

Progress toward the 2030 targets of Brazil's Strategic Action Plan for noncommunicable diseases: a time-series and projection analysis of risk factors



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Summary

Background Brazil's progress toward national targets for modifiable noncommunicable diseases (NCD) risk factors remains underexplored. This study analyzed trends in NCD risk factors and projected their prevalence through 2030, assessing progress toward the Strategic Action Plan for NCDs (2021–2030).

Methods We analyzed 643,196 adults (≥ 18 years) from Vigitel—an annual telephone survey across the 26 Brazilian capitals and the Federal District—between 2009–2023. Prais–Winsten regression model was used to assess temporal trends and project prevalence through 2030. The 2019 survey served as baseline to evaluate progress toward Brazil's 2030 goals established in the Strategic Action Plan. Progress was quantified using the attainment score, estimating the percentage distance between projected and target values.

Findings If current trends continue, smoking will decline from 9.8% (2019) to 4.7% (2030), surpassing its reduction target by 30.1%. Regular sugar-sweetened beverage consumption will fall from 15.0% to 3.2%, exceeding the target by 162%. Binge drinking is projected to rise from 18.8% to 21.3%, deviating from its target by 133%, with sharper increases among women. Fruit and vegetable intake will increase modestly (22.9% to 24.5%), achieving only 23.3% of its target. Leisure-time physical activity will rise from 39.0% to 45.3%, meeting 53.8% of the target. Obesity (+39.4%), diabetes (+47.3%), and hypertension (+11.4%) will continue to increase.

Interpretation Despite progress in smoking and sugar-sweetened beverages consumption, most NCD risk factors remain off track among Brazilians living in the capitals, underscoring the need for strengthened, equity-oriented, multisectoral strategies to achieve Brazil's 2030 NCD targets.

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Keywords: Noncommunicable diseases; Risk factors; Trend analysis; Projections; Strategic action plan

Introduction

Noncommunicable diseases (NCDs) cause over 40 million deaths globally each year, with an increasing burden in low- and middle-income countries.¹ In Brazil, NCDs account for over 700 thousand deaths annually (54.7% of all deaths), with nearly 40% classified as

premature (30–69 years).¹ In response, both the World Health Organization (WHO) and Ministry of Health of Brazil developed strategies aligned with Target 3.4 of the United Nations Sustainable Development Goals aiming to reduce premature NCD mortality by one-third by 2030.²

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Research in context

Evidence before this study

We searched PubMed from 1 February 2025 to 31 March 2025 for studies on trends and projections of noncommunicable disease (NCD) risk factors in Brazil in relation to the Strategic Action Plan for NCDs 2021–2030, using the terms: (Brazil AND noncommunicable diseases AND risk factors AND trends AND projections AND strategic plan). No language or date restrictions were applied. Two studies were retrieved: one methodological article on projecting indicators for Brazil's NCD Strategic Action Plan, and one on projected cancer burden by 2030. No study evaluated multiple modifiable risk factors in relation to the national targets established in the Strategic Action Plan for NCDs 2021–2030, nor systematically examined sex-specific trajectories or the probability of achieving these targets.

Added value of this study

This is the first comprehensive assessment of Brazil's progress toward all major NCD risk factor targets in the 2021–2030 Strategic Plan. Using 15 years of data from the Brazilian capital cities (2009–2023; $n = 643,196$ adults), we projected prevalence through 2030 and quantified target attainment using attainment scores, stratified by sex.

Implications of all the available evidence

While progress in tobacco control and reductions in sugar-sweetened beverages consumption align with national goals, Brazil is unlikely to meet targets for obesity, harmful alcohol use, fruit and vegetable intake, and leisure-time physical activity. These findings offer actionable evidence for policymakers, highlighting significant gaps in the country's NCD prevention efforts.

A key priority is primary prevention through reduction in modifiable risk factors, including smoking, alcohol consumption, physical inactivity, unhealthy diets, and obesity.^{1,2} In Brazil, the Surveillance System of Risk and Protective Factors for Chronic Diseases by Telephone Survey (Vigitel) monitors these behaviors.³ Conducted annually since 2006 among adults (≥ 18 years) living in the 26 capitals and the Federal District, Vigitel is the country's largest and longest-running health survey.²

Although previous studies have assessed time trends in individual risk factors, none have comprehensively evaluated multiple risk factors against the targets of Brazil's 2021–2030 Strategic Action Plan for the Prevention and Control of NCDs.^{3–5} The current plan (2021–2030), updated after a review of progress and challenges under the 2011–2022 plan, aligns with key NCD policies and the 2030 Sustainable Development Goals Agenda, and specifies 15 targets and over 200 actions across four intervention areas, including health surveillance.¹

This study analyzed time trends (2009–2023) and projected the prevalence of major NCD risk factors, hypertension, and diabetes through 2030 among Brazilian adults, stratified by sex. We also estimated the probability of meeting national targets, assuming continuity of current trends, providing evidence to inform public health planning and NCD prevention in Brazil.

Methods

Study design, sample and data source

Vigitel is an annual, telephone-based surveillance system that monitors modifiable NCD risk factors among adults (≥ 18 years) living in households with at least one landline in the 26 Brazilian state capitals and the Federal District.² Details on the Vigitel sampling strategy

and data collection have been described previously.⁶ Briefly, approximately 2000 individuals per city were interviewed each year, allowing prevalence estimates (in each city) with a 95% confidence interval (CI) and a maximum sampling error of two percentage points. In cities with low landline coverage ($<40\%$) or fewer than 50,000 landline-connected households, smaller samples were accepted, resulting in wider error margins (up to 3% for total population estimates and 4% for sex-specific estimates).^{3,7} Since 2020, due to administrative restrictions imposed by the COVID-19 pandemic, the sample size was reduced to 1,000 individuals across all sample domains resulting in wider error margins (up to 3.5% for total population estimates and 4.5% for sex-specific estimates).⁷ Data collection was not conducted in 2022 due to the withdrawal of the contracted survey firm. In 2023, mobile phone interviews were also included (comprising 50% of total interviews).²

The sampling strategy follows a two-stage process. First, a random sample of 10,000 landlines per city is selected from operators-provided lists and grouped into 25 replicates of 200 numbers. Each line was contacted up to six times (between 9 a.m. and 9 p.m., local time, including weekends and holidays). Non-residential, out-of-service, and unanswered numbers were considered ineligible. In the second stage, one adult per household is randomly selected (in the case of landline numbers). In the case of mobile phone numbers, the main user of the line is interviewed with no further selection. A weighting factor, based on population census data for Brazilian state capitals and the Federal District, is applied to match the sample with the city's adult population distribution by sex, age, and educational attainment.⁶ Sex was self-reported by participants during telephone interviews conducted by trained interviewers. Vigitel's anonymized databases and documentation are publicly available.^{3,7} Vigitel was

approved by Brazil's National Ethics Committee (protocol: 65610017.1.0000.0008). The present study is a secondary analysis of publicly available, de-identified data and therefore did not require additional ethical approval or informed consent.

Time trends and projected prevalence of NCDs risk and protective factors

We analyzed data on modifiable risk factors included in Brazil's Strategic Action Plan for NCDs 2021–2030: current smoking, binge drinking, regular consumption of sugar-sweetened beverages (SSB), recommended fruit and vegetable intake, leisure-time physical activity (LTPA), and obesity.¹ Data were collected by trained interviewers using standardized questionnaires, ensuring consistency across survey years. The indicators included in this study were assessed using the same questions throughout the entire time series.³ Of note, the physical activity questionnaire underwent methodological changes between 2006 and 2008; therefore, we restricted our analysis to the period 2009–2023 to ensure comparability over time.²

Current smoking was defined as answering “yes” to the question “Currently, do you smoke?”, regardless of frequency or number of cigarettes. Binge drinking was defined as consuming ≥ 4 alcoholic drinks for women or ≥ 5 for men on a single occasion in the past 30 days. One drink was equivalent to one can of beer, one glass of wine, or one shot of distilled spirits (e.g., cachaça or whiskey).²

Regular SSB consumption was defined as drinking soda or artificial juice ≥ 5 days per week. Recommended fruit and vegetable intake was defined as consuming at least 5 servings per day on ≥ 5 days per week, considering responses about cooked (e.g., lettuce, tomato, kale, carrot, chayote, eggplant, zucchini, excluding potatoes, cassava, or yams) and raw vegetables (e.g., lettuce and tomato or any other raw vegetable), and fruits.²

LTPA was defined as engaging in at least 150 min of moderate-intensity activity or 75 min of vigorous-intensity activity per week, based on information about the frequency and duration of activities performed over the previous three months.²

Obesity was identified based on self-reported weight and height, with individuals classified as having obesity if their body mass index (BMI) was equal to or greater than 30 kg/m². Self-reported medical diagnoses of hypertension and diabetes were also assessed.²

Assessment of the progress towards 2030 targets from Brazil's Strategic Action Plan for NCDs

To evaluate progress toward the 2030 goals established in Brazil's Strategic Action Plan for the Prevention and Control of NCDs (2021–2030), we calculated an attainment score for each selected risk factor. In alignment with the Plan's guidelines, we adopted 2019 as the

baseline year. The attainment score quantifies the proportion of the gap between the observed prevalence in 2019 and the 2030 target that is projected to be closed by 2030, based on linear trend estimates.⁶

The attainment score was calculated using the formula:

$$AS = \frac{P_{2019-observed} - P_{2030-projected}}{P_{2019-observed} - P_{2030-target}} \times 100$$

where $P_{2019-observed}$ is the prevalence measured in 2019, $P_{2030-projected}$ represents the prevalence projected for 2030 based on linear regression models, and $P_{2030-target}$ corresponds to the target prevalence for 2030. The target was determined by applying the relative change established in the Strategic Plan to the Vigitel 2019 baseline.¹

An attainment score of 100% indicates full achievement of the target by 2030. Values above 100% reflect that the target is projected to be surpassed; the degree of surpassing was calculated as the difference between the attainment score and 100%. Similarly, values below 100% indicate underachievement, with the deviation from the target represented by how much the attainment score falls short of 100%. Negative values indicate that current trends are moving away from the target; that is, the projected 2030 prevalence is expected to be worse than the 2019 baseline, reflecting a setback rather than progress toward the goal.⁷ For obesity, the target is to maintain 2019 prevalence (i.e., halt further increases). As no prevalence or incidence targets are defined for hypertension and diabetes, analyses for these outcomes were limited to temporal trends.

Statistical analysis

Time trends from 2009 to 2023 were analyzed using Prais–Winsten linear regression models, with coefficients representing the average annual percentage point (pp) change in prevalence. Projections for 2024–2030 were obtained using linear regression models with time (survey year) as the only independent variable, assuming current trends continue. This reduced covariate model is justified because observed prevalence in each survey year implicitly accounts for trends in demographic subgroup composition (e.g., age distribution and race/ethnicity categories) and other determinants of NCD risk factors.⁸ Point estimates and 95% confidence intervals for projected values were generated using the *margins* function in Stata and subsequently used to calculate the attainment score for each indicator.

We performed a sensitivity analysis using Prais–Winsten regression model restricted to the most recent period (2015–2023), given that this period was marked by the rollback of social and economic policies implemented through 2014, prior to the onset of

Brazil's economic and political crisis.⁹ All statistical analyses were performed using Stata version 17.0 (StataCorp LLC, College Station, TX, USA).

Role of the funding source

The VIGITEL surveillance system is funded and conducted by the Ministry of Health of Brazil. For the present study, neither the Brazilian National Research Council (CNPq) nor the Ministry of Health of Brazil had any role in data analysis or interpretation of findings. Representatives of the Ministry of Health participated in the review and critical revision of the manuscript. All authors agreed on the final version of the manuscript, and the decision to submit the manuscript for publication was made independently by the first and last authors (JW and LFMR), who also selected the journal.

Results

Time trends in modifiable risk factors for NCDs between 2009 and 2023

Sociodemographic characteristics of the study population for each survey year are presented in [Table 1](#). Between 2009 and 2023, the greatest relative decline was observed for regular SSB consumption (–42.7%; from 26.0% to 14.9%) and smoking (–35.1%; from 14.3% to 9.3%), with men consistently reporting higher prevalence than women throughout the period in both indicators. Binge drinking increased by 12.5% (from 18.5% to 20.8%), driven mainly by a rise among women (51%; from 10.8% to 15.2%), while prevalence remained stable among men; the male-to-female prevalence ratio narrowed from 2.8 in 2009 to 1.8 in 2023. LTPA increased by 34.1% (from 30.3% to 40.6%), with a greater rise among women than men, while fruit and vegetable intake remained stable (from 20.2% to 21.4%) in both sexes. Obesity had the largest relative increase among all indicators (69.9%; from 14.3% to 24.3%), with similar trends across both sexes. Diabetes increased by 61.9% (from 6.3% to 10.8%) and hypertension by 9.9% (from 25.4% to 27.9%), with higher increases among women for diabetes and among men for hypertension ([Table 1](#); [Figs. 1–3](#)).

Projected prevalence in NCD risk factors by 2030 and probability of reaching the Brazil's strategic Action Plan for NCD from 2019 to 2030

Projections through 2030 indicate continued declines in regular SSB consumption and smoking. The most pronounced reduction is expected for regular SSB consumption, with prevalence projected to decline from 15.0% (95% CI: 14.3–15.9) in 2019 to 3.2% (95% CI: 0.0–7.0) in 2030, surpassing the 2030 target (prevalence: 10.5%) by 162% (attainment score: 262). The decline is projected to be more pronounced among women, who are expected to surpass their sex-specific target by

187%, compared to 144% among men ([Table 2](#); [Supplementary Table S1](#); [Figs. 1–3](#)).

Smoking prevalence is expected to decline from 9.8% (95% CI: 9.2–10.5) in 2019 to 4.7% (95% CI: 3.4–6.0) in 2030, surpassing the 2030 target (prevalence: 5.9%) by 30% (attainment score: 130). The reduction is projected to be greater among women, who are expected to surpass their sex-specific target by 46%, compared to 17% among men ([Table 2](#); [Supplementary Table S1](#); [Figs. 1–3](#)).

In contrast, binge drinking is projected to increase from 18.8% (95% CI: 18.0–19.6) in 2019 to 21.3% (95% CI: 19.5–23.2) by 2030, moving away from the 2030 target (prevalence: 16.9%) by 133% (attainment score: –133). The attainment score of –133 indicates that, rather than progressing toward the target, the projected trajectory represents a 133% deviation in the opposite direction. This worsening trend is primarily driven by a substantial rise among women, who are projected to deviate from their sex-specific target by 286%, compared to 39% among men ([Table 2](#); [Supplementary Table S1](#); [Figs. 1–3](#)).

Recommended fruit and vegetable consumption is projected to increase modestly, from 22.9% (95% CI: 22.1–23.7) in 2019 to 24.5% (95% CI: 21.4–27.7) in 2030, meeting only 23% of the 2030 target (prevalence: 29.8%) (attainment score: 23). The increase is expected to be more pronounced among men, who are projected to meet 37% of their sex-specific target, compared to 14% among women ([Table 2](#); [Supplementary Table S1](#); [Figs. 1–3](#)).

LTPA is projected to increase from 39.0% (95% CI: 38.1–39.9) in 2019 to 45.3% (95% CI: 42.3–48.3) in 2030, corresponding to 54% of the 2030 target (prevalence: 50.7%) (attainment score: 54). Projections are notably more favorable for women, who are expected to attain 95% of their sex-specific target, compared to 54% among men ([Table 2](#); [Supplementary Table S1](#); [Figs. 1–3](#)).

Obesity prevalence is projected to increase from 20.3% (95% CI: 19.5–21.0) in 2019 to 28.3% (95% CI: 27.4–29.2) in 2030, representing a 39.4% relative increase and diverging from the 2030 target of halting any further rise, with similar trends projected across both sexes ([Table 2](#); [Supplementary Table S1](#); [Figs. 1–3](#)).

Diabetes is projected to increase by 47.3%, from 7.4% (95% CI: 7.0–7.9) in 2019 to 10.9% (95% CI: 9.9–11.9) in 2030, with a slightly higher increase among women than men. Hypertension is expected to rise 11.4%, from 24.5% to 27.3% (95% CI: 25.8–28.9), with a greater relative increase among men than women ([Table 2](#); [Supplementary Table S1](#); [Figs. 1–3](#)).

Sensitivity analysis

When considering trends from the most recent period (2015–2023), some differences emerged in the slopes, relative to the main analysis (2009–2023). The smoking

Variable	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2023	Annual variation (2009–2023)	P-value (2009–2023)
Total sample																
N	54,367	54,339	54,144	45,448	52,929	40,853	54,174	53,210	53,034	52,395	52,443	27,077	27,093	21,690	–	–
Mean age, years (SD)	40.7 (16.1)	40.9 (16.3)	41.1 (16.3)	41.3 (16.4)	41.6 (16.5)	41.7 (16.5)	42.0 (16.6)	42.2 (16.6)	42.4 (16.7)	42.6 (16.7)	42.7 (16.7)	42.9 (16.8)	43.1 (17.0)	43.4 (16.7)	0.206	<0.0001
Sex, %																
Men	46.1	46.1	46.1	46.1	46.1	46.1	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.1	–0.007	0.047
Women	53.9	53.9	53.9	53.9	53.9	53.9	54.0	54.0	54.0	54.0	54.0	54.0	54.0	53.9	0.007	0.047
Race/Skin Color, %																
White	39.2	40.0	43.5	40.6	41.5	39.7	40.8	43.6	42.0	41.3	41.0	41.6	39.5	38.6	–0.040	0.73
Black/Brown	60.1	59.4	51.2	47.3	46.2	46.5	42.3	46.2	47.9	48.9	50.6	50.9	54.8	56.4	–0.259	0.71
Other	0.5	0.5	4.2	4.7	3.8	4.1	4.3	3.3	2.5	2.2	2.0	2.7	1.8	2.1	0.040	0.78
Smoking	14.3	14.1	13.4	12.1	11.3	10.8	10.4	10.2	10.1	9.3	9.8	9.5	9.1	9.3	–0.414	<0.0001
Binge Drinking	18.5	18.1	16.5	18.4	16.4	16.5	17.2	19.1	19.1	17.9	18.8	20.9	18.3	20.8	0.210	0.0008
Regular consumption SSB	26.0	26.8	27.5	26.0	23.3	20.8	19.0	16.5	14.6	14.4	15.0	15.2	14.0	14.9	–1.118	<0.0001
Recommended Fruits and Vegetables	20.2	19.5	22.0	22.7	23.6	24.1	25.2	24.4	23.7	23.1	22.9	22.5	22.1	21.4	0.105	0.55
Leisure PA	30.3	30.5	31.6	33.5	33.8	35.3	37.6	37.6	37.0	38.1	39.0	36.8	36.7	40.6	0.721	<0.0001
Obesity	14.3	15.1	16.0	17.4	17.5	17.9	18.9	18.9	18.9	19.8	20.3	21.5	22.4	24.3	0.715	<0.0001
Hypertension	25.4	24.3	24.3	24.3	24.1	24.8	24.9	25.7	24.3	24.7	24.5	25.2	26.3	27.9	0.218	0.011
Diabetes	6.3	6.8	6.3	7.4	6.9	8.0	7.4	8.9	7.6	7.7	7.4	8.2	9.1	10.2	0.220	<0.0001
Men																
N	21,347	20,764	21,426	17,389	20,276	15,521	20,368	20,258	19,504	19,039	18,354	9757	9271	8132	–	–
Mean age, years (SD)	39.6 (15.8)	39.6 (15.8)	40.0 (15.9)	39.9 (15.9)	40.0 (16.1)	40.4 (16.3)	40.3 (16.3)	40.4 (16.1)	40.8 (16.4)	41.0 (16.4)	40.9 (16.3)	41.8 (16.7)	42.2 (16.7)	42.8 (16.5)	0.235	<0.0001
Race/Skin Color, %																
White	37.3	37.5	42.1	38.4	39.9	38.1	39.7	42.1	41.2	39.4	38.7	41.3	38.1	36.9	0.012	0.92
Black/Brown	62.0	61.8	53.0	48.8	47.2	47.7	43.6	47.3	49.0	50.0	52.8	50.7	55.7	57.4	–0.327	0.64
Other	0.5	0.5	3.9	5.2	4.0	4.2	4.3	3.6	2.7	2.6	2.2	3.0	1.9	2.8	0.087	0.56
Smoking	17.5	16.8	16.5	15.5	14.4	12.8	12.8	12.7	13.2	12.1	12.3	11.7	11.8	11.7	–0.502	<0.0001
Binge Drinking	28.3	27.0	25.3	27.9	24.2	24.8	25.3	27.3	27.1	26.0	25.3	26.6	25.0	27.3	0.007	0.90
Regular consumption SSB	29.3	30.0	32.0	29.8	26.7	23.9	22.4	19.6	17.4	17.7	18.3	17.9	17.2	16.8	–1.271	<0.0001
Recommended Fruits and Vegetables	15.8	16.0	17.5	17.6	19.3	19.3	21.0	19.4	18.5	18.4	18.4	17.9	16.9	19.3	0.205	0.14
Leisure PA	39.8	40.0	40.4	41.5	41.2	41.6	45.6	46.6	43.4	45.4	46.7	44.2	43.1	45.8	0.462	0.0052
Obesity	13.9	14.4	15.5	16.5	17.5	17.6	18.1	18.1	19.2	18.7	19.5	20.3	22.0	23.8	0.675	<0.0001
Hypertension	22.2	21.5	21.4	21.3	21.5	22.5	22.0	23.6	21.7	22.1	21.2	24.1	25.4	26.4	0.301	0.0051
Diabetes	5.8	6.1	5.9	6.5	6.5	7.3	6.9	7.8	7.1	7.1	7.1	7.3	8.6	9.1	0.220	<0.0001
Women																
N	33,020	33,575	32,718	28,059	32,653	25,332	33,806	32,952	33,530	33,356	34,089	17,320	17,822	13,558	–	–
Mean age, years (SD)	41.7 (16.4)	42.1 (16.6)	42.0 (16.6)	42.6 (16.7)	42.8 (16.7)	42.9 (16.5)	43.4 (16.8)	43.7 (16.9)	43.7 (16.8)	44.0 (16.8)	44.3 (16.9)	43.9 (16.9)	44.0 (17.1)	43.9 (16.9)	0.181	0.0002

(Table 1 continues on next page)

Variable	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2023	Annual variation (2009–2023)	P-value (2009–2023)
(Continued from previous page)																
Race/Skin Color, %																
White	40.8	42.1	44.7	42.4	42.8	41.2	41.7	44.9	42.7	42.9	42.9	41.9	40.6	40.1	−0.083	0.45
Black/Brown	58.4	57.3	49.6	46.0	45.4	45.4	41.1	45.3	47.0	48.0	48.7	51.0	54.0	55.5	−0.196	0.77
Other	0.6	0.5	4.4	4.3	3.6	4.1	4.4	3.0	2.4	1.9	1.8	2.5	1.8	1.5	−0.006	0.97
Smoking	11.5	11.7	10.7	9.2	8.6	9.0	8.3	8.0	7.5	6.9	7.7	7.6	6.7	7.2	−0.363	<0.0001
Binge Drinking	10.0	10.5	9.0	10.3	9.7	9.4	10.2	12.1	12.2	11.0	13.3	16.0	12.7	15.2	0.388	<0.0001
Regular consumption SSB	23.2	24.1	23.6	22.7	20.4	18.2	16.1	13.9	12.2	11.6	12.3	12.8	11.3	13.2	−0.988	<0.0001
Recommended Fruits and Vegetables	23.9	22.5	25.8	27.2	27.3	28.2	28.9	28.7	28.2	27.2	26.8	26.3	26.4	23.2	0.008	0.97
Leisure PA	22.2	22.4	24.1	26.5	27.4	30.0	30.8	29.9	31.5	31.8	32.4	30.5	31.3	36.2	0.950	<0.0001
Obesity	14.7	15.6	16.5	18.2	17.5	18.2	19.7	19.6	18.7	20.7	21.0	22.6	22.6	24.8	0.702	<0.0001
Hypertension	28.2	26.6	26.9	26.9	26.3	26.8	27.3	27.5	26.4	27.0	27.3	26.2	27.1	29.3	0.096	0.09
Diabetes	6.7	7.4	6.6	8.1	7.2	8.7	7.8	9.9	8.1	8.1	7.8	9.0	9.6	11.1	0.223	<0.0001

N: unweighted sample size. Values for sex and race/skin color are weighted proportions (%). Mean age and standard deviation (SD) were calculated using analytical weights (pesorake). Race/skin color was standardized across survey years; indigenous and East Asian respondents are grouped under 'Other'. Annual variation (pp/year) and p-values were estimated by Prais-Winsten regression on annual weighted proportions.

Table 1: Sociodemographic characteristics and time trends in NCD risk and protective factors, hypertension and diabetes, by sex. Vigitel, 2009–2023.

reduction trend decelerated, while the upward trend in binge drinking slightly accelerated. Improvements in regular SSB consumption and LTPA showed signs of stagnation, and recommended fruit and vegetable intake showed a significantly decreasing trend. Obesity showed a slightly steeper increasing trend, whereas hypertension and diabetes stagnated over the more recent period ([Supplementary Table S2](#)). Consequently, when projections for 2030 were based on the 2015–2023 period, more unfavorable prevalence and attainment score estimates emerged for most risk factors, in comparison with the projections considering the entire period (2009–2023) ([Supplementary Table S3](#) and [Supplementary Table S4](#)). Detailed results of the sensitivity analysis are presented in the [Supplementary Results](#).

Discussion

We evaluated progress toward the 2030 targets established in Brazil's Strategic Action Plan for NCDs by analyzing time trends (2009–2023) in modifiable risk factors and the prevalence of diabetes and hypertension, with projections through 2030. If current trends continue, regular SSB consumption and smoking targets are likely to be surpassed, and women may meet their LTPA-specific target. In contrast, obesity and binge drinking (particularly among women) are projected to rise, moving further away from the 2030 target. While recommended fruit and vegetable consumption has slightly increased, the magnitude of change remains insufficient to meet the 2030 goals. Additionally, both diabetes and hypertension are projected to increase, highlighting ongoing and substantial challenges in achieving the broader objectives (reducing NCD mortality) of the Strategic Action Plan.

Regular SSB consumption showed the largest decline, with projections dropping to 3.2% by 2030, below the 10.5% target set in the 2019 Vigitel baseline, exceeding it by 162%. This finding is consistent with national data from the National Health Survey (NHS), which showed a marked reduction in regular SSB consumption from 23.3% (2013) to 9.2% (2019).¹⁰ Similar declining trends have been observed across Latin America, where fiscal and regulatory measures (e.g., taxation, front-of-package warning labels, and advertising restrictions) have been widely implemented.¹¹ In Brazil, policies such as advertising bans and sales restrictions in schools may have also contributed to this downward trend, particularly among young adults.¹¹ Furthermore, the increasing awareness of the harms caused by the consumption of SSBs might also partially explain this shift, influenced by social desirability bias and not by a true change in intake.¹² Of note, our analysis operationalized SSBs as soft drinks and artificial juices; thus, it does not capture other relevant categories such as ready-to-drink teas,

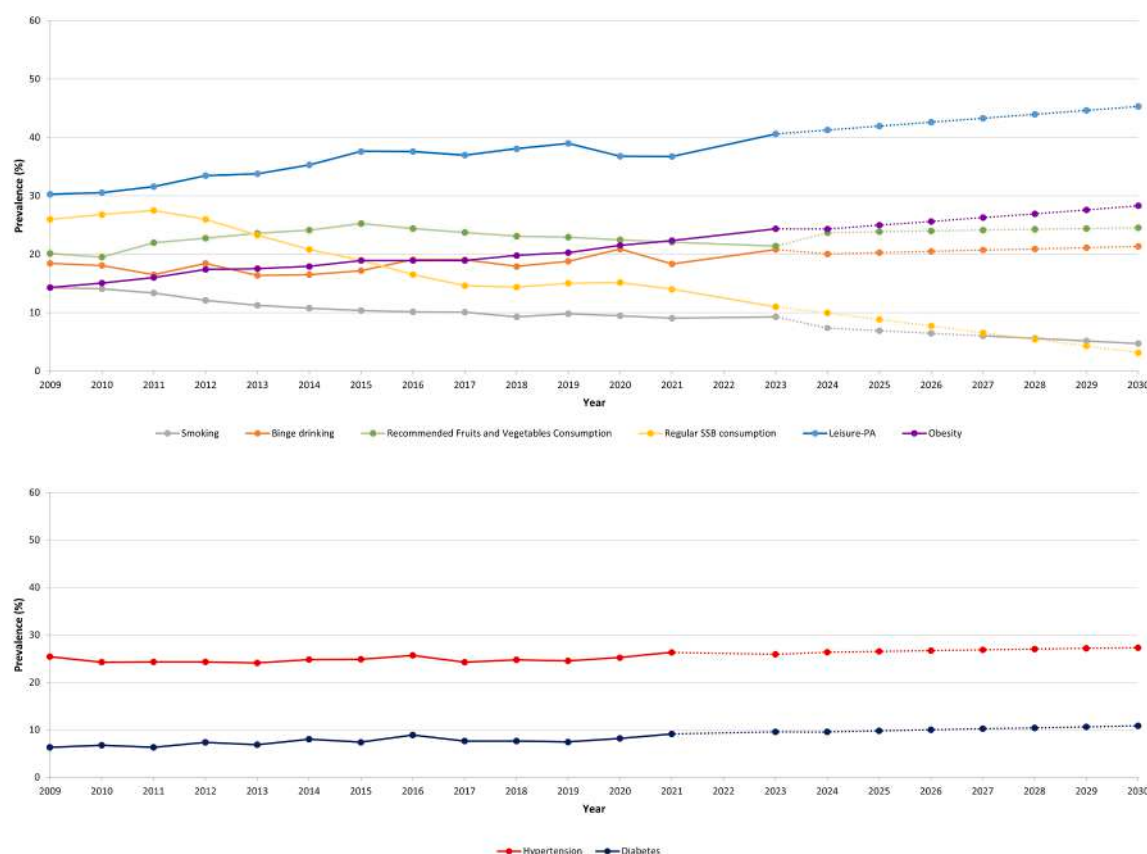


Fig. 1: Time trends and projected prevalence (%) of risk and protective factors for noncommunicable diseases (NCDs), hypertension and diabetes, for total sample. Upper panel: smoking, binge drinking, recommended fruits and vegetables consumption, regular sugar-sweetened beverage (SSB) consumption, leisure-time physical activity (LTPA) and obesity. Lower panel: hypertension and diabetes. Solid lines indicate observed data (2009–2023); dotted lines indicate projected values (2024–2030). Vigitel, 2009–2030.

flavored waters, and newer sweetened beverages. Recent evidence suggests a shift in consumption from sodas to other sweetened beverage categories,¹³ a nuance particularly salient amid current policy debates on including both sugar-sweetened and non-sugar-sweetened beverages in selective taxes, countering industry claims that taxes on soft drinks are unnecessary because soda consumption is already falling. Our sensitivity analysis based on the more recent period (2015–2023) suggests signs of stagnation in this trend, with projected prevalence rising to 10.9% (95% CI: 5.7–16.1), falling short of the 10.5% prevalence target. This signals that the progress observed over the full period may not be sustained, and that continued policy efforts to reduce SSB consumption remain essential. National discussions on the introduction of selective taxes are ongoing in Brazil, with adoption expected by 2027.¹⁴ These policy developments should be closely monitored, as they may further reinforce and more accurately target reductions in total SSB consumption.

Smoking prevalence is projected to decline to 4.7% by 2030, below the 5.9% target, surpassing it by 30%. This finding is consistent with NHS data, which showed a reduction in smoking prevalence from 14.7% (2013) to 12.6% (2019).¹⁰ This significant progress reflects the cumulative impact of Brazil's long-standing tobacco control efforts. Key milestones include the implementation of advertising bans in the 1980s, the launch of the National Program to Control Tobacco Use in 1989, and Brazil's early ratification of the WHO Framework Convention on Tobacco Control.¹⁵ These measures were supplemented by subsequent policies such as tobacco taxation, the introduction of smoke-free environments, and the implementation of graphic health warnings, all of which have contributed to sustained reductions in smoking prevalence.¹⁵ However, recent evidence suggests a possible plateau in smoking declines.¹⁶ The lack of adjustments in tobacco taxation since 2016 and the increasing availability of novel nicotine and tobacco products (e.g., electronic cigarettes), which were not included in this analysis, may

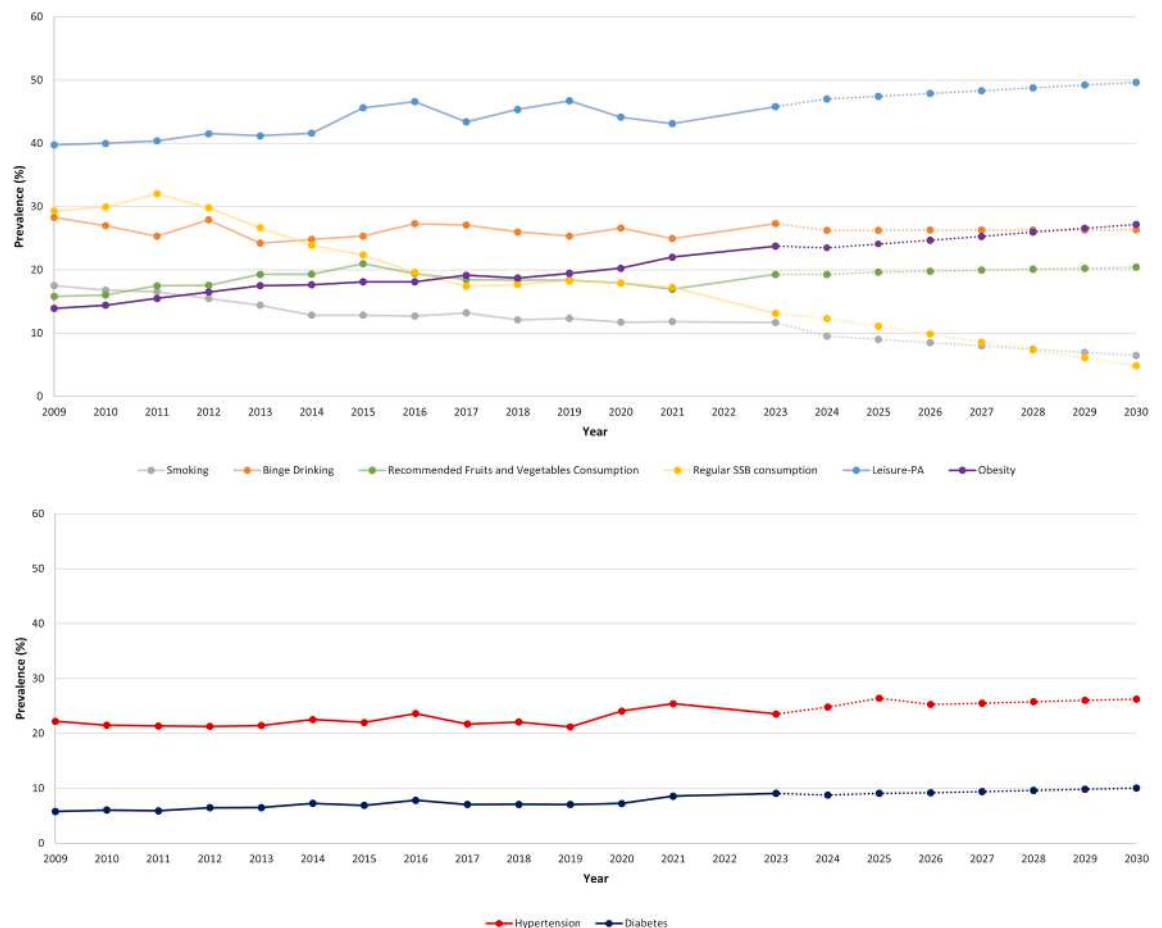


Fig. 2: Time trends and projected prevalence (%) of risk and protective factors for noncommunicable diseases (NCDs), hypertension and diabetes, for men. Upper panel: smoking, binge drinking, recommended fruits and vegetables consumption, regular sugar-sweetened beverages (SSB) consumption, leisure-time physical activity (LTPA) and obesity. Lower panel: hypertension and diabetes. Solid lines indicate observed data (2009–2023); dotted lines indicate projected values (2024–2030). Vigitel, 2009–2030.

pose new challenges.¹⁶ Our sensitivity analysis based on the more recent period (2015–2023) suggested a deceleration in the reduction trend, with projected prevalence of 8.0% (95% CI: 6.8–9.1), falling short of the 2030 target—an attainment score of 46—underscoring the need for continued strengthening of tobacco control measures, including the regulation of emerging nicotine products.

Binge drinking prevalence is projected to reach 21.3% by 2030, above the 16.0% target, deviating from it by 133%. NHS data corroborate this upward trend, showing an increase in binge drinking from 13.6% (2013) to 17.1% (2019).¹¹ In our analysis, this increase is particularly notable among women, suggesting a narrowing of the historical sex gap in binge drinking. Emerging evidence indicates that differences between men and women in alcohol consumption and related harms are decreasing among more recent birth cohorts across countries.¹⁷ These concerns are reinforced by our

sensitivity analysis, which suggested that the projected prevalence of binge drinking based on the 2015–2023 trend will rise to 19.2% (95% CI: 13.8–24.7), deviating from the women-specific target. The WHO's Global Strategy (2010) and Alcohol Action Plan (2022–2030) offer key frameworks, but Brazil's adherence was low.¹⁸ Policy gaps were identified in pricing measures and marketing regulations.¹⁸ Recently, the standard drink measure for alcoholic beverages was defined in the country, aiming to improve alcohol epidemiological surveillance and reinforcing the recommendation that there is no safe level of alcohol consumption.¹⁹ Gender-tailored alcohol control policies remain essential to accelerate progress toward national targets.

Recommended fruit and vegetable intake is projected to reach 24.5% by 2030, meeting only 23% of the progress towards the 2030 target (prevalence: 29.8%). Notably, fruit and vegetable intake in the capitals has consistently surpassed the absolute national target of

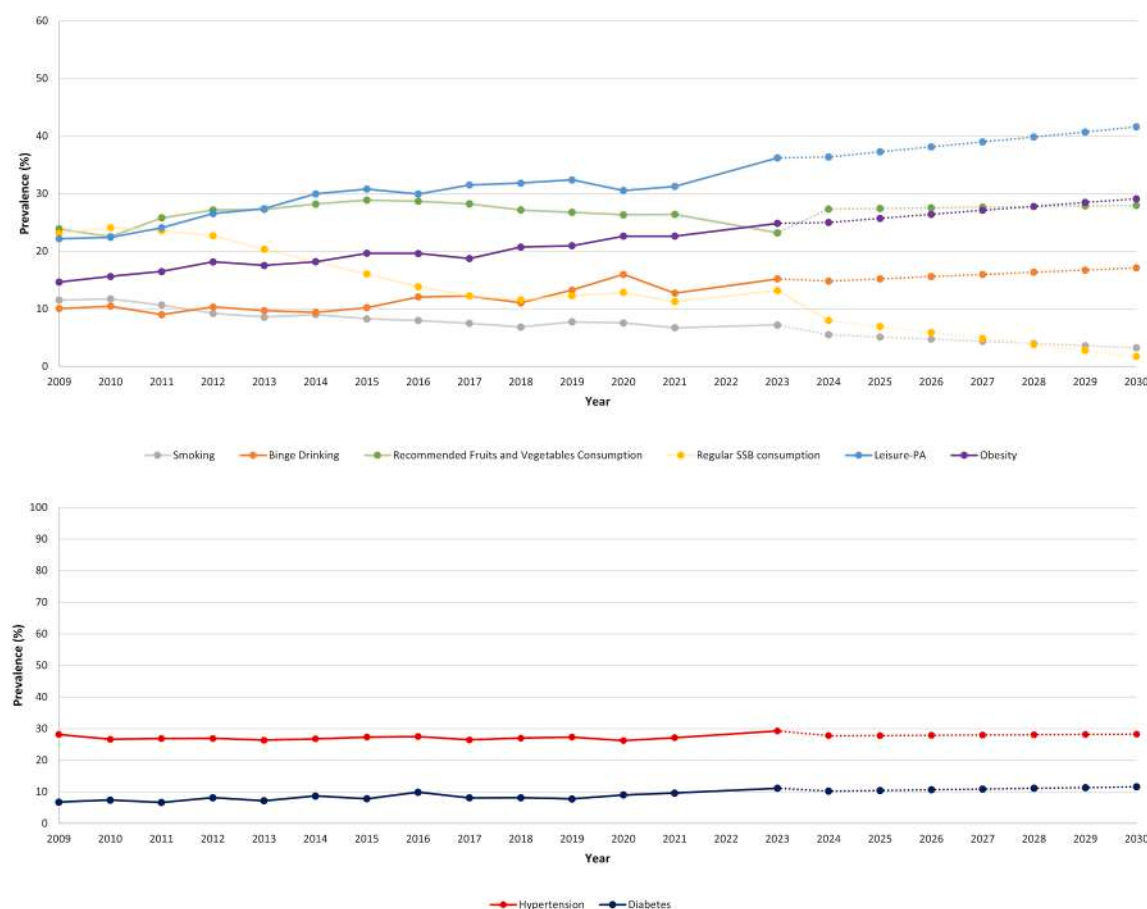


Fig. 3: Time trends and projected prevalence (%) of risk and protective factors for noncommunicable diseases (NCDs), hypertension and diabetes, for women. Upper panel: smoking, binge drinking, recommended fruits and vegetables consumption, regular sugar-sweetened beverages (SSB) consumption, leisure-time physical activity (LTPA) and obesity. Lower panel: hypertension and diabetes. Solid lines indicate observed data (2009–2023); dotted lines indicate projected values (2024–2030). Vigitel, 2009–2030.

16.9% since 2009.⁴ Nevertheless, 75.5% of adults in these cities are still projected to fall short of the minimum recommended intake. NHS data showed a stable trend in regular fruit and vegetable consumption between 2013 (28.7%) and 2019 (29.5%).¹⁰ Persistent barriers, including food affordability, supply chain disruptions, and limited access to fresh produce, continue to impede progress, particularly in low- and middle-income countries.²⁰ In Brazil, long-standing initiatives such as the National School Feeding Program (1955) and the *Bolsa Família* conditional cash transfer (2003) have improved access to healthy foods.²¹ More recent efforts, including the Food on the Plate program (2024) and the expansion of the basic food basket, aim to encourage fruit and vegetable consumption further.²² Despite these advances, current measures remain insufficient. If the negative trend observed in the most recent period continues, the attainment score will turn negative, underscoring the need for integrated

strategies addressing economic, environmental, and behavioral determinants of diet.

LTPA in Brazil is projected to reach 45.3% by 2030, therefore meeting 53.8% of 2030 target (prevalence: 50.7%). NHS data are consistent with this trend, showing an increase in LTPA from 22.7% (2013) to 30.1% (2019).¹⁰ Projections were more optimistic for women, who are expected to attain 95% of their specific target, whereas men are projected to achieve only 21% of the target. Despite relative gains among women, their absolute participation remains lower than that of men (41.6% vs. 46.7% in 2030). Women also continue to show a higher likelihood of being insufficiently active worldwide and a global analysis reported a significant association between higher physical activity inequality and lower levels of women's participation, underscoring the importance of persistent, inclusive, equity-driven policies.²³ Our findings also suggested that 54.7% of adults residing in Brazilian state capitals

Variable	Observed prevalence in 2019 (% and 95%CI)	Observed prevalence in 2023 (% and 95%CI)	Projected ^a prevalence in 2030 (% and 95%CI)	Overall and Sex-Specific Strategic's Plan 2030 Target ^b (%)	Attainment score ^c (AS)
Total					
Regular consumption SSB	15.0 (14.3–15.9)	14.9 (13.8–16.1)	3.2 (0.0–7.0)	10.5	262
Smoking	9.8 (9.2–10.5)	9.3 (8.4–10.2)	4.7 (3.4–6.0)	5.9	130
Binge Drinking	18.8 (18.0–19.6)	20.8 (19.5–22.0)	21.3 (19.5–23.2)	16.9	–133
Recommended Fruits and Vegetables	22.9 (22.1–23.7)	21.4 (20.1–22.8)	24.5 (21.4–27.7)	29.8	23
LTPA	39.0 (38.1–39.9)	40.6 (39.1–42.1)	45.3 (42.3–48.3)	50.7	53
Obesity	20.3 (19.5–21.0)	24.3 (23.1–25.6)	28.3 (27.4–29.2)	20.3	–
Men					
Regular consumption SSB	18.3 (17.0–19.7)	16.8 (15.1–18.8)	4.9 (0.8–8.9)	12.8	244
Smoking	12.3 (11.2–13.5)	11.7 (10.3–13.3)	6.5 (4.9–8.0)	7.4	117
Binge Drinking	25.3 (24.0–26.7)	27.3 (25.2–29.5)	26.3 (24.2–28.3)	22.8	–39
Recommended Fruits and Vegetables	18.4 (17.3–19.6)	19.3 (17.4–21.4)	20.4 (17.7–23.1)	23.9	37
LTPA	46.7 (45.2–48.3)	45.8 (43.5–48.1)	49.7 (49.2–53.2)	50.7	54
Obesity	19.5 (18.3–20.7)	23.8 (21.8–25.8)	27.2 (26.1–28.3)	19.5	–
Women					
Regular consumption SSB	12.3 (11.4–13.2)	13.2 (11.8–14.8)	1.7 (0.0–5.6)	8.6	287
Smoking	7.7 (7.1–8.4)	7.2 (6.3–8.2)	3.2 (2.0–4.5)	4.6	141
Binge Drinking	13.3 (12.4–14.2)	15.2 (13.8–16.6)	17.1 (15.1–19.1)	12.0	–286
Recommended Fruits and Vegetables	26.8 (25.8–27.8)	23.2 (21.5–25.0)	28.0 (24.0–32.0)	34.8	15
LTPA	32.4 (31.3–33.5)	36.2 (34.3–38.2)	41.6 (38.2–45.0)	42.1	95
Obesity	21.0 (20.0–21.9)	24.8 (23.3–26.5)	29.1 (28.0–30.3)	21.0	–

^aLinear projection based on trends observed from 2009 to 2023. For further details, see the Methods section. ^bCalculated using the relative targets set in the Strategic Plan for each indicator, based on 2019 prevalence (see Methods). ^cThe Attainment Score (AS) represents the proportion of the gap between the 2019 observed prevalence and the 2030 target that is projected to be closed by 2030, based on linear trend estimates.

Table 2: Comparison between projected absolute and relative changes (2019–2030) in NCD risk factors and the absolute and relative targets set by Brazil's Strategic Action Plan.

are anticipated to remain physically inactive by 2030. At the global level, progress toward the 2030 target of reducing physical inactivity has been insufficient.²³ In Brazil, the prioritization of physical activity by the Ministry of Health has been recognized globally, including in *The Lancet's* 2012 series on physical activity, with a notable example being the Health Academy Program (*Programa Academia da Saúde*, PAS), launched in 2011, which expanded access to community-based initiatives in more than 2,700 municipalities.²⁴ Nonetheless, the sensitivity analysis based on the 2015–2023 period suggests signs of stagnation, with projected prevalence falling to 40.5% (95% CI: 35.3–45.6) and an attainment score of 13, a substantially less favorable scenario that highlights the importance of sustained policy efforts.

Obesity prevalence in Brazil is projected to increase from 20.3% in 2019 (baseline) to 28.3% by 2030, representing a 39.4% relative increase and diverging significantly from the Strategic Plan's objective to halt the rise in prevalence. A previous modeling study utilizing Vigitel data from 2006 to 2019 similarly projected a continued upward trend, estimating a prevalence of 29.6% by 2030.²⁵ In 2024, the Brazilian government launched the Obesity Prevention Strategy, a multi-sectoral initiative that frames obesity as a societal issue and promotes actions such as breastfeeding, healthier

diets, reduced ultra-processed food intake, and increased physical activity.²⁶ Globally, efforts to curb the rise in obesity have largely been unsuccessful: no country has successfully reversed obesity trends at the population level, and the Lancet Commission on the Global Syndemic of Obesity, Undernutrition, and Climate Change attributes this stagnation to “political inertia,” encompassing weak governance, corporate opposition, and insufficient public demand for structural reform.²⁷

Diabetes prevalence is expected to increase by 47.3% between 2019 and 2030, similarly affecting both sexes, while hypertension is projected to rise more modestly (11.4%), with women consistently reporting higher prevalence. NHS data are consistent with these trends, showing increases in both diabetes (6.2% to 7.7%) and hypertension (21.4% to 23.9%) between 2013 and 2019.¹⁰ Our sensitivity analysis suggests stagnation in both conditions over the 2015–2023 period, but projected prevalences for 2030 remain on an upward trajectory, diverging from Brazil's NCD reduction targets. Globally, diabetes and hypertension continue to pose serious public health challenges, particularly in low- and middle-income countries.²⁸ The continued rise in obesity, diabetes, and hypertension suggests that other major drivers of these conditions persist. The increasing consumption of ultra-processed foods in the

Brazilian diet, as observed in the latest Household Budget Survey, may help explain this pattern, and has been further substantiated by the recent Lancet Series on Ultra-Processed Food and Human Health, which synthesized evidence linking ultra-processed food intake to several adverse health outcomes, including obesity, type 2 diabetes, and cardiovascular diseases.²⁹ Therefore, while Brazil has made notable progress in reducing SSB consumption and smoking, obesity, diabetes, and hypertension require more robust and targeted strategies to curb their growing burden.

This study has several limitations. Self-reported data may be prone to measurement error and misclassification bias, particularly regarding socially sensitive behaviors like smoking, alcohol intake, SSB consumption, fruit and vegetable intake, and LTPA, as well as body weight and height. Additionally, because the Strategic Plan does not include numerical targets for ultra-processed food consumption, we chose not to include this indicator in the analysis; future studies should consider incorporating ultra-processed food consumption. Some projected prevalences presented wide confidence intervals, which require cautious interpretation. Targets of Brazil's Strategic Action for NCDs were set for the entire adult population, but our analyses were restricted to adults living in the 26 capitals and the Federal District due to lack of long-term, representative data for the entire Brazilian adult population. Therefore, findings may not adequately represent rural populations, or the overall Brazilian population and conclusions should be interpreted within the scope of the surveyed population. Furthermore, ethnicity data were not reported in this analysis, limiting the assessment of potential disparities by racial or ethnic group; future studies should incorporate ethnicity as a stratification variable to better characterize inequalities in NCD risk factor trends. The introduction of cell phone interviews in 2023 may have captured a distinct population segment compared to landline respondents, given the substantially lower response rate for mobile phones (24.1% vs. 58.7% for landlines), though its impact on overall trends is limited, as it affects only the last year of the time series.³⁰ The use of landlines in the survey may have led to the inclusion of adults with higher socioeconomic status compared to the general population of Brazilian capitals. However, we applied a weighting factor based on the Brazilian Census to reflect the socio-demographic distribution (by sex, age and educational attainment) in each city.

Finally, projections were based on linear regression models, which assumes a constant rate of change over time and does not account for non-linear dynamics or potential shifts in trends due to policy changes or socioeconomic factors. The NCD risk factors analyzed are embedded within a complex, multifactorial system

influenced by social, economic, environmental, and political determinants. These factors respond positively to comprehensive, cost-effective public policies, but may also be negatively affected by aggressive market strategies aimed at increasing consumption, which can exacerbate health inequities and associated outcomes.

In conclusion, among surveyed adult participants living in the Brazilian capitals, meaningful progress has been observed in reducing regular SSB consumption (projected at 3.2% in 2030) and smoking (projected at 4.7% in 2030), both of which are on track to surpass their 2030 targets. Improvements in LTPA are encouraging, particularly among women (projected at 42.1% in 2030), who may meet the women-specific target. However, the continued rise in obesity (projected at 27.2% in 2030), the increase in binge drinking, especially among women (projected at 17.1% in 2030), and the modest gains in fruits and vegetables consumption (projected at 28.0% in 2030) indicate that significant gaps persist in the implementation and effectiveness of current public health strategies. Our sensitivity analysis based on the more recent period (2015–2023) suggests that progress in several indicators may be stalling, with signs of stagnation in SSB consumption and LTPA, a decelerating smoking reduction trend, and a declining trajectory in fruits and vegetables consumption. This pattern underscores the importance of renewed and sustained policy efforts, particularly given the political and economic instability that characterized the post-2015 period. Finally, the projected increases in diabetes (projected at 10.9% in 2030) and hypertension (projected at 27.3% in 2030) prevalence underscore the urgent need for strengthened, equity-oriented, and multisectoral actions to achieve the broader objectives of Brazil's Strategic Action Plan for NCDs.

Contributors

LFMR, RC and JW participated in the design and conceptualization of the study. LFMR and JW were responsible for the data curation. LFMR and JW conducted the formal analysis. JW and LFMR wrote the original draft. All authors revised and edited the manuscript and approved the final version of the manuscript. JW and LFMR made the decision to submit the manuscript for publication and were responsible for the choice of journal.

Data sharing statement

All datasets used in this study are publicly available online and are de-identified. Vigitel databases are freely accessible at: <https://svs.aids.gov.br/daent/cgdn/vigitel/>. The analytical code is available upon request to the corresponding author.

Use of artificial intelligence

During the preparation of this work the author(s) used Claude (Anthropic) in order to assist with language editing and manuscript revision. The AI was not used for data collection, statistical analysis, or generation of study conclusions. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Declaration of interests

The authors declare no competing interests.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.j.lana.2026.101494>.

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