Tobacco Smoking Status and the Contribution to Burden of Diseases in Iran, 1990–2010: findings from the Global Burden of Disease Study 2010

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Abstract

Background: Tobacco smoking and exposure to second-hand smoke in the indoor environment are major public health risks worldwide. The aim of this paper is to report and critique a global assessment of smoking prevalence, smoking-attributable deaths, and disability adjusted life years (DALYs) extracted from the Global Burden of Disease study 2010, by sex and age in Iran from 1990 to 2010.

Methods: The Global Burden of Disease Study 2010 estimated the distributions of exposure and relative risks per unit of exposure by systematically reviewing and analyzing published and unpublished data. These assessments were used, together with estimates of death and DALYs due to specific risk factors, to calculate the attributed burden for each risk factor exposure compared with the theoretical-minimum-risk exposure. Uncertainties in the distribution of exposure, relative risks, and relevant outcomes were incorporated into estimates of attributable mortality and burden. In this study, our aim was to reformulate the GBD 2010 data, produce new graphs, and explain the results for Iran in greater detail.

Results: Between 1990 and 2010, the prevalence of tobacco smoking at all ages increased by 1% in men and declined by 2% in women in Iran, but the overall prevalence in the general population was unchanged (12%). A reduction was observed in the age-standardized death and DALY rates (per 100,000 population) attributed to tobacco smoking, including second-hand smoke. The attributed DALY rate was greater for Iranian men than for Iranian women. The highest rates of DALYs because of tobacco smoking were found in smoker men and women aged 70+, but exposure to second-hand smoke had the most significant burden in children under 5 years old. In 1990, the three leading disease burdens attributed to tobacco smoking, including second-hand smoke, were ischemic heart disease; communicable, maternal, neonatal, and nutritional disorders; and chronic respiratory diseases. In 2010, three leading burden of diseases attributed to tobacco smoking belonged to ischemic heart disease, chronic respiratory disease, and cerebrovascular diseases, respectively.

Conclusion: Despite a reduction in the rate of tobacco smoking, including second-hand smoke, since 1990, smoking exposure remained the fifth leading risk factor for death and DALYs in Iran in 2010. Overall, our data clearly show the need for new efforts in Iran to reduce the and disease burden attributed to tobacco smoking.

Keywords: Global Burden of Disease, Iran, Tobacco smoking

Introduction

Tobacco smoking is one of the greatest public health problems, with high mortality and morbidity worldwide. Despite growing global efforts to control tobacco use, it remains a common health concern, with more than one billion smokers in the world.[1] Second-hand smoke—a known cause of morbidity and premature mortality—is also one of the most important and widespread airborne pollutants in the indoor environment.[2,3] Given the significance of tobacco as a major health risk, monitoring the distribution and intensity of tobacco use is critical for identifying healthcare priorities and allocating resources.

Recent estimates show that almost one third of the world population smokes,[4] and about 84% of these smokers live in developing countries.[5] The prevalence of daily tobacco smoking varies widely among different regions and men smoke more than women in all regions. In the Eastern Mediterranean region, smoking prevalence is about 30% in men and nearly 5% in women.[6] The prevalence of daily cigarette smoking in Iran is 11.3% (21.4% in men and 1.4% in women).[7] Additionally, 40% of children are regularly exposed to second-hand smoke indoors worldwide, but exposure varies widely in different regions.[2] In the Eastern Mediterranean region, more than 22% of men and 32% of women are exposed to second-hand smoke,[2] and according to a study conducted in Iran, the prevalence of second-hand smoke exposure in children is 35.7%.[8]

Globally, about 6 million people die from tobacco-related causes each year.[9,10] Of these deaths, over 600,000 are attributable to second-hand smoke exposure [3] and more than 5 million are due to direct tobacco use. Most of these deaths occur in low-and middle-income countries.[9,10] In Iran, smoking was responsible for 11,000

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deaths in 2005.[11] Tobacco smoking also causes a remarkably increased risk of non-communicable diseases, such as cardiovascular disease, lung cancer, other cancers, chronic obstructive pulmonary disease, and other respiratory diseases, as does second-hand smoke.[12,13]

In this regard, a detailed description is needed of the burden of tobacco smoking, including second-hand smoke, and the other diseases and their risk factors, in order to advance better health interventions and policies and to develop preventive strategies. The Institute for Health Metrics and Evaluation (IHME) performed a comprehensive systematic review and calculated the Global Burden of Disease in 2010, providing results for the years 1990, 1995, 2000, 2005, and 2010.[14] A comparative risk assessment (CRA) of the burden of disease attributable to different risk factors has been calculated in the GBD study 2010, and the components of the study are available across countries, including Iran. The aim of this paper is to present the global assessment of smoking prevalence, smoking-attributable death, and disability adjusted life years (DALYs) by sex and age, from 1990 to 2010, for Iran. We also discuss the data, methods, and limitations of the GBD Study 2010 in terms of different aspects of policy making.

Materials and Methods

The GBD Study 2010 was a systematic effort that used common frameworks for data collection, statistical methods, and estimation processes, as described elsewhere.[15–22] Further details are also available on the data and methods used to produce final estimates for comparative risk assessments of death and DALYs attributable to specific risk factors such as tobacco smoking.[22]

The five main steps for estimating the disease burden attributable to risk factors by the GBD Study 2010 were as follows: 1) Risk-outcome pairs were included in the analysis based on causal association criteria; 2) The distribution of exposure to each risk factor was estimated by a systematic search to identify published and unpublished data sources; 3) Relative risk (RR) per unit of exposure for each risk-outcome pair was calculated; 4) Theoretical-minimum-risk exposure distributions for counterfactual comparison were included (these were no tobacco smoking and no second-hand smoke exposure); 5) Death and disease burdens attributable to risk factors (the population attributable fraction) were computed by comparing the current distribution of exposure to the theoretical-minimum-risk counterfactual distribution of the exposure for each country, year, sex, age group, and cause.

Following the estimation of the distribution of risk factors, risk factor models were then designed to use available data for exposures in countries over several years, and for sex and different age groups, in order to produce a complete and comprehensive dataset of exposure distributions.[22] In addition, some specific methods, such as estimating cumulative exposure, were also used for tobacco smoking, including second-hand smoke. This alternative method used lung cancer mortality (i.e., the smoking impact ratio) as a marker of the cumulative population exposure to smoking for cancers and chronic respiratory diseases.[23] The ten-year lagged tobacco smoking prevalence was used for all other outcomes, including cardiovascular diseases.[22] A wide range of covariates in databases generated at the IHME for the GBD study 2010 were verified, and significant study characteristics were considered for estimating the exposure distribution.

Uncertainty in the estimations was also calculated by simula-

tion analysis, taking 1000 draws from the posterior distribution of exposure, RR, and each relevant outcome for each country, year, sex, and age group.[22] The entire measures have been reported with a 95% Uncertainty Interval (UI). The mean rates of death and DALYs attributable to each risk factor and the mean rank for the risk factors included in the ranking list were subsequently computed. The exposure estimates, relative risks, theoretical-minimum-risk distributions, and uncertainty in the background outcome rates were disseminated into the final estimations.

Using this protocol, we extracted data about tobacco smoking and second-hand smoke in Iran based on the GBD study 2010, analyzed the data, and critiqued the results.

Results

We report the GBD study results for Iran on the prevalence of tobacco smoking, as well as on deaths and the disease burden caused by tobacco smoking, including second-hand smoke, between 1990 and 2010. The term "tobacco smoking" refers to tobacco smoking, but excludes exposure to second-hand smoke.

In 1990, 3.7 (95% UI: 3.1–4.4) million Iranians were smokers. The prevalence of tobacco smoking at all ages was 12% (10%–14%) for both sexes. It was21% (18%-25%) for men and 3% (2%–4%) for women. The number of smokers increased to 6.7 (95% UI: 6.1–7.3) million in 2010, which meant that 12% (11%–13%) of the population, including 22% (20%–24%) of all men and 1% (1%–2%) of all women, were smokers. Figure 1 shows the smoking prevalence by sex and age in 1990 and 2010.

In absolute terms, the number of deaths at all ages attributed to tobacco smoking, including second-hand smoke, increased (23%) from 27,374 (95% UI: 22,970–31,096) in 1990 to 33,559 (27,382–39,543) in 2010; while the DALYs for all ages decreased(1%) from 883,305 (95% UI: 749,820-1,009,140) to 875,500 (721,292–1,026,600). The number of deaths and DALYs for all ages due to second-hand smoke declined from 2,556 (95% UI: 1,915-3,321) in 1990 to 1,933 (1,439–2,476) in 2010, and from 172,117 (95% UI: 119,724–233,807) to 67,415(51,471–88,672), respectively. Over this period, rates (per 100,000 population) of age-standardized deaths and DALYs due to tobacco smoking, including second-hand smoke, showed falling trends for both sexes. Time trends of rates of age-standardized deaths and DALYs caused by tobacco smoking and second-hand smoke between 1990 and 2010 are indicated in Figure 2.

Table1 presents the detailed estimates of DALY rates per 100,000 population due to tobacco smoking, including second-hand smoke, as well as tobacco smoking and second-hand smoke separately, by sex and four age groups from 1990 to 2010. The attributed rates at all ages were greater for Iranian men than for Iranian women. In accordance with the rates of DALYs due to tobacco smoking in the three main age groups (15–49, 50–69, +70), the lowest rates were in Iranian smoker men aged 15–49 years. The rates increased by age, with the highest levels seen in smoker men aged 70+. Female age-specific DALY rates showed the same trends as men's rates in the same age groups. Thus, the highest rates were found in smoker women over the age of 70 years. The DALY rates caused by second-hand smoke in the four main age groups (under 5, 15–49, 50–69, 70+) indicated a predominant disease burden in children under age 5 and a non-trivial burden in the older age groups. The age trends for DALY rates in males and females caused by tobacco smoking and second-hand smoke, broken down by five-year age periods from 1990 to 2010,
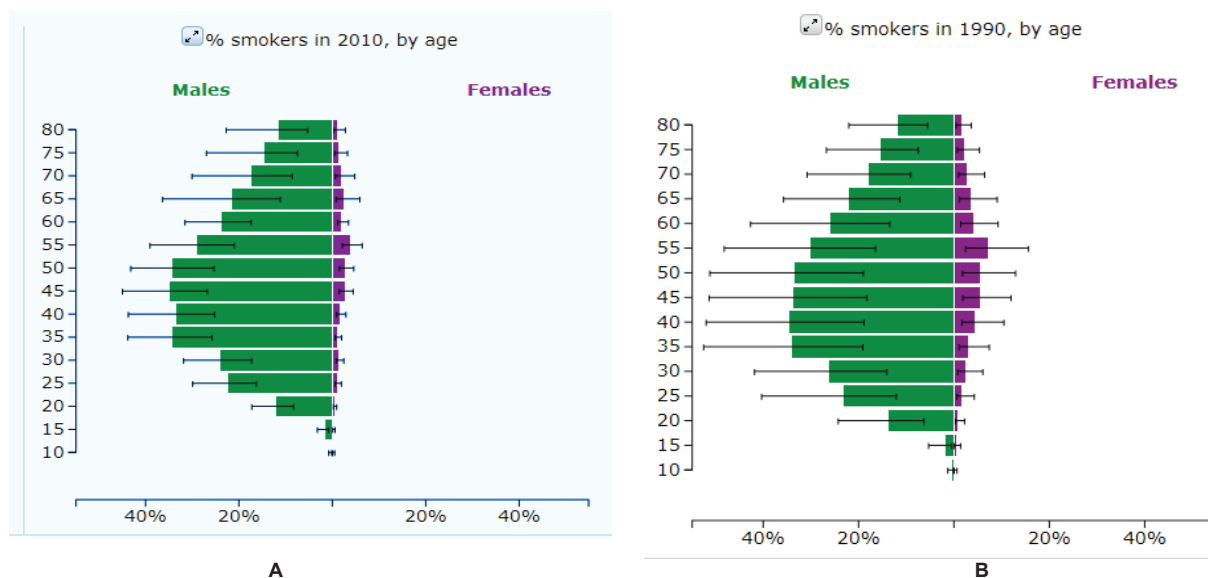
Figure 1. Prevalence of tobacco smoking in males and females by age in 1990 and 2010 for Iran **(A)** 1990, **(B)** 2010.
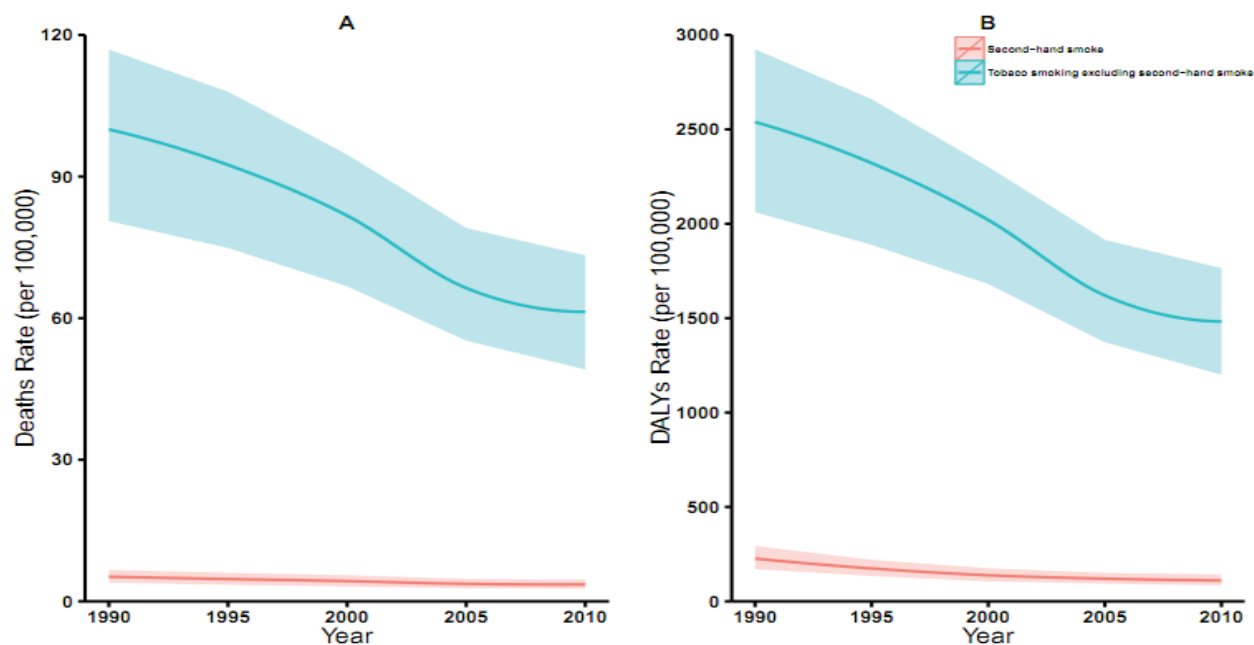

Figure 2. Time trends of age-standardized deaths and DALYs rates attributed to tobacco smoking excluding second-hand smoke, and second-hand smoke from 1990 to 2010 in Iran: **(A)** Deaths rate, **(B)** DALYs rate.

are shown in Figure 3.

Overall, the all-cause death and disease burden data indicated that tobacco smoking, including second-hand smoke, contributed to 8.5% (95% UI: 7.2%–9.7%) of total deaths and 4.0% (3.4%–4.6%) of total DALYs in 1990, compared with 9.5% (95% UI: 7.9%–11.1%) and 4.5% (3.7%–5.2%) in 2010, respectively. Figure 4 illustrates the percentages of cause-specific mortality and burden due to tobacco smoking and second-hand smoke, separately, in 1990 and 2010.

The DALYs attributable to tobacco smoking, including second-hand smoke, by cause in 1990 and 2010 are compared in Table 2. Ischemic heart disease was the first leading cause of DALYs in both years. Communicable, maternal, neonatal, and nutritional disorders were the second and chronic respiratory disease the third most common attributed burdens in 1990. These leading disease burdens attributed to tobacco smoking, including second-hand smoke, were replaced by chronic respiratory disease and cerebrovascular disease in 2010. In 1990, diabetes mellitus was at the bottom of the list as a cause of DALYs; this was replaced by stomach cancer in 2010.

Table 1. DALYs Rates (Per 100,000 population) attributable to tobacco smoking including second-hand smoke, tobacco smoking excluding second-hand smoke, and second-hand smoke by sex and age from 1990 to 2010 in Iran.

Year		1990	1995	2000	2005	2010	1990	1995
Risk Factor	**Sex**							
	Age			Men				
Tobacco smoking including second-hand smoke	Under 5	1710.4 (1019.7-2586.2)	1035.7 (634.1-1537.3)	667.4 (414.8-1010.4)	631.8 (376.5-1021.2)	542.7 (297.6-941.1)	1590.5 (969.8-2380.0)	963.2 (589.0-1427.3)
	15-49	1354.4 (1067.2-1669.8)	1300.8 (1027.4-1581.2)	1088.8 (867.7-1300.7)	839.4 (645.7-1036.9)	837.1 (611.8-1077.6)	374.1 (191.9-575.1)	308.93 (167.0-460.1)
	50-69	12950.3 (10459.5-15378.0)	12521.7 (10242.1-14684.2)	11200.3 (9173.3-13098.7)	8914.3 (7308.3-10765.)	8115.4 (6335.0-9841.4)	3322.8 (1950.8-4881.2)	2754.9 (1647.8-4027.5)
	+70	16960.9 (12552.4-21368.2)	16157.5 (12026.4-20492.1)	14915.8 (11162.5-18673.5)	12704.2 (9486.5-16338.5)	12001.7 (8951.0-15142.4)	6651.6 (3409.1-10465.8)	5378.8 (2883.6-8583.8)
	All ages	2370.2 (1976.4-2728.8)	2195.3 (1813.2-2516.9)	2041.6 (1699.6-2335.1)	1874.2 (1568.5-2209.5)	1944.3 (1560.9-2305.3)	837.6 (600.0-1066.1)	621.1 (442.0-787.1)
Tobacco smoking excluding second-hand smoke	15-49	1330.1 (1041.3-1649.5)	1272.8 (995.3-1556.9)	1062.6 (835.4-1278.4)	818.2 (622.2-1019.6)	813.0 (587.9-1050.5)	345.7 (162.7-548.3)	281.5 (134.6-433.8)
	50-69	12698.8 (10166.8-15146.2)	12253.6 (9927.2-14462.5)	10940.3 (8875.9-12850.7)	8701.0 (7082.0-10534.0)	7909.6 (6150.1-9618.1)	3137.4 (1746.9-4728.4)	2562.2 (1435.0-3858.5)
	+70	16514.5 (12059.8-21038.3)	15701.1 (11534.2-20083.9)	14458.5 (10655.0-18261.9)	12299.5 (9104.7-15963.5)	11592.5 (8573.7-14716.1)	6282.5 (2991.1-10073.0)	4996.1 (2474.2-8165.8)
	All ages	2039.9 (1671.1-2389.0)	2010.9 (1630.7-2333.8)	1925.7 (1575.7-2229.3)	1772.8 (1459.7-2113.6)	1845.1 (1459.5-2212.5)	540.3 (324.6-743.8)	459.0 (286.9-618.9)
Second-hand smoke	Under 5	1710.4 (1019.7-2586.2)	1035.7 (634.1-1537.3)	667.4 (414.8-1010.4)	631.8 (376.5-1021.2)	542.7 (297.6-941.1)	1590.5 (969.8-2380.0)	963.2 (589.0-1427.3)
	15-49	24.3 (14.0-39.7)	28.0 (15.9-45.7)	26.2 (15.2-41.9)	21.2 (13.6-30.3)	24.1 (14.7-36.0)	28.4 (16.5-42.9)	27.4 (16.1-41.5)
	50-69	251.5 (166.4-362.9)	268.1 (175.6-383.6)	260.0 (173.9-365.4)	213.4 (146.8-301.6)	205.8 (135.2-290.4)	185.5 (120.1-270.0)	192.8 (125.8-277.2)
	+70	446.4 (298.4-635.5)	456.5 (302.0-642.2)	457.4 (309.8-635.4)	404.7 (276.7-560.8)	409.2 (272.1-572.0)	369.1 (245.1-524.7)	382.6 (255.5-546.1)
	All ages	330.3 (211.3-475.7)	184.4 (129.7-255.9)	115.9 (85.4-155.2)	101.5 (75.0-137.6)	99.2 (71.2-139.0)	297.3 (193.1-430.0)	162.1 (110.7-226.1)

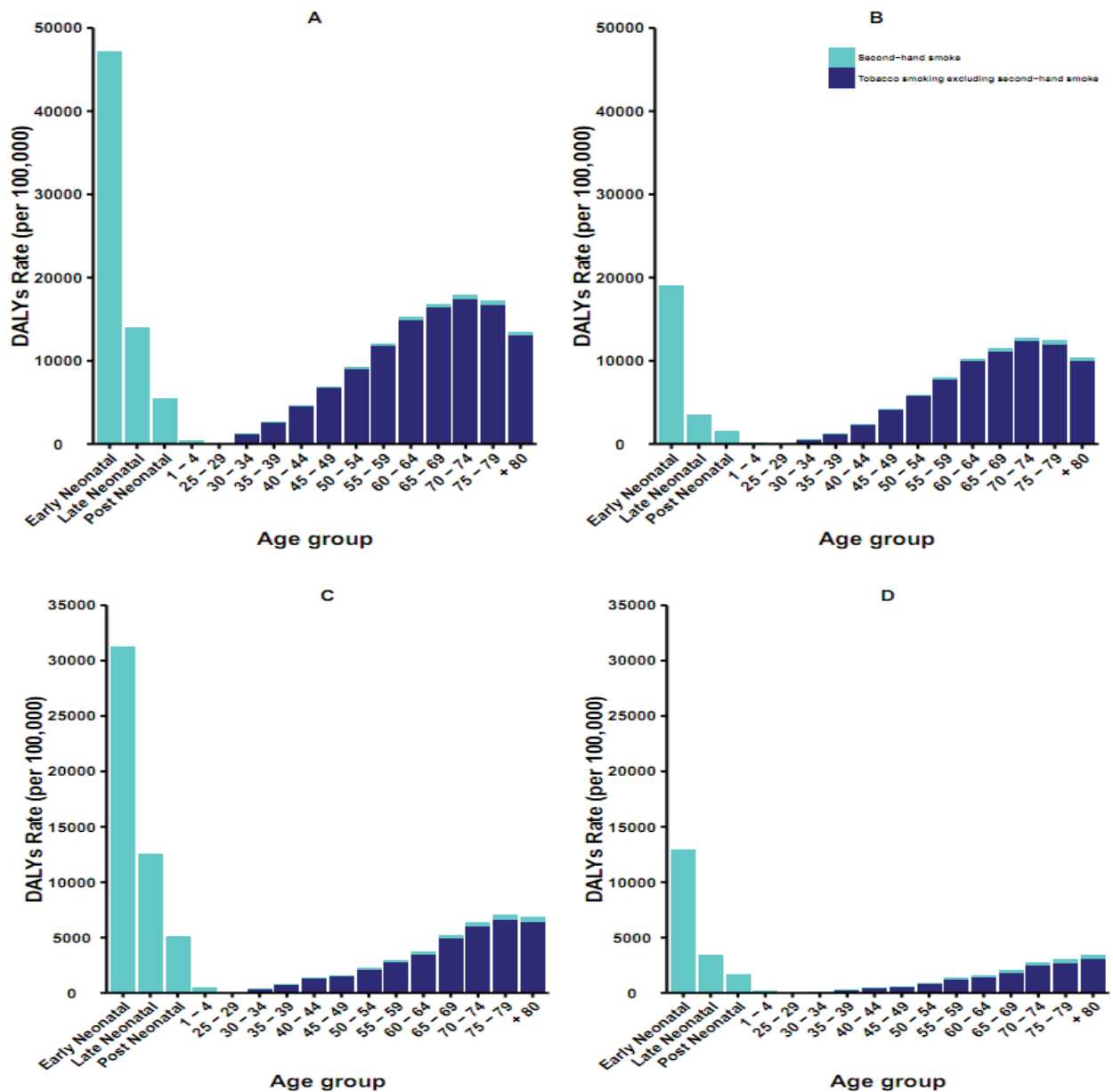| 2000	2005	2010	1990	1995	2000	2005	2010
Women				**Both**			
648.2 (422.8-944.4)	618.7 (386.9-956.9)	533.0 (294.7-911.9)	1651.8 (1084.2-2296.8)	1000.3 (647.5-1397.2)	658.0 (434.6-921.2)	625.4 (413.9-893.0)	538.0 (329.7-821.3)
240.9 (140.4-353.7)	168.6 (81.1-293.4)	150.5 (64.3-266.5)	858.4 (668.3-1048.9)	799.8 (626.4-958.5)	663.9 (535.3-786.2)	509.0 (404.1-629.8)	498.1 (375.4-634.1)
2210.6 (1322.6-3252.3)	1560.9 (924.8-2450.2)	1331.3 (788.1-2026.0)	8291.9 (6763.0-9680.1)	7716.9 (6364.4-8970.1)	6691.6 (5571.9-7727.3)	5245.0 (4398.6-6207.3)	4716.5 (3784.9-5687.5)
4448.4 (2485.2-7246.7)	3430.2 (1799.2-6013.3)	3042.6 (1445.9-5014.3)	11922.2 (9159.0-14767.9)	11032.5 (8469.4-13663.8)	9929.3 (7697.1-12263.3)	8416.7 (6535.3-10684.3)	7786.0 (5936.2-9816.7)
505.4 (364.4-640.3)	418.9 (289.0-603.8)	399.8 (266.4-559.1)	1611.2 (1367.8-1840.8)	1414.2 (1200.3-1594.4)	1279.4 (1097.3-1443.1)	1159.9 (992.4-1356.4)	1183.7 (975.2-1388.0)
216.3 (110.3-330.4)	150.1 (60.3-277.2)	132.7 (47.6-251.5)	832.0 (639.4-1020.8)	772.1 (596.4-932.5)	638.6 (505.2-765.2)	489.2 (383.4-610.9)	477.1 (356.4-611.4)
2020.5 (1140.6-3075.8)	1406.9 (769.5-2295.5)	1191.8 (654.3-1879.4)	8072.4 (6529.8-9489.0)	7485.8 (6100.0-8724.1)	6466.7 (5311.1-7514.5)	5061.3 (4200.9-6037.6)	4543.9 (3591.5-5538.1)
4057.6 (2097.4-6856.5)	3084.3 (1475.5-5677.3)	2712.2 (1136.6-4687.8)	11513.6 (8667.9-14331.9)	10611.2 (8043.3-13285.2)	9503.6 (7275.2-11850.7)	8039.1 (6135.7-10319.4)	7413.9 (5532.9-9436.0)
402.4 (256.4-544.0)	329.3 (197.2-510.6)	317.0 (182.3-479.2)	1297.3 (1051.4-1505.3)	1240.9 (1013.0-1428.1)	1169.9 (976.7-1336.4)	1064.2 (897.6-1256.2)	1092.6 (884.9-1302.7)
648.2 (422.8-944.4)	618.7 (386.9-956.9)	533.0 (294.7-911.9)	1651.8 (1084.2-2296.8)	1000.3 (647.5-1397.2)	658.0 (434.6-921.2)	625.4 (413.9-893.0)	538.0 (329.7-821.3)
24.6 (14.9-37.9)	18.4 (12.3-26.4)	17.8 (11.4-25.7)	26.4 (16.5-38.7)	27.7 (17.5-40.8)	25.4 (16.4-37.1)	19.9 (13.6-26.6)	21.0 (14.0-29.1)
190.0 (126.5-274.6)	153.9 (103.7-208.9)	139.5 (92.7-192.7)	219.6 (150.8-299.1)	231.0 (159.4-314.8)	224.9 (156.3-306.8)	183.7 (131.0-244.2)	172.6 (119.0-231.8)
390.7 (261.2-555.2)	345.9 (234.3-471.4)	330.3 (223.1-453.1)	408.6 (280.4-564.3)	421.4 (283.9-565.9)	425.6 (292.7-575.2)	377.5 (270.6-502.6)	372.1 (260.7-490.9)
103.0 (76.1-136.7)	89.6 (66.7-118.4)	82.8 (60.0-114.7)	314.0 (218.4-426.5)	173.4 (127.2-226.5)	109.5 (83.6-139.6)	95.6 (73.5-121.8)	91.2 (69.6-119.9)

Figure 3. Trends of DALYs rates attributed to tobacco smoking excluding second-hand smoke, and second-hand smoke for male and female by age-group in 1990 and 2010 for Iran: **(A)** Male-1990, **(B)** Male-2010, **(C)** Female-1990, **(D)** Female-2010.

Discussion

The results of the GBD Study 2010 indicate that the number of smokers in Iran rose substantially between 1990 and 2010, due primarily to the substantial population growth occurring over this period. The prevalence of tobacco smoking at all ages increased by 1% in men and declined by 2% in women, but the overall prevalence was unchanged in the general population (12%). During these two decades, deaths for all ages caused by tobacco smoking, including second-hand smoke, increased by 23% (95% UI:3%–45%), but the DALYs decreased by 1% (-16%–16%). In addition, a reduction was noted in the attributed age-standardized deaths and DALYs rates (both per 100,000 population).One reason could

be the introduction of a number of regulations such as "A plan for how to decrease smoking" in 1994 and "A ban on smoking and supply of cigarettes and other tobacco products in public places" in 1997, approved by the Council of Ministries, and implemented by different ministries and organizations in Iran.[24]

Iranian women smoke less frequently than men due to cultural barriers[25]; therefore, the rates of DALYs for all ages due to tobacco smoking, including second-hand smoke, were substantially higher in men than in women. The most significant DALY rates attributed to tobacco smoking were found in Iranian smokers older than 70 years, while second-hand smoke caused the greatest burden in Iranian children younger than 5 years of age. Worldwide, older smokers have greater risks for smoking-associated
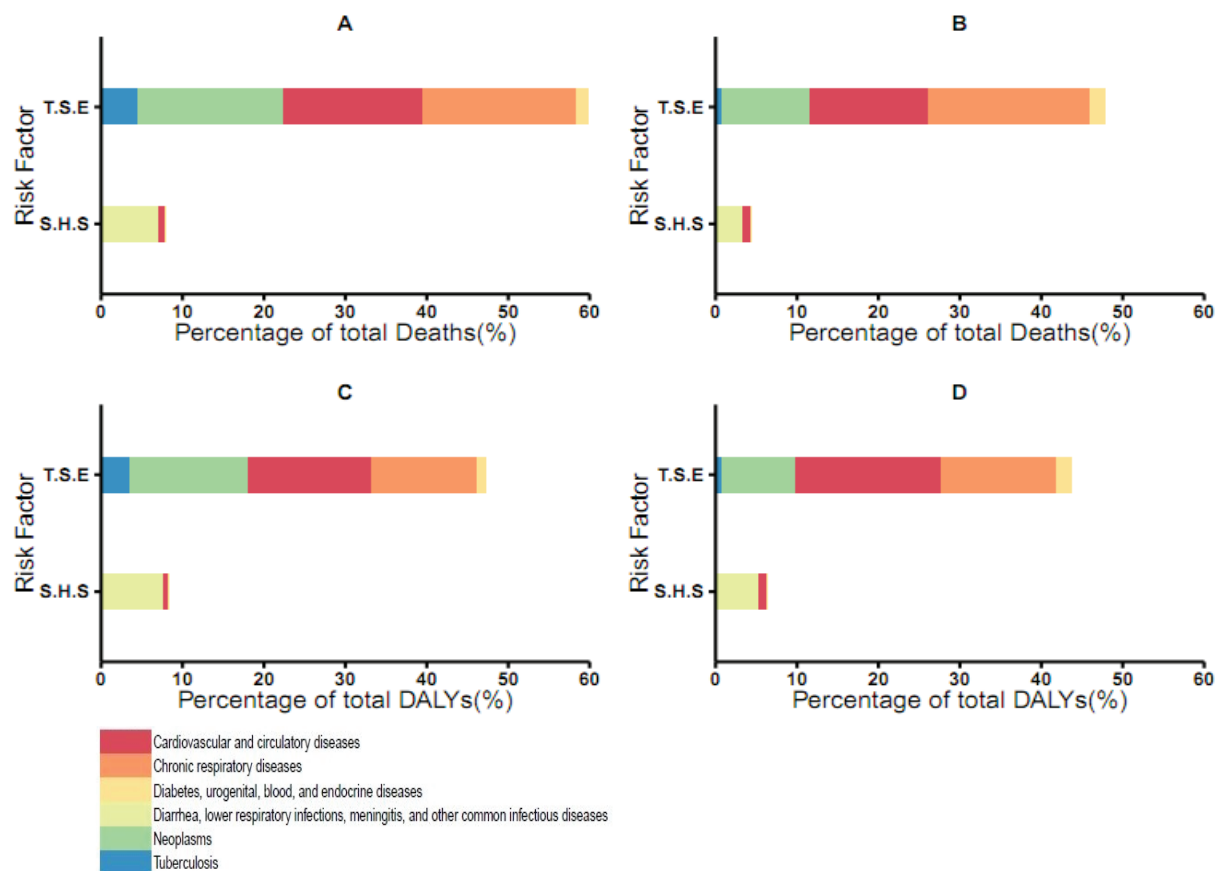
Figure 4. Percentages of deaths and DALYs attributable to tobacco smoking excluding second-hand smoke, and second-hand smoke by cause in 1990 and 2010 for Iran TSE = tobacco smoking excluding second-hand smoke, SHS = second-hand smoke: **(A)** 1990, **(B)** 2010, **(C)** 1990, **(D)** 2010.

Table 2. DALYs attributable to tobacco smoking including second-hand smoke by cause in 1990 and 2010 in Iran.

1990		2010	
DALYs	**Disease**	**Disease**	**DALYs**
298,873	1 Ischemic heart disease	1 Ischemic heart disease	390,691
154,113	2 Communicable, maternal, neonatal, and nutritional disorders	2 Chronic respiratory disease	116,512
111,275	3 Chronic respiratory disease	3 Cerebrovascular disease	112,683
101,416	4 Cerebrovascular disease	4 Other Non-communicable diseases	73,033
64,835	5 Trachea, bronchus, and lung cancer	5 Trachea, bronchus, and lung cancer	54,946
56,633	6 Other Non-communicable diseases	6 Communicable, maternal, neonatal, and nutritional disorders	34,449
27,194	7 Hypertensive heart disease	7 Hypertensive heart disease	31,280
22,137	8 Other cancers	8 Diabetes mellitus	22,698
22,009	9 Esophageal cancer	9 Other cancers	17000
14,768	10 Stomach cancer	10 Esophageal cancer	13,486
10,052	11 Diabetes mellitus	11 Stomach cancer	8,721

Communicable, maternal, neonatal, and nutritional disorders: HIV/AIDS and tuberculosis (Tuberculosis), Diarrhea, lower respiratory infections (Influenza, Pneumococcal pneumonia, H influenzae type B pneumonia, Respiratory syncytial virus pneumonia, Other lower respiratory infections), meningitis, and other common infectious diseases, Otitis media.

Non-communicable diseases: Neoplasms, Cardiovascular and circulatory diseases, Chronic respiratory diseases, Diabetes, urogenital, blood, and endocrine diseases.

Neoplasms: **Esophageal cancer, Stomach cancer,** Liver cancer (Liver cancer secondary to hepatitis B, Liver cancer secondary to hepatitis C, Liver cancer secondary to alcohol use, Other liver cancer), **Trachea, bronchus, and lung cancers,** Cervical cancer, Colon and rectum cancers, Mouth cancer, Nasopharynx cancer, Pancreatic cancer, Kidney and other urinary organ cancers, Bladder cancer, Leukemia.

Other cancers: Liver cancer (Liver cancer secondary to hepatitis B, Liver cancer secondary to hepatitis C, Liver cancer secondary to alcohol use, Other liver cancer), Cervical cancer, Colon and rectum cancers, Mouth cancer, Nasopharynx cancer, Pancreatic cancer, Kidney and other urinary organ cancers, Bladder cancer, Leukemia.

Cardiovascular and circulatory diseases: **Ischemic heart disease, Cerebrovascular disease** (Ischemic stroke, Hemorrhagic and other non-ischemic stroke), **Hypertensive heart disease,** Atrial fibrillation and flutter, Aortic aneurysm, Peripheral vascular disease, Other cardiovascular and circulatory diseases.

Chronic respiratory diseases: Chronic obstructive pulmonary disease, Pneumoconiosis, Asthma, Interstitial lung disease and pulmonary sarcoidosis, Other chronic respiratory diseases.

Diabetes, urogenital, blood, and endocrine diseases: **Diabetes mellitus.**

Other Non-communicable diseases: Atrial fibrillation and flutter, Aortic aneurysm, Peripheral vascular disease, Other cardiovascular and circulatory diseases.

diseases, because they have smoked for more years, tend to be heavier smokers, are more likely to suffer from smoking-related diseases, and are significantly less likely than younger smokers to believe that smoking is harmful to their health.[26] In addition, globally, young children are more heavily exposed to second-hand smoke than are any other age groups, since they are unable to avoid the main source of exposure, namely smoking by their close smoker relatives at home. Thus, childrenunder5years old are the group that is most harmed by second-hand smoke.[2] We believe that the same holds true for Iran.

Tobacco smoking, including second-hand smoke, contributed to a 1% increase in all-cause deaths and a 0.5% rise in the all-cause disease burden. Iran also experienced a shift in the pattern of smoking-attributed diseases, and some differences occurred for cause-specific burdens. The most significant change occurred in communicable, maternal, neonatal, and nutritional disorders attributable to smoking, which showed a decrease. This change arises from the epidemiological shift from communicable to non-communicable diseases (NCDs) in Iran, as is also reported worldwide, because the major burden of disease in the country as a whole, and especially in the large metropolitan areas, is due to NCDs.[27,28]

Despite all the valuable features of the GBD Study 2010, it suffers from some limitations in terms of calculating the health burden of tobacco smoking. Therefore, our study clearly has the same limitations. The limitations of the GBD Study 2010 have been explained elsewhere.[15–22] In Iran, exposure estimations for many risk factors, including tobacco smoking, were affected by data source limitations, which emphasizes the importance of an appropriate surveillance system for national risk factor exposure as an essential component of national health information systems. The main sources for tobacco smoking data for Iran included the 2005 and 2007 Iran STEPS Non-communicable Disease Risk Factor Survey and the 2003 and 2007 Iran Global Youth Tobacco Survey; however, other comprehensive nationally-representative sources of data were also available for tobacco smoking in Iran but were not used. These included population-based epidemiological studies, as well as national registration systems (death and cancer), and existing national and sub-national health surveys such as the National Health Survey (NHS), Isfahan Healthy Heart Program (IHHP), Tehran Lipid and Glucose Study (TLGS), Golestan Cohort Study (GCS), Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable disease (CASPIAN), Kerman Coronary Artery Disease Risk Study (KERCADRS),and House Hold Expenditure (HHE). Estimation of exposure with the approach used here is one of the weaknesses of the study because of the data gaps for specific regions such as Iran. Lack of accessibility to data sources used for tobacco smoking estimates in Iran created a fundamental limit to precise estimates, with large-scale uncertainties. Thus, the findings of the GBD study 2010 cannot effectively influence health policy decisions and public health strategies in Iran. In fact, the GBD study results were mostly model-driven, whereas data-driven studies are more valuable. Finally, the GBD findings were at a national level, while the design of appropriate interventions and allocation of resources in the country requires information about the burden of diseases and risk factors at the sub-national level.

Because of the limitations mentioned above, the burden of diseases, injuries, and risk factors in Iran should be evaluated and national assessments should be taken into account alongside sub-national analyses at the provincial or district levels. The health policy makers of Iran need to monitor the major health risk factors, set priorities for the health system, select intervention strategies, and track policy implementation at the national and sub-national levels. Tobacco smoking is one of the leading risk factors of prime importance in Iran and will require strong national and sub-national management, which could be supported by improvement of specific data systems, such as death and cancer registration systems, for an effective multi-sectorial response.

The necessity of estimating the burdens of disease, injuries, and risk factors in Iran, together with the limitations of the GBD study 2010, has led to the introduction of the National and Sub-national Burden of Disease (NASBOD) Study. This is a systematic comprehensive study[29] being conducted in Iran using a standardized protocol of data collection, statistical methods, and estimation processes to calculate the burden of disease, injuries, and risk factors at national and sub-national levels from 1990 to 2013.More details are available about the two advanced statistical methods used in the NASBOD study.[30,31] The study provides precise information for estimating the health status over time in a province or across provinces. This study will serve as a major source for identifying national and sub-national priorities.

The health system of Iran implements many national interventions to address the health problems for some geographic areas, but not all sub-national areas.[11] Evaluating the distribution of diseases and risk factors at the sub-national level would provide guidance in selecting public health interventions that address the main health problems among sub-national populations, and to inform policy makers regarding resource allocations. The national and sub-national burden of chronic diseases attributed to lifestyle risk factors, including tobacco smoking, is a sub component of the NASBOD study, which aims to quantify the prevalence of tobacco smoking, the attributed burden, and the inequalities in health care at national and sub-national levels between 1990 and 2013.[32] The results of the NASBOD study will allow comparisons of the national and sub-national assessments with the global estimates and provide effective strategies for priority setting and policy making in different regions of our country.

In conclusion, an important finding of the GBD Study 2010 is that smoking retains its position as the fifth leading risk factor for deaths and DALYs in Iran, despite a reduction in the rate of tobacco smoking, including second-hand smoke, in the country since 1990. Although different strategies have been developed over the past few decades to reduce the consumption of tobacco in Iran and to inform users about the hazards of tobacco, more action is still needed. Therefore, high priority should be given to calculate the burden of tobacco smoking. In this regard, active tobacco control policies and national public health programs for smoking cessation should be increased. Overall, our data clearly show the need for a new effort throughout Iran to reduce the premature mortality and the disability attributed to tobacco smoking.

Acknowledgments

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

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