Cardiovascular disease in the Americas: the epidemiology of cardiovascular disease and its risk factors

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Summary

This first article of the Series about Cardiovascular Disease in the Americas summarizes the epidemiology of CVD and its risk factors, and population-level strategies in place aimed at CVD prevention. While age-standardized CVD incidence and CV mortality rates have been decreasing across in the Americas since 1990, the annual number of CVD cases and related deaths have increased due to population growth and ageing. The burden of CVD is also slowly transitioning from high-income countries in North America to middle-income countries in Latin America and the Caribbean. Trends in CV risk factor levels have been mixed, with declines in smoking and mean cholesterol counterbalanced by higher prevalence of obesity and diabetes. Population-wide strategies aimed at controlling cardiometabolic risk factors and tobacco use have been implemented with varying degrees of success. There is a need to better implement existing CVD prevention strategies in the region.

Keywords: Cardiovascular disease; Epidemiology; Americas

Introduction

In 2015, member states of the United Nations adopted the Sustainable Development Goals as part of a commitment to improve the health of the global population.[1,2] A key target outlined in the SDGs is a one-third reduction in premature mortality related to non-communicable diseases by 2030 through improvements in their prevention and treatment.[1] Cardiovascular disease (CVD) remains the leading cause of death and disability worldwide.[3–5] The Global Burden of Disease (GBD) study estimates that in 2021, CVD caused 19 million deaths globally and accounted for 438 million disability adjusted life years lost.[3,4] Achieving a large reduction in non-communicable disease related premature mortality require comprehensive and multilevel strategies for the prevention and management of CVD.[6,7]

Approximately 1 billion people live in the region of the Americas, representing 13% of the global population.[8] Between 1990 and 2021 the population in North America grew from 275 to 375 million people. During the same period of time, the population in Latin America and the Caribbean grew from 442 to 656 million people.[8] One-third of the regions' population now lives in North America, while two-thirds lives in Latin America and the Caribbean. In 2021, the GBD estimated that in the region of the Americas, CVD caused 2 million deaths and contributed to 43 million disability adjusted life years lost, second only to respiratory infections in the context of the COVID-19 pandemic.[3,4] As a leading cause of death and disability in the Americas, there is a need to examine the current epidemiology of CVD and its predominant risk factors within the region, and how current strategies for CVD prevention and treatment can be improved. This is the first of two narrative review articles examining the status of CVD in the Americas. In this article, we first summarize the current epidemiology of CVD in the region of the Americas, focusing on differences in CVD prevalence, CVD incidence, CV mortality compared to other world regions, and among major geographical subregions in the Americas. We then examine variations in the predominant risk factors for CVD development in the region, and the strategies that are currently in place at the population-level to control these risk factors.

Search strategy and article selection

For the sections of this review focusing on CVD prevalence, CVD incidence and CV mortality, data were

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obtained through the publicly available Global Health Data Exchange, derived from the GBD Study 2021 (GBD 2021), coordinated by the Institute for Health Metrics and Evaluation.[3–5] Using standardized approaches, the GBD estimates deaths and disease burden across 204 countries or territories at global, regional, national or subnational levels.[5] Deaths are classified using International Classification of Disease codes from vital registries, or household mortality surveys.[5] CVD cases are defined using structured clinical case definitions, which have been previously reported.[5,9] In the GBD 2021 iteration, CVD incidence is defined as the cumulative incidence of common types of CVD (i.e. ischemic heart disease, stroke, peripheral arterial disease) as well as less common CVDs (e.g. cardiomyopathy, atrial fibrillation, valvular disease).[9] We collected and present age-standardized rates of CVD prevalence, incidence and mortality between 1990 and 2021 in males and females combined for the overall region of the Americas and for major geographical subregions. Rates in males and females are also reported separately in a dedicated section of the article.

To identify articles for our sections focused on CVD risk factors we performed separate searches in PubMed for articles published in the English Language between 2014 and February 2024 that included terms to identify regions of interest (i.e. global, worldwide, North America, Latin America, South America, Caribbean), a term for each risk factor studied (i.e. hypertension, high blood pressure, diabetes, obesity, cholesterol, diet quality, physical activity, physical inactivity, smoking, tobacco use), and an epidemiological term (e.g. prevalence). To identify articles for our sections focused on CVD prevention strategies, we performed separate searches in Pubmed for articles published in the English Language between 2014 and February 2024 that included terms to identify regions of interest (i.e. global, worldwide, North America, Latin America, South America, Caribbean), and a term for each CVD prevention strategy of interest (i.e. blood pressure control, hypertension control, 'WHO HEARTS', statin use, diabetes prevention, obesity prevention, smoking cessation, smoking prevention, 'MPOWER'). We also identified relevant articles through each of the authors. Articles were selected for inclusion based on their recency, inclusion of regional (or subregional) comparisons, and relevance to the scope of this review.

Cardiovascular disease in the Americas compared to other world regions

Unless otherwise specified, data for this section were extracted from GBD 2021.[3,4] The World Health Organization (WHO) geographically classifies the world into six world regions: the region of the Americas, the African region, the South-East Asian Region, the European Region, the Eastern Mediterranean region, and the Western Pacific Region. In 2021 the age-standardized prevalence of CVD in the Americas was estimated to be 7.7%, which was lower than the Eastern Mediterranean (10.1%) region, similar to the African (7.9%) and European (7.8%) regions, and higher than the South-East Asian (7.1%) and Western Pacific (6.7%) regions. The age-standardized incidence of CVD in 2021 was estimated to be 639 cases per 100,000 persons, the lowest among WHO world regions. Comparatively, the age standardized incidence of CVD in the European region was 764 cases per 100,000 persons. However, during this time the annual number of CVD cases in the Americas increased from 2.9 million in 1990 to 4.4 million in 2021. The increasing absolute number of CVD cases in the context of declining age-standardized rates of CVD is likely the function of population growth and ageing.[10] In 2021, CVD accounted for 1.1 million deaths in the Americas (representing 11% of CVD related deaths globally); the age standardized CV mortality rate was 181 per 100,000 persons, which was the lowest among WHO world regions. Although the Americas account for a relatively small proportion of all CV deaths globally, CVD accounts for a third of deaths in the region. Similar to the global rankings, ischemic heart disease and stroke are leading causes of death in the Americas (Table 1). Goals to reduce premature NCD related mortality in the region require a focus on reducing CV mortality, particularly due to ischemic heart disease and stroke.

Cardiovascular disease within the Americas

Unless otherwise specified, data for this section were extracted from GBD 2021.[3,4] For comparisons within the region of the Americas, we primarily utilized the World Bank's region classification to separate countries into the subregion of North America (consisting of Canada, the United States of America, and Bermuda), and the subregion of Latin America and the Caribbean (consisting of all other countries).

Prevalence and incidence of cardiovascular disease

The age-standardized prevalence of CVD in 2021 was approximately 8.4% in North America. Ranges for the prevalence of CVD between countries in North America are shown in Fig. 1. Over three decades, the age-standardized incidence of CVD has decreased in North America from 986 new cases per 100,000 persons in 1990, to 670 cases per 100,000 persons in 2021 (Fig. 2). However, the yearly number of new CVD cases still increased during this time from 3.4 million in 1990 to 4.3 million in 2021, likely due to population growth and ageing. As a consequence, the total number of CVD cases in North America increased from 29 million to 48 million over this period. Among countries in North America, the age-standardized incidence of CVD in

Rank		Global: number of deaths ('000s)		Americas: number of deaths ('000s)
1	Ischemic heart disease	8991	COVID 19	1808
2	COVID-19	7887	Ischemic heart disease	1080
3	Stroke	7252	Stroke	521
4	COPD	3719	COPD	377
5	Other COVID outcomes	2686	Alzheimer's disease	354
6	Lower respiratory tract infections	2183	Chronic kidney disease	349
7	Lung Cancer	2017	Diabetes	310
8	Alzheimer's disease	1953	Other COVID outcomes	300
9	Neonatal disorders	1831	Lung Cancer	293
10	Diabetes	1656	Lower respiratory tract infections	272

COPD: chronic obstructive pulmonary disease, CKD: chronic kidney disease. Data complied from GBD 2021.[4]

Table 1: **Leading causes of death globally and in the Americas in 2021.**

2021 was similar in Canada (638 cases per 100,000 persons) and the United States of America (673 cases per 100,000 persons) (Fig. 1).

In 2021, the age-standardized prevalence of CVD In Latin America and the Caribbean was 7.0%. Ranges for the prevalence of CVD among countries in this subregion are shown in Fig. 1. Between 1990 and 2021, the age-standardized incidence of CVD in this subregion decreased from 704 cases per 100,000 persons to 589 cases per 100,000 persons (Fig. 2). However, new CVD cases nearly doubled from 2.0 million in 1990 to 4.1 million in 2021 and the total number of prevalent CVD cases in the subregion increased from 20 million to 47 million during this period, likely due to the effects of population growth and ageing. Most countries in Latin America and the Caribbean experienced a decline in the age-standardized incidence of CVD between 1990 and 2021. Ranges for CVD incidence in 2021 among countries in the subregion are summarized in Fig. 1, with the highest age standardized incidences of CVD occurring in several Caribbean countries, Venezuela, Guyana and Suriname, with each having over 800 cases per 100,000 persons.

Differences in the age-standardized incidence of the most common subtypes of CVD—ischemic heart disease, stroke, and peripheral vascular disease—between subregions are summarized in Fig. 2. In 1990 the age-standardized incidence of ischemic heart disease was substantially higher in North America compared to Latin America and the Caribbean; but North America

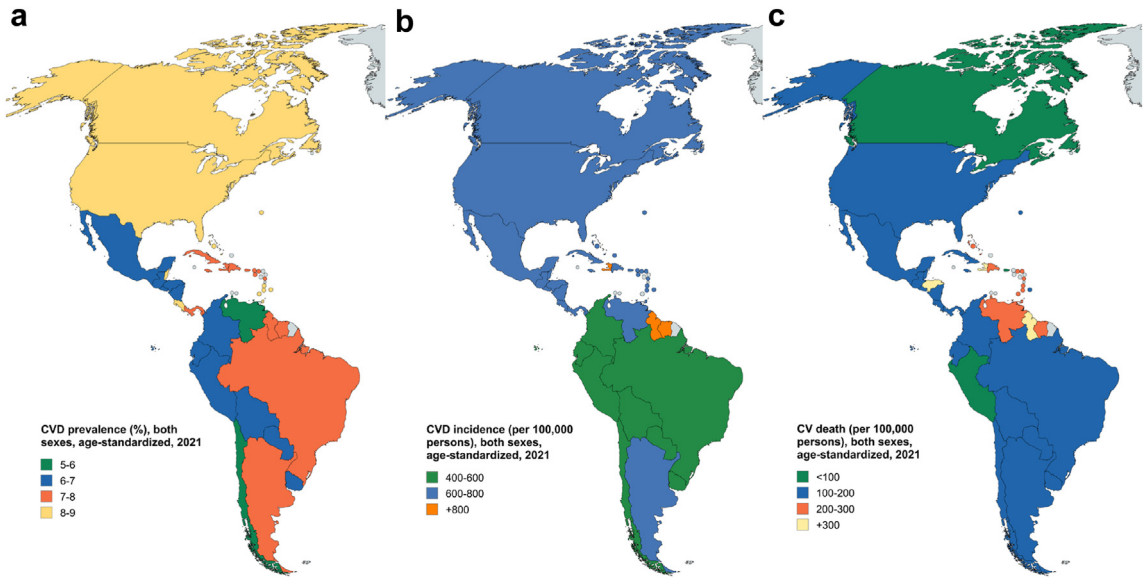

Fig. 1: **Age-standardized a) cardiovascular disease prevalence b) cardiovascular disease incidence and c) cardiovascular mortality in the Americas for 2021.** CVD, cardiovascular disease. Data complied from the GBD 2021.[4] This figure was created using MapChart (https://www.mapchart.net). Licence: CC BY-SA 4.0.

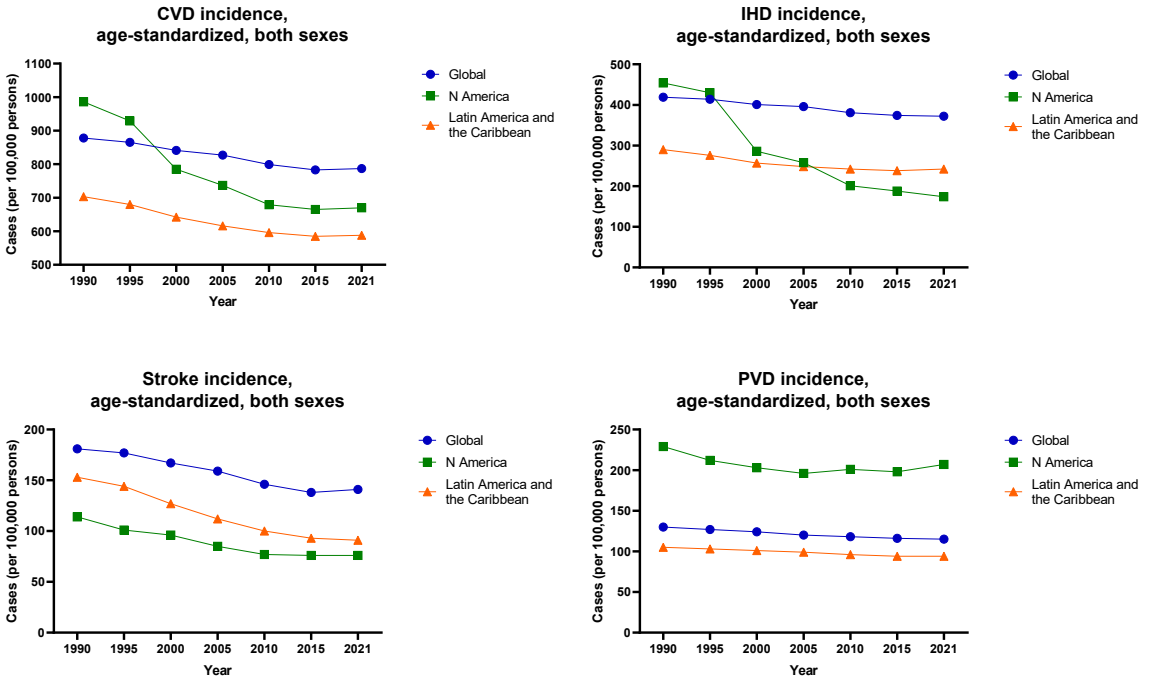

***Fig. 2:* Age-standardized incidence of cardiovascular disease and its common subtypes in the Americas, 1990 to 2021.** Data are for rates in men and women combined. CVD, cardiovascular disease, N America, North America. Data complied from GBD 2021.[4]

has experienced a much larger decline in ischemic heart disease since this time, and in 2021 the incidence of ischemic heart disease was similar between subregions. Age standardized incidence of stroke has been persistently higher in Latin America and the Caribbean compared with North America since 1990. The incidence of peripheral vascular disease is reported to be substantially higher in North America compared with Latin America and the Caribbean, but this may reflect better methods of detection in North America.[11]

Cardiovascular mortality

In North America, the age-standardized CV mortality rate substantially decreased from 260 per 100,000 persons in 1990 to 139 per 100,000 persons in 2021 (Fig. 3). This large decrease in age standardized CV mortality has resulted in relatively stable absolute numbers of yearly deaths from CVD (in the range of 900,000 to 1 million deaths per year). The largest decrease in the age-standardized CV mortality rate occurred between 1990 and 2010, with modest changes since that time (Fig. 3). In 2021, age standardized CV mortality rate was substantially lower in Canada (108 per 100,000 persons) than in the United States of America (157 per 100,000 persons) (Fig. 1).

Between 1990 and 2021, age-standardized CV mortality in Latin America and the Caribbean decreased from 288 to 157 deaths per 100,000 persons (Fig. 3). This has been counterbalanced by rapid population growth and ageing, resulting in an increase in the annual number of persons dying from CVD in the subregion, from 679,000 in 1990 to over 1 million in 2021. Similar to North America, the largest decrease in age-standardized CV mortality was observed between 1990 and 2010, and only modest changes have occurred since 2010. Both the age-standardized CV mortality rate and the yearly number of deaths due to CVD are now higher in Latin America and the Caribbean than in North America. However, there is also significant variation in CV mortality trends within the subregion. For example, reductions in mortality from ischemic heart disease have been largest in the Southern Cone and Andean regions of South America, and smaller in Mexico, Central America, and the Caribbean.[12] In 2021, most countries had an age-standardized CV mortality rate between 100 and 200 deaths per 100,000 persons, with lower rates in Peru, and higher rates in Venezuela, Guyana, Suriname, Honduras, and some Caribbean countries (Fig. 1).

Cardiovascular disease in males compared to females

For the subregions of North America, and Latin America and the Caribbean trends in CVD incidence and mortality in males and females have been consistent with trends for the overall population. However, females generally have an overall lower incidence of CVD

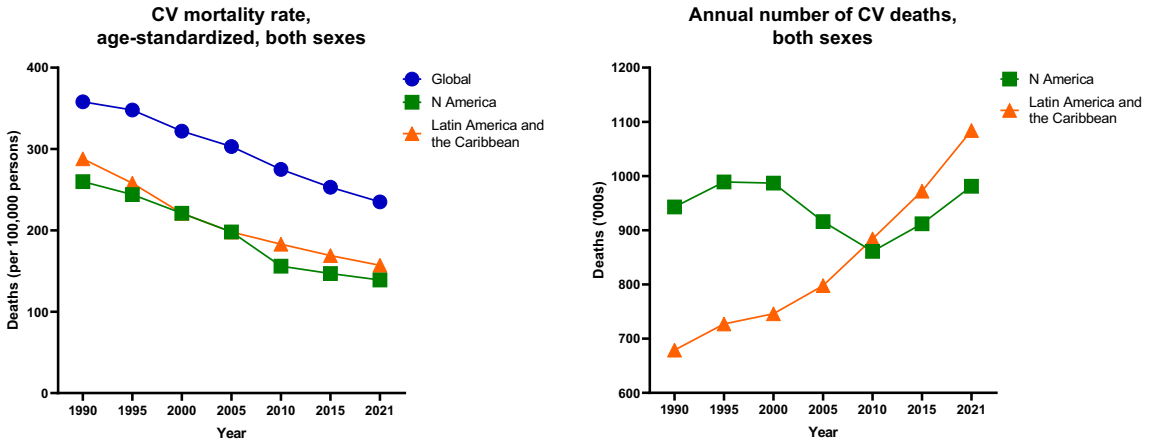

***Fig. 3:* Cardiovascular mortality rate and number of cardiovascular deaths in the Americas, 1990 to 2021.** Data are for rates in men and women combined. CV, cardiovascular; N America, North America. Data complied from the GBD 2021.[4]

associated mortality compared with males. In 2021, the incidence of CVD in North America was 781 per 100,000 males compared to 568 per 100,000 females. Similarly, in Latin America and the Caribbean, CVD incidence was 655 per 100,000 males compared to 531 per 100,000 females. In 2021, CVD mortality in North America was 173 per 100,000 males compared to 110 per 100,000 females. Similarly, CVD mortality in Latin America and the Caribbean was 188 per 100,000 males compared to 132 per 100,000 females.

Availability of data across the region and the potential for bias

When comparing estimates of CVD between sub-regions in the Americas, some factors related to the availability and quality of source data need to be considered. First, while the completeness of death registration is very high in the Americas, with 95% of deaths registered, there is variation in the quality of useable data to confirm the cause of death, with less useable data in Latin America and the Caribbean than in North America.[13] While estimation models account for differences in source data quality, this could still result in some degree of misclassification and under-estimation of CV mortality in Latin America and the Caribbean.[13]

Source data on non-fatal CVD outcomes (and therefore disease incidence) vary to an even larger extent between countries in the Americas, with less data generally available to estimate the incidence of CVD and its subtypes in Latin America and the Caribbean compared to North America.[11] This could lead to an underestimation of the prevalence and incidence of CVD in Latin America and the Caribbean. Finally, CVD could be underdiagnosed in Latin America and the Caribbean due to more limited healthcare resources.[14]

Summary of cardiovascular disease trends in the Americas

While the age-standardized incidence of CVD has decreased across the Americas, the absolute number of CVD cases has increased, likely due to the dominant effects of population growth and ageing. Incident CVD remains higher in North America compared to Latin America and the Caribbean, which may be partly related to better detection of some common CVDs (such as peripheral arterial disease) in North America.[11] Trends in the age-standardized CV mortality rate for both sub-regions suggest that substantial gains occurred between 1990 and 2010, but have since largely flattened. CV mortality is now higher in Latin America and the Caribbean compared to North America. Changes in CVD incidence and CV mortality since 1990 signal that the burden of CVD is shifting away from high-income countries in North America to middle-income countries in Latin America and the Caribbean.

Cardiovascular disease risk factors, and strategies aimed at their control

Predominant risk factors for cardiovascular disease development in the Americas

In an analysis of the multi-national Prospective Urban Rural Epidemiology (PURE) study in 155,722 individuals from 21 countries (including 5 countries in Americas), approximately 70% of the population attributable fraction for CVD globally was related to common cardiometabolic, lifestyle or environmental factors; with cardiometabolic risk factors (i.e. high blood pressure, cholesterol, diabetes, obesity) and tobacco use accounting for most of this risk.[15] Of these, high blood pressure (population attributable fraction of 22% for CVD) was the largest single risk factor, followed by high non-high-density lipoprotein (HDL) cholesterol (population

attributable fraction of 8%), tobacco use (population attributable fraction of 6%), abdominal obesity (population attributable fraction of 6%) and diabetes (population attributable fraction of 5%), and together these risk factors accounted for 47% of the population attributable fraction of CVD.[15] Similar results were reported by the Global Cardiovascular Risk Consortium, where in a pooled analysis of 112 cohort studies conducted in 34 countries and 8 geographic regions of the world, these five risk factors accounted for 56% of the population attributable fraction of CVD in females and 53% of the population attributable fraction of CVD in males.[16] Similar estimates were observed in both North America and Latin America, suggesting that half of CVD cases in the Americas are related to these four cardiometabolic risk factors and tobacco use. Finally, although the direct risk of CVD associated with poor-quality diet or with physical inactivity are smaller than the risks associated with cardiometabolic risk factors or tobacco use, both are important mediators for the development of obesity and diabetes, which are common in the region. The remainder of this article will focus on the epidemiology of these risk factors in the region, and current population-level strategies in place aimed at their control.

High blood pressure

High blood pressure is the largest population-level risk factor for CVD development in the world and in the Americas.[15,17] While observational data show that the risk of CVD related to high blood pressure increases proportionally above a threshold level of 110 mmHg systolic, hypertension is commonly defined as a blood pressure of greater than 140/90 mmHg for the general population.[18,19]

Global trends in the age-standardized prevalence of hypertension in adults ages 30–79 were reported by the Non-Communicable Disease Risk Factor Collaboration between 1990 to 2019.[20] In 2019, the global prevalence of hypertension was 34% in males and 32% in females, with no significant change compared to its prevalence in 1990. However, large differences in the prevalence of hypertension were reported between countries in the Americas. In Canada, the age-standardized prevalence of hypertension has decreased over time and in 2019 was among the lowest in the world, affecting 24% of males and 20% of females. In the United States of America, the prevalence of hypertension did not substantially change over time, and in 2019 was 34% in males and 29% in females. In contrast, most countries in Latin America and the Caribbean have experienced either an increase or no material change in the age-standardized prevalence of hypertension since 1990. In 2019 the prevalence of hypertension among countries in the subregion ranged widely, between 18 and 62%. The lowest prevalence of hypertension for the subregion was reported in Peru (23% in males and 18% in females). Hypertension prevalence exceeded 40% for both males and females in Argentina, Brazil, Paraguay, and most Caribbean countries.

High cholesterol

Higher levels of atherogenic lipids (e.g. non-HDL lipoprotein, low-density lipoprotein) increase the risk of atherosclerosis plaque development and atherosclerotic CV events. Globally, elevated cholesterol is the second largest population-level risk factor for CVD, and the largest risk factor for myocardial infarction.[15]

Global trends in age-standardized mean non-HDL lipoprotein cholesterol levels in adults have been reported by the NCD Risk Factor Collaboration between 1980 to 2018.[21] In 2018, the worldwide mean non-HDL cholesterol level was 3.3 mmol/L in males and in females, which is largely unchanged from 1980. Some regions have seen important declines (e.g. Europe, North America) in their populations' non-HDL cholesterol levels; a few have seen significant increases (e.g. South East Asia, East Asia); but most have seen only marginal changes. In 1980, non-HDL cholesterol levels in high-income Western countries such as Canada and the United States of America (3.8–4.0 mmol/L) were substantially higher than the global average. Since then, mean non-HDL cholesterol levels markedly declined in these countries, and in 2018 levels in males (3.3 mmol/L) and in females (3.2 mmol/L) were similar to the global average. In most Latin America and the Caribbean countries, mean non-HDL cholesterol levels have either modestly decreased or have remained largely unchanged over the same period of time, and in 2018 ranged around 3.4–3.7 mmol/L. Within the Americas, Central Latin American countries now have the highest mean non-HDL cholesterol levels in both males (3.7 mmol/L) and females (3.7 mmol/L).

Obesity

Obesity is an independent risk factor for CVD as well as several metabolic risk factors.[22] It is estimated that half of the risk of CVD development associated with obesity is related to its effects on metabolic risk factor levels (e.g. blood pressure, cholesterol, glucose), with the rest likely mediated through independent mechanisms.[23] Obesity when defined as a body mass index (BMI) > 30 kg/m^2 is associated with a 46% higher relative risk of CVD in males and a 64% higher relative risk of CVD in females when compared to a BMI <25 kg/m^2.[22] Measures more specific to central obesity, such as waist circumference or waist-to-hip ratio, better reflect visceral adiposity and provide incremental prognostic value to BMI.[24,25]

Although an imperfect measure of obesity, BMI has been the most frequently used measure to compare the prevalence of obesity across populations. Using a BMI >30 kg/m^2 to define obesity, over the last four decades the global prevalence of obesity has tripled in both males

and females.[26,27] In 2020, global estimates reported a prevalence of obesity of 14% in adult males and 18% of adult females. The prevalence of obesity is substantially higher in the Americas, where 32% of males and 37% of females are reported to be obese. Data from within the Americas report large differences in the prevalence of obesity among countries. In males, the highest prevalence of obesity occur in countries in North America. In females, the highest prevalence of obesity occur in several Caribbean countries, the United States of America, and Suriname. Estimates of obesity may also be higher in Latin America and the Caribbean if measures more specific to central obesity are used instead of BMI.[28]

Diabetes

Diabetes is associated with a 1.6- to 2.3-fold higher risk of developing CVD.[15] Between 1990 and 2019 the global age-standardized prevalence of diabetes has increased from 4.1% to 6.3% in males, and from 3.7% to 5.3% in females.[4] The prevalence of diabetes has also increased substantially in both North America and Latin America and the Caribbean, and currently both subregions have a higher prevalence of diabetes compared to the global average. In 2019, the age-standardized prevalence of diabetes in North America was 9.2% in males and 7.1% in females, while in Latin America and the Caribbean the prevalence was 7.4% in males and 6.6% in females. The increase in diabetes prevalence across the Americas is largely attributable to the increase in obesity prevalence across the region.[29]

Tobacco smoking

The risk of CVD development with tobacco smoking is related to smoking intensity (e.g. packs per day), age of initiation, and cumulative exposure (e.g. pack-years of smoking).[30,31] Trends in tobacco smoking within the Americas vary considerably by sex and among subregions (Table 2).[4,32] Since 1990, there has been a decline in smoking prevalence across the Americas, with the largest changes occurring between 1990 and 2010, and smaller changes occurring after 2010. Since 1990, the largest decline in tobacco smoking has occurred in Tropical Latin America (i.e. Brazil, Paraguay), which now has among the lowest rates of tobacco smoking in both males and females. Smoking prevalence is also low in the Andean Latin American countries. Large declines in tobacco smoking have also occurred in North America, the Caribbean, and Central Latin America. Countries in Southern Latin America (i.e. Argentina, Chile, Uruguay) have had more modest declines in smoking prevalence, and as a group now have the highest prevalence of male and female smokers in the Americas.

	Prevalence of current smoking in 2019		Percent change in prevalence from 1990 to 2019	
	Males	Females	Males	Females
North America	19.7	15.3	−31.8	−39.9
Caribbean	19.6	8.7	−30.9	−37.1
Central Latin America	22.7	8.7	−40.1	−42.2
Tropical Latin America[a]	11.2	6.9	−71.5	−74.3
Andean Latin America[b]	14.0	4.8	−16.9	−17.4
Southern Latin America[c]	31.3	23.3	−17.2	−20.0

Data compiled from the GBD 2019 Tobacco Collaborators. Lancet 2021; 397: 2337–60.[32] [a]Tropical Latin America = Brazil, and Paraguay. [b]Andean Latin America = Bolivia, Ecuador, and Peru. [c]Southern Latin America = Argentina, Chile and Uruguay.

Table 2: **Prevalence of tobacco use in men and women across subregions of the Americas.**

Diet quality

Consumption of an overall healthy diet is associated with a lower risk of CVD development.[33] Comparing diet quality among world regions can be complex given the vastly different types of foods that are consumed, and the generally limited availability of nationally representative and individual-level dietary surveys in many parts of the world. Using dietary surveys from 175 countries and Bayesian hierarchical modeling methods, Miller et al. compiled data on the consumption of nine healthy (fruit, vegetables, whole grains, legumes/nuts, seafood omega-3 fatty acids, polyunsaturated fatty acids) and unhealthy (sugar-sweetened beverages, unprocessed red/processed meat, sodium) components of diet to generate regional estimates of diet quality based on the Alternative Health Eating Index.[34] Using this method, overall diet quality in the Americas was lower than the global average, with Latin America and the Caribbean estimated to have the lowest diet quality among world regions. Generally, high consumption of sugar-sweetened beverages and unprocessed red/processed meat, and low consumption of whole grains and polyunsaturated fatty acids were the greatest contributors to lower diet quality in the Americas. Diet quality was substantially higher among rural versus urban areas and higher versus lower educated individuals in Latin America and the Caribbean, while these differences among groups were not found in other parts of the Americas.

Physical inactivity

Using representative survey data from 168 countries, Guthold et al. examined variations in physical inactivity in different regions of the world from 2000 to 2016.[35] Physical inactivity was defined as not achieving at least 150 min of moderate activity, or 75 min of vigorous physical activity (or an equivalent combination) per week. In 2016, the prevalence of physical inactivity in the region was worse than the global average. In high-income western countries (including Canada and the USA), 31.2% of males and 42.3% of females were

considered to be inactive. The highest prevalence of physical inactivity was observed in Latin America and the Caribbean, affecting 34.3% of males and 43.7% of females. These data suggest that physical inactivity is a substantially larger health problem in the Americas compare to other parts of the world.

Current population-wide strategies in place to improve cardiovascular risk factor control

It is increasingly recognized that controlling CV risk factors at the population-level requires comprehensive approaches that not only focus on high-risk individuals, but also reduce the distribution and mean levels of risk factors in entire populations. Historically, most CVD prevention strategies have focused on treating 'high-risk groups', but this approach focuses on a relatively small proportion of the overall population, while the vast majority of CV events occur in the larger group deemed to be at a lower CV risk.[36] CVD prevention strategies implemented at the population-level can take various forms, including the dissemination of health information (e.g. guidelines, advertising, awareness campaigns), population-wide risk factor screening, and government regulations or legislative actions. Many population level strategies considered to be the most effective (e.g. population screening, taxation of unhealthy products) have not been widely adopted due to lack of coordination, perceptions of high implementation costs, or opposing interests. This section will focus on the extent to which population-level strategies aimed at reducing cardiometabolic risk factor levels and tobacco use have been implemented in the Americas.

Hypertension control

While the management of hypertension is generally better in the Americas compared to other parts of the world, it remains suboptimal in the region (Fig. 4).[20] Pooled analyses of studies by the Non-Communicable Disease Risk Factor Consortium reported that in high-income Western countries (including the United States of America and Canada), 73% of females with hypertension were aware of the diagnosis, and while 64% received treatment, only 43% achieved adequate blood pressure control. In males with hypertension, 69% were aware of their diagnosis, 58% were treated and 37% were controlled. In Latin America and Caribbean countries, 72% of females with hypertension were aware of the diagnosis, 64% were treated, and 35% achieved control; while in males with hypertension, 57% were aware of the diagnosis, 47% were treated, and 23% achieved control.[20] These data indicate that less than half of individuals with hypertension in North America, and only about a quarter in Latin America the Caribbean, achieve hypertension control, with the largest implementation gaps occurring with identifying hypertension, and achieving blood pressure control in those who are treated.

In most countries in the Americas, few population-level strategies exist to improve hypertension treatment. The most widely adopted strategy thus far has been the use of standardized treatment guidelines or technical packages (i.e. a set of rules or procedures governing program implementation). One notable example has been the HEARTS technical package through the Pan American Health Organization (regional office of the WHO) to improve CVD and CV risk factor management in the primary care setting.[37–39] HEARTS outlines standardized processes focused on five domains of hypertension management (diagnosis, treatment, continuity of care, delivery systems, and performance evaluation), and has been implemented in over 2000 facilities in over 20 countries in Latin America and the Caribbean.[39] The Pan American Health Organization Strategic Fund has also been a successful mechanism of increasing access to blood pressure lowering medications in several countries through pooled procurement mechanisms that lower costs.[40] While these efforts demonstrate progress in improving hypertension care at the system level, additional strategies are needed to address barriers to hypertension diagnosis and achieving pharmacologic blood pressure control.

Control of elevated cholesterol

Mean cholesterol levels have decreased in North America, as well as in parts of Latin America and the Caribbean, demonstrating some overall progress in the control of this risk factor.[21] Most countries have now developed health recommendations related to diet and physical activity to promote CV health. In addition, several countries in the Americas have been successful in implementing government regulations to substantially reduce artificial trans fat in the food supply. In fact, bans on partially hydrogenated oils (the major contributor of artificial trans fat) in the United States of America, Canada and Brazil are among the most successful recent examples of government regulation to improve CV health at the population-level.[41] Treatment of dyslipidemia remains suboptimal across the Americas, with countries across the region reporting underuse of statins in both primary and secondary CVD prevention. In the United States of America, the National Health and Nutrition Examination Survey observed that statins were used in 51.9% of participants with diabetes, but in only 37.0% of participants with a history of CVD, and in 19.1% of participants without vascular disease but at increased CVD risk. Even lower rates of statins use have been reported in middle-income countries in the Americas, with only 11% of eligible individuals receiving statin therapy in primary CVD prevention, and 17% in secondary CVD prevention.[42]

Tobacco control

Adopted in 2005, the WHO Framework Convention on Tobacco Control has been the central organizing treaty

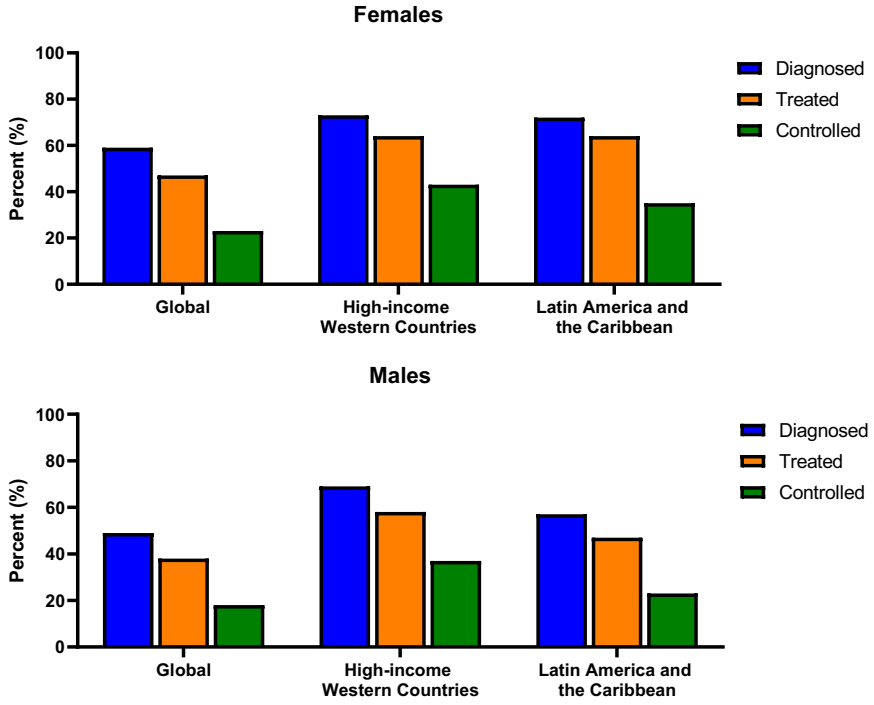

***Fig. 4:* Diagnosis, treatment, and control of hypertension globally and in the Americas.** Data compiled from the NCD Risk Factor Consortium. *Lancet* 2021; 398: 957–80.[20]

among countries to reduce tobacco use. In conjunction, the WHO's MPOWER package has been a key measure of successful tobacco control policy implementation; it is focused on achieving 'best practice' in six domains of tobacco control at a national (or equivalent) level (Table 3).[43,44] Greater adoption of these policies by countries correlate well with country-level reductions in tobacco use.[45]

Compared to most regions of the world, countries in the Americas have been relatively successful in implementing tobacco control policies. However, based on the 2022 Pan American Health Organization's report on tobacco control for the region of the Americas, the adoption of MPOWER has been variable, and there is still room for improvement.[43] Of the 6 MPOWER measures, Canada has implemented four, and the USA has

	Measure	Highest level of application or 'best practice'	Number of member states in the Americas achieving best practice[a]
M (Monitor)	Monitor tobacco use and prevention policies	There are recent (since 2015), representative (national), and periodic (at least every 5 years) data on both adults and youth	10: Bahamas, Brazil, Canada, Chile, Costa Rica, Ecuador, Panama, Peru, USA, Uruguay
P (Protect)	Protect against exposure to tobacco smoke	All indoor public places, workplaces, and public transport are completely smoke free (or at least 90% of the population are covered by subnational legislation)	24: Antigua and Barbuda, Argentina, Barbados, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Jamaica, Mexico, Panama, Paraguay, Peru, Saint Luca, Suriname, Trinidad and Tobago, Uruguay, Venezuela
O (Offer)	Offer help to quit tobacco use	National quit line available, and both NRT and some cessation services available and cost-covered	6: Brazil, Canada, Costa Rica, Jamaica, Mexico, USA
W (Warn)	Warn about the dangers of tobacco	Large warning (average of >50% coverage of front and back of package) with all appropriate characteristics on harm	22: Antigua and Barbuda, Argentina, Barbados, Bolivia, Brazil, Canada, Chile, Costa Rica, Ecuador, El Salvador, Guyana, Honduras, Jamaica, Mexico, Panama, Peru, Saint Luca, Suriname, Trinidad and Tobago, Uruguay, USA, Venezuela
E (Enforce)	Enforce bans of tobacco advertising, promotion and sponsorship	Ban on all forms of direct and indirect advertising	9: Antigua and Barbuda, Brazil, Colombia, Guyana, Mexico, Panama, Suriname, Uruguay, Venezuela
R (Raise)	Raise taxes of tobacco	Taxes comprise 75% or more of the retail sale price	3: Argentina, Brazil, Chile

NRT, nicotine replacement therapy. Data compiled from Pan American Health Organization. Report on Tobacco Control for the Region of the Americas 2022.[43] [a]Out of 35 WHO member states.

***Table 3:* MPOWER measurements for tobacco control in 35 World Health Organization member states in the Americas.**

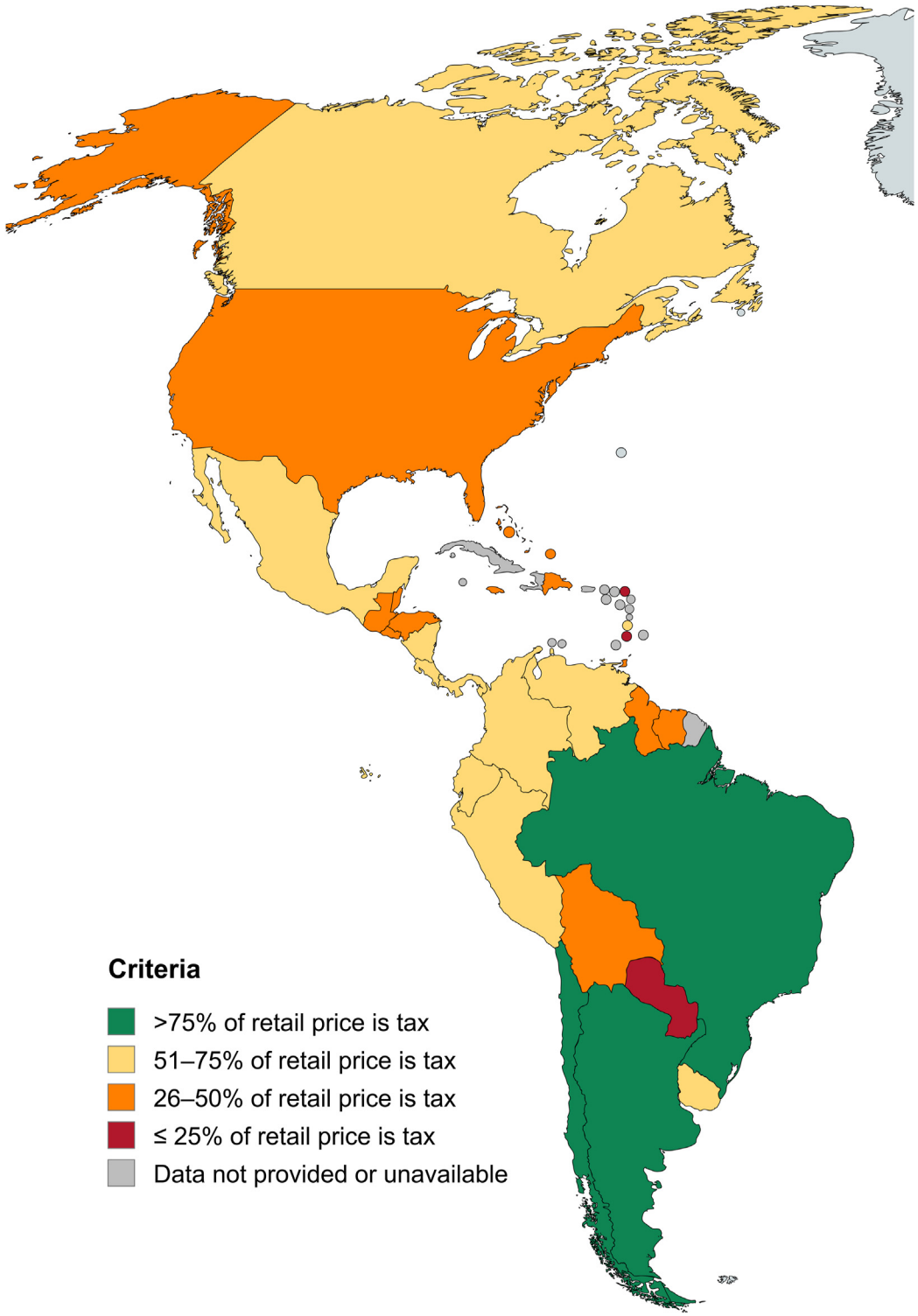

Fig. 5: **Amount of tobacco taxation relative to the retail sale price among countries in the Americas, 2020.** Reproduced from "Report on Tobacco Control for the Region of the Americas 2022." Washington, DC: Pan American Health Organization; 2022. Licence: CC BY-NC-SA 3.0 IGO.[43]

implemented three, at 'best practice'. Both have developed comprehensive strategies to monitor tobacco use, services to aid in tobacco cessation, and have regulated warnings on tobacco products; with Canada also having broad legislation to promote smoke free environments. Although increasing taxes is considered a very effective method to promote tobacco cessation, neither country has achieved 'best practice' in this measure.[43] In Latin America and the Caribbean, adoption of MPOWER measures has been highly variable. Brazil has adopted all six MPOWER measures at best practice, while Mexico, Panama, and Costa Rica have adopted four of six measures. Many countries have adopted regulations to warn of the harmful effects of tobacco products, and to promote smoke free environments; but there has been less adoption of smoking cessation programs, and restrictions on tobacco promotion. Similar to North America, tobacco taxation is underutilized at best practice (Fig. 5). Finally, several countries (particularly in Central America) have not implemented any MPOWER measure at best practice.[43]

Prevention of obesity and diabetes

Comprehensive strategies to control obesity and diabetes at the population-level aim to go beyond targeting individual behaviors, and to also address systemic factors that promote poor nutrition and physical inactivity. Given that poor diet and physical inactivity are key modifiable risk factors for both obesity and diabetes, population level strategies to control these risk factors overlap in their aims to improve diet quality and physical activity levels. Policies are broadly related to: 1) methods to estimate changes in the prevalence of these conditions, 2) providing individual guidance on healthy food choices and physical activity, 3) improving the availability and affordability of healthy foods; 4) taxing unhealthy foods; 5) food marketing regulations (e.g. food labelling, restricting marketing of unhealthy foods to youth); and 4) improving the built environment to promote activity.[46]

Most countries in the Americas have adequate systems to estimate population levels of obesity (using BMI) and diabetes, as well as general nutrition and physical activity guidelines. Streamlined processes to improve diabetes management at the primary care level have also been implemented in several countries through the Pan American Health Organization HEARTS technical package.[47] Government regulations or legislations that aim to improve environmental factors have been enacted with varying levels of success. For example, in a review of state-wide obesity prevention policies in the United States of America, Cleveland et al. reported some success in enacting policies related to school nutrition or improving food access and assistance, but less success with policies that improve the built environment, increase taxes on unhealthy foods, improve food labelling, or restrict marketing of unhealthy foods.[48] Among states, there were large

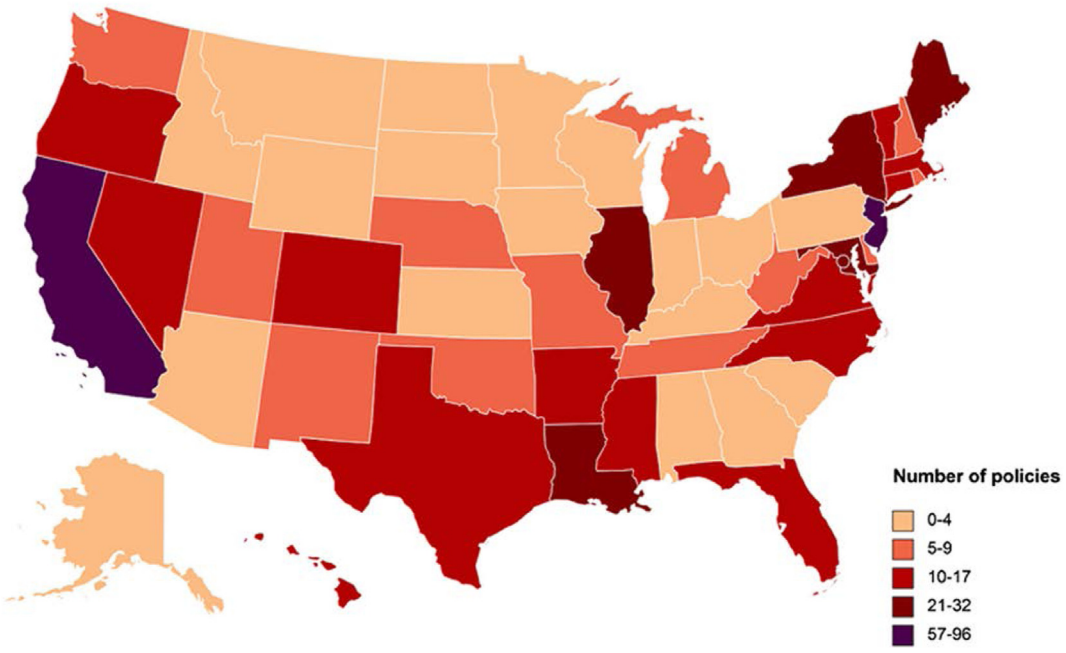

Fig. 6: **Number of state-level obesity prevention policies enacted in the United States of America between 2009 and 2019.** Reproduced from Cleveland LP, Grummon AH, Konieczynski E et al. "Obesity prevention across the US: A review of state-level policies from 2009 to 2019." Obes Sci Prac; 2023. Licence: CC BY-NC-ND 4.0.[48]

differences in the number of obesity prevention policies that were implemented (Fig. 6). A similar pattern has been observed in Latin America, where many countries have implemented policies or programs to improve school nutrition, food access, and food labelling, but there has been less efforts to restrict marketing of unhealthy foods.[49] Sugar sweetened beverage taxes are associated with higher prices, lower consumer demand, and lower consumption.[50,51] Recently, there have been successful legislative efforts to tax sugar sweetened beverages in several parts of the Americas, particularly in Latin America and the Caribbean. As of 2023, sugar-sweetened beverage taxes have been implemented in 22 countries in Latin America and the Caribbean, covering 81% of the population, as well as in 2 Canadian provinces and in 8 US cities.[52]

Summary of trends in CVD risk factor and measures aimed at their control

Trends in the levels of key CVD risk factors over the past few decades in the Americas have been mixed, with reductions in smoking and mean cholesterol levels counterbalanced by an increasing prevalence of obesity and of diabetes. Strategies to control CVD risk factors at the population level have only been implemented at moderate levels of success.

Conclusions: progress towards the UN Sustainable Development Goals

Over the past 30-years, age-standardized CV mortality has substantially declined in the Americas, but this trend has flattened since 2010, and with population grown and ageing the annual number of CV deaths continues to increase. These trends suggest that the region as a whole will continue to experience a significant burden of disease related morbidity and mortality from CVD. Preventing CVD and premature CV mortality (to align with the United Nations Sustainable Development Goals) will require substantial changes to current approaches. There is a need to better implement existing strategies that address CV risk factor control at the population-level. There is also the need to consider novel approaches that overcome current barriers to CVD prevention and care in the region, which will be the focus of the second part of this review.

Contributors

PJ contributed to the conceptualisation, design, and writing—original draft. He has directly assessed and verified the underlying data reported in the manuscript. SY contributed to the conceptualisation, design, and writing—review & editing. All other authors contributed to the design, writing—review & editing. PJ was responsible for the decision to submit the manuscript.

Declaration of interests

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