Priorities to reduce the burden of stroke in Latin American countries

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The large and increasing burden of stroke in Latin American countries, and the need to meet the UN and WHO requirements for reducing the burden from non-communicable disorders (including stroke), brought together stroke experts and representatives of the Ministries of Health of 13 Latin American countries for the 1st Latin American Stroke Ministerial meeting in Gramado, Brazil, to discuss the problem and identify ways of cooperating to reduce the burden of stroke in the region. Discussions were focused on the regional and country-specific activities associated with stroke prevention and treatment, including public stroke awareness, prevention strategies, delivery and organisation of care, clinical practice gaps, and unmet needs. The meeting culminated with the adoption of the special Gramado Declaration, signed by all Ministerial officials who attended the meeting. With agreed priorities for stroke prevention, treatment, and research, an opportunity now exists to translate this Declaration into an action plan to reduce the burden of stroke.

Introduction

Stroke is the second leading cause of death and disability in Latin American countries and worldwide.[1] Similar to most other countries in the world, stroke incidence, prevalence, mortality, and disability-adjusted life-years (DALYs) in Latin American countries have declined from 1990 to 2017.[2] However, the absolute number of people with incident strokes has significantly increased by 81% from 1990 to 2017, the number of people who survived by 95%, and the number of those who died from stroke by 40%.[2] These data suggest that substantial problems exist either in the widespread use of the proven effective acute and post-acute stroke care management, the population-wide primary prevention strategies of stroke, the currently used individual high absolute risk stroke, the secondary stroke prevention strategies, or any combination of these factors.[3]

In this Policy View, we discuss the current status of the stroke burden in Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Venezuela, and Uruguay) and priorities to be addressed in stroke prevention and care to reduce this burden in this region of the world. The specific aims of this Policy View are listed in panel 1.

Stroke burden

In 2017, in Latin American countries, there were over 5·5 million stroke survivors, 0·60 million new first-ever strokes, over 0·26 million deaths from stroke, and almost 5·50 million stroke-related DALYs.[2] This region is also known for a relatively low proportion of ischaemic stroke (57%) compared with high-income countries (80–85%), such as those in Australia, New Zealand, North America, and western Europe, but high proportion of intracerebral haemorrhage (27%) and subarachnoid haemorrhage (15%).[4] Although age-standardised stroke incidence, mortality, prevalence, and DALYs in Latin American countries in 2017 (table 1)[2] were similar to that reported in high-income countries of Asia Pacific, Australasia, North America, and western Europe, between-country variations were noticeable between Latin American countries (figure).[2,5] The highest age-standardised rates of incidence, mortality, and DALYs were reported in Paraguay (incidence 128 cases per 100 000 population; mortality 67 cases per 100 000 population; DALYs 1276 cases per 100 000), and prevalence in Brazil (1133 cases per 100 000 population) and Uruguay (1120 cases per 100 000 population), whereas the lowest levels were reported in Colombia and Peru (incidence 85–87 cases per 100 000 population; mortality

***Panel 1:* Aims of this Policy View**

- To describe stroke burden in Latin American countries
- To describe variations in the stroke burden, delivery, and quality of care in Latin American countries
- To present our results on stroke awareness and risk factors in Latin American countries
- To present issues with and needs for primary stroke prevention in Latin American countries
- To suggest implications for providing recommendations to policy makers, funding agencies, and other stakeholders for priorities in stroke care organisation, treatment, and prevention in Latin American countries

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	Age-adjusted rates (95% uncertainty interval) per 100 000 person-years			Absolute number (95% uncertainty interval) of people (thousands)		
	1990	2017	Change (%)	1990	2017	Change (%)
Incidence	140·0 (132·4–147·9)	104·8 (97·6–112·3)	–25%	331·4 (312·7–351·7)	600·0 (558·2–643·0)	+81%
Prevalence	1179·7 (1128·9–1240·5)	991·9 (941·6–1044·7)	–16%	2928·2 (2804·6–3079·6)	5713·4 (5429·1–6015·0)	+95%
Mortality	89·7 (88·5–90·9)	47·2 (46·0–48·3)	–47%	184·4 (181·8–186·8)	258·9 (252·4–264·7)	+40%
Disability-adjusted life-years	1849·8 (1809·1–1890·9)	957·3 (925·1–990·7)	–48%	4594·1 (4447·7–4705·1)	5465·5 (5282·3–5657·7)	+19%

Data from from GBD Compare Data Visualization.[2]

Table 1: **Trends in stroke burden in Latin American countries from 1990 to 2017**

25–29 cases per 100 000 population; DALYs 530–595 cases per 100 000 population; prevalence 790–812 cases per 100 000 population).

According to the Global Burden of Diseases, Injuries, and Risk Factors (GBD) 2017 Study estimates,[2] large between-country and within-country variations exist in the population-attributable risk factors of stroke-associated DALYs in Latin American countries (figure), with a huge potential to reduce the stroke burden by 85·3% (95% Uncertainty interval 82·6–87·8).

Delivery and quality of stroke care

The countries in Latin America took longer than high-income countries to develop acute stroke care.[6–9] Some countries (eg, Bolivia, Ecuador, and Guatemala) still have very few centres for acute stroke care, and even in countries with some level of organisation (ie, infrastructure) to treat stroke (eg, stroke units, stroke rehabilitation services), the quality of the services is not monitored. Only two countries (Chile and Brazil) have a Ministry of Health-led National Stroke Policy,[10,11] but since 2015 several initiatives have also been implemented to improve stroke care in Latin American countries. For example, in October, 2015, the Latin American Stroke Summit took place in Santiago, Chile,[12] led by the American Heart Association and the American Stroke Association, supported by the Pan American Health Organization (PAHO), World Stroke Organization (WSO), Latin American and Caribbean Stroke Network, and other local societies. The Declaration of Santiago was a consensus of the group on prioritising stroke care in Latin American countries.[12]

The participants of the Ministerial Meeting in Gramado, Brazil (from 13 countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Panama, Paraguay, Peru, and Uruguay), provided information on the burden of stroke and the differences in stroke care in each country. Characteristics, models of health-care systems, and prevalence of risk factors vary substantially across these 13 countries (table 2).[6,7,9–20] The highest proportion of private health-care systems was reported in Uruguay (58%),[19–21] and the lowest in Argentina (8%),[20,21] Guatemala (8%),[20,22] Paraguay (7%),[20,21] and Peru (7%).[20,21] Although 100% of the population in Argentina[20,21] and Brazil,[9,20,21] and at least 90% of the population in Colombia,[20,23] Costa Rica,[20] and Panama[18,20] are covered by the Ministry of Health or social security system, in Uruguay,[19–21] and Bolivia,[20,21] this coverage was available to only 37% to 65% of the population, respectively. Similarly, there were large variations in the delivery of acute stroke care among these countries (table 3 and appendix).[20] Although stroke centres were available in all countries, their number varied substantially (eg, only one centre was available in Ecuador and Guatemala, whereas, Brazil has 156 centres), and workforce development issues existed in the majority of countries (country-specific findings are shown in the appendix). Thrombolysis for patients with acute ischaemic stroke was available in all countries but only for a relatively small proportion of patients (usually <1%). An even smaller proportion of eligible patients received thrombectomy. Data for in-hospital and postdischarge rehabilitation services were not available for Argentina, Bolivia, Guatemala, Mexico, Peru, and Uruguay (no data were available for Colombia, Ecuador, and Paraguay for postdischarge rehabilitation services only).

Risk factors and public stroke awareness

Knowledge of stroke risk factors in various countries and populations is essential for developing country and population-specific primary stroke prevention strategies. Risk factors included in the GBD[5] analysis in 2016 were tobacco use; alcohol use; diet low in fruits, vegetables, whole grains, nuts and seeds, milk, fibre, calcium, seafood omega-3 fatty acid, or polyunsaturated fatty acid; diet high in red meat, processed meat, sugar-sweetened beverages, trans fatty acids, or sodium; low physical activity; high systolic blood pressure; high body-mass index; high low-density cholesterol; high fasting plasma glucose; impaired kidney function; and ambient particulate matter pollution, household air pollution from solid fuels, and lead exposure. Although there were no significant differences in stroke risk factors between Latin American and high-income countries,[2] the contribution of high systolic blood pressure, high body-mass index, alcohol use, and air pollution to DALYs in Latin American countries were greater than those in high-income countries (table 4).[2]

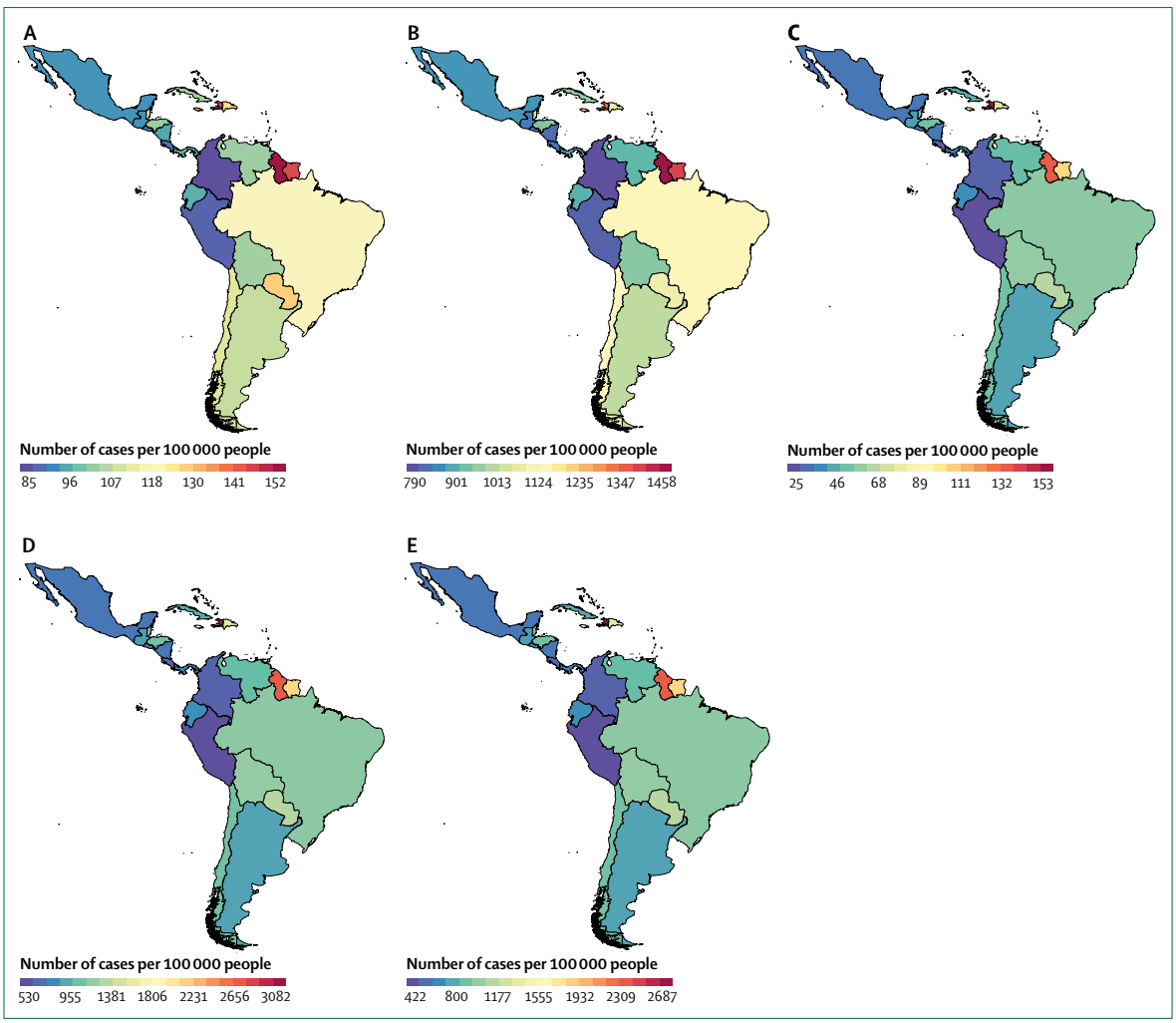

Figure: **Stroke burden in Latin American countries in 2017**
Age-standardised stroke incidence (A), prevalence (B), mortality (C), disability-adjusted life-years (DALYs) (D), and stroke burden (percent of total DALYs) attributable to all risk factors (E). Risk factors included in the analysis are tobacco use; alcohol use; diet low in fruits, vegetables, whole grains, nuts and seeds, milk, fibre, calcium, seafood omega-3 fatty acid, or polyunsaturated fatty acid; diet high in red meat, processed meat, sugar-sweetened beverages, trans fatty acids, or sodium; low physical activity; high systolic blood pressure; high body-mass index; high low-density cholesterol; high fasting plasma glucose; impaired kidney function; and ambient particulate matter pollution, household air pollution from solid fuels, and lead exposure.[5] Reproduced from GBD Compare Data Visualization.[2]

Public stroke awareness is very poor in Latin American countries compared with high-income countries. A cross-sectional study[24] in Brazil involving 800 people (mean age 39 years [SD 16]) in four different regions of the country showed that 176 people (22%) did not recognise any warning signs of stroke, only 280 (35%) people knew the nationwide emergency medical service number, and only 400 (50%) people would call the emergency medical service number for a symptom suggestive of acute stroke. In a study[23] in Mexico with 3600 people, only 133 (4%) people were able to identify three or more stroke signs and 1008 (28%) recognised three or more risk factors . In a large survey[25] of 12710 people (mean age 51 years [SD 17]) in Argentina, only 3685 (29%) people knew about the signs of a transient ischaemic attack and 3940 (31%) people were not able to identify any stroke risk factors. Since 2011, there have been several initiatives in Latin American countries to improve public stroke awareness during the WSO annual campaigns in October. For example, Brazil has had a large stroke awareness campaign in almost all regions since 2011, with participation of the Ministry of Health; however, this campaign has not been sufficient to raise stroke awareness in the whole population and only 30–40% of patients with stroke are hospitalised within 4 h of symptoms onset.[26] The other Latin American countries have participated in local initiatives restricted to certain cities or regions to raise the awareness of the population (so called non-national initiatives; appendix).

Primary stroke prevention

The majority of Latin American countries are committed to implement, at least in part, the strategies of WHO to

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See Online for appendix

For more on the **1st Latin American Stroke Ministerial Meeting** see http://siecv2018.com.br/en/latin-american-ministerial-meeting-on-stroke/

	Population (million)	Socio-demographic Index	Health-care system		
			Private funding (%)	Public funding (%)	Other (%)
Argentina[20,21]	43·9	High income	8%	100% from MoH (40% from social security)	NA
Bolivia[20,21]	10·9	Lower-middle income	10%	65% (28% from MoH and 37% from social security)	NA
Brazil[9,20,21]	207·7	Upper-middle income	25%	100% from MoH	NA
Chile[20,21]	17·9	High income	18%	76% from MoH	NA
Colombia[20,23]	49·8	Upper-middle income	45%	93% (45% from MoH and 48% from social security)	5% of people have an exception regime; 2% of people do not have any coverage
Costa Rica[20]	4·9	Upper-middle income	10%	90% from social security	NA
Ecuador[20,21]	15·1	Upper-middle income	27%	83% (60% from MoH and 23% from social security)	6% of public funding for special insurance for police, army, and farmers
Guatemala[20,22]	16·5	Upper-middle income	8%	88% (70% from MoH and 18% from social security)	NA
Mexico[20,21]	127·5	Upper-middle income	18%	86% of any coverage (42% from social security and from 44% MoH, but stroke is not covered)	NA
Panama[18,20]	4·0	High income	5–10%	90% (60–80% from social security and 20–40% from MoH)	NA
Paraguay[20,21]	6·7	Upper-middle income	7%	92% (71% from MoH and 21% from social security)	1% of public funding for the military
Peru[20,21]	31·7	Upper-middle income	7%	82% (51% from MoH and 31% from social security [EsSalud])	NA
Uruguay[19-21]	3·5	High income	58%	37% (both from MoH and social security)	NA

MoH=Ministry of Health. NA=not available.

***Table 2*: Sociodemographic characteristics and health-care system funding by Latin American country**

reduce the burden of non-communicable diseases, including stroke, by 2025, with different levels of implementation between countries.[27,28] For example, as was presented at the 1st Latin American Stroke Ministerial Meeting in Gramado, Brazil, Colombia has launched a national programme to detect and control hypertension and obesity. The social insurance in Mexico launched a programme for primary prevention with a focus on obesity and physical activity, whereas a new programme in Peru focuses on screening and identification of stroke risk factors, such as hypertension, diabetes, and obesity. Guatemala developed a proposal of law for the prevention of non-communicable diseases, with strategies focused on obesity, unhealthy food, exercise, hypertension, and dyslipidaemias. Ecuador has launched a pilot project, *Know your numbers*, which encourages the population to measure their systolic blood pressure, as a strategy to reduce the burden of stroke and cardiovascular diseases.[29] Overall, in Latin America, adherence to the healthy lifestyle recommendations is poor and essential medications to control important stroke risk factors, such as atrial fibrillation, are not freely available for the whole population in many countries (appendix).[27,28]

Similar to high-income countries, the two most commonly used primary stroke prevention strategies in Latin America are population-wide[30] and high absolute cardiovascular disease risk[31] strategies, which are recommended by WHO to be used together.[32] However, as was emphasised at the meeting, some problems and issues exist in implementing these strategies.

Population-wide strategies

Population-wide strategies are aimed at the reduction of exposure to risk factors among all people regardless of their risk, therefore preventing not only stroke, but other non-communicable diseases. This approach is the most effective strategy for the prevention of primary stroke and other non-communicable diseases. The best example of such a strategy is smoking cessation programmes successfully introduced in Australia, Brazil, New Zealand, UK, USA, and western European countries. However, even these widely recognised smoking cessation programmes are not implemented in most countries in the world, hence smoking remains one of the largest contributor to the burden of stroke, cardiovascular disease,[3,33,34] and other major non-communicable diseases, such as cancer and chronic obstructive pulmonary disease.[35] For example, in Chile daily smoking prevalence in 2017 was as high as 26%, and in Bolivia, Uruguay, and Argentina its prevalence ranged between 18% and 20%.[36] Over the past 10 years, smoking cessation campaigns in Brazil and Panama have achieved good results: currently, smoking prevalence has been reduced to 11% and 6%, respectively. Compared with implementation of smoking cessation programmes, fewer countries have implemented programmes to reduce salt and sugar consumption,[37,38] both

	National plan for stroke	Acute stroke care			Rehabilitation		
		Stroke centres and units	Thrombolysis	Thrombectomy	In-hospital	After discharge	Access to stroke care and rehabilitation*
Argentina	No	1 public and 5 private hospitals; no stroke units	5 private hospitals	5 private hospitals	No data	No data	Poor
Bolivia	No	Few private hospitals (no quantitative data available); no stroke units	Private hospitals	Few private hospitals (no quantitative data available)	No data	No data	Poor
Brazil	Yes	156 hospitals, 78 are private; 74 with stroke units	78 public and 78 private hospitals; in 24 hospitals thrombolysis is provided by the use of telemedicine	2 public and 64 private hospitals	Widely available in stroke units	Yes	Intermediate access to acute care; quick access to rehabilitation after discharge is limited
Chile	Yes	54 hospitals (20 public and 34 private); all with stroke units	20 public and 34 private hospitals, including 6 (private) that provide telemedicine	6 public and 6 private hospitals	Widely available in stroke units	Yes	Good
Colombia	No	48 hospitals (including 14 public hospitals); no stroke units	14 public and 34 private hospitals	3 private hospitals	Yes	No data	Intermediate access to acute care; no data about rehabilitation
Costa Rica	No	4 public and 1 private hospitals; all with stroke units	4 public and 1 private hospitals	2 public hospitals	Yes	Yes	Intermediate access to acute care; quick access to rehabilitation after discharge is limited
Ecuador	No	1 public hospital with a stroke unit	1 public hospital	Not available	Only 1 public hospital	No data	Poor
Guatemala	No	1 private hospital with a stroke unit	1 private hospital	1 private hospital	No data	No data	Poor
Mexico	No	2 public and 4 private hospitals; 5 hospitals with stroke units	4 private and 1 public hospitals	4 private hospitals	No data	No data	Poor
Panama	No	8 public and 5 private hospitals	8 public and 5 private hospitals	1 public and 4 private hospitals	1 public and 4 private hospitals	Yes	Intermediate access to acute care; quick access to rehabilitation after discharge is limited
Paraguay	No	2 public hospitals with stroke units; 6 private hospitals without stroke units	2 public and 6 private hospitals	Not available	Yes	No data	Poor access to acute care; no data about rehabilitation after discharge
Peru	No	4 public hospitals with one stroke unit, 1 private hospital without stroke unit	4 public and 1 private hospitals	Not available	No data	No data	Poor access to acute care; no data about rehabilitation after discharge
Uruguay	No	18 hospitals (16 private without stroke units; 1 public and 1 private hospitals with stroke units)	1 public 17 private hospitals	1 private hospital	No data	No data	Poor access to acute care; no data about rehabilitation after discharge

Data based on personal communication with the Ministries and experts in the countries listed in the table. Intermediate access to acute care defined as within 1-2 h and quick access to rehabilitation defined as within 7 days after hospital discharge. *Poor access: only few (one or two) stroke centres in the country; intermediate access: number of stroke centres is not sufficient for the number of inhabitants, or the overall number of centres is sufficient but the country has some areas without coverage; good access: sufficient number of centres for the number of inhabitants and the centres are well distributed across the country.

Table 3: **Delivery of stroke care by Latin American country**

important stroke risk factors.[36] Chile has a programme to reduce sugar in processed food. In Brazil, negotiations with the food industry led to a reduction of salt in food by 5% to 17%, depending on the type of food, in 4 years.[16] A population-wide strategy requires policy and legislative changes supported by strong law enforcement and regulatory agencies. Although only modest investment (US$1–3 per person) is required to control many non-communicable diseases (including stroke),[28] many of these necessary policy changes are often not supported by major industries (eg, salt reduction in processed food, and reduction of exposure to smoking, alcohol, and fast food) and, therefore, political support for these changes can be weakened by strong lobbying efforts of the relevant industry. All these challenges make the population-wide primary stroke and cardiovascular disease prevention

	Latin American countries	High-income countries
High systolic blood pressure	54·2% (47·0–60·9)	49·5% (42·3–56·3)
Poor and unbalanced diet	44·9% (38·2–52·6)	46·0% (40·8–51·7)
High body-mass index	37·5% (27·0–47·7)	31·8% (22·3–40·9)
High fasting blood glucose	19·4% (13·7–26·9)	22·8% (15·4–33·8)
Smoking	17·2% (15·6–18·8)	18·1% (16·7–19·6)
Alcohol use	10·7% (7·2–14·1)	7·4% (3·1–11·5)
Air pollution	9·0% (6·9–11·2)	6·2% (4·6–8·0)
High low-density cholesterol	8·5% (4·9–14·3)	11·4% (6·3–19·6)
Impaired kidney function	7·1% (5·7–8·7)	6·2% (4·8–7·7)

Data are shown as percentage of population-attributable fraction of stroke-related disability-adjusted life-years due to these risk factors (95% uncertainty interval). Data from from GBD Compare Data Visualization.[2]

Table 4: **Age-standardised disability-adjusted life-years lost due to stroke attributable to risk factors in Latin American countries and high-income countries in 2017**

strategy very difficult to implement on a national level[39] and, although the mass strategy was suggested by Dr Rose 35 years ago,[30] there is still no country in the world where population-wide primary prevention strategies are implemented in full on a national level.[3] But certainly, efforts should continue in this direction.

High absolute stroke and cardiovascular disease risk prevention strategies

The widely available and promoted high absolute cardiovascular disease risk prevention strategies allow the identification of people at high risk of cardiovascular disease based on a combination of risk factors.[40,41] However, these strategies have a number of limitations and disadvantages.[3,42]

First, up to 80% of all cases of stroke and heart attack occur in people at low or moderate risk of cardiovascular disease (ie, people who have a 5-year risk of cardiovascular disease of less than 10%).[43,44] If people are aware that their risk is low, they are falsely reassured that they are protected from stroke or heart attack. Naturally, they are not likely to be motivated to modify their risk factors, although most do have risk factors that need to be controlled to reduce their risk of having stroke and other cardiovascular diseases. For example, for a 35-year-old Caucasian man who smokes and has a systolic blood pressure of 140/85 mm Hg, the 10-year absolute risk of cardiovascular disease (as determined by a commonly used Atherosclerotic Cardiovascular Disease Risk Evaluation)[31,45] is 2·9%, which is conventionally regarded as mild or low risk, although he has two very important risk factors for stroke (hypertension and smoking) that warrant adequate preventive interventions.

Second, the screening of high risk of cardiovascular disease is done by doctors. Visiting a doctor incurs in costs for the patient (unless covered by insurance or government); therefore, paying a visit to a doctor just for primary prevention when there is no medical problem might not be affordable or even acceptable to many people, especially people with low income and low socioeconomic status. As a result, this high cardiovascular disease risk strategy is rarely used in Latin American countries.[32,43]

Finally, and probably most importantly, these screening programmes do not seem effective for reducing the burden of stroke and cardiovascular disease. Results of 15 randomised-controlled trials[46,47] (including Cochrane meta-analysis of 14 trials)[46] with a 240 000 study participants showed no effect of high cardiovascular disease risk screening (even with some counselling for risk factors control)[47] on stroke and ischaemic heart disease incidence and mortality. However, this high-risk screening approach is still preferred by doctors over the population-wide approach.[48] Simon Capewell, proponent of the high cardiovascular disease risk strategy, argued that the greatest harm arising from high risk strategies is misleading professionals, planners, and politicians into thinking they can tick the so-called mission accomplished box for preventing cardiovascular disease.[49] Capewell emphasised that screening for high-risk individuals represents a costly and relatively ineffective strategy, which distracts from cheaper and more effective policy interventions that benefit entire populations.[42]

Policy implications and recommendations

The most effective solution to reduce stroke burden is primary stroke prevention.[50–53] The UN resolution[54] followed by the WHO Global Action Plan for Non-communicable Diseases[55] called upon all governments to give primary prevention of non-communicable diseases, including stroke, the highest priority. Mandatory and voluntary global targets were set until 2030. Unfortunately, as emphasised in the GBD 2017 Study[56] and stated by the UN Secretary-General in December, 2017,[57] progress has been slow and, if it continues at this pace, these global goals will not be achieved, particularly in Latin American countries.

As one of the strategies to meet the UN resolution on non-communicable diseases, PAHO and WHO highly recommend that governments consider the implementation of the so called WHO best-buy interventions,[28] which are a core set of evidence-based, cost-effective, feasible interventions appropriate to implement within the constraints of the local health system in Latin American countries and elsewhere. These interventions include measures to reduce tobacco and alcohol use; strategies to promote a healthy diet and physical activity; improved treatment of cardiovascular disease and diabetes; and prevention of certain types of cancer. If implemented in the region, these interventions could potentially result in millions of lives saved from premature deaths and billions in economic output.

It was acknowledged at the meeting that for primary stroke prevention to be effective, the emphasis should be

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shifted from high-risk prevention to prevention at any level of stroke or cardiovascular disease risk. Although mainstream preventive strategies, such as population-wide prevention, should be similar across the world, differences in the epidemiology of stroke (including prevalence and relative importance of risk factors) and availability of resources for stroke prevention should be considered when setting realistic goals and priorities. It was also suggested that motivating and empowering people to reduce their risk of having a stroke or cardiovascular disease by using widely available smartphone technologies could bridge the gap between population-wide and high-risk prevention strategies,[58] even in developing countries and for people with low income and poor access to health care. With the wide and continually increasing use of smartphones worldwide (eg, 60% in Latin America)[59] that would have effective apps for controlling risk factors of non-communicable diseases, even a small reduction in the exposure to risk factors on an individual level would possibly result in a shift in the distribution of risk factors on a population level. This approach could have a comparable preventive effect on stroke, cardiovascular disease, and other major non-communicable diseases, because it would be comparable to the population-wide prevention strategy. By taking advantage of population-wide and high-risk prevention strategies and at the same time addressing their current limitations, these mobile technologies (apps) could be incorporated into the hospital and community patient management systems, thus providing an important communication interface between patients and health-care providers. A pilot randomised-controlled trial (50 people aged >19 years, followed-up for 6 months)[60] on primary stroke prevention with a validated and internationally endorsed Stroke Riskometer app[58,61,62] showed high acceptability (86%) of the intervention by the general people with at least two modifiable stroke risk factors identified. It was superior to the usual care group, in which no positive changes in the lifestyle factors were observed. Although the trial was not powered for the efficiency outcome, there was a 0·36-point increase in the Life's Simple 7 score (ie, a validated measure for lifestyle behaviour changes that includes blood pressure, cholesterol, blood glucose, body-mass index, smoking, physical activity, and diet), which is equivalent to about 3% in stroke incidence reduction per year.[63] As many stroke risk factors are also common for other major non-communicable diseases, such as ischaemic heart disease, type 2 diabetes, and vascular dementia,[55] the expected preventive effects of the Stroke Riskometer app intervention would also include these other non-communicable diseases, with considerable not only humanitarian but also economic effects of annual savings in health-care costs.[64] For example, just in Brazil, the estimated annual economic burden from these non-communicable diseases is about US$91 billion.[65–67] Thus, even conservatively assuming 2% reduction in the incidence of these diseases in Brazil, the wide use of the Stroke Riskometer app by individuals and health professionals (eg, in electronic patient management systems) would save the country about US$1·8 billion annually. Additionally, by showing the app users not only their absolute but also their relative risk of stroke compared with someone of their age, sex, and ethnicity without additional risk factors, the Stroke Riskometer app motivates the users to know their personal risk factors and how to control them (so-called motivational population-wide strategy).[58]

Latin American countries have elected their priorities listed in the Declaration of Gramado (panel 2) according to the stage of local development. It was a general consensus that Latin American countries need to increase stroke education and prevention on a national level by using population-wide motivational and proven effective preventive strategies; increase the development of stroke units (recommended at least 50 beds per 1 million inhabitants) with a multidisciplinary approach, and implementation of evidence-based treatments of thrombolysis as a first step and thrombectomy in comprehensive centres as the next step (the suggestion is to create more high-level stroke centres providing all necessary treatment options, with at least one centre per 2 million inhabitants); use telemedicine to increase the access to stroke specialists; create a nationwide registry and essential quality control instrument of all patients with stroke admitted to hospitals with a minimum dataset; do high-quality stroke epidemiology and prevention studies; increase workforce and improve access to adequate acute stroke care and rehabilitation, both in-hospital and in the community; and continue collaboration with the GBD Study Stroke Collaborators to generate more accurate estimates of stroke burden and risk factors that would be used to advance evidence-based stroke care and prevention in Latin American countries.

The first actions taken after the Ministerial Meeting were to send the official meeting report to each Ministry of Health of the Latin American countries (including those who did not send representatives and did not take part in the meeting), inviting them to join efforts and to work collaboratively; to immediately start a unified registry of hospital quality indicators with a minimum dataset including outcomes; to organise a stroke signs and risk factors awareness campaign (World Stroke Campaign) annually in October, involving the Ministries of Health; to submit a suggestion to the Brazilian Ministry of Health concerning implementation of the population-wide motivational strategy for stroke education and prevention in the country; to support cooperation among countries with support from the PAHO to optimise existing health-care capacities and encourage the sharing of knowledge and expertise between partners; and to take actions to promote free online education for health-care professionals using the World Stroke Academy and World Stroke Organization online stroke teaching course in Spanish, launched in 2018.

For more on the **World Stroke Academy** see world-stroke-academy.org

Panel 2: Declaration of Gramado

We, representatives of the 13 countries and representatives of their Ministries that participated in the 1st Latin-American Ministerial Stroke Meeting in Gramado, Brazil, on Aug 2, 2018:

- acknowledging that cerebrovascular diseases, including stroke, are among the main causes of death in the adult population of Latin America, and that stroke is preventable and treatable through evidence-based and cost-effective strategies;
- highlighting that the cooperation among Latin American countries for tackling stroke is included in the implementation framework of the Sustainable Development Goals of the UN 2030 agenda, which proposes collaboration for reducing premature death by noncommunicable diseases by means of prevention and treatment, and for promoting mental health and wellbeing until 2030;
- and considering the WHO Global Action Plan for Prevention and Control of Noncommunicable Diseases 2013–2020 that aims to reduce in 25% the premature death by chronic diseases until 2025; decided to unite our efforts to promote the development and implementation of effective, integrated, sustainable, and evidence-based public policies for the prevention and treatment of stroke and its risk factors in Latin America,

We resolved:

- to provide public education on the stroke signs, treatment urgency, and control of risk factors;
- to promote safe and healthy environments for the practice of physical activity;
- to implement policies to control smoking, to stimulate healthy eating habits and physical activity, to reduce sodium intake and alcohol use, and to control weight, aiming in reducing the incidence of cardiovascular and cerebrovascular diseases;
- to set strategies for the detection of modifiable risk factors, such as hypertension, atrial fibrillation, diabetes, and hyperlipidaemia;
- to promote health care for the control of modifiable risk factors;
- to organise the pre-hospital care to prioritise the patient with stroke;
- to prioritise the structuring and implementation of stroke centres by organising stroke units with a defined physical space and a trained multidisciplinary team, providing evidence-based acute treatments, providing exams for minimal workup of stroke causes, promoting the prescription of secondary prevention therapies in the hospital discharge, and encouraging the use of telemedicine in hospitals without a specialist 24 h per day, every day;
- to advise acute treatment;
- to increase access to in-hospital and post-hospital rehabilitation;
- to train all the health-care professionals engaged in stroke care;
- to monitor national prevalence of the main risk factors and quality indicators of stroke care;
- to set national and regional evidence-based practice guidelines, with frequent updates, to standardise stroke care;
- to prioritise the structuring and implementation of Integrated Networks for Continuous Care of patients with stroke or stroke risk factors, which encompass all levels of health care, creating a line of care;
- to assign human and financial resources for the development of a stroke line of care;
- to implement national stroke care policies;
- to promote exchange of experiences among countries for the improvement of stroke care;
- to implement research in stroke based on the priorities and realities of each country.

We sign the Declaration of Gramado, Brazil, and we manifest our commitment to these recommendations.

Search strategy and selection criteria

We searched MEDLINE, Embase, Google Scholar, the Cochrane Library, and Google for articles on stroke research in Latin American countries in English, Spanish, and Portuguese, published between Jan 1, 1970, and Nov 1, 2018, using the following key words in title or abstract: "stroke", "intracerebral h(a)emorrhage", "subarachnoid h(a)emorrhage", "transient isch(a)emic attack", or "cerebrovascular disease" AND "incidence", "prevalence", "mortality", "cost", "care", "prevention", "service", "trial", or "outcomes". The GBD 2017 Study findings were also included Moreover, we included in the search terms an affiliation country, such as Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Venezuela, or Uruguay. We focused on nationwide representative reports, population-based studies, and randomised controlled trials. Additionally, we manually searched the reference lists of relevant publications and consulted with experts in stroke and other relevant stakeholders, including representatives of patient organisations (eg, stroke organisations) and Ministries of Health of Latin American countries, to complement the electronic searches.

Conclusions and future directions

The high burden of stroke, as measured by the number of people affected by stroke, who die, or remain disabled from stroke, in Latin American countries, requires concerted actions from governments and other key stakeholders of the region to improve its primary prevention, acute care, and rehabilitation, as outlined in the Gramado Declaration (panel 2). With established priorities for stroke treatment and prevention, an opportunity now exists to translate this Declaration into an action plan to reduce the global and regional burden of stroke. Given that epidemiological and health-care quality data on stroke in Latin American countries are scarce, further research in stroke prevention, incidence, prevalence, outcomes, acute care, and rehabilitation is warranted. However, priority should be given to epidemiological and translational research aimed at improving stroke prevention and outcomes. However, new population-based epidemiological studies of stroke and transient ischaemic attack incidence and outcome in the region should include both WHO clinical[68] and new tissue-based diagnostic criteria,[69,70] and the updated standard methods of case-ascertainment, data collection, and presentation.[71] The time to act is now.

Contributors

VLF prepared the first draft of the manuscript. SCOM analysed data from Latin American countries, reviewed and edited the first draft and final versions of the manuscript. VLF and SCOM reviewed all drafts. The remaining authors provided data, reviewed the result, and approved the final version of the manuscript.

Declaration of interests

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