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Review / Derleme

Stroke Epidemiology and Near Future Projection in Turkey: Analysis of Turkey Data from the Global Burden of Disease Study

Türkiye'de İnme Epidemiyolojisi ve Yakın Gelecek Projeksiyonu: Küresel Hastalık Yükü Çalışması Türkiye Verilerinin Analizi

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Abstract

The most up-to-date stroke statistics for Turkey are presented using the Global Burden of Disease e-research system. In 2019, the incidence of stroke for Turkey was estimated as 125,345 (154 per hundred thousand), the prevalence was 1,080,380 (1.3%), the death rate due to stroke was 48,947 and the number of life years lost due to stroke-related death/disability was estimated to be 993,082 years. Of strokes 17.4% occurred under the age of fifty, 58.5% under the age of seventy, and 54.3% in women. 65.1% of strokes are acute ischemic stroke, 24% intracerebral and 10.9% subarachnoid hemorrhage. Although there is a numerical increase in all stroke types with the aging of our country's population, it has been observed that the increase in the frequency of hemorrhagic strokes are limited over time when frequency standardization is made according to age.

Keywords: Acute stroke, aging, incidence, vascular risk, vascular health

Öz

Küresel Hastalık Yükü sistemi kullanılarak Türkiye'ye dair en güncel inme istatistikleri sunulmuştur. 2019 yılında Türkiye için inme insidansı 125.345 (yüz binde 154), prevalansı 1.080.380 (yüzde 1,3), inme nedenli ölüm hızı 48.947 kişi ve inmeye bağlı ölüm/sakatlık nedeniyle kaybedilen yaşam yılları sayısı 993.082 yıl olarak tahmin edilmiştir. İnmelerin %17,4'ü elli yaş altında, %58,5'i yetmiş yaş altında ve %54,3'ü de kadınlarda görülmüştür. İnmelerin %65,1'i akut iskemik inme, %24'ü intraserebral kanama ve %10,9'u subaraknoid kanamadır. Ülkemiz popülasyonunun yaşlanması ile birlikte tüm inme tiplerinde sayısal artış olmakla birlikte yaşa göre standardizasyon yapıldığında özellikle hemorajik inmelerin sıklık artışının zaman içinde sınırlandırılmış olduğu görülmüştür.

Anahtar Kelimeler: Akut inme, yaşlanma, insidans, vasküler risk, vasküler sağlık

Introduction

One of the consequences of the aging population in our country is the remarkable increase in the frequency of vascular diseases, especially acute stroke. After the end of the pandemic, the critical level of the stroke frequency requires meticulous planning of what needs to be done in the country in the regional context. It is clear that this planning will be built on the epidemiological data of stroke in our country. The most up-to-date estimates of data for Turkey presented in 2019 in the "Global Burden of Disease (GBD)" study, were reviewed for this purpose.

Method

GBD project is the most comprehensive worldwide observational epidemiological study to date led by the Institute for Health Metrics and Evaluation at the University of Washington, Seattle (USA) which was prioritized by the World Health Organization (1). The GBD study provides a powerful resource for understanding the changing health challenges faced by people around the world in the 21st century. Within the scope of GBD, there are estimated data for the last 30 years on 369 diseases or medical conditions and 84 risk factors in 204 countries, and in countries such as USA, UK and Iran depicting regional context. GBD released the latest global data in 2019. Researches using this database are published within the framework of determined reporting rules (2), so that both inter-country comparisons (3) and global (4) and temporal (5,6) trends can be evaluated. In this review, GBD Turkey data are summarized and introduced under the title of stroke.

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Stroke in Turkey in 2019

The official population of Turkey in 2019 was 83,429,615. In the same year, the incidence of "combined" stroke was estimated as 125,345 (154 per hundred thousand), the prevalence 1,080,380 (1.3%), stroke-related death 48,947, and the number of life years lost due to stroke-related death/disability 993,082 years. Of strokes 17.4% were seen under the age of 50, 58.5% under the age of 70, and 54.3% in women. Approximately one-fourth of the patients who survived a stroke were under the age of 50, two-thirds were under the age of 70, and 56.8% were women. Of those who died due to stroke 4.1% were under 50 years old, 24.5% were under 70 years old, and 55% were women. Of the life years lost due to death and disability 13.4% affected those under the age of 50, 49.1% under the age of 70, and 52% women. Turkey's main stroke metrics are within the range determined for the global scale (Table 1).

Approximately 81,500 new acute ischemic strokes (AIS) were diagnosed in Turkey in 2019. IS accounted for 65.1% of all strokes. Of the individuals with IS, 14.1% were under the age of 50, 55.7% were under the age of 70, and 54.3% were women. The prevalence of IS in our country in 2019 was approximately 838,000, and 20.9% of the patients were younger than 50, and 63.2% were younger than 70. The prevalence of IS was higher in women in Turkey, similar to the rest of the world (57.2%, Table 2). In 2019, approximately 30,000 patients died in our country due to IS. Of dying patients due to IS 1.2% were younger than 50, and 14% were younger than 70. While 55% of the lives lost due to IS in our country were women in 2019, the rate of women lives lost due to IS worldwide was approximately 49% (4). In 2019, more than half a million years of healthy life were lost in our country due to IS-related death and disability (Table 2).

In 2019, approximately 30 thousand new patients of acute intracerebral hemorrhage (ICH) were diagnosed in Turkey. This accounted for 24% of all strokes. In our country, 18% of those diagnosed as having ICH were under the age of 50 and 57.1% were under the age of 70. The female-male ratio in ICHs in Turkey was comparable (50.6% vs. 49.4%). In 2019, the prevalence of ICH in Turkey was 213,000. Of them 36.4% were younger than 50 and 81% of them were younger than 70 years. The male sex ratio in patients who survived after ICH was lower in Turkey (47.2% to 52%) compared to the rest of the world (4). In 2019, approximately 15,500 patients died in our country due to ICH, and more than 350,000 years of healthy life were lost due to death and disability due to ICH (Table 3).

In Turkey, approximately 14,000 new cases of acute subarachnoid hemorrhage (SAH) were diagnosed in 2019. This accounted for 10.9% of all strokes. In our country, SAH was seen at younger ages compared to the rest of the world. Among SAHs, the rate of patients under the age of 50 (35.9% in Turkey, 16% in the world) and the rate of patients under the age of 70 (77.8% in our country, 62% in the world) were higher in our country than in the world. Seventy-four thousand patients survived after SAH and 55.7% of these patients were younger than 50 years and 93.6% were younger than 70 years. The male sex ratio in patients with SAH was lower in Turkey, similar to the rest of the world. An estimated 3,120 patients died in our country in 2019 due to SAH, and more than 91,000 years of healthy life were lost due to death and disability due to SAHSAH (Table 4).

The Course of Stroke Frequency in the Last Thirty Years

Turkey's population was 53,921,760 in 1990, with an increase of 17.3% in 2000, to 63,240,194, in 2010 with an increase of 34,1% to 72,326,988 and in 2019 with an increase of 54,7% to 83,429,615 (7). In 2019, the proportion of women in the total population was 49.9%, and the average life expectancy was 81.3 years for women and 75.9 years for men (8). Over the last 30 years, the combined incidence of all hemorrhagic and ISs has increased by 117% with a fairly stable acceleration, increasing from 57,650 (97 per 100,000) to 125,235 (154 per 100,000). The number of patients surviving after stroke (prevalence) increased from 531,000 (889 out of 100,000) in 1990 to 1,081,000 (1328 out of 100,000) in 2019, an increase of 104%.

In our country, 34,254 patients were diagnosed as having acute IS (AIS) in 1990, and it increased by 138% in thirty years and reached 81,599 in 2019. The increase in the incidence of IS was higher in men than in women (157% vs. 125%) (Figure 1a, top row). The increase in the incidence of IS was slower in the group under 50 years of age. While the incidence of IS was 57 per 100,000 in 1990, it increased by 75.4% to 100 per 100,000 in 2019. The rate of increase was higher in men (from 47 to 88 per 100,000, 87.2% increase) than in women (from 68 to 113 per 100,000, 66.2% increase). After the age of 50, it was observed that the increase accelerated with age. Under 50 years of age, a stable course was observed (Figure 1b, top row). The prevalence of IS was 390,577 numerically in 1990 and reached 838,412 in 2019, increasing by 115% in thirty years with approximately constant acceleration. The increase in prevalence was slightly more pronounced in males and in the advanced (>70) age group (Figure 2a, top row). The rate of IS survivors was 653 per 100,000 in 1990, it increased with a constant acceleration in thirty years and increased to 1.031 per 100,000 in 2019 with a total increase of 58%. While the increase was higher in males than in females (129.2% vs 105%), a stable trend under the age of 50 (from 364 to 384 per 100,000, 5.5% increase) was noted. There was an increasing trend in other age groups. (Figure 2b, top row). The age-standardized incidence and rate of AIS tended to decrease in women over the last 30 years (incidence decreased by 2% and prevalence decreased by 11.1% from 1990 to 2019), but increased in men (from 1990 to 2019, incidence increased by 12.5% and prevalence increased by 3.9%) (Figure 3, top row). The number of patients who died due to AIS increased from 11,051 people in 1990 to 30,216 in 2019 with an increase of 173.4%. The number of deaths caused by AIS increased significantly between 2000 and 2010, but the increase was lower in the previous and subsequent decades. The number of deaths from IS increased by 3.2% in the decade after 1990 to 11,400 in 2000, by a total increase of 131.4% in the following decade, to 26,378 in 2010 and by 14.6% in the next decade. In 2019, the number of deaths from IS increased to 30,216. The incidence of death from AIS was 18.5 per 100,000 in 1990, and decreased by 16.5% in 2000, decreasing by 10.8% in the following ten years. It rose to 35.5 per 100,000, but then the increase slowed (4.5% increase in ten years) and entered a more stable period (37.1 per 100,000 in 2019). Although the mortality rate did not change according to gender, it tended to increase with age. The number of life years lost due to death and disability due to AIS increased from 236,297 in 1990 to 551,064 in 2019 with an increase of 133.2%. The rate of loss of disability adjusted life years (DALY) also increased from 395 per 100,000 in 1990 to 677 per 100,000

Table 1. Combined stroke incidence, prevalence, mortality and DALY estimates in Turkey according to the GBD 2019 report

	Number	Annual rate per 100,000		Comment
		Rough	Standardized by age	
Incidence				
Age (all) Gender (all)	125,345 [114,548-138,123]	154 [141-170]	146 [133-161]	In 2019, approximately 125,000 patients with acute stroke were recorded in Turkey. It was given as 12.2 million in the world.
15-49 years	21,821 [18,520-26,017]	48 [41-57]	-	Of patients with stroke 17.4% were under the age of 50, which was similar to the global average (16%).
<70 years	73,276 [65,214-81,684]	96 [85-107]	-	Of patients with stroke 58.5% were under the age of 70, which was similar to the global average (62%).
Male (all ages)	57,285 [52,111-63,599]	139 [127-155]	141 [128-157]	Of patients with stroke in Turkey 45.7% were males and 47% of the patients in the world were males.
Female (all ages)	68,061 [62,106-75,403]	169 [154-187]	150 [136-166]	Of patients with stroke in Turkey 54.3% were females and 53% of the patients in the world were females.
Prevalence				
Age (all) Gender (all)	1,080,380 [1,002,616-1,164,932]	1,328 [1,232-1,432]	1,214 [1,125-1,309]	There were approximately 1.1 million patients in our country and 101 million in the world who survived after having a stroke.
15-49 years	279,882 [248,781-310,182]	613 [545-679]	-	Of patients who survived after stroke in Turkey 25.9% were younger than 50 years old and 22% of those in the world were younger than 50 years old.
<70 years	740,270 [682,967-801,825]	967 [892-1,047]	-	Of patients who survived after stroke in Turkey 68.5% were younger than 70 years old and 67% of those in the world were younger than 70 years old.
Male (all ages)	466,492 [430,873-505,233]	1,135 [1,048-1,229]	1,092 [1,004-1,185]	Of stroke survivors in Turkey 43.2% were males and 44% of them in the world were males.
Female (all ages)	613,888 [567,050-665,488]	1,525 [1,409-1,653]	1,324 [1,225-1,437]	Of stroke survivors in Turkey 56.8% were females and 56% of them in the world were females.
Mortality				
Age (all) Gender (all)	48,947 [39,204-59,511]	60 [48-73]	61 [49-74]	In 2019, approximately 49.000 people in our country and 6.5 million people in the world died due to stroke.
15-49 years	2,011 [1,543-2,562]	4.4 [3.4-5.6]	-	In 2019, 4.1% of deaths due to stroke in our country and 6% in the world were under the age of 50.
<70 years	11,990 [9,396-15,052]	16 [12-20]	-	In 2019, 24.5% of deaths due to stroke in our country and 34% in the world were under the age of 70.
Male (all ages)	22,036 [17,687-26,926]	54 [43-66]	61 [49-74]	In 2019, 45% of those who died due to stroke in our country and 51% in the world were males,
Female (all ages)	26,911 [21,195-32,999]	67 [53-82]	60 [47-74]	In 2019, 55% of those who died due to stroke in our country and 49% in the world were females.
DALYs				
Age (all) Gender (all)	993,082 [820,881-1,177,528]	1,221 [1,009-1,447]	1,163 [965-1,380]	In 2019, approximately 1 million years of healthy life in our country and more than 143 million years in the world were lost due to stroke-related death and disability.
15-49 years	133,353 [112,469-167,086]	301 [246-366]	-	In 2019, 13.4% of healthy life years lost in our country and 15% in the world due to stroke-related death and disability affected individuals under the age of 50.
<70 years	487,586 [399,578-586,403]	170 [140-205]	-	About half of the healthy life lost in 2019 due to stroke-related death and disability (49.1% in our country and 57% in the world) affected individuals under the age of 70.
Male (all ages)	477,022 [387,366-574,662]	1,161 [942-1,398]	1,187 [969-1,426]	In 2019, 48% of healthy life years lost due to stroke-related disability / death affected males in our country and 54% in the world.
Female (all ages)	516,060 [428,104-611,138]	1,282 [1,063-1,518]	1,132 [940-1,341]	In 2019, 52% of healthy life years lost due to stroke-related disability / death affected females in our country and 46% in the world.

Values in square brackets are 95% "uncertainty interval" values. For details, see Feigin et al. (4). Global figures are also derived from the same source. DALYs: Disability-adjusted life years", GBD: Global Burden of Disease

Table 2. Estimates of IS incidence, prevalence, mortality and DALY in Turkey according to the GBD 2019 report

	Number	Annual rate per 100,000		Comment
		Rough	Standardized by age	
Incidence				
Age (all) Gender (all)	81,599 [71,499-93,648]	100 [88-115]	95 [84-110]	In 2019, it was estimated that there were 81,500 new patients with acute IS in Turkey. This means that 65.1% of all strokes are ischemic.
15-49 years	11,489 [8,459-15,300]	25 [19-34]	-	In 2019, 14.1% of ISs in our country and 11% in the world were under the age of 50.
<70 years	45,456 [37,727-53,440]	53 [49-70]	-	In 2019, 55.7% of ISs in our country and 58% in the world were under the age of 70.
Male (all ages)	38,260 [31,237-42,266]	88 [76-103]	90 [78-105]	In 2019, 46.9% of patients with IS in Turkey and 45% in the world were males.
Female (all ages)	43,319 [39,422-52,412]	113 [98-130]	100 [87-115]	In 2019, 54.3% of patients with IS in Turkey and 53% in the world were females.
Prevalence				
Age (all) Gender (all)	838,412 [764,091-920,762]	1,031 [939-1,132]	956 [873-1,050]	In 2019, there were approximately 838,000 patients in our country and 77 million in the world who survived after having an IS.
15-49 years	175,276 [150,198-203,197]	384 [329-445]	-	In 2019, 20.9% of patients who continued their lives after IS in Turkey and 19% in the world were younger than 50 years old.
<70 years	529,893 [478,948-587,289]	692 [625-767]	-	In 2019, 63.2% of patients who survived IS in Turkey and 61% in the world were younger than 70 years old.
Male (all ages)	358,608 [324,016-395,275]	873 [788-962]	860 [776-951]	The male sex ratio in patients surviving IS was similar in Turkey and in the world (43% vs 42.8%).
Female (all ages)	479,804 [435,467-528,089]	1,192 [1,082-1,312]	1,042 [949-1,146]	The female sex ratio in patients who survived IS was similar in Turkey and in the world (57% vs 57.2%).
Mortality				
Age (all) Gender (all)	30,216 [24,111-36,742]	37 [30-45]	38 [31-46]	In 2019, approximately 30,000 people in our country and 3.3 million people in the world died due to IS.
15-49 years	364 [269-481]	0.8 [0.6-1.1]	-	In 2019, 1.2% of deaths due to IS in our country and 2% in the world were under the age of 50.
<70 years	4,243 [3,256-5,446]	5.5 [4.3-7.1]	-	In 2019, 14% of deaths due to IS in our country and 19% in the world were under the age of 70.
Male (all ages)	12,887 [10,157-16,012]	31 [25-39]	37 [29-46]	Of those who died due to IS in 2019, 42.6% in our country and 48% in the world were males.
Female (all ages)	17,328 [13,485-21,068]	43 [34-52]	39 [30-48]	Of those who died due to IS in 2019, 55% in our country and 49% in the world were females.
DALYs				
Age (all) Gender (all)	551,064 [459,967-649,248]	677 [565-798]	663 [553-780]	In 2019, more than half a million years of healthy life years in our country and more than 63 million years in the world were lost due to death and disability due to IS.
15-49 years	41,154 [32,330-50,958]	90 [71-112]	-	In 2019, 7.5% of the healthy life years lost due to death and disability due to IS in our country and 7% in the world affected individuals under the age of 50.
<70 years	196,667 [161,747-238,218]	69 [56-83]	-	Individuals under the age of 70 affected 35.7% of the healthy life years lost in 2019 due to death and disability due to IS in our country and 41% in the world.
Male (all ages)	246,017 [202,489-296,238]	599 [493-721]	644 [530-775]	In 2019, 44.6% of healthy life years lost due to IS-related disability/death in our country and 50% in the world affected males
Female (all ages)	305,047 [254,644-361,114]	758 [633-897]	675 [563-798]	In 2019, 55.4% of healthy life years lost due to IS-related disability/death in our country and 50% in the world affected females.

Values in square brackets are 95% "uncertainty interval" values. For details, see Feigin et al. (4). Global figures are also derived from the same source. DALYs: Disability-adjusted life years", GBD: Global Burden of Disease, IS: Ischemic stroke

Table 3. Incidence, prevalence, mortality and DALY estimations of ICH in Turkey according to the GBD 2019 report

	Number	Annual rate per 100,000		Comment
		Rough	Standardized by age	
Incidence				
Age (All) Gender (all)	30,027 [26,923-33,453]	37 [33-41]	35 [31-39]	In 2019, 30 thousand new cases of acute ICH were diagnosed in Turkey. This accounted for 24% of all strokes.
15-49 years	5,406 [4,398-6,589]	11.8 [9.6-14.4]	-	In 2019, 8% of patients with ICHs in our country and 23% in the world were under the age of 50.
<70 years	17,149 [15,066-19,785]	22 [20-26]	-	In 2019, 57.1% of patients with ICHs in our country and 68% in the world were under the age of 70.
Male (all ages)	14,820 [13,106-16,537]	36 [32-40]	36 [32-41]	The male sex ratio in ICHs was 49.4% in Turkey and 54% in the world.
Female (all ages)	15,207 [13,547-17,076]	38 [34-42]	34 [30-38]	The female sex ratio in ICHs was 50.6% in Turkey and 46% in the world.
Prevalence				
Age (all) Gender (all)	212,849 [190,914-233,873]	262 [235-288]	235 [211-258]	In 2019, there were 213,000 patients in Turkey and 21 million in the world who could continue their lives after ICH.
15-49 years	77,574 [66,634-88,750]	170 [146-194]	-	In 2019, 36.4% of the patients who continued their lives after ICH in Turkey and 33% in the world were younger than 50 years old.
<70 years	172,450 [154,194-191,771]	225 [201-250]	-	In 2019, 81% of patients who survived after ICH in Turkey and 85% in the world were younger than 70 years old.
Male (all ages)	100,385 [89,830-110,609]	244 [219-269]	225 [202-248]	The male sex ratio in patients who survived after ICH was lower in Turkey compared to the rest of the world (47.2% versus 52%).
Female (all ages)	112,464 [100,650-123,758]	279 [250-307]	243 [217-267]	The female sex ratio in patients who survived after ICH was higher in Turkey than in the world (48% vs 52.8%)
Mortality				
Age (all) Gender (all)	15,611 [12,430-19,184]	19 [15-24]	19 [15-23]	In 2019, approximately 15,500 people in our country and 3 million people in the world died due to ICH.
15-49 years	1,103 [841-1,434]	2.4 [1.8-3.1]	-	In 2019, 7.1% of patients who died due to ICH in our country and 9% in the world were under the age of 50.
<70 years	6,072 [4,698-7,694]	7.9 [6.1-10.1]	-	In 2019, 38.9% of patients who died due to ICH in our country and 47% in the world were younger than 70 years of age.
Male (all ages)	7,551 [5,878-9,444]	18 [14-23]	20 [15-25]	In 2019, 48.4% of those who died due to ICH in our country and 55% in the world were males.
Female (all ages)	8,040 [6,292-9,998]	20 [16-25]	18 [14-22]	In 2019, 51.6% of those who died due to ICH in our country and 45% in the world were females.
DALYs				
Age (all) Gender (all)	350,826 [284,141-427,496]	431 [349-525]	399 [324-486]	In 2019, approximately 350,000 years of healthy life in our country and more than 69 million years in the world were lost due to death and disability due to ICH.
15-49 years	63,886 [50,427-79,709]	140 [110-175]	-	Individuals under the age of 50 affected 18.2% of the healthy lives lost in 2019 due to death and disability due to ICH in our country and 19% in the world.
<70 years	219,913 [176,423-271,366]	77 [62-95]	-	Individuals under the age of 70 affected 62.7% of healthy lives lost in 2019 due to death and disability due to ICH in our country and 69% in the world.
Male (all ages)	183,593 [144,388-227,586]	447 [351-554]	435 [343-540]	In 2019, 52.3% of the healthy life lost due to disability/death related to ICH in our country and 57% in the world affected males.
Female (all ages)	167,233 [135,650-203,557]	415 [337-506]	363 [294-442]	In 2019, 47.7% of healthy lives lost due to disability/death related to ICH in our country and 43% in the world affected females.

Values in square brackets are 95% "uncertainty interval" values. For details, see Feigin et al. (4). Global figures are also derived from the same source. DALYs: Disability-adjusted life years", GBD: Global Burden of Disease, ICH: Intracerebral hemorrhage

Table 4. Estimates of SAH incidence, prevalence, mortality and DALY in Turkey according to the GBD 2019 report

	Number	Annual rate per 100,000		Comment
		Rough	Standardized by age	
Incidence				
Age (all) Gender (all)	13,719 [11,850-15,875]	17 [15-20]	15 [13-17]	In 2019, approximately 14,000 new cases of acute SAH were diagnosed in Turkey. This accounted for 10.9% of all strokes.
15-49 years	4.927 [3,853-6,127)	11 [8-13]	-	While 35.9% of patients with SAHs were under the age of fifty in our country, it was 16% in the world.
<70 years	10,671 [9,049-12,582]	14 [12-16]	-	While 77.8% of patients with SAHs were under the age of seventy in our country, it was 62% in the world.
Male (all ages)	6,184 [5,289-7,174]	15 [13-18]	14 [12-16]	The male sex ratio in SAHs was 45.1% in Turkey and 47% in the world.
Female (all ages)	7,535 [6,452-8,779]	19 [16-22]	16 [14-19]	The female sex ratio in SAHs was 54.9% in Turkey and 53% in the world.
Prevalence				
Age (all) Gender (all)	74,005 [62,671-86,497]	91 [77-106]	78 [66-91]	In 2019, there were 74,000 patients in Turkey and 8.4 million in the world who could continue their lives after SAH.
15-49 years	41,189 [34,779-48,211]	90 [76-106]	-	In 2019, 55.7% of patients who continued their lives after SAH in Turkey and 35% in the world were younger than 50 years old.
<70 years	69,294 [58,191-81,799]	91 [76-107]	-	In 2019, 93.6% of the patients who survived after SAH in Turkey and 82% in the world were younger than 70 years old.
Male (all ages)	29,318 [24,649-34,415]	71 [60-84]	62 [52-73]	The male sex ratio in patients surviving after SAH was similar in Turkey compared to the rest of the world (39.6% vs 40%).
Female (all ages)	44,687 [37,688-52,582]	111 [94-131]	94 [80-111]	The female sex ratio in patients who survived after SAH in Turkey was at a similar level compared to the rest of the world (60.4% vs. 60%).
Mortality				
Age (all) Gender (all)	3,120 [2,422-3,942]	3.8 [3.0-4.9]	3.6 [2.8-4.6]	In 2019, an estimated 3120 people in our country and 373,000 people in the world died due to SAH.
15-49 years	543 [399-708]	1.2 [0.9-1.6]	-	In 2019, 17.4% of patients who died due to SAH in our country and 17% in the world were under the age of 50.
<70 years	1,675 [1,247-2,178]	2.2 [1.6-2.8]	-	In 2019, 53.7% of patients who died due to SAH in our country and 56% in the world were younger than 70 years of age.
Male (all ages)	1,598 [1,134-2,072]	3.9 [2.8-5.0]	4 [2.8-5.1]	In 2019, 51.2% of those who died due to SAH in our country and 50% in the world were males.
Female (all ages)	1,522 [1,166-1,955]	3.8 [2.9-4.9]	3.3 [2.5-4.3]	In 2019, 48.8% of those who died due to SAH in our country and 50% in the world were females.
DALYs				
Age (all) Gender (all)	91,143 [72,042-114,240]	112 [89-140]	101 [80-126]	In 2019, approximately 91,000 years of healthy life in our country and more than 143 million years in the world were lost due to death and disability due to SAH.
15-49 years	32,314 [25,291-40754]	71 [55-89]	-	Individuals under the age of 50 affected 17.4% of healthy lives lost in 2019 due to death and disability due to SAH in our country and 17% in the world.
<70 years	71,004 [55,497-89,014]	25 [19-31]	-	Individuals under the age of 70 affected 53.7% of healthy lives lost in 2019 due to death and disability due to SAH in our country and 56% in the world.
Male (all ages)	47,412 [35,169-61,194]	115 [86-149]	108 [80-139]	In 2019, 52% of healthy life lost due to disability/death related to SAH in our country and 54% in the world affected males.
Female (all ages)	43,780 [35,193-54,628]	109 [87-136]	94 [76-117]	In 2019, 48% of healthy lives lost due to disability/death related to SAH in our country and 46% in the world affected females.

Values in square brackets are 95% "uncertainty interval" values. For details, see Feigin et al. (4). Global figures are also derived from the same source. DALYs: Disability-adjusted life years", GBD: Global Burden of Disease, SAH: Subarachnoid hemorrhage

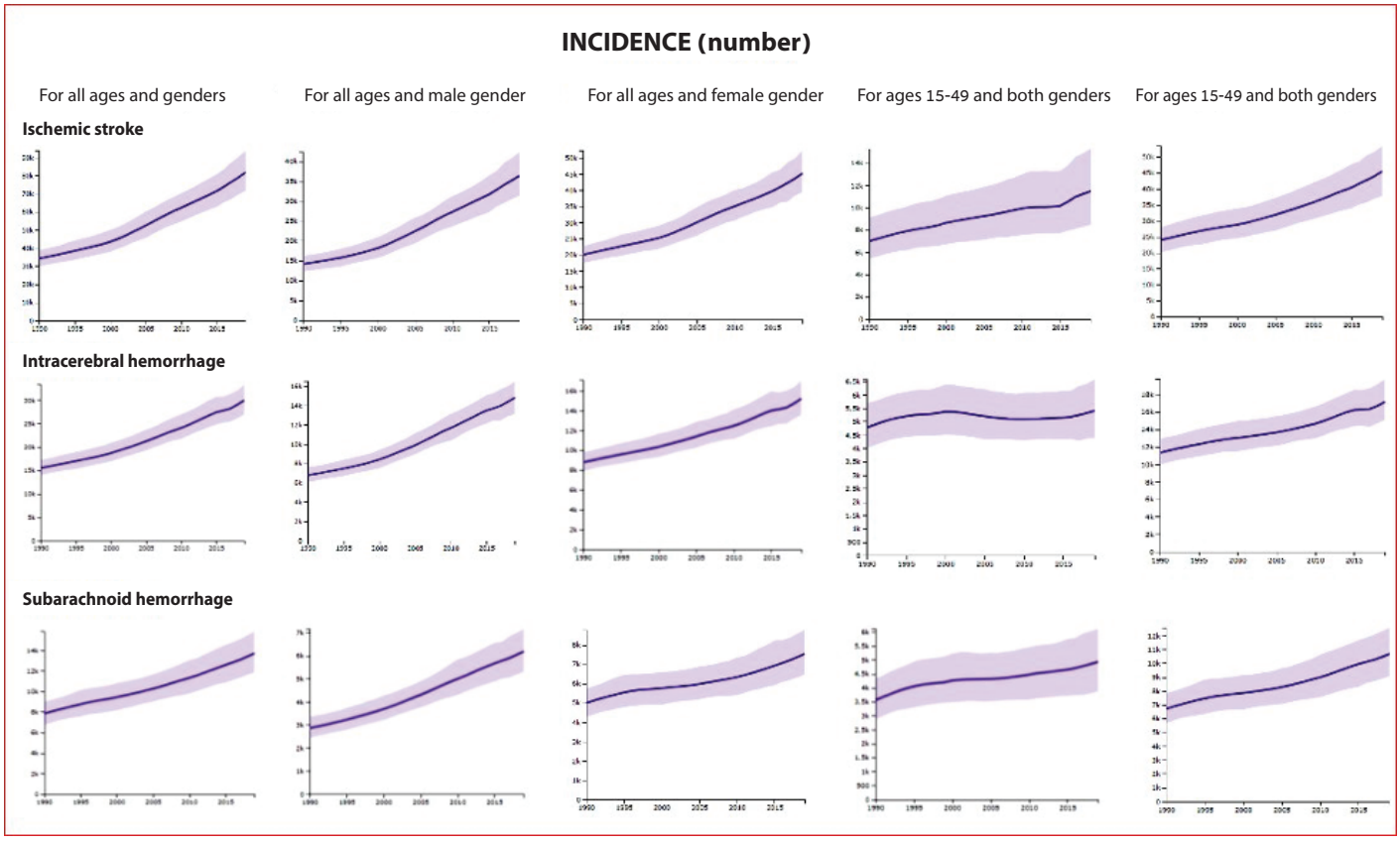

Figure 1a. Incidence of stroke: Course over the last 30 years

Ischemic stroke: In 1990, 34,254 people were diagnosed with acute ischemic stroke (AIS) in Turkey, and the number of patients increased by 138% with a stable acceleration in 30 years, reaching 81,599 in 2019. The number of people diagnosed as having AIS increased from 14,147 to 36,280 (an increase by 156.5%) in males, from 20,106 to 45,319 (an increase by 125.4%) in females, from 7,008 to 11,488 under the age of 50 in 30 years (an increase by 63.9%) and under 70 years of age from 23,942 to 45,456 (an increase by 89.9%) (top row)

Intracerebral hemorrhage (ICH): In our country, 15,548 people were diagnosed as having ICH in 1990, and the number of patients increased to 30,017 in 2019 with an approximately stable increase by 42% in 30 years. The number of people diagnosed as having ICH in the same time period increased from 6,777 to 14,820 (an increase by 118%) in males, from 8,770 to 15,207 (an increase by 73%) in females, from 4,777 to 5,406 (an increase by 13%) under the age of 50, and under 70 years of age increased from 11,320 to 17,149 (an increase by 52%) (middle row)

Subarachnoid hemorrhage (SAH): In Turkey, 7,849 people were diagnosed as having SAH in 1990, and it increased to 13,719 in 2019 with a stable increase by 75% in total. In the same time period, the number of people diagnosed as having SAH increased from 2,862 to 6,184 (an increase by 116%) in males, from 4,988 to 7,535 (an increase by 51%) in females, from 3,556 to 4,927 (an increase by 39%) under the age of 50, and aged under 70 years increased from 6,703 to 10,671 (an increase by 59%) (bottom row)

with an increase of 71.4% in 2019. While the number and rate of DALYs increased rapidly between 2000 and 2010, they remained relatively stable in the previous and following decades. DALY loss from AIS increased to 259,049 in the decade up to 2000, with a total increase of 9.6%, and increased much more rapidly (93.2%) in the following decade to 500,430 in 2010. After 2010, it showed a more stable course (10.1% increase in ten years). The DALY rate first decreased to 374 per 100,000 with a 5.3% decrease in 2000, and increased to 651 per 100,000 in 2010 with a total increase of 76.1% in the next ten years, and remained almost constant in the following ten years (4% increase).

In Turkey, 15,548 patients were diagnosed as having ICH in 1990, and it increased by 42% in thirty years and nearly doubled (30,027) in 2019. The increase in the number of ICHs was higher in men than in women (118% vs 73%) (Figure 1a, middle row). The increase in the incidence of ICH under the age of 70 was slow, especially in the group under the age of 50. While the incidence of ICH was 26 per 100,000 in 1990, it increased by 42% to 36.9 per 100,000 in 2019. The rate of increase was higher in men (from 22.3 to 36.1 per hundred thousand, 62% increase) than in women (from 29.8 to 37.8 per hundred thousand, 27% increase). An increase in the rate of increase was observed with increasing age (Figure 1b, middle row). The numerical prevalence of ICH was 122,997 in 1990 and reached 212,849 in 2019 with a total increase of 64% with approximately constant acceleration. The increase in prevalence was more pronounced in males and advanced (>70) age group (Figure 2a, middle row). The frequency of patients who were able to continue their lives after ICH was 206 per 100,000 in 1990, and increased slightly in the last 10 years to 262 per 100,000 in 2019 with a total increase of 27%. While the increase was more pronounced in men than in women (44% vs 15%), the tendency to decrease under the age of 50 (6.6% decrease from 182 per hundred

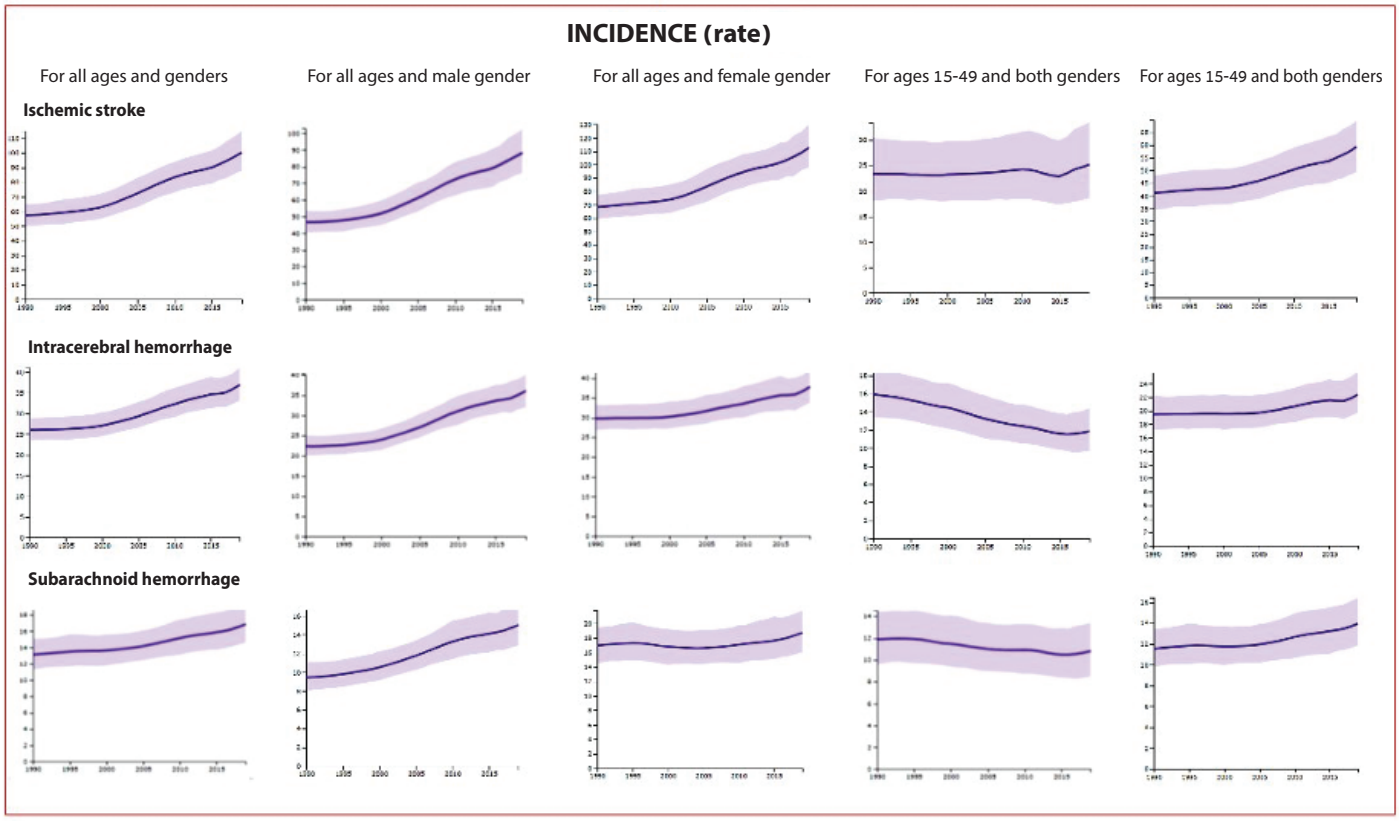

Figure 1b. Incidence of stroke: Course over the last 30 years

Ischemic stroke (IS): The rate of diagnosis of acute IS (AIS) in our country in 1990 was 57 per 100,000, and it increased to 100 per 100,000 in 2019, with an almost constant annual increase by 75.4% in 30 years. During the same period, the rate of diagnosis of AIS was higher in males [47 to 88 per 100,000 (an increase by 87.2%)] than females [68 to 113 per 100,000 (an increase by 66.2%)]. The rate of AIS under 70 years of age increased from 41 to 59 per 100,000 (an increase by 43.9%) from 1990 to 2019. Under the age of 50, the rate of AIS showed a stable and minimally fluctuating course (from 23 to 25 per 100,000, an increase by 8.7%) in the same time period (top row)

Intracerebral hemorrhage (ICH): The rate of diagnosis of ICH in Turkey in 1990 was 26 per 100,000, increasing with a constant acceleration by 42% in total, reaching 36.9 per 100,000 in 2019. During the same period, the rate of diagnosis of ICH (per hundred thousand) was higher in males [from 22.3 to 36.1 (an increase by 61.9%)] than in females [29.8 to 37.8 (an increase by 27%)]. The incidence of ICH under 70 years of age increased from 19.5 to 22.4 per 100,000 (an increase by 14.9%) from 1990 to 2019. Under the age of 50, the rate of ICH showed a significant decrease (a decrease by 26%) in this time period (from 16 per 100,000 in 1990 to 11.9 per 100,000 in 2019). [Middle row] This decrease was by 40% in females (18.7 per hundred thousand in 1990, 11.2 per hundred thousand in 2019) and by 6.7% in males (13.4 per hundred thousand in 1990, 12.5 per hundred thousand in 2019) (not shown in the chart)

Subarachnoid hemorrhage (SAH): The rate of diagnosis of SAH in Turkey in 1990 was 13.1 per 100,000, and increased to 16.9 per 100,000 in 2019, with a constant increase by 29% in total. In the same period, the rate of diagnosis of SAH (per hundred thousand) was higher in males [from 9.4 to 15 (an increase by 60%)] than in females [16.9 to 18.7 (an increase by 11%)]. The rate of SAH under 70 years of age increased from 11.5 to 13.9 per 100,000 (an increase by 21%) from 1990 to 2019. Under the age of 50, the rate of SAH decreased slightly by 9% over the same time period (from 11.9 per 100,000 in 1990 to 10.8 per 100,000 in 2019) (bottom row)

thousand to 170 per hundred thousand) was remarkable. There was an increasing trend in other age groups (Figure 2b, middle row). It was noteworthy that the frequency and rate of age-standardized ICH tended to decrease more significantly in women over the last 30 years (Figure 3, middle row). The number of deaths due to ICH was 8,960 in 1990 and increased by 74% to 15,611 in 2019. The number of deaths from ICH increased markedly between 2000 and 2010, and remained approximately stable in the previous and subsequent decades (approximately 75% increase from 8,635 to 15,901 between 2000 and 2010). The incidence of death from ICH was 15 per 100,000 in 1990 and decreased by 21% over the next ten years to 11.9% in 2000, but increased by 70% in the following ten years to 20.2 per 100,000 in 2010 and then again entered a stable period with a slow (5%) decrease (19.2 per hundred thousand in 2019). Although the mortality rate did not change according to gender, it tended to increase continuously over the age of 50. The number of life years lost due to death and disability due to ICH increased from 256,093 in 1990 to 350,129 in 2019 with an increase of 37%. The rate of DALY loss also increased from 428 per 100,000 in 1990 to 431 per 100,000 in 2019 with an increase of 7%. While the number and rate of DALYs increased rapidly between 2000 and 2010, they remained relatively stable in the previous and next two decades. DALY loss from ICH decreased by 10.9% to 228,897 in 2000; however, it increased by 51.2% in

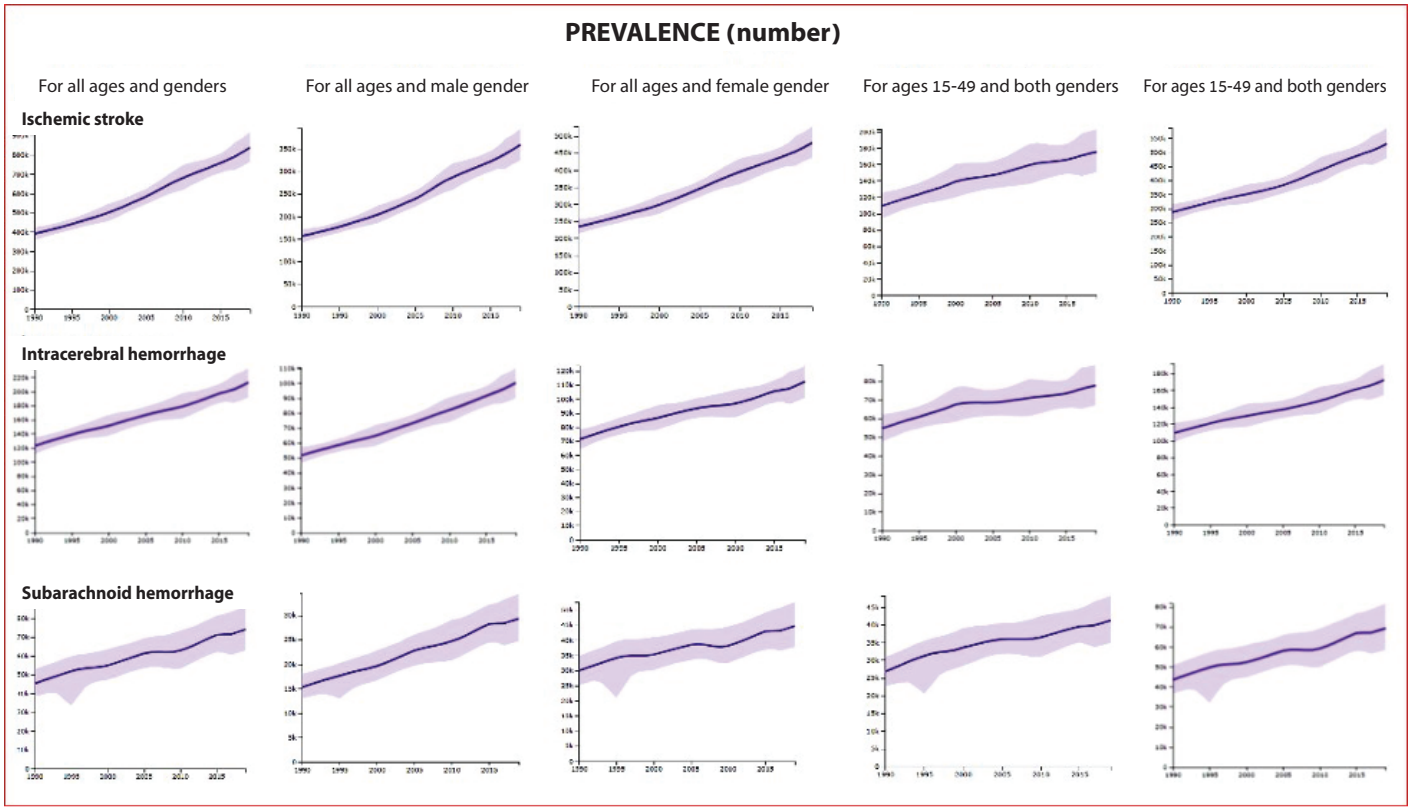

Figure 2a. Stroke prevalence: Course over the last 30 years

Ischemic stroke (IS): While 390,577 people continued to live after acute IS (AIS) in 1990 in Turkey, its prevalence increased to 838,412 people in 2019 with a stable accelerated increase by 115% in total in 30 years. In the same period, the number of patients with AIS increased from 156,481 to 358,608 (an increase by 129.2%) in males, from 234,096 to 479,804 (an increase by 105%) in females, from 109,078 to 175,276 (an increase by 60.7%) under the age of 50, and under 70 years old from 285,945 to 529,893 (an increase by 85.3%) (top row)

Intracerebral hemorrhage (ICH): While 122,997 people continued to live after ICH in 1990 in our country, this increased with a constant acceleration by 73% and reached 212,849 in 2019. The number of patients with ICH during this period increased from 51,663 to 100,384 (an increase by 94%) in males, from 71,333 to 112,464 (an increase by 58%) in females, from 54,613 to 77,574 (42% increase) for those under 50 years of age, and for the under 70 years of age, it increased from 109,167 to 172,450 (an increase by 58%) (middle row)

Subarachnoid hemorrhage (SAH): While 42,201 people continued to live after SAH in 1990 in Turkey, this increased to 74,005 in 2019 with a stable increase by 64%. In the same period, the number of patients with SAH increased from 15,291 to 29,318 (an increase by 92%) in males, from 29,911 to 44,687 (an increase by 52%) in females, from 27,736 to 41,189 (an increase by 54%) under the age of 50, and under the age of 70 years, it increased from 43,502 to 69,294 (an increase by 59%) (bottom row)

the following decade to 346,129 in 2010. After 2010, it showed a stable course (1.4% increase). The DALY rate decreased by 24.3% in 2000 to 324 per 100,000, then increased gradually (39.8% in total) to 463 per 100,000 in 2010 and remained stable in the following ten years (2%, 3 increments).

The number of patients diagnosed as having SAH was 7,849 in 1990, increasing by 75% in approximately thirty years to reach 13,719 in 2019. The increase in the number of SAHSAHs was higher in men than in women (116 vs 51%) and in those under 70 years of age than in those under 50 (59% vs 39%) (Figure 1a, bottom row). The rate of SAHSAH increased from 13.1 per 100,000 in 1990 to 16.9 per 100,000 in 2019, with a stable increase of 29%. The rate of increase was higher in men (from 9.4 to 15 per 100,000, 60% increase) than in women (from 16.9 to 18.7 per 100,000, 11% increase). While the incidence of SAH decreased slightly under the age of 50 (from 11.9 to 10.8 per 100,000, 9% decrease), an increase in frequency was observed above this age (Figure 1a, bottom row). The numerical prevalence of SAHSAH was 42,201 in 1990 and reached 74,005 in 2019 with a stable acceleration of 64%. The increase in prevalence was similar across gender and age groups (Figure 2a, bottom row). The rate of patients surviving SAH was 75.6 per 100,000 in 1990, with a slight but gradual increase (20.4% in total) to 91 per 100,000 in 2019. The increase was mainly seen in men (41.2%) and over the age of 50 (21%). While the rate of incidence of SAH was lower in women, there was a stable course under the age of 50 (Figure 2b, bottom row). It was noteworthy that while the frequency and rate of age-standardized SAH remained stable in men in the last 30 years, there was a marked decrease in women (Figure 3, bottom row). The number and rate of deaths caused by SAH remained at a fluctuating but stable level from 1990 to 2019 (the number of deaths from SAHSAH in 1990 was 994 people and the rate was 3.6 per 100,000, while it was 1,598 people and 3.8 in 2019. There were increases by 61% and 5.6%, respectively). Mortality rates

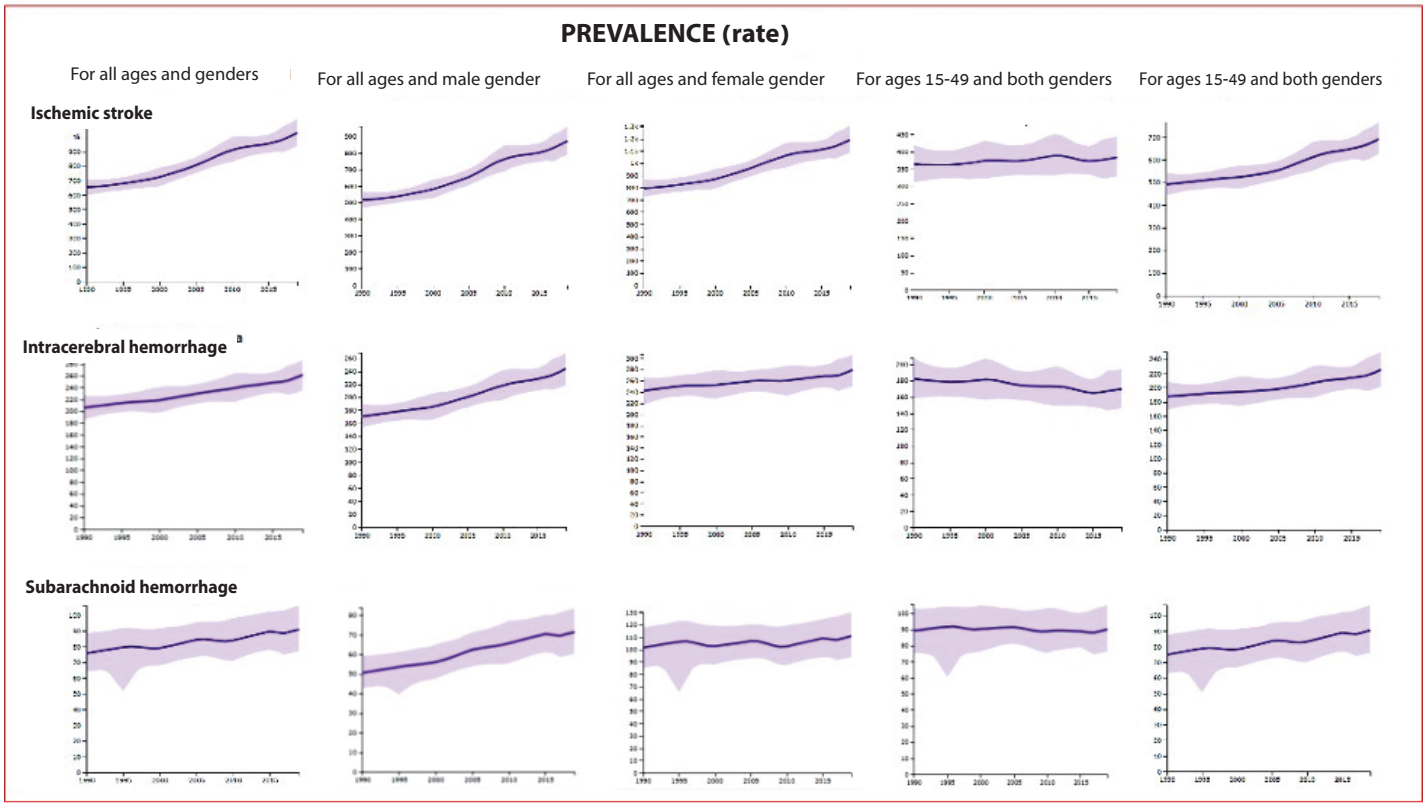

Figure 2b. Stroke prevalence: Course over the last 30 years

Ischemic stroke (IS): In our country, the rate of patients surviving after acute IS (AIS) increased from 653 per 100,000 in 1990 to 1.031 per 100,000 in 2019, with a total increase by 57.9%. In the same period, the rate of patients diagnosed as having AIS increased more in males (from 516 to 873 per 100,000, an increase by 69.2%) than in females (from 795 to 1,192 per 100,000, an increase by 49.9%). While the prevalence of AIS under the age of 50 remained stable over time (fluctuating from 364 to 384 per 100,000, an increase by 5.5%), there was a net increase under the age of 70 (from 491 to 692 per 100,000, an increase by 40.9%) (top row)

Intracranial hemorrhage (ICH): In Turkey, the rate of patients surviving after ICH increased from 206 per 100,000 in 1990 to 262 per 100,000 in 2019 with a stable accelerated increase by 27%. In the same period, the rate of patients diagnosed as having ICH (per hundred thousand) increased more in males [from 170 to 244 (an increase by 44%)] than in females [from 242 to 279 (an increase by 15%)]. The prevalence of ICH under the age of 50 showed a slight decreasing trend over time [from 182 to 170 (a decrease by 6.6%)], whereas under the age of 70, there was an increasing trend in the last 15 years [from 188 to 225, (an increase by 20%)] (middle row)

Subarachnoid hemorrhage (SAH): In our country, the rate of patients surviving after SAH in 1990 increased from 75.6 per 100,000 to 91 per 100,000 in 2019 with a total and fluctuating increase by 20.4%. In the same period, the rate of patients diagnosed as having SAH (per hundred thousand) increased more in males [from 50.5 to 71.3 (an increase by 41.2%)] than females [from 101.5 to 111 (an increase by 9.4%)]. The prevalence of SAH under the age of 50 did not change significantly over time [from 89.3 to 90.2 (0.9% change)], while there was a fluctuating increase under the age of 70 [from 74.8 to 90.5, (an increase by 21%)] (bottom row)

did not differ according to age and gender. The number of life years lost due to death and disability due to SAH increased from 74,248 in 1990 to 91,192 in 2019, an increase of 23%. However, the DALY loss rate was 124.2 per 100,000 in 1990, decreasing by 9.7% to 112.1 per 100,000 in 2019.

Validity and Compliance

In the field study conducted in Denizli in 2010-2011, the prevalence of stroke was found to be 0.9% (0.68% in men, 1.21% in women) (9). For the same time period, the prevalence in the GBD system in 2010 was 1.24% in general, 1.06% in men, 1.41% in women, and in 2011, the prevalence was 1.25% in general, 1.08% in men and 1.43% in women. In a field study conducted in Istanbul in 2013, the prevalence of stroke over the age of 18 was found to be 1.7% (10). With the "GBD" method, the prevalence of stroke was found to be 1.12% for the same age group in the same period. In a field study conducted in Karabük in 2014, the prevalence of stroke over the age of 44 was found to be 4.12% (11). This is lower than the value that can be calculated from the GBD site (10.3%). In a field study conducted in Akcakoca (Duzce) rural area in 2017, the prevalence of stroke was determined as 2.2% over the age of 44, which was higher than the GBD estimate (1.32%) (12).

Studies on the incidence of stroke are few in our country. In the field study conducted in Isparta between 1993-1997, the incidence of stroke was given as 151 per 100,000 (13,14). In 2019,

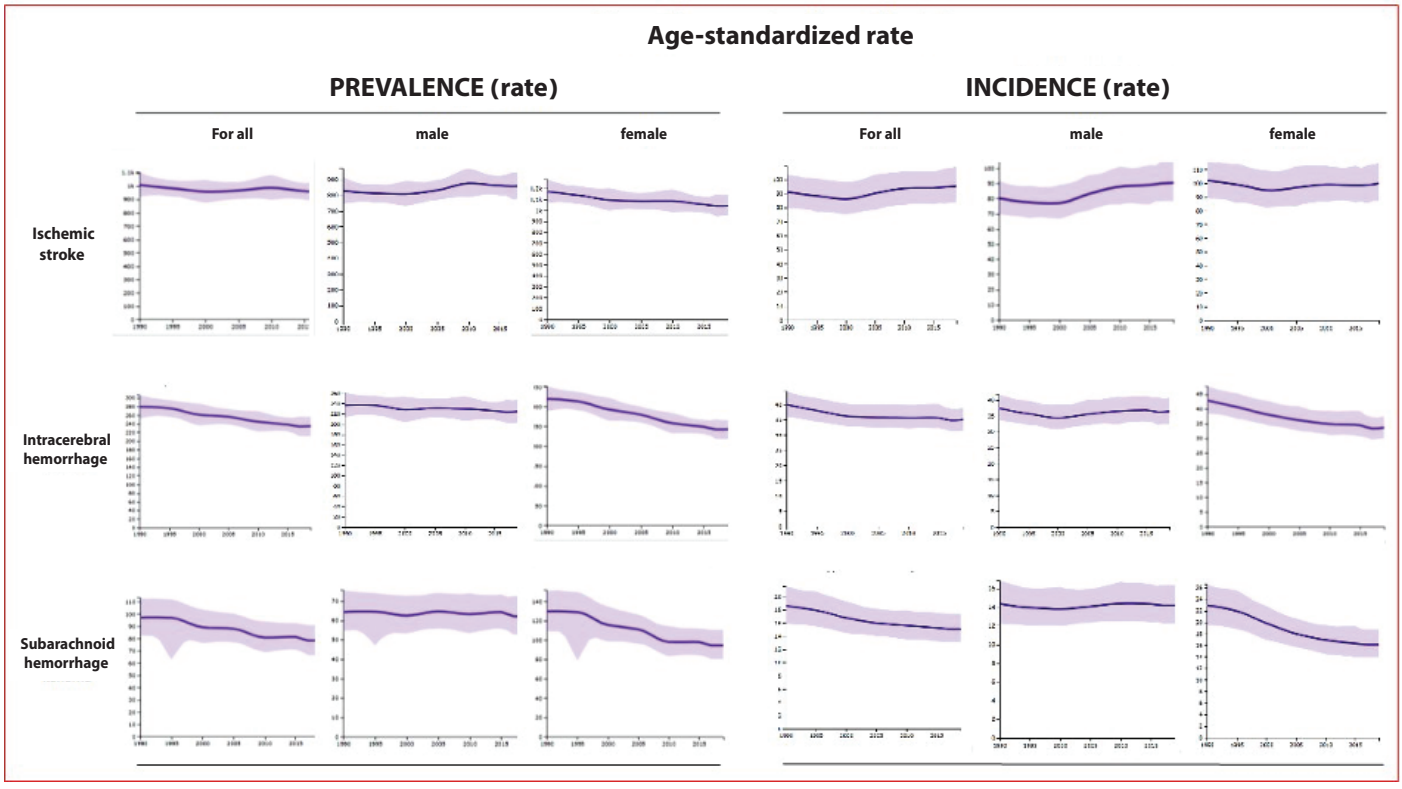

Figure 3. Age-standardized stroke incidence and prevalence: Course over 30 years

Ischemic stroke (IS): While the age-standardized acute ischemic stroke (AIS) prevalence in our country was 1.009 per 100,000 in 1990, it decreased to 956 per 100,000 in 2019 with a total decrease by 5.4%. In other words, there was a stable course in the last 30 years. There was a net decrease in females (from 1,173 to 1,043 per 100,000, a decrease by 11.1%), while there was a slight increase in males (from 829 to 861 per 100,000, an increase by 3.9%). [Top row, half right]. The age-standardized incidence of AIS varied slightly from 1990 to 2019, but generally remained stable (from 91 to 95 per 100,000, an increase by 4.4%). Incidence decreased slightly in females (from 102 to 100 per 100,000, a decrease by 2.1%), while in males, it increased clearly (from 80 to 90 per 100,000, an increase by 12.5%) (top row, left half)

Intracerebral hemorrhage (ICH): While the age-standardized ICH prevalence (per 100,000) was 279 in 1990 in our country, it decreased to 235 with a decrease by 16% in 2019. The decrease in prevalence was evident in females. There was a decrease by 24% in females from 320 to 243 versus a decrease by 5% in males from 237 to 225 [Middle row, right half]. The age-standardized incidence of ICH (per 100,000) tended to decline from 1990 to 2019 (a decrease by 12.5%, from 40 to 35). The reason for this was considered to be the apparent decline in females. There was a decrease by approximately 21.5% from 42.8 to 33.6 per hundred thousand in females, while there was a decrease by approximately 2.4% from 37.4 to 36.5 or a relatively stable course in males (middle row, left half)

Subarachnoid hemorrhage (SAH): While the prevalence of age-standardized SAH (per hundred thousand) was 97.1% in 1990 in our country, it decreased to 78.4% in 2019 with a decrease by 19.3%. The decrease in prevalence was significant in females (a decrease by 27.2%, from 129.7 to 94.5 in females versus a decrease by 3.4% from 64.3 to 62.1 in males) [Bottom row, right half]. The age-standardized incidence of SAH (per 100,000) tended to decrease from 1990 to 2019 (a decrease by 18.8% from 18.6 to 15.1). The reason for this was the decrease in prevalence in females (from 22.9 to 16.1 in females, a decrease by 29.7%) (from 14.3 to 14.2 in males, a stable course) (bottom row, left half)

the incidence of stroke in Cankiri was found to be 124 per 100,000 in a hospital-based study. The estimation of GBD for the same period was 154 per 100,000, which was higher (15). However, the rate of IS/hemorrhagic stroke was 4.6 times higher in Cankiri than the estimation of GBD (15). In 2015-2016, the incidence of stroke in Ardahan was reported as 199 per 100,000. In this hospital-based extrapolation, the incidence of ISIS was calculated as 142 per 100,000 and the incidence of hemorrhagic stroke as 41 per 100,000 (16). The stroke incidence calculated for Turkey from the GBD database was 141 (129-154) per 100,000 in 2015 and 143 (131-156) per 100,000 in 2016, which was lower than this value. The same is true for ISIS [90 (79-102) per 100,000 in GBD 2015 and 92 (81-105) per 100,000 in GBD 2016] and for hemorrhagic stroke [35 (31-39) per 100,000 in GBD 2015 and 2016, similarly].

As a result, the estimates made from the GBD system show some differences compared to the epidemiological data published in Turkey. Compared to the GBD estimate for Turkey in general, the prevalence of stroke is lower in Denizli central (9) and Karabuk central (11) regions, while it is higher in Istanbul rural (10), Akcakoca rural (12), and Ardahan central (16) regions. The incidence of stroke is higher in Cankırı (15). These differences are likely to be a reflection of geographical differences.

Mortality statistics of the Turkish Statistical Institute (TUIK) presented lower values than GBD estimates. According to TUIK data, the number of deaths from cerebrovascular events was 38,099

(9% of all deaths) in 2017, while the GBD estimate was 48,776 (95% uncertainty range-BA: 40,961-56,937) (17). In 2018, TUIK reported 36,280 (8.6% of all deaths) deaths from cerebrovascular events, while the GBD estimate was 48,415 (95% CI: 39,647-57,765) (17). In 2019, TUIK reported the number of deaths due to cerebrovascular events as 36,706 (8.4% of all deaths), while the GBD estimate was 48,947 (95% CI: 39,204-59.511) (18). Identification problems may have contributed to this difference.

Conclusion

Based on the current population characteristics in Turkey, it is inevitable that acute stroke will continue to be an important public health problem. Acute stroke management should be improved; however, stroke prevention is a more important priority. Achieving this can only be possible with the widespread use of measures and lifestyle changes for vascular health. It is clear that the place to start this is with realistic epidemiological data. In this article, we present the most basic epidemiological view of Turkey from the GBD research page. We think that this data is a useful guide until the epidemiological studies that will be conducted directly in the field are published.

Ethics

Peer-review: Externally and internally peer-reviewed.

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