Original Article

The Burden of Cardiovascular Diseases in the Kurdistan Province, Iran, from 2011 through 2017

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Abstract

Background: *Calculating the burden of diseases is essential for their monitoring. The burden of cardiovascular diseases in Kurdistan Province has not been reported. This study aimed at calculating the burden of cardiovascular diseases in the Kurdistan Province from 2011 through 2017.*

Methods: *In this cross-sectional study, incidence data were extracted from registration systems. The methods of the World Health Organization (WHO) were employed to calculate disability-adjusted life years (DALYs) of cardiovascular diseases in the Kurdistan Province. DALYs were calculated by summing the years of life lost (YLLs) and the years of life lived with disability (YLDs) for sex, age group, and year.*

Results: *The burden of cardiovascular diseases increased from 18569.1 DALYs in 2011 to 34929.8 DALYs in 2017. The highest increase and the largest decrease in DALY according to the all age-standardized DALYs index were related to acute myocardial infarction and heart failure in women, respectively. The highest DALYs in both sexes were in the age group of over 80 years.*

Conclusion: *The burden of cardiovascular diseases is increasing in the Iranian province of Kurdistan. It is, therefore, essential to implement appropriate and adequate interventions such as lifestyle modification, extensive screening, public education promotion, and operational plan development. We hope our results will aid decision-makers in performing urgent interventions.*

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Introduction

Cardiovascular diseases are the most important causes of death and obstacles to achieving the goal of sustainable development in reducing the burden of diseases.[1] It is predicted that they remain the most important cause of death by 2030.[2] While the age-standardized death rate of cardiovascular diseases has decreased in some developed countries in recent decades, the incidence and burden of these diseases have increased in low- and middle-income

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countries.[3] In 2015, the incidence and mortality due to cardiovascular diseases were estimated to be 422.7 and 17.9 million, respectively, with deaths mostly being due to coronary artery disease in individuals under the age of 70, thus classified as premature deaths. Most deaths have been reported in low- and middle-income countries.[4] According to the results of a study on the global burden of diseases in 2017, the burden of cardiovascular diseases was estimated at 366 million disability-adjusted life years (DALYs), while the burden of ischemic heart diseases increased by 17.8% compared with 2007 and ranked first.[5] According to a 2017 study by George A et al,[6] the years of life lost (YLLs) of cardiovascular diseases worldwide were 330 and 35.6 million years, respectively.[6] According to a 2016 study by Shiwei Liu,[7] 3.97 million deaths were reported in China due to cardiovascular diseases. A 2015 study by Gregory A[1] estimated the standard prevalence of cardiovascular diseases in the Middle East and North Africa at 8017 per 100 000 people. In a study by Talaei et al,[2] the raw incidence of cardiovascular diseases in 2001 in Isfahan, Iran, was reported to be 1436 and 1168 per 100 000 in men and women, respectively. For decades, noncommunicable diseases, especially cardiovascular diseases, have had the largest share in the burden of diseases.[8] Consequently, the World Health Organization (WHO) seeks an appropriate response from countries by setting targets called "the Package of Essential Noncommunicable (PEN) Disease" to reduce deaths from these diseases by 25% by 2025 compared with 2015. The western Iranian province of Kurdistan is one of the mountainous and less developed provinces at the Iran-Iraq border. The population of the Kurdistan Province was 1 600 000 in the 2016 census. Most of the inhabitants of the province are of Kurdish ethnicity, with their own culture and customs. The ultimate goal of estimating the burden of diseases is to provide the most objective evidence required for policy-making, design and management of health programs, prioritization of strategic research in the field of population health, development and allocation of human and financial resources, and expansion of organizational capacity for design, implementation, and evaluation of cost-effective prevention, treatment, and rehabilitation interventions. Data are scarce on the calculation of the burden of cardiovascular diseases in Iran. However, a study used modeling to estimate the nationwide burden of diseases in 2003 in Iran. Many studies have utilized modeling to estimate the burden of cardiovascular diseases, which can have limits. In this study, we calculated the burden of cardiovascular diseases from 2011 through 2017 in the western Iranian province of Kurdistan as a population sample of Iran using registration systems. This procedure is different from that employed by other studies in terms of data type. The current study was performed on limited cardiovascular disease load and estimations are only based on modeling. Surely, studies based on data in registration systems are preferable to those based on estimation and modeling. The present study is among the few works to compute cardiovascular disease load in Iran based on cardiovascular disease registration systems in Kurdistan-based hospitals. Given the benefits of the use of DALYs to measure the status of diseases and the absence of research on cardiovascular diseases in the Kurdistan Province, the present study was an attempt to survey the indicators of cardiovascular diseases with a view to depicting a picture of the trend of these diseases. The results can help modify health policies.

Methods

The present cross-sectional study was conducted in 2019 in all age groups of the Kurdistan Province based on the population data of the province during the years 2011 through 2017. The burden of diseases was calculated using the global burden of disease calculation method in terms of DALYs. A DALY is the equivalent of 1 year of life that should be spent in health but is lost either due to premature death or disability caused by disease or injury. The higher a DALY is, the worse the disease is or the less likely it is to be controlled by the health system of that country or region. DALYs are obtained from the sum of YLLs due to premature mortality and the years lived with disability (YLDs).[9] YLDs were calculated as the product of the cardiovascular disease incidence and disability weight while considering the course of the disease. For the calculation of YLL due to premature mortality, the number of individuals who died of cardiovascular diseases was multiplied by the life expectancy of the age group. The 2 components of the DALY index were used based on the following formula: DALY=YLL+YLD, where YLL=N×L and YLD=I×DW×D. In the formula, N represents the number of deaths, L denotes life expectancy, D stands for the disease period, and DW indicates disability weight.

The distinctive feature of the current study is that it used data from stroke and death registration systems. However, many studies calculating the DALYs of these diseases worldwide have used modeling for estimating the burden of these diseases due to the lack of data from disease and mortality registration systems. Model-based estimates are not as accurate as the estimates made using registration systems. Moreover, in this study, DALYs were calculated separately for 10 types of cardiovascular diseases. DALYs were calculated in terms of sex, 8 age groups (0-4, 5-14, 15-29, 30-44, 45-59, 60-69, 70-79, and over 80 years), and the year of the cardiovascular disease incidence. Because the burden of stroke is worrying worldwide, it has been studied separately and not addressed in this article. The disability weight used in the present study was obtained from the results of research on the global burden of diseases reported by the WHO and the disability weights used by Minsu Ock in South Korea.[10, 11] Incidence-related data were

extracted from hospital information systems in the Kurdistan Province. Patients were identified based on the International Statistical Classification of Diseases and Related Health Problems-10th Revision (ICD10) codes and admission year in order to prevent repeated data. The population of the Kurdistan Province in each year was extracted separately from the website of the Statistics Center of Iran. It covers all the inhabitants of the province. Mortality data were extracted from the System of Registration and Classification of the Causes of Death. The incidence of cardiovascular diseases and mortality were calculated separately for 9 sequels according to the ICD10 codes: angina pectoris (I20), acute myocardial infarction (I21), subsequent myocardial infarction (I22), chronic ischemic heart diseases (I25), chronic rheumatic heart diseases (I05-I09), acute and subacute endocarditis (I33), other acute ischemic heart diseases (I24), and other cardiovascular diseases except for stroke and heart failure (I50).

Results

From 2011 through 2017, in the Kurdistan Province, cardiovascular diseases caused 24 196 deaths, and 66 809 new cases occurred. The age-standardized incidence rate increased from 173.3/100,000 in 2011 to 671.5/100,000 in 2017. The burden of cardiovascular diseases increased from 18 569 DALYs in 2011 to 34,930 DALYs in 2017. In all the years of the study, the burden of diseases was higher for men than for women. Additionally, the burden of diseases increased during the years of the study. Throughout the 2011–2017 period, the burden, incidence, and mortality of cardiovascular diseases were higher in men than in women, YLLs were higher than YLDs, and YLLs among men were higher than those among women (Table 1). The highest and lowest percentages of age-standardized DALYs in both sexes during the period from 2011 through 2017 were related to acute ischemic heart disease and other heart diseases, respectively. DALYs and age-standardized DALYs of heart failure decreased among the 10 categories of cardiovascular

Table 1. New cases, deaths, and burden of cardiovascular disease in the Kurdistan Province, Iran, from 2011 through 2017

	2011	2012	2013	2014	2015	2016	2017
Male							
New Case	2947	3112	5357	6257	6753	6962	6509
CIR	361.9	335.4	669.9	695.2	809.8	856.5	820.3
Death	1296	1446	2676	2861	3405	2898	2901
CDR	159.1	155.8	334.6	317.8	408.3	356.5	374.6
DALYs	10175.3	11922.8	19423.2	18965.3	19704.8	19276.8	19498.4
YLL	9279.7	10975.6	17046.9	16680.9	17223.5	16488.5	16811.6
YLD	895.6	947.2	2376.6	2284.8	2481.2	2788.4	2686.8
ASIR	177.5	400.3	692.0	806.4	842.4	9013	656.5
Female							
New Case	2462	2403	3938	4413	5144	5374	5178
CIR	413.5	290.8	521.1	630.4	644.1	680.0	668.7
Death	664	669	1073	1022	1053	1082	1150
CDR	111.5	80.9	142.0	146.0	131.8	136.9	148.5
DALYs	8393.8	8983.6	13957.5	14330.2	14671.4	15271.1	15431.4
YLL	7518.2	8089.1	12081.9	11808.7	12104.0	12499.1	12717.2
YLD	875.6	894.5	1875.9	2521.9	2567.4	2772.0	2714.2
ASIR	169.4	388.2	689.6	778.7	916.0	911.7	684.8
Total							
New Case	5409	5515	9295	10670	11897	12336	11687
CIR	383.7	314.4	1230.1	666.8	728.7	769.5	745.5
Death	1960	2115	3749	3883	4458	3980	4051
CDR	139.0	120.5	496.1	242.6	273.0	248.2	258.4
DALYs	18569.1	20906.4	33380.7	33295.6	34376.1	34547.9	34929.8
YLL	16797.9	19064.7	29128.8	28489.6	29327.5	28987.6	29528.8
YLD	1771.2	1841.6	4252.4	4806.6	5048.5	5560.3	5401.0
ASIR	173.3	393.9	691.1	793.1	880.7	907.1	671.5

CIR, Crude incidence rate; CDR, Crude death rate; DALYs, Disability-adjusted life years; YLL, Years of life lost due to premature mortality; YLD, Years of healthy life lost due to disability; ASIR, Age-standardized incidence rate

Table 2. Absolute numbers and age-standardized DALYs of cardiovascular diseases in the Kurdistan Province, Iran, from 2011 through 2017

	ICD -10	All-Age DALYs				Change 2011-2017		All Age Standardized DALYs				Change 2011-2017	
		Male		Female		Male	Female	Male		Female		Male	Female
		2011	2017	2011	2017			2011	2017	2011	2017		
Ischemic heart disease	I20-I25	395.9	9653.8	354.1	6991			51.5	1192.4	47.0	877.4	22.1	17.6
Acute myocardial infarction	I21	94.8	7008.9	35.3	4583.3	72.9	128.2	12.2	847.4	4.5	560.3	68.4	123.5
Chronic ischemic heart disease	I25	156.4	1783.8	196.1	1620.3	10.4	7.2	20.6	235.7	26.0	214.2	10.4	7.2
Heart failure	I50	830.9	325.1	608.6	293.7	-0.6	-0.5	113.9	38.5	75.5	37.9	-0.6	-0.4
Angina pectoris	I20	99.5	335.1	114.5	359.9	2.3	2.1	12.8	43.1	15.3	46.6	2.3	2.04
Chronic rheumatic heart disease	I05-I09	5.4	109.0	10.8	231.7	19.1	20.4	0.7	12.9	1.3	28.3	17.4	20.7
Other acute ischemic heart disease	I24	4.0	380.0	2.0	378.0	94.0	188.0	0.5	46.9	0.3	50.0	92.8	165.6
Subsequent myocardial infarction	I22	41.2	146	6.2	49.5	2.5	6.9	5.2	19.1	0.7	6.2	2.6	7.8
Acute and subacute endocarditis	I33	52.9	57.6	0.0	56.7	0.08	56.7	5.8	6.5	0.0	7.8	0.1	7.8
Other cardiovascular disease	-	8890.3	9352.7	7419.8	7858.9	0.05	5.9	1099.8	1151.6	933.6	957.7	0.04	0.02

DALYs, Disability-adjusted life years; ICD, International classification of diseases

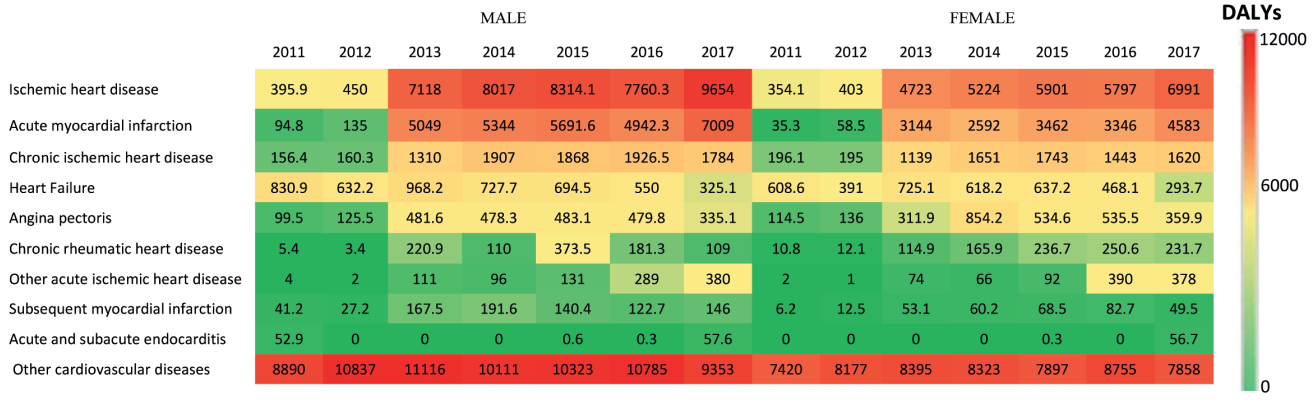

Figure 1. The table illustrates the disability-adjusted life years (DALYs) of cardiovascular subtypes in the Kurdistan Province from 2011 through 2017. (The dark red color indicates the highest DALYs, the light red and orange colors indicate lower DALYs, the yellow color indicates moderate DALYs, and the light green color indicates the lowest DALYs.)

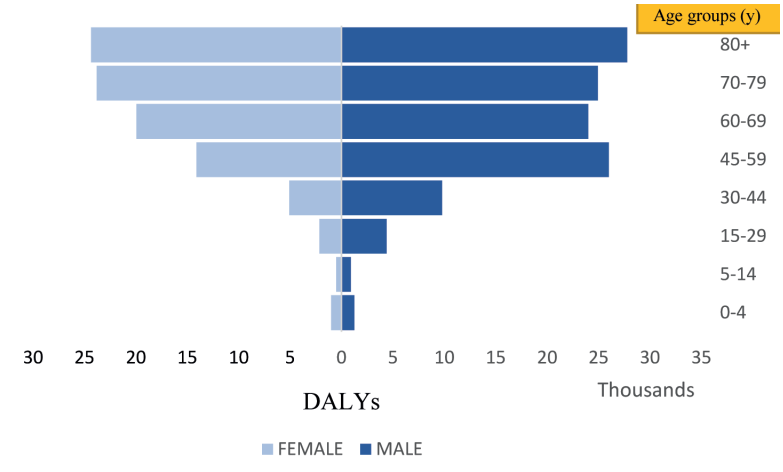

Figure 2. The image illustrates the disability-adjusted life years of cardiovascular diseases in the Kurdistan province from 2011 through 2017 by age groups.

diseases in 2017 compared with 2011, while the other categories had an increasing trend (Table 2). The burden of cardiovascular diseases increased over the years of this study for all causes except for heart failure (Figure 1). DALYs in the age groups 0-4, 5-14, 15-29, 30-44, 45-59, 60-69, 70-79, and ≥80 were 1242.3, 904.6, 4391.0, 9767.8, 25996.7, 23978.1, 24921.2, and 27765.1 in men and 1014.5, 528.4, 2156.1, 5097.1, 14106.1, 19965.6, 23809.3, and 24361.7 in women, respectively. The highest DALYs in both sexes were in the age group of over 80 years (Figure 2).

Discussion

To our knowledge, this study is one of the few studies to calculate the burden of diseases in Iran over a 7-year period and the first study to calculate the burden of cardiovascular diseases in the Kurdistan Province. The most significant finding of this study is that 86% of DALYs were attributed to YLLs due to premature mortality. Further, 33.8% of DALYs (71102.3) were related to ischemic heart diseases. Another important finding of this study was that 118967.3 DALYs (56%) were related to men. The total burden of cardiovascular diseases was 210005.7 DALYs, and the highest number of DALYs was registered in 2017. It seems that the burden of cardiovascular diseases continues to increase.

Unable to find similar studies in recent years, we used the age-standardized rate and the crude incidence rate for comparison. The highest burden of cardiovascular diseases was related to ischemic heart diseases, which is consistent with the results of various studies.[5, 7, 12-14] The burden of cardiovascular diseases rose during the study period, which is concordant with the results of various other investigations.[15-17] We found that the burden of chronic rheumatic heart diseases was higher in women than in men during all the study years, which chimes in with the results of a study by Liu Shiwei.[7] In our study, the ratio of the DALYs of ischemic heart diseases to the total DALYs of cardiovascular diseases was 476 per 1000 in 2017, which is inconsistent with the results of the first study to estimate the burden of diseases in 2003 in Yazd, Hormozgan, Chaharmahal and Bakhtiari, Bushehr, and East Azerbaijan with values of 619, 688, 576, 555, and 552 per 1000, respectively, but consistent with the results for the Khorasan Province with a value of 495 per 1000.[14] This difference may be due to the fact that, in all types of cardiovascular diseases in our study, the burden of diseases in 2011 and 2012 was less than expected. This may have been due to failure in registration, which in turn might have been caused by weakness in population-based registration. In our study, YLLs and YLDs had an increasing trend, which is in concordance with the results of various studies.[18, 19] In addition, the burden of ischemic heart diseases in men was more than that in women, which is in line with the results of a 2017 study on the global burden of diseases. Alcohol consumption and smoking increase the incidence and prevalence of cardiovascular diseases.[20] The results of the STEPs study in 2016 showed that the Kurdistan Province ranked third and fourth in Iran in terms of alcohol consumption and smoking, respectively.[21] The greatest risk factor for cardiovascular diseases is hypertension. The Kurdistan Province had the highest prevalence of hypertension in Iran in 2016; accordingly, it appears that the burden of cardiovascular diseases in this province is higher than that in most other Iranian provinces. In our study, the age-standardized DALYs of ischemic heart diseases were on the rise in men and women, which is consistent with the results reported by Liu Shiwei.[7] We found a rising trend for age-standardized DALYs, except for heart failure, a result not consistent with those of various studies due to a variety of risk factors for noncommunicable diseases, including smoking, hyperlipidemia, poor physical activity, poor nutrition, and lack of proper and adequate interventions, all of which can lessen the burden of cardiovascular diseases.[5, 15] According to our results, the DALYs of heart failure in both sexes in 2011 and 2012 were lower than those in the other years of the study. The figures increased from 2013 up to 2017, at which point they showed a decreasing trend again. Heart failure is a clinical syndrome and has various causes. It is usually diagnosed in the final stages of cardiovascular diseases.[22] The diagnosis of this syndrome coincides with clinical symptoms and special diagnostic tests.[23] One of the reasons for the increased prevalence of heart failure and consequently its DALYs is the improvement of service quality and population aging.[22] Due to the increased population growth in the Kurdistan Province and the young population of the province in recent decades,[24] the reduced burden of heart failure can be justified. However, heart failure is associated with hypertension and some heart diseases such as heart attack and coronary artery disease. Furthermore, the burden of these diseases in this study demonstrated a rising trend. Thus, the burden of heart failure seems to be higher than this. Since the definition of heart failure syndrome may be different in different regions, the decrease in the DALYs of this syndrome may be due to different diagnoses of patients and consequently a decrease in its burden.

Similar to various studies, the present study has its limitations. A lack of population-based registration systems or their weaknesses was one of the limitations of this study. Despite the weaknesses, we tried to collect all necessary data for a more accurate calculation of the burden of cardiovascular diseases in the Kurdistan Province.

Conclusion

The burden of cardiovascular diseases is increasing in the Iranian province of Kurdistan. It is, therefore, essential to implement appropriate and adequate interventions such as

lifestyle modification, extensive screening, public education promotion, and operational plan development. We hope that our findings will aid decision-makers to devise more appropriate and urgent interventions.

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References

1. Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, Ahmed M, Aksut B, Alam T, Alam K, Alla F, Alvis-Guzman N, Amrock S, Ansari H, Ärnlöv J, Asayesh H, Atey TM, Avila-Burgos L, Awasthi A, Banerjee A, Barac A, Bärnighausen T, Barregard L, Bedi N, Belay Ketema E, Bennett D, Berhe G, Bhutta Z, Bitew S, Carapetis J, Carrero JJ, Malta DC, Castañeda-Orjuela CA, Castillo-Rivas J, Catalá-López F, Choi JY, Christensen H, Cirillo M, Cooper L, Jr, Criqui M, Cundiff D, Damasceno A, Dandona L, Dandona R, Davletov K, Dharmaratne S, Dorairaj P, Dubey M, Ehrenkranz R, El Sayed Zaki M, Faraon EJA, Esteghamati A, Farid T, Farvid M, Feigin V, Ding EL, Fowkes G, Gebrehiwot T, Gillum R, Gold A, Gona P, Gupta R, Habtewold TD, Hafezi-Nejad N, Hailu T, Hailu GB, Hankey G, Hassen HY, Abate KH, Havmoeller R, Hay SI, Horino M, Hotez PJ, Jacobsen K, James S, Javanbakht M, Jeemon P, John D, Jonas J, Kalkonde Y, Karimkhani C, Kasaeian A, Khader Y, Khan A, Khang YH, Khera S, Khoja AT, Khubchandani J, Kim D, Kolte D, Kosen S, Krohn KJ, Kumar GA, Kwan GF, Lal DK, Larsson A, Linn S, Lopez A, Lotufo PA, El Razek HMA, Malekzadeh R, Mazidi M, Meier T, Meles KG, Mensah G, Meretoja A, Mezgebe H, Miller T, Mirrakhimov E, Mohammed S, Moran AE, Musa KI, Narula J, Neal B, Ngalesoni F, Nguyen G, Obermeyer CM, Owolabi M, Patton G, Pedro J, Qato D, Qorbani M, Rahimi K, Rai RK, Rawaf S, Ribeiro A, Safiri S, Salomon JA, Santos I, Santric Milicevic M, Sartorius B, Schutte A, Sepanlou S, Shaikh MA, Shin MJ, Shishehbor M, Shore H, Silva DAS, Sobngwi E, Stranges S, Swaminathan S, Tabarés-Seisdedos R, Tadele Atnafu N, Tesfay F, Thakur JS, Thrift A, Topor-Madry R, Truelsen T, Tyrovolas S, Ukwaja KN, Uthman O, Vasankari T, Vlassov V, Vollset SE, Wakayo T, Watkins D, Weintraub R, Werdecker A, Westerman R, Wiysonge CS, Wolfe C, Workicho A, Xu G, Yano Y, Yip P, Yonemoto N, Younis M, Yu C, Vos T, Naghavi M, Murray C. Global, regional, and national burden of cardiovascular diseases for 10 causes, 1990 to 2015. J Am Coll Cardiol 2017;70:1-25.
2. Talaei M, Sarrafzadegan N, Sadeghi M, Oveisgharan S, Marshall T, Thomas GN, Iranipour R. Incidence of cardiovascular diseases in an Iranian population: the Isfahan Cohort Study. Arch Iran Med 2013;16:138-144.
3. Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, McQueen M, Budaj A, Pais P, Varigos J, Lisheng L; INTERHEART Study Investigators. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet 2004;364:937-52.
4. Jahangiry L, Khosravi-Far L, Sarbakhsh P, Kousha A, EntezarMahdi R, Ponnet K. Prevalence of metabolic syndrome and its determinants among Iranian adults: evidence of IraPEN survey on a bi-ethnic population. Sci Rep 2019;9:7937.
5. GBD 2017 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018;392:1859-1922.
6. Mensah GA, Roth GA, Fuster V. The global burden of cardiovascular diseases and risk factors: 2020 and beyond. J Am Coll Cardiol 2019;74:2529-2532.
7. Liu S, Li Y, Zeng X, Wang H, Yin P, Wang L, Liu Y, Liu J, Qi J, Ran S, Yang S, Zhou M. Burden of cardiovascular diseases in China, 1990-2016: findings from the 2016 Global Burden of Disease Study. JAMA Cardiol 2019;4:342-352.
8. No authors listed. The World Health Organization MONICA Project (monitoring trends and determinants in cardiovascular disease): a major international collaboration. WHO MONICA Project Principal Investigators. J Clin Epidemiol 1988;41:105-114.
9. GBD 2016 Neurology Collaborators. Global, regional, and national burden of neurological disorders, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol 2019;18:459-480.
10. Lopez AD, Murray CC. The global burden of disease, 1990-2020. Nat Med 1998;4:1241-1243.
11. Ock M, Lee JY, Oh IH, Park H, Yoon SJ, Jo MW. Disability weights measurement for 228 causes of disease in the Korean Burden of Disease Study 2012. J Korean Med Sci 2016;Suppl 2:S129-S138.
12. GBD 2015 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 2016;388:1603-1658.
13. Global Burden of Cardiovascular Diseases Collaboration, Roth GA, Johnson CO, Abate KH, Abd-Allah F, Ahmed M, Alam K, Alam T, Alvis-Guzman N, Ansari H, Ärnlöv J, Atey TM, Awasthi A, Awoke T, Barac A, Bärnighausen T, Bedi N, Bennett D, Bensenor I, Biadgilign S, Castañeda-Orjuela C, Catalá-López F, Davletov K, Dharmaratne S, Ding EL, Dubey M, Faraon EJA, Farid T, Farvid MS, Feigin V, Fernandes J, Frostad J, Gebru A, Geleijnse JM, Gona PN, Griswold M, Hailu GB, Hankey GJ, Hassen HY, Havmoeller R, Hay S, Heckbert SR, Irvine CMS, James SL, Jara D, Kasaeian A, Khan AR, Khera S, Khoja AT, Khubchandani J, Kim D, Kolte D, Lal D, Larsson A, Linn S, Lotufo PA, Magdy Abd El Razek H, Mazidi M, Meier T, Mendoza W, Mensah GA, Meretoja A, Mezgebe HB, Mirrakhimov E, Mohammed S, Moran AE, Nguyen G, Nguyen M, Ong KL, Owolabi M, Pletcher M, Pourmalek F, Purcell CA, Qorbani M, Rahman M, Rai RK, Ram U, Reitsma MB, Renzaho AMN, Rios-Blancas MJ, Safiri S, Salomon JA, Sartorius B, Sepanlou SG, Shaikh MA, Silva D, Stranges S, Tabarés-Seisdedos R, Tadele Atnafu N, Thakur JS, Topor-Madry R, Truelsen T, Tuzcu EM, Tyrovolas S, Ukwaja KN, Vasankari T, Vlassov V, Vollset SE, Wakayo T, Weintraub R, Wolfe C, Workicho A, Xu G, Yadgir S, Yano Y, Yip P, Yonemoto N, Younis M, Yu C, Zaidi Z, Zaki MES, Zipkin B, Afshin A, Gakidou E, Lim SS, Mokdad AH, Naghavi M, Vos T, Murray CJL. The burden of cardiovascular diseases among US States, 1990-2016. JAMA Cardiol 2018;3:375-389.
14. Naghavi M, Abolhassani F, Pourmalek F, Lakeh M, Jafari N, Vaseghi S, Mahdavi Hezaveh N, Kazemeini H. The burden of disease and injury in Iran 2003. Popul Health Metr 2009;7:9.
15. GBD 2016 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet 2017;390:1260-1344.

16. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases: part I: general considerations, the epidemiologic transition, risk factors, and impact of urbanization. Circulation 2001;104:2746-2753.
17. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases: Part II: variations in cardiovascular disease by specific ethnic groups and geographic regions and prevention strategies. Circulation 2001;104:2855-2864.
18. Lopez AD, Murray CC. The global burden of disease, 1990-2020. Nat Med 1998;4:1241-1243.
19. Murray CJ, Lopez AD. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. Lancet 1997;349:1436-1442.
20. GBD 2016 Risk Factors Collaborators. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet 2017;390:1345-1422.
21. Fathollahi S, Saeedi Moghaddam S, Rezaei N, Jafari A, Peykari N, Haghshenas R, Shams-Beyranvand M, Damerchilu B, Mehregan A, Khezrian M, Hasan M, Momen Nia Rankohi E, Darman M, Moghisi A, Farzadfar F. Prevalence of behavioural risk factors for road-traffic injuries among the Iranian population: findings from STEPs 2016. Int J Epidemiol 2019;48:1187-1196.
22. Gouveia M, Ascenção R, Fiorentino F, Costa J, Caldeira D, Broeiro-Gonçalves P, Fonseca C, Borges M. The current and future burden of heart failure in Portugal. ESC Heart Fail 2019;6:254-261.
23. Ponikowski P, Anker SD, AlHabib KF, Cowie MR, Force TL, Hu S, Jaarsma T, Krum H, Rastogi V, Rohde LE, Samal UC, Shimokawa H, Budi Siswanto B, Sliwa K, Filippatos G. Heart failure: preventing disease and death worldwide. ESC Heart Fail 2014;1:4-25.
24. Sheikhattari P, Stephenson R, Assasi N, Eftekhar H, Zamani Q, Maleki B, Kiabayan H. Child maltreatment among school children in the Kurdistan Province, Iran. Child Abuse Negl 2006;30:231-245.