

Burden of stroke and risk attributed to smoking in Iran: A Global Burden of Disease Study 2021

Moien AB Khan¹, Sohrab Amiri²

¹Department of Family Medicine, College of Medicine and Health Sciences, United Arab Emirates University, Al-Ain, United Arab Emirates

²Spiritual Health Research Center, Lifestyle Institute, Baqiyatallah University of Medical Sciences, Tehran, Iran

ABSTRACT

Objectives: This study aimed to provide a report and update on the burden of stroke in Iran and globally and to provide new estimates of disability-adjusted life years (DALYs) and stroke-related deaths attributed to smoking.

Materials and methods: This study was conducted in accordance with the Global Burden of Disease Study 2021. All age and age-standardized estimates of stroke attributed to smoking were calculated for DALYs and death between the years 1990 and 2021. Estimates were based on per 100,000 individuals. The 95% uncertainty interval (UI) was reported for each of the reported estimates.

Results: In 2021, 93 (95% UI 89-99) million stroke cases were detected globally, and 787,178 (95% UI 726,667-855,320) cases were detected in Iran. In 2021, global age-standardized death rate of stroke per 100,000 individuals was 87.45 (95% UI 78.92-94.14), while it was 63.89 (95% UI 56.76-69.69) in Iran. Age-standardized DALYs of stroke per 100,000 individuals in 2021 was 1,886.20 (95% UI 1,738.99-2,017.90) globally and 1,229.18 (95% UI 1,119.52-1,332.60) in Iran. Although the prevalence, incidence, mortality, and disability rates of stroke globally and in Iran decreased between 1990 and 2021, the number of cases increased. In 2021, tobacco use was responsible for over one million deaths worldwide (1,077,804 [95% UI 865,541-1,320,753]), including 4,007 (95% UI 3,159-4,972) in Iran. Compared to 1990, there was an increase in the number of deaths caused by smoking globally (0.52[95% UI 0.31-0.79]) and in Iran (0.20 [95% UI 0.06-0.35]).

Conclusion: The burden caused by stroke on the health system can be significant. Therefore, it is necessary to address the preventable risk factors of stroke, including smoking, which is a major risk factor.

Keywords: Death, global burden of disease, prevalence, stroke, tobacco smoking.

Diseases, life expectancy, demographic changes, causes of death, and socioeconomic factors are constantly changing in the world.^[1] Globally, stroke is one of the noncommunicable diseases that significantly affects health^[2] and is one of the main causes of disability and death worldwide. Stroke remained the second leading cause of death (11.6% of total deaths) and the third cause of death and disability (5.7% of total disability-adjusted life years [DALYs]) in 2019.^[3] The costs of poststroke care are high, and 34% of healthcare expenditures are related to stroke.^[2,4] The healthcare cost of a patient with stroke in the USA was estimated to be 140,048.^[5] The most

recently published Global Burden of Disease (GBD) report on stroke shows that stroke as the third most common cause of death at level 3.^[6] The global direct and indirect costs of stroke in 2017 were \$891 billion, equivalent to 1.12% of global GDP (gross domestic product).^[7] Between 1990 and 2019, the incidence of strokes in the world has increased significantly by 70.0% (67.0-73.0), prevalent strokes increased by 85.0% (83.0-88.0), deaths increased by 43.0% (31.0-55.0), and DALYs increased by 32.0% (22.0-42.0).^[1] Considering the explosive incidence of stroke, particularly in young groups and in middle-income countries such as Iran, there are concerns in this field.^[8,9]

Correspondence: Sohrab Amiri, PhD. Spiritual Health Research Center, Life Style Institute, Baqiyatallah University of Medical Sciences, Tehran, Iran.

E-mail: Amirysohrab@yahoo.com

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According to the GBD report, five main causes of stroke were high systolic blood pressure (79.6 million [67.7-90.8] DALYs), high body mass index (34.9 million [22.3-48.6] DALYs), high fasting plasma glucose (28.9 million [19.8-41.5] DALYs), ambient particulate matter pollution (28.7 million [23.4-33.4] DALYs), and smoking (25.3 million [22.6-28.2] DALYs).^[1] Furthermore, based on the GBD Study 2021, substantial increases in DALYs were attributed to high BMI, high ambient temperature, high fasting plasma glucose, sugar-sweetened beverages, low physical activity, high systolic blood pressure, lead exposure, and diet low in omega-6 polyunsaturated fatty acids.^[6]

Tobacco use is one of the most important health problems that is associated with many health consequences.^[10] The tobacco epidemic is one of the biggest health threats in the world, which leads to the death of more than 8 million people every year.^[11] Of these, 7 million deaths are directly related to smoking, and 1.3 million are related to exposure to secondhand smoke.^[11] The global estimate in 2019 showed that 1.14 billion people in the world were smokers, with 7.41 trillion cigarette-equivalents of tobacco in 2019.^[12] Compared to 1990, the prevalence of smoking has decreased for both sexes, but due to population growth, the number of smokers has increased.^[12] The role of smoking in mortality and disability is known, with 7.69 million deaths (13.6% of all deaths) and 200 million DALYs (7.89% of all DALYs) attributed to smoking.^[12] Smoking has been associated with a wide range of health issues, including risk of cancer,^[13,14] tuberculosis,^[15] coronary heart disease,^[16] stroke,^[17-19] sleep-related issues,^[20] and physical impairment.^[21] The health issues with the highest of deaths attributed to tobacco use were ischemic heart disease (1.68 million), chronic obstructive pulmonary disease (1.59 million), tracheal, bronchial, and lung cancer (1.31 million), and stroke (0.931 million).^[12]

In recent decades, Iran has undergone changes in the demographic and health-related structures, including increased life expectancy, decreased fertility rate, and an aging population, and noncommunicable diseases have become a health challenge that requires a multisectoral approach.^[22-26] As mentioned, an increasing stroke incidence is observed in Iran,^[8,9,27] and smoking is one of the main preventable causes of stroke in the world. The present study followed two main objectives. First, the study aimed to provide a report and an update on the incidence, prevalence,

DALYs, and death due to stroke in Iran and globally. The second objective was to report new estimates about DALYs and death due to stroke attributed to smoking.

MATERIALS AND METHODS

Data source

This study was conducted in accordance with the GBD Study 2021.^[23,28,29] The GBD Study 2021 reported incidence, prevalence, DALYs, years lived with disability, years of life lost, and death for 371 diseases and injuries, along with estimates of healthy life expectancy.^[29] These estimates were provided for sex and age groups in 204 countries and territories, including subnational estimates for 21 countries. Data sources used in the GBD Study 2021 included 100,983 data sources (19,189 new data sources for DALYs), 12 new causes, and other important methodological updates. More details about the data sources and methodology of the GBD Study 2021 were previously reported.^[29] This research did not involve human or animal subjects, clinical trials, or sensitive personal data. Therefore, it falls outside the scope of studies requiring ethical clearance according to established guidelines.

Case definitions

Smoking was defined as tobacco smoking, chewing tobacco use, and second-hand smoke exposure.^[30] Stroke was defined according to World Health Organization criteria as rapidly developing clinical signs of focal (or less commonly global) disturbance of cerebral function lasting more than 24 h or leading to death with no apparent cause other than that of vascular origin. Cases of transient ischemic attack were not included.^[29] Ischemic stroke: (ICD-9 433-435.9, 437.0-437.1, 437.5-437.8) (ICD-10 G45-G46.8, I63-I63.9, I65-I66.9, I67.2-I67.3, I67.5-I67.6, I69.3) "characterized by occlusion of blood flow to part of the brain due to hypoperfusion, most commonly due to a thrombus or embolism. It is defined as an episode of neurological dysfunction caused by focal cerebral, spinal, or retinal infarction". Intracerebral hemorrhage: (ICD-9 431-432.9, 437.2) (ICD-10 I61-I62, I62.1-I62.9, I68.1-I68.2, I69.1-I69.2) "characterized by the rupture of a blood vessel resulting in bleeding into the intracerebral part of the brain. It is defined as focal collection of blood within the brain parenchyma or ventricular system that is not caused by trauma and results in a clinical stroke". Subarachnoid hemorrhage:

(ICD-9 430-430.9) (ICD-10 I60-I60.9, I62.0, I67.0-I67.1, I69.0) “characterized as bleeding into the subarachnoid space (the space between the arachnoid membrane and the pia mater of the brain or spinal cord) resulting in a clinical stroke”. Refer elsewhere for more details on GBD methodology.^[29]

Estimation framework

Years lived with disability were estimated by multiplying prevalence estimates at varying levels of severity by an appropriate disability weight.^[29] Years lived with disability were calculated by multiplying cause-specific deaths by the years of life expected to remain at death based on a normative life expectancy.^[29] Disability-adjusted life years were calculated as the sum of years lived with disability and years of life lost.^[29]

Statistical analysis

Analyses were conducted using Python version 3.10.4 (Python Software Foundation, Wilmington,

DE, USA), Stata version 13.1 (StataCorp, College Station, TX, USA), and R version 4.2.1 2 (R Foundation for Statistical Computing, Vienna, Austria). All ages and age-standardized estimates were calculated for prevalence, incidence, DALYs, and death due to stroke between 1990 and 2021.^[31] In the GBD Study 2021, the relationship between 88 risk factors with selected health outcomes were estimated.^[28] All age and age-standardized estimates of stroke attributed to smoking were calculated for DALYs and death between the years 1990 and 2021.^[29] Estimates were based on per 100,000 individuals. A 95% uncertainty interval (UI) was reported for each of the reported estimates. More details about data, data processing, and modeling in the GBD Study 2021 were previously reported.^[29] The GBD Study 2021 complied with the GATHER (Guidelines for Accurate and Transparent Health Estimates Reporting).^[32]

TABLE 1
Age-standardized and all-age prevalence, incidence, DALY, and death globally and in Iran between 1990 and 2021

Measure	Cause	Location	Metric	Year						
				1990			2021			
				Value	Lower	Upper	Value	Lower	Upper	
Prevalence	Stroke	Global	Age-standardized rate	1,201.11	1,137.99	1,271.32	1,099.31	1,044.17	1,162.11	
Incidence				180.97	163.98	200.62	141.55	127.97	155.81	
DALYs				3,078.95	2,893.58	3,237.34	1,886.20	1,738.99	2,017.90	
Deaths				144.31	133.86	152.04	87.45	78.92	94.14	
Prevalence		Iran		1,097.12	996.5	1,203.13	934.35	860.27	1,015.71	
Incidence				147.72	128.6	169.68	100.81	88.38	114.21	
DALYs				2,470.21	2,277.04	2,673.16	1,229.18	1,119.52	1,332.60	
Deaths				124.68	111.57	135.1	63.89	56.76	69.69	
Prevalence		Ischemic stroke		Iran	899.17	795.73	1,001.64	784.92	710.53	863.92
Incidence					118.31	99.48	139.54	82.8	70.53	95.67
DALYs					1,825.58	1,677.25	1,988.32	957.72	869.79	1,044.25
Deaths					99.79	89.3	108.93	52.97	47.06	57.9
Prevalence	Intracerebral hemorrhage	Iran	127.81	112.46	144.12	90.78	81.57	100.59		
Incidence			22.53	19.24	25.79	13.25	11.46	15.05		
DALYs			540.41	480.36	594.2	230.56	210.89	251.65		
Deaths			21.22	18.26	23.36	9.53	8.54	10.5		
Prevalence	Subarachnoid hemorrhage	Iran	73.61	65.53	82.82	61.11	54.85	67.86		
Incidence			6.88	5.97	7.98	4.76	4.15	5.41		
DALYs			104.22	79.98	147.11	40.9	34.14	48.29		
Deaths			3.66	2.34	5.5	1.4	1.05	1.69		
DALYs	Stroke	Global	All ages number	121,405,471.72	114,722,212.95	127,625,131.78	160,457,220.63	147,781,420.22	171,642,573.58	
Prevalence				50,415,602.15	47,793,499.16	53,227,185.77	93,816,414.10	89,030,218.63	99,335,466.96	
Incidence				7,019,116.45	6,345,597.43	7,794,216.33	11,946,273.94	10,772,079.55	13,219,841.45	
Deaths				5,033,557.89	4,712,391.53	5,296,054.77	7,252,675.54	6,566,884.21	7,808,179.59	
DALYs		639,836.09		592,990.09	693,488.82	904,630.42	828,258.53	981,197.99		
Prevalence		Iran		383,202.59	349,215.94	417,620.25	787,178.55	726,667.84	855,320.19	
Incidence				41,071.24	36,126.57	47,100.58	76,271.63	67,431.43	86,132.34	
DALYs				22,960.12	21,033.05	24,840.13	41,908.22	37,515.95	45,630.12	
Deaths										

DALYs: Disability-adjusted life years.

RESULTS

Prevalence and death caused by stroke

The burden caused by stroke globally and in Iran was investigated, and the results are listed in Table 1. Age-standardized prevalence percent of stroke in 2021 was 1.14 (95% UI 1.09-1.21) globally and 0.98 (95% UI 0.90-1.06) in Iran (Supplementary Figure 1). Globally, 93,816,414 (95% UI 89,030,218-99,335,466) strokes were detected in 2021, and 787,178 (95% UI 726,667-855,320) cases of stroke were detected in Iran. The age-standardized prevalence rate of stroke per 100,000 individuals in 2021 was 1,099.31 (95% UI 1,044.17-1,162.11) globally and 934.35 (95% UI 860.27-1,015.71) in Iran. The age-standardized death rate of stroke per 100,000 individuals in 2021 was 87.45 (95% UI 78.92-94.14) globally and 63.89 (95% UI 56.76-69.69) in Iran. Age-standardized DALYs of stroke per 100,000 individuals in 2021 was 1,886.20 (95% UI 1,738.99-2,017.90) globally and 1,229.18 (95% UI 1,119.52-1,332.60) in Iran (Table 1). Although the prevalence, incidence, mortality, and disability rates of stroke globally and in Iran decreased between 1990 and 2021, the number of cases increased (Supplementary Figure 2).

Burden of pathological types of stroke in Iran

The highest to lowest prevalence rates were ischemic stroke with 653,015.73 (95% UI 591, 272.44-718,460.97), intracerebral hemorrhage with 81,265.68 (95% UI 72,921.41-90,120.11), and subarachnoid hemorrhage with 54,855.13 (95% UI 49,044.16-61,208.86). Ischemic stroke had the highest death rate with 34,027.27 (95% UI 30,355.10-37,131.72), followed by intracerebral hemorrhage (6,875.13 [95% UI 6,192.56-7,539.64]) and subarachnoid hemorrhage (1,005.82 [95% UI 786.71-1,212.57]; Supplementary Figure 3).

Burden of stroke stratified by males and females in Iran

Age-standardized prevalence ratio per 100,000 individuals in 2021 was higher in males (1,011.98 [95% UI 925.92-1,105.32]) than in females (856.98 [95% UI 792.85-928.94]). Age-standardized DALYs per 100,000 individuals in 2021 was higher in males (1,274.02 [95% UI 1,162.97-1,398.27]) than in females (1,190.38 [95% UI 1,058.47-1,307.77]). However, age-standardized death rate per 100,000 in 2021 was higher in females (66.18 [95% UI 56.46-

74.20]) than in males (62.37 [95% UI 55.68-68.74]; Table 2, Supplementary Figure 4).

Stroke burden stratified by provinces

The highest age-standardized prevalence rate of stroke per 100,000 individuals was in Bushehr (1,203.06 [95% UI 1,099.39-1,312.52]), and the lowest was in Tehran (809.91 [95% UI 740.53-879.40]). The highest age-standardized DALYs of stroke per 100,000 individuals was in Golestan (1,747.00 [95% UI 1,539.88-1,943.83]), and the lowest was in Tehran (847.70 [95% UI 721.41-985.51]). The highest age-standardized death rate of stroke per 100,000 individuals was in Golestan (85.59 [95% UI 74.89-95.69]), and the lowest was in Tehran (44.67 [95% UI 36.71-52.81]; Table 3 Figure 1).

Stroke burden stratified by age in Iran

The highest age-standardized prevalence rate of stroke per 100,000 individuals was detected in those aged 55 years or older (3,171.30 [95% UI 2,824.99-3,512.51]), and the lowest was detected in those aged 15 to 19 years (228.55 [95% UI 197.74-265.27]). The highest age-standardized DALYs rate of stroke per 100,000 individuals was in those aged 55 years or older (5,268.44 [95% UI 4,798.71-5,719.31]), and the lowest was in those aged 15 to 19 years (134.79 [95% UI 117.79-150.88]). More than 90% of all stroke deaths occurred in those aged 55 years or older (38,308.07 [95% UI 34,084.10-41,826.74]; Table 4).

Stroke attributed to smoking

Age-standardized DALYs of stroke attributed to smoking per 100,000 individuals was 328.94 [95% UI 270.32-393.11] globally and 141.75 [95% UI 112.46-173.37] in Iran. The global age-standardized death from stroke attributed to smoking per 100,000 individuals was 12.65 [95% UI 10.09-15.55], with 5.40 [95% UI 4.18-6.81] in Iran. More than one million cases of death have been attributed to tobacco use in the world (1,077,804 [95% UI 865,541-1,320,753]), with 4,007 [95% UI 3,159-4,972] in Iran. Compared to 1990, there was an increase in the number of deaths caused by tobacco use (0.20 [95% UI 0.06-0.35]), and this growth was higher in Iran (0.52 [95% UI 0.31-0.79]; Table 5; Figure 2).

Stroke attributed to smoking stratified by sex

Age-standardized DALYs of stroke attributed to smoking per 100,000 individuals was 218.97

TABLE 2
Age-standardized prevalence, incidence, DALY, and death in Iran stratified sex between 1990 and 2021

Measure	Cause	Sex	Year						
			1990			2021			
			Value	Lower	Upper	Value	Lower	Upper	
DALYs (Disability-Adjusted Life Years)	Stroke	Males	2,476.36	2,236.46	2,718.37	1,274.02	1,162.97	1,398.27	
		Females	2,441.59	2,137.34	2,712.03	1,190.38	1,058.47	1,307.77	
Prevalence		Males	1,097.47	989.15	1,204.83	1,011.98	925.92	1,105.32	
		Females	1,100.22	1,002.60	1,207.26	856.98	792.85	928.94	
Incidence		Males	151.24	130.63	175.81	107.05	93.85	121.23	
		Females	143.1	125.29	162.12	95.03	83.64	107.49	
Deaths		Males	121.32	107.5	133.22	62.37	55.68	68.74	
		Females	126.52	108.52	140.37	66.18	56.46	74.2	
DALYs (Disability-Adjusted Life Years)		Ischemic stroke	Males	1,794.10	1,608.83	1,976.63	972.53	876.62	1,070.08
			Females	1,840.00	1,611.26	2,070.62	949.02	841.2	1,044.06
Prevalence			Males	903.25	798.03	1,005.26	860.95	776	951.01
			Females	898.44	801.37	1,002.12	709.23	642.74	778.53
Incidence	Males		119.75	100.04	143.87	87.66	74.69	102.1	
	Females		115.81	97.85	134.53	78.43	67.06	90.53	
Deaths	Males		95.37	84.27	105.13	50.93	45.12	56.04	
	Females		102.93	87.78	115.45	55.72	47.74	62.35	
DALYs (Disability-Adjusted Life Years)	Intracerebral hemorrhage		Males	580.76	497.32	660.82	262.44	240.07	286.26
			Females	494.87	423.71	576.52	198.57	174.56	222.7
Prevalence			Males	135.8	119.37	152.82	102.02	91.77	113.17
			Females	119.3	104.81	134.63	79.36	71.14	88.1
Incidence		Males	24.81	21.05	28.55	14.85	12.84	16.92	
		Females	20.18	17.16	23.01	11.62	9.94	13.29	
Deaths		Males	22.27	18.65	25.39	10.14	9.14	11.16	
		Females	19.96	16.59	23.41	8.96	7.71	10.26	
DALYs (Disability-Adjusted Life Years)		Subarachnoid hemorrhage	Males	101.51	57.94	154.51	39.05	29.87	50.44
			Females	106.72	72.36	147.01	42.79	35.07	51.96
Prevalence			Males	61.96	54.88	69.81	51.85	46.35	57.94
			Females	85.88	76.56	96.27	70.46	63.21	78.18
Incidence	Males		6.68	5.76	7.74	4.54	3.95	5.16	
	Females		7.12	6.15	8.23	4.98	4.31	5.69	
Deaths	Males		3.68	1.7	6.02	1.3	0.88	1.74	
	Females		3.63	2.22	5.59	1.5	1.09	1.83	

DALYs: Disability-adjusted life years.

[95% UI 176.33-265.12] in males and 64.77 [95% UI 45.87-84.77] in females. Number of DALYs of stroke attributed to smoking was 93,526 [95% UI 75,896-112,357] in males and 26,886 [95% UI 19,240-34,988] in females.

Age-standardized death from stroke attributed to smoking per 100,000 individuals was 8.18 [95%

UI 6.42-10.23] in males and 2.63 [95% UI 1.77-3.55] in females. Almost a quarter of deaths attributed to tobacco use in Iran were in males (3,084 [95% UI 2,469-3,784]) compared with females (922 [95% UI 636-1,223]). This finding suggests that the burden of stroke attributable to smoking was much higher in males than in females (Table 6; Supplementary Figure 5).

TABLE 3
Age-standardized prevalence, incidence, DALY, and death in Iran stratified by provinces between 1990 and 2021

Measure	Location	Year					
		1990			2021		
		Value	Lower	Upper	Value	Lower	Upper
DALYs	Alborz	2,484.56	2,113.63	2,857.66	1,236.43	1,045.28	1,442.04
	Ardebil	2,360.40	2,004.63	2,770.78	1,421.11	1,230.02	1,646.23
	Bushehr	2,882.13	2,456.37	3,350.32	1,564.45	1,351.40	1,790.51
	Chahar Mahaal and Bakhtiari	2,211.61	1,905.32	2,522.75	1,026.65	883.67	1,203.86
	East Azerbaijan	2,791.95	2,411.78	3,207.67	1,394.90	1,186.62	1,679.06
	Fars	2,571.83	2,219.87	3,006.69	1,419.29	1,219.21	1,642.73
	Gilan	2,877.06	2,447.39	3,284.93	1,496.35	1,308.99	1,693.41
	Golestan	2,897.08	2,472.59	3,361.80	1,747.00	1,539.88	1,943.83
	Hamadan	2,747.33	2,306.45	3,203.57	1,323.64	1,150.05	1,509.57
	Hormozgan	2,990.42	2,557.35	3,496.88	1,372.14	1,170.84	1,584.47
	Ilam	1,949.65	1,677.67	2,230.37	1,144.93	984.98	1,311.49
	Isfahan	1,965.27	1,655.08	2,345.85	1,032.55	882.01	1,186.57
	Kerman	2,480.42	2,122.37	2,845.76	1,252.68	1,054.49	1,444.86
	Kermanshah	3,328.11	2,806.08	3,815.43	1,497.28	1,284.77	1,722.22
	Khorasan-e-Razavi	2,988.14	2,528.68	3,486.25	1,381.61	1,186.08	1,587.82
	Khuzestan	2,784.05	2,395.14	3,221.00	1,569.18	1,373.20	1,776.91
	Kohgiluyeh and Boyer-Ahmad	2,236.25	1,885.39	2,601.45	1,162.13	998.52	1,337.36
	Kurdistan	2,862.82	2,483.47	3,318.93	1,213.26	1,026.37	1,403.89
	Lorestan	2,815.57	2,405.38	3,217.58	1,351.42	1,149.71	1,555.75
	Markazi	2,753.47	2,361.90	3,174.43	1,094.01	920.66	1,278.56
	Mazandaran	2,190.89	1,833.92	2,559.67	1,225.66	1,052.40	1,421.51
	North Khorasan	2,875.07	2,419.80	3,397.71	1,384.41	1,187.66	1,621.48
	Qazvin	2,448.95	2,093.63	2,816.54	1,334.46	1,157.12	1,521.49
	Qom	2,816.26	2,384.61	3,244.44	1,142.34	974.52	1,306.23
	Semnan	2,573.82	2,235.11	2,954.84	1,159.33	990.89	1,331.30
	Sistan and Baluchistan	2,571.74	2,169.16	2,956.61	1,440.06	1,208.71	1,689.91
	South Khorasan	1,919.64	1,653.58	2,219.78	975.03	849.58	1,114.71
	Tehran	1,630.64	1,340.55	1,961.93	847.7	721.41	985.51
	West Azerbaijan	2,802.62	2,430.41	3,247.09	1,495.42	1,305.15	1,745.70
	Yazd	2,754.47	2,346.71	3,153.43	1,228.09	1,046.57	1,416.23
Zanjan	2,301.72	1,953.52	2,656.59	1,223.51	1,077.78	1,396.33	
Prevalence	Alborz	1,175.38	1,055.59	1,288.44	999.95	916.85	1,089.39
	Ardebil	1,098.87	976.45	1,207.52	1,024.76	939.83	1,127.25
	Bushehr	1,325.46	1,199.65	1,459.91	1,203.06	1,099.39	1,312.52
	Chahar Mahaal and Bakhtiari	1,089.38	983.01	1,199.23	933.58	847.28	1,024.29
	East Azerbaijan	1,120.32	1,015.20	1,239.87	943.86	861.79	1,031.31
	Fars	1,071.25	965.32	1,180.35	995.48	905.01	1,096.27
	Gilan	1,211.99	1,094.13	1,319.61	1,050.71	956.96	1,156.85
	Golestan	1,231.08	1,105.02	1,365.36	1,129.74	1,016.62	1,241.16
	Hamadan	1,115.58	1,001.30	1,232.04	1,000.21	913.5	1,094.05
	Hormozgan	1,182.14	1,057.01	1,306.94	991.84	906.05	1,084.22
	Ilam	906.04	818.7	1,000.33	826.48	757.28	908.5
	Isfahan	1,006.78	912.6	1,106.36	816.25	743.58	892.36
	Kerman	1,013.72	913.36	1,128.01	844.59	766.29	929.41

TABLE 3
Continued

Measure	Location	Year					
		1990			2021		
		Value	Lower	Upper	Value	Lower	Upper
Prevalence	Kermanshah	1,189.42	1,066.32	1,326.28	999.11	911.65	1,086.26
	Khorasan-e-Razavi	1,123.55	1,013.33	1,240.65	919.98	838.7	1,006.91
	Khuzestan	1,232.73	1,110.90	1,365.69	1,172.89	1,056.86	1,294.76
	Kohgiluyeh and Boyer-Ahmad	1,094.17	990.05	1,210.08	979.89	893.75	1,070.61
	Kurdistan	1,073.39	969.12	1,187.43	884.02	804.87	966.48
	Lorestan	1,127.27	1,013.91	1,244.48	962.59	876.76	1,059.42
	Markazi	1,170.99	1,065.75	1,285.14	940.35	862.3	1,028.36
	Mazandaran	1,197.20	1,081.62	1,321.82	1,040.49	950.22	1,133.70
	North Khorasan	1,119.65	1,000.81	1,227.62	987.97	897.58	1,080.45
	Qazvin	959.29	865.46	1,056.07	864.24	793.37	950.6
	Qom	1,127.20	1,031.10	1,241.58	813.84	743.21	882.43
	Semnan	1,179.19	1,066.39	1,310.62	992.8	899.14	1,088.60
	Sistan and Baluchistan	953.3	859.05	1,052.82	918.6	840.99	1,003.21
	South Khorasan	957.99	868.15	1,057.87	840.24	770.23	920.76
	Tehran	1,007.43	909.06	1,110.17	809.91	740.53	879.4
	West Azerbaijan	1,071.43	967.79	1,176.72	928.92	849.04	1,020.21
	Yazd	1,072.68	972.89	1,175.54	921.49	839.55	1,007.55
Zanjan	1,081.18	979.51	1,185.45	896.78	817.04	974.82	
Incidence	Alborz	152.31	132.79	173.72	105.66	92.66	120.1
	Ardebil	147.75	128.74	169.24	114.18	99.59	130.14
	Bushehr	167.2	144.67	193.86	129.52	112.76	147.46
	Chahar Mahaal and Bakhtiari	146.4	126.73	170.08	100.73	88.18	114.44
	East Azerbaijan	153.97	134.57	175.49	107.38	94.48	121.27
	Fars	149.39	128.75	172.51	111.74	97.91	126.06
	Gilan	163.11	141.96	185.14	116.09	102.37	131.28
	Golestan	159.94	138.97	184.95	123.27	106.73	139.32
	Hamadan	147.91	130.03	170.79	109.61	96.28	125.54
	Hormozgan	158.21	136.77	183.3	107.61	94.66	122.38
	Ilam	126.34	110.28	145.87	94.25	82.37	106.78
	Isfahan	138.19	119.04	159.06	87.63	76.53	98.81
	Kerman	132.95	115.94	153.28	96.4	84.55	109.32
	Kermanshah	166.7	144.73	192.04	112.16	98.6	126.85
	Khorasan-e-Razavi	162.72	141.75	186.24	105.51	92.82	118.6
	Khuzestan	160.24	138.07	185.48	123.16	107.36	139.69
	Kohgiluyeh and Boyer-Ahmad	148	130.64	169.39	102.13	90.13	115.81
	Kurdistan	153.02	134.15	175.26	98.58	87.17	110.38
	Lorestan	157.59	137.89	180.49	109.36	96.07	123.6
	Markazi	159.2	138.22	183.44	101.71	89.31	115.68
Mazandaran	153.4	132.54	175.89	109.82	96.77	123.41	
North Khorasan	156.37	135.61	180.67	109.41	95.5	124.83	
Qazvin	137.46	120.15	156.95	102.37	91.16	114.96	
Qom	161.23	139.57	185.56	93.83	82.88	106.7	
Semnan	150.71	130.2	175.39	106.83	93.33	122.63	

TABLE 3
Continued

Measure	Location	Year					
		1990			2021		
		Value	Lower	Upper	Value	Lower	Upper
Incidence	Sistan and Baluchistan	137.02	120.88	157.64	102.03	91.07	115.99
	South Khorasan	138.25	119.86	160.48	95.39	83.94	108.05
	Tehran	127.04	110.23	145.66	79.02	68.68	90.13
	West Azerbaijan	147.49	128.87	169.06	109.4	96.06	123.38
	Yazd	149.3	129.25	171.09	104.35	91.96	118.25
	Zanjan	143.53	125.56	163.84	101.83	89.14	115.31
Deaths	Alborz	134.06	113.41	154.97	67.88	56.45	79.79
	Ardebil	112.18	93.4	130.89	72.02	61.27	84.5
	Bushehr	149.41	125.61	170.3	83.01	70.65	95.15
	Chahar Mahaal and Bakhtiari	108.15	92.17	122.63	52.94	44.68	62.72
	East Azerbaijan	153.34	132.09	175.58	80.11	68.07	96.6
	Fars	134.6	114.86	154.49	77.81	65.23	90.26
	Gilan	149.25	125.4	170.38	79.98	68.54	91.2
	Golestan	137.42	116.24	158.03	85.59	74.89	95.69
	Hamadan	130.31	107.59	152.53	63.85	53.71	73.34
	Hormozgan	142.88	122.94	166.06	69.95	59.02	80.8
	Ilam	96.07	82.7	110.17	61.48	52.19	70.27
	Isfahan	103.75	85.66	123.43	55.19	45.35	64.19
	Kerman	125.55	107.54	142.41	67.34	56.6	78.02
	Kermanshah	162.7	138.44	185.15	77.89	65.52	90.01
	Khorasan-e-Razavi	150.43	128.67	173.85	72.35	60.6	84.54
	Khuzestan	140.3	120.09	160.5	79.33	68.04	91.33
	Kohgiluyeh and Boyer-Ahmad	106.14	88.85	124.47	56.26	47.02	65.98
	Kurdistan	136.89	118.35	157.05	61.96	50.86	72.52
	Lorestan	136.87	116.64	156.19	68.51	57.05	78.98
	Markazi	138.95	118.91	159.5	55.29	45.69	65.22
	Mazandaran	111.23	91.35	130.44	61.47	51.21	72.53
	North Khorasan	137.79	115.56	162.83	67.33	56.72	79.73
	Qazvin	122.38	103.32	140.77	71.71	61.24	82.45
	Qom	149.33	126.03	172.58	61.97	51.98	71.28
Semnan	130.44	112.68	149.11	62.77	52.04	72.83	
Sistan and Baluchistan	122.81	102.78	140.59	62.11	50.93	73.65	
South Khorasan	95.4	80.33	111.72	49.75	42.07	57.84	
Tehran	81.81	66.59	98.31	44.67	36.71	52.81	
West Azerbaijan	149.84	128.05	170.93	85.53	73.38	100.39	
Yazd	147.71	124.27	167.29	69.07	57.54	80.28	
Zanjan	111.6	94.67	129.48	64.79	55.13	74.38	

DALYs: Disability-adjusted life years.

Stroke attributed to smoking stratified by provinces

The highest age-standardized DALYs attributed to smoking per 100,000 individuals was in Golestan

(207.43 [95% UI 162.20-264.40]), and the lowest was in Tehran (99.95 [95% UI 75.87-131.30]). The highest age-standardized death rate attributed to smoking per 100,000 individuals was in Golestan (7.53 [95% UI 5.79-9.79]), and the lowest was in

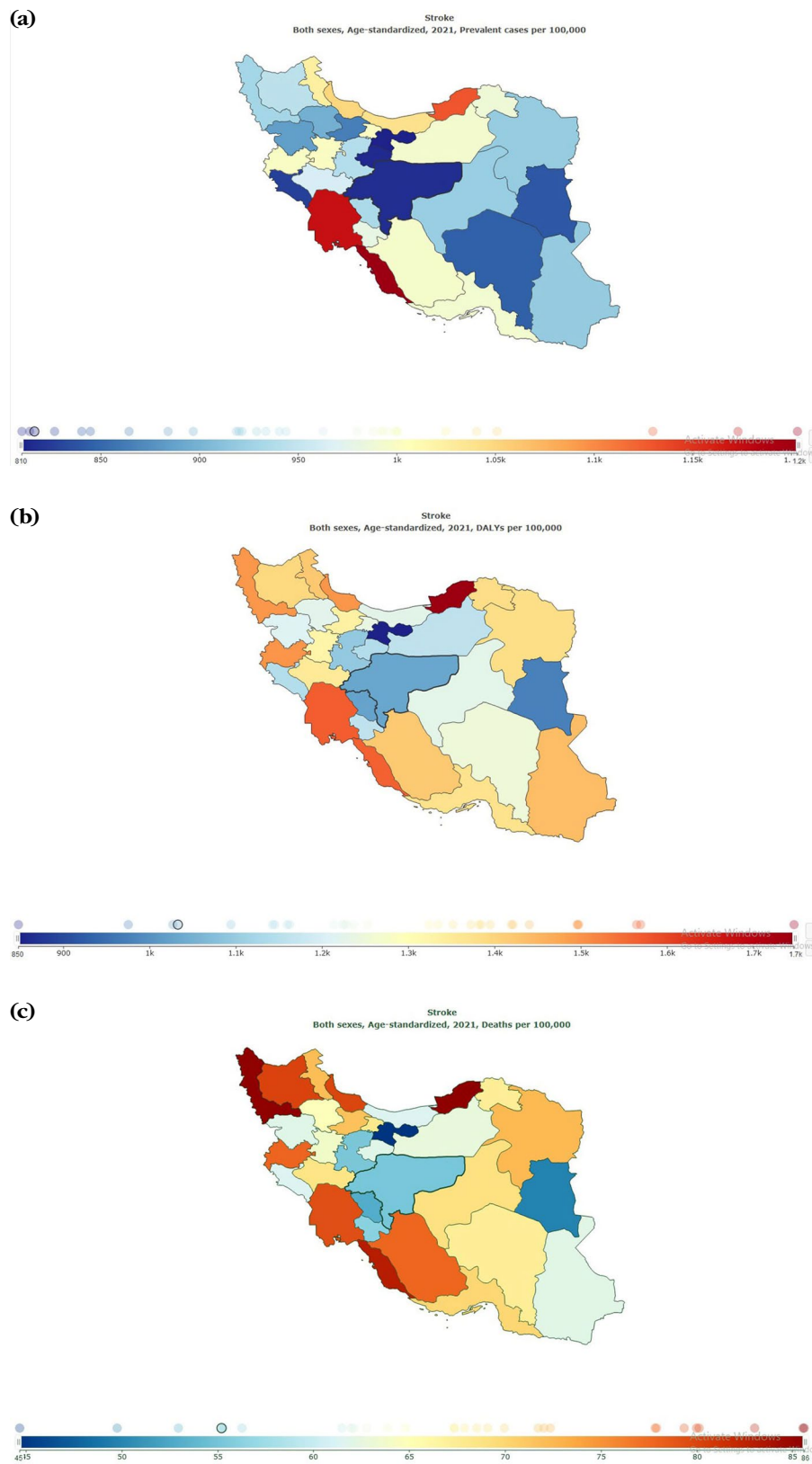


Figure 1. (a) Age-standardized prevalence rate of stroke per 100,000 individuals. (b) Age-standardized DALYs of stroke per 100,000 individuals. (c) Age-standardized death rate of stroke per 100,000 individuals.

DALYs: Disability-adjusted life years.

TABLE 4
Age-standardized prevalence, incidence, DALY, and death in Iran stratified by age between 1990 and 2021

Measure	Age	Year					
		1990			2021		
		Value	Lower	Upper	Value	Lower	Upper
Prevalence	15-19 years	319.88	274.54	374.41	228.55	197.74	265.27
	20-24 years	422.95	365.75	487.51	316.99	277.2	359.81
	25-29 years	537.45	466.81	615.03	413.37	363.86	470.8
	30-34 years	671.77	582.64	767.4	520.36	456.85	587.55
	35-39 years	846.8	730.36	962.92	655.41	576.85	735.2
	40-44 years	1,086.23	942.12	1,235.76	842.24	744.9	944.71
	45-49 years	1,460.35	1,272.93	1,652.30	1,141.59	1,006.22	1,280.00
	50-54 years	1,973.22	1,685.57	2,259.90	1,557.96	1,357.34	1,754.02
	55+ years	3,428.57	2,979.82	3,885.10	3,171.30	2,824.99	3,512.51
Incidence	15-19 years	22	15.34	32.98	179	12.33	26.3
	20-24 years	25.57	18.75	35.25	20.3	14.94	27.93
	25-29 years	29.27	20.55	40.73	21.52	15.27	29.1
	30-34 years	38.47	29.2	50.57	26.45	19.81	35.11
	35-39 years	53.22	37.05	75.93	35.18	24.73	50.48
	40-44 years	82.59	60.58	106.73	53.53	39.94	68.51
	45-49 years	127.28	87.62	172.24	82.16	60.55	108.29
	50-54 years	185.27	137.95	232.89	117.95	91.37	147.09
	55+ years	479.33	387.33	592.34	390.15	327.53	458.62
DALYs	15-19 years	206.15	179.49	233.19	134.79	117.79	150.88
	20-24 years	234.78	204.77	264.46	173.44	152.93	193.26
	25-29 years	306.77	265.03	355.75	201.07	178.35	224.01
	30-34 years	411.32	356.56	469.27	244.23	217.74	271.39
	35-39 years	620	548.65	704.73	330.63	293.66	365.3
	40-44 years	1,014.17	909.7	1,137.33	485.77	438.9	532.05
	45-49 years	1,632.90	1,484.23	1,812.97	740.92	666.95	813.84
	50-54 years	2,766.38	2,526.95	3,071.06	1,192.22	1,082.11	1,304.70
	55+ years	8,872.68	8,173.38	9,582.98	5,268.44	4,798.71	5,719.31
Deaths	15-19 years	2.23	1.91	2.52	1.42	1.22	1.6
	20-24 years	2.6	2.23	2.95	1.91	1.68	2.16
	25-29 years	3.69	3.09	4.35	2.29	2.07	2.52
	30-34 years	5.5	4.7	6.45	2.99	2.71	3.3
	35-39 years	9.53	8.46	11.01	4.56	4.1	5.04
	40-44 years	18.11	16.22	20.57	7.76	7.07	8.53
	45-49 years	33.53	30.28	37.48	13.74	12.36	15.25
	50-54 years	65.79	60.25	73.16	25.84	23.54	28.34
	55+ years	419.85	381.34	454.29	294.88	262.37	321.97

DALYs: Disability-adjusted life years.

TABLE 5
Stroke (death and DALYs per 100,000 individuals) attributed to smoking globally and in Iran between 1990 and 2021

Measure	Risk	Cause	Location	Year					
				1990			2021		
				Value	Lower	Upper	Value	Lower	Upper
Age-standardized DALYs rate	Tobacco	Stroke	Global	613.23	514.78	731.39	328.94	270.32	393.11
		Intracerebral hemorrhage		337.56	281.82	398.47	179.2	147.04	214.88
		Ischemic stroke		209.52	169.47	255.88	126.7	101.47	155.29
		Subarachnoid hemorrhage		66.15	44.17	86.12	23.04	18.3	28.32
Age-standardized deaths rate	Tobacco	Stroke		23.59	19.26	28.63	12.65	10.09	15.55
		Intracerebral hemorrhage		12.04	9.72	14.44	6.56	5.29	8.01
		Ischemic stroke		9.48	7.5	11.79	5.42	4.2	6.79
		Subarachnoid hemorrhage		2.07	1.3	2.76	0.67	0.52	0.82
All ages DALYs number	Tobacco	Stroke		25,195,959.70	21,222,115.67	29,905,438.43	28,531,038.58	23,461,344.62	34,072,552.23
		Intracerebral hemorrhage		14,220,061.80	11,917,868.79	16,732,278.02	15,617,850.27	12,811,183.17	18,749,348.99
		Ischemic stroke		8,113,773.07	6,613,088.09	9,838,072.28	10,918,707.62	8,756,100.80	13,397,298.36
		Subarachnoid hemorrhage		2,862,124.83	1,927,963.77	3,698,457.74	1,994,480.69	1,584,808.26	2,450,625.29
All ages deaths number	Tobacco	Stroke		897,170.27	743,246.63	1,079,898.74	1,077,804.74	865,541.39	1,320,753.78
		Intracerebral hemorrhage		480,491.77	394,466.35	571,225.71	565,682.36	456,626.21	689,531.94
		Ischemic stroke		332,039.90	264,009.84	408,772.70	454,272.06	354,036.04	566,679.78
		Subarachnoid hemorrhage		84,638.59	53,557.29	112,457.49	57,850.32	45,272.63	70,501.92
Age-standardized DALYs rate	Tobacco	Stroke	Iran	287.25	226.03	353.91	141.75	112.46	173.37
		Ischemic stroke		197.51	155.32	246.75	102.44	80.5	126.91
		Intracerebral hemorrhage		76.43	59.93	93.34	33.69	27.35	39.98
		Subarachnoid hemorrhage		13.31	8.9	20.62	5.62	4.25	7.35
Age-standardized deaths rate	Tobacco	Stroke		10.99	8.37	13.87	5.4	4.18	6.81
		Ischemic stroke		8.11	6.09	10.34	4.17	3.15	5.34
		Intracerebral hemorrhage		2.49	1.93	3.07	1.08	0.87	1.31
		Subarachnoid hemorrhage		0.4	0.24	0.66	0.15	0.1	0.2
All ages DALYs number	Tobacco	Stroke		82,961.15	66,180.62	102,001.93	120,413.23	96,797.89	145,857.82
		Ischemic stroke		54,399.31	43,139.40	67,502.74	83,875.39	66,918.58	102,984.82
		Intracerebral hemorrhage		24,299.10	18,979.26	29,643.13	31,179.33	25,411.39	37,181.14
		Subarachnoid hemorrhage		4,262.74	2,865.42	6,566.07	5,358.51	3,997.04	7,111.73
All ages deaths number	Tobacco	Stroke		2,629.72	2,059.43	3,251.06	4,007.45	3,159.91	4,972.31
		Ischemic stroke		1,813.14	1,416.54	2,259.41	2,981.54	2,318.20	3,778.16
		Intracerebral hemorrhage		705.4	548.76	863.5	902.32	727.09	1,080.10
		Subarachnoid hemorrhage		111.18	70.97	179.65	123.59	88.37	166.42

TABLE 5
Continued

Measure	Risk	Cause	Location	Year					
				1990			2021		
				Value	Lower	Upper	Value	Lower	Upper
Age-standardized DALYs rate	Smoking	Stroke	Global	484.27	416.16	560.89	258.85	219.08	305.72
		Intracerebral hemorrhage		268.97	230.93	312.63	142.49	120.18	167.75
		Ischemic stroke		162.68	136.07	193.54	98.29	81.26	118.66
		Subarachnoid hemorrhage		52.62	34.39	68.23	18.07	14.72	21.86
Age-standardized deaths rate		Stroke		18.08	15.18	21.38	9.69	7.92	11.68
		Intracerebral hemorrhage		9.41	7.85	11.11	5.11	4.21	6.14
		Ischemic stroke		7.06	5.71	8.66	4.06	3.18	4.98
		Subarachnoid hemorrhage		1.62	0.98	2.16	0.52	0.41	0.64
All ages DALYs number		Subarachnoid hemorrhage		2,279,175.93	1,505,542.37	2,936,906.63	1,567,375.46	1,277,561.95	1,897,373.81
		Stroke		20,013,308.76	17,298,099.70	23,117,512.01	22,522,285.86	19,059,171.05	26,588,415.21
		Ischemic stroke		6,372,605.56	5,375,527.15	7,533,254.58	8,510,889.09	7,039,200.58	10,283,724.78
		Intracerebral hemorrhage		11,361,527.27	9,776,351.41	13,171,483.00	12,444,021.31	10,494,379.50	14,653,810.23
All ages deaths number		Stroke		698,404.60	592,597.39	816,395.01	829,924.27	681,059.02	998,841.59
		Ischemic stroke		252,737.32	208,023.27	305,597.68	342,674.05	271,782.20	420,041.76
		Subarachnoid hemorrhage		66,792.93	40,811.02	88,420.32	45,069.81	35,698.52	55,899.00
		Intracerebral hemorrhage		378,874.36	319,139.32	445,177.94	442,180.41	364,995.51	529,686.84
Age-standardized DALYs rate		Intracerebral hemorrhage	Iran	61.21	48.64	74.34	27.05	22.63	31.82
		Subarachnoid hemorrhage		10.44	7.05	16.15	4.33	3.23	5.64
		Stroke		223.05	181.88	271.73	110.5	90.5	133.61
		Ischemic stroke		151.4	122.56	185.9	79.12	63.83	96.82
Age-standardized deaths rate		Intracerebral hemorrhage		1.95	1.53	2.4	0.85	0.69	1.01
		Stroke		8.14	6.44	10.11	4.02	3.18	5.03
		Ischemic stroke		5.89	4.6	7.4	3.06	2.37	3.88
		Subarachnoid hemorrhage		0.31	0.18	0.5	0.11	0.08	0.15
All ages DALYs number		Intracerebral hemorrhage		19,538.69	15,558.91	23,696.01	25,292.68	21,221.94	29,602.59
		Subarachnoid hemorrhage		3,348.81	2,314.25	5,118.71	4,165.54	3,074.95	5,448.99
		Stroke		65,706.56	54,028.62	79,269.13	95,184.77	78,772.18	114,576.26
		Ischemic stroke		42,819.06	35,103.60	52,581.70	65,726.54	53,711.23	80,076.42
All ages deaths number		Intracerebral hemorrhage		565.99	446.73	690.98	720.39	597.46	848.59
		Stroke		2,051.20	1,649.32	2,497.06	3,056.40	2,450.34	3,760.85
		Ischemic stroke		1,397.36	1,122.86	1,726.34	2,240.21	1,787.16	2,803.28
		Subarachnoid hemorrhage		87.86	54.99	141.14	95.8	68.36	130.39

TABLE 5
Continued

Measure	Risk	Cause	Location	Year					
				1990			2021		
				Value	Lower	Upper	Value	Lower	Upper
Age-standardized DALYs rate	Secondhand smoke	Intracerebral hemorrhage	Global	81.94	57.08	109.91	43.06	29.39	56.93
		Subarachnoid hemorrhage		16.39	10.57	22.97	5.84	3.91	7.85
		Stroke		151.84	105.34	203.71	81.15	55.07	107.4
		Ischemic stroke		53.51	36.87	72.46	32.26	21.3	43.39
Age-standardized deaths rate		Stroke		6.26	4.38	8.48	3.34	2.21	4.48
		Ischemic stroke		2.67	1.8	3.68	1.5	0.99	2.06
		Intracerebral hemorrhage		3.06	2.09	4.12	1.66	1.11	2.21
		Subarachnoid hemorrhage		0.53	0.32	0.76	0.17	0.11	0.23
All ages DALYs number		Intracerebral hemorrhage		3,432,189.56	2,398,075.82	4,581,582.95	3,726,863.06	2,545,045.41	4,925,845.11
		Ischemic stroke		2,011,605.19	1,385,147.47	2,714,948.44	2,741,835.15	1,819,494.99	3,680,991.52
		Stroke		6,153,487.26	4,278,033.65	8,256,919.75	6,970,263.50	4,734,823.17	9,224,428.26
		Subarachnoid hemorrhage		709,692.51	459,845.85	985,710.58	501,565.30	336,169.32	673,382.16
All ages deaths number		Intracerebral hemorrhage		119,179.15	81,821.29	159,936.13	141,550.15	94,510.03	188,419.90
		Ischemic stroke		88,678.46	60,524.16	121,138.38	123,790.74	81,620.64	168,952.06
		Stroke		229,085.83	159,149.68	307,214.49	280,052.23	185,101.25	375,638.67
		Subarachnoid hemorrhage		21,228.22	12,913.58	30,332.19	14,711.34	9,779.85	19,921.28
Age-standardized DALYs rate	Iran	Intracerebral hemorrhage	Iran	17.69	11.55	23.95	7.68	5.24	10.24
		Subarachnoid hemorrhage		3.31	2.00	5.14	1.47	0.97	2.07
		Stroke		72.40	48.11	99.80	34.98	23.25	47.02
		Ischemic stroke		51.39	33.98	71.15	25.83	17.20	34.83
Age-standardized deaths rate		Subarachnoid hemorrhage		0.10	0.06	0.18	0.04	0.03	0.05
		Stroke		3.11	2.01	4.37	1.48	0.97	2.06
		Ischemic stroke		2.39	1.54	3.40	1.18	0.77	1.67
		Intracerebral hemorrhage		0.61	0.40	0.83	0.26	0.18	0.35
All ages DALYs number		Intracerebral hemorrhage		5,587.60	3,698.55	7,579.48	6,908.14	4,712.01	9,233.05
		Ischemic stroke		13,198.92	8,870.85	18,352.78	20,416.49	13,563.38	27,401.42
		Stroke		19,847.32	13,355.54	27,003.77	28,697.94	19,407.57	38,348.64
		Subarachnoid hemorrhage		1,060.79	647.04	1,625.57	1,373.30	893.84	1,942.72
All ages deaths number		Intracerebral hemorrhage		161.35	105.71	217.88	207.47	142.45	279.87
		Ischemic stroke		462.32	304.77	642.01	803.41	523.39	1,116.95
		Stroke		650.47	433.99	890.26	1,042.21	686.44	1,436.13
		Subarachnoid hemorrhage		26.8	15.68	43.37	31.33	20.61	44.93

DALYs: Disability-adjusted life years.

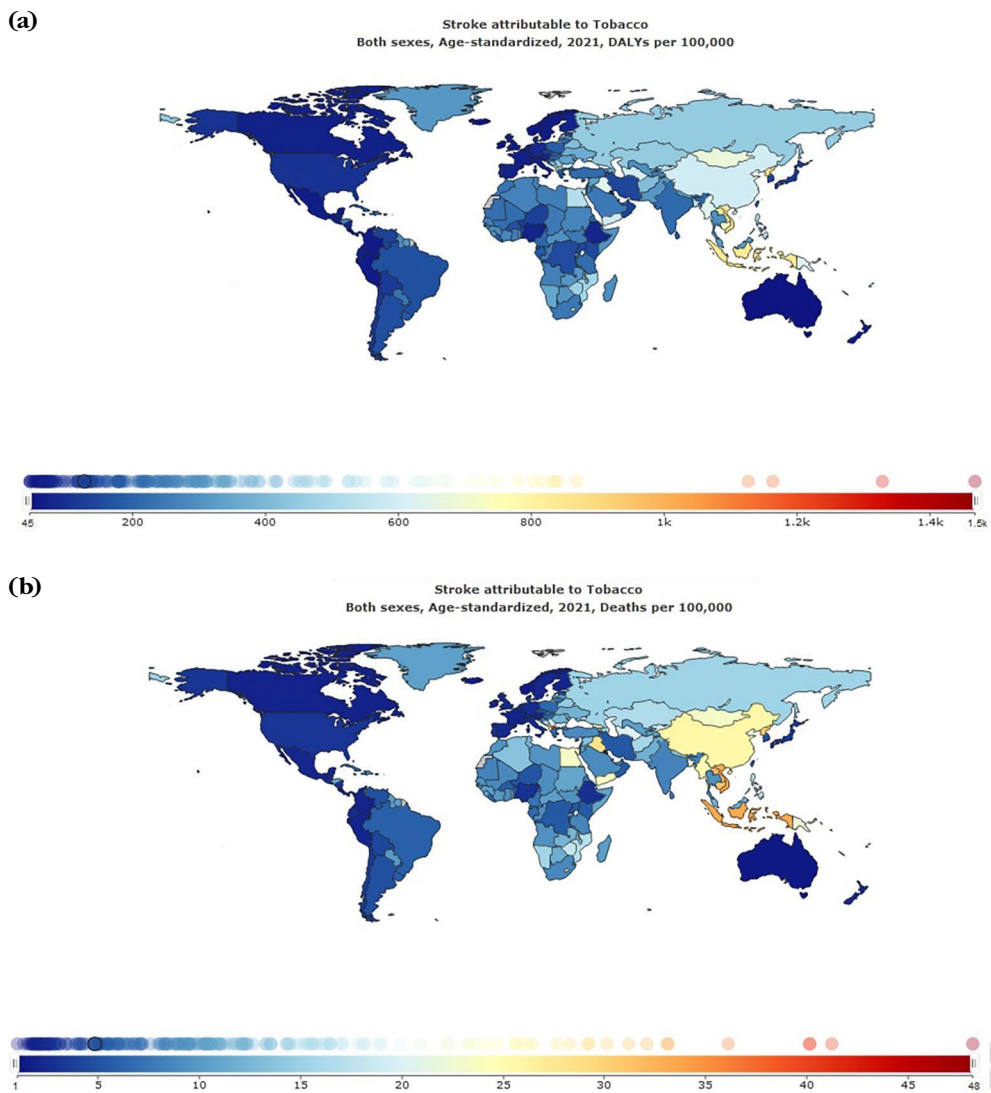


Figure 2. (a) Global age-standardized DALYs of stroke attributed to smoking per 100,000 individuals. (b) Global age-standardized deaths from stroke attributed to smoking per 100,000 individuals.

DALYs: Disability-adjusted life years.

South Khorasan (3.75 [95% UI 2.67-5.04]; Table 7, Figure 3).

Stroke attributed to smoking stratified by age in Iran

The highest DALYs attributed to smoking per 100,000 individuals was in those aged 55 years or older (542.17 [95% UI 423.69-675.10]), and the lowest was in Tehran (99.95 [95% UI 75.87-131.30]). More than a third of stroke-related deaths attributed to smoking occurred in those aged 55 years or older (3,124 [95% UI 2,391-3,981]; Table 8; Supplementary Figure 6).

DISCUSSION

Stroke is one of the important health challenges in the international classification of diseases.^[33] This research was based on the most comprehensive epidemiological estimate of the global burden of diseases in 2021. In the first section, incidence, prevalence, DALYs, and death due to stroke in Iran and globally were estimated. In the second section, new estimates on DALYs and stroke-related deaths attributed to smoking were reported.

In 2021, stroke remained the second leading cause of death and the third leading cause

TABLE 6
Stroke (death and DALYs per 100,000 individuals) attributed to smoking stratified by sex between 1990 and 2021

Measure	Risk	Cause	Sex	Year						
				1990			2021			
				Value	Lower	Upper	Value	Lower	Upper	
Age-standardized DALYs rate	Tobacco	Intracerebral hemorrhage	Males	116.23	89.55	144.29	53.64	44.22	63.09	
	Tobacco	Intracerebral hemorrhage	Females	33.24	23.68	43.41	13.61	9.62	17.51	
	Tobacco	Ischemic stroke	Males	293.41	232.48	364.09	157.24	126.12	193.9	
	Tobacco	Ischemic stroke	Females	95.6	67.07	126.8	48.03	33.95	63.61	
	Tobacco	Stroke	Males	428.91	339.36	527.17	218.97	176.33	265.12	
	Tobacco	Stroke	Females	135.74	97.5	177.56	64.77	45.87	84.77	
	Tobacco	Subarachnoid hemorrhage	Males	19.27	11.75	30.39	8.09	5.89	10.97	
	Tobacco	Subarachnoid hemorrhage	Females	6.9	4.05	10.27	3.13	2.19	4.24	
	Smoking	Intracerebral hemorrhage	Males	102.52	79.98	126.2	47.74	40.09	55.88	
	Smoking	Intracerebral hemorrhage	Females	16.47	11.98	22.27	6.19	4.41	8.02	
	Smoking	Ischemic stroke	Males	253.26	204.22	312.65	138.44	111.75	170.12	
	Smoking	Ischemic stroke	Females	43.55	31.76	58.05	19.93	14.32	26.38	
	Smoking	Stroke	Males	372.77	300.66	452.77	193.39	157.93	232.97	
	Smoking	Stroke	Females	63.43	47.41	83.66	27.54	19.84	36.38	
	Smoking	Subarachnoid hemorrhage	Males	16.99	10.49	26.65	7.21	5.26	9.85	
	Smoking	Subarachnoid hemorrhage	Females	3.41	2.04	5.13	1.42	0.99	1.96	
	Secondhand smoke	Intracerebral hemorrhage	Males	17.68	11.34	24.9	7.61	5.01	10.46	
	Secondhand smoke	Intracerebral hemorrhage	Females	17.62	11.55	24.52	7.76	5.14	10.46	
	Secondhand smoke	Ischemic stroke	Males	48.56	31.24	67.94	22.89	15.3	31.71	
	Secondhand smoke	Ischemic stroke	Females	53.98	34.91	77.3	29.05	19.13	39.33	
	Secondhand smoke	Stroke	Males	69.19	44.37	96.11	31.64	21.09	43.49	
	Secondhand smoke	Stroke	Females	75.27	49.64	105.73	38.61	25.25	52.39	
	Secondhand smoke	Subarachnoid hemorrhage	Males	2.96	1.54	4.88	1.14	0.72	1.64	
	Secondhand smoke	Subarachnoid hemorrhage	Females	3.68	2.09	5.74	1.8	1.17	2.6	
	Age-standardized Deaths rate	Tobacco	Intracerebral hemorrhage	Males	3.81	2.91	4.78	1.7	1.38	2.04
		Tobacco	Intracerebral hemorrhage	Females	1.08	0.76	1.42	0.46	0.32	0.61
		Tobacco	Ischemic stroke	Males	12.18	9.27	15.42	6.26	4.82	7.93
		Tobacco	Ischemic stroke	Females	4	2.75	5.44	2.09	1.4	2.86
Tobacco		Stroke	Males	16.58	12.86	20.63	8.18	6.42	10.23	
Tobacco		Stroke	Females	5.27	3.65	7.05	2.63	1.77	3.55	
Tobacco		Subarachnoid hemorrhage	Males	0.59	0.3	0.98	0.21	0.15	0.3	
Tobacco		Subarachnoid hemorrhage	Females							

TABLE 6
Continued

Measure	Risk	Cause	Sex	Year					
				1990			2021		
				Value	Lower	Upper	Value	Lower	Upper
Age-standardized Deaths rate	Tobacco	Subarachnoid hemorrhage	Females	0.19	0.1	0.31	0.08	0.05	0.11
	Smoking	Intracerebral hemorrhage	Males	3.3	2.54	4.11	1.5	1.22	1.8
	Smoking	Intracerebral hemorrhage	Females	0.5	0.37	0.68	0.19	0.14	0.26
	Smoking	Ischemic stroke	Males	10.19	7.9	12.82	5.38	4.16	6.79
	Smoking	Ischemic stroke	Females	1.58	1.12	2.17	0.73	0.5	1.08
	Smoking	Stroke	Males	14	10.95	17.41	7.07	5.59	8.83
	Smoking	Stroke	Females	2.17	1.57	2.93	0.96	0.67	1.37
	Smoking	Subarachnoid hemorrhage	Males	0.51	0.27	0.84	0.19	0.13	0.27
	Smoking	Subarachnoid hemorrhage	Females	0.09	0.05	0.14	0.03	0.02	0.05
	Secondhand smoke	Intracerebral hemorrhage	Males	0.62	0.39	0.87	0.25	0.17	0.34
	Secondhand smoke	Intracerebral hemorrhage	Females	0.6	0.39	0.83	0.27	0.18	0.37
	Secondhand smoke	Ischemic stroke	Males	2.28	1.44	3.2	1.01	0.67	1.41
	Secondhand smoke	Ischemic stroke	Females	2.48	1.55	3.58	1.39	0.88	1.93
	Secondhand smoke	Stroke	Males	3	1.9	4.18	1.29	0.86	1.78
	Secondhand smoke	Stroke	Females	3.18	2.02	4.49	1.71	1.09	2.36
	Secondhand smoke	Subarachnoid hemorrhage	Males	0.1	0.04	0.17	0.03	0.02	0.05
	Secondhand smoke	Subarachnoid hemorrhage	Females	0.11	0.06	0.18	0.05	0.03	0.07
	All ages DALYs number	Tobacco	Intracerebral hemorrhage	Males	19,215.58	14,753.42	23,785.35	25,078.02	20,816.71
Tobacco		Intracerebral hemorrhage	Females	5,083.52	3,619.95	6,668.09	6,101.31	4,317.13	7,854.55
Tobacco		Ischemic stroke	Males	41,856.10	33,607.86	51,453.52	64,556.68	52,308.03	78,601.95
Tobacco		Ischemic stroke	Females	12,543.21	8,808.07	16,509.24	19,318.71	13,774.96	25,414.53
Tobacco		Stroke	Males	64,252.05	51,507.34	78,511.98	93,526.28	75,896.26	112,357.59
Tobacco		Stroke	Females	18,709.10	13,475.22	24,440.04	26,886.95	19,240.15	34,988.58
Tobacco		Subarachnoid hemorrhage	Males	3,180.38	1,991.42	4,953.39	3,891.58	2,810.05	5,312.63
Tobacco		Subarachnoid hemorrhage	Females	1,082.37	639.43	1,598.59	1,466.94	1,015.74	1,996.41
Smoking		Intracerebral hemorrhage	Males	17,005.62	13,181.38	20,856.50	22,464.68	18,880.03	26,299.43
Smoking		Intracerebral hemorrhage	Females	2,533.07	1,835.00	3,411.72	2,827.99	2,013.68	3,656.73
Smoking		Ischemic stroke	Males	36,752.93	29,988.88	45,345.75	57,314.20	46,933.68	69,597.13
Smoking		Ischemic stroke	Females	6,066.13	4,407.64	8,147.26	8,412.35	6,049.29	11,140.59
Smoking		Stroke	Males	56,572.47	46,040.34	69,073.02	83,273.18	68,783.04	99,433.82
Smoking		Stroke	Females	9,134.09	6,799.79	12,167.50	11,911.58	8,553.95	15,758.08
Smoking	Subarachnoid hemorrhage	Males	2,813.92	1,781.28	4,411.94	3,494.30	2,534.76	4,774.51	

TABLE 6
Continued

Measure	Risk	Cause	Sex	Year					
				1990			2021		
				Value	Lower	Upper	Value	Lower	Upper
All ages DALYs number	Smoking	Subarachnoid hemorrhage	Females	534.89	321.76	804.58	671.24	469.55	935.96
	Secondhand smoke	Intracerebral hemorrhage	Males	2,898.99	1,857.25	4,109.39	3,465.88	2,293.28	4,792.02
	Secondhand smoke	Intracerebral hemorrhage	Females	2,688.60	1,756.41	3,715.30	3,442.27	2,287.88	4,677.76
	Secondhand smoke	Ischemic stroke	Males	6,427.24	4,248.41	9,002.11	9,075.78	6,076.55	12,504.19
	Secondhand smoke	Ischemic stroke	Females	6,771.69	4,353.00	9,594.44	11,340.71	7,414.45	15,496.18
	Secondhand smoke	Stroke	Males	9,808.95	6,383.56	13,602.64	13,075.67	8,677.67	17,862.42
	Secondhand smoke	Stroke	Females	10,038.36	6,536.55	13,997.60	15,622.27	10,275.38	21,110.25
	Secondhand smoke	Subarachnoid hemorrhage	Males	482.72	252.04	796.82	534.01	337.04	775.84
	Secondhand smoke	Subarachnoid hemorrhage	Females	578.07	328.12	899.28	839.29	545.88	1,210.97
	Tobacco	Intracerebral hemorrhage	Males	562.35	429.64	698.1	718.64	586.83	852.82
	Tobacco	Intracerebral hemorrhage	Females	143.05	101.82	186.64	183.69	131.11	241.3
	Tobacco	Ischemic stroke	Males	1,406.24	1,104.83	1,750.44	2,274.14	1,784.26	2,839.56
	Tobacco	Ischemic stroke	Females	406.9	283.1	544.57	707.4	481.31	945.89
	All ages deaths number	Tobacco	Stroke	Males	2,053.97	1,630.67	2,531.50	3,084.72	2,469.78
Tobacco		Stroke	Females	575.75	410.44	756.82	922.73	636.91	1,223.33
Tobacco		Subarachnoid hemorrhage	Males	85.38	46.61	138.52	91.94	63.36	128.59
Tobacco		Subarachnoid hemorrhage	Females	25.8	14.16	39.86	31.65	20.8	43.42
Smoking		Intracerebral hemorrhage	Males	494.98	383.45	611.62	638.66	528.65	752.55
Smoking		Intracerebral hemorrhage	Females	71.01	50.68	96.01	81.73	57.99	108.17
Smoking		Ischemic stroke	Males	1,214.75	969.03	1,508.62	1,973.46	1,564.20	2,468.82
Smoking		Ischemic stroke	Females	182.61	130.59	247.17	266.76	187.53	376.43
Smoking		Stroke	Males	1,784.77	1,428.17	2,187.53	2,693.84	2,168.09	3,296.72
Smoking		Stroke	Females	266.42	195.5	355.44	362.56	257.86	497.89
Smoking		Subarachnoid hemorrhage	Males	75.05	41.3	122.06	81.72	56.79	115.23
Smoking		Subarachnoid hemorrhage	Females	12.81	7.1	20.09	14.07	9.51	19.39
Secondhand smoke		Intracerebral hemorrhage	Males	85.85	55.5	120.7	101.35	67.4	139.51
Secondhand smoke		Intracerebral hemorrhage	Females	75.51	49.59	105.03	106.11	69.41	144.67
Secondhand smoke		Ischemic stroke	Males	230.64	151.46	316.92	352.34	232.78	484.68
Secondhand smoke		Ischemic stroke	Females	231.68	148.11	331.58	451.07	287.08	622.54
Secondhand smoke		Stroke	Males	329.65	214.54	458.38	466.69	308.7	637.33
Secondhand smoke		Stroke	Females	320.82	210.79	449.49	575.52	370.13	788.7
Secondhand smoke	Subarachnoid hemorrhage	Males	13.16	6.16	22.52	13	7.61	19.14	
Secondhand smoke	Subarachnoid hemorrhage	Females	13.64	7.26	21.87	18.33	11.37	26.61	

DALYs: Disability-adjusted life years.

TABLE 7
Death and DALYs attributed to smoking stratified by provinces between 1990 and 2021

Measure	Location	Year						
		1990			2021			
		Value	Lower	Upper	Value	Lower	Upper	
Age-standardized DALYs rate	Alborz	267.48	195.59	349.13	137.17	98.79	176.39	
	Ardebil	256.91	184.64	337.61	175.84	134.47	226.39	
	Bushehr	319.79	239.98	416.51	178.98	136.96	235.15	
	Chahar Mahaal and Bakhtiari	255.31	187.91	341.44	124.88	93.54	164.32	
	East Azerbaijan	305.3	227.2	394.24	148.8	109.39	190.72	
	Fars	294.71	212.2	388.73	164.18	123.63	214.74	
	Gilan	322.76	242.46	420.81	169.73	125.72	219.6	
	Golestan	336.31	244.82	443.82	207.43	162.2	264.4	
	Hamadan	322.16	238.34	429.73	162.81	123.78	207.94	
	Hormozgan	385.83	292.31	500.3	161.31	121.6	209.09	
	Ilam	228.08	168.43	296.31	132.97	98.86	170.87	
	Isfahan	217.95	159.43	291.63	117.17	86.58	152.13	
	Kerman	290.09	217.73	376.72	143.49	108.17	186	
	Kermanshah	413.59	295.31	535.13	170.6	126.2	219.24	
	Khorasan-e-Razavi	345.81	258.92	461.79	153.83	117.58	196.93	
	Khuzestan	311.9	230.29	399.14	177.18	135.65	223.06	
	Kohgiluyeh and Boyer-Ahmad	247.06	178.64	323.16	138.68	103.34	177.72	
	Kurdistan	332.58	246.45	442.57	144.19	108.45	184.93	
	Lorestan	334.2	242.79	440.11	169.98	129.74	218.37	
	Markazi	311.78	230.59	416.05	129.07	98.14	167.15	
	Mazandaran	243.64	175.95	326.1	144.56	110.54	184.94	
	North Khorasan	345.11	252.15	455.72	152.3	116.94	193.93	
	Qazvin	266.78	193.93	345.61	164	124.6	210.3	
	Qom	316.67	227.92	427.15	126.15	96.63	160.79	
	Semnan	306.66	228.55	399.87	131.89	100.01	170.2	
	Sistan and Baluchistan	312.61	223.91	405.04	163.03	119.31	213.53	
	South Khorasan	217.45	155.08	285.57	101.32	77.11	127.88	
	Tehran	212.92	154.89	286.87	99.95	75.87	131.3	
	West Azerbaijan	312.54	226.76	402	156.11	117.84	206.53	
	Yazd	306.24	234.91	392.16	130.65	99.02	167.78	
	Zanjan	257.58	190.47	341.61	147.92	114.16	186.03	
	Age-standardized deaths rate	Alborz	10.74	7.72	14.22	5.52	3.79	7.42
		Ardebil	9.6	6.7	12.88	6.53	4.86	8.57
		Bushehr	12.59	9.28	16.87	7.01	5.1	9.46
Chahar Mahaal and Bakhtiari		9.54	6.99	12.78	4.66	3.3	6.48	
East Azerbaijan		12.47	9.03	16.53	6.1	4.36	8.24	
Fars		11.9	8.56	15.81	6.84	4.93	9.14	
Gilan		12.33	8.97	16.32	6.58	4.73	8.72	
Golestan		12.15	8.81	16.18	7.53	5.79	9.79	
Hamadan		11.97	8.81	15.94	5.72	4.19	7.51	
Hormozgan		14.29	10.71	19.2	6.03	4.55	8	
Ilam		8.72	6.28	11.56	5.26	3.75	6.99	
Isfahan		8.4	5.99	11.16	4.49	3.14	6.07	
Kerman		10.92	8.12	14.32	5.49	3.95	7.38	
Kermanshah		15.66	11.14	20.26	6.51	4.65	8.73	
Khorasan-e-Razavi		13.34	9.87	17.86	5.9	4.33	7.85	
Khuzestan		11.85	8.55	15.4	6.61	4.87	8.55	
Kohgiluyeh and Boyer-Ahmad		8.94	6.4	12.08	4.9	3.53	6.6	
Kurdistan		12.74	9.43	16.85	5.39	3.91	7.03	

TABLE 7
Continued

Measure	Location	Year						
		1990			2021			
		Value	Lower	Upper	Value	Lower	Upper	
Age-standardized deaths rate	Lorestan	12.66	8.84	16.74	6.32	4.63	8.42	
	Markazi	11.94	8.82	16.1	4.64	3.48	6.28	
	Mazandaran	9.17	6.48	12.15	5.26	3.81	7.05	
	North Khorasan	12.91	9.24	17.22	5.56	4.12	7.26	
	Qazvin	10.22	7.39	13.32	6.53	4.83	8.53	
	Qom	12.56	8.74	17.09	4.92	3.65	6.54	
	Semnan	11.72	8.47	15.58	5.17	3.81	6.92	
	Sistan and Baluchistan	11.66	8.08	15.25	5.34	3.84	7.23	
	South Khorasan	8.36	5.78	10.95	3.75	2.67	5.04	
	Tehran	7.93	5.62	10.81	3.85	2.72	5.24	
	West Azerbaijan	12.44	8.68	16.48	6.38	4.58	8.76	
	Yazd	12.1	9.2	15.85	5.26	3.87	7.03	
	Zanjan	9.64	6.92	12.9	5.76	4.24	7.48	
	All ages DALYs number	Alborz	1,737.42	1,263.24	2,246.96	3,977.59	2,952.39	5,034.90
		Ardebil	1,432.08	1,035.23	1,869.91	2,334.94	1,781.82	2,984.92
		Bushehr	960.14	720.93	1,248.43	1,813.28	1,398.93	2,353.50
		Chahar Mahaal and Bakhtiari	840.55	622.89	1,099.02	1,193.49	894.7	1,554.43
		East Azerbaijan	5,425.63	3,997.26	7,092.35	6,375.74	4,717.16	8,096.26
		Fars	5,028.10	3,633.35	6,649.07	8,314.92	6,240.98	10,755.84
Gilan		4,452.68	3,353.59	5,859.82	5,654.93	4,213.20	7,299.28	
Golestan		2,126.11	1,552.45	2,824.42	3,829.76	3,000.98	4,816.20	
Hamadan		2,866.09	2,103.46	3,867.87	3,206.82	2,447.93	4,105.84	
Hormozgan		1,666.58	1,234.84	2,199.47	2,382.83	1,816.23	3,058.45	
Ilam		419.66	308.5	544.41	757.24	577.37	966.96	
Isfahan		4,318.00	3,149.94	5,812.12	6,936.12	5,190.03	8,909.49	
Kerman		2,691.91	2,000.29	3,491.49	4,274.20	3,214.12	5,508.23	
Kermanshah		3,404.98	2,443.52	4,431.30	3,682.91	2,733.78	4,674.29	
Khorasan-e-Razavi		8,276.81	6,217.13	11,011.95	9,543.05	7,272.14	12,046.64	
Khuzestan		4,327.74	3,170.73	5,545.03	7,515.37	5,752.03	9,458.03	
Kohgiluyeh and Boyer-Ahmad		494.86	361.92	653.37	935.32	700.65	1,204.02	
Kurdistan		2,024.44	1,496.37	2,717.37	2,458.16	1,844.96	3,152.84	
Lorestan		2,342.10	1,702.37	3,072.84	2,915.02	2,235.06	3,754.53	
Markazi		2,068.12	1,517.24	2,801.40	2,152.16	1,640.88	2,775.32	
Mazandaran		3,239.34	2,321.56	4,337.24	6,070.20	4,626.55	7,764.07	
North Khorasan		1,092.16	800.52	1,452.00	1,235.31	959.63	1,563.26	
Qazvin		1,234.43	900.11	1,617.76	2,142.70	1,657.43	2,718.07	
Qom		1,054.42	756.07	1,425.62	1,584.36	1,233.26	2,005.47	
Semnan		878.98	654.65	1,140.22	1,004.31	769.58	1,278.21	
Sistan and Baluchistan		1,962.60	1,425.24	2,554.77	3,194.52	2,329.80	4,199.92	
South Khorasan		824.21	596.08	1,090.00	819.48	619.79	1,019.80	
Tehran		9,989.00	7,337.78	13,429.77	16,196.54	12,474.76	21,258.39	
West Azerbaijan		3,482.23	2,480.42	4,519.89	4,894.49	3,712.27	6,427.74	
Yazd		1,128.41	870.08	1,445.06	1,378.37	1,048.22	1,772.11	
Zanjan	1,171.38	863.1	1,534.18	1,639.12	1,259.18	2,079.62		
All ages deaths number	Alborz	54.46	39.08	71.17	124.5	87.86	164.68	
	Ardebil	44.47	31.34	59.58	77.07	57.68	99.93	
	Bushehr	30.05	22.08	39.45	57.74	43.12	75.77	
	Chahar Mahaal and Bakhtiari	26.42	19.15	35.54	39.03	28.09	53.66	
	East Azerbaijan	174.55	127.09	229.61	218.75	158.07	291.29	

TABLE 7
Continued

	Location	Year					
		1990			2021		
		Value	Lower	Upper	Value	Lower	Upper
All ages deaths number	Fars	164	115.68	216.69	293.23	213.07	389.38
	Gilan	142.87	105.09	190.78	198.08	144.31	260.7
	Golestan	64.1	46.4	85.74	118.54	92.17	152.24
	Hamadan	91.81	67.32	122.35	106.53	78.21	138.81
	Hormozgan	53.72	40.49	71.29	72.54	54.27	94.28
	Ilam	13.54	9.82	17.75	24.72	18.07	32.23
	Isfahan	136.18	96.83	185.04	234.53	166.14	311.25
	Kerman	86.14	62.96	112.88	134.67	98.45	177.29
	Kermanshah	109.28	76.56	142.91	125.64	91.22	167.55
	Khorasan-e-Razavi	266.07	198	356.08	318.47	236.95	418.21
	Khuzestan	142.13	103.3	183.83	239.04	179.51	304.17
	Kohgiluyeh and Boyer-Ahmad	14.5	10.31	19.29	28.27	20.57	37.29
	Kurdistan	65.73	47.8	88.1	82.17	60.07	106.82
	Lorestan	75.25	54.02	100.4	94	70.89	124.05
	Markazi	67	48.96	90.99	74.34	55.77	100.7
	Mazandaran	99.97	71.66	135.71	198.01	145.36	260.53
	North Khorasan	33.69	24.35	45.11	40.31	30.25	51.9
	Qazvin	40.21	28.83	52.68	73.45	55.1	94.64
	Qom	34.13	23.73	46.29	51.74	39.12	67.8
	Semnan	29.18	21.31	38.74	34.57	25.7	46.1
	Sistan and Baluchistan	62.01	44.2	81.47	88.23	63.63	117.24
	South Khorasan	26.91	18.8	35.5	28.73	20.62	38.46
	Tehran	297.66	211.99	405.61	563.34	408.23	761.7
	West Azerbaijan	108.8	78.33	143.57	161.02	118.56	216.05
	Yazd	37.81	28.69	48.83	48.32	35.98	63.62
	Zanjan	37.08	26.59	49.2	57.86	43.11	75.07

DALYs: Disability-adjusted life years.

of disability among noncommunicable diseases. Although the prevalence, incidence, mortality, and disability rates of stroke globally and in Iran decreased between 1990 and 2021, the number of cases increased. Among stroke pathologies, ischemic stroke was the highest in the world and Iran. In the USA, 87% of strokes were reported as ischemic strokes.^[34] More than 90% of all stroke-related deaths occurred in those aged 55 years or older. In similar studies, it was shown that the highest rate of stroke occurred in older ages,^[35] and almost three-quarters of strokes occurred in those aged 65 years or older.^[35] Age remains the largest risk factor for stroke.^[36] Mechanisms of aging and stroke were based on changes in brain activity.^[36] Since stroke is a vascular disease, it is necessary to pay attention to the effects of aging on vascular diseases and based on the study showed that "Aging was also associated

with decreased expression of endothelial nitric oxide synthase (eNOS) and increased production of inducible nitric oxide synthase (iNOS), factors that alter vascular function".^[37]

Smoking was a major factor in stroke globally and in Iran. The 2019 global estimate of stroke-related factors showed that smoking was the fifth leading cause of stroke, with 25.3 million DALYs attributed to smoking.^[1] Ten stroke risk factors were identified, and 88% of stroke risk factors were attributed to these; researchers stated that stroke could be prevented to a large extent.^[38] The evidence for the relationship between tobacco use and stroke is well established.^[39,40] Some studies reported up to six times the risk of stroke caused by smoking.^[41] The effects of exposure to secondhand smoke and the risk of stroke were shown in the current study, as well as in previous studies.^[41-45] The mechanisms

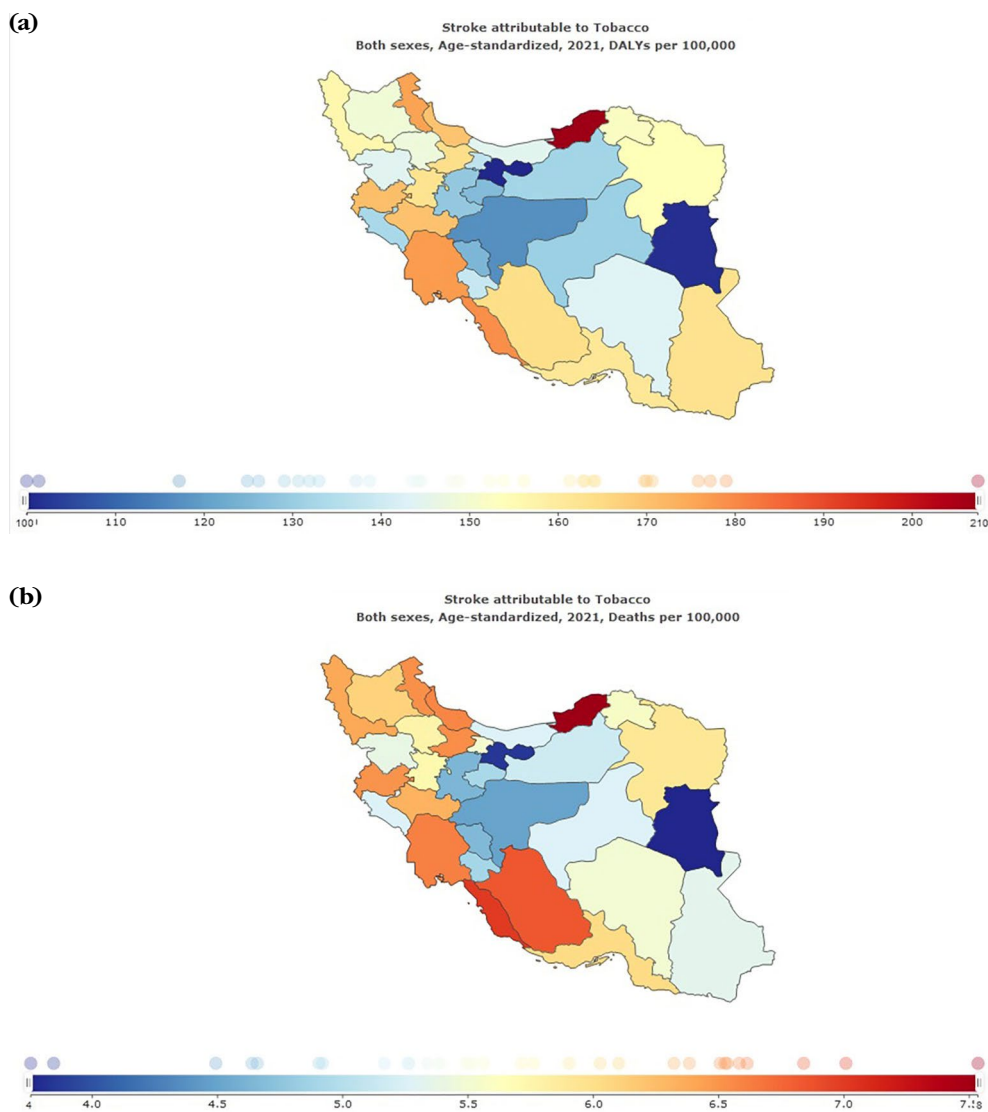


Figure 3. (a) Age-standardized DALYs of stroke attributed to smoking per 100,000 individuals stratified by provinces. (b) Age-standardized deaths from stroke attributed to tobacco smoking per 100,000 individuals stratified by provinces.

DALYs: Disability-adjusted life years.

listed for how the relationship between smoking and the risk of stroke are extensive include carboxyhemoglobinemia, increased platelet aggregability, increased fibrinogen levels, reduced high-density lipoprotein cholesterol, and direct toxic effects of compounds, such as 1,3-butadiene, a vapor phase constituent of environmental tobacco smoke that accelerated atherosclerosis in animal models.^[46] Furthermore, secondhand smoking was related to atherosclerosis as measured by B-mode ultrasound of the carotid wall,^[47,48] as well as to early arterial damage as assessed by endothelium-dependent brachial artery dilatation.^[49]

This study shared certain limitations with the GBD Study 2021, which were previously addressed.^[28,29] While smoking was a major focus, future studies could expand to include other emerging risk factors for stroke, such as dietary habits and physical inactivity, to provide a more comprehensive picture of the disease's burden.

In conclusion, this was a comprehensive study on the burden of stroke and its burden attributable to tobacco use globally and in Iran. The evidence obtained from this study, representing the most up-to-date estimates, is insightful. The findings obtained from the current study show that stroke

TABLE 8
Death and DALYs attributed to smoking stratified by ages between 1990 and 2021

Measure	Age (years)	Year					
		1990			2021		
		Value	Lower	Upper	Value	Lower	Upper
DALYs rate	25-29	24.37	13.22	38.87	16.26	8.96	25.39
	30-34	100.28	70.95	132.52	67.42	50.71	87.32
	35-39	159.68	119.72	207.58	94.38	71.86	121.94
	40-44	265.61	204.55	335.64	138.06	109.88	174.59
	45-49	408.43	311.95	529.96	196.89	149.5	246.47
	50-54	659.21	507.65	836.74	295.06	229.75	360.39
	55+	1,108.42	870.75	1,379.38	542.17	423.69	675.1
Deaths rate	25-29	0.29	0.16	0.47	0.18	0.1	0.29
	30-34	1.36	0.97	1.86	0.86	0.66	1.09
	35-39	2.49	1.85	3.31	1.35	1.02	1.72
	40-44	4.79	3.62	6.08	2.27	1.8	2.83
	45-49	8.46	6.36	10.79	3.72	2.88	4.64
	50-54	15.78	12.04	19.96	6.49	5	7.92
	55+	43.57	33.8	54.59	24.05	18.41	30.64
DALYs number	25-29	1,032.19	560.14	1,646.58	1,035.51	570.58	1,617.11
	30-34	3,552.59	2,513.79	4,695.02	5,618.39	4,225.87	7,276.79
	35-39	4,432.53	3,323.13	5,762.05	8,408.05	6,401.73	10,863.35
	40-44	5,782.13	4,452.74	7,306.47	9,863.40	7,850.22	12,473.66
	45-49	6,676.70	5,099.59	8,663.47	10,927.75	8,297.82	13,679.59
	50-54	10,387.59	7,999.39	13,185.14	14,126.85	11,000.06	17,254.84
	55+	51,097.42	40,141.06	63,588.39	70,433.28	55,041.43	87,701.75
Deaths number	25-29	12.39	6.84	20.11	11.63	6.49	18.3
	30-34	48.24	34.21	66.03	71.93	54.91	91.18
	35-39	69.22	51.31	91.92	120.34	91.24	152.85
	40-44	104.33	78.86	132.41	161.83	128.76	201.98
	45-49	138.23	103.97	176.44	206.53	159.99	257.5
	50-54	248.67	189.75	314.49	310.63	239.46	379.43
	55+	2,008.65	1,558.38	2,516.35	3,124.57	2,391.10	3,981.02

DALYs: Disability-adjusted life years.

remains a noncommunicable disease with a major burden, and although its prevalence has decreased compared to previous decades, due to the increase in the population, the case of stroke has also increased. Considering the decrease in the fertility rate in the world, particularly in Iran, and the increase in the elderly population in the coming decades, the burden caused by stroke on the health system can be significant. Therefore,

it is necessary to address the preventable risk factors of stroke, including tobacco use, which is a major risk factor, helping to reduce the burden of stroke.

Data Sharing Statement: The data sources of this study were taken from GBD 2021, which is publicly available. The data can be accessed through the links below. <https://vizhub.healthdata.org/gbd-results/>, <https://vizhub.healthdata.org/gbd-compare/>

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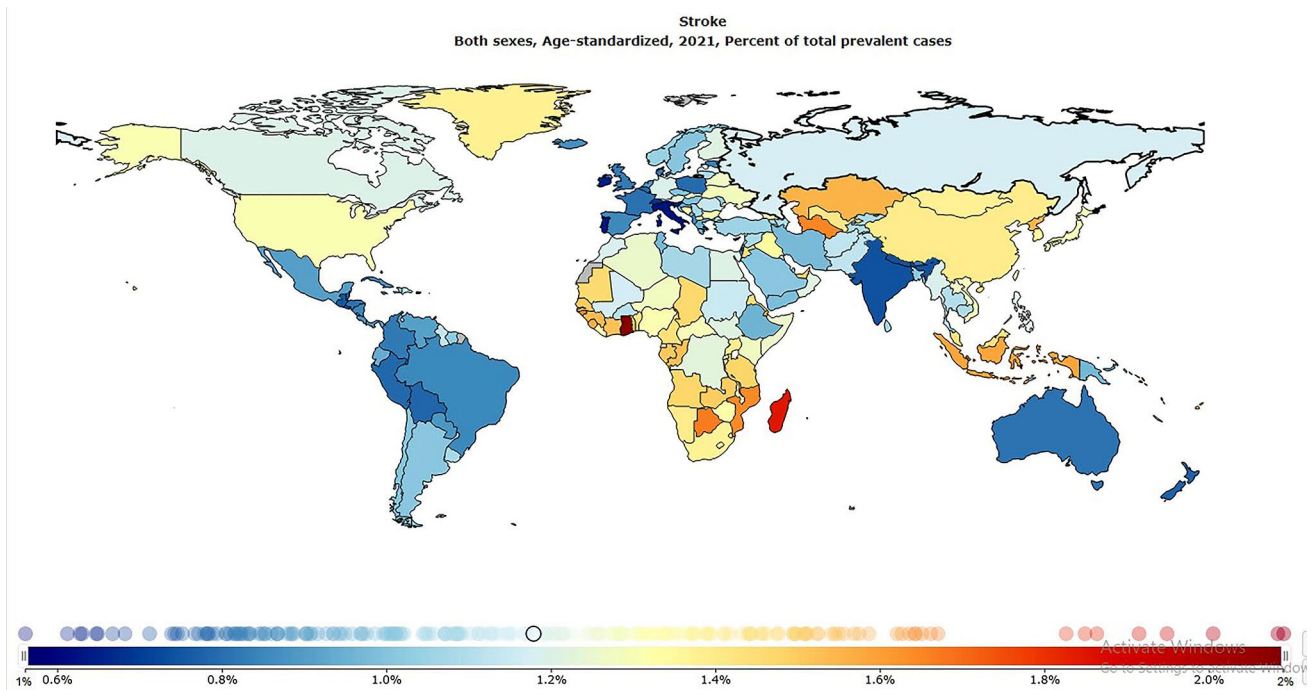
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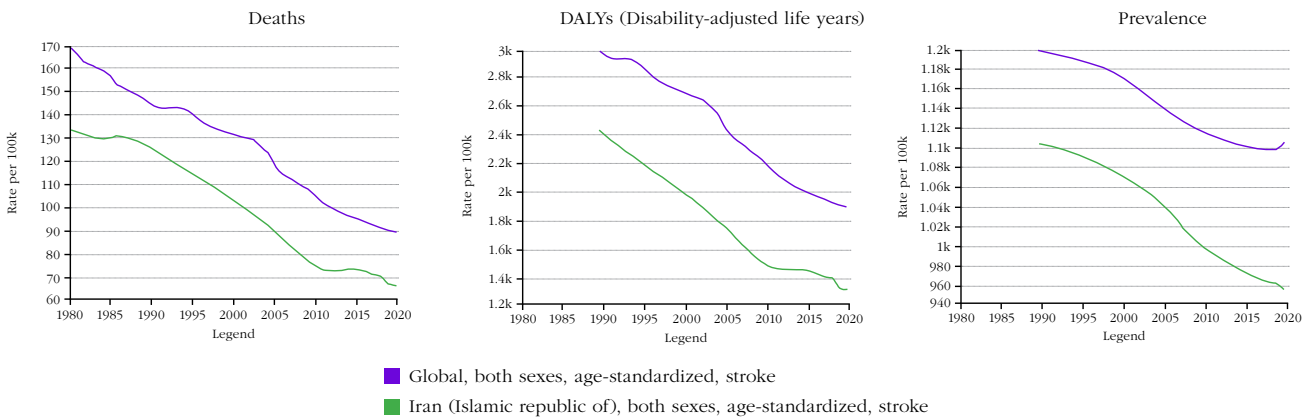
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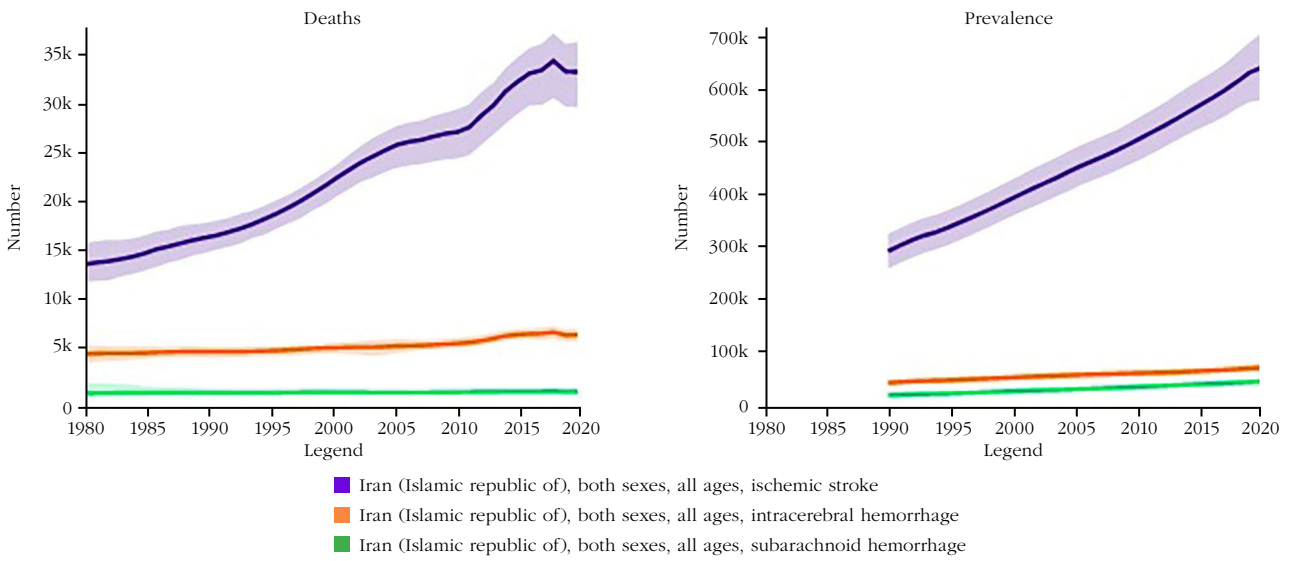


Supplementary Figure 1. Global age-standardized prevalence of stroke in 2021.

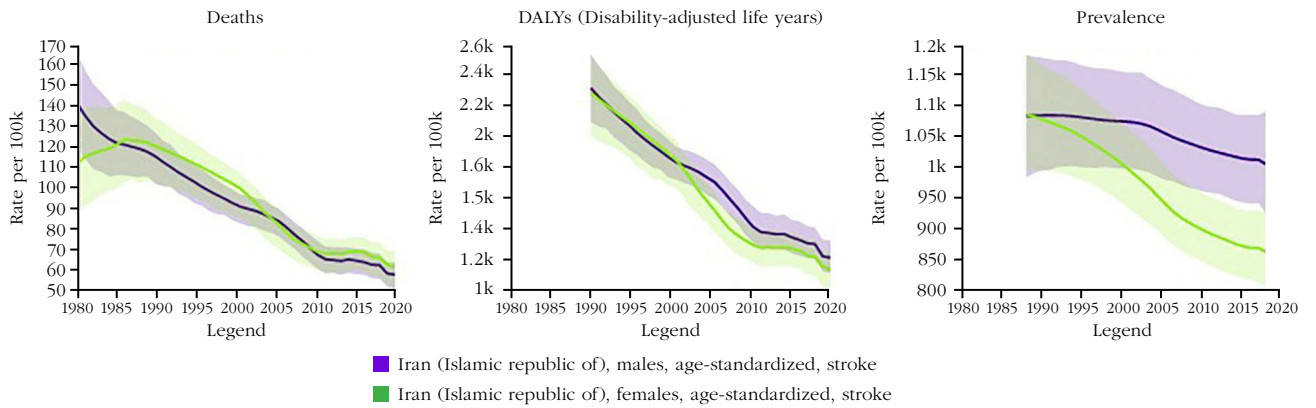


Supplementary Figure 2. Prevalence, death, and DALYs of stroke per 100,000 individuals globally and in Iran.

DALYs: Disability-adjusted life years.

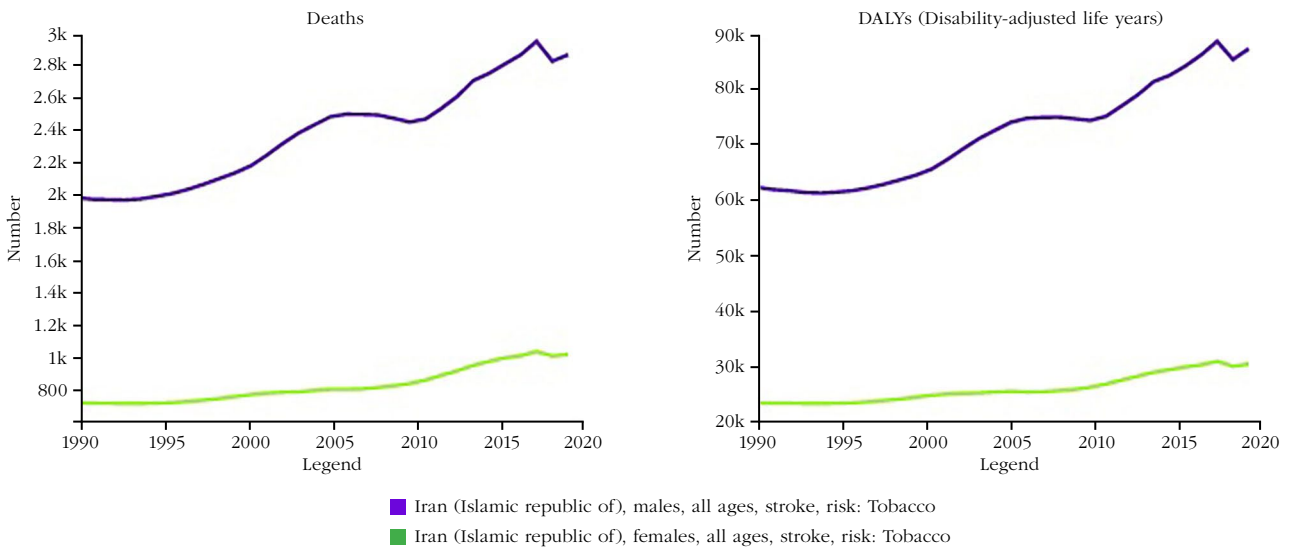


Supplementary Figure 3. Count estimates of pathological types of stroke in Iran.



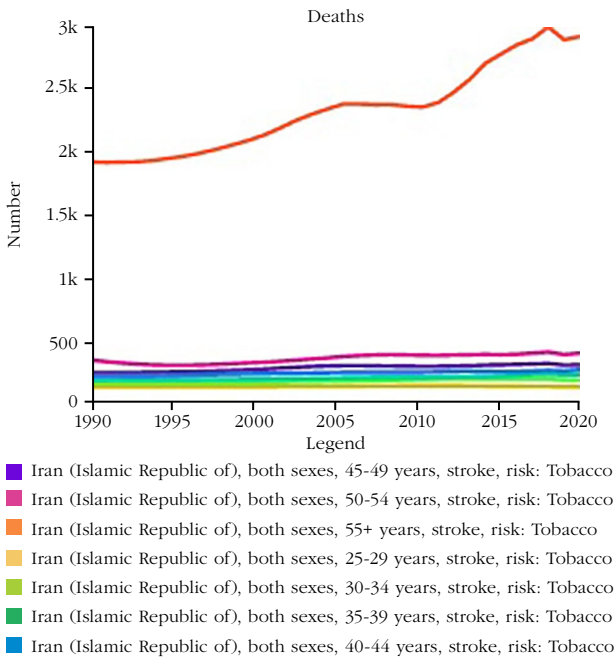
Supplementary Figure 4. Age-standardized prevalence, death, and DALYs of stroke stratified by sex.

DALYs: Disability-adjusted life years.



Supplementary Figure 5. All-age DALYs and death of stroke attributed to smoking stratified by sex.

DALYs: Disability-adjusted life years.



Supplementary Figure 6. All-age deaths from stroke attributed to smoking stratified by ages.