Journal of Community Health Research. 2015;4(1):38-46.

Original Article

Population Attributable Fraction of Ischemic Heart Disease Associated to Hypertension in The Middle East and North Africa

Marzieh Mirzajani[1], Masoud Mirzaei[*2]

[1] Zanjan University of Medical Sciences, Zanjan, Iran
[2] Yazd Cardiovascular Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

Received: 2015/5/17 **Accepted:** 2015/6/9

Abstract

Introduction: Ischemic Heart Disease (IHD) has been increasing in the Middle East and North Africa. Hypertension is an important modifiable risk factor of IHD and plays an important role in the epidemic of IHD. Hypertension is responsible for about 45% of IHD mortality and affects more than one billion people around the world. This study aimed to quantify the population attributable fraction PAF of IHD due to hypertension in the Middle East and North Africa (MENA).

Materials & Methods: Sex-specific prevalence of hypertension was obtained from national and international studies. Moreover, age-adjusted hazard ratio (HR) of IHD and hypertension was extracted from the Tehran Lipid and Glucose Study (TLGS). HR and sex-specific prevalence of hypertension were used to calculate PAF of IHD due to hypertension in various countries of the region.

Results: The sex-specific prevalence of hypertension was available for seventeen countries of the region. Hypertension ranged from 4.5% in Palestine to 47% in Algeria in females and from 2.2%in Palestine to 50.7% in Oman in males. The fraction of IHD attributable to hypertension ranged from 4.3%in Palestine to 32%in Algeria in females and from 2.2% in Palestine to 33.7%in Oman in males.

Conclusion: Up to 33% IHD male's mortality attributable to hypertension. It seems that hypertension is increasing in MENA and prevention programs are needed to control prevalence IHD.

Keywords: Population attributable fraction, Ischemic Heart Disease, Hypertension, Middle East, North Africa

[*] **Corresponding author**; **Tel:** 09134509917, **E-mail:** mmirzaei@ssu.ac.ir

[Downloaded from jhr.ssu.ac.ir on 2026-11-24]

Introduction

Ischemic Heart Disease (IHD) is the leading cause of death in developed regions with 1.4 million and developing countries with 5.7 million deaths annually. Age-standardize IHD death rate has decreased in high-income countries over the last five decades (Mirzaei, 2009- Heart). on the other hand urbanization and lifestyle change may increase the number of IHD death in some low and middle income countries [1].

Hypertension is a major risk factor of IHD and play an important role in the epidemic of IHD (Taylor Mirzaei 2006) [1, 2]. Hypertension or high blood pleasure is one of the important modifiable risk factor that affects cardiovascular disease and cerebrovascular around the world [3-5]. Hypertension affects 79 million people in the United State and one billion people world wild [5]. In 2010 , high blood pressure was leading 7.0% of global DALYs and also causes 9.4 million death worldwide [6] . In 2000, about 1billion people lived with Hypertension which predicted to increase 1.56billion by 2025 [7] In 1999 to 2010 , the prevalence of hypertension was reported 30.5% among men and 28.5% among women [8] . In 2008, six million people lived with diagnosed hypertension in Canada[9] Of all death, 16.5% is related to hypertension [10]. Hypertension is responsible for about 45% of IHD and 51% of stroke mortality [11] The prevalence of hypertension is lower (35%) in high-income countries compared to other countries (40%) [10, 11].Hypertension and its related cardiovascular diseases cause major global burden of disease and 8.1% of disability adjusted life years (DALYs) related to hypertension and its attributable cardiovascular disease[12]. Rising hypertension causes increase in mortality of coronary heart disease among aged 45-65 years old in both sexes [13].Control of high blood pressure could prevent About 19% of coronary heart disease in males and 31% of coronary heart disease in females [14].

Little is known about IHD attributed to hypertension in the Middle East. This study was designed to quantify the fraction of IHD related to hypertension in the Middle East by estimation of the population attributable risk (PAFs).

Materials & Methods

This is a cross sectional study and the aim of study is to calculate PAF of Ischemic Heart Disease due to hypertension.

According to WHO definition: PAF is proportional to reduction in population disease mortality that would occur if exposure to a risk factor was reduced to an alternative ideal exposure scenario [15].

To calculate PAF estimate of sex and age-specific prevalence of hypertension is required. Data on the sex-specific prevalence of hypertension extracted for seventeen countries including Bahrain, Iran, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria,

[Downloaded from jhr.ssu.ac.ir on 2026-11-24]

Turkey, United Emirates, Yemen, Algeria, Egypt, Libya, Morocco and Tunisia. Moreover, estimate of Hazard Ratio of IHD associated with hypertension is required.

Prevalence: The sex-specific prevalence of hypertension data was gathered separately for each country in Middle East and North Africa by searching in MEDLINE, national surveys and WHO Global Info base. In MEDLINE search, using prevalence, epidemiology, hypertension or blood pressure and name of countries of the region were figured out. The relevant data were extracted from nationally representative hypertension data from WHO or ministries of health databases.

Hypertension was defined as diastolic blood pressure (DBP)>140 and systolic blood pressure (SBP)>90. Also hypertension was clonsideredICD9 codes 401 to 409 and ICD10 codes I10 to I15 [(5)].

Hazard Ratio: Estimate of hazard ratio of hypertension for fatal IHD was required and obtained from the Tehran Lipid and Glucose Study [(16)]. There are few prospective studies on IHD and its risk factors in the MENA region. Tehran Lipid and Glucose Study (TLGS) is one of the largest of its kind in the region and can be representative of MENA region because the estimates come from the same region. The study divided into two sections, first a cross- sectional study followed by a 10 years cohort study including (about 17,000) people in MENA. The details of the study were published elsewhere [(17)].

According to TLGS study, the estimate of hazard ratio with 95% confidence interval for coronary heart disease and hypertension was reported 1.8 (1.4- 2.2) for males and2.1(1.6-2.8) for females [(18)] .

The formula used to calculate PAF (%) was: $[100^{x}\text{prevalence}^{x}\ (HR-1)]/\ [100+\text{prevalence}^{x}\ (HR-1)]$ [(19)].

Results

Table1 demonstrate sex-specific prevalence of hypertension in seventeen countries of the MENA region. Data from Iraq and Jordan were not available. For Bahrain and Lebanon, only prevalence of SBP was available and used.

The prevalence of hypertension in MENA were reported from 4.5% in Palestine [(20)] to 47% in Algeria [(21)] in females and from 2.2% in Palestine [(20)] to 50.7% in Oman [(22)] in males (Figure1).

[Downloaded from jhr.ssu.ac.ir on 2026-11-24]

Table1. Sex-specific prevalence of hypertension in seventeen countries of the Middle East and North Africa (1996-2014)

Country	Sample size	Age (Years)	Year of publication	%p (male)	%p (female)
Bahrain[23]	1137	N/A	2014	27.5	14.3
Iran[24]	4233	25-64	2009	24.7	28.6
Kuwait[25]	3003	20+	1996	4.7	6.5
Lebanon[26]	5875	40+	2012-13	23.1	13
Oman[22]	3370	18+	2012	50.7	31
Palestine[20]	1108	0-65+	2013	2.2	4.2
Qatar[27]	1208	25-65	2004	32.6	31.7
Saudi Arabia[28]	17230	30-70	2007	28.6	23.9
Syria[29]	1168	25+	2011	47.4	34.9
Turkey[30]	2208	20+	2009	41.6	46.1
United Arab Emirates [31]	817	20+	2008	21.8	20
Yemen[32]	250	34+	2008	29.3	23
Algeria[21]	606	40-99	2007	41	47
Egypt[33]	N/A	N/A	1999	25.7	28.9
Libya[34]	N/A	N/A	2010	45.8	35.6
Morocco[35]	N/A	20+	2003	30.2	37
Tunisia[36]	N/A	40+	2005	48.2	38.7

Figure2 shows the population attributable fraction (PAF) of IHD due to hypertension for males and females separately, it ranged from 4.3% in Palestine to 32% Algeria among females and from 2.2 %in Palestine to 33.7% in Oman in males.

[Downloaded from jhr.ssu.ac.ir on 2026-11-24]

Figure1: Prevalence of hypertension in Middle East and North Africa region by sex

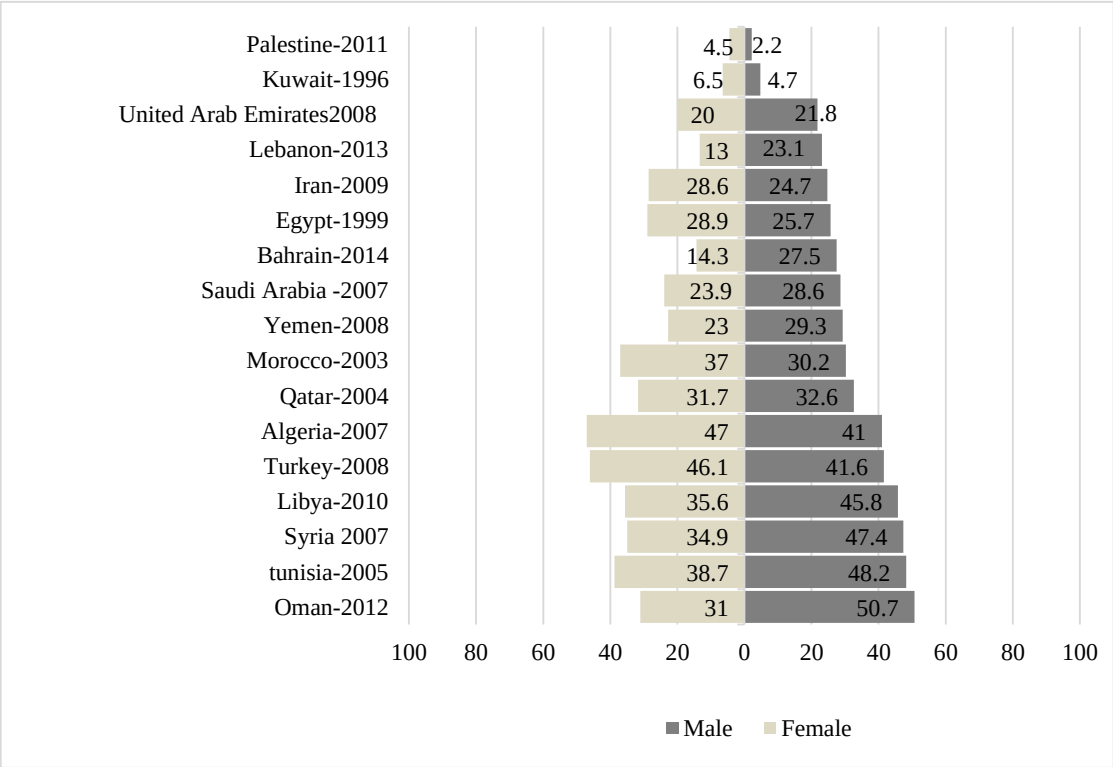
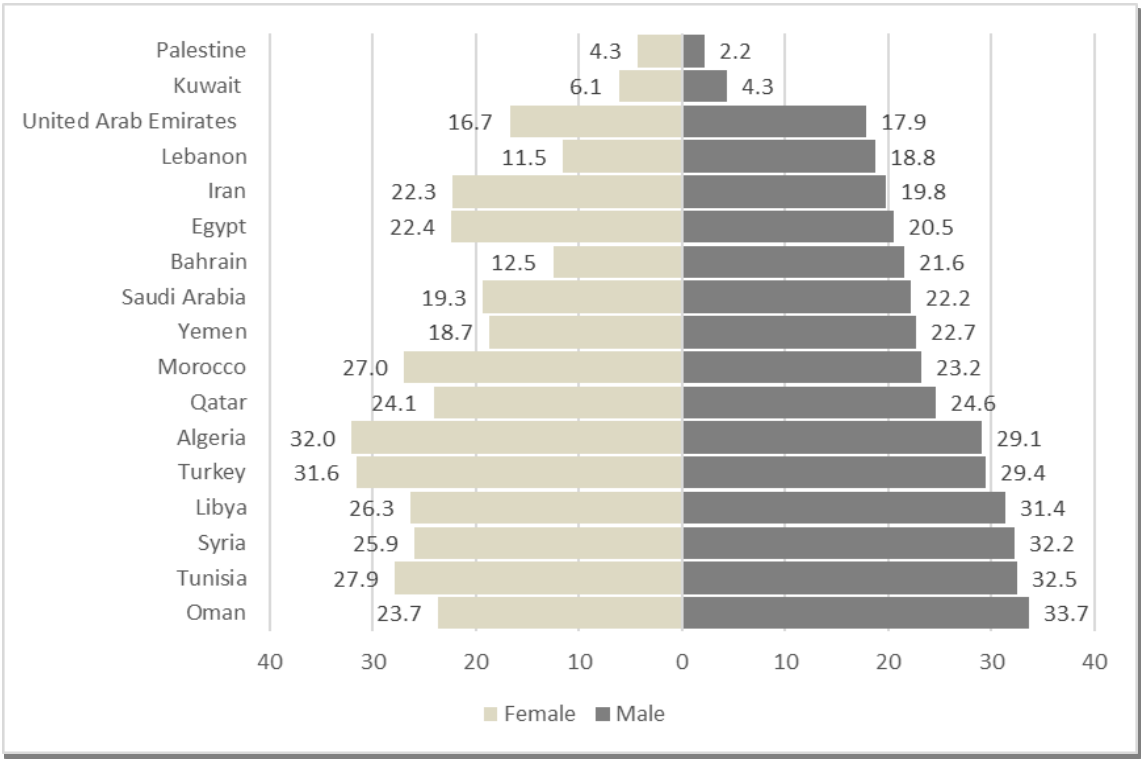


Figure 2: Population attributable fraction (%) of heart disease caused by hypertension



[Downloaded from jhr.ssu.ac.ir on 2026-11-24]

Discussion

In the present study, population attributable fraction of IHD associated hypertension was calculated to use as quantities scale to evaluate burden of hypertension.

Approximately up to 33% of PAFs of IHD related to hypertension and PAFs of IHD were higher among males compared to females excluding Iran, Egypt, Algeria and Turkey.

According to Global Burden of Disease studies, the MENA regions had the highest IHD death rate after Eastern Europe and Central Asia and in this region IHD death occurs in younger age groups compared to the other regions [(1).]

In an earlier analysis, Martinuik et al. presented that 66% of cardiovascular diseases are attributable to hypertension in Western Pacific and South-east Asia, the fraction of IHD was 4-28% in male and 8-39% in female accordingly [(37)]. Gaziano et al., reported that about 49% of IHD is attributable to high blood pressure and the PAFs of IHD mortality associated with hypertension was higher (61%) in Europe and central Asia compared to other regions i.e. less than 50% [(38)] .

Danaei et al, showed that blood pressure was one of the leading risk factors for mortality and two- thirds (66%) of deaths are attributable to hypertension in US [(39).] Grau et al. demonstrated that population attributable fraction of CVD due to hypertension was 37% in Spain [(40).] In Ohasaki study it was reported that 47% of CVD mortality in middle age and 26% of CVD death in elderly were related to non-optimal blood pressure [(41).]

In Iran, Morocco, Algeria, Turkey and Egypt PAF of IHD due to hypertension are greater in females. It seems that diagnosis and treatment of hypertension is more common among females than males [(21)] . Female's hypertension may also increase by urbanization, stressful life style, changing eating habits, smoking following an increase of the related PAFs in the MENA region.

In the MENA region, up to 30% of IHD can be associated to hypertension. However, the treatment, control, diagnosis, awareness in developing countries is lower than develop countries. The degree of awareness in Egypt was about (20-50%), hypertension control was about (2-15%). Under diagnosis (33%) and under-treatment (76%) in United Arab Emirates, Blood Pressure to level of <140/90mmHg was 8% in Egypt and 5% in China [(33, 42, 43)].

Limitation

The first limitation of this study was lake of relevant date in MENA, the prevalence, incidence and mortality of hypertension are underestimate because of low diagnosis, control and treatment of patients and inaccessible health care center and valid statistic of pre-hypertension and hypertension.

[Downloaded from jhr.ssu.ac.ir on 2026-11-24]

The second limitations was use of estimate of hazard ratio from TLGS study since no measure of association from prospective studies were available for other countries of the region.

Conclusion

There is a large variation across the countries of MENA. Different prevention strategies should be considered to control this preventable risk factor. Following to increase prevalence of hypertension and the main role of hypertension to event IHD, It seems that use of primary and secondary prevention of hypertension impacts to reduction in large proportion of death by IHD and other chronic diseases. However, hypertension prevention policies are used in some countries, but the best way to reduce PAF of IHD associated with high blood pressure is implementation of national and international hypertension control protocols and following them.

References

1. Moran AE, Forouzanfar MH, Roth G, et al. Temporal Trends in Ischemic Heart Disease Mortality in 21 World Regions, 1980-2010: The Global Burden of Disease 2010 Study. Circulation. 2014:CIRCULATIONAHA. 113.004042.
2. Yusuf S, Reddy S, Ôunpuu S, et al. Global burden of cardiovascular diseases part I: general considerations, the epidemiologic transition, risk factors, and impact of urbanization. Circulation. 2001;104(22):2746-53.
3. Santulli G. Epidemiology of cardiovascular disease in the 21st century: updated numbers and updated facts. Journal of Cardiovascular Disease (JCvD). 2013;1(1):1-2.
4. Daugherty SL, Powers JD, Magid DJ, et al. Incidence and prognosis of resistant hypertension in hypertensive patients. Circulation. 2012;125(13):1635-42.
5. Go AS, Bauman MA, King SMC, et al. An effective approach to high blood pressure control: a science advisory from the American Heart Association, the American College of Cardiology, and the Centers for Disease Control and Prevention. Journal of the American College of Cardiology. 2014;63(12):1230-8.
6. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. The lancet. 2013;380(9859):2224-60.
7. Joffres M, Falaschetti E, Gillespie C, et al. Hypertension prevalence, awareness, treatment and control in national surveys from England, the USA and Canada, and correlation with stroke and ischaemic heart disease mortality: a cross-sectional study. BMJ open. 2013;3(8):e003423.
8. Guo F, He D, Zhang W, et al. Trends in prevalence, awareness, management, and control of hypertension among United States adults, 1999 to 2010. Journal of the American College of Cardiology. 2012;60(7):599-606.
9. Robitaille C, Dai S, Waters C, et al. Diagnosed hypertension in Canada: incidence, prevalence and associated mortality. Canadian Medical Association Journal. 2012;184(1):E49-E56.

[Downloaded from jhr.ssu.ac.ir on 2026-11-24]

10. Basu S, Millett C. Social Epidemiology of Hypertension in Middle-Income Countries Determinants of Prevalence, Diagnosis, Treatment, and Control in the WHO SAGE Study. Hypertension. 2013;62(1):18-26.
11. a global brief on hypertension [Internet]. 2013. Available from: http://www.who.int/cardiovascular_diseases/publications/global_brief_hypertension/en/.
12. Mittal BV, Singh AK. Hypertension in the developing world: challenges and opportunities. American Journal of Kidney Diseases. 2010;55(3):590-8.
13. Antikainen R, Jousilahti P, Tuomilehto J. Systolic blood pressure, isolated systolic hypertension and risk of coronary heart disease, strokes, cardiovascular disease and all-cause mortality in the middle-aged population. Journal of hypertension. 1998;16(5):577-83.
14. Wong ND, Thakral G, Franklin SS, et al. Prevention and rehabilitation: preventing heart disease by controlling hypertension: impact of hypertensive subtype, stage, age, and sex. American Heart Journal. 2003;145(5):888-5.
15. Metrics: Population Attributable Fraction (PAF) [Internet]. Available from: http://www.who.int/healthinfo/global_burden_disease/metrics_paf/en.
16. Hadaegh F, Mohebi R, Cheraghi L, et al. Do Different Metabolic Syndrome Definitions Predict Cerebrovascular Events and Coronary Heart Disease Independent of Their Components? 9 Years Follow-Up of the Tehran Lipid and Glucose Study. Stroke. 2012;43(6):1669-71.
17. Azizi F, Rahmani M, Madjid M, et al. Target introduction of practical methods and structure of TLGS ,Tehran Lipid and Glucose Study (TLGS): rationale and design. Iran Journal Endoc and Met. 2000;2:77-86.
18. Khalili D, Sheikholeslami FH, Bakhtiyari M, et al. 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.
19. Woodward M. Epidemiology: study design and data analysis: CRC Press; 2013.
20. Abukhdeir H, Caplan L, Reese L, et al. Factors affecting the prevalence of chronic diseases in Palestinian people: an analysis of data from the Palestinian Central Bureau of Statistics. Eastern Mediterranean Health Journal. 2013;19(4).
21. Temmar M, Labat C, Benkhedda S, et al. Prevalence and determinants of hypertension in the Algerian Sahara. Journal of Hypertension. 2007;25(11):2218-26.
22. Al Riyami A, Elaty MA, Morsi M, et al. Oman world health survey: Part 1—Methodology, sociodemographic profile and epidemiology of non-communicable diseases in Oman. Oman Medical Journal. 2012;27(5):425-43.
23. AL-Nooh AA, Abdulabbas Abdulla Alajmi A, Wood D. The Prevalence of Cardiovascular Disease Risk Factors among Employees in the Kingdom of Bahrain between October 2010 and March 2011: A Cross-Sectional Study from a Workplace Health Campaign. Cardiology Research and Practice. 2014;2014.
24. Esteghamati A, Meysamie A, Khalilzadeh O, et al. Third national Surveillance of Risk Factors of Non-Communicable Diseases (SuRFNCD-2007) in Iran: methods and results on prevalence of diabetes, hypertension, obesity, central obesity, and dyslipidemia. BMC Public Health. 2009;9(1):167.
25. Abdella N, Al Arouj M, Al Nakhi A, et al. Non-insulin-dependent diabetes in Kuwait: prevalence rates and associated risk factors. Diabetes research and clinical practice. 1998;42(3):187-96.

[Downloaded from jhr.ssu.ac.ir on 2026-11-24]

26. Yamout R, Adib SM, Hamadeh R, et al. Peer Reviewed: Screening for Cardiovascular Risk in Asymptomatic Users of the Primary Health Care Network in Lebanon, 2012–2013. Preventing chronic disease. 2014;11.
27. Bener A, Al-Suwaidi J, Al-Jaber K, et al. The prevalence of hypertension and its associated risk factors in a newly developed country. Saudi medical journal. 2004;25(7):918-22.
28. Al-Nozha MM, Abdullah M, Arafah MR, et al. Hypertension in Saudi Arabia. Saudi Medical Journal. 2007;28(1):77-84.
29. Al Ali R, Rastam S, Fouad FM, et al. Modifiable cardiovascular risk factors among adults in Aleppo, Syria. International Journal of Public Health. 2011;56(6):653-62.
30. Erem C, Hacihasanoglu A, Kocak M, et al. Prevalence of prehypertension and hypertension and associated risk factors among Turkish adults: Trabzon Hypertension Study. Journal of Public Health. 2009;31(1):47-58.
31. Baynouna LM, Revel AD, Nagelkerke NJ, et al. High prevalence of the cardiovascular risk factors in Al-Ain, United Arab Emirates. An emerging health care priority. Saudi medical journal. 2008;29(8):1173-8.
32. Gunaid A, Assabri A. Prevalence of type 2 diabetes and other cardiovascular risk factors in a semirural area in Yemen. East Mediterr Health Journal. 2008;14(1):42-56.
33. Ibrahim MM. Epidemiology of hypertension in Egypt. Saudi Journal of Kidney Diseases and Transplantation. 1999;10(3):352.
34. Beshyah SA. Non-communicable diseases and diabetes care guidelines: Epidemiology and call for collective action. February, 6th 2010, Dat Elmad Conference Hall Complex, Tripoli, Libya. Ibnosina Journal of Medicine and Biomedical Sciences. 2010;2(3):142-8.
35. Tazi MA, Abir-Khalil S, Chaouki N, et al. Prevalence of the main cardiovascular risk factors in Morocco: results of a National Survey, 2000. Journal of Hypertension. 2003;21(5):897-903.
36. Ben RH, Skhiri H, Bougatef S, et al. [Hypertension prevalence, awareness, treatment and control: results from a community based survey]. La Tunisie medicale. 2005;83:41-6.
37. Martiniuk AL, Lee CM, Lawes CM, et al. Hypertension: its prevalence and population-attributable fraction for mortality from cardiovascular disease in the Asia-Pacific region. Journal of Hypertension. 2007;25(1):73-9.
38. Gaziano TA, Bitton A, Anand S, al e. Growing epidemic of coronary heart disease in low-and middle-income countries. Current Problems in Cardiology. 2010;35(2):72-115.
39. Danaei G, Ding EL, Mozaffarian D, et al. The preventable causes of death in the United States: comparative risk assessment of dietary, lifestyle, and metabolic risk factors. PLoS medicine. 2009;6(4):e1000058.
40. Grau M, Subirana I, Elosua R, et al. Why should population attributable fractions be periodically recalculated?: An example from cardiovascular risk estimation in southern Europe. Preventive Medicine. 2010;51(1):78-84.
41. Hozawa A. Attributable fractions of risk factors for cardiovascular diseases. Journal of Epidemiology (Japan Epidemiological Association). 2010;21(2):81-6.
42. Abdulle AM, Nagelkerke NJ, Abouchacra S, et al. Under-treatment and under diagnosis of hypertension: a serious problem in the United Arab Emirates. BMC cardiovascular disorders. 2006;6(1):24.
43. Whelton P, He J, Muntner P. Prevalence, awareness, treatment and control of hypertension in North America, North Africa and Asia. Journal of Human Hypertension. 2004;18(8):545-51.

[Downloaded from jhr.ssu.ac.ir on 2026-11-24]