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Trends in stroke mortality in Latin America and the Caribbean from 1997 to 2020 and predictions to 2035: An analysis of gender, and geographical disparities

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ABSTRACT

Background: Stroke is a leading cause of death and disability globally, with significant public health implications. In Latin America, while mortality rates have declined, the number of stroke cases has increased due to prevalent risk factors like high blood pressure and obesity. Unlike Europe, recent trends in stroke mortality in this region remain underreported.

Objective: This study evaluates stroke mortality rates in Latin America Latin American and Caribbean (LAC) countries from 1997 to 2020 and predictions to 2035.

Methods: This ecological observational study utilized mortality data from the World Health Organization database. Trends were analyzed using Joinpoint regression to evaluate the annual percent change (APC) by sex and country. Predicted mortality rates through 2035 were calculated using the Nordpred package in R. Changes in stroke mortality were assessed by disentangling the effects of population growth, aging, and risk factor modifications, based on age-specific rates and projections. Results were presented as absolute case numbers and relative percentages.

Results: From 1997 to 2020, twelve countries presented significant reductions in stroke mortality rates for men in LAC, the main ones being Chile (−4.2 %), El Salvador (−4.2 %), and Puerto Rico (−4.0 %). Thirteen countries reported a reduction in their mortality for women, mainly in Puerto Rico (−4.3 %), Chile (−3.7 %), Argentina, El Salvador, and Uruguay (−3.5 %). By 2035, an increase in deaths among men and women is expected, mainly due to the increase in population structure and size. However, a decrease in the mortality rate will be reported, mainly due to the reduction of risk factors.

Conclusion: Our final findings show a reduction in stroke mortality trends in LAC countries between 1997 and 2020, due to creating public awareness about vascular risk factors by authorities and the implementation of effective health policies. By 2035, an overall increase in mortality is expected, mainly due to population change in each country.

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Introduction

Stroke is the second leading cause of death worldwide and the leading cause of long-term neurological disability in adults.[1] It represents a significant public health challenge on a global scale, affecting over 101 million people and resulting in over 6 million deaths annually in 2019.[1] Without the development of prevention strategies, the number of strokes is likely to continue to increase.[2] Similarly, in 2019, stroke was the second leading cause of death in the Americas, with 47.3 deaths per 100,000 people.[3] From 1979 to 2015, Latin America and the Caribbean reported a decrease of 1.9 % annually, with the most notable reductions in Chile, Colombia, and Uruguay (from −2.8 % to −3.4 %).[4]

Despite a reduction in stroke mortality from 89.7 % in 1979 to 47.2 % in 2015 in Latin America, the number of cases has increased from 184,400 to 258,900.[4] The risk factors reported for disease are elevated glucose,[5] smoking,[6] high blood pressure,[7] and higher body mass index.[1] Gender-specific factors such as androgen deprivation therapy in men and hypertensive disorders of pregnancy in women also play a role.[8] This context is quite relevant in the Latin American population because some risk factors such as high blood pressure and high body mass index have a significant impact in this region.[9-11]. This could lead to a greater stroke burden in Latin America.

In comparison to developments in European countries, Latin America and the Caribbean have not provided updates on the evolution of stroke mortality in recent years. Furthermore, it is crucial to ascertain the projected mortality rate in the coming years in order to effectively plan for the impact of this disease. To address this gap in knowledge, this study aimed to evaluate stroke mortality rates in Latin American and Caribbean countries from 1997 to 2020 and project future rates to 2035.

Methods

Study design and data sources

We conducted an observational ecological study. The mortality database was obtained through World Health Organization (WHO), which is freely accessible through the following link: https://www.who.int/data/data-collection-tools/who-mortality-database. Mortality data was used for the period between 1997 and 2020 for Latin American and the Caribbean countries. Deaths from stroke were identified with code (I60-I69.9) according to the International Classification of Diseases 10th revision (ICD-10).[12] The age groups were grouped as follows (0-4, 5-9, 10-14, …, 85+).

The present study included only data from countries that had properly coded their data according to the ICD-10. The following LAC countries had data available: The following Latin American and Caribbean countries were included in the study: Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Republica Domicana, Uruguay and Venezuela.

To address missing mortality data, linear interpolation was applied for years with isolated gaps within the study period (1997–2020), ensuring that estimates were only used when adjacent years had reported values. For countries where the most recent available mortality data preceded 2020, extrapolations were performed using the latest recorded rates while acknowledging potential limitations. Additionally, countries with substantial missing data for extended periods were excluded from the analysis to maintain consistency.

Statistical analysis

Age-standardized mortality rates (ASMR) per 100,000 person-years were calculated by the direct method using the SEGI world standard population.[13] Trends mortality were estimated using the Joinpoint regression program version 4.9.[14] The annual percentage change (APC) and the corresponding 95 % confidence intervals (95 %CI) were estimated for each country. The APC were considered statistically significant at a p-value <0.05. In case there are 2 or more joinpoints we calculated the average APC (AAPC). The significance levels used in this study were based on the Monte Carlo permutation method.[15],[16]

Mortality rate predictions through 2035 were computed using the Nordpred package in R software.[17] An age-period-cohort model was applied to the observed data from 2006 to 2020, followed by the calculation of Segi world-standardized mortality rates for 18 five-year age groups (e.g., 0–4, 5–9, 10–14, …, 80–84, ≥85). Trends based on the observed rates from the periods 2006–2010, 2011–2015, and 2016–2020 were extrapolated to predict mortality rates for three subsequent five-year periods: 2021–2025, 2026–2030, and 2031–2035. For these projections, we used the median population for each five-year period (i.e., 2025, 2030, and 2035). To adjust the linear drift, the "cut trend" method was applied, attenuating the drift by 0 %, 25 %, and 50 % for the first, second, and third five-year periods, respectively. In predictive modeling, 'cut trend' refers to the statistical attenuation of historical trends over time, assuming that past patterns may not continue indefinitely at the same rate. This approach, applied in the Nordpred model, progressively reduces the influence of previous trends in long-term projections, helping to prevent overestimation or underestimation of future mortality rates. The attenuation levels (0 %, 25 %, 50 %) represent different scenarios: 0 % assumes that historical trends persist unchanged, 25 % assumes a moderate slowing of the trend, and 50 % assumes a substantial deceleration. Following the recommendations by Møller et al.,[17] we applied 25 % attenuation as the standard approach, with 0 % and 50 % used for sensitivity analysis to assess potential variations in projected mortality trends. Predicted deaths due to demographic changes (population growth and aging) were calculated using observed rates, while those attributed to changes in risk factors were estimated as the difference between the total predicted deaths and those driven by demographic changes.[18]

Ethical Consideration

This study was not submitted to an ethics committee because a secondary database was used, which did not identify any patients.

Role of funding source

There was no funding source for this study.

Results

Among men, by 1997, Brazil (74.1), Uruguay (68.6) and Argentina (61.0) reported the highest mortality rates; while by 2035 the countries with the highest mortality rates will be Venezuela (64.0), Paraguay (50.3) and Cuba (50.2). Fifteen of the eighteen (15/18) countries will decrease their mortality rates by 2035. Only Cuba, Peru and Venezuela will report higher rates by 2035 compared to 2020 (Fig. 1). Amon women, by 2035, all countries in Latin America and the Caribbean will decrease their mortality rates compared to 2020. In 1997, Brazil (59.3), Colombia (50.3), and Venezuela (49.0) reported the highest mortality rates, while by 2035, Venezuela (44.1), Cuba (29.9) and Paraguay (28.2) will have the highest mortality rates.

With respect to the evolution of stroke mortality in the AAPC (Fig. 2) for men, thirteen countries had significant decreases in mortality, the most notable being El Salvador (AAPC, −4.2 %), Chile (AAPC, −4.0 %), and Puerto Rico (AAPC, −4.0 %). For women, fourteen countries had significant decreases in stroke mortality, the most notable being Puerto Rico (AAPC, −4.3 %), Chile (AAPC, −4.0 %), and Argentina and El Salvador (AAPC, −3.5 %) (**Supplemental Table 1**).

Fig. 2 Average annual percent change (AAPC) and 95 % confidence interval (CI95 %) for stroke mortality rates in Latin America and the Caribbean.

Table 1 and Table 2 show the estimated number of stroke deaths,

Table 1
Number of stroke deaths, age-standardized mortality rates, and percentage change in cases due to population growth and risk among men in Latin America and the Caribbean, 2020 and predicted 2035.

Countries	Male population (annual million)		Number of deaths in men		Age-standardized mortality rates		Change total (%)	Change due to population (%)	Change due to risk (%)
	2020	2035	2020	2035	2020	2035			
Argentina	22.0	24.9	48196	60124	32.6	29.1	24.7	39.9	−15.2
Brazil	103.3	111.1	256259	402844	47.5	34.9	57.2	114.6	−57.4
Chile	9.3	9.8	20229	19129	26.2	13.6	−5.4	81.0	−86.4
Colombia	24.3	26.8	36690	67868	29.9	24.7	85.0	135.1	−50.1
Costa Rica	2.5	2.8	3488	6814	21.3	18.3	95.4	129.4	−34.0
Cuba	5.6	5.4	25850	44429	43.7	50.2	71.9	52.5	19.4
Ecuador	8.5	10.4	11546	22856	27.8	27.2	98.0	104.2	−6.2
El Salvador	2.9	3.2	2292	2916	15.0	12.3	27.2	56.4	−29.1
Guatemala	8.3	11.3	8126	10474	28.0	18.5	28.9	89.3	−60.4
Mexico	60.6	71.2	86137	132624	25.3	25.0	54.0	60.9	−7.0
Nicaragua	3.2	3.8	3473	7891	38.5	35.9	127.2	143.6	−16.4
Panama	20.5	26.0	4710	10447	40.9	39.8	121.8	128.3	−6.5
Paraguay	3.2	4.2	6345	14004	48.1	50.3	120.7	106.9	13.8
Peru	15.9	18.5	16522	44004	18.2	26.9	166.3	82.2	84.1
Puerto Rico	1.6	1.3	2908	2477	14.2	10.9	−14.8	18.7	−33.5
Republica Dominicana	5.4	6.0	7183	7139	25.9	16.6	−0.6	62.1	−62.7
Uruguay	1.7	1.8	4976	5266	32.6	25.7	5.8	34.6	−28.8
Venezuela	15.2	17.1	34665	78328	58.4	64.1	126.0	105.2	20.7

Table 2
Number of stroke deaths, age-standardized mortality rates, and percentage change in cases due to population growth and risk among women in Latin America and the Caribbean, 2020 and predicted 2035.

Countries	Male population (annual million)		Number of deaths in men		Age-standardized mortality rates		Change total (%)	Change due to population (%)	Change due to risk (%)
	2020	2035	2020	2035	2020	2035			
Argentina	22.4	25.9	48246	54097	19.6	16.2	21.1	34.1	−22.0
Brazil	106.7	116.1	248292	382244	32.4	22.6	53.9	120.9	−66.9
Chile	9.4	10.0	20667	19556	18.3	9.8	−5.4	67.0	−72.3
Colombia	24.9	27.8	41517	66646	24.8	18.5	60.5	132.6	−72.0
Costa Rica	2.5	2.8	3638	6792	17.0	13.7	86.7	128.4	−41.7
Cuba	5.6	5.5	24587	36218	31.7	29.9	47.3	61.4	−14.1
Ecuador	8.5	10.4	11201	21769	21.1	20.7	94.4	97.4	−3.0
El Salvador	3.3	3.7	2742	3546	12.1	9.0	29.3	76.6	−47.2
Guatemala	8.5	11.5	8291	12866	23.3	17.0	55.2	103.2	−48.0
Mexico	63.2	74.5	87245	117073	20.3	16.1	34.2	74.3	−40.1
Nicaragua	3.3	4.0	3913	9063	29.7	26.7	131.6	155.6	−24.0
Panama	2.1	2.6	3885	8535	25.6	26.9	119.7	127.0	−7.3
Paraguay	3.2	4.1	5907	9784	35.1	28.2	65.6	97.3	−31.6
Peru	16.2	18.7	16543	47408	15.5	23.1	186.6	94.4	92.2
Puerto Rico	1.8	1.5	3114	3037	9.6	6.4	−2.5	49.0	−51.5
Republica Dominicana	5.4	6.0	5761	5587	20.0	8.8	−3.0	74.2	−77.2
Uruguay	1.7	1.8	6933	6041	23.0	17.4	−12.9	20.0	−32.9
Venezuela	15.4	17.7	34005	78902	40.2	44.1	132.0	113.0	18.4

age-standardized mortality rates, and percentage change in cases due to population growth and risk in Latin America and the Caribbean, 2020 and predicted 2035. For men, fourteen countries had a decrease in mortality according to risk factors, however, in most of these (11 countries) the effect of population aging is stronger, resulting in increases in total deaths. Only Chile (−5.4 %), Puerto Rico (−14.8 %) and the Republica Dominicana (−0.6 %) had a stronger increase in risk factors compared to population structure (Table 1 and **Supplemental Fig. 1**). For women, sixteen countries will decrease their projected mortality due to changes in risk, while all countries included will increase mortality mainly due to the increase in population structure, generating an overall increase in crude deaths for 14 countries (most notably Nicaragua, Peru, Venezuela) and a decrease for four countries in the region (Chile, Puerto Rico, Dominican Republic, and Uruguay) (Table 2 and **Supplemental Fig. 2**). Venezuela and Peru will show worrisome trends with increases in projected mortality, while Chile, Puerto Rico, and Argentina will have the largest decreases in mortality (Fig. 3).

Discussion

Stroke mortality rates have shown notable declines in most Latin American and Caribbean countries, with significant reductions over the study period. However, the projected trends reveal disparities, with some countries expected to experience increased mortality rates by 2035, particularly influenced by shifts in risk factors and population aging. While reductions in mortality attributed to improved risk factor management are evident, the aging population is expected to counterbalance these gains, leading to increased crude deaths in many countries. These findings highlight the urgent need to implement region-specific strategies that address both modifiable risk factors and the demographic transition to mitigate the future burden of stroke in the region.

The most countries showed significant reductions in stroke mortality for both sexes. These results are similar to previous studies that reported decreases in the mortality in the last decade.[19] Between 1975 and 2015, Latin America and the Caribbean experienced an overall decrease in stroke mortality close to −1.9 %, especially in Chile, Colombia, and

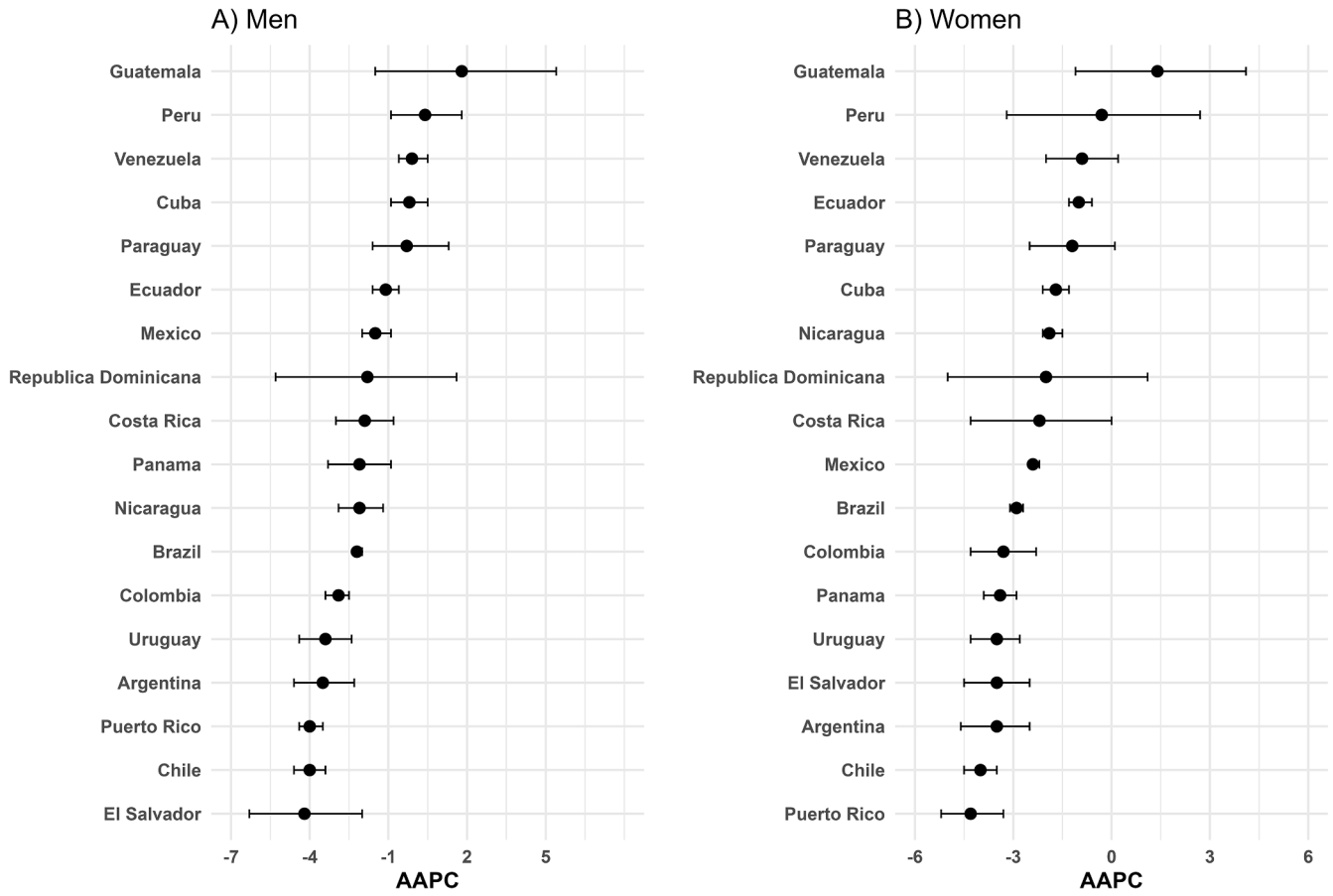

Fig. 1. Age-standardized (SEGI's world standard population) stroke mortality rates per 100,000 persons-years in 2020 and predicted 2035 in Latin America and the Caribbean. *Data from 2019 for Ecuador, 2018 for El Salvador, 2019 for Panama, 2017 for Puerto Rico, 2018 for Republica Dominicana, and 2016 for Venezuela.

Uruguay.[4] These trends coincide with regional efforts to increase public awareness of cardiovascular risk factor and the implementation of effective stroke health policies.[20] However, while these reductions suggest progress in stroke prevention and management, our study follows an ecological design, which does not allow for direct causality to be established between these efforts and the observed mortality trends.[21] The role of healthcare access, national policies, and socioeconomic disparities in shaping stroke mortality remains an important area for further investigation. Future research should aim to integrate longitudinal health policy evaluations and socioeconomic data to assess how these factors contribute to the observed trends.

Despite the reduction in mortality in most regions, the burden has increased in some countries.[22] It is important to highlight that stroke disproportionately affect the poorest sectors of the population, having a negative impact on families, communities and governments.[23] This explains why, despite advances, challenges persist in the accessibility of healthcare and the effective management of risk factors such as hypertension and diabetes, which require continued attention.[23] Socioeconomic disparities contribute to differences in stroke prevention,[24] timely diagnosis,[25] and treatment adherence,[26] reinforcing the need for comprehensive public health strategies tailored to each country's realities.

Modifiable risk factors continue to be determinants of stroke mortality in LATAM. In South America, the predominant risk factors for stroke include arterial hypertension (18.7 %), obesity (15.4 %), smoking (13.5 %), low muscle strength (5.6 %), and diabetes (5.3 %)[27-30]. However, despite efforts to improve access to antihypertensive drugs, a gap remains in the effective treatment of hypertension, especially when compared to regions such as Europe, where more rigorous control has been achieved[31] In contrast, women, being more represented in older age groups, have a higher incidence of subarachnoid hemorrhage, although this association remains an area for further research.[32] The relationship between stroke mortality projections and the prevalence of key risk factors, such as hypertension and obesity, varies across countries in Latin America and the Caribbean.[4,10] Mexico and Venezuela, which have some of the highest rates of hypertension and obesity in the region, exhibit different projected trends in stroke mortality. While Mexico is expected to experience a decline in mortality, Venezuela's mortality rates are projected to increase. This divergence may be explained by differences in healthcare access, stroke prevention strategies, and the socioeconomic crisis affecting Venezuela, which has likely hindered effective management of cardiovascular risk factors.[33]

Public health interventions have played a crucial role in shaping past stroke mortality trends in some countries. For example, smoking bans and tobacco control policies have contributed to a reduction in stroke mortality in countries like Uruguay and Brazil,[34] where national legislation has led to significant declines in smoking prevalence.[35,36] Additionally, obesity prevention programs and hypertension control initiatives in Chile.[37,38] and Costa Rica.[39] have been associated with improvements in cardiovascular health indicators. However, in several countries, the growing burden of obesity and uncontrolled hypertension remains a challenge, particularly where access to healthcare and preventive programs is limited.

Disparities in stroke mortality trends across Latin America and the Caribbean reflect differences in healthcare system strength, access to preventive services, and the effectiveness of national health policies. Countries such as Chile.[40,41] and Puerto Rico,[42] which have well-established healthcare systems and comprehensive stroke management programs, have demonstrated the most significant reductions in mortality rates. These nations have benefited from early detection

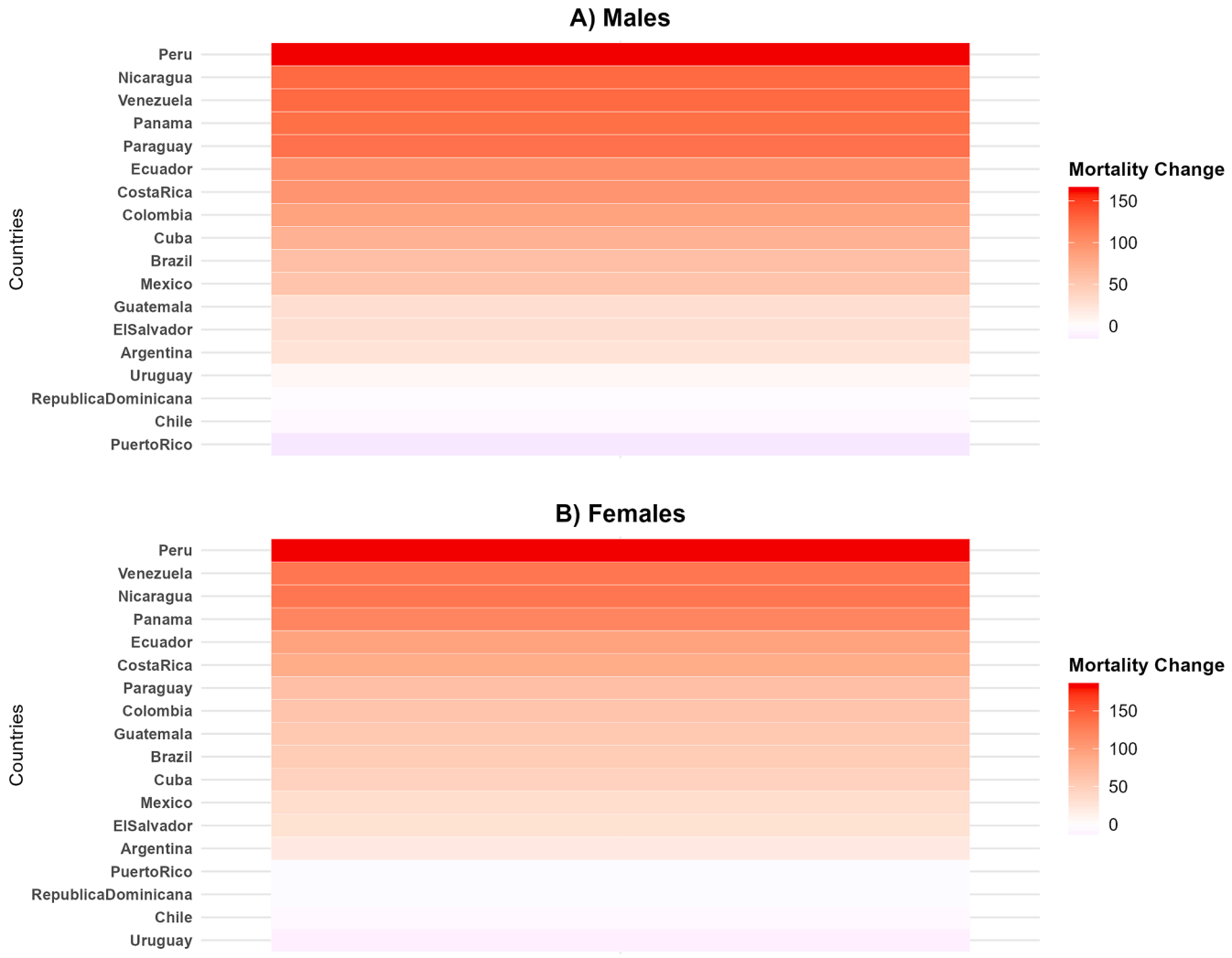

Fig. 2. Average annual percent change (AAPC) and 95 % confidence interval (CI) for gastric cancer age-adjusted mortality rates among Hispanic/Latino populations in the United States, Latin America, and the Caribbean by sex, 1997*–2020**. *Data from 2001 for Cuba, 2005 from Guatemala, 1998 from Mexico and Panama,1999 from Peru and Puerto Rico; **Data from 2018, El Salvador 2019 for Panama, 2017 for Puerto Rico, 2016 for Venezuela

programs, improved hypertension control, greater availability of specialized stroke care, and the implementation of public health strategies focused on cardiovascular risk reduction. On the other hand, countries with weaker healthcare systems, such as Venezuela and Peru, continue to face significant challenges in stroke prevention and treatment.[43] In Venezuela, the humanitarian crisis has led to medication shortages, reduced access to essential healthcare services, and a decline in stroke awareness and prevention programs.[33] Similarly, in Peru, despite improvements in healthcare access, disparities in rural and urban healthcare availability, inadequate hypertension control, and limited access to specialized stroke care contribute to the persistence of high mortality rates.[44] These healthcare limitations hinder the effectiveness of stroke prevention and treatment programs, leading to increased stroke burden in these countries.

The projected increases in mortality from cerebrovascular disease for Peru and Venezuela by 2035 reflect a major public health challenge in these countries. In both countries, the impact of population growth, particularly in older age groups, is a critical determinant in the increase in deaths from this disease. In addition, the prevalence of risk factors such as hypertension, overweight, obesity, and the limited control of other comorbidities, contribute significantly to the projected increase in mortality rates. For example, Peru has reported an increase in the prevalence of several stroke risk factors.[45,46] Furthermore, another problem is the reduction in the number of patients who know their diagnosis.[47] In Venezuela, the complex humanitarian crisis could be affecting the epidemiology of stroke risk factors, impacting both prevention and treatment strategies.[33] These trends highlight the urgent need to implement effective primary and secondary prevention strategies aimed at reducing exposure to risk factors and improving access to public health interventions, particularly in vulnerable populations.

The results of our study demonstrate the efforts of Latin American countries to counteract the burden of stroke in the region. Previous studies have recommended the analysis of this disease in Latin American countries with verified data.[9,20]; in this sense, our study provides a clear perspective of this problem with authentic and standardized data. However, efforts need to be strengthened, as stroke continues to be one of the most prevalent conditions in less developed health systems in Latin America.[10] Moreover, while our study identifies important regional trends in stroke mortality, it does not incorporate a detailed analysis of national health policies and healthcare system effectiveness. Future research should explore how differences in stroke care infrastructure, emergency response capacity, and national prevention programs influence these trends.

Based on the findings obtained, we make suggestions to guide future research. First, we propose a substantial improvement in data quality and accuracy through effective collaborations between different institutions. Secondly, we recommend the inclusion of health determinants in subsequent research, with the aim of identifying risk

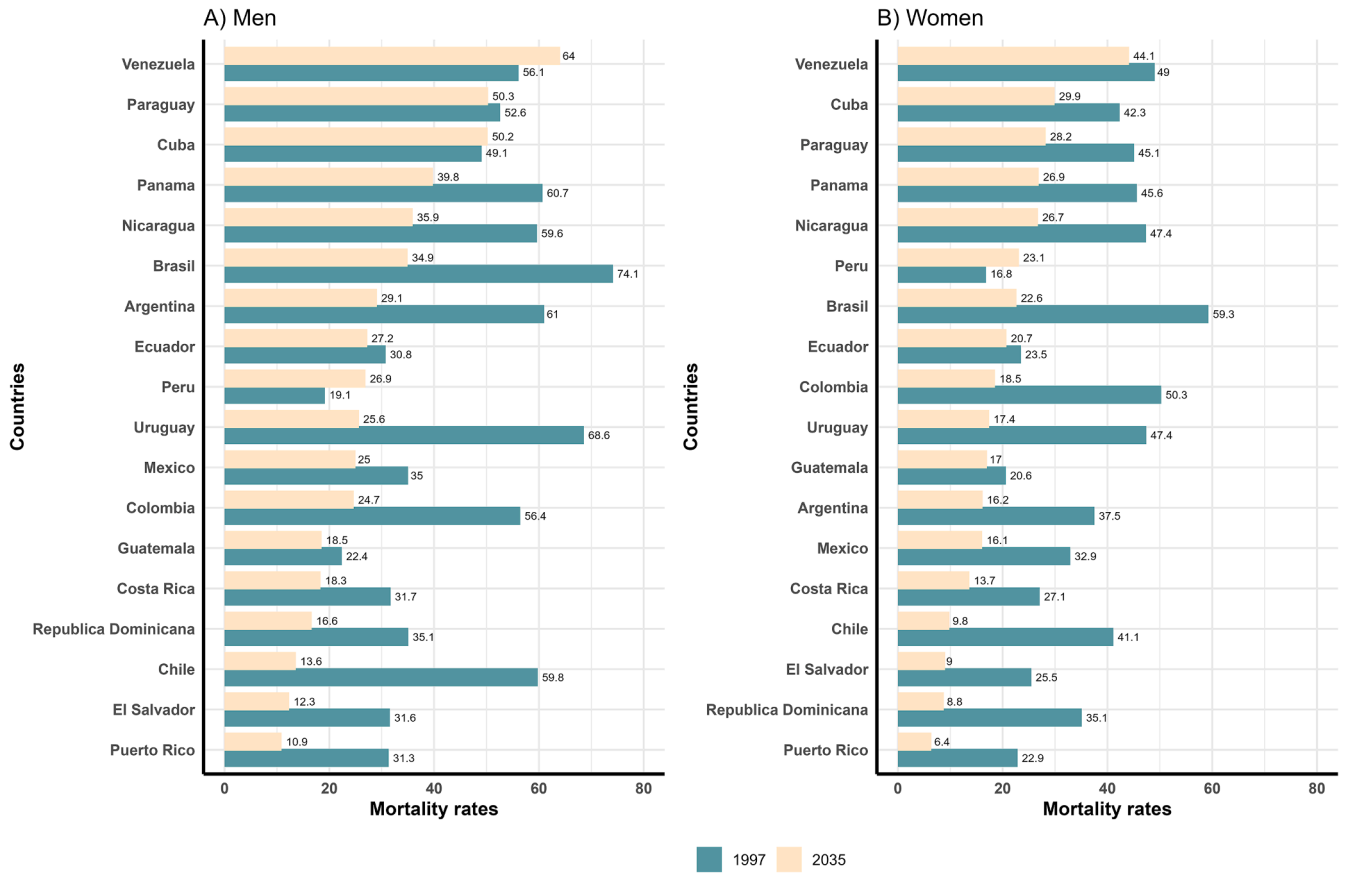

Fig. 3. Heatmap of Stroke Mortality Trends in Latin America and the Caribbean (2020–2035)

factors that affect the health of the population. Finally, we urge continued reporting on stroke mortality trends in Latin American countries during the period following our study, in order to maintain effective monitoring of the evolution of this problem in the region, following the example from other studies.

This study has some limitations. As an ecological study, it does not incorporate individual-level data on key risk factors such as hypertension, obesity, or smoking, which could influence stroke mortality trends. Although our projections are based on observed mortality patterns, they do not directly account for changes in risk factor prevalence, access to healthcare, or control measures at the individual level. Additionally, the database provided by the WHO does not provide the possibility of analyzing other variables that may also be associated with mortality, such as socioeconomic level, comorbidities, nutritional assessment, among others. Another important limitation is that our projections assume a continuation of historical trends without explicitly incorporating unforeseen external disruptions, such as global pandemics, economic downturns, or significant medical advancements in stroke prevention and treatment. While the Nordpred model applies trend attenuation (0 %, 25 %, and 50 %) to accommodate potential changes in mortality patterns, it does not fully account for external shocks that may alter the trajectory of stroke mortality in specific countries. The COVID-19 pandemic, for instance, has influenced healthcare systems and stroke-related outcomes globally,[48] and emerging public health initiatives or breakthroughs in treatment could further modify future mortality trends. Future studies should consider integrating dynamic models that incorporate real-time epidemiological and policy-driven data to enhance the accuracy of long-term projections. Additionally, data reliability may vary across countries, particularly in regions affected by economic and political crises, such as Venezuela. Underreporting or misclassification of stroke-related deaths may introduce some degree of uncertainty in mortality estimates,[49] especially in countries where healthcare and vital statistics systems have been disrupted. The WHO mortality database relies on national reporting systems, which differ in terms of completeness and accuracy, particularly in contexts where health surveillance infrastructure has been weakened. While our analysis focuses on long-term trends, future studies should integrate complementary data sources and employ sensitivity analyses to assess the impact of data quality on mortality projections. As for the strengths, a meticulous analysis of the WHO database was conducted, ensuring a proper evaluation of the data for each country, year, and age group. Additionally, a wide study period was covered (1997 to 2020), multiple countries in LAC allowing for an updated and comprehensive view of death trends. Moreover, it is also the first study in the region that predicts deaths by the year 2035, so that each country can implement measures to reduce the number of deaths from this disease. It is expected that the results of this study will serve as an epidemiological basis for improvements in the public policies of each evaluated country and for future studies on this disease, also aiming to promote the collection of epidemiological data from each country.

Future Directions

The main future directions taking into account these results would be the development of specific strategies for countries with upward trends, mainly Venezuela, Peru and Cuba. This includes the interaction between population aging and risk factors such as arterial hypertension, obesity and insufficient control of chronic diseases. Further studies should focus on interventions aimed at these vulnerable populations. In addition, it is important to evaluate in detail the prevention policies implemented in countries with significant declines in mortality rates, such as Chile and Puerto Rico, in order to identify strategies that can be replicated in other contexts. In addition, it is essential to study the effectiveness of programs that address modifiable risk factors in communities with limited access

to health services. Finally, future research should analyze in detail how aging planning policies and improved access to geriatric services could mitigate this impact.

Conclusions

In conclusion, we report a reduction in stroke mortality trends in most Latin American and Caribbean countries between 1997 and 2020, probably due to increased public awareness of vascular risk factors promoted by health authorities and the implementation of effective health policies. By 2035, there will be an increase in stroke deaths, mainly due to the structure and size of the population, which is stronger than the decrease in risk factors, resulting in a net increase in stroke deaths in most countries in Latin America and the Caribbean.

Supplementary materials

Supplemental Table 1. Supplementary Table 1. Average annual percent change (APC) and 95 % uncertainty intervals (UIs) for stroke mortality rates in Latin America, and the Caribbean by sex, 1997-2020

Supplemental Fig. 1. Evolution of stroke mortality among men in Latin America and the Caribbean, 1997* to 2020** and its prediction for 2035. *Data from 2001 for Cuba, 2005 from Guatemala, 1998 from Mexico and Panama,1999 from Peru and Puerto Rico; **Data from 2018, El Salvador 2019 for Panama, 2017 for Puerto Rico, 2016 for Venezuela

Supplemental Fig. 2. Evolution of stroke mortality among women in Latin America and the Caribbean, 1997* to 2020** and its prediction for 2035. *Data from 2001 for Cuba, 2005 from Guatemala, 1998 from Mexico and Panama,1999 from Peru and Puerto Rico; **Data from 2018, El Salvador 2019 for Panama, 2017 for Puerto Rico, 2016 for Venezuela

During the preparation of this work the author(s) used ChatGPT in order to improve the writing in English in some of the requested lines. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication

Data Sharing

All data is available for sharing upon publication and can be requested from the corresponding author

CRediT authorship contribution statement

J. Smith Torres-Roman: Writing – review & editing, Writing – original draft, Supervision, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Carlos Quispe-Vicuña:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation. **Alexandra Benavente-Casas:** Writing – original draft, Formal analysis, Data curation. **Dante Julca-Marin:** Writing – original draft, Formal analysis, Data curation. **Wagner Rios-Garcia:** Writing – original draft, Formal analysis, Data curation. **Mabel R. Challapa-Mamani:** Writing – original draft, Formal analysis, Data curation. **Lita del Rio-Muñiz:** Writing – review & editing, Writing – original draft, Supervision, Methodology. **Jorge Ybaseta-Medina:** Writing – review & editing, Supervision, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jstrokecerebrovasdis.2025.108286.

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