# **Original Article**

# Health Transition in Iran toward Chronic Diseases Based on Results of Global Burden of Disease 2010

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**See the pages:** 302 – 303, 304 – 320, 336 – 342

#### Abstract

**Background:** Drawing on the results of the country-level Global Burden of Diseases, Injuries, and Risk Factors 2010 Study, we attempted to investigate the drivers of change in the healthcare system in terms of mortality and morbidity due to diseases, injuries, and risk factors for the two decades from 1990 to 2010.

**Methods:** We decomposed trends in mortality, cause of death, years of life lost due to disability, disability-adjusted life years (DALYs), life expectancy, health-adjusted life expectancy, and risk factors into the contribution of total increase in population size, aging of the population, and changes in age-specific and sex-specific rates.

**Results:** We observed a decrease in age-specific mortality rate for both sexes, with a higher rate for women. The ranking of causes of death and their corresponding number of years of life lost remained unchanged between 1990 and 2010. However, the percentages of change indicate patterns of reduction for most causes, such as ischemic and hemorrhagic stroke, hypertensive heart disease, stomach cancer, lower respiratory infections, and congenital anomalies. The number of years lost due to disability caused by diabetes and drug use disorders has significantly increased in the last two decades. Major causes of DALYs, such as injuries, interpersonal violence, and suicide, showed increasing trends, while rates of communicable diseases, neonatal disorders, and nutritional deficiencies have declined significantly. Life expectancy and health-adjusted life expectancy increased for both sexes by approximately 7 years, with the highest rate of increase pertaining to females over the age 30.

**Conclusions:** Time trend information presented in this paper can be used to evaluate problems and policies specific to medical conditions or risk factors. Despite recent improvements, implementing policies to reduce the number of deaths and years of life lost due to road traffic injury remains the highest priority for Iranian policymakers. Immediate action by Iranian researchers is required to match Iran's decreasing mortality rate due to liver and stomach cancers to a rate comparable to the global level. Prevention and treatment plans for mental disorders, such as major depressive disorder, anxiety disorder, and particularly drug use disorders, should be considered in reforms of the health, education, and judiciary systems in Iran.

Keywords: Disability, healthcare system, global burden of diseases (GBD), Iran, life expectancy

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#### Introduction

In the last five decades, from 1960 - 2010, Iran has faced significant economic and social changes. The eight-year Iran-Iraq war, starting 2 years after a major regime change in Iran, left behind more than 200,000 dead, and more than half a million injured. Two devastating earthquakes with over 100,000 fatalities, continuous fluctuation of oil prices, and three decades of international, political, and economic sanctions have drastically affected the society.

A rapid and significant decrease in fertility, increasing urbanization, and increasing population age were three main factors affecting Iran's public health. Total fertility rate dropped from 6.5 children per fertile woman in 1976 to 1.9 in 2006.<sup>1</sup> Urbanization fraction increased from 47% to 71.4%. Similarly, the median population age increased by 10 years over the last 30 years.<sup>2</sup>

Between 1976 and 1988, Iran's gross domestic product (GDP) dropped by more than 50%. This trend continued until 2006, at which point the GDP returned to its 1978 value. Iran's high inflation rate is a continuous challenge that weakens the economy. Similarly, health care consumer price index (CPI) rose by 60% from 1984 to 2007. Out-of-pocket payment has remained as high as 55% or greater since the year 2000.<sup>3</sup> The total health expenditure proportion of GDP was in a fairly stable range of 1.5% to 2.7% between 1996 and 2006.<sup>4</sup>

Providing effective access to primary health care in Iran's rural areas with 90% population coverage, integration of medical education and health care services and establishment of medical schools in all provinces have increased the number of medical

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doctors, and improved accessibility to health care. In 1976, there were five physicians for every 10,000 people. This number increased to 13.4 physicians by 2007, while 13 active hospital beds were available per 10,000 people, of which 82.1% are in public hospitals.<sup>4</sup>

The fraction of under-5 mortality dropped from 40% of total deaths in the late 1960s to 9% in 2005. Infectious and diarrheal diseases were the main causes of death in Iran in 1960; however, the main causes of death had shifted to cardiovascular disease (CVD) to 34.3%, and road traffic injuries to 10.3% by 2005.<sup>5</sup>

The results of the collaborative Global Burden of Disease (GBD) 2010 study provide a unique opportunity to examine changes in the health profile of the country from 1990 to 2010. The GBD study used consistent definitions, data sources, and methods to examine health loss from 291 diseases and injuries and 67 risk factors for 187 countries. Hence, comparisons in country-level health profiles were made possible.<sup>5</sup>

We use GBD results for Iran to examine the performance of its healthcare system in terms of mortality and morbidity due to diseases, injuries and risk factors for two decades between 1990 and 2010. To evaluate the current Iran's health care status, we investigate the trend of mortality, causes of death, morbidity and disabilities over the last 20 years.

## **Methods**

We attempted to identify the drivers of change in the numbers of deaths or disability-adjusted life years (DALYs) by causes using decomposition analysis. These trends were decomposed into the contribution of total increase in population size, aging of the population, and changes in age-specific and sex specific rates. We computed two counterfactual sets of cause of death numbers: 1) a population growth scenario computed as the number of deaths expected in 2010 if only total population numbers increased to the level of 2010 but the age-sex structure of population remained the same as in 1990 and age-sex specific rates remained at 1990 levels; and 2) a population growth and population aging scenario computed as the number of deaths expected in 2010, using 1990 age-sex specific rates and 2010 age-specific and sex-specific population numbers. The difference between 1990 numbers and the population growth scenario is the change in death numbers due strictly to the growth in total population. The change from the population growth scenario to the population growth and aging scenario is the number of deaths due to aging of the population. The difference between 2010 deaths and the population growth and aging scenario is the difference in deaths or DALYs due to epidemiological change in age-specific and sex-specific death rates. Each of these three differences is also presented as a percentage change compared to 1990. Further details on the micro-level calculations of the changes can be found elsewhere.<sup>5</sup>

## **Results**

#### Trend of Mortality by Age and Sex

Age-specific mortality rate between the years 1990 and 2010 declined with increasing age for both males and females, but with a higher rate in women across all ages. The most rapid rate reduction in women versus men occurred for the age groups between 20 and 40 years old (Table 1 and Figure 1). Sex ratio for death has dramatically increased in the last decade. For the age 20, the sex mortality ratio was between 225 and 243 in the period between 1990 and 2000. However, this ratio grew to approximately 290 from 2000 to 2010 the (Figure 2).

## Trends in cause of death and years of life lost

By decomposition of population growth and population aging for the first fifty causes of death in Iran from 1990 to 2010 the true percentage change of causes of mortality is obtained. For most causes, the percentage of change shows a pattern of reduction. However, the percentage of change increased for 12 causes of death. These 12 causes and their 2010 respective ranks are road injury (2<sup>nd</sup>), diabetes mellitus (19<sup>th</sup>), Alzheimer's disease and other dementia (22<sup>nd</sup>), drug use disorders (23<sup>rd</sup>), liver cancer (31<sup>st</sup>), prostate cancer (40<sup>th</sup>), accidental falls (41<sup>st</sup>), chronic kidney disease (42<sup>nd</sup>), encephalopathy, birth asphyxia, and birth trauma (45<sup>th</sup>), sepsis and other infectious disorders of the newborn (49<sup>th</sup>), and typhoid and paratyphoid fevers (50<sup>th</sup>). The majority of causes of mortality have decreased, such as ischemic and hemorrhagic stroke (72%), hypertensive heart disease (68%), stomach cancer (71%), lower respiratory infections (45%) and congenital anoma-

Table 1. Age-specific death	rate per 100,000 by sex, Iran
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A	Death Ra	ate 1990	Death Ra	ate 2010
Age	Male	Female	Male	Female
< 1	5,007.2	4,255.8	2,383.7	2,064.6
1–4	318.5	295.4	132.0	115.5
5–9	85.3	68.6	45.4	36.6
10-14	90.3	56.5	38.9	24.0
15-19	170.5	83.0	90.4	38.0
20-24	244.0	108.2	137.6	47.4
25-29	262.5	128.2	154.4	55.1
30–34	300.1	159.6	179.0	71.5
35–39	390.7	212.6	231.4	98.4
40-44	527.4	290.4	310.0	147.7
45-49	759.1	416.3	450.1	227.0
50-54	1,137.0	617.8	689.5	351.4
55–59	1,680.6	891.2	1,067.3	529.6
60–64	2,543.3	1,424.1	1,724.2	882.5
65–69	3,727.6	2,227.8	2,684.3	1,443.8
70–74	5,543.8	3,667.2	4,195.4	2,469.0
75–79	8,153.7	5,923.7	6,514.2	4,254.8
80+	13,912.1	11,648.2	12,845.3	10,070.0

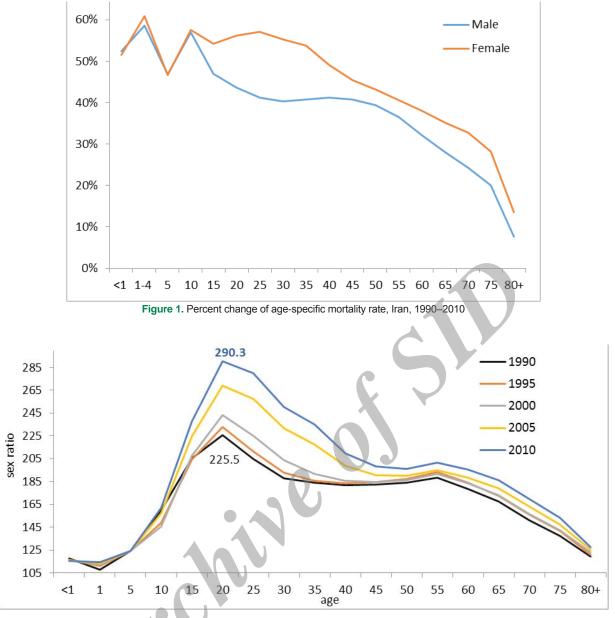


Figure 2. Mortality sex ratio (number of male deaths for 100 female deaths) by age and year

lies (30%). Appendix Table 1 shows details such as age-standardized death rate (ASDR) by cause and gender in 1990 and 2010. In addition, Figure 3 shows the pattern of cause of death numbers between 1990 and 2010.

From 1990 to 2010, the ranking of causes of death and their corresponding number of years of life lost (YLLs) remained unchanged. However, the number of YLLs changed for the same cause pattern in 2010. The causes with an increasing trend adjusted by the effect of population growth and aging from 1990 to 2010 showed a particular pattern depending on age-specific mortality rate. For example, comparing the pattern of age-specific mortality rate between mortality due to two-wheeled motorized vehicle accidents and liver cancer shows early and later peaks, respectively. The pattern of increase in mortality rate due to liver cancer is around age 40, which is explained by drug use disorders at an earlier age. However, the rate of death due to two-wheeled vehicle accidents increases in age groups above 10 years olds. Among children, 15 years old and younger, YLLs due to congeni-

tal anomalies ranked third among all other causes (Figures 6, 7, and 8).

#### Causes of years lost due to disability (YLDs)

Similar to the trend for YLLs over time, causes of YLDs showed small changes between 1990 and 2010. Among females, the top causes of YLDs stayed the same in both periods; these were major depressive disorders, low back pain, iron deficiency anemia, anxiety disorders, and osteoarthritis. In males, the top three causes of YLDs were low back pain, major depressive disorders, and iron deficiency anemia for both time periods. By 2010, drug use disorders and diabetes replaced road injuries and neck pain as the fourth and fifth leading causes among men (Figures 9 and 10).

Figure 11 conveys information on percent changes in 50 YLD causes between the two time periods after adjusting for the effect of population growth and aging. In the top 10 causes of YLD, only three causes, other than transport injuries, migraine, and chronic kidney diseases, showed true increases from 1990. Diabetes and

	-100%	-50%	0%	50%	100%	150%	200%	250%	300%	350%	400%
22	Alzheimer's disease and other dementias										4039
31	Liver cancer						180%				
23	Drug use disorders					15	2%				
19	Self-harm				75%						
10	Diabetes mellitus			40	.1%						
4	Falls			36	%						
4	Chronic kidney diseases			26%							
49	Sepsis and other infectious disorders of the newborn baby			25%							
45	Neonatal encephalopathy (birth asphyxia and birth trauma)			21%							
2	Road injury			14%							
4	Prostate cancer			8%							
20	Typhoid and paratyphoid fevers			1%							
11	Preterm birth complications		-	12%							
36	Brain and nervous system cancers		-	17%							
30	Tubulointerstitial nephritis, pyelonephritis, and UTI		-	24%							
თ	Congenital anomalies		-	30%							
12	Chronic obstructive pulmonary disease		-	35%							
25	Interpersonal violence		-	43%							
21	Leukemia		-4	4%		<u> </u>					
00	Lower respiratory infections		-	45%							
34	Colon and rectum cancers		-	50%							
ч	Ischemic heart disease		-	51%							
33	Breast cancer			56%			<u> </u>				
35	Drowning		-4	56%							
ŝ	Ischemic stroke		-	59%							
27	Cirrhosis of the liver		-(	57%							
9	Hypertensive heart disease		-6	58%							
16	Fire, heat and hot substances		-(	58%							
20	Unintentional injuries not classified elsewhere			<sup>59</sup> %							
$\sim$	Stomach cancer			71%							
ŋ	Hemorrhagic and other non-ischemic stroke			73%							
47	Diarrheal diseases			74%							
48	Larynx cancer			76%							
37	Poisonings		-	77%							
13	Trachea, bronchus, and lung cancers			78%							
18	Asthma			79%							
. 26	Esophageal cancer			86%							
4	Bladder cancer			97%							
38	Paralytic ileus and intestinal obstruction			.03%							
15	Rheumatic heart disease			L07%							
43	Exposure to mechanical forces		V	111%							

Figure 3. Percent change in causes of death between 1990 and 2010 after decomposition for 50 top causes of death; \* We excluded HIV/AIDS and other causes in each disease group.

drug disorders were among the tenth- to fiftieth-ranked causes that have significantly increased in the last two decade.

#### DALYs trend

The top cause of DALYs in males was ischemic heart disease for both periods. The subsequent four causes by DALYs in 2010 were road injuries (fourth in 1990), low back pain (seventh in 1990), depression (eleventh in 1990), and stroke (eighth in 1990). Some of major DALYs' causes related to injuries, such as accidental falls, interpersonal violence and suicides, showed increasing trend in the two-decade interval. On the other hand, ranks of DALYs due to communicable diseases, neonatal and nutritional deficiencies have declined significantly (Figure 12).

Two significant causes of DALYs in males were ischemic heart

disease (IHD) and road injuries, both fatal and disabling conditions. However, the two main causes of DALYs in women are low back pain and major depression which are nonfatal but disabling (Figures 12 and 13). Factoring out the impacts of population growth and population aging, drug use disorders, diabetes mellitus, and Alzheimer's disease remain as the highest-ranking causes of DALYs for both sexes combined between 1990 and 2010. Figure 14 inclusively visualizes the changes over time in top-ranked DALYs' causes. It is important to note that despite the constant patterns of self-harm between 1990 and 2010, the rate nearly doubled by 2010 for young adults (Figure 15).

## Risk Factors

Four major risk factors causing childhood illnesses and infec-

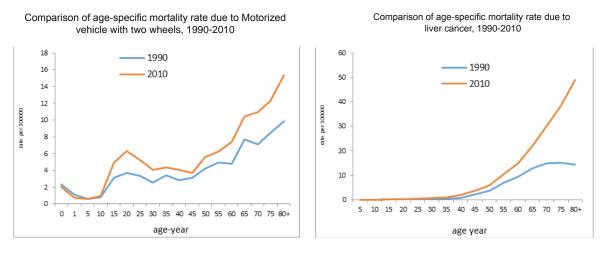
								240%	_
30 48 12 40 17 47	Alzheimer's disease and other dementias								26
<u> </u>	Drug use disorders						7%		
f	Liver cancer						6%		
1	Self-harm				839	6			
4	Epilepsy				53%				
	Sepsis and other infectious disorders of the newborn baby			25%					
1	Neonatal encephalopathy (birth asphyxia and birth trauma)			20%					
Ĵ	Diabetes mellitus			17%					
ň	Falls			17%					
N	Road injury			12%					
ţ	Typhoid and paratyphoid fevers		1	%					
t	Preterm birth complications		-129						
3	Chronic kidney diseases		14	%					
6	Brain and nervous system cancers		-23	%					
ì.	Tubulointerstitial nephritis, pyelonephritis, and urinary tract infections		-28%	5					
n	Congenital anomalies		-309	6					
9	Leukemia		-399	6					_
Ĥ P	Interpersonal violence		-439	6					_
רע	Lower respiratory infections		-47%	6					
μ	Drowning		499	6					
ñ	Breast cancer		-499	6					
Ĵ	Chronic obstructive pulmonary disease		-519	6					-
	Unintentional injuries not classified elsewhere		539	6					
1	Colon and rectum cancers		-58	%					
T0 43 T3	Fire, heat and hot substances		-599	6					-
	Ischemic heart disease		-63%						-
ł	Diarrheal diseases		-63%						-
74 77	Poisonings		-66%	6					-
9	Meningitis		-67%						-
x	Ischemic stroke		-689	6					
-	Hypertensive heart disease	7	-719	6					
<del>2</del> 1	Protein-energy malnutrition		-71%	5					
22	Cirrhosis of the liver		-74%						
4	Stomach cancer		-77%	5					
<u></u>	Hemorrhagic and other non-ischemic stroke		-79%						
7	Trachea, bronchus, and lung cancers		-80%	5					
2	Trachea, bronchus, and ding currecto	_	-81%						
<del>1</del>	Paralytic ileus and intestinal obstruction without hernia		-85						
24	Paralytic ileus and intestinal obstruction without remaine Esophageal cancer		-899						
2	Rheumatic heart disease		-897						
7 72	Exposure to mechanical forces		-987						

Figure 4. Percent change in causes of YLLs between 1990 and 2010 after decomposition for 50 top causes of death; \* We excluded HIV/AIDS and other causes in each disease group.

tions are childhood underweight, household air pollution, sanitation, and unimproved water. Figure 16 shows the decreasing trend of these risk factors over the two-decade period. Contrary to this downward shift, risk factors such as high body mass index and low bone mineral density demonstrated an upward trend in all age groups over the same period. Dietary risks, high blood pressure, high body mass index, and physical inactivity made up the four leading health risk factors for the year 2010. Figures 17 to 19 present more information on the ranks of the measured risk factors by age groups which provide a more inclusive picture of risk factors change over the study period. For instance, changing the importance of ambient air pollution and cigarette smoking over time can be easily evident from these illustrations. Dietary risk factors, primarily low fruit consumption, were estimated to make up to 7% to 10% of the CVD burden. Closely followed by this risk factor were high blood pressure and high body mass index, which also contributed significantly to CVD burden.

#### (Health-adjusted) Life Expectancy

Life expectancy (LE) and health-adjusted life expectancy (HALE) both grew in value from 1990 to 2010 for both sexes by approximately 7 years. The rate of increase for these two indicators was higher in males aged 0 to 15 than females of the same age group. For the age range of 20 to 30, LE and HALE increased at a comparable rate from the age group above 30, the incremental rate was higher in females compared to their male counterparts. The highest leading female gap in the inter-gender growth of the LE and HALE rates was seen for the age group 60 to 70 years



Comparison of age-specific mortality rate due to drug use disorders, 1990-2010



Figure 5. Comparison of age-specific mortality rate for 4 different causes in Iran, 1990–2010

1990 mean rank (95% UI)	2010 mean rank (959	% UI)	% change (95% UI)
1.0 (1, 1) 1 Congenital anomalies	1 Congenital anomali	es 1.2 (1, 2)	-63 (-78, -37)
2.2 (2, 3) 2 Preterm birth complications	2 Preterm birth comp	lications 1.8 (1, 2)	-43 (-61, -7)
2.8 (2, 4) 3 Lower respiratory infections	3 Road injury	3.3 (3, 4)	-42 (-65, -4)
4.4 (3, 6) 4 Diarrheal diseases	4 Lower respiratory in	nfections 3.9 (3, 5)	-78 (-85, -65)
4.9 (4, 7) 5 Forces of nature	5 Neonatal encephale	opathy 5.5 (3, 8)	-14 (-57, 106)
6.7 (4, 9) 6 Road injury	6 Other cardio & circu	latory 6.2 (5, 8)	-71 (-85, -40)
7.4 (4, 11) 7 Other cardio & circulatory	7 Neonatal sepsis	7.1 (5, 11)	-8 (-45, 72)
8.2 (5, 12) 8 Ischemic heart disease	8 Fire	8.2 (5, 11)	-75 (-88, -45)
9.3 (6, 13) 9 Protein-energy malnutrition	9 Drowning	8.6 (6, 11)	-69 (-83, -33)
9.3 (6, 12) 10 Fire	10 Diarrheal diseases		-92 (-95, -85)
11.6 (9, 14) 11 Drowning	11 Ischemic heart dis	ease  11.8 (8, 16)	-88 (-94, -72)
11.7 (8, 15) 12 Stroke	12 Leukemia	12.4 (10, 16)	
12.3 (10, 14) 13 Meningitis	13 Poisonings	14.7 (10, 20)	
13.7 (10, 17) 14 Neonatal encephalopathy	14 Falls	15.2 (10, 22)	
16.5 (13, 23) 15 Neonatal sepsis	15 Meningitis	15.9 (12, 20)	
16.9 (14, 21) 16 Poisonings	16 Protein-energy ma		
17.9 (14, 23) 17 Mechanical forces	17 Typhoid fevers	16.7 (9, 41)	
18.3 (15, 24) 18 Leukemia	18 Interpersonal viole	ence  20.2 (15, 25)	-55 (-75, 25)
20.7 (17, 25) 19 Encephalitis	19 Stroke	20.3 (13, 28)	
21.1 (16, 28) 20 Syphilis	20 Epilepsy	20.4 (13, 35)	
22.0 (15, 32) 21 Leishmaniasis	21 Mechanical forces		
23.5 (18, 29) 22 Falls	22 Leishmaniasis	21.7 (16, 30)	
23.7 (15, 39) 23 Measles	23 Pyelonephritis & U		
26.0 (19, 34) 24 COPD	24 COPD	25.2 (19, 32)	-76 (-88, -42)
27.2 (21, 36) 25 Intestinal obstructions	25 Brain cancer	25.4 (14, 37)	-46 (-84, 80)
26 Typhoid fevers	27 Encephalitis		
27 Interpersonal violence	33 Intestinal obstruct	ions	
29 Pyelonephritis & UTI	35 Syphilis		
36 Brain cancer	7 No 38 Measles		
42 Epilepsy	134 Forces of nature		

Communicable, maternal, neonatal, and nutritional Non-communicable Injury Figure 6. YI L ranks in Ira

Figure 6. YLL ranks in Iran, top 30 causes and percentage change, both sexes, ages under 15, 1990–2010

1990 mean rank (95% UI)		2010 mean rank (95% UI)		% change (95% UI)
1.1 (1, 2) 1 Forces of nature		1 Road injury	1.0 (1, 1)	154 (26, 271)
2.3 (1, 3) 2 Ischemic heart disease		2 Ischemic heart disease	2.0 (2, 2)	2 (-18, 26)
2.6 (1, 3) 3 Road injury		3 Self-harm	4.3 (3, 10)	222 (20, 396)
4.5 (4, 6) 4 Stroke	$h \neq$	4 Fire	4.8 (3, 8)	5 (-29, 45)
5.0 (4, 7) 5 Fire	H.	5 Other cardio & circulatory	5.9 (4, 9)	12 (-22, 67)
6.5 (5, 8) 6 Other cardio & circulatory	-V	6 Interpersonal violence	6.3 (3, 10)	31 (-15, 188)
6.7 (4, 10) 7 Mechanical forces		7 Drug use disorders	6.5 (3, 12)	281 (33, 948)
7.9 (5, 10) 8 Interpersonal violence	K/	8 Stroke	7.0 (4, 9)	-21 (-36, 5)
9.6 (8, 13) 9 Drowning		9 HIV/AIDS	7.7 (5, 10)	6,073 (4,228, 23,803)
10.4 (8, 14) 10 Poisonings	K T-	10 Drowning	10.9 (9, 13)	3 (-29, 59)
10.7 (8, 13) 11 Self-harm	1	11 Leukemia	11.5 (10, 14)	31 (-1, 78)
12.4 (10, 16) 12 Leukemia	-74	12 Poisonings	11.6 (9, 16)	4 (-26, 54)
13.3 (9, 20) 13 Maternal disorders		13 Mechanical forces	12.2 (7, 16)	-43 (-64, 44)
14.7 (12, 17) 14 Rheumatic heart disease		14 Brain cancer	16.5 (13, 25)	70 (1, 177)
14.8 (12, 18) 15 Stomach cancer	++	15 Breast cancer	16.5 (13, 21)	63 (19, 122)
17.1 (14, 22) 16 Cirrhosis		16 Stomach cancer	16.8 (13, 24)	5 (-28, 45)
18.1 (8, 34) 17 Drug use disorders		17 Rheumatic heart disease	19.0 (14, 29)	-8 (-59, 36)
19.4 (16, 23) 18 Lower respiratory infections		18 Lower respiratory infections	19.0 (14, 24)	31 (-3, 78)
19.5 (16, 28) 19 Lung cancer	NAN .	19 Diabetes	19.1 (15, 23)	108 (47, 174)
20.0 (16, 24) 20 Hypertensive heart disease	NAX	20 Falls	19.4 (13, 30)	226 (-1, 466)
20.4 (17, 24) 21 Breast cancer	I - A	21 Cirrhosis	20.8 (15, 24)	-5 (-32, 55)
21.1 (15, 32) 22 Brain cancer		22 Lung cancer	21.5 (16, 25)	8 (-23, 80)
27.2 (22, 33) 23 Tuberculosis		23 Hypertensive heart disease	22.4 (17, 26)	8 (-18, 48)
27.4 (22, 33) 24 Meningitis		24 Typhoid fevers	24.3 (12, 60)	75 (12, 160)
27.4 (19, 35) 25 Asthma		25 Pyelonephritis & UTI	25.6 (15, 32)	51 (-34, 347)
28 Diabetes	1 Ax	30 Asthma		
32 Pyelonephritis & UTI	T	36 Maternal disorders		
34 Typhoid fevers	1	38 Meningitis		
35 Falls	1	41 Tuberculosis	7	
78 HIV/AIDS	1			

Communicable, maternal, neonatal, and nutritional Non-communicable Injury

Figure 7. YLL ranks in Iran, top 30 causes and percentage change, both sexes, ages 15 – 49, 1990–2010

		<b>A7</b> .		
1990 mean rank (95% UI)		2010 mean rank (95% UI)		% change (95% UI)
1.4 (1, 3) 1 Congenital anomalies		1 Ischemic heart disease	1.0 (1, 1)	14 (1, 30)
2.2 (1, 3) 2 Ischemic heart disease		2 Road injury	2.0 (2, 2)	60 (-9, 131)
2.5 (1, 4) 3 Forces of nature	X	3 Congenital anomalies	3.5 (3, 6)	-62 (-77, -36)
4.7 (3, 7) 4 Preterm birth complications		4 Stroke	3.9 (3, 5)	-6 (-19, 13)
5.1 (4, 7) 5 Lower respiratory infections		-5 Preterm birth complications	4.8 (3, 6)	-43 (-61, -7)
5.6 (4, 8) 6 Road injury		6 Other cardio & circulatory	5.8 (5, 6)	-22 (-46, 13)
7.2 (6, 9) 7 Stroke		7 Lower respiratory infections	7.2 (7, 9)	-67 (-76, -54)
8.0 (5, 9) 8 Other cardio & circulatory		8 Fire	9.3 (7, 12)	-45 (-66, -17)
8.5 (6, 10) 9 Diarrheal diseases		9 Hypertensive heart disease	9.5 (8, 12)	25 (6, 48)
10.1 (9, 11) 10 Fire	F /	10 Self-harm	11.1 (7, 22)	199 (20, 339)
11.5 (10, 14) 11 Protein-energy malnutrition		11 Stomach cancer	11.4 (9, 16)	18 (-8, 41)
11.8 (11, 14) 12 Drowning	$\sqrt{1}$	12 Diabetes	12.5 (11, 16)	95 (48, 131)
13.7 (12, 17) 13 Meningitis	17-11	13 Interpersonal violence	14.4 (7, 22)	13 (-25, 139)
14.5 (12, 19) 14 Mechanical forces	XX	14 Leukemia	15.0 (12, 21)	-4 (-24, 26)
15.5 (13, 19) 15 Hypertensive heart disease		15 Drowning	15.2 (10, 20)	-49 (-66, -9)
17.2 (13, 21) 16 Stomach cancer		16 Drug use disorders	15.7 (7, 26)	263 (39, 806)
17.2 (13, 23) 17 Poisonings	XX	17 Lung cancer	18.3 (13, 24)	11 (-9, 64)
18.1 (14, 25) 18 Leukemia	~XL	18 Neonatal encephalopathy	18.5 (9, 29)	-14 (-57, 106)
19.4 (13, 29) 19 Neonatal encephalopathy	The	19 HIV/AIDS	18.5 (15, 22)	4,845 (3,340, 18,112)
20.3 (17, 23) 20 Rheumatic heart disease	1-1/1	20 COPD	19.9 (15, 24)	4 (-19, 46)
20.3 (16, 26) 21 Interpersonal violence	1 XX	21 Poisonings	20.9 (14, 31)	
23.3 (18, 29) 22 COPD	71/15	22 Rheumatic heart disease	21.0 (15, 31)	-15 (-49, 10)
23.4 (20, 33) 23 Lung cancer	11 AH	23 Cirrhosis	25.6 (19, 30)	-11 (-29, 28)
25.5 (22, 31) 24 Cirrhosis	HT	24 Mechanical forces	25.6 (14, 34)	-57 (-71, 8)
26.6 (22, 30) 25 Diabetes		25 Neonatal sepsis	25.9 (14, 37)	-8 (-45, 72)
26 Neonatal sepsis	HT	33 Diarrheal diseases		
29 Self-harm	//	38 Meningitis		
43 Drug use disorders		41 Protein-energy malnutrition		
99 HIV/AIDS				

#### Legend

Communicable, maternal, neonatal, and nutritional Non-communicable Injury

Figure 8. YLL ranks in Iran, top 30 causes and percentage change, both sexes, all ages, 1990–2010

1990 mean rank (95% UI)	2010 mean rank (95% UI)		% change (95% UI)
1.5 (1, 4) 1 Major depressive disorder	1 Major depressive disorder	1.6 (1, 3)	63 (-16, 226)
1.9 (1, 4) 2 Low back pain	2 Low back pain	1.6 (1, 3)	81 (47, 121)
2.9 (1, 4) 3 Iron-deficiency anemia	3 Iron-deficiency anemia	3.7 (3, 5)	-10 (-16, -4)
4.5 (1, 12) 4 Anxiety disorders	4 Anxiety disorders	4.3 (1, 11)	65 (-58, 654)
6.1 (4, 10) 5 Osteoarthritis	5 Osteoarthritis	5.3 (3, 8)	104 (46, 184)
6.2 (4, 9) 6 Neck pain	6 Other musculoskeletal	6.0 (4, 8)	97 (67, 133)
6.6 (5, 9) 7 Other musculoskeletal	7 Neck pain	6.7 (4, 9)	74 (51, 102)
8.9 (4, 18) 8 Asthma	8 Diabetes	7.6 (5, 10)	147 (86, 226)
11.1 (7, 16) 9 Diabetes	9 Migraine	10.6 (8, 16)	80 (32, 148)
11.4 (5, 21) 10 COPD	10 COPD	10.9 (5, 18)	70 (-9, 215)
11.6 (7, 17) 11 Epilepsy	11 Bipolar disorder	13.1 (8, 21)	97 (34, 190)
11.7 (7, 18) 12 Diarrheal diseases	12 Asthma	13.2 (9, 21)	13 (-20, 55)
11.9 (7, 19) 13 Migraine	13 Epilepsy	13.3 (9, 19)	38 (4, 88)
13.7 (9, 19) 14 Falls	14 Falls	13.7 (9, 19)	56 (21, 104)
16.4 (9, 24) 15 Bipolar disorder	15 Drug use disorders	15.0 (9, 24)	106 (6, 303)
17.9 (11, 25) 16 Thalassemia	16 Dysthymia	16.2 (10, 25)	76 (24, 147)
18.0 (12, 27) 17 Dysthymia	17 Road injury	18.1 (13, 24)	69 (20, 139)
19.3 (11, 28) 18 Drug use disorders	18 Schizophrenia	19.5 (11, 29)	101 (16, 253)
19.4 (8, 33) 19 lodine deficiency	19 Diarrheal diseases	20.5 (14, 28)	-16 (-43, 26)
19.6 (14, 26) 20 Road injury	20 Other hearing loss	20.9 (13, 28)	
21.2 (13, 33) 21 Eczema	21 lodine deficiency	21.2 (9, 36)	42 (-51, 306)
21.9 (14, 29) 22 Other hearing loss	22 Polycystic ovary	22.6 (12, 34)	118 (84, 162)
22.5 (15, 30) 23 Edentulism	23 Thalassemia	23.6 (17, 32)	6 (-29, 57)
23.7 (14, 34) 24 Schizophrenia	24 Eczema	24.5 (16, 36)	25 (-20, 95)
27.0 (22, 32) 25 Fibroids	25 Eating disorders	25.4 (14, 41)	185 (8, 682)
27 Polycystic ovary	-26 Fibroids		
36 Eating disorders	30 Edentulism		

Communicable, maternal, neonatal, and nutritional Non-communicable Injury

Figure 9. YLDs ranks in Iran, top 25 causes and percentage change, females, all ages, 1990–2010

1990 mean rank (95% UI)	2010 mean rank (95% UI)		% change (95% UI)
1.1 (1, 2) 1 Low back pain	1 Low back pain	1.0 (1, 2)	83 (52, 125)
2.5 (1, 4) 2 Major depressive disorder	2 Major depressive disorder	2.0 (1, 3)	68 (-20, 241)
2.5 (2, 3) 3 Iron-deficiency anemia	3 Iron-deficiency anemia	4.7 (3, 8)	-33 (-39, -27)
7.1 (4, 12) 4 Road injury	4 Drug use disorders	5.3 (3, 12)	136 (18, 396)
7.9 (4, 13) 5 Neck pain	5 Diabetes	5.6 (3, 9)	151 (87, 245)
8.1 (3, 24) 6 Anxiety disorders	6 Neck pain	7.8 (3, 12)	73 (50, 99)
9.0 (4, 18) 7 Asthma	7 Anxiety disorders	8.0 (2, 21)	63 (-63, 636)
9.1 (4, 17) 8 Drug use disorders	8 Osteoarthritis	8.6 (5, 14)	98 (41, 184)
9.3 (5, 15) 9 Falls	9 Falls	8.9 (5, 14)	79 (36, 131)
9.7 (4, 19) 10 COPD	10 COPD	9.0 (3, 17)	75 (-6, 249)
9.9 (4, 16) 11 Epilepsy	11 Road injury	9.3 (5, 14)	55 (16, 109)
10.7 (5, 17) 12 Osteoarthritis	12 Other musculoskeletal	12.9 (8, 17)	99 (71, 133)
11.5 (6, 17) 13 Diabetes	13 Epilepsy	13.0 (7, 17)	34 (-2, 86)
12.5 (6, 19) 14 Diarrheal diseases	14 Asthma	14.4 (7, 23)	11 (-21, 57)
14.4 (7, 23) 15 Conduct disorder	15 Bipolar disorder	16.0 (9, 24)	103 (38, 201)
16.3 (11, 21) 16 Other musculoskeletal	16 Schizophrenia	16.1 (8, 24)	114 (27, 273)
17.5 (9, 27) 17 Other hearing loss	17 Other hearing loss	16.3 (10, 23)	65 (26, 115)
19.2 (12, 28) 18 Thalassemia	18 Migraine	18.1 (13, 25)	88 (33, 155)
20.7 (12, 32) 19 Bipolar disorder	19 Dysthymia	21.0 (15, 30)	81 (31, 157)
21.3 (12, 33) 20 Schizophrenia	20 Diarrheal diseases	21.4 (16, 29)	-16 (-44, 28)
21.7 (15, 31) 21 Migraine	21 Conduct disorder	22.2 (15, 32)	-11 (-39, 28)
24.7 (19, 33) 22 Neonatal encephalopathy	22 Ischemic heart disease	23.0 (17, 32)	94 (48, 158)
25.1 (17, 36) 23 Dysthymia	23 Benign prostatic hyperplasia	24.1 (18, 32)	93 (50, 147)
26.0 (16, 39) 24 Eczema	24 Alcohol use disorders	24.9 (16, 38)	90 (-7, 299)
26.7 (18, 36) 25 Edentulism	25 Aspergers	27.6 (20, 36)	37 (-3, 94)
26 Aspergers	26 Eczema		
28 Ischemic heart disease	28 Thalassemia		
31 Benign prostatic hyperplasia	29 Neonatal encephalopathy		
32 Alcohol use disorders	37 Edentulism		

## Legend

Communicable, maternal, neonatal, and nutritional Non-communicable Injury

Figure 10. YLDs ranks in Iran, top 30 causes and percentage change, males, all ages, 1990–2000

	-11	5%	-65%	-15%	35%	85%
~~	E-time disordore					98%
50 46 19 17	Eating disorders Diabetes mellitus					60%
-19-	Diabetes menitus Drug use disorders				25%	0070
- Q	Polycystic ovarian syndrome				19%	
285	Congenital anomalies				13%	
-0	Other transport injury				12%	
36	Alzheimer's disease and other dementias				12%	
6	Acne vulgaris				7%	
4039	Benign prostatic hyperplasia				6%	
9	Chronic kidney diseases				5%	
00	Migraine				4%	
33	Schizophrenia				3%	
4	Childhood behavioral disorders				3% 3% 3%	
33	Eczema					
26	Other skin and subcutaneous diseases				2%	
38	Dental caries				1%	
34	Osteoarthritis				1%	
4	Pervasive development disorders				0%	
232516143438263141	Other musculoskeletal disorders				0%	
22	Anxiety disorders				0%	
23	Urticaria				-1%	
5	Viral skin diseases				-1%	
ŝ	Low back and neck pain				-2%	
21	Unipolar depressive disorders				-2%	
6	Bipolar affective disorder				-2% -2%	
5 49	Epilepsy				-2% -3%	
45	Asthma				-3% -3%	
7	Alcohol use disorders				-3%	
5	Periodontal disease				-6%	
21	Refraction and accommodation disorders Other vision loss				-6%	
3	Diarrheal diseases				-7%	
6	Thalassemias				-7%	
-22-	Ischemic heart disease				-10%	
- <u>m</u>	Preterm birth complications				-13%	
18	Other neglected tropical diseases		7.			
24	Otitis media				- <u>13%</u> -13%	
22 24 18 43 35 29 13 12 1	Chronic obstructive pulmonary disease				-15%	
47.48	Other infectious diseases				-16%	
	lodine deficiency				-18%	
თ	Neonatal encephalopathy				-20%	
32.20	Falls				-22%	
32	Other chronic respiratory diseases				-22%	
10	Road injury				-24%	
11	Iron-deficiency anemia				-25%	
4	Other hearing loss				-26%	
47	Uterine fibroids				-35%	
4	Unintentional injuries not classified elsewhere				-61%	
30 37 44 42	Tuberculosis				-74%	
ň	Edentulism				-112%	

Figure 11. Percent change in causes of YLDs after decomposition for 50 top causes of YLDs, 1990–2010

old. Figure 20 and Table 2 provide visual and numerical reference information on LE and HALE in Iran for the two periods.

# Discussion

The current study presents multiple health indicators that help assess the healthcare sector's overall performance in the last two decades. While many indicators have improved over time, the profile of diseases and risk factors has changed dramatically. The mean mortality age increased from 38.04 years in 1990 to 59.17 years in 2010. Age-specific mortality rate declined between 13% and 61% over this period. LE rose by 21 years for males and 22

years for females from 1970 to 2010.<sup>6</sup> This increase in life expectancy places Iran among countries with the highest positive change in LE.<sup>6</sup> Of important note, compared to females, the age-specific mortality rate in males showed slow growth, in particular in younger age groups. The mortality sex ratio for the young age category increased by 29% from 1990 to 2010. This was caused by relatively more deaths due to injuries and drug use in males.<sup>5,7</sup>

Time trend information furnished by this paper can be used to evaluate problems and policies specific to a medical condition or risk factor. For example, in 1990, stomach cancer was the chief cause of mortality among all cancers for both genders. In 2010, however, stomach cancer was replaced by breast cancer in fe-

1990 mean rank (95% UI)	2010 mean rank (95% UI)		% change (95% UI)
1.8 (1, 3) 1 Ischemic heart disease	1 Ischemic heart disease	1.3 (1, 2)	25 (6, 44)
2.3 (1, 4) 2 Congenital anomalies	2 Road injury	1.8 (1, 3)	79 (-6, 166)
2.5 (1, 5) 3 Forces of nature	3 Low back pain	2.9 (2, 4)	83 (52, 125)
4.1 (2, 6) 4 Road injury	4 Major depressive disorder	5.3 (3, 10)	68 (-20, 241)
5.2 (3, 9) 5 Preterm birth complications	5 Stroke	5.5 (4, 8)	1 (-17, 22)
6.4 (4, 9) 6 Lower respiratory infections	6 Congenital anomalies	6.3 (4, 12)	-59 (-81, -18)
6.9 (4, 10) 7 Low back pain	7 Preterm birth complications	7.3 (4, 12)	-43 (-68, 2)
8.2 (6, 11) 8 Stroke	8 Drug use disorders	8.0 (4, 12)	176 (53, 386)
9.3 (6, 12) 9 Other cardio & circulatory	9 Other cardio & circulatory	8.2 (6, 11)	-14 (-45, 22)
9.5 (6, 12) 10 Diarrheal diseases	10 Diabetes	10.0 (7, 12)	129 (86, 186)
11.7 (7, 17) 11 Major depressive disorder	11 COPD	12.5 (7, 18)	44 (-7, 123)
11.8 (9, 16) 12 Iron-deficiency anemia	12 Falls	13.4 (10, 19)	67 (15, 117)
13.6 (10, 18) 13 Fire	13 Lower respiratory infections	13.9 (10, 20)	-64 (-76, -42)
15.1 (12, 21) 14 Drowning	14 Iron-deficiency anemia	14.7 (10, 22)	-33 (-40, -28)
15.8 (12, 22) 15 Mechanical forces	15 Interpersonal violence	18.7 (9, 28)	23 (-15, 151)
15.9 (11, 25) 16 Protein-energy malnutrition	16 Neck pain	19.3 (13, 28)	73 (50, 99)
18.3 (13, 26) 17 COPD	17 Anxiety disorders	19.4 (5, 42)	63 (-63, 636)
20.8 (15, 30) 18 Asthma	18 Asthma	19.6 (13, 29)	8 (-18, 50)
21.8 (16, 30) 19 Meningitis	19 Self-harm	19.8 (12, 36)	211 (27, 369)
21.9 (16, 29) 20 Falls	20 Osteoarthritis	20.3 (13, 31)	98 (41, 184)
21 Drug use disorders	23 Fire		
22 Diabetes	26 Drowning		
23 Interpersonal violence	30 Mechanical forces		
28 Anxiety disorders	33 Diarrheal diseases		
31 Neck pain	62 Meningitis		
34 Osteoarthritis	66 Protein-energy malnutrition		
40 Self-harm			
Legend			
Communicable, maternal, neonatal, and nutrition	nal		
Non-communicable			

Communicable, maternal, neonatal, and nutritional Non-communicable Injury

Figure 12. Shifts in top 20 causes of DALYs for males, all ages, Iran, 1990–2010

J

1990 mean rank (95% UI)		2010 mean rank (95% UI)		% change (95% UI)
1.1 (1, 2) 1 Congenital anomalies		1 Low back pain	1.9 (1, 4)	81 (47, 121)
2.5 (2, 4) 2 Ischemic heart disease		2 Major depressive disorder	1.9 (1, 4)	63 (-16, 226)
3.6 (1, 8) 3 Forces of nature		3 Ischemic heart disease	2.5 (1, 4)	2 (-16, 23)
5.4 (3, 9) 4 Lower respiratory infections		4 Road injury	5.4 (4, 8)	21 (-22, 66)
5.6 (2, 12) 5 Major depressive disorder	$\mathbf{K}$	5 Congenital anomalies	5.5 (2, 12)	-62 (-80, -10)
6.4 (3, 12) 6 Preterm birth complications		6 Stroke	7.5 (5, 11)	-8 (-27, 16)
6.7 (3, 12) 7 Low back pain		7 Iron-deficiency anemia	7.6 (4, 12)	-10 (-16, -4)
8.2 (4, 13) 8 Diarrheal diseases		8 Anxiety disorders	8.1 (1, 20)	65 (-58, 654)
9.5 (5, 13) 9 Iron-deficiency anemia		9 Preterm birth complications	8.7 (4, 14)	-38 (-65, 22)
9.7 (6, 13) 10 Stroke		10 Diabetes	9.5 (7, 13)	125 (82, 174)
10.6 (6, 13) 11 Road injury	$( \land \land )$	11 Osteoarthritis	11.1 (6, 16)	104 (46, 184)
11.0 (5, 15) 12 Other cardio & circulatory	<b>- <del>X - X/</del></b>	12 Other cardio & circulatory	12.0 (8, 15)	-29 (-57, 41)
13.0 (10, 15) 13 Fire	$\mathbb{N} \setminus \mathbb{N}$	13 Other musculoskeletal	12.1 (9, 15)	99 (71, 137)
14.5 (4, 30) 14 Anxiety disorders		14 Neck pain	13.6 (9, 17)	74 (51, 102)
15.3 (11, 23) 15 Protein-energy malnutrition		15 COPD	15.6 (9, 23)	46 (-9, 135)
18.1 (14, 26) 16 Asthma	ŀX/ ₩	16 Lower respiratory infections	16.0 (11, 22)	-67 (-80, -46)
18.9 (15, 24) 17 Diabetes		17 Fire	18.4 (14, 24)	-40 (-67, -11)
19.4 (15, 27) 18 Osteoarthritis		18 Asthma	18.9 (14, 26)	5 (-21, 35)
20.0 (15, 28) 19 COPD	$// \land \land$	19 Migraine	20.0 (15, 28)	80 (32, 148)
20.3 (15, 27) 20 Neck pain	$/$ $\times$	20 Epilepsy	21.1 (16, 27)	42 (5, 88)
22 Other musculoskeletal		25 Diarrheal diseases		
27 Epilepsy	/	63 Protein-energy malnutrition		
28 Migraine	/			

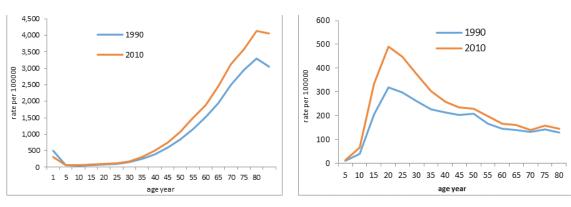
## Legend

Communicable, maternal, neonatal, and nutritional Non-communicable Injury

Figure 13. Shifts in top 20 causes of DALYs for females, all ages, Iran, 1990–2010

Sepsis and other infectious disorders of the newborn baby		L (			I			I	
Alzheimer's disease and other dementia						-		20	
Neonatal encephalopathy (birth asphyxia and birth trauma								17%	
Drug use disorders								14%	
Diabetes mellitus								13%	
Other neurological disorders							5%	1570	
							3%		
Migraine						1%			
Anxiety disorders						0%			
Pervasive development disorders						0%			
Osteoarthritis						0%			
Bipolar affective disorder					0%				
Low back and neck pair					0%	1			
Other musculoskeletal disorders					-1%	1			
Schizophrenia					-1%	7			
Unipolar depressive disorders					-3%				
Epilepsy					-3%				
lodine deficiency					-4%				
Chronic kidney diseases					-4%				
Preterm birth complications					-7%				
Falls				-10					
Iron-deficiency anemia				-10		2			
Other hearing loss				-10	%				
Chronic obstructive pulmonary disease				-119	%				
Thalassemia				-119	6		17		
Road injury				-12%					
Other infectious diseases				-12%		)			
Asthma				-14%					
Leukemia				-14%					
Lower respiratory infections				0%					
				070					
Other neoplasms			-24%						
Trachea, bronchus, and lung cancers			-26%						
Interpersonal violence			-27%						
Other chronic respiratory diseases			-28%						
Self-harm			-28%						
Ischemic stroke		-3	1%						
Diarrheal diseases		-3	1%						
Drowning		-32	%						
Other cardiovascular and circulatory diseases		-34%							
Congenital anomalies		-34%							
Fire, heat and hot substances		-35%							
Other neonatal disorders		-35%							
Unintentional injuries not classified elsewhere									
		-35%							
Cirrhosis of the live		-36%							
Hypertensive heart disease		-37%							
Hemorrhagic and other non-ischemic stroke		-40%							
Ischemic heart disease		-42%							
Exposure to mechanical forces	-	43%							
Poisoning									
Stomach cancer									
Rheumatic heart disease									

Figure 14. Percent change in causes of DALYs after decomposition for population growth and population aging for 50 top causes of death, 1990–2010



Comparison of DALYs specific age per capita due to diabetes mellitus between 1990 and 2010

Figure 15. Comparison of DALYs specific age per capita due to diabetes mellitus and suicide between 1990 and 2010

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Comparison of DALYs specific per capita due to self-harm between 1990 and 2010

	1990 Mean rank (95% UI)		2010 Mean rank (95% UI)	M	Median % change (95% UI)		
1.0 (1-1)	1 Dietary risks	<u> </u>	1 Dietary risks	1.1 (1-2)	71% (55 to 85)		
2.0 (2-2)	2 High blood pressure		2 High blood pressure	1.9 (1-2)	78% (53 to 107)		
3.0 (3-3)	3 Smoking		3 High body-mass index	3.0 (3-3)	171% (111 to 268)		
4.1 (4-5)	4 Ambient PM pollution		4 Physical inactivity	4.5 (4-7)	No estimates		
5.6 (4-7)	5 High total cholesterol		5 Smoking	5.5 (4-7)	23% (3 to 45)		
5.6 (4-7)	6 High body-mass index		6 Ambient PM pollution	5.9 (4-7)	45% (30 to 60)		
6.8 (5-8)	7 High fasting plasma glucose		7 High total cholesterol	6.4 (4-8)	72% (22 to 156)		
8.9 (8-11)	8 Childhood underweight		8 High fasting plasma glucose	7.7 (6-8)	78% (18 to 162)		
9.4 (6-21)	9 Household air pollution		9 Alcohol use	9.7 (9-12)	58% (-41 to 370)		
10.4 (8-12)	10 Suboptimal breastfeeding	i.i.	10 Lead	10.3 (9-13)	201% (110 to 264)		
10.6 (8-12)	11 Alcohol use	The second	11 Occupational risks	11.0 (9-13)	26% (-11 to 103)		
11.2 (10-12)	12 Occupational risks		12 Drug use	11.6 (9-13)	347% (103 to 877)		
12.9 (12-14)	13 Lead	i i i i i i i i i i i i i i i i i i i	13 Suboptimal breastfeeding	14.4 (13-18)	-81% (-90 to -64)		
14.3 (13-17)	14 Drug use		14 Intimate partner violence	14.5 (13-18)	No estimates		
15.5 (13-21)	15 Sanitation		15 Low bone mineral density	15.5 (13-18)	222% (73 to 429)		
16.8 (15-19)	16 Iron deficiency	KN, NX	16 Radon	16.2 (13-20)	No estimates		
17.6 (15-21)	17 Unimproved water	1888 - X 2	17 Ozone	17.3 (15-19)	87% (37 to 154)		
17.8 (15-20)	18 Vitamin A deficiency		18 Childhood underweight	17.6 (15-20)	-95% (-97 to -91)		
18.0 (14-21)	19 Zinc deficiency		19 Childhood sexual abuse	19.5 (17-22)	No estimates		
19.5 (17-21)	20 Ozone		20 Household air pollution	19.9 (9-25)	-100% (-100 to 27)		
19.8 (17-21)	21 Low bone mineral density		21 Sanitation	20.5 (18-25)	-82% (-93 to -46)		
		1997 - 1997 -	22 Iron deficiency	21.8 (20-24)	-85% (-90 to -69)		
		12.1	23 Unimproved water	22.3 (20-25)	-85% (-94 to -60)		

Figure 16. Top risk factors and their rank change, for all ages and both sexes, 1990–2010

24 Zinc deficiency

25 Vitamin A deficiency

	1990 Mean rank (95% UI)	
1.0 (1-1)	1 Dietary risks	
2.1 (2-4)	2 High blood pressure	
3.5 (2-5)	3 Ambient PM pollution	
3.7 (2-6)	4 High body-mass index	
5.1 (4-7)	5 High total cholesterol	
6.5 (5-8)	6 Smoking	
7.8 (5-16)	7 Household air pollution	
7.9 (6-10)	8 High fasting plasma glucose	
8.4 (5-10)	9 Alcohol use	
10.2 (8-11)	10 Iron deficiency	· · · · · · · · · · · · · · ·
10.3 (8-12)	11 Lead	
12.2 (11-13)	12 Drug use	
12.7 (12-14)	13 Occupational risks	
14.2 (13-16)	14 Sanitation	
15.2 (14-16)	15 Unimproved water	
15.4 (14-16)	16 Ozone	the second second
		A Sala Sala Sala Sala Sala Sala Sala Sal

2010 Mean rank (95% UI)	м	edian % change (95% UI)
1 Dietary risks	1.0 (1-1)	-3% (-24 to 27)
2 High body-mass index	2.1 (2-3)	88% (30 to 198)
3 High blood pressure	3.1 (2-4)	5% (-35 to 59)
4 Physical inactivity	4.0 (3-5)	No estimates
5 Ambient PM pollution	5.4 (4-7)	-10% (-31 to 19)
6 High total cholesterol	5.8 (4-7)	12% (-32 to 98)
7 High fasting plasma glucose	7.6 (6-10)	60% (-22 to 259)
8 Intimate partner violence	8.3 (5-11)	No estimates
9 Smoking	9.1 (7-11)	-29% (-66 to 40)
10 Alcohol use	9.1 (6-11)	17% (-60 to 267)
11 Lead	11.5 (9-14)	20% (-59 to 293)
12 Drug use	11.7 (10-13)	344% (102 to 788)
13 Occupational risks	13.5 (12-15)	142% (28 to 388)
14 Childhood sexual abuse	14.8 (13-17)	No estimates
15 Iron deficiency	15.1 (14-17)	-81% (-89 to -52)
16 Radon	16.4 (14-19)	No estimates
17 Household air pollution	17.0 (9-20)	-100% (-100 to -9)
18 Sanitation	17.3 (15-20)	-1% (-67 to 217)
19 Ozone	18.5 (17-20)	16% (-35 to 106)
20 Unimproved water	18.8 (17-20)	-14% (-66 to 126)

22.7 (20-25)

24.0 (22-25)

-86% (-94 to -75)

-93% (-96 to -87)

13.4 (14-16)	16 Ozone		16 Kadon	10.4 (14-15)	No estimates	
			17 Household air pollution	17.0 (9-20)	-100% (-100 to -9)	
			18 Sanitation	17.3 (15-20)	-1% (-67 to 217)	
			19 Ozone	18.5 (17-20)	16% (-35 to 106)	
		<u></u>	20 Unimproved water	18.8 (17-20)	-14% (-66 to 126)	
	1990 Mean rank (95% UI)		2010 Mean rank (95% UI)	м	ledian % change (95% U	
1.0 (1-1)	1 Dietary risks	]	1 Dietary risks	1.1 (1-2)	26% (-1 to 57)	
.6 (2-4)	2 High blood pressure	]	2 High blood pressure	2.5 (2-5)	41% (-4 to 106)	
2.8 (2-4)	3 Smoking		3 Smoking	4.0 (2-7)	18% (-10 to 55)	
1.7 (3-6)	4 Ambient PM pollution	h /	4 High body-mass index	4.4 (2-7)	96% (36 to 182)	
.4 (3-8)	5 Occupational risks		5 Occupational risks	6.2 (2-10)	39% (-15 to 157)	
5.1 (4-8)	6 High total cholesterol		6 Ambient PM pollution	7.1 (5-10)	20% (-7 to 51)	
.7 (4-9)	7 High body-mass index		7 High total cholesterol	7.3 (4-10)	41% (-14 to 139)	
.7 (2-11)	8 Alcohol use	h	8 Physical inactivity	7.4 (5-10)	No estimates	
.2 (7-11)	9 High fasting plasma glucose		9 Drug use	7.4 (2-10)	364% (82 to 1101)	
.8 (7-16)	10 Household air pollution		10 Alcohol use	8.0 (1-11)	43% (-73 to 1131)	
0.3 (8-11)	11 Drug use		11 High fasting plasma glucose	10.7 (10-12)	29% (-44 to 191)	
1.9 (11-12)	12 Lead	<u>}_`</u>	12 Lead	12.2 (12-13)	83% (39 to 135)	
3.7 (12-16)	13 Sanitation	X	13 Childhood sexual abuse	13.5 (13-15)	No estimates	
4.3 (13-16)	14 Iron deficiency		14 Radon	14.6 (13-17)	No estimates	
4.5 (13-16)	15 Ozone		15 Sanitation	15.7 (14-19)	-7% (-71 to 194)	
5.2 (13-16)	16 Unimproved water	X	16 Ozone	16.0 (14-18)	11% (-33 to 118)	
			17 Household air pollution	16.0 (11-19)	-100% (-100 to 22)	
		100	18 Unimproved water	17.2 (16-18)	-18% (-68 to 116)	
			19 Iron deficiency	18.7 (17-19)	-92% (-96 to -84)	
	sanitation Air pollution	Other environmental Physical inactivity	Undernutrition Smoking	Alcohol &	2	
, .						

Figure 17. Top risk factors and their rank change, age 15 to 49 years, female and male, 1990–2010

v risks lood pressure ng nt PM pollution otal cholesterol ody-mass index asting plasma glucose hold air pollution I use pational risks use		1 Dietary risks     2 High blood pressure     3 High body-mass index     4 Smoking     5 Physical inactivity     6 High total cholesterol     7 Ambient PM pollution     8 High fasting plasma glucose     9 Lead     10 Alcohol use     11 Occupational risks	1.0 (1-1) 2.0 (2-2) 3.0 (3-3) 4.4 (4-6) 5.5 (4-7) 5.7 (4-8) 6.6 (5-8) 7.7 (6-8) 9.7 (9-12) 9.8 (9-11) 1.0 (1-1) 9.8 (9-11)	12% (-4 to 27) 11% (-9 to 31) 92% (43 to 168) -6% (-24 to 15) No estimates 26% (-9 to 85) 10% (-6 to 25) 23% (-20 to 83) 82% (20 to 129) 14% (-28 to 85)
ng nt PM pollution otal cholesterol ody-mass index asting plasma glucose hold air pollution I use pational risks		3 High body-mass index 4 Smoking 5 Physical inactivity 6 High total cholesterol 7 Ambient PM pollution 5 High fasting plasma glucose 9 Lead 10 Alcohol use	3.0 (3-3) 4.4 (4-6) 5.5 (4-7) 5.7 (4-8) 6.6 (5-8) 7.7 (6-8) 9.7 (9-12) 9.8 (9-11)	92% (43 to 168) -6% (-24 to 15) No estimates 26% (-9 to 85) 10% (-6 to 25) 23% (-20 to 83) 82% (20 to 129)
nt PM pollution otal cholesterol ody-mass index asting plasma glucose hold air pollution I use pational risks		<ul> <li>4 Smoking</li> <li>5 Physical inactivity</li> <li>6 High total cholesterol</li> <li>7 Ambient PM pollution</li> <li>8 High fasting plasma glucose</li> <li>9 Lead</li> <li>10 Alcohol use</li> </ul>	4.4 (4-6) 5.5 (4-7) 5.7 (4-8) 6.6 (5-8) 7.7 (6-8) 9.7 (9-12) 9.8 (9-11)	-6% (-24 to 15) No estimates 26% (-9 to 85) 10% (-6 to 25) 23% (-20 to 83) 82% (20 to 129)
stal cholesterol ody-mass index asting plasma glucose hold air pollution I use pational risks		5 Physical inactivity 6 High total cholesterol 7 Ambient PM pollution 8 High fasting plasma glucose 9 Lead 10 Alcohol use	5.5 (4-7) 5.7 (4-8) 6.6 (5-8) 7.7 (6-8) 9.7 (9-12) 9.8 (9-11)	No estimates           26% (-9 to 85)           10% (-6 to 25)           23% (-20 to 83)           82% (20 to 129)
ody-mass index asting plasma glucose hold air pollution I use pational risks use		<ul> <li>6 High total cholesterol</li> <li>7 Ambient PM pollution</li> <li>8 High fasting plasma glucose</li> <li>9 Lead</li> <li>10 Alcohol use</li> </ul>	5.7 (4-8) 6.6 (5-8) 7.7 (6-8) 9.7 (9-12) 9.8 (9-11)	26% (-9 to 85) 10% (-6 to 25) 23% (-20 to 83) 82% (20 to 129)
asting plasma glucose hold air pollution I use pational risks use		7 Ambient PM pollution 8 High fasting plasma glucose 9 Lead 10 Alcohol use	6.6 (5-8) 7.7 (6-8) 9.7 (9-12) 9.8 (9-11)	10% (-6 to 25) 23% (-20 to 83) 82% (20 to 129)
hold air pollution I use pational risks use		<ul> <li>S High fasting plasma glucose</li> <li>9 Lead</li> <li>10 Alcohol use</li> </ul>	7.7 (6-8) 9.7 (9-12) 9.8 (9-11)	23% (-20 to 83) 82% (20 to 129)
l use pational risks use		9 Lead - 10 Alcohol use	9.7 (9-12) 9.8 (9-11)	82% (20 to 129)
pational risks use		- 10 Alcohol use	9.8 (9-11)	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
use				14% (-28 to 85)
	· · · · · · · · · · · · · · · · · · ·	- 11 Occupational risks	11 2 (10 12)	24/2 ( 20 10 00)
			11.3 (10-13)	-11% (-33 to 25)
and a second state the		12 Drug use	12.1 (10-13)	299% (60 to 887)
one mineral density		13 Low bone mineral density	14.0 (13-16)	100% (-1 to 255)
e		14 Radon	14.1 (12-17)	No estimates
ation		15 Intimate partner violence	15.5 (14-17)	No estimates
deficiency	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	16 Ozone	15.9 (14-17)	+4% (-31 to 45)
proved water	the second	17 Household air pollution	16.2 (9-20)	-100% (-100 to 13)
	and the second	18 Childhood sexual abuse	17.5 (16-19)	No estimates
		19 Sanitation	18.4 (17-21)	-66% (-88 to 2)
		20 Unimproved water	19.6 (18-21)	-70% (-88 to -28)
		21 Iron deficiency	20.9 (19-21)	-95% (-97 to -91)
on Air pollution	Other environ		20.9 (19-21)	-95% (-97 to -91)
P	roved water	roved water	noved water 17 Household air pollution 18 Childhood sexual abuse 19 Sanitation 20 Unimproved water 21 Iron deficiency on Air pollution Other environmental Undernutrition	noved water 17 Household air pollution 16.2 (9-20) 18 Childhood sexual abuse 17.5 (16-19) 19 Sanitation 18.4 (17-21) 20 Unimproved water 19.6 (18-21) 21 Iron deficiency 20.9 (19-21) on Air pollution Other environmental Undernutrition Smoking

Figure 18. Top risk factors and their rank change, age 50 to 69 years, both sexes, 1990–2010

	1990 Mean rank (95% UI)	2010 Mean rank (95% UI)		Median % change (95%
1.3 (1-2)	1 Dietary risks	1 Dietary risks	1.3 (1-2)	165% (139 to 191)
.7 (1-2)	2 High blood pressure	2 High blood pressure	1.7 (1-2)	165% (127 to 205)
.3 (3-5)	3 Smoking	3 High body-mass index	3.1 (3-4)	347% (240 to 525)
.1 (3-6)	4 Ambient PM pollution	4 Physical inactivity	4.2 (3-6)	No estimates
1.7 (3-7)	5 High body-mass index	5 Ambient PM pollution	5.6 (4-8)	152% (122 to 184)
.8 (4-7)	6 High total cholesterol	6 Smoking	6.3 (4-8)	107% (52 to 178)
.1 (4-7)	7 High fasting plasma glucose	T 7 High total cholesterol	6.7 (4-8)	176% (90 to 341)
.7 (8-17)	8 Household air pollution	8 High fasting plasma glucose	7.2 (5-8)	173% (88 to 289)
.0 (8-10)	9 Alcohol use	9 Lead	9.2 (9-11)	542% (346 to 685)
9.8 (8-11)	10 Lead	10 Alcohol use	10.1 (9-11)	181% (54 to 404)
0.8 (10-11)	11 Occupational risks	11 Occupational risks	11.9 (11-13)	45% (14 to 78)
2.5 (11-14)	12 Low bone mineral density	12 Low bone mineral density	12.5 (11-15)	337% (122 to 703)
.2.5 (11-14)	13 Ozone	13 Ozone	14.0 (12-16)	186% (112 to 284)
14.6 (13-17)	14 Iron deficiency	14 Radon	14.1 (11-17)	No estimates
5.1 (13-17)	15 Sanitation	15 Drug use	14.2 (11-16)	680% (188 to 2340)
5.3 (13-17)	16 Drug use	16 Intimate partner violence	16.4 (15-18)	No estimates
6.5 (15-17)	17 Unimproved water	17 Household air pollution	16.8 (9-21)	-99% (-100 to 160)
		18 Sanitation	17.6 (16-21)	-29% (-75 to 119)
		19 Unimproved water	19.0 (17-21)	-39% (-74 to 49)
		20 Childhood sexual abuse	19.3 (17-21)	No estimates
		21 Iron deficiency	19.8 (17-21)	-84% (-92 to -65)

Figure 19. Top risk factors and their rank change, age 70+ years, both sexes, 1990–2010

males while remaining the top cancer in males.

Worldwide and regional trends of major causes of death and morbidity derived from the GBD 2010 study help better assess the measured outcomes in Iran. For example, worldwide age-standardized death rate (per 100,000 population) due to IHD dropped from 131.28 (95% UI: 126.44 – 142.2) in 1990 to 105.73 (95% UI: 98.83 – 111.88) in 2010. While the decrement in this rate was also observed for Iran (174.9 per 100,000 in 2010), it is still well above the global average. In the third paper of this

series, we will compare Iran with its neighbors in greater detail. Lowering overall and cause-specific death rates to more acceptable levels requires critical and immediate action by the Iranian government.<sup>8</sup> As another useful example, we can discuss stomach cancer and liver cancer. The rate of stomach cancer dropped both in Iran and on the global level over the study period. Compared to most other countries and the worldwide estimates, the rate of this cancer in Iran decreased considerably more slowly. More specifically, Iran's mortality rate due to stomach cancer for both sexes

Table 2. Life expectancy and health-adjusted life expectancy, Iran, 1990 and 2010

	Both Sexes			Males				Females				
Age	19	990	2010		19	990	2010		1990		2010	
	LE	HALE	LE	HALE	LE	HALE	LE	HALE	LE	HALE	LE	HALE
0	67.5	57.2	74.4	63.2	64.6	55.3	71.6	61.5	71.0	59.5	77.8	65.3
1	69.6	58.9	74.9	63.6	66.8	57.2	72.2	61.9	73.0	61.1	78.3	65.7
5	66.5	55.9	71.4	60.2	63.7	54.2	68.7	58.5	69.9	58.1	74.7	62.2
10	61.8	51.4	66.5	55.5	59.0	49.7	63.8	53.9	65.2	53.6	69.9	57.6
15	57.0	47.0	61.6	51.0	54.2	45.3	58.9	49.4	60.4	49.1	65.0	53.1
20	52.3	42.8	56.8	46.6	49.7	41.1	54.2	45.0	55.6	44.8	60.1	48.7
25	47.8	38.7	52.1	42.4	45.2	37.1	49.5	40.8	50.9	40.6	55.2	44.3
30	43.2	34.6	47.3	38.1	40.8	33.1	44.9	36.6	46.2	36.5	50.4	40.1
35	38.7	30.6	42.6	34.0	36.4	29.2	40.3	32.5	41.5	32.5	45.5	35.9
40	34.2	26.8	38.0	29.9	32.0	25.4	35.7	28.5	37.0	28.6	40.7	31.8
45	29.9	23.1	33.4	26.0	27.8	21.7	31.2	24.6	32.5	24.8	36.0	27.8
50	25.7	19.6	28.9	22.2	23.8	18.3	26.9	20.9	28.1	21.2	31.4	24.0
55	21.7	16.3	24.6	18.7	20.0	15.1	22.7	17.4	23.9	17.8	26.9	20.3
60	18.0	13.3	20.5	15.3	16.6	12.3	18.8	14.1	19.9	14.6	22.6	16.8
65	14.6	10.6	16.7	12.2	13.5	9.8	15.3	11.2	16.1	11.6	18.5	13.5
70	11.6	8.2	13.2	9.5	10.7	7.6	12.1	8.7	12.7	9.0	14.6	10.5
75	9.0	6.2	10.2	7.1	8.3	5.7	9.4	6.6	9.8	6.7	11.2	7.9
80	6.8	4.6	7.6	5.2	6.3	4.2	7.0	4.8	7.3	4.9	8.3	5.7

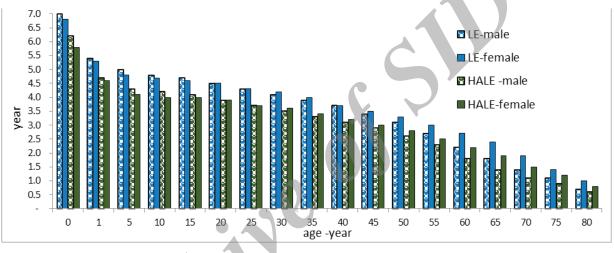


Figure 20. Comparison of increase in life expectancy and health-adjusted life expectancy by sex, Iran 1990–2010

was 24.09 in 1990; with a 31% decrease, this rate dropped to 16.3 per 100,000 in 2010. On the other hand, Japan's mortality rate due to stomach cancer decreased by 45%, from 33.6 in 1990 to 18.4 in 2010. Similar to Japan, China's mortality rate due to stomach cancer decreased significantly, by 39%, from 34.2 in 1990 to 20.8 in 2010 for both genders. For liver cancer, the age-standardized death rate for the global level has increased between 2% and 3% for both sexes. However, Iran's mortality rate due to liver cancer has increased by 88% in males and 103% in females. These two latter examples warn policymakers to plan condition-specific policies to search for possible triggers of the problems and to prevent these fatal conditions. It is essential to consider some immediate actions by Iranian public health researchers to plan and apply interventions in order to break these patterns and improve public health in Iran.

Mental and behavioral disorders are of special prominence. Major depressive disorders have risen 81% since 1990 and become the top condition as measured by DALYs in 2010. Anxiety disorders also showed a dramatic rise of 65% during this period. The suicide death rate, after adjusting for population growth and population age pattern, grew by 75%. Adjusted for the same population factors, death rate due to drug use disorders showed a 152% increase. We believe this is convincing evidence that emphasizes a specific direction for any future reforms in healthcare, education and justice system with consideration of improvement of societies' mental health the country.

The GBD results for injuries in Iran and in particular for road injuries should gain considerable attention. The increasing fatality rate of 14% for road injuries over these two decades caused YLLs for this condition to rank first in 2010. A qualitative assessment of probable causes of the increase in road injuries in Iran has been published elsewhere. A sharp boost in production of unsafe cars and motorcycles and driving on unsafe roads were deemed to be the major contributing factors in rising road injury death in the country during these two decades.<sup>9</sup> Road injury fatality reduction was particularly emphasized in the fourth five-year (2005 – 2009) National Development Plan.<sup>7</sup> The current report and the ensuing GBD results will be an invaluable benchmark for the evaluation of the national five-year policies with a specific goal of reducing the burden of road injuries.

Expanding urbanization and low fertility together brought about a demographic transition that in turn developed into an epidemiological transition, which is evident from predominant and rising mortality due to non-communicable conditions. We posit that the disease- and injury-related death events that occurred over the last two decades could have been prevented to a large extent if the country had a coordinated plan to control the important risk factors and expanded the primary preventive healthcare network to effectively cover non-communicable diseases and injuries.

The GBD study team holds the commitment to promote the quality of the data and regular reporting. The health sector of the country can benefit from the data for disease monitoring and surveillance. Equally important, interacting with the GBD team provides the opportunity to improve local burden statistics.

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