by Wendy Brown et al.,[29] in the Australian female population found that physical inactivity in women aged 30 to 90 years old was a major risk factor for MI.

In addition, in the present study, hypertension in both genders is the third most important risk factor for MI. A study by Khalili et al.,[20] in Tehran in 2014 found that hypertension was the first risk factor for MI for women (17%) and men (9.7%). Another study by Medrano et al.,30 in 2007 in Spain suggested that hypertension, after smoking and diabetes, was an important risk factor for heart disease (PAF=8.9%).

This is the first study in the province of West Azerbaijan to estimate the risk of PAF and the number of deaths attributed to some modifiable risk factors for MI using the comparative risk assessment method. While it has some limitations, it is essential to consider that since a separate size effect for women and men has not been performed in the present study in calculating the PAF of risk factors for MI, the causation for generalizing current findings should be approached with caution.

Conclusions

The current findings demonstrate that some modifiable factors, such as hypertension, high blood glucose, smoking, being overweight, and obesity, are involved in the incidence of MI and related deaths. Therefore, it can be mentioned that planning to control these modifiable risk factors in West Azerbaijan province can reduce the number of deaths due to MI. Thus, by reducing the prevalence of smoking and high blood glucose in men and by reducing the prevalence of high blood glucose, overweight, and obesity in women, a significant number of deaths due to MI can be prevented.

Acknowledgment

The authors take this opportunity to thank the Non-Communicable Diseases Management Center of the Ministry

of Health and Medical Education for providing the data and the Vice Chancellor for Research and Technology of Urmia University of Medical Sciences and Health Services for the technical support.

Competing interests

The authors declare that they have no competing interests.

Abbreviations

Myocardial infarction: MI;

Population Attributable Fraction: PAF;

Fasting blood glucose: FBS;

Body Mass Index: BMI;

Non-communicable diseases care system: NCD;

World Health Organization: WHO;

International Classification of Diseases: ICD.

Authors' contributions

TA was responsible for the study concept and design. SSL, and KE led data collection. TA, and KE were responsible for the analysis and interpretation of data. TA wrote the first draft. KE and SSL provided comments on initial drafts and coordinated the final draft. All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

Funding

None.

Role of the funding source

None.

Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval was obtained.

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

References

1. White HD, Chew DP. Acute myocardial infarction. The Lancet. 2008;372(9638):570-84. doi: 10.1016/S0140-6736(08)61237-4 PMid:18707987
2. Khalili D, Mosavi-Jarrahi A, Eskandari F, Mousavi-Jarrahi Y, Hadaegh F, et al. Evaluation of cause of deaths' validity using outcome measures from a prospective, population-based cohort study in Tehran, Iran. PLoS One. 2012; 7: e31427 doi:10.1371/journal.pone.0031427 PMid:22355365 PMCid:PMC3280301
3. Hadaegh F, Harati H, Ghanbarian A, Azizi F. Prevalence of coronary heart disease among Tehran adults: Tehran Lipid and Glucose Study. East Mediterr Health J. 2009; 15: 157-166 doi:10.26719/2009.15.1.157 PMid:19469439
4. Azizi F, Rahmani M, Emami H, Mirmiran P, Hajipour R, Madjid M, et al. Cardiovascular risk factors in an Iranian urban population: Tehran lipid and glucose study (phase 1). Sozial-und präventivmedizin. 2002; 47: 408-426 doi:10.1007/s000380200008 PMid:12643001
5. Unal B, Capewell S, Critchley JA. Coronary heart disease policy models: a systematic review. BMC Public Health. 2006; 6:213. doi:10.1186/1471-2458-6-213 PMid:16919155 PMCid:PMC1560128
6. Yusuf S, Hawken T, Ounpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries. Lancet. 2004; 364: 937-52. doi:10.1016/S0140-6736(04)17018-9
7. Ruckinger S, Kries VR, Toschke MA. An illustration of and programs estimating attributable fractions in large scale surveys considering multiple risk factors. BMC. 2009; 9: 7-13. doi:10.1186/1471-2288-9-7 PMid:19166593 PMCid:PMC2636839
8. Qiu H, Yu IT. Making monogram to estimate the population attributable fraction. Zhonghua liuxingbingxue zazhi. 2008; 29: 75-7.
9. Rothman K, Greenland S. Modern epidemiology. Philadelphia: Lippincontt-Raven. 1998;
10. Peto R, Boreham J, Lopez AD, Thun M, Heath C. Mortality from tobacco in developed countries: indirect estimation from national vital statistics. Lancet. 1992; 339(8804):1268-78. doi:10.1016/0140-6736(92)91600-D
11. Ministry of Health and Medical Education. Blood pressure measurement guide. Tehran. 2011;(8-47).[Persian]
12. Ministry of Health and Medical Education. National program for prevention and control of diabetes type 2. Tehran, Sepid Barg. 2011;(1-3)
13. World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO Consultation. WHO Technical Report Series 894. Geneva 2000.
14. Katanoda K, Marugame T, Saika K, Satoh H, Tajima K, Suzuki T, et al. Population attributable fraction of mortality associated with tobacco smoking in Japan: a pooled analysis of three large-scale cohort studies. J Epidemiol. 2008; 18(6): 251-264. doi:10.2188/jea.JE2007429 PMid:19075498 PMCid:PMC4771610
15. Sepanlou S, Sharafkhah M, Poustchi H, Malekzadeh M, Etemadi A, Khademi H, et al. Hypertension and mortality in the Golestan Cohort Study: a prospective study of 50,000 adults in Iran. J Hum

Hypertens. 2016; 30(4): 260-7. doi:10.1038/jhh.2015.57 PMid:26063561
16. Woodward M, Zhang X, Barzi F, Pan W, Ueshima H, Rodgers A, et al. The effects of diabetes on the risks of major cardiovascular diseases and death in the Asia-Pacific region. Diabetes Care. 2003; 26(2): 360-6. doi:10.2337/diacare.26.2.360 PMid:12547863
17. Chen Y, Copeland WK, Vedanthan R, Grant E, Lee JE, Gu D, et al. Association between body mass index and cardiovascular disease mortality in east Asians and south Asians: pooled analysis of prospective data from the Asia Cohort Consortium. BMJ. 2013; 347: f5446. doi:10.1136/bmj.f5446 PMid:24473060 MCid:PMC3788174
18. Rockhill B, Newman B, Weinberg C. Use and misuse of population attributable fractions. Am J Public Health. 1998; 88 (1):15-9 doi:10.2105/AJPH.88.1.15 PMid:9584027 PMCid:PMC1508384
19. Mason CA, Tu S. Partitioning the population attributable fraction for a sequential chain of effects. Epidemiol Perspect Innov. 2008;5:5-22 doi:10.1186/1742-5573-5-5 PMid:18831748 PMCid:PMC2572052
20. Khalili D, Haj Sheikholeslami F, Bakhtiyari M, Azizi F, Momenan AA, Hadaegh F. The incidence of coronary heart disease and the population attributable fraction of its risk factors in Tehran: a 10-year population-based cohort study. PloS one. 2014;9(8):e105804. doi:10.1371/journal.pone.0105804 PMid:25162590 PMCid:PMC4146560
21. Ezzati M, Henley SJ, Thun MJ, Lopez AD. Role of smoking in global and regional cardiovascular mortality. Circulation. 2005; 112(4): 489-97 doi:10.1161/CIRCULATIONAHA.104.521708 PMid:16027251
22. Takashima N, Miura K, Hozawa A, Kadota A, Okamura T, Nakamura Y, et al. Population attributable fraction of smoking and metabolic syndrome on cardiovascular disease mortality in Japan: a 15-year follow up of NIPPON DATA90. BMC public Health. 2010;10(1):1-9. doi:10.1186/1471-2458-10-306 PMid:20525280 PMCid:PMC2894774
23. Rückinger S, Von Kries R, Toschke AM. An illustration of and programs estimating attributable fractions in large scale surveys considering multiple risk factors. BMC Med Rese Methodol. 2009;9(1):7 doi:10.1186/1471-2288-9-7 PMid:19166593 PMCid:PMC2636839
24. Azimi SS, Khalili D, Hadaegh F, Mehrabi Y, Yavari P, Azizi F. Direct estimate of population attributable fraction of risk factors for cardiovascular diseases: Tehran Glucose and Lipid Study. Iran J Epidemiol. 2012;7(4):9-18.
25. Mohammadi M, Mirzaei M. Population attributable fraction of cardiovascular disease associated with diabetes mellitus in Yazd city. J Shahid Sadoughi Univ Med Sci. 2017;25(8):603-11.
26. Danaei G, Lawes CM, Vander Hoorn S, Murray CJ, Ezzati M. Global and regional mortality fromischaemic heart disease and stroke attributable to higher-than-optimum blood glucose concentration: comparative risk assessment. Lancet. 2006; 368 (9548): 1651-9. doi:10.1016/S0140-6736(06)69700-6
27. Moran A, DeGennaro V, Ferrante D, Coxson PG, Palmas W, Mejia R, et al. Coronary heart disease and stroke attributable to major risk factors is similar in Argentina and the United States: the Coronary Heart Disease Policy Model. Int J Cardiol. 2011;150 (3):332-7. doi:10.1016/j.ijcard.2011.04.013 PMid:21550675 PMCid:PMC3139755
28. Wilson PW, D'Agostino RB, Sullivan L, Parise H, Kannel WB. Overweight and obesity as determinants of cardiovascular risk: the Framingham experience. Arch Intern Med. 2002;162 (16): 1867-72. doi:10.1001/archinte.162.16.1867 PMid:12196085
29. Brown WJ, Pavey T, Bauman AE. Comparing population attributable risks for heart disease across the adult lifespan in women. Br J Sports Med. 2015;49(16): 1069-76. doi:10.1136/bjsports-2013-093090 PMid:24809696
30. Medrano MJ, Pastor-Barriuso R, Boix R, Del Barrio JL, Damian J, Alvarez R, et al. Coronary disease risk attributable to cardiovascular risk factors in the Spanish population. Rev Esp Cardiol. 2007;60(12):1250-6. doi:10.1157/13113930 PMid:18082090

Cite this article as:
Ahangari T, Ebrahimi K, Salari Lak S. Estimating the attributable mortality of modifying selected risk factors for myocardial infarction. Novel Clin Med. 2022; 1(1):38-43. doi: 10.22034/NCM.2022.140807