Original Article

Evaluating Causes of Death and Morbidity in Iran, Global Burden of Diseases, Injuries, and Risk Factors Study 2010

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Abstract

Background: we aimed to recap and highlight the major results of the Global Burden of Diseases, Injuries, and Risk Factors Study 2010 by mortality and morbidity to clarify the current health priorities and challenges in Iran.

Methods: We estimated Iran's mortality and burden of 289 diseases with 67 risk factors and 1160 sequelae, which were used to clinically present each disease and its disability or cause of death. We produced several measures to report health loss and status: all-cause mortality, cause-specific mortality, years of life lost due to death (YLL), healthy years of life lost due to disability (YLD), disability-adjusted life years (DALYs), life expectancy, and healthy life expectancy, for three time periods: 1990, 2005, and 2010.

Results: We found out that life expectancy at birth was 71.6 years in men and 77.8 years in women. Almost 350 thousand deaths occurred in both sexes and all age groups in 2010. In both males and females and all age groups, ischemic heart disease was the main cause of death, claiming about 90 thousand lives. The main contributors to DALYs were: ischemic heart disease (9.1%), low back pain (9.0%), road injuries (7.3%), and unipolar depressive disorders (6.3%). The main causes of death under 5 years of age included: congenital anomalies (22.4%), preterm birth complications (18.3%), and other neonatal disorders (13.5%). The main causes of death among 15 – 49 year olds in both sexes included: injuries (23.6%) and ischemic heart disease (12.7%) The highest rates of YLDs were observed among 70+ year olds for both sexes (27,365 per 100,000), mainly due to low back pain, osteoarthritis, diabetes, falls, and major depressive disorder. The main risk factors to which deaths were attributable among children under 5 years included: suboptimal breast feeding, ambient PM pollution, tobacco smoking, and underweight. The most important risk factors among 15 to 49 year olds were: dietary risks, high blood pressure, high body mass index, physical inactivity, smoking, and ambient PM pollution. The pattern was similar among 50+ year olds.

Conclusion: Although non-communicable diseases had the greatest burden in 2010, the challenge of communicable and maternal diseases for health system is not over yet. Diet and physiological risk factors appear to be the most important targets for public health policy in Iran. Moreover, Iranians would greatly benefit from effective strategies to prevent injury and musculoskeletal disorders and expand mental care. Persistent improvement is possible by strengthening the health information system to monitor the population health and evaluate current programs.

Keywords: Burden of disease, Disability Adjusted Life Years (DALY), disability, mortality

Introduction

While there is no doubt about the burden of common diseases and risk factors, especially in developed countries, the Global Burden of Diseases, Injuries, and Risk Factors Study 2010 estimated the burden of a wide range of diseases, health disorders, and risk factors for 187 countries for 1990, 2005 and 2010 by sex and age. This study quantified the epidemiological transition in the majority of countries by significant improvement in life expectancy, decrease in childhood infectious diseases

and maternal death, an increase in chronic diseases, especially cardiovascular, and nonfatal health burden caused by mental disorders and musculoskeletal diseases.[1–5]

Globally, 52.8 million (95% UI: 51.6 – 54.1 million) deaths occurred in 2010 compared to 46.5 million (95% UI: 45.7 – 47.4 million) deaths in 1990. The pattern of diseases has changed in developing countries from communicable diseases to non-communicable diseases and injuries. In 1990, infectious diseases caused 15.9 million deaths (15,065.8 – 16,842.5), and cardiovascular diseases accounted for 25.6% of total morbidity. In 2010, 24.9% of deaths were due to communicable diseases. Non-communicable diseases caused 75.1% of all deaths.[5] There is a great deal of interest in how these changes can be detected and addressed by health systems for policymaking.

Iran's health system restructuring, which started in 1980, succeeded in expanding the health system's coverage of primary services, including family planning, vaccination, maternal and perinatal care, and children's health and growth monitoring. Fertility rate,[6] under-5 mortality,[7] and maternal mortality[8,9] have decreased

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significantly due to infectious disease control and perinatal care.[10] The Iranian population is much largest and older now, and life expectancy has increased significantly.[11,12] The change in distribution of diseases has been significant during the past 20 years, necessitating revision of health targets for health system planning and resource allocation.

Iran's burden of disease study, published in 2009, for the first time highlighted the great mortality and burden caused by road traffic injuries.[13] It gained a great deal of attention in different sectors, leading to a decline in road traffic injury deaths from more than 33,000 in 2005 to 19,000 in 2012. The case of air pollution is an opposite example.[14] Air pollution has been discussed in Iran for years and has increased and extended to almost all cities. However, lack of sufficient data about the mortality and disability caused by air pollution in Iran may be one reason for lack of serious intervention and attention from different sectors.[14] These examples highlight the necessity of estimating the burden of diseases and risk factors for monitoring the health status of the community and effective policymaking. There are multiple effective interventions to improve health on national and subnational levels; however, as resources are limited, determining priorities is the key. In this paper, we aim to provide scientific evidence, which can be crucial for guiding policymaking.

Overall, the burden of 291 diseases and 67 risk factors was estimated for 1990, 2005, and 2010. In this paper, we attempt to summarize and highlight the major findings on the burden of all diseases and risk factors by death and morbidity to clarify the current situation of health priorities and challenges in Iran.

Methods

Methods of estimating mortality and burden of diseases have been discussed extensively in capstone papers published by *The Lancet*.[15] The burden of 289 diseases with 1160 sequelae and 67 risk factors was assessed for three time periods: 1990, 2005, and 2010. A sequela is a clinical presentation of a disease that produces disability or causes death. One disease can have several sequelae, e.g., ischemic heart disease has three sequelae: myocardial infarction, angina pectoris, and heart failure. Several diseases may have common sequelae (impairment sequelae), e.g., heart failure is a sequela of both ischemic heart disease and cardiomyopathy.[4]

The Global Burden of Disease (GBD) studies produce several measures to report health loss and status: all-cause death, cause-specific death, years of life lost due to death (YLL), healthy years of life lost due to disability (YLD), disability-adjusted life years (DALYs), life expectancy, and healthy life expectancy. All measures were estimated for each estimation unit: 187 countries, two genders, three years (1990, 2005, and 2010), and 19 age groups from early neonatal (first week), late neonatal (first week to 28 days), post-neonatal (first month to one year), 1 – 4 years, five-year intervals until age 80, and above 80.[1–5,16,17]

Life expectancy was calculated by estimated age-sex-specific mortality rate. YLLs were calculated by multiplying the number of deaths due to each cause at each estimation block by a reference life expectancy, calculated by accounting the lowest observed mortality rate in each age group for each sex across all countries in 2010. So, the lowest mortality rate that may be observed in an age group in a certain sex-country may be observed in another age group in a different sex-country. The reference life expectancy at birth was 86 years and similar for both genders.

For modeling death and morbidity, data from all countries were standardized by format and were aggregated. All available data of a disease or sequela were used for modeling to inform country-level covariates and spatial analysis. The level of mortality or prevalence of a sequela in Iran is informed primarily by the data available from Iran, and then informed by country-level covariates such as income per capita, education, prevalence of smoking, or mean BMI. Moreover, a spatial analysis based on the random effects by super-region (regions are aggregated into seven super-regions), region, and country, as well as space-time smoothing of residuals helps to incorporate non-sampling variances and deviation from linear predictions. Finally, a combination of these techniques determines the level, which is different by cause and by the parameter of interest (mortality analysis or estimating prevalence of sequelae).

To estimate the number of deaths due to each GBD cause, data from vital registration systems, death registries, verbal autopsy studies, censuses, and demographic and health surveys were processed to attain standard age and sex format. Undefined causes of death were redistributed across other defined groups of causes of death based on the GBD cause list.

Briefly, the number of deaths was modeled as rate (ln_rate) and cause fraction (logit cf) measures for death. We tested and used more than 300 country-level covariates such as income per capita, access to health system, prevalence of smoking, and different metabolic and dietary risk factors. Each combination of covariates and outcome was modeled by three methods of linear, space-time smoothing, and Gaussian process regression. The final ensemble method evaluates performance of each model by the external validity of each component model and pools all results to estimate posterior distribution of the death variable (mortality rate or cause fraction).

By a COD correct process, we took advantage of different amounts of data at different levels of sub-causes under a GBD cause. For example, we estimated the total number of deaths, cardiovascular deaths, stroke deaths, and deaths by ischemic stroke and hemorrhagic stroke separately. We rescaled the number of cause-specific deaths to be added up into the total number of deaths and parent causes (all CVD deaths and stroke deaths in this example) at each estimation unit.[1,18]

YLDs were calculated by multiplying the number of patients (prevalence) having a specific sequela by the disability weight estimated in a separate study. Prevalence of the majority of sequelae was estimated by a Bayesian meta-regression tool called DisMod-MR.[4]

For each sequela, epidemiological data from published literature, country reports, and analyzed available datasets (such as world health survey, MONICA study, and STEP) were fed to the software. Seven epidemiological parameters can be used in DisMod-MR, including incidence, prevalence, remission, case fatality (in terms of excess mortality, relative risk of mortality, with condition mortality), and cause-specific mortality rate. DisMod-MR has the capability of using country-level covariates in the analysis. DisMod-MR estimation includes two main steps. In the first step, all epidemiological parameters were used in a generic compartmental model (including compartments of susceptible population, patients, and deaths). The output of the first step contributed to a first guess or empirical prior distribution for region-, sex-, and year-specific analysis (second level), in which only local data were used in the model. The posterior distribution of preva-

lence was eventually estimated and used.

Disability weights of different conditions were estimated by population-based surveys including one telephone survey in the United States and household surveys in Bangladesh, Indonesia, Peru, and Tanzania.[17]

DALYs are prevalence-based and were calculated by adding YLL to YLD at the estimation block. We did not incorporate discounting for YLL and so did not weight the outcome estimate by age (no discounting and age weighting).[2] Definitions are provided in Table 1.

Burden of disease attributable to each of 67 risk factors was calculated by comparing current distribution of each risk factor with a theoretical minimum risk counterfactual distribution. Different statistical methods such as space-time/GPR technique or meta-regression (by DisMod-MR) were used to pool available data to estimate prevalence of each risk factor by country, age, and sex. The relative risk of mortality/morbidity was estimated by meta-analysis of current published literature or from recently published systematic reviews. Attributable outcome fraction for each risk factor was calculated by population-attributable fraction formula using prevalence of risk factor, relative risk, and theoretical minimum risk distribution.

$$PAF = \frac{\int_{x=0}^{m} RR(x)P(x)dx - \int_{x=0}^{m} RR(x)P'(x)dx}{\int_{x=0}^{m} RR(x)P(x)dx}$$

Where $RR(x)$ is the relative risk at exposure level x, $P(x)$ is the (observed or estimated) population distribution of exposure, $P'(x)$ is the counterfactual distribution of exposure, i.e., the TMRED, and m the maximum exposure level.[16]

The burden of each risk factor was multiplied by the attributable risk fraction to calculate the attributable burden of the sequela to the risk factor. Total burden of diseases attributable to the risk fac-

tor was the sum of the burden of all sequelae attributable to that risk factor. Because the burden associated with each risk factor was estimated separately, the total risk factor burden for a disease could be greater than the total burden of the disease.[16]

Age-standardized mortality rate and DALYs per capita were calculated using WHO standard population. Uncertainty intervals were estimated by a Monte Carlo method, taking one thousand draws of the posterior estimation of each parameter at every step. Cumulative mortality of cancers was estimated by age-specific mortality rates for the interval of zero to 80 years of age. Numbers in parentheses are 95% credible intervals of the posterior distribution of the estimate.[2,5]

Results

Life expectancy at birth in Iran was estimated to be 71.6 years (68.5 – 74.6) for men and 77.8 years (75.3 – 80.2) for women in 2010. Healthy life expectancy for men was 61.5 years (58.5 – 64.6) and for women was 65.3 (62.4 – 68.3). The disability gap (the proportional difference) between LE and HALE was notably wider in young and middle age groups, denoting more healthy life loss by the diseases morbidity in women under age 60 (Figure 1).

Overall, 351,814 (326,704 – 392,817) deaths occurred in 2010 in Iran, with 223,768 deaths (204,561 – 256,176) in men and 128,045 (111,220 – 148,610) in women. Non-communicable diseases were responsible for 76.4% of total deaths (74.0 – 79.1), injuries caused 14.4% of total deaths (11.8 – 16.4), and communicable, maternal, neonatal, and nutritional diseases caused 9.2% of all deaths (7.9 – 10.6) (Table 2).

All-cause mortality rate was 475.7 per 100,000 (441.7 – 531.1), with a much higher rate of death in men (596.1: 544.9 – 682.4) versus women (351.5: 305.3 – 408.0). Age-standardized mortality rate was about 1.6 times higher in men. The largest gap between men and women pertained to age 15 – 49 years, in which men die 2.36 times more than women on the average. Under-1 mortality

Table 1. Outcome measures for assessment of population health and burden of diseases in GBD 2010 study in Iran

Outcome definition	Unit of Measurement
All-cause mortality (rate): Total number of deaths, or rate by any cause.	Total number of deaths, mortality rate, age-specific death number and age-standardized mortality rate
Cause-specific mortality: number of deaths caused by a disease. The disease is a real cause of death (not an intermediate cause or presentation at death).	Total number of cause-specific deaths, cause-specific death rate, and standardized mortality rate
Life expectancy: number of years expected to live at each age based on current age-specific rates of death	Number of years, different by age and sex
Reference life expectancy: life expected if the best age-specific mortality rates among countries in 2010 are assumed for a population.	Number of years, different by age
YLL, years of life lost due to premature death: total number of potential years lost based on reference life expectancy. It would be zero for a disease that does not cause death, such as low back pain.	Total YLL, YLL per capita, age-standardized YLL per capita
YLD, years of life lost due to disability: number of years lost by disability of a sequela compared with a healthy person. For example, one year living with a sequela with disability weight of 0.05 yields 0.05 YLD. It would be zero if a disease is primarily subclinical without disability such as aortic aneurysm.	Total YLD, YLD per capita, age-standardized YLD per capita
DALY, disability-adjusted life years, sum of total years lost due to death and total years lost due to disability	Total DALYs, DALYs per capita, age-standardized DALYs per capita
Healthy life expectancy, number of years expected to live free of any disability. A part of life expectancy after extracting years lost due to disability.	Number of years, different by age

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Table 2. Total number of deaths, YLLs, YLDs and DALYs (thousands) lost in 2010 (all ages)

|	Female				Male			
	DALYs	YLDs	YLLs	Deaths	DALYs	YLDs	YLLs	Deaths
All cause	8415.4 (7394.9, 9502.9)	4592.1 (3695.7, 5526.6)	3823.2 (3319.6, 4639.1)	128 (111.2, 148.6)	10986 (9879.3, 12381.1)	4252.4 (3495.4, 5106.3)	6733.6 (6041.3, 7841.6)	223.8 (204.6, 256.2)
Communicable, maternal, neonatal, and nutritional disorders	1282 (1032.3, 1597.2)	503.7 (374.1, 672.8)	778.3 (564, 1057.4)	12.5 (9.9, 15.7)	1540.6 (1223, 1886)	417.9 (318.4, 546)	1122.7 (838.9, 1465.4)	19.8 (16.2, 24)
HIV/AIDS and tuberculosis	32.3 (25.9, 40.8)	15.2 (9.7, 23.2)	17.1 (14, 20.7)	0.5 (0.4, 0.6)	142.8 (123.1, 166)	31.7 (21.1, 45.7)	111.2 (95.4, 128.6)	2.7 (2.3, 3.1)
Diarrhea, lower respiratory infections, meningitis, and other common infectious diseases	286.8 (226, 361.3)	91 (59.8, 138.5)	195.8 (148.4, 255.5)	4.5 (3.6, 5.6)	341.4 (273.9, 422.6)	95.5 (59.1, 149.3)	245.8 (190.8, 318.7)	6.6 (5.2, 8.1)
Neglected tropical diseases and malaria	26.9 (19.2, 38.9)	16 (10.4, 24.4)	10.9 (5.9, 19)	0.2 (0.1, 0.3)	39.4 (26.7, 56.9)	17.6 (11.4, 26.3)	21.8 (11.8, 38.2)	0.4 (0.2, 0.8)
Maternal disorders	26 (12.3, 68.7)	15.2 (3.4, 57.4)	10.8 (6.6, 15.9)	0.2 (0.1, 0.3)	. (.,.)	. (.,.)	. (.,.)	. (.,.)
Neonatal disorders	504.6 (311.2, 754)	32.8 (23.8, 43.9)	471.9 (275.3, 723.2)	5.5 (3.2, 8.4)	684.3 (410.6, 1016.7)	45.5 (32.7, 60.9)	638.8 (367.4, 971.8)	7.4 (4.3, 11.3)
Nutritional deficiencies	326 (228.4, 455.1)	310.6 (213.3, 442.6)	15.4 (9.5, 25.7)	0.3 (0.2, 0.6)	217.2 (151.1, 304.5)	201.1 (136.2, 289.8)	16.1 (10.1, 25.3)	0.4 (0.3, 0.6)
Other communicable, maternal, neonatal, and nutritional disorders	79.4 (58.5, 122.6)	23 (15.3, 33.6)	56.5 (37.7, 98.8)	1.3 (0.8, 1.9)	115.5 (87.2, 157.3)	26.6 (18.3, 38.3)	89 (61, 126.9)	2.3 (1.6, 3.1)
Non-communicable diseases	6351.5 (5495.2, 7255.3)	3906.3 (3151.4, 4728.5)	2445.2 (2080, 3135)	103.1 (87.9, 122.3)	7313.9 (6546.9, 8345.3)	3490.7 (2845.5, 4208.4)	3823.1 (3421.7, 4694.7)	165.6 (150, 192.3)
Neoplasms	422.3 (354.3, 499.4)	8.1 (5.7, 11)	414.1 (346, 490.4)	14.7 (12.5, 17.2)	603.2 (515.5, 719)	9.7 (6.8, 13.3)	593.5 (505.4, 708.1)	25.4 (21.5, 30)
Other non-communicable diseases	703.3 (487.6, 1001.2)	372 (248.5, 553.1)	331.3 (155.9, 588.8)	4 (1.9, 7)	736.3 (499, 1045.8)	376.8 (248.1, 573.3)	359.4 (172.9, 600.7)	4.3 (2.1, 7.1)
Cardiovascular and circulatory diseases	1173.6 (892.5, 1400)	65.8 (46.4, 89.9)	1107.8 (830.3, 1337.3)	62.2 (48.1, 71)	2062.8 (1871.9, 2305.9)	79.6 (55, 111.2)	1983.2 (1792.8, 2227.2)	102.2 (92.5, 113.3)
Chronic respiratory diseases	352.7 (246.6, 507.9)	238 (134.7, 396.1)	114.6 (96.8, 141.1)	5 (4.3, 5.8)	458.2 (340.9, 631.2)	258.8 (148.6, 427.4)	199.3 (169.4, 238.7)	9.4 (8, 11)
Cirrhosis of the liver	25.3 (19.7, 37.3)	0.8 (0.4, 1.5)	24.5 (19, 36.6)	.9 (.7, 1.3)	53 (42.5, 74.1)	1.2 (.6, 2.1)	51.8 (41.4, 73)	1.9 (1.5, 2.6)
Digestive diseases (except cirrhosis)	59.1 (49.6, 71.9)	14.4 (8.4, 25.6)	44.6 (38.3, 51.8)	2 (1.7, 2.3)	84.4 (66.4, 106.2)	16.8 (9.2, 30.3)	67.6 (52.3, 83.9)	3 (2.3, 3.8)
Neurological disorders	306.7 (247.5, 369.5)	233.2 (180.4, 288.7)	73.5 (47.6, 108.3)	2.9 (1.9, 4.4)	283.1 (235, 331.7)	189.3 (150, 229.9)	93.8 (64.7, 127.8)	3.9 (2.7, 5.6)
Mental and behavioral disorders	1403.9 (944.9, 2109.8)	1386.5 (929.8, 2096.5)	17.4 (11.8, 28.7)	0.5 (0.3, 0.8)	1268.7 (949.5, 1736.6)	1120.9 (828.7, 1532.8)	147.8 (75.7, 308.6)	3.4 (1.9, 7.1)
Diabetes, urogenital, blood, and endocrine diseases	692 (507.3, 1085.8)	382.8 (274.1, 533)	309.2 (201.1, 677.1)	10.8 (7.7, 19.8)	608.8 (465.7, 992.3)	287 (213.1, 383.4)	321.8 (224.4, 717.6)	11.8 (8.8, 21.9)
Musculoskeletal disorders	1212.8 (923.1, 1511.5)	1204.7 (914.6, 1504.1)	8 (5.3, 15)	0.3 (0.2, 0.5)	1155.5 (854.4, 1514.5)	1150.7 (849.6, 1511.4)	4.8 (3.1, 9.8)	0.2 (0.1, 0.4)
Injuries	781.9 (625.6, 960.3)	182.1 (122.3, 260.9)	599.7 (456.2, 776)	12.4 (9.8, 15.6)	2131.6 (1681.7, 2554.1)	343.8 (234.1, 492.9)	1787.8 (1366.2, 2174.9)	38.4 (30.1, 46.4)
Transport injuries	328.8 (241.6, 432.3)	73.3 (47.7, 108.9)	255.5 (170.6, 360.3)	5.6 (3.9, 7.5)	1136.2 (785.5, 1456.2)	141.6 (93.1, 201.2)	994.6 (639.6, 1304.8)	22.2 (15, 28.6)
Unintentional injuries other than transport injuries	355.5 (290.8, 439.3)	102.1 (68.5, 147.5)	253.3 (199.1, 327.1)	5 (4, 6.2)	727.9 (620.4, 859.9)	180.4 (122.6, 262.4)	547.5 (463, 658.7)	11.2 (9.7, 13.2)
Self-harm and interpersonal violence	97.6 (52.2, 150.4)	6.7 (4.2, 10)	90.9 (45.7, 144.2)	1.8 (0.9, 2.8)	267.5 (190.4, 373)	21.9 (14.3, 31.5)	245.6 (166.9, 352.8)	5 (3.5, 7.2)
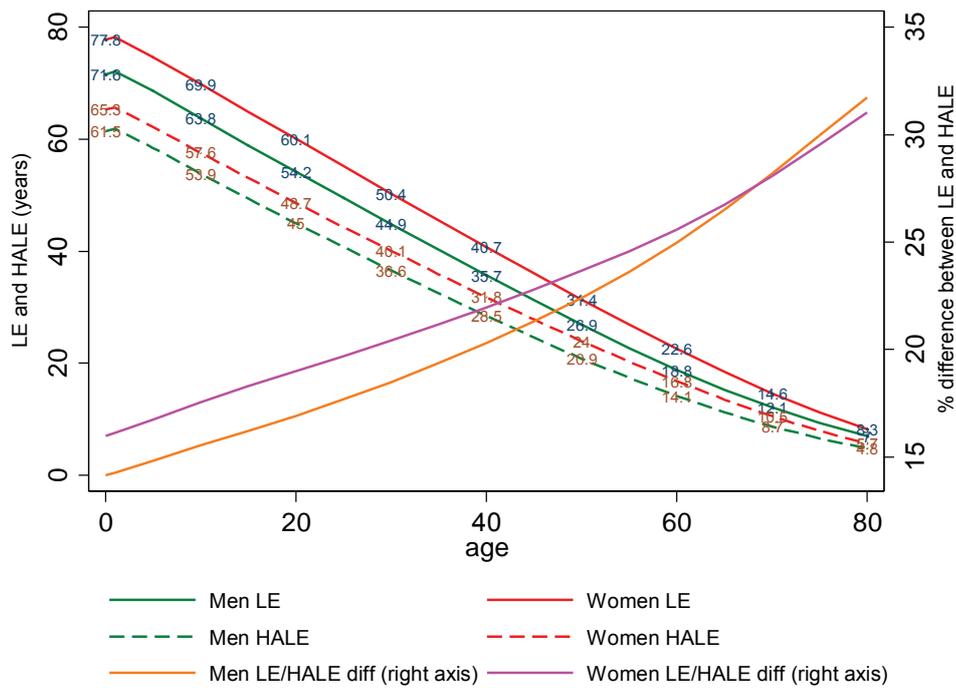
Figure 1. Life expectancy, healthy life expectancy, and proportion of life expectancy lost by disability in men and women, 2010

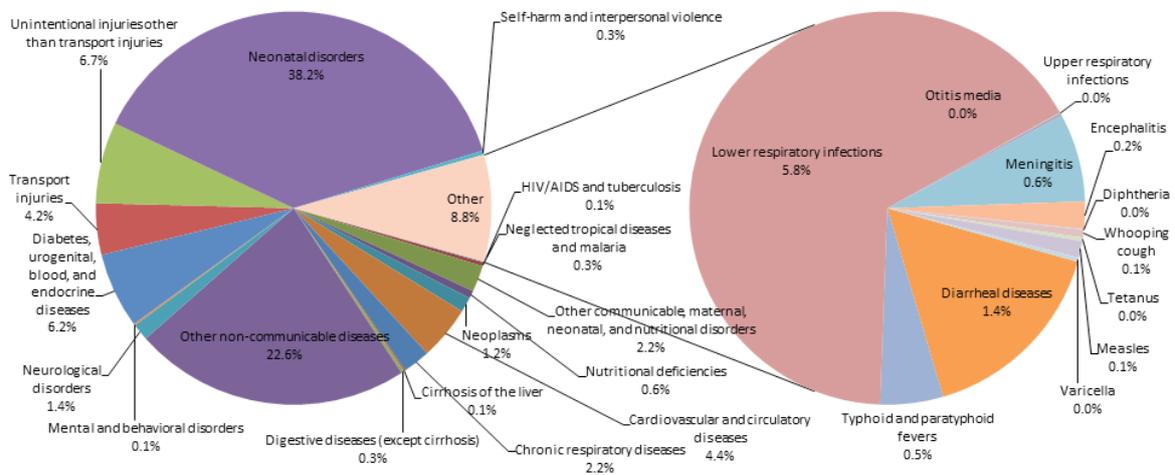**Proportion of under-5 deaths by cause**

Figure 2. Proportion of causes of death among children under 5

rate (total number of deaths in this age group) was 2,227.8 per 100,000 (1,665.4 – 2,940.7), and under-5 mortality rate was 550.9 per 100,000 (425.5 – 729.1). 5q0 or probability of death before the fifth birthday was estimated to be 2.7% (1.65 – 4.1) for girls and boys. The lowest death rate belonged to females aged 5 – 14, at 30.2 per 100,000 (23.3 – 39.1). Two hundred (120 – 299) mothers died because of pregnancy and childbearing complications, with a total maternal death rate of 0.89 per 100,000 (0.53 – 1.32). 45q15, or cumulative probability of death between 15 and 60 years of age was 7.6% (5.7 – 10.0) for women and 15.25% (11.1 – 20.2) for men.

A total of 33,821 deaths (26,122 – 44,756) occurred in both males and females under 5, with 478 deaths (299 – 755) due to diarrheal diseases and 1,974 (1,323 – 2,814) due to lower respi-

ratory infections. However, the most important causes of death among children under 5 included, in descending order, congenital anomalies, causing 6,149 deaths (2,766 – 10,567); preterm birth complications, causing 6,089 deaths (4,240 – 8,331); and lower respiratory infections, responsible for 1,974 deaths (1,323 – 2,814) (Figure 2). The pattern is similar in both sexes for deaths, YLLs, and DALYs. As for YLDs for both sexes, iron-deficiency anemia, causing 115,664 YLDs (75,837 – 169,774); diarrheal diseases, responsible for 48,928 YLDs (28,858 – 77,535); and thalassemia, causing 16,591 YLDs (10,754 – 24,665), were the most important causes of disability in descending order of magnitude.

As for deaths and DALYs attributable to risk factors, the following are the top causes among children under 5, in descending order of magnitude: iron deficiency, suboptimal breastfeeding,
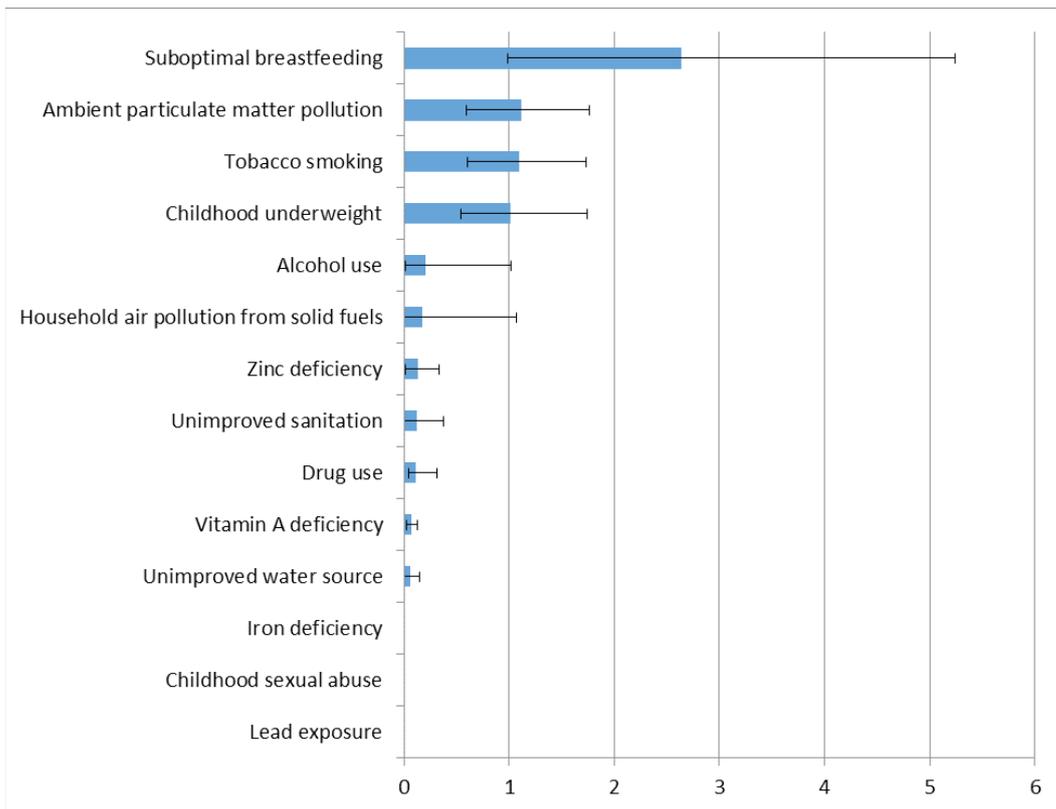
Figure 3. Percent of deaths attributable to main risk factors in children under 5, both sexes, Iran, 2010
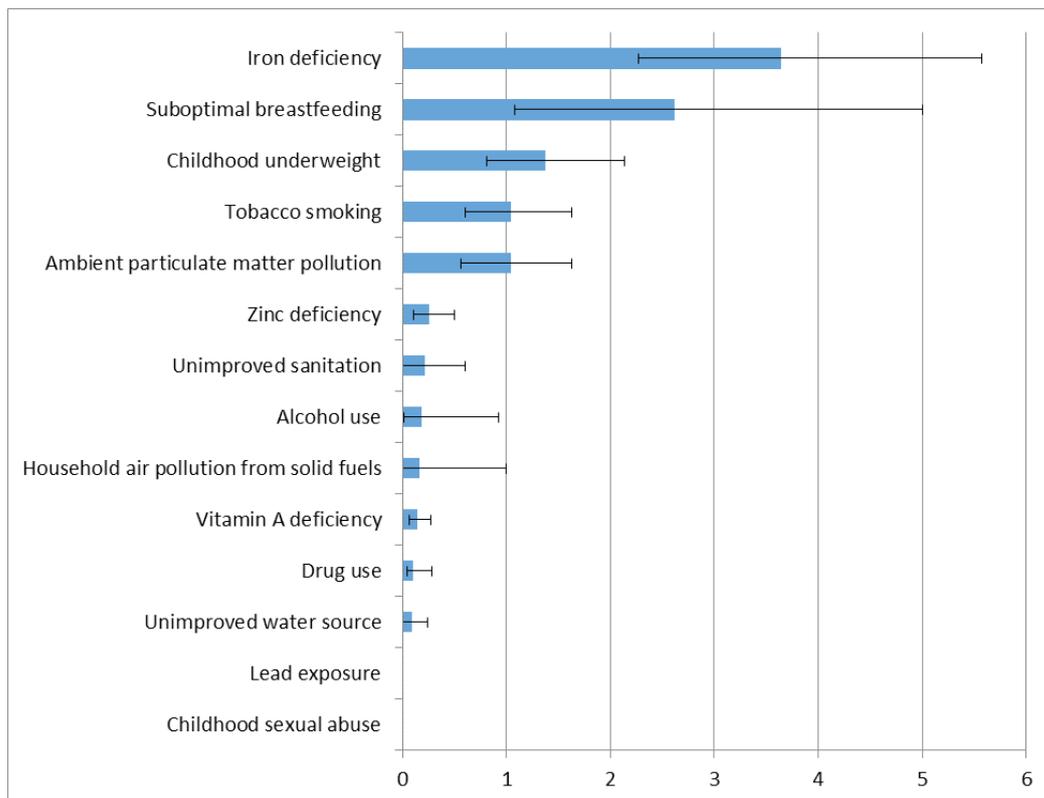

Figure 4. Percent of DALYs attributable to main risk factors in children under 5, both sexes, Iran, 2010

childhood underweight, smoking (secondhand), and ambient particulate matter (PM) pollution (Figures 3 and 4).

The most important cause of death in 2010 was ischemic heart disease, with 89,250 deaths (77,673 – 97,058). This condition was responsible for 25.4% (21.3% – 28.3%) of all deaths (25.9% in men and 24.7% in women) (Figures 5 and 6). Road injuries, at 27,486 (20,459 – 37,330); ischemic stroke at 19,870 (16,765 – 23,464); and hemorrhagic stroke at 17,003 (14,035 – 21,631) were the next most important causes of death overall. The cumulative risk of cancer from birth to age 80 was 17.3% (15.2% – 19.6%)
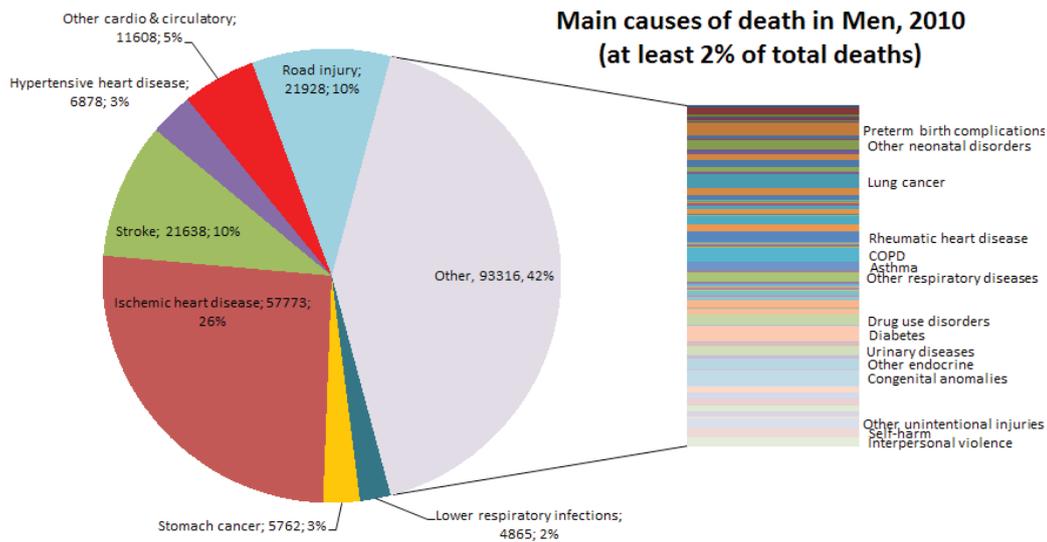
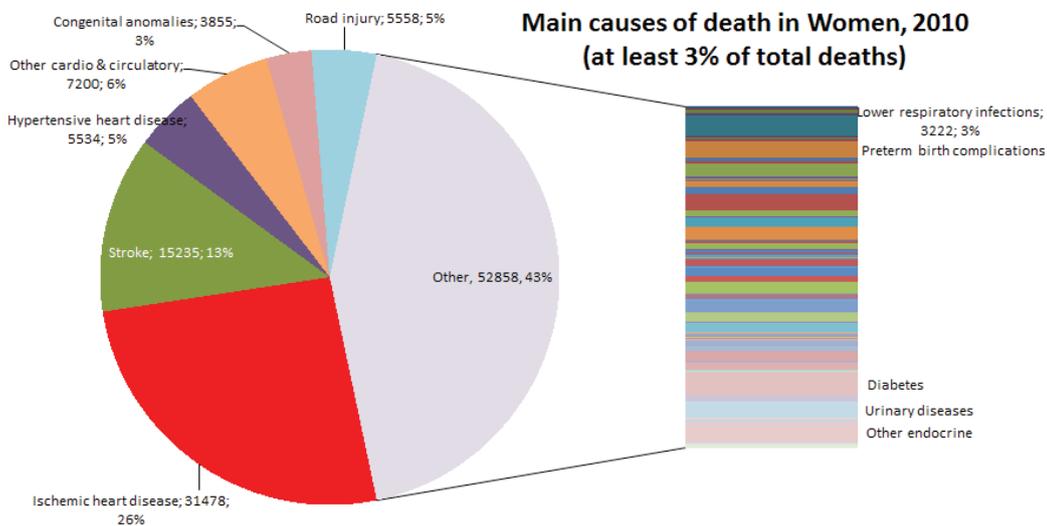**Figure 5.** Main causes of death in men, 2010

Figure 6. Main causes of death in women, 2010

for men and 10.9% (9.7% – 12.6%) for women. Stomach cancer has the highest lifetime risk in men, followed by prostate cancer, whereas for women, breast cancer has the highest cumulative risk followed by stomach cancer. Figure 7 demonstrates the cumulative risk of different cancers up to 80 in 2010 in Iran and Figure 8 demonstrates the risk of mortality caused by different cancers in Iran 2010. The main causes of DALYs in men and women are demonstrated in Figures 9 and 10 respectively.

Among 15 to 49-year-olds, road injuries and ischemic heart disease were the top two causes of deaths for men and women, followed by self-harm, other cardiac & circulatory diseases, fire, and stroke. Drug use disorders, HIV/AIDS, and interpersonal violence were other main causes of deaths in men. Maternal disorders ranked nineteenth among causes of death in women (Figures 11 and 12).

The two main causes of disability among both men and women were low back pain (946,543 YLDs: 648,563 – 1,295,848) and major depressive disorder (815,342 YLDs: 525,734 – 1,255,597).

Major depressive disorder caused the highest fraction of YLDs and DALYs in women, while low back pain was the most important cause of disability in men. Osteoarthritis and other musculoskeletal disorders contributed to more YLDs in women than men, while a reverse pattern is observed for road injuries and falls. Road traffic injury has the highest priority and top rank by the number of deaths and YLLs compared with other causes in men (Figure 13).

Dietary risks (527,114 DALYs: 449,012 – 603,302) and high body mass index (521,247 DALYs: 424,188 – 630,325) were the most important risk factors in 15 to 49-year-olds. The next most important risk factors included occupational risks (460,154: 336,709 – 608,662), drug use (397,028: 264,827 – 630,172), high blood pressure (307,572: 227,805 – 391,703), physical inactivity (258,906: 207,562 – 313,749), smoking (227,515: 171,465 – 289,648), high fasting plasma glucose (211,910: 157,771 – 276,534), ambient PM pollution (201,548: 163,351 – 241,603), and high total cholesterol (190,140: 136,263 – 247,790). Men had
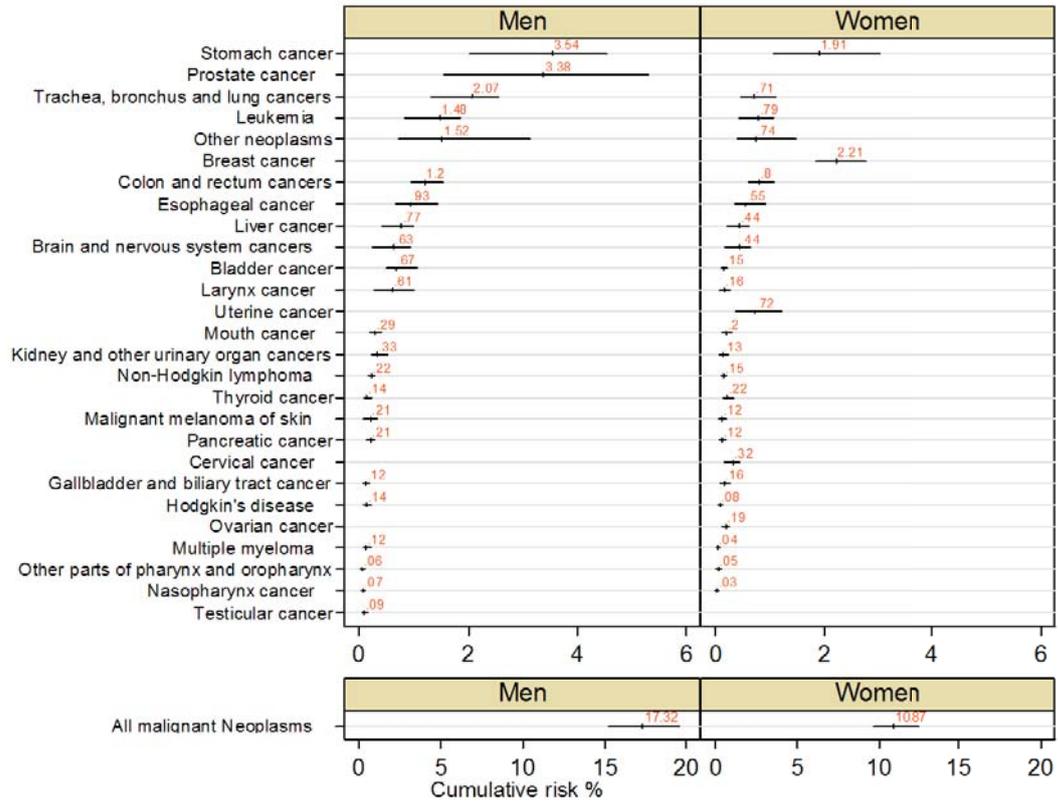
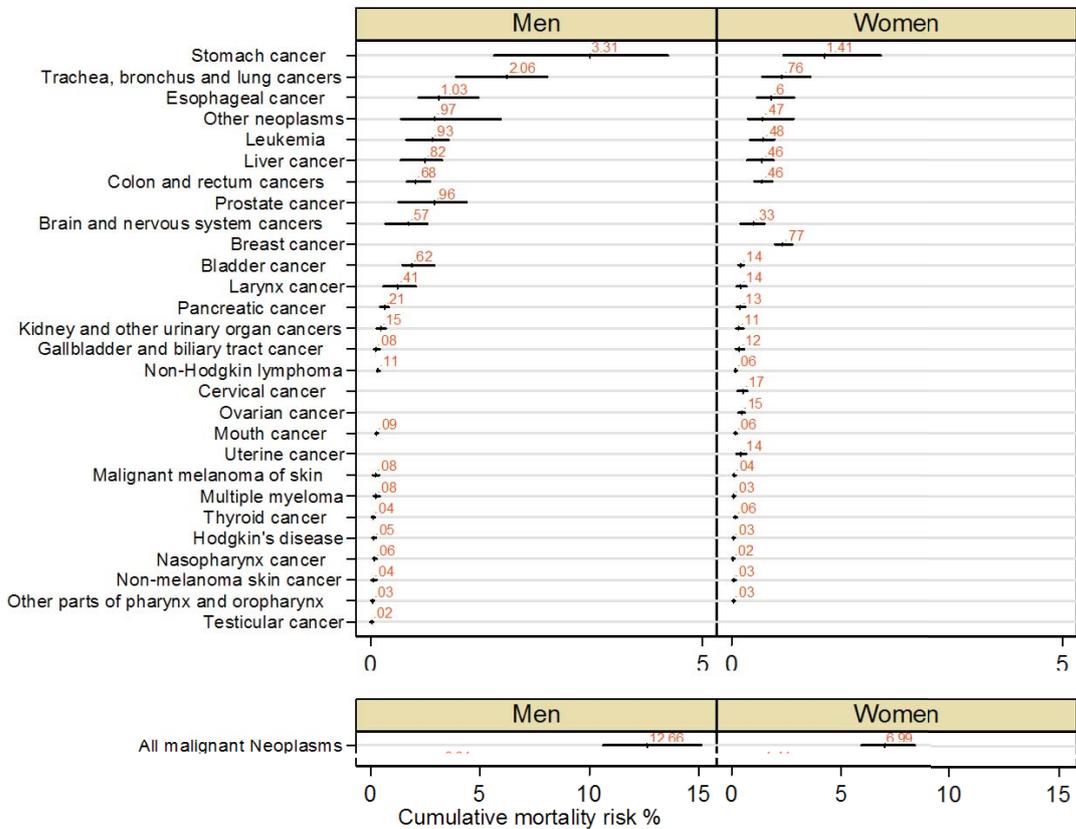**Figure 7.** Cumulative risk of different cancers, up to age 80, Iran, 2010

Figure 8. Cumulative risk of mortality caused by different cancers, up to age 80 in Iran, 2010
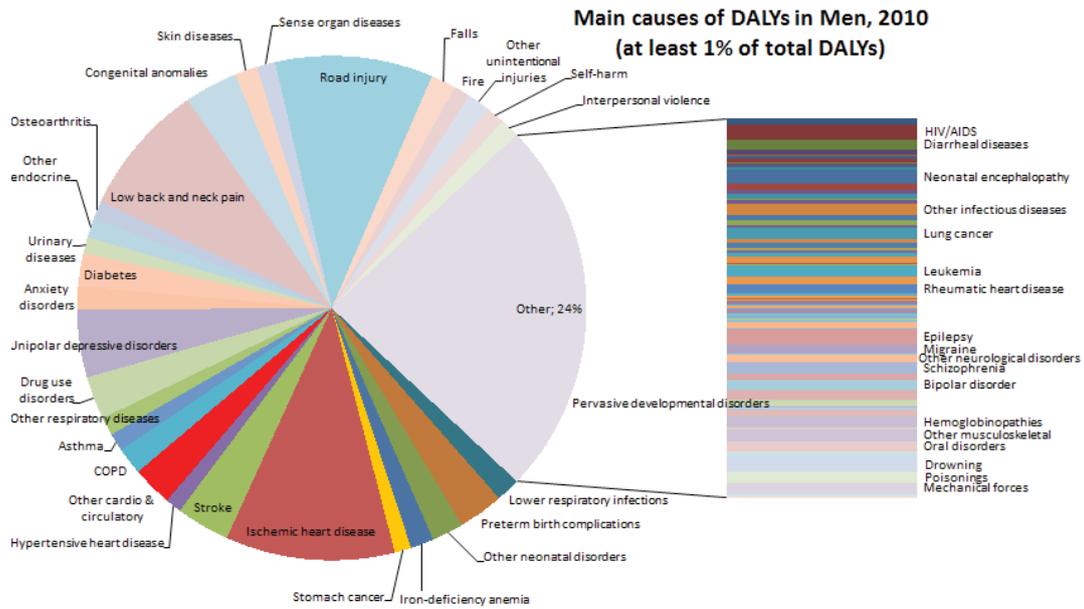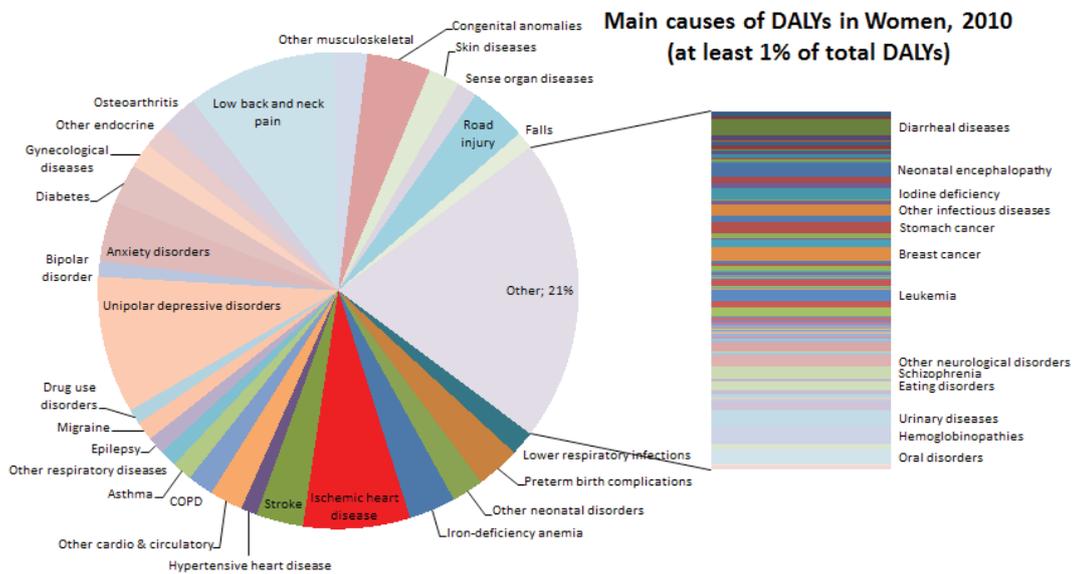
Main causes of DALYs in Men, 2010 (at least 1% of total DALYs)

Skin diseases
Congenital anomalies
Osteoarthritis
Other endocrine
Low back and neck pain
Urinary diseases
Diabetes
Anxiety disorders
Jnipolar depressive disorders
Drug use disorders
Other respiratory diseases
Asthma
COPD
Other cardio & circulatory
Hypertensive heart disease
Stroke
Ischemic heart disease
Stomach cancer
Iron-deficiency anemia
Other neonatal disorders
Preterm birth complications
Lower respiratory infections
Pervasive developmental disorders
Other; 24%

Sense organ diseases
Road injury
Falls
Fire
Other unintentional injuries
Self-harm
Interpersonal violence

HIV/AIDS
Diarrheal diseases
Neonatal encephalopathy
Other infectious diseases
Lung cancer
Leukemia
Rheumatic heart disease
Epilepsy
Migraine
Other neurological disorders
Schizophrenia
Bipolar disorder
Hemoglobinopathies
Other musculoskeletal
Oral disorders
Drowning
Poisonings
Mechanical forces

Figure 9. Main causes of DALYs in men, 2010

Main causes of DALYs in Women, 2010 (at least 1% of total DALYs)

Other musculoskeletal
Osteoarthritis
Other endocrine
Gynecological diseases
Diabetes
Bipolar disorder
Anxiety disorders
Unipolar depressive disorders
Drug use disorders
Migraine
Epilepsy
Other respiratory diseases
Asthma
COPD
Other cardio & circulatory
Hypertensive heart disease
Stroke
Ischemic heart disease
Iron-deficiency anemia
Other neonatal disorders
Preterm birth complications
Lower respiratory infections
Other; 21%

Congenital anomalies
Skin diseases
Sense organ diseases
Low back and neck pain
Road injury
Falls

Diarrheal diseases
Neonatal encephalopathy
Iodine deficiency
Other infectious diseases
Stomach cancer
Breast cancer
Leukemia
Other neurological disorders
Schizophrenia
Eating disorders
Urinary diseases
Hemoglobinopathies
Oral disorders

Figure 10. Main causes of DALYs in women, 2010

Main causes of DALYs in Men 15-49, 2010 (at least 2% of total DALYs)

Interpersonal violence; 2.3%
Self-harm; 2.2%
Other unintentional injuries; 3.2%
Road injury; 15.5%
Low back and neck pain; 12.1%
Anxiety disorders; 2.5%
Unipolar depressive disorders; 7.0%
Drug use disorders; 5.5%
Ischemic heart disease; 5.6%
Other; 44.2%

HIV/AIDS
Stroke
Other cardio & circulatory
COPD
Epilepsy
Schizophrenia
Bipolar disorder
Diabetes
Other musculoskeletal
Skin diseases
Falls
Drowning
Fire
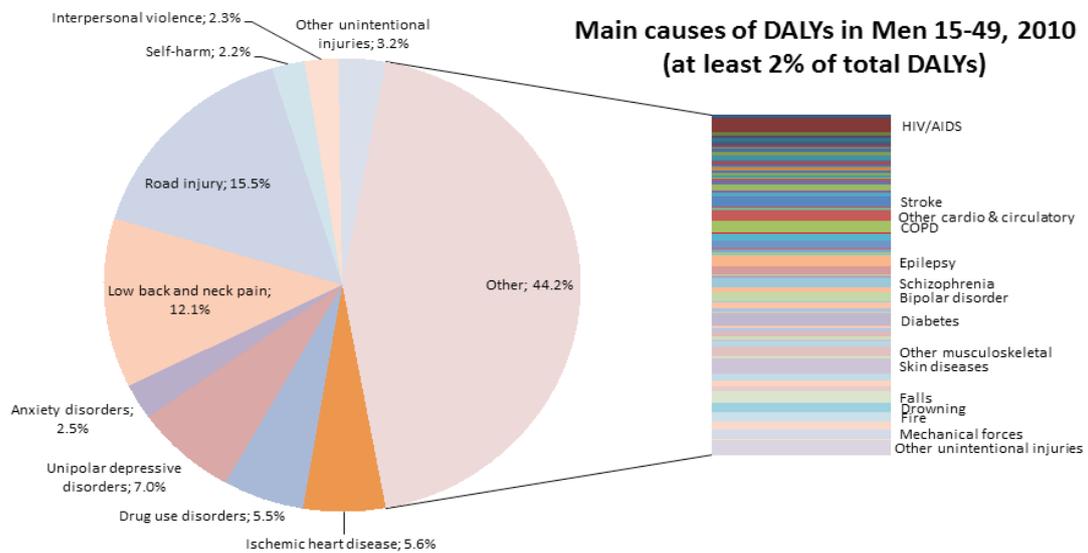Mechanical forces
Other unintentional injuries

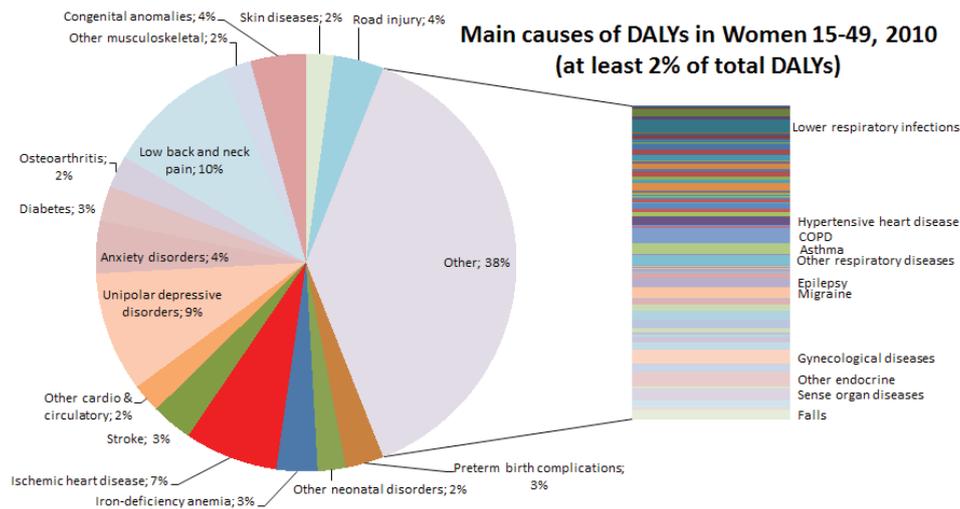**Figure 11.** Main causes of DALYs in men 15 – 49 years, 2010

Figure 12. Main causes of DALYs in women 15 – 49 years, 2010

higher DALYs and number of deaths attributable to dietary risk factors and physical inactivity in 25 to 49-year-olds (351,047 and 7,000, respectively) than women (176,067 and 3,177, respectively). Alcohol use ranks fifth among DALYs in men (537,248) but is much lower in women (126,099). Drug and alcohol use contribute to the highest DALYs among 25 to 29-year-old men (138,902 DALYs and 1303 deaths). The number of DALYs and deaths attributable to ambient PM pollution is higher in men (137,397 DALYs and 2,862 deaths) than women (64,151 DALYs and 1,267 deaths) between 25 and 49 years old, and highest in men 45 to 49 years old (47,579 DALYs and 1,160 deaths), (Figures 14 and 15).

As expected, DALYs and deaths attributable to smoking are higher among men (193,561 DALYs and 3,725 deaths) than women (33,954 DALYs and 530 deaths) in all ages from 25 to 49 years old. And also as expected, the proportion of DALYs and deaths attributable to secondhand smoke is higher in women (11.8% of DALYs and 15.2% of deaths) than men (2.8% of DALYs and 3.1% of deaths).

A large fraction of deaths and DALYs loss occur after age 50. A total number of 250,411 deaths (226,719 – 282,548) and 6,496,964 DALYs (5,884,831 – 7,287,661) occurred in this age group in 2010 in Iran. A total of 47.3% of all deaths across all ages occurred in 70+ year olds (166,470: 152,839 – 183,607) and 23.9% have occurred in 50-69 year olds (83,941: 73,880 – 98,941). The figures for the fraction of DALYs in 70+ year olds (2,524,562: 2,316,532 – 2,763,786) and 50 – 69 year olds (3,972,403: 3,568,298 – 4,523,876) amount to 13.0% and 20.5% of total DALYs in all age groups, respectively. Ischemic heart disease was the main cause of death among males, causing 33.1% of deaths (34,010: 28,738 – 38771) in 70+ year olds and 32.1% of all deaths (17,701: 13,635 – 20,626) among 50 – 69 year olds. Ischemic heart disease is the most important cause of death in females, as well, causing 33.2% of all deaths among 70+ year olds (21,131: 17,363 – 24,208) and 27.5% of all deaths among 50 – 69 year olds (7,920: 6,094 – 9,499). The second main cause of death is ischemic stroke among 70+ year olds (9.3% of total deaths in that age group) causing 15,513 deaths (12,702 – 18,817), and hemorrhagic and other non-ischemic stroke among 50-69 year olds (5.5% of total deaths in that age group) causing 4,620 deaths (3,626 – 6,052). The pattern is similar in men and women.

As for DALYs, ischemic heart disease still ranks first in both

sexes in 70+ years old (611,105: 532,624 – 672,072) and 50-69 year olds (720,142: 583,864 – 819,937). Ischemic stroke ranks second among 70+ year olds in terms of DALYs (165,736: 138,154 – 200,160). However, the second most important cause of DALYs among 50 – 69 year olds is low back pain (322,629: 220,604 – 437,654). Low back pain is also the most important cause of YLDs, both among 70+ year olds (125,236: 86,205 – 169,680) and 50-69 year olds (720,142: 583,864 – 819,937).

Generally speaking, it is noticeable that health loss by morbidity of diseases, YLD, is much higher in 70+ year olds than younger age groups such that the mean YLD per 100,000 people increases from 11,857 (9,806 – 14,068) in the 15 – 49 age group to 19,602 (16,101 – 23,303) in the 50 – 69 age group, and increases sharply still among 70+ year olds to 27,365 (22,454 – 32,733) per 100,000 people (Figure 16). The main causes of YLDs among 70+ year olds in both sexes include: low back pain with YLD per 100,000 people of 4743.8 (3265.3 – 6427.3), osteoarthritis (2054.9: 1343.8 – 2966.8), diabetes (2047.5: 1389.9 – 2862.1), falls (1563.4: 1084.0 – 2213.5), and major depressive disorder (1468.9: 943.7 – 2231.9). The main causes of YLD among 50 – 69 year olds in both sexes are the following (per 100,000 people): low back pain (3716.7: 2541.4 – 5041.8), osteoarthritis (1946.8: 1259.1 – 2832.7), major depressive disorder (1878.1: 1181.5 – 2876.3), and diabetes (1254.7: 863.8 – 1771.7).

As for deaths attributable to risk factors among 70+ year olds, dietary risks (63,931: 56,663 – 71,194), high blood pressure (61,705: 52,093 – 70,134), high body mass index (24,130: 19,278 – 28,955), physical inactivity (19,639: 15,816 – 23,428), ambient air pollution (16,754: 13,584 – 20,398), tobacco smoking (15,658: 11,730 – 20,449), high total cholesterol (14,756: 9,630 – 20,522), and high fasting plasma glucose (13,916: 10,051-18,080) are the most important risk factors of death in descending order of magnitude (Figure 17). The main risk factors among 50 – 69 year olds to which deaths are attributable include: dietary risks (33,753: 29,380 – 37,570), high blood pressure (29,002: 24,228 – 33,327), high body mass index (17,213: 14,082 – 20,449), tobacco smoking (13,281: 10,697 – 15,940), physical inactivity (12,235: 9,668 – 14,861), high total cholesterol (12,007: 8,802 – 15,392), ambient air pollution (11,032: 9,132 – 12,921), and high fasting plasma glucose (9,163: 6,491 – 12,080), demonstrated in Figure 18.
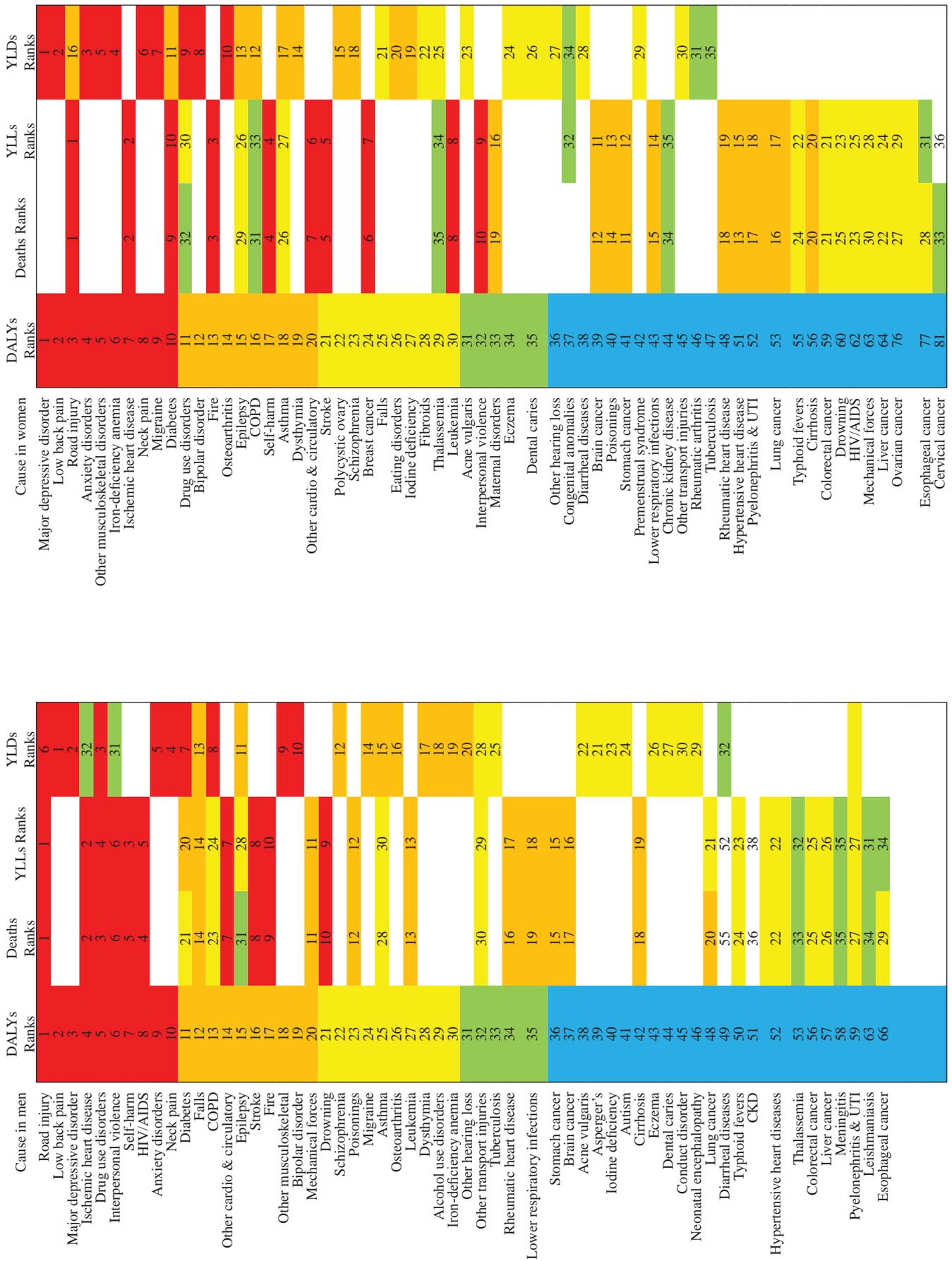
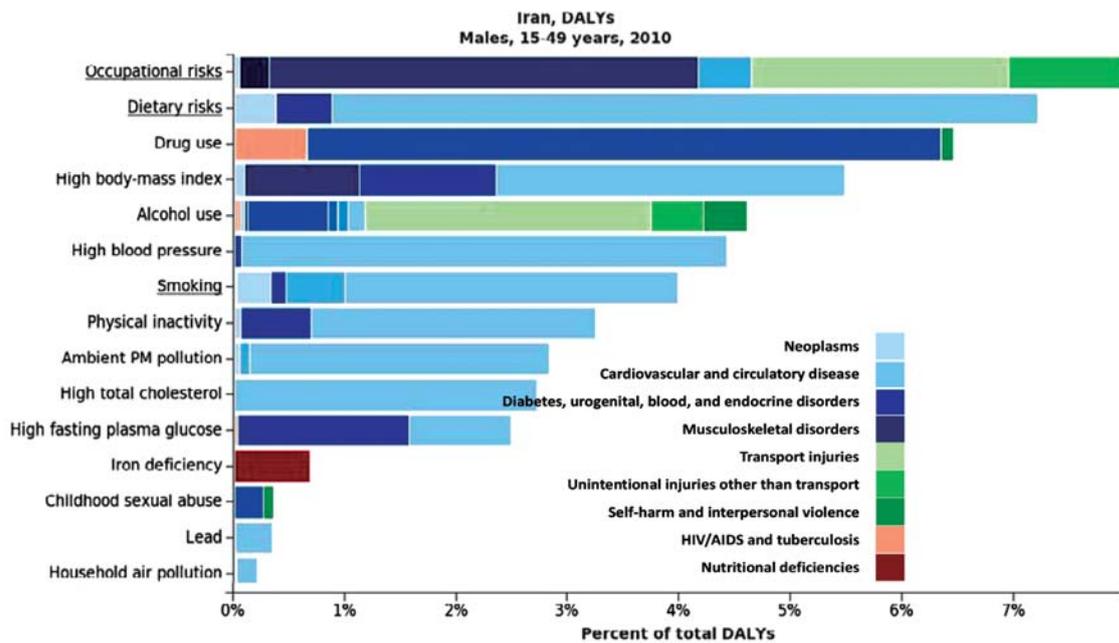**Figure 13.** Heatmap of DALYs, deaths, YLLs, and YLDs in men and women

Figure 14. DALYs attributable to main risk factors in men 15 – 49 years old, Iran, 2010
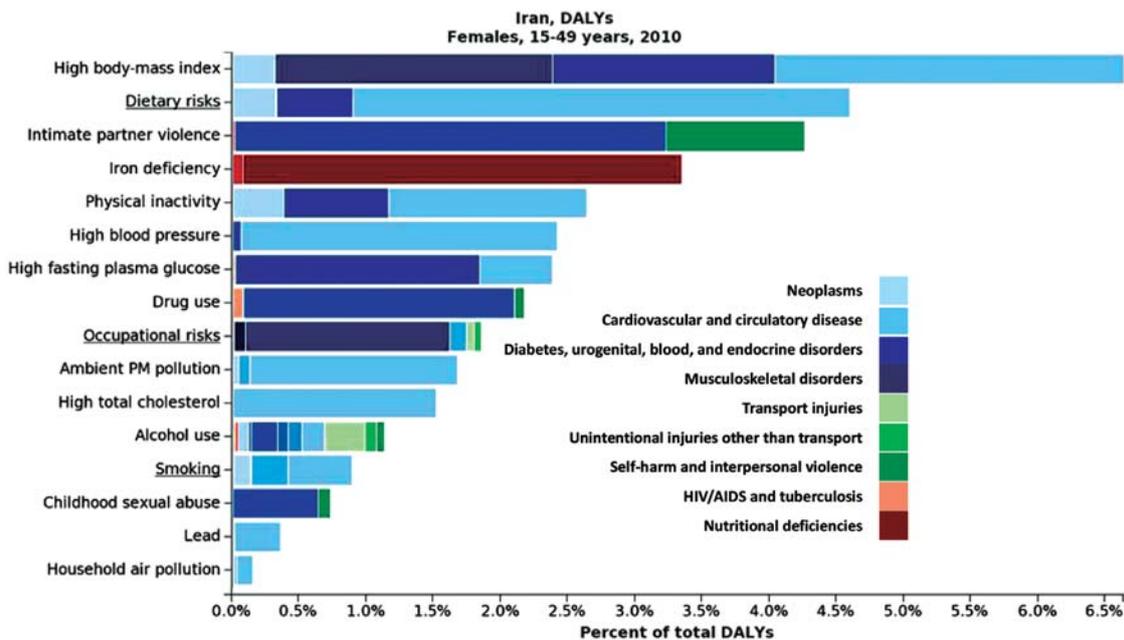

Figure 15. DALYs attributable to main risk factors in women 15 – 49 years old, Iran, 2010

Discussion

GBD provides a scientifically sound sketch of the distribution of diseases and risk factors at the national level in Iran in 2010. Several indicators have been used for assessing the level of health in Iran. Life expectancy and healthy life expectancy in Iran are increasing faster than other countries at the global scale, and are higher in women compared to men - the same pattern observed at the global scale. The gap between LE in men and women is bigger in middle age, showing that a higher proportion of disease burden in women is caused by disability, in contrast to men, who have a greater level of burden due to high rates of death from injuries and drug abuse. As a result, the proportion of YLL/YLD is lower for women than men.

The burden of disease in 2010 was dominated by non-communicable diseases. Injuries and maternal/infectious diseases accounted for 30% of the total burden. This picture varies by age, and injuries are a more significant source of burden in young adults 15 – 49 years, especially males, with 30% of DALYs and 47% of total YLLs.

As for children under 5, congenital anomalies, preterm birth complications, and lower respiratory infections are the top three causes of death, YLLs, and DALYs, ahead of birth trauma, diarrheal diseases, neonatal sepsis and other neonatal infections, and other neonatal disorders. However, iron-deficiency anemia and diarrheal diseases still persist and are the top causes of YLDs among children under 5. These results accompany the low rate of maternal mortality, suggesting that better maternal care may

Iran
Total (All Causes)
Both sexes, 2010
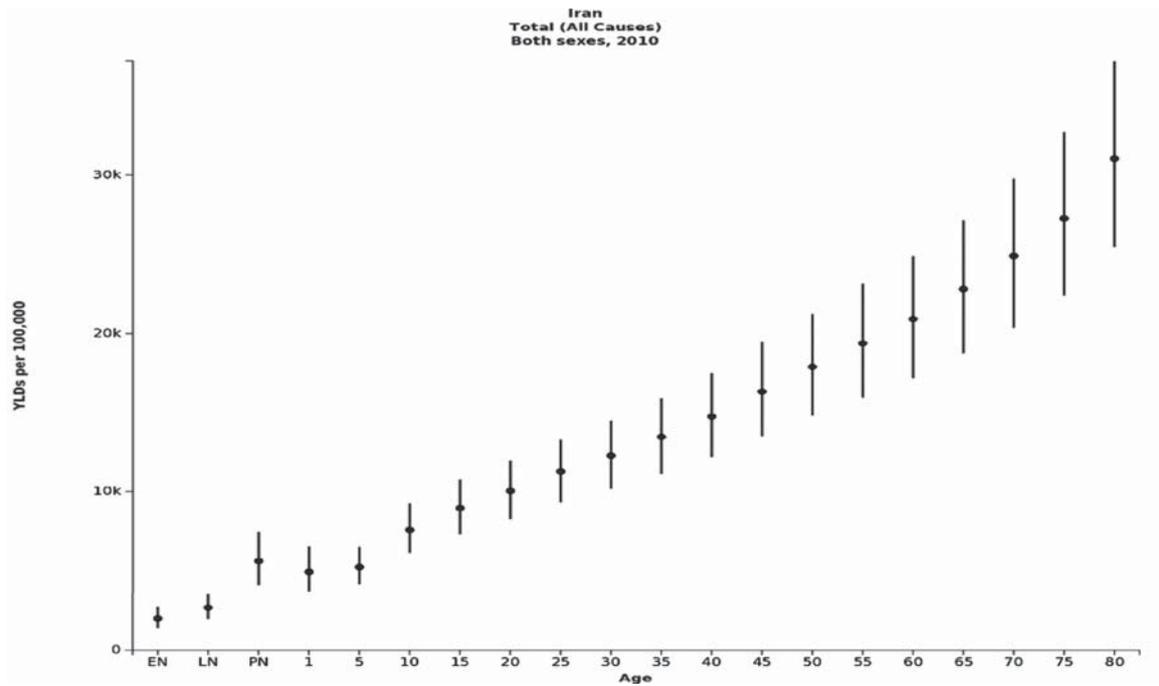
Figure 16. YLD per 100,000 people among all ages and both sexes in Iran, 2010

Iran, deaths
Both sexes, 70+ years, 2010
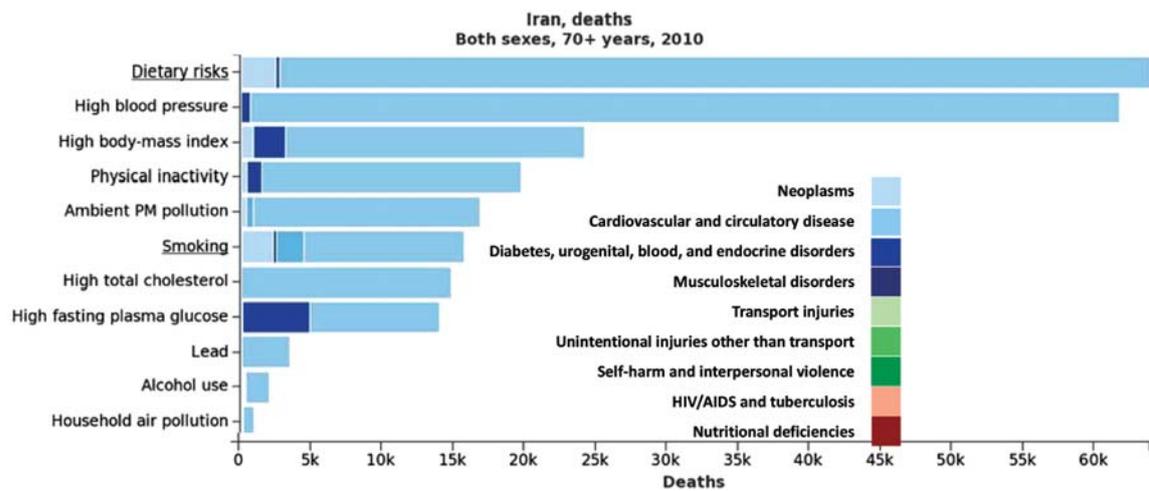
Figure 17. Deaths attributable to risk factors among 70+ year olds in both sexes

Iran, deaths
Both sexes, 50-69 years, 2010
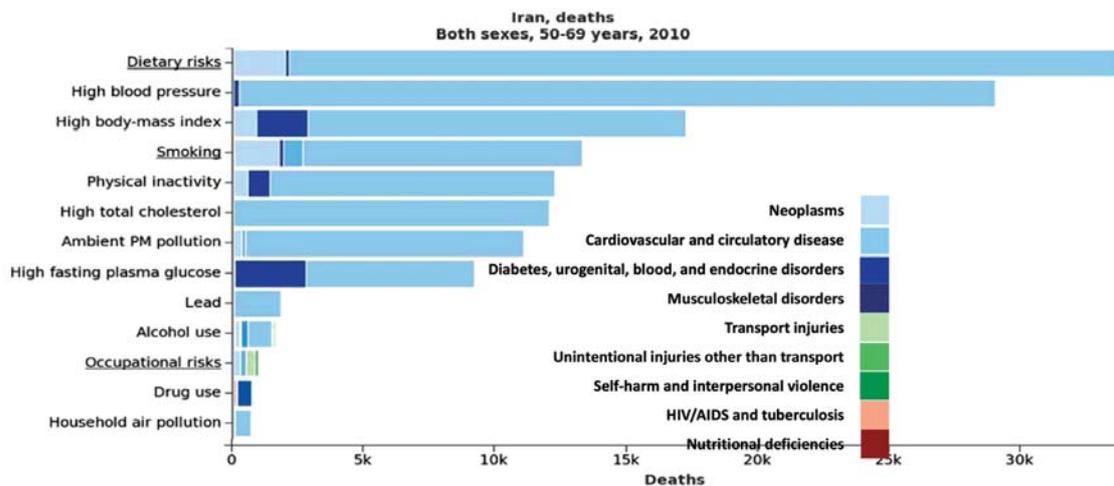
Figure 18. Deaths attributable to risk factors among 50 – 69 year olds in both sexes

	Global	Developing	Developed	Iran
Ischemic heart disease	1	3	1	1
Low back pain	7	10	3	2
Road injury	10	8	8	3
Major depressive disorder	11	11	4	4
Congenital anomalies	17	17	30	5
Stroke	3	5	2	6
Preterm birth complications	8	7	35	7
Other cardio & circulatory	37	37	24	8
Diabetes	14	16	9	9
Anxiety disorders	26	26	17	10
Iron-deficiency anemia	15	14	49	11
Drug use disorders	31	36	18	12
COPD	9	9	6	13
Osteoarthritis	38	41	23	14
Lower respiratory infections	2	1	16	15
Neck pain	21	23	11	16
Other musculoskeletal	23	25	7	17
Falls	19	21	10	18
Asthma	28	28	27	19
Fire	34	30	62	20

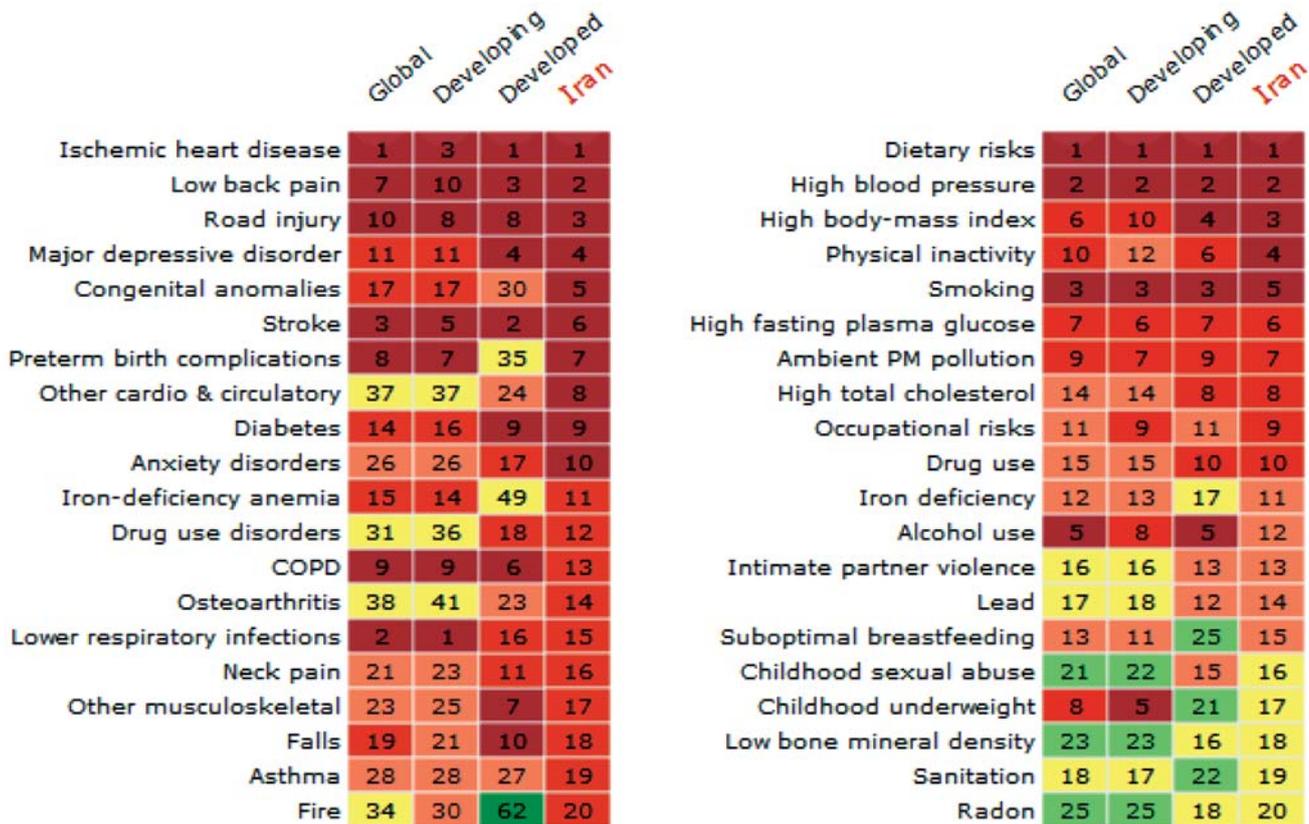|	Global	Developing	Developed	Iran
Dietary risks	1	1	1	1
High blood pressure	2	2	2	2
High body-mass index	6	10	4	3
Physical inactivity	10	12	6	4
Smoking	3	3	3	5
High fasting plasma glucose	7	6	7	6
Ambient PM pollution	9	7	9	7
High total cholesterol	14	14	8	8
Occupational risks	11	9	11	9
Drug use	15	15	10	10
Iron deficiency	12	13	17	11
Alcohol use	5	8	5	12
Intimate partner violence	16	16	13	13
Lead	17	18	12	14
Suboptimal breastfeeding	13	11	25	15
Childhood sexual abuse	21	22	15	16
Childhood underweight	8	5	21	17
Low bone mineral density	23	23	16	18
Sanitation	18	17	22	19
Radon	25	25	18	20

Figure 19. Top diseases and risk factors causing burden in Iran compared to global levels, developed, and developing countries

have changed the disease pattern among children under 5. The risk factors responsible for the majority of DALYs include iron-deficiency anemia, suboptimal breastfeeding, and childhood underweight, which implies that improvement of maternal and child care is a necessity.

The burden of disease in all ages is dominated by cardiovascular diseases (especially ischemic heart disease (IHD)), low back pain and neck pain, unipolar disease, and road traffic injury. While the burden of IHD and injury results primarily from death,[19, 20] musculoskeletal and mental diseases are debilitating and are responsible for a large number of YLDs.[4] With increasing life expectancy and population aging, these diseases will be the main source of burden and a challenge for the Iranian health system for years.

The highest fraction of deaths occur after 50 years; the most important causes of death in these groups are ischemic heart disease, and ischemic and hemorrhagic strokes. Apart from deaths, the quality of life decreases in older ages as YLDs per capita sharply increase in 50+ age groups. The main sources of disability among the elderly consist of chronic diseases such as low back pain, osteoarthritis, major depressive disorder, and diabetes, all of which require appropriate primary and secondary prevention methods that have not been foreseen in the current health care system in Iran. It can be predicted that following the increase in mean age in Iran over coming years, the fraction of deaths and burden of different disabilities in the elderly will increase as well. There should be policies to envision the growing need for special care that should be provided to the elderly and their families in Iran in order to deal with deaths and disabling conditions and maintain the quality of their life.

Iran's remarkable success in maternal and child health has decreased communicable and maternal burden, although diarrhea and lower respiratory infection burdens are still significant. The health system should push this effort to access remote places and improve patient care and prevention, since children still die from diarrhea and pneumonia. Improving vaccination against diarrhea and pneumonia pathogens, such as rotavirus and RSV, can be a good strategy. Although there is good access to improved sources of water and sanitation in Iran, maintaining the system's quality is always a priority in controlling diarrhea. Iron deficiency and suboptimal breastfeeding still cause the largest burden in children, with the current focus of primary health care system in Iran on maternal and child health. Protecting children from exposure to tobacco smoke and air pollution should be a priority of the government and community by implementing necessary laws to reduce smoking, limit smoking in public areas, reduce air pollution, and educate families.

More than 57% of deaths in 2010 were caused by cardiovascular diseases and cancers. The burden of IHD was twice as high as that of stroke, although both have common physiological and behavioral risk factors. The most important risk factor groups are dietary risks and physiological risk factors, including high body mass index, high blood pressure, high fasting plasma glucose, high blood cholesterol, physical inactivity, and smoking.[21] Several interventions and preventive methods can reduce exposure to these risk factors. Training programs on balanced nutrition, limiting daily caloric intake, and increasing physical activity can reduce obesity and its consequences. Controlling obesity decreases blood pressure and glucose intolerance and increases cholesterol metabolism, which significantly reduces the risk of cardiovascular disease. Successful prevention of diabetes by medications such as metformin, health benefit of joint treatment by statins, blood-pressure-lowering medicines, and aspirin (called Polypill) suggest

effective programs that can be implemented in the current health system structure.[22–24] Preventive drug treatment can be a quick intervention for controlling the burden of cardiovascular diseases and can be delivered with the reliable coverage of the current Iranian health system.

After smoking, dietary risk factors are the most important behavioral risk factors. More than 8.5% of total DALYs can be attributed to dietary risks, which strike primarily through cardiovascular disease, diabetes and endocrine diseases, and to a lesser extent through cancer. Diets low in fruits and vegetables, high in sodium, low in whole grains, low in omega-3 fatty acids and high in trans fats, and low in fiber are the major culprits. Encouraging the population to eat a healthy diet and limit salt and trans fat intake requires contributions from different sectors such as agriculture, education, and health care. Children can benefit from complimentary fruit and milk distribution in the schools and training families to replace calories from other sources with fruit, vegetables, and milk.

Road injury is the second-leading cause of death in Iran, with 27,000 deaths in 2010. The age-standardized death rate is more than twice the global average. One out of 200 men aged 15 to 49 years died in road traffic accidents. This problem has been a major threat to people's health since it was noted for the first time in Iran's first global burden of disease study in 2003.[13,25–27] Improving road safety, enforcing safe driving laws, requiring use of seatbelts, and improving quality and safety of cars should be a priority of the health system in cooperation with other departments such as the police, policymakers, and industries. Iran's government should take responsibility for implementing a coordinated interdisciplinary program to reduce traffic accidents.[28–32]

Cancer is the second most frequent cause of death and the second highest burden by YLLs. The most important cancers in Iran are gastric cancer (sixth-leading death rate) and lung cancer (eleventh), followed by breast cancer (twelfth).[33] Tobacco use is the most important risk factor for lung cancer which, along with diet, also increases the risk of gastric cancer. Aggressive tobacco control is important to reduce the risk of these two cancers as well as the burden of cardiovascular disease. Increasing free access to mammography as a cost-effective preventive intervention for breast cancer can reduce the burden of breast cancer significantly. High body mass index is a risk factor for breast cancer as well.

In terms of total DALYs and disability, the burden of musculoskeletal diseases and mental health is prominent in Iran. Low back and neck pain cause 11.4% of total DALYs, and unipolar disorders 6.2%. As no significant risk factor is responsible, the main strategy should focus on increasing disease care and rehabilitation. Osteoarthritis and back pain limit physical activity, and decreased physical activity increases the risk of cardiovascular disease and reduces cognitive health in older people. One percent of DALYs is attributable to drug abuse. This contributes to the largest proportion of DALY between 20 and 30 years of age.

Low physical activity and physical inactivity is the fifth most important risk factor in terms of DALYs (4.6% of total DALYs). Encouraging physical activity for all ages should be considered as part of any program aiming to reduce the burden of cardiovascular diseases, diabetes and endocrine disorders, and cancer. A large burden of cardiovascular disease can be attributed to ambient air pollution (PM2.5).[14] Air pollution has been proven as an important cause of lower respiratory infection and it predisposes children to other infectious diseases. A main source of air pollution

is the dust in the air which has become a major challenge in Iran over recent years. This problem needs long-term planning and international cooperation to reduce the PM2.5 concentration and its health effects. In Tehran and other large cities and some industrial cities, the main source of air pollution is manmade, disseminated from cars and factories, that can be addressed locally by a strong commitment of national and local authorities.

Comparing the leading diseases in Iran to those in other countries, ischemic heart disease, low back pain, road injuries, and major depressive disorder are the top four causes of burden in Iran, similar to other developing and developed countries. However, certain diseases such as congenital anomalies and preterm birth complications are more common in Iran, highlighting the importance of maternal care. Regarding risk factors, Iran's pattern is very similar to that of developed countries. The top risks causing burden in Iran are dietary and physiological risk factors that are more similar to those in developed, rather than developing, countries (Figure 19).

Iran's health system restructuring was a successful move toward expanding health services and care over most parts of the country. It was designed to provide access to preventive health interventions, vaccinations, improve water and sanitation, and control environmental risks. GBD 2010 showed that the main source of burden is non-communicable diseases and metabolic plus dietary risk factors. The rapid health and epidemiological transition in Iran has imposed new challenges on the health system as well as the national and subnational policies. Addressing these challenges requires a flexible and responsive structure supported by infrastructure and necessary human resources. Universal and rural insurance and family medicine are necessary to improve access to and quality of health care. Some preventive interventions such as monitoring blood pressure and follow-up of diabetics or free access to cholesterol-lowering and antihypertensive drugs for eligible people, can be incorporated into health system services through improvements to the current structure. For many risk factors, such as dietary risks, physical inactivity, smoking, and more importantly, mental health and musculoskeletal health, the current health system needs improved infrastructure and empowerment through recruiting more skilled health professionals and long-term planning supported by legislators. Iran can benefit from decentralization of public health management if it is supported by reliable health data at the local level, followed over time. Restructuring the health system to deal with non-communicable diseases is the most important topic. The Iranian health system was designed for controlling communicable diseases and reducing maternal and child death. Recently, there have been incentives for integrating interventions for prevention of or screening for certain non-communicable diseases, but this is not an effective method under current circumstances. We have to restructure our health system to have a core of NCD prevention and control and implement a number of programs to improve maternal and child health and prevent communicable diseases.

The GBD 2010 study has certain limitations, as well. Some of the limitations are inherent in the nature of the study. First, the theoretical minimum risk exposure distribution has no specific definition, and it may not be considered similar across nations. Second, relative risks are taken from large international meta-analyses, and there may be cross-country differences. However, there are studies demonstrating that despite other lifestyle and environmental risk factors for infectious diseases, the relative risks

for metabolic risk factors are somehow similar between countries. Third, relative risks differ for mortality and incidence of the disease. And finally, disability weights are not calculated specifically for the country under study and are taken from global studies.

The next category of limitations is specific to Iran. The major challenge was the lack of nationally representative and accurate data, both on death and on diseases or sequelae. Specifically, data on mortality have significant defects of incompleteness and misclassification.[34–36] Data on morbidity are too scarce and of low quality. The scarcity of data makes it impossible to estimate burden at the subnational level in order to measure inequalities across provinces in Iran. Another challenge is the poor cooperation of research bodies in sharing the data. The Ministry of Health should take the lead and supervise the health information system, gather and clean available data systematically, and take on the responsibility of data warehousing at the national level. Also, it is the responsibility of the Ministry of Health to create a network of research entities in Iran to improve collaborations for studies that can be more representative of the Iranian population.

It is also necessary to recognize that health policies are not restricted to the health sector. There are several sectors outside the health system that can affect the health status of people, are related to the health sector, and should be involved in policy planning. It is the duty of the Ministry of Health to improve inter-sectoral collaborations in policymaking.

Conclusion

Iran has been successful in controlling infectious and maternal diseases overall. However, GBD 2010 shows evidence of an epidemiological transition from infectious to non-communicable disease burden, a fact that poses serious challenges to policymakers in the health sector and brings about new implications for the management of the health care system in Iran. Dealing with new challenges requires new thoughts, designs, and innovations to introduce flexibility to the overall health system and other health-related sectors in Iran. The rise of non-communicable diseases and chronic risk factors is too complex and thus need to be addressed by extensive inter-sectoral collaborations and cost-effective policies at the national and subnational levels.

The most important function of a responsive health system is to systematically collect, analyze, and utilize data for decision-making. Data should be of sufficiently high quality to provide a credible reference for measuring the prevailing diseases and risk factors and the overall health status of a nation. In this regard, measuring burden of disease entails two aspects: first, subnational estimation at the level of provinces or districts is required to discover local health challenges and burdensome conditions as well as inequality in health status and access to health care. Second, the measurements have to be performed annually in order to detect trends of diseases and effectiveness of programs. Development of a comprehensive national health data system, including vital registration (recording of births and deaths), and a system for registering causes of death is necessary. Disease-specific registries, such as cancer registries, should be launched with enough coverage across the whole country to provide subnationally and nationally representative estimates. Another useful source of data is hospital records. Standardizing methods of coding and the system of reporting diseases among hospitalized patients can provide unique data for certain diseases that are not routinely captured in

demographic study sites and disease registries and can provide invaluable low-cost data critical for cost-efficiency analysis.

The GBD 2010 project may convey several messages, but the most important to health policy-makers in Iran, as well as all other countries across the world, is that rigorous measurement of health status is the first and indispensable step for planning programs aimed at disease prevention, health promotion, and health system performance assessment at both the national and subnational scales.

Acknowledgments

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