Epidemiology of stroke in the last decade: a systematic review

Francisco Purroy, Nuria Montalà

Introduction. Cerebrovascular disease (CVD) is responsible for the majority of disability-adjusted life years and is a leading cause of mortality. This impact justifies having up-to-date data on its incidence.

Patients and methods. We conducted a systematic review of the studies published since 2010 that provided information on the crude incidence rate (CIR) and adjusted incidence rate of CVD during the second decade of the 21st century.

Results. Thirty-five articles were identified. Twenty-eight provided information on the overall incidence of CVD, 19 on the incidence of ischaemic stroke (IS), 19 on the incidence of haemorrhagic stroke (HS) and 10 on the incidence of subarachnoid haemorrhage (SAH). The incidence was heterogeneous across countries. Thus, the median CIR was 149.5 – confidence interval 95% (CI 95%): 122-256 – cases per 100,000 inhabitants for CVD; 155 (CI 95%: 95.6-246.12) for SI; 29 (CI 95%: 19-43) for HS; and 6.5 (CI 95%: 4.8-13.5) for SAH. The incidence for both CVD and IS and HS was higher in men than in women in most studies, with the exception of some Asian, European and North American studies. The majority of studies showed a decreasing or stabilising trend in incidence, with the exception of studies conducted in China, Singapore, France and Australia.

Conclusion. There are few studies that analyse the incidence of CVD and even fewer that analyse its evolution. The overall median remains high, although the figures are heterogeneous across studies. Worldwide the trend is towards its decrease, and there are geographical areas, especially in Asia, with an alarming upward trend.

Key words. Cerebrovascular disease. Haemorrhagic stroke. Incidence. Ischaemic stroke. Subarachnoid haemorrhage. Systematic review.

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Introduction

Cerebrovascular disease (CVD) is responsible for the majority of disability-adjusted life years and is a leading cause of mortality [1]. In 2016, CVD was directly responsible for approximately 5.5 million deaths and the loss of 116.4 million years of quality of life [1], which had a significant impact on the economy [2]. Advances in secondary prevention and the reduction in premorbid risk factors [3,4], such as smoking and high blood pressure [5], could lead to a decrease in the incidence of CVD. However, the rise in life expectancy in these countries and the increase in obesity [6] and diabetes mellitus [7] could reverse this trend. Data from population-based observational studies, such as that conducted in Oxfordshire, estimate that there will be a 13% increase in the number of first strokes in the UK by 2045 despite a drop in the incidence between the last decade of the 20th century and the first of the 21st [8]. In addition, the development of the stroke code and the advent of thrombectomy have reduced the mortality of patients with ischaemic stroke, with the consequent increase in the prevalence of stroke [9]. During the early 21st century, the incidence of haemorrhagic stroke has probably risen due to the increase in anti-thrombotic treatment in elder people with atrial fibrillation. In Latin America, the incidence of stroke is significant, as shown in the document resulting from the first Latin American ministerial meeting on stroke, held in Gramado, Brazil [10]. According to this document, 600,000 new cases of the disease were registered in 2017 in the 13 Latin American countries participating in the meeting. In the Latin American and Caribbean area, the absolute number of new stroke cases increased significantly over the period between 1990 and 2019. The figure rose from 467,634 cases in 1990 to 708,355 cases in 2019 [11].

The impact of CVD justifies the need for up-to-date data on the incidence of the disease. Such information makes it easier to design primary, sec-

ondary and tertiary prevention strategies aimed at reducing its impact. We conducted a systematic review of the incidence of CVD along with its trend between 2010 and 2020.

Patients and methods

A systematic search was carried out following the PRISMA recommendations. The search was performed in PubMed to look for articles of interest using the terms '*stroke*' and '*incidence*' and was limited to the period from 2010 to the present, including the last article from December 2020. Articles not written in English or Spanish were excluded. The abstracts of all the articles identified in the aforementioned search were reviewed by the two authors (F.P. and N.M.). Both authors then reviewed the full text of the selected articles. Population-based studies were included in the review if they: a) followed the definition of stroke according to the World Health Organisation diagnostic criteria; b) comprised incident cases, including first strokes; c) included cases after 31 December 2009; and d) established a well-defined study population. We excluded studies that pooled data from more than 10 years without being able to obtain individual data from time periods after 2005. Crude incidence rate (CIR) and adjusted incidence rate (AIR) data were collected for ischaemic stroke (IS), haemorrhagic stroke (HS), subarachnoid haemorrhage (SAH) and all forms of stroke.

Statistical analysis

The median CIR for CVD and for each subtype of stroke, and the percentage difference in CIR between men and women were determined. The results were presented with a 95% confidence interval (CI 95%). Differences between continents and/or regions were analysed using non-parametric tests. Values of $p < 0.05$ were considered statistically significant. SPSS version 24 was used for the statistical analysis. In addition, Graph Pad Prism version 8 and Keynote software were used for the graphical presentation of the results.

Results

A total of 54,668 articles were identified. After an initial selection, 602 of them were registered. Then, after checking in the abstract that they were studies on the incidence of CVD, the full text of 203 studies was examined. Finally, 35 articles were included, 28 of which provided information on the overall incidence of CVD, 19 on IS incidence, 19 on HS incidence and 10 on SAH incidence.

Cerebrovascular disease incidence

As shown in Table I and Figure 1a, the CIR of CVD ranged from 60 cases per 100,000 inhabitants in Saudi Arabia [13] to 786 in Cuba, in a study that only included people aged ≥ 65 years [20]; the median was 149.5 (CI 95%: 122-256). The continent with the most studies was Europe with ten, followed by Asia with nine. Interestingly, there was one Spanish study [23] and three conducted in Latin America [14,16,20]. The Caribbean region had the highest CIR –median: 466.4 (CI 95%: 146-786.2)–, followed by Europe –median: 199.5 (CI 95%: 198-256)–; $p = 0.088$. Studies conducted in African countries had the lowest CIR –median: 95.5 (CI 95%: 60.7-130.3)–. Twenty-four studies calculated the AIR: 7 for the standardised European population, 11 for the global population and 6 for the Segi standard world population. In terms of the AIR, European countries had higher incidences, although the differences were not statistically significant. Overall, the CIR was lower among women, with a median of less than 15.4% (CI 95%: 0.5-28.2%) (Fig. 2a). Studies in certain countries such as China [17], France [24,25], the United States [22] and Portugal [36] observed an inverse relationship, with a higher CIR in women. Eleven studies provided information on the evolution of the CIR. Thus, as shown in Figure 3a, studies from China [17-19], Australia [15] and France [24] showed an increasing trend in the CIR. In contrast, studies in Denmark [21], the United Kingdom [37] and the United States [40] reflected a downward trend.

Incidence of ischaemic strokes

As can be seen in Table II, 19 studies provided information on the CIR of ischaemic strokes. The continent where most studies had been conducted was Asia, with 11. The CIR ranged from 31 cases per 100,000 inhabitants in Nigeria [34] to 474 cases per 100,000 inhabitants in Greece [26]. The median CIR across all the studies was 155 (CI 95%: 95.6-246.12) cases per 100,000 inhabitants. European studies had the highest CIR: 314.5 (CI 95%: 216-453) (Fig. 1b). As in CVD (Fig. 2b), women had a lower CIR than men and a lower median: 26.7% (CI 95%: –4.8-35.6). Two Spanish studies [23,42] and

Table I. Studies providing information on the incidence of cerebrovascular disease.

	Study	Period of analysis	Age at inclusion	Sample of cases	Raw incidence of men	Raw incidence of women	Total raw incidence	Standard population	Standardised incidence of men	Standardised incidence of women	Total standardised incidence
Algeria	Bezzaoucha et al, 2020 [12]	2018	≥ 25 years old	828	143.6	116.9	130.3	–	–	–	–
Argentina	Bahit et al, 2016 [14]	2013-2015	All	334	–	–	127.9 (114.5-142.4)	Segi	–	–	114.7 (102.4-128.1)
Australia	Anderlini et al, 2020 [15]	2002	All	3.193	89 (85-93)	86 (82-90)	87 (84-90)	WHO	65 (62-68)	51 (48-53)	58 (56-60)
		2010	All	4.534	111 (106-115)	95 (91-99)	103 (100-106)	WHO	75 (72-78)	54 (52-56)	64 (62-66)
		2015	All	5.153	117 (113-121)	99 (95-103)	108 (105-111)	WHO	79 (76-82)	57 (54-59)	67 (66-69)
Brazil	Cabral et al, 2016 [16]	1995	All	320	96.4 (83.2-111.6)	70 (59.4-83.8)	83.5 (74.6-93.1)	Segi	183.5 (158-211.9)	111.3 (93.3-131.7)	143.7 (128.4-160.3)
		2005-2006	All	759	80.2 (72.5-88.5)	73.5 (66.2-81.4)	76.9 (71.6-82.6)	Segi	134.1 (121.2-148.1)	85.8 (77.2-95)	105.4 (98-113.2)
		2012-2013	All	922	88.6 (80.8-97)	83.3 (75.8-91.4)	85.9 (80.4-91.6)	Segi	107.1 (97.7-117.2)	77.2 (70.2-84.6)	90.9 (85.1-96.9)
China	Wang et al 2016 [17]	1992	All	–	118	77.9	98	–	–	–	–
		2004	All	–	250.6	196.4	220.1	–	–	–	–
		2014	All	–	280	308.8	297.4	–	–	–	–
	Jiang et al, 2016 [18]	1992	All	–	154.5	103.4	128.6	–	–	–	–
		2000	All	–	293.1	200.3	245.3	–	–	–	–
		2004	All	–	275.8	157.5	214.8	–	–	–	–
		2010	All	–	378	249.7	317	–	–	–	–
	Sun et al, 2014 [19]	2005	All	231	259.6 (215.4-303.8)	196.2 (157.6-234.8)	228 (198.6-254.5)	Segi	178.3 (141.6-215)	143 (110-176)	159.1 (134.6-183.6)
		2008	All	254	290 (243.3-336.7)	211.1 (171-251.2)	250.8 (220-281.6)	Segi	192.2 (154.2-230.2)	148.4 (114.7-182.1)	170 (144.6-195.4)
		2011	All	274	309.3 (261.3-357.3)	222.9 (182.2-263.6)	266.1 (234-297.6)	Segi	199.6 (161-238.2)	164.4 (129.4-199.4)	
Cuba	Libre-Guerra et al, 2015 [20]	2008-2011	≥ 65 years old	82	1.080 (790-1.480)	590 (440-790)	786.2 (672.3-906.4),	–	–	–	–
Denmark	Yafasoa et al, 2019 [21]	1996-1998	≥ 18 years old	30.521	–	–	270 (265-276)	Danish population in 2016	–	–	–
		2002-2004	≥ 18 years old	36.127	–	–	325 (320-331)	Danish population in 2016	–	–	–

Table I. Studies providing information on the incidence of cerebrovascular disease *(cont.)*.

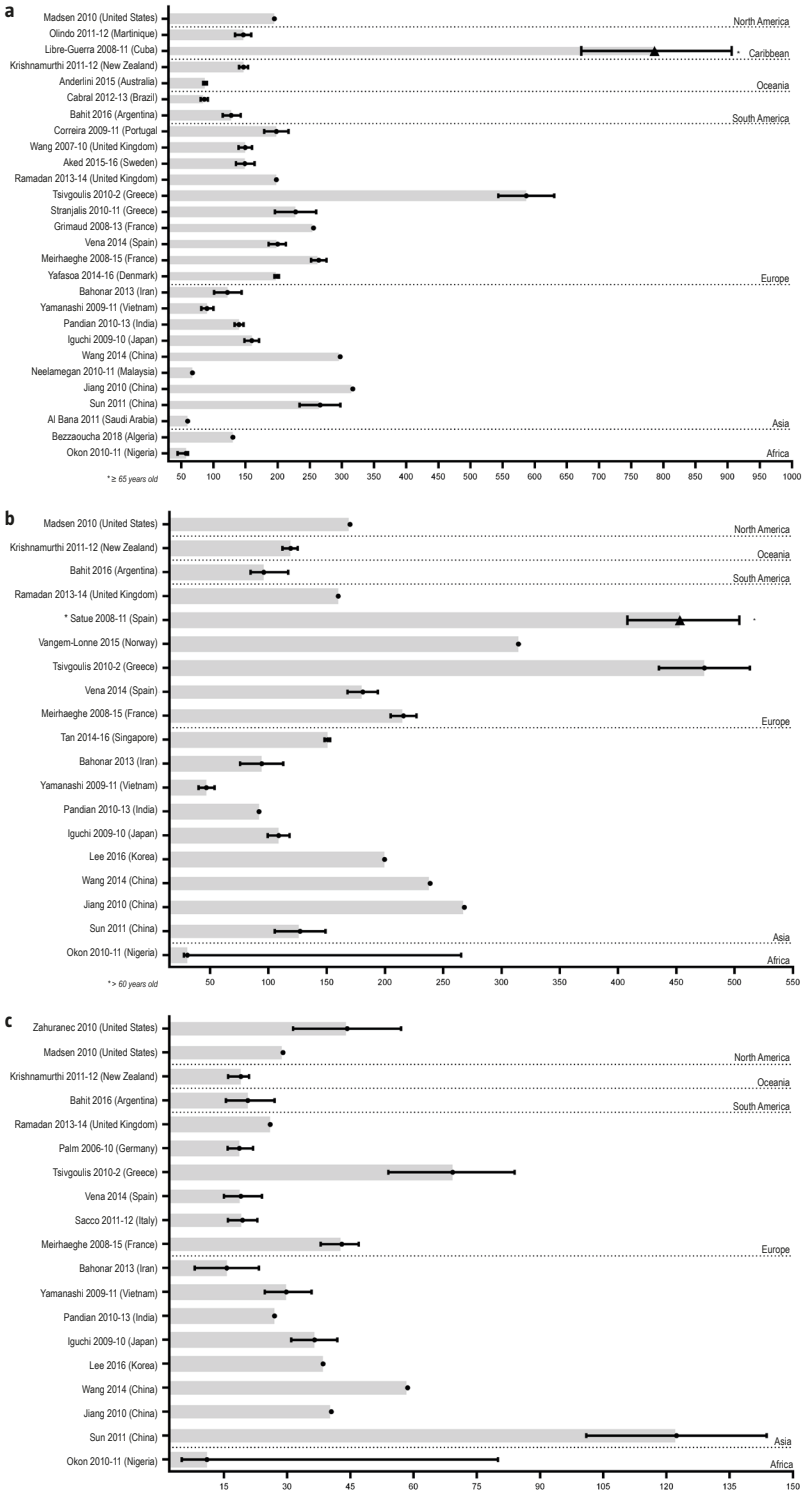
	Study	Period of analysis	Age at inclusion	Sample of cases	Raw incidence of men	Raw incidence of women	Total raw incidence	Standard population	Standardised incidence of men	Standardised incidence of women	Total standardised incidence
Denmark	Yafasoa et al, 2019 [21]	2014-2016	≥ 18 years old	29.941	–	–	199 (195-202)	Danish population in 2016	–	–	–
England	Ramadan et al, 2018 [29]	2013-2014	≥ 18 years old	541	–	–	198	WHO	–	–	166
France	Grimaud et al, 2019 [24]	2008-2013	≥ 25 years old	3.854	254.6	260	256	European population in 2013	–	–	267 (259-276)
	Meirhaeghe et al, 2018 [25]	2008-2015	≥ 35 years old	1.917	257 (240-275)	270 (254-286)	264 (252-276)	Standardised European population; WHO	264 (246-282); 231 (215-247)	174 (162-186); 145 (135-156)	214 (204-224); 184 (174-193)
Greece	Tsivgoulis et al, 2018 [26]	2010-2012	≥ 18 years old	703	618.7 (555.8-717)	554.8 (495.1-614.5)	586.8 (543.4–630.2)	Standardised European population; WHO; Segi	618.7 (555.8-681.7); 650.8 (584.6-717); 364.1 (327.1-401.2); 335.7 (301.6-369.9)	554.8 (495.1-614.5); 431.6 (385.1-478); 212.4 (189.6-235.3); 185.6 (165.7-205.6)	534.1 (494.6–573.6); 285 (189.6–235.3); 257.9 (238.8-277)
	Stranjalis et al, 2014 [27]	2010-2011	All	197	262.9 (214-312)	193.9 (153-235)	227.9 (196–260)	Standardised European population	148 (119-181)	86 (65-110)	117 (99-136)
			All	197	–	–	–	WHO	–	–	86 (73-101)
			All	197	–	–	–	Segi	–	..	74 (62-88)
India	Pandian et al, 2016 [28]	2010-2013	≥ 18 years old	1.491	162	115	140 (133-147)	WHO	151 (141-161)	106 (97-115)	130 (123-137)
Iran	Bahomar et al, 2017 [30]	2003	All	2.556	152.6 (128.9-175.6)	167.4 (143.7-191.1)	159.8 (135.8-183.8)	Segi	298 (268.5-327.6)	167.4 (143.7-191.1)	229.8 (201.5-258.2)
		2009	All	1.533	86.8 (69.5-104.1)	77.8 (61.4-94.1)	86.4 (68.7-104.1)	Segi	138.2 (117.2-159.1)	101.7 (83.4-120.1)	111.3 (91.4-131.2)
		2013	All	2.283	125 (104.3-145.7)	118.9 (98.7-139.1)	122 (101-143.9)	Segi	187.3 (162.7-212)	138.8 (117.2-160.4)	142.9 (120.2-165.6)
Japan	Iguchi et al, 2013 [32]	2009-2010	All	758	–	–	159.8 (148.4-171.1)	Segi	–	–	60.7 (45.4-75.9)
		2009-2010	All	758	–	–	–	Standardised European population	–	–	91.2 (72.5-109.9)
Malaysia	Neelamegam et al, 2013 [33]	2010-2011	All	174	73.6	60.3	67.4	–	–	–	–
Martinique	Olindo et al, 2014 [31]	1998-1999	All	580	165.8 (146-186)	154.9 (138-182)	160.1 (149-172)	WHO	122 (107-137)	104 (92-116)	111 (102-120)
		2011-2012	All	544	171.2 (152-190)	125.7 (110-141)	146.6 (134-159)	WHO	90 (79-101)	69 (60-78)	77 (70-84)
New Zealand	Krishnamurthi et al, 2018 [35]	2011-2012	≥ 15 years old	1643	148 (137-158)	146 (136-156)	147 (140-154)	WHO	129 (120-138)	115 (107-123)	122 (116-128)

Table I. Studies providing information on the incidence of cerebrovascular disease *(cont.)*.

	Study	Period of analysis	Age at inclusion	Sample of cases	Raw incidence of men	Raw incidence of women	Total raw incidence	Standard population	Standardised incidence of men	Standardised incidence of women	Total standardised incidence
Nigeria	Okon et al, 2015 [34]	2010-2011	All	298	75 (23-145)	46.4 (13.8-136.7)	60.7 (298- 491)	WHO	–	–	60.7
Portugal	Correia et al, 2017 [36]	1998-2000	All	261	235 (200-270)	244 (260-328)	269 (244-293)	Standardised European population	179 (148-209)	167 (141-193)	173 (153-192)
		2009-2011	All	203	196 (168-225)	200 (173-226)	198 (179-217)	Standardised European population	160 (134-185	107 (88-127)	130 (114-146)
Saudi Arabia	Al Banna et al, 2015 [13]	2011	≥ 16 years old	521	–	–	60	–	–	–	–
Spain	Vena et al, 2020 [23]	2010	All	888	234 (214-254)	169 (151-186)	202 (189-215)	WHO	131 (119-143)	74 (65-83)	100 (93-108)
		2011	All	854	226 (207-246)	159 (142-175)	193 (180-206)	WHO	130 (118-142)	68 (60-77)	98 (91-105)
		2012	All	852	230 (211-250)	153 (137-170)	192 (179-205)	WHO	127 (116-139)	62 (54-70)	93 (86-100)
		2013	All	929	251 (230-271)	169.5 (152-187)	211 (197-224)	WHO	141 (129-154)	70 (61-79)	104 (96-111)
		2014	All	874	244 (223-264)	154 (138-171)	200 (186-213)	WHO	137 (125-149)	62 (54-70)	98 (90-105)
Sweden	Aked et al, 2018 [38]	2001-2002	≥ 15 years old	456	220 (193-249)	169 (146-195)	194 (176-213)	Standardised European population	321 (283-363)	185 (160-213)	253 (230-277)
		2015-2016	≥ 15 years old	413	162 (141-185)	137 (118-158)	149 (135-164)	Standardised European population	199 (174-227)	136 (117-157)	167 (151-184)
United Kingdom	Wang et al, 2013 [37]	1995-1998	All	1.303	277.3 (254.4-302.2)	217.5 (201.2-234.9)	247 (233.5-261.2)	–	–	–	–
		1999-2002	All	1.072	235.5 (214.9-258)	186.6 (171.1-203.3)	211.7 (199-225.1)	–	–	–	–
		2003-2006	All	994	207.9 (189.8-227.7)	145.5 (132.3-159.7)	175.3 (164.3-186.8)	–	–	–	–
		2007-2010	All	876	158 (142.4-175.1)	138.6 (125.8-152.4)	149.5 (139.4-160.1)	–	–	–	–
United States	Madsen et al, 2020 [22]	1993-1994	≥ 20 years old	1.916	263 (246-281)	217 (205-230)	–	–	–	–	–
		1999	≥ 20 years old	1.995	269 (251-286)	241 (228-254)	–	–	–	–	–
		2005	≥ 20 years old	1.858	228 (214-244)	189 (178-201)	–	–	–	–	–
		2010	≥ 20 years old	1.941	192 (179-205)	198 (187-210)	–	–	–	–	–
Vietnam	Yamanashi et al, 2016 [39]	2009-2011	All	190	–	–	90.2 (81.1-100.2)	WHO	104.9 (90.8-120.5)	77 (65.4-90.1)	115.7 (95.9-139.1)

WHO: standard population of the World Health Organisation.

Figure 1. Representation of the crude incidence rates: a) Cerebrovascular disease; b) Ischaemic stroke; c) Haemorrhagic stroke; d) Subarachnoid haemorrhage.



one South American study [14] were identified. In the Spanish study conducted by Vena et al, which included subjects of all ages, the CIR during the period 2010-2014 ranged from 171 (CI 95%: 159-184) to 191 (CI 95%: 178-204) [23], while in the study by Satue et al, which included subjects > 60 years of age, the CIR rose to 453 (CI 95%: 408-504) [42]. In both cases, the CIR was higher in men. The CIR was significantly lower in the Argentinian study conducted by Bahit et al (96.1 [CI 95%: 84.6-116.9]) [14].

In studies from China [17], France [25] and the United States [40], there was an inverse relationship with a higher CIR in women. Nine studies provided information on the evolution of the CIR over time (Fig. 3b). Both Chinese [17-19] and Singaporean studies [44] reflected an increase in the CIR (Fig. 3b), unlike those conducted on Korean [41] and US populations [40].

Incidence of haemorrhagic strokes

As Table III shows, 19 studies provided information on the CIR of haemorrhagic strokes, with a median CIR of 29 (CI 95%: 19-43) cases per 100,000 inhabitants. Asia and Europe were the continents with the most studies, with seven each (Fig. 1c). The Chinese study by Sun et al [19] had the highest CIR, with 122.4 cases per 100,000 inhabitants. The lowest incidence was detected in Nigeria [34], with 11 cases per 100,000 inhabitants. There were no significant differences between studies from different continents and regions (p = 0.315). The Asian and the US studies had the highest incidences (medians: 38.5 [CI 95%: 33.2-49.6] and 36 [CI 95%: 29-43], respectively). Women had a lower CIR than men (lower median: 26.5% [CI 95%: 10.338.4]) (Fig. 2c). However, three studies carried out in New Zealand [35], Italy [48] and Nigeria [34] reported higher rates in women. Only six studies provided inforrhagic strokes (Fig. 3c). Wang et al described an upward trend in the incidence in a rural area of China [17]. In contrast, in the same country, Jiang et al [18] published data on the decreasing trend in a metropolitan area, as in Korea [46] and the United States [22,47]. In Spain, Vena et al reported a stabilising trend after studying the CIR for five consecutive years, from 2010 to 2014 [23].

Incidence of subarachnoid haemorrhage

Ten studies were identified that determined the CIR of SAH (Table IV). Asia had the largest number of studies, with a total of four (Fig. 1d). The

median CIR was 6.5 (CI 95%: 4.8-13.5) cases per 100,000 inhabitants and ranged from 17.5 cases per 100,000 inhabitants in Greece [26] to 4 cases per 100,000 in Nigeria [34]. The CIR was higher among women. Sun et al in China [19], Madsen et al in the United States [40] and Bahonar et al in Iran [30] analysed the evolution of the disease, with different results. As in the other forms of CVD, Sun et al described a clear trend towards an increase in the CIR [19], in contrast to Madsen et al, who reported a decreasing trend [22]. The rising trend in the CIR described by Bahonar et al in Iran [30] was lower than that described by Sun et al in China [19].

Discussion

This review of the global incidence of CVD in the second decade of the 21st century shows significant differences from one country to another in the study, even within the same continent. Although CVD is a global problem associated with high disability and a high economic and social impact [2], few countries have published information on the CIR or the AIR, and fewer still provide information on trends over time. Among the different forms of CVD, SAH has the lowest number of identified studies. In our review, the country with the highest number of studies was China, and in terms of continents, Europe and Asia.

The variation in the incidence can be attributed to factors that are specific to each study design and to factors related to the population. As expected, studies that excluded subjects under 60 or 65 years of age reported a higher incidence [20,42]. In contrast to previous reviews [9], studies from countries with low per capita income had low CIRs [33,34]. This could be explained by the fact that patient registration is less comprehensive in these countries compared to others with higher per capita income [34] and to lower access to neuroimaging tests [33]. The higher incidence of HS observed in Asian countries can be accounted for by well-known racial and genetic reasons [49]. Another interesting finding is the diversity in the results of the studies carried out in European countries. The Greek study conducted by Tsivgoulis et al had the highest incidence for the CVD forms [26]. The characteristics of the population studied could justify the high figures, given that the study was carried out in an elderly rural population with a significant concentration of vascular risk factors [26].

Figure 1. Representation of the crude incidence rates: a) Cerebrovascular disease; b) Ischaemic stroke; c) Haemorrhagic stroke; d) Subarachnoid haemorrhage. *(cont.)*.

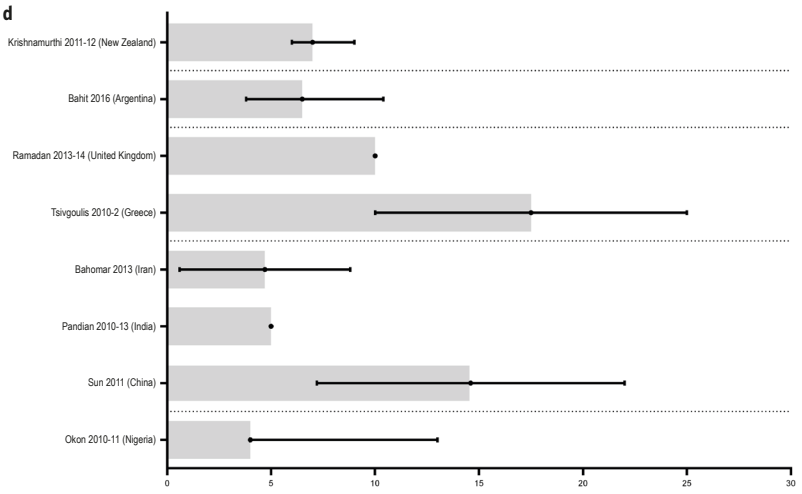


Figure 2. Representation of the crude incidence rates by gender: a) Cerebrovascular disease; b) Ischaemic stroke; c) Haemorrhagic stroke; d) Subarachnoid haemorrhage.

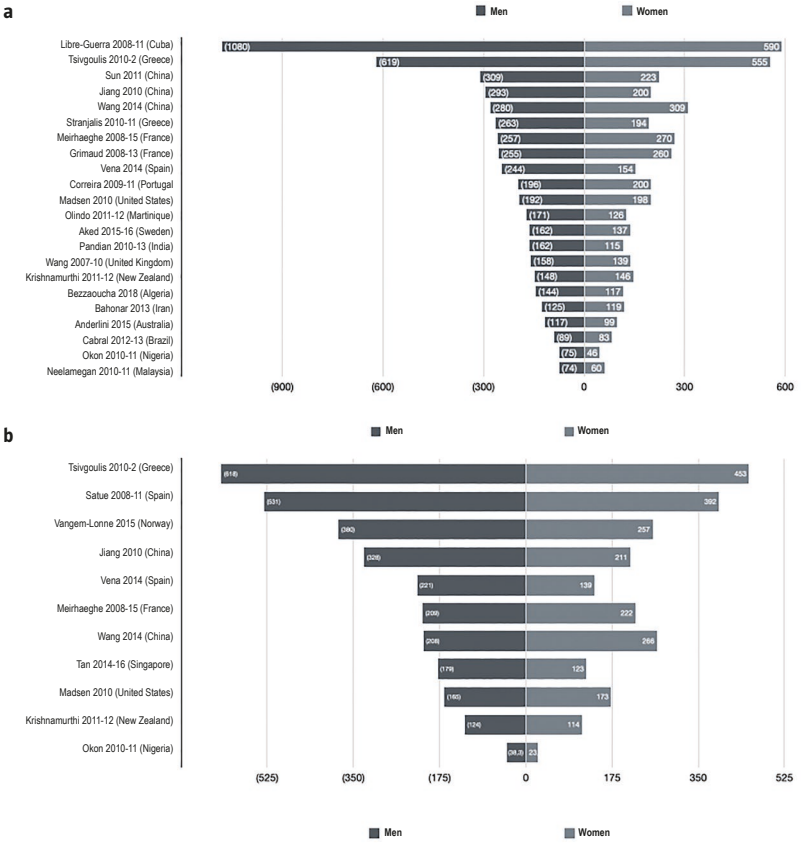
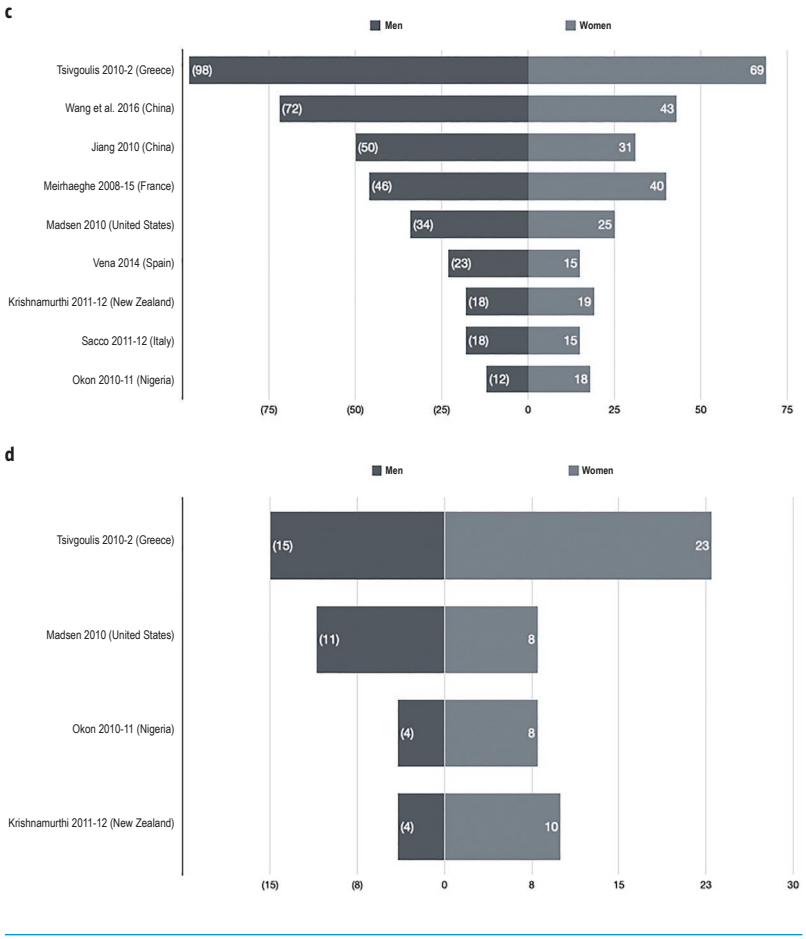


Figure 2. Representation of the crude incidence rates by gender: a) Cerebrovascular disease; b) Ischaemic stroke; c) Haemorrhagic stroke; d) Subarachnoid haemorrhage. *(cont.)*.



Overall, differences were observed in the CIR and AIR according to gender. There are known to be differences between men and women in the proportion of vascular risk factors and aetiology [50-52]. The higher concentration of vascular risk factors could explain the higher CIR and AIR both for CVD and for IS and HS in men observed in most of the studies analysed. However, Asian, European and North American studies reported a higher incidence of CVD [24,25,36,40,53] and IS [17,25,53] in women, but this was not the case with HS. This may be explained by the increased prevalence of vascular risk factors among women [53], especially the increase in hypertension with age [54] and by the longer life expectancy [55]. Hence, there are more women in the older age groups [23,40,55]. It is known that there is a higher incidence of SAH among women [26,34,35] although this difference is still to be explained [56].

Most studies reported a downward or stabilising trend in the incidence of CVD, IS, HS and SAH as a consequence of better control of vascular risk factors among the population [35,37]. However, the opposite trend was found in studies conducted in China [18,19,53], Singapore [44], France [24] and Australia [15]. In China, the increased incidence can be explained by the parallel increase in life expectancy and poor control of vascular risk factors [17-19], especially in rural areas [17]. Smoking, unhealthy diets and a decrease in physical activity seem to be causes for concern in that country [18]. The increased incidence was more notable for IS than for HS [18]. The French study conducted by Grimaud et al was designed to explore differences in the incidence of CVD between rural, urban and suburban areas rather than to analyse how the incidence progressed. The reasons given above, such as the increase in life expectancy, can be extrapolated mainly to justify the rising incidence [24,25]. In Australia, there was evidence of a greater increase in the incidence of IS versus HS [15], with an alarming increase in the young adult population.

Our systematic review has limitations that need to be mentioned. The methodologies used in the studies were heterogeneous and this could contribute to the difference in incidence from one territory to another. Above all, there was no homogeneity in the determination of the AIR. Although the results have been identified or classified by country, in most cases they are the result of a study of a particular region rather than from a national data source. For the calculation of the medians of the CI, the sample size in each study was not taken into account.

Conclusion

Despite the fact that CVD is a major global problem, there are few studies that analyse its incidence and even fewer that analyse its evolution. The overall median remains high, although the figures are heterogeneous across studies. In contrast to previous reviews from the first decade of the 21st century [57], we can state that the worldwide trend is towards a decrease in the incidence of the disease, probably as a result of a better control of vascular risk factors. Some geographical areas of the Asian continent have been identified with upward trends that are quite alarming.

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Figure 3. Time trend of the crude incidence rate: a) Cerebrovascular disease; b) Ischaemic stroke; c) Haemorrhagic stroke; d) Subarachnoid haemorrhage.

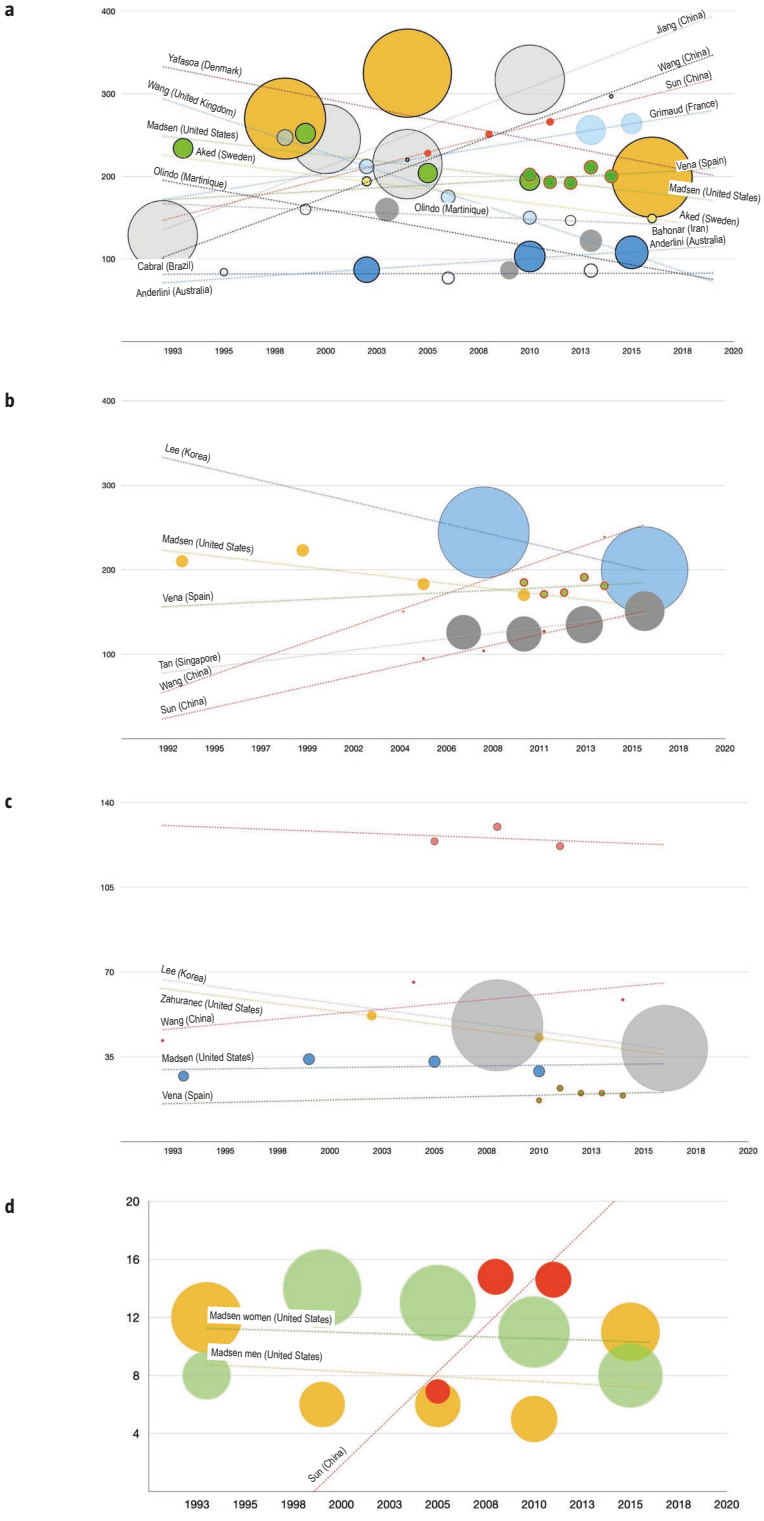

Table II. Studies providing information on the incidence of ischaemic strokes.

	Study	Period of analysis	Age at inclusion	Sample of cases	Raw incidence of men	Raw incidence of women	Total raw incidence	Standardised population	Standardised incidence of men	Standardised incidence of women	Total standardised incidence
Argentina	Bahit et al 2016 [14]	2013-2015	All	251	–	–	96.1 (84.6-116.9)	Segi	–	–	85.6 (75-97.1)
China	Wang et al 2016 [17]	1992	All	–	62.6	50.2	56.4	–	–	–	–
		2004	All	–	174.7	132.6	150.6	–	–	–	–
		2014	All	–	208.2	266	238.8	–	–	–	–
	Jiang et al 2016 [18]	1988	All	–	64.8	28.2	43.7	–	–	–	–
		2000	All	–	212.1	142.3	176.2	–	–	–	–
		2010	All	–	327.6	211	268.1	–	–	–	–
	Sun et al 2014 [19]	2005	All	92	–	–	94.8 (75.8-113.8)	Segi	–	–	66.2 (50.4-82)
		2008	All	104	–	–	103.7 (83.9-123.5)	Segi	–	–	69.3 (53.1-85.5)
		2011	All	130	–	–	127.2 (105.4-149)	Segi	–	–	84.6 (66.8-102.4)
England	Ramadan et al 2018 [29]	2013-2014	≥ 18 years old	421	–	–	160		–	–	–
France	Meirhaeghe et al 2018 [25]	2008-2015	≥ 35 years old	1.562	209 (193-224)	222 (207-237)	216 (205-227)				
Greece	Tsivgoulis et al 2018 [26]	2010-2012	≥ 18 years old	568	617.8 (548-688)	452.9 (399-507)	474.1 (435-513)	Standardised European population; WHO; Segi	525.6 (465.8-585.4); 282.4 (250.3-314.6); 259.3 (229.8-288.8)	342.4 (301.6-383.1); 164.4 (144.8-184); 142.3 (125.3-159.2)	425.9 (390.9-460.9); 220.5 (202.3-238.6); 198.7 (182.4-215)
India	Pandian et al 2016 [28]	2010-2013	≥ 18 years old	976	–	–	92	WHO	–	–	85 (80-90)
Iran	Bahomar et al 2017 [30]	2003	All	–	–	–	108.6 (88.8-128.4)	Segi	–	–	157 (133.6-180.4)
		2009	All	–	–	–	69.1 (53.3-84.9)	Segi	–	–	89.6 (71.7-107.5)
		2013	All	–	–	–	94.2 (75.7-112.7)	Segi	–	–	110.7 (90.7-130.7)
Japan	Iguchi et al 2013 [32]	2009-2010	All	516	–	–	108.8 (99.4-118.1)	Segi	–	–	38.4 (26.3-50.5)
		2009-2010	All	516	–	–	–	Standardised European population			59.2 (44.2-74.3)
Korea	Lee et al 2020 [41]	2008	–	92.691	–	–	244.2	–	–	–	–
		2016	–	83.939	–	–	199.6	–	–	–	–

Table II. Studies providing information on the incidence of ischaemic strokes *(cont.)*.

	Study	Period of analysis	Age at inclusion	Sample of cases	Raw incidence of men	Raw incidence of women	Total raw incidence	Standardised population	Standardised incidence of men	Standardised incidence of women	Total standardised incidence
New Zealand	Krishnamurthi et al 2018 [35]	2011-2012	≥ 15 years old	1.329	124 (114-133)	114 (106-123)	119 (112-125)	WHO	108 (100-116)	87 (81-95)	97 (92-103)
Nigeria	Okon et al 2015 [34]	2010-2011	All	152	38.3 (32.6-414.7)	23.6 (24.1-234.3)	30.5 (47.5-265.3)	–	–	–	–
Norway	Vangen-Lønne et al 2015 [43]	1991-1995	≥ 30 years old	98	130.1	81.5	107.9	–	–	–	–
		1996-2000	≥ 30 years old	313	276.9	197.8	235.9	–	–	–	–
		2001-2005	≥ 30 years old	413	376.3	273.3	331	–	–	–	–
		2006-2010	≥ 30 years old	367	379.7	256.8	314.5	–	–	–	–
Singapore	Tan et al 2020 [44]	2005-2007	All	13.384	141 (138-144)	112 (109-115)	126 (124-129)	–	–	–	–
		2008-2010	All	13.866	140 (137-143)	109 (106-111)	124 (122-126)	–	–	–	–
		2011-2013	All	15.448	158 (155-161)	112 (110-115)	135 (133-137)	–	–	–	–
		2014-2016	All	17.627	179 (176-183)	123 (120-126)	151 (148-153)	–	–	–	–
Spain	Vena et al 2020 [23]	2010	All	813	217 (198-237)	151 (135-169)	185 (172-198)	WHO	120 (108-132)	64 (56-74)	90 (83-98)
		2011	All	758	200 (182-220)	142 (126-158)	171 (159-184)	WHO	114 (103-127)	60 (52.4-69)	86 (79-93)
		2012	All	765	208 (190-228)	136 (121-152)	173 (161-185)	WHO	114 (104-127)	55 (47-63)	83 (76-90)
		2013	All	842	229 (209-250)	152 (136-169)	191 (178-204)	WHO	128 (116-140)	60 (53-70)	92 (85-100)
		2014	All	791	221 (202-241)	139 (124-156)	181 (168-194)	WHO	122 (111-135)	54 (47-63)	86 (80-94)
	Satue et al 2016 [42]	2008-2011	>60 years old	343	531	392	453 (408-504)	–	–	–	–
United States	Madsen et al 2020 [22]	1993-1994	≥ 20 years old	1.693	238 (223-257)	193 (181-205)	–	–	–	–	–
		1999	≥ 20 years old	1.750	249 (232-266)	207 (195-219)	–	–	–	–	–
		2005	≥ 20 years old	1.653	207 (193-221)	168 (157-178)	–	–	–	–	–
		2010	≥ 20 years old	1.665	165 (153-177)	173 (162-184)	–	–	–	–	–
Vietnam	Yamanashi et al 2016 [39]	2009-2011	All	38	–	–	46.7 (40.1-53.9)	WHO	52.2 (42.4-63.5)	41.5 (33.1-51.4)	60.7 (46.7-78.4)

WHO: standard population of the World Health Organisation.

Table III. Studies providing information on the incidence of haemorrhagic strokes.

	Study	Period of analysis	Age at inclusion	Sample of cases	Raw incidence of men	Raw incidence of women	Total raw incidence	Standardised population	Standardised incidence of men	Standardised incidence of women	Total standardised incidence
Argentina	Bahit et al 2016 [14]	2013-2015	All	54	–	–	20.7 (15.5-27)	Segi	–	–	19.4 (14.4-25.4)
China	Wang et al 2016 [17]	1992	All	–	55.4	27.7	41.7	–	–	–	–
		2004	All	–	67.8	63.8	65.8	–	–	–	–
		2014	All	–	71.9	42.8	58.6	–	–	–	–
	Jiang et al 2016 [18]	1988	All	–	72	37.7	51.7	–	–	–	–
		2000	All	–	81	57.9	69.1	–	–	–	–
		2010	All	–	50.2	30.9	40.5	–	–	–	–
	Sun et al 2014 [19]	2005	All	123	–	–	124.4 (102.7-146.1)	Segi	–	–	86.7 (68.6-104.8)
		2008	All	132	–	–	130.4 (108.2-152.6)	Segi	–	–	88.6 (70.3-106.9)
		2011	All	125	–	–	122.4 (101-143.8)	Segi	–	–	83.8 (66.1-101.5)
England	Ramadan et al 2018 [29]	2013-2014	≥ 18 years old	70	–	–	26		–	–	–
France	Meirhaeghe et al 2018 [25]	2008-2015	≥ 35 years old	299	46 (38-53)	40 (34-46)	43 (38-47)	–	–	–	–
Germany	Palm et al 2013 [45]	2006-2010	All	152	–	–	18.7 (15.9-21.9)	Standardised European population	–	–	11.9 (10.2-14)
Greece	Tsivgoulis et al 2018 [26]	2010-2012	≥ 18 years old	83	97.8 (70-126)	60.2 (41-80)	69.3 (54-84)	Standardised European population; WHO; Segi	80.1 (57.2-102.9); 47.4 (33.8-60.9); 44.4 (31.7-57.1)	44.6 (30.1-59.2); 21.7 (14.6-28.8); 19.5 (13.2-25.9)	63.3 (49.7-76.9); 34.6 (27.2-42); 31.7 (24.9-38.5)
India	Pandian et al 2016 [28]	2010-2013	≥ 18 years old	290	–	–	27	WHO	–	–	26 (23-29)
Iran	Bahonar et al 2017 [30]	2003	All	–	–	–	37.3 (25.7-48.9)	Segi	–	–	53.8 (40.1-67.5)
		2009	All	–	–	–	13.6 (6.6-20.6)	Segi	–	–	17.4 (9.5-25.3)
		2013	All	–	–	–	15.7 (8.1-23.3)	Segi	–	–	18.3 (10.2-26.4)
Italy	Sacco et al 2016 [48]	2011-2012	All	115	17.9 (13.5-23.2)	20.6 (15.9-26.1)	19.3 (16-23)	Standardised European population	17.9 (13.5-23.2)	20.6 (15.9-26.1)	14.8 (11.7-18.4)
Japan	Iguchi et al 2013 [32]	2009-2010	All	173	–	–	36.5 (31-41.9)	Segi	–	–	16.1 (8.3-24)

Table III. Studies providing information on the incidence of haemorrhagic strokes *(cont.)*.

	Study	Period of analysis	Age at inclusion	Sample of cases	Raw incidence of men	Raw incidence of women	Total raw incidence	Standardised population	Standardised incidence of men	Standardised incidence of women	Total standardised incidence
Japan	Iguchi et al 2013 [32]	2009-2010	All	173	–	–	–	Standardised European population	–	–	23 (13.6-32.4)
Korea	Lee et al 2020 [46]	2008	–	18211	–	–	48	–	–	–	–
		2016	–	16174	–	–	38.5	–	–	–	–
New Zealand	Krishnamurthi et al 2018 [35]	2011-2012	≥ 15 years old	211	18 (15-22)	19 (16-23)	19 (16-21)		16 (13-19)	16 (13-19)	16 (14-18)
Nigeria	Okon et al 2015 [34]	2010-2011	All	54	11.8 (15-52.3)	18 (0.3-24.9)	11 (5-80)	–	–	–	–
Spain	Vena et al 2020 [23]	2010	All	75	17 (12-23)	17 (12-24)	17 (13-21)	WHO	10 (7-15)	8.8 (6-14)	9 (7-12)
		2011	All	96	26 (20-34)	17 (12-24)	22 (18-27)	WHO	16 (12-22)	8 (5-12)	12 (9-15)
		2012	All	87	22 (17-30)	17 (12-23)	20 (16-24)	WHO	12 (9-17)	7 (5-12)	10 (8-13)
		2013	All	87	22 (16-30)	18 (12-24)	20 (16-24)	WHO	13 (10-19)	8 (6-13)	11 (8-14)
		2014	All	83	23 (17-30)	15 (10-21)	19 (15-24)	WHO	14 (10-19)	7 (5-11)	10 (8-13)
United States	Madsen et al 2020 [22]	1993-1994	≥ 20 years old	250	31 (25-37)	25 (21-30)	–	–	–	–	–
		1999	≥ 20 years old	298	35 (29-41)	33 (28-38)	–	–	–	–	–
		2005	≥ 20 years old	318	37 (31-43)	30 (25-34)	–	–	–	–	–
		2010	≥ 20 years old	303	34 (28-39)	25 (21-30)	–	–	–	–	–
	Zahuranec et al 2014 [47]	2000	≥ 44 years old	209	–	–	52.1 (43.6-62.4)	–	–	–	–
		2010	≥ 44 years old	191	–	–	43 (32.1-57.6)	–	–	–	–
Vietnam	Yamanashi et al 2016 [39]	2009-2011	All	25	–	–	29.8 (24.7-35.8)	WHO	36.9 (28.8-46.6)	23.2 (17.1-30.9)	36.9 (26.1-51)

WHO: standard population of the World Health Organisation.

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Table IV. Studies providing information on the incidence of subarachnoid haemorrhage.

	Study	Period of analysis	Type of stroke	Age at inclusion	Sample of cases	Raw incidence of men	Raw incidence of women	Total raw incidence	Standardised population	Standardised incidence of men	Standardised incidence of women	Total standardised incidence
Argentina	Bahit et al 2016 [14]	2013-2015	SAH	All	17	–	–	6.5 (3.8-10.4)	Segi	–	–	6.3 (3.6-10.2)
China	Sun et al 2014 [19]	2005	SAH	All	7	–	–	6.9 (1.8-12)	Segi	–	–	4.6 (0.4-8.8)
		2008	SAH	All	15	–	–	14.8 (7.3-22.3)	Segi	–	–	10.6 (4.3-16.9)
		2011	SAH	All	15	–	–	14.6 (7.2-22)	Segi	–	–	11.5 (5-18)
England	Ramadan et al 2018 [29]	2013-2014	SAH	≥ 18 years old	25	–	–	10		–	–	–
Greece	Tsivgoulis et al 2018 [26]	2010-2012	SAH	≥ 18 years old	31	14.6 (4-25)	23.4 (11-36)	17.5 (10-25)		10.6 (2.7-18.4); 4.6 (1.2-7.9); 3.6 (0.9-6.3)	23.4 (11.1-35.4); 7 (3.3-10.7); 4.5 (2.1-6.8)	19.1 (10.9-27.3); 6.3 (3.6-8.9); 4.5 (2.6-6.4)
India	Pandian et al 2016 [28]	2010-2013	SAH	≥ 18 years old	53	–	–	5	WHO	–	–	4 (3-5)
Iran	Bahomar et al 2017 [30]	2003	SAH	All	–	–	–	3.7 (1.3-7.3)	Segi	–	–	4.9 (2.7-9)
		2009	SAH	All	–	–	–	2.5 (0.5-5.5)	Segi	–	–	2.8 (0.4-6)
		2013	SAH	All	–	–	–	4.7 (0.6-8.8)	Segi	–	–	5.1 (0.8-9.4)
New Zealand	Krishnamurthi et al 2018 [35]	2011-2012	SAH	≥ 15 years old	79	4 (2-5)	10 (8-13)	7 (6-9)		4 (2-6)	10 (8-13)	7 (5-9)
Nigeria	Okon et al 2015 [34]	2010-2011	SAH	All	20	3.7 (3.2-111.4)	8.1 (3.5-97.9)		–	–	–	–
United States	Madsen et al 2020 [22]	1993-1994	SAH	≥ 20 years old	85	8 (5-11)	11 (8-11)	–	–	–	–	–
		1999	SAH	≥ 20 years old	95	6 (3-9)	14 (11-17)	–	–	–	–	–
		2005	SAH	≥ 20 years old	91	5 (3-8)	12 (9-15)	–	–	–	–	–
		2010	SAH	≥ 20 years old	84	5 (3-7)	10 (8-13)	–	–	–	–	–
Vietnam	Yamanashi et al 2016 [39]	2009-2011	SAH	All	2	–	–	–	WHO	3.2 (1.2-6.9)	2 (0.5-5.1)	3.2 (0.6-5.1)

SAH: subarachnoid haemorrhage; WHO: standard population of the World Health Organisation.

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Epidemiología del ictus en la última década: revisión sistemática

Introducción. La enfermedad cerebrovascular (ECV) es la responsable de la mayoría de los años de vida ajustados por discapacidad y una de las principales causas de mortalidad. Dicho impacto justifica disponer de datos actualizados sobre su incidencia.

Pacientes y métodos. Se realizó una revisión sistemática de los estudios publicados desde 2010 hasta la actualidad que

aportaran información sobre la tasa de incidencia cruda (TIC) y la tasa de incidencia ajustada de la ECV durante la segunda década del siglo XXI.

Resultados. Se identificaron 35 artículos. Veintiocho ofrecieron información sobre la incidencia global de ECV, 19 sobre la incidencia de ictus isquémico (IcI), 19 sobre la de ictus hemorrágico (IH) y 10 sobre la de hemorragia subaracnoidea (HSA). La incidencia fue heterogénea entre países. Así, la mediana de la TIC fue de 149,5 –intervalo de confianza al 95% (IC 95%): 122-256– casos por cada 100.000 habitantes para la ECV; 155 (IC 95%: 95,6-246,12) para el IcI; 29 (IC 95%: 19-43) para el IH; y 6,5 (IC 95%: 4,8-13,5) para la HSA. La incidencia tanto para la ECV como para el IcI y el IH fue mayor en los hombres que en las mujeres en la mayoría de los estudios, a excepción de algunos estudios asiáticos, europeos y norteamericanos. En la mayoría de los estudios se registró una tendencia al descenso o la estabilización en la incidencia, a excepción de estudios realizados en China, Singapur, Francia y Australia.

Conclusión. Existen pocos estudios que analicen la incidencia y aún menos la evolución de la ECV. La mediana global continúa siendo elevada, aunque las cifras son heterogéneas entre los estudios. Existe una tendencia mundial a su decremento, y hay áreas geográficas, sobre todo en el continente asiático, con una preocupante tendencia al incremento.

Palabras clave. Enfermedad cerebrovascular. Hemorragia subaracnoidea. Ictus hemorrágico. Ictus isquémico. Incidencia. Revisión sistemática.