

BMJ Open Projected impact of change in the percentage of energy from each NOVA group intake on cardiovascular disease mortality in Brazil: a modelling study

Patricia Vasconcelos Leitão Moreira ¹, Adélia da Costa Pereira de Arruda Neta,¹ Flávia Emília Leite de Lima Ferreira,¹ Jevuks Matheus de Araújo ², Maria Laura da Costa Louzada,³ Rafaela Lira Formiga Cavalcanti de Lima,¹ Rodrigo Pinheiro de Toledo Vianna,¹ José Moreira da Silva Neto,⁴ Zoe Colombet,⁵ Martin O'Flaherty⁵

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For numbered affiliations see end of article.

Correspondence to

Dr Patricia Vasconcelos Leitão Moreira;
patriciamoreira1111@hotmail.com

ABSTRACT

Objective Estimate reductions in cardiovascular mortality achievable through improvement in nutrient intakes according to processing level (NOVA classification), that is, reducing consumption of culinary ingredients (G2), processed (G3) and ultra-processed foods (G4) while encouraging consumption of unprocessed and minimally processed foods (G1).

Design Modelling study.

Setting General adult population of Brazil.

Participants Men and women aged 25 or more years (34 003) investigated in the Household Budget Survey 2017–2018, in the consumption data module.

Main outcome measures We used the IMPACT Food Policy Model to estimate the reduction in deaths from cardiovascular diseases (CVD) up to 2048 in five scenarios with reductions in saturated fat, trans fat, salt and added sugar intakes resulting from changes in NOVA groups. (1) The optimistic scenario modelised an increase in the energy intake provided by G1 and a reduction in the energy intake from G2, G3 and G4, return to previous levels. (2) The minimal scenario modelised a 3.7% increase in the energy intake from G1, and a reduction in the energy intake from G4 to the 2008–2009 level. (3) The modest scenario only modelised a 25.0% reduction of the energy intake from G2 and G3. (4) The intermediary scenario modelised the minimal scenario plus a 25.0% reduction in the energy intake from G2. (5) Finally, the advanced scenario modelised the minimal scenario plus a 25.0% reduction in the energy intake from G2 and G3.

Results Proposed changes in the optimistic scenario could prevent or delay 52.8% CVD-related deaths by 2048. Changes modelled in the minimal, modest, intermediary and advanced scenarios may result in a 10.1%, 28.4%, 31.4% and 38.6% reduction in 2048 CVD mortality, respectively.

Conclusions Substantial health gains can be achieved by improving the diet, through plausible modifications aimed at the level of processing as a tool for Brazilian food policies.

Strengths and limitations of this study

- One of this study strengths is to have built scenarios to be realistic and reasonably plausible, modelling changes that target levels of consumption.
- Although all food intake data are representative of the Brazilian population, the scenarios were set up based on home purchase data, due to the lack of intake data using the NOVA classification in the previous years.
- We assumed no 'lag time' between dietary risk factor change and mortality reduction.
- The model does not track future risk factor trends, and this might result in overestimating or underestimating the potential reduction.

INTRODUCTION

Cardiovascular diseases (CVD) are one of the most prevalent preventable public health issues nowadays, due to their large impact on the number of deaths and disability in adults. This worldwide issue, particularly affecting developing countries such as Brazil, has been steadily increasing, from 12.1 million of deaths worldwide in 1990 to 18.6 million in 2019.^{1,2} However, as nutrition is an important risk factors of CVD development, they represent one of the most promissive lever of action for the prevention and reduction of CVD morbidity and mortality.^{3,4}

Dietary quality has worsened in the recent decades, with reduced consumption of 'healthy' foods alongside an increase in consumption of highly processed foods rich in sodium, sugar, saturated and trans fatty acids that are associated to higher cardiovascular risk.^{2,5} Studies show that the consumption of ultra-processed foods is directly associated with an unhealthy dietary pattern,

which is characterised by high energy density, high consumption of free sugars and total, saturated and trans fatty acids, and with low consumption of protein, dietary fibre, and most of the estimated vitamins and minerals.^{6–8} In Brazil, the phenomenon is also happening, and ultra-processed foods represented 16.0% of the total energy value purchased in 2008–2009 and increased to 18.4% in 2017–2018.^{9 10}

This trend of increasing consumption of ultra-processed products brings concern, since there is already some scientific evidence linking the high consumption of these products with the increased risk of incidence and mortality from all causes,^{11–13} and the particular effect on CVD and mortality.^{11 14–17}

If this trend continues, it is predicted that there will be an increase in CVD in Brazil in the coming years and, consequently, an increase in associated mortality, with appropriate behavioural and political interventions being urgently needed.² A recent modelling was performed by Moreira *et al* in Brazil; however, data on food acquisition was used and there was no availability of this acquisition by age group when the model was developed.¹⁸

Thus, the objective of this study is to estimate reductions in cardiovascular mortality achievable through improvement in nutrient intakes according to processing level, that is, reducing consumption of culinary ingredients, processed and ultra-processed foods while encouraging consumption of unprocessed and minimally processed foods.

METHODS

Our approach builds on our previous modelling exercises in the UK and Brazil, using methods adapted from the IMPACT Food Policy Model.^{18 19}

In summary, we estimated the numbers of deaths to be expected in 2048 if current trends persist and then estimate the change in dietary intake using a food processing level classification (NOVA)²⁰ to define different scenarios of changes in consumption.

Patient and public involvement

No patient involved.

Estimating CVD mortality projection by 2048

To define CVD mortality, we used codes I20–I25 (Coronary Heart Disease - CHD) and I60–I64, I67 and I69 (Stroke) from The International Classification of Diseases, version 10. The number of CVD deaths was obtained from the Mortality Information System and we calculated CVD mortality rates stratified by seven age–gender group, at 10-year intervals.

In order to project mortality trends by 2048, we used a negative binomial model. The covariates used were a cohort dummies (*Cohort_t*) and year (*T*).

Equation 1:

$$g(v_t) = \beta_0 + \beta_1 \text{Cohort}_t + \beta_2 T$$

Estimating food intakes

The data related to the individual food intake were collected through a 24-hour recall for all residents aged 10 years and over, from 20 112 selected households, investigated in the Household Budget Survey (HBS) 2017–2018, in the consumption data module. Thus, information was obtained on the individual food intake of 34 003 residents and a second food recall was carried out in 84.2% of these individuals.^{21 22}

All foods and beverages were classified according to the nature, extent and purpose of food processing. Essentially, foods and beverages were divided into four main groups according to the NOVA classification²³: ‘unprocessed or minimally processed foods’ (G1); ‘processed culinary ingredients’ (G2); ‘processed foods’ (G3); and ‘ultra-processed food and drink products’ (G4). Online supplemental table 1) shows all NOVA classification groups and some examples of foods and beverages, and more detailed information on methodological classification can be found elsewhere.^{20 24} Habitual intakes of energy, saturated fats, trans fat, salt and added sugar, from each NOVA group, were estimated using the Multiple Source Method. Then, the contributions in percentage of energy of each nutrient were calculated for the modelling by groups G1, G2, G3 and G4.

The Kolmogorov-Smirnov test was performed to verify the normality of the variables (habitual consumption of salt, saturated fat, trans fat and added sugar, in grams and/or percentage of energy), which showed that all variables had a normal distribution. For the descriptive analyses, tests were carried out to verify the measures of mean, SD and minimum and maximum consumption of each nutrient, by NOVA group, sex and age group. These results were used for modelling.

Scenarios of changes in intakes of saturated fat, trans fat, added sugar and salt by 2048

We designed five scenarios to model the effect of decreasing saturated fat, trans fat, salt and added sugar intakes by various amounts of change in the percentage of energy from each NOVA group. The first scenario proposes modifications in the four NOVA food groups at the same time, while other scenarios propose gradual evolutions. Detailed value inputs in each scenario are presented in the [table 1](#) and in the online supplemental technical appendix.

- ▶ The optimistic scenario, challenging, models a return to food intake values once seen in the Brazilian population diet. It models an increase in the energy intake provided by G1 (return to 2008–2009 consumption levels), and a reduction to 10.0%, 8.0% and 12.5% in the energy intake from G2, G3 and G4, respectively (return to 2002–2003 acquisition levels).
- ▶ The minimal scenario models a 3.7% increase in the energy intake from G1, and a reduction in the energy intake from G4 to 2008–2009 levels, without changing the average percentage of energy intake of G2 and G3 (maintained to 2017–2018 levels).

Table 1 Scenarios of changes in energy intakes (from saturated fat, trans fat, added sugar and salt) provided by food groups to estimate effects in cardiovascular mortality in Brazilian adult population

	Baseline	Optimistic scenario		Minimal scenario		Modest scenario		Intermediary scenario		Advanced scenario	
	% of DDE*		% of DDE		% of DDE		% of DDE		% of DDE		% of DDE
NOVA classification†											
Unprocessed or minimally processed foods (G1)	53.4	↗	69.5‡	↗	57.1§	↔	53.4	↗	57.1§	↗	57.1§
Processed culinary ingredients (G2)	15.6	↘	10.0	↔	15.6	↘	11.7	↘	11.7	↘	11.7
Processed foods (G3)	11.3	↘	8.0¶	↔	11.3	↘	8.5	↔	11.3	↘	8.5
Ultra-processed food and drink products (G4)	19.7	↘	12.5¶	↘	16.0‡	↔	19.7	↘	16.0‡	↘	16.0‡

*Daily average dietary energy from the 2017–2018 Brazilian Household Budget Survey (consumption data).

†According to the nature, extent and purpose of food processing²³.

‡Daily average dietary energy from the 2008–2009 Brazilian Household Budget Survey (consumption data).

§3.7% increase in energy provided by the reduction in G4 from the 2008–2009 Brazilian Household Budget Survey.

¶Daily average dietary energy from the 2002–2003 Brazilian Household Budget Survey (acquisition data).

↔, maintain; ↘, decrease; ↗, increase; DDE, daily average dietary energy.

- ▶ The modest scenario models a 25.0% reduction of the energy intakes from G2 and G3 without changing the average percentage of energy intake from G1 and G4 (maintained to 2017–2018 levels).
- ▶ The intermediary scenario models a 3.4% increase in the energy intake from G1, a 25.0% reduction in the energy intake from G2, and a reduction in the energy intake from G4 to the 2008–2009 level, without changing the average percentage of energy intake of G3 (maintained to 2017–2018 levels).
- ▶ The advanced scenario models a 3.4% increase in the energy intake from G1, a 25.0% reduction in the energy intake from G2 and G3, and a reduction in the energy intake from G4 to the 2008–2009 levels.

Modelling the effect of changing saturated fat, trans fat, added sugar and salt intakes on CVD mortality

Our primary outcome was the total number of deaths prevented or postponed (DPPs) that can be attributed to increased intake of in natura or minimally processed foods (G1) and reduced intake of saturated fat, trans fat, salt and added sugar from culinary ingredients (G2), processed foods (G3) and ultra-processed (G4). DPPs are defined as the difference between the number of expected deaths in 2048 and the expected deaths if there is an increase in the intake of foods belonging to G1 and a reduction in the intake of foods belonging to G2, G3 and G4 in the Brazilian diet by 2048.

We calculate separately the DPPs for CHD and stroke. To calculate DPPs from nutrient changes, we used the following approach:

Step 1: Calculate expected deaths for CHD and stroke by binomial regression (Equation 1).

Step 2: Calculate the cumulative mortality changes (Equation 2)—all nutrients changes are in the same

equation and the β -coefficients are provided for meta-analyses of large cohorts studies.

Equation 2:

$$CMC = 1 - [1 - (\beta_{SatFat} \times SatFat_{Baseline\ G1} - SatFat_{Scenario\ n} \times 1)] \times [1 - (\beta_{Salt} \times Salt_{Baseline\ G1} - Salt_{Scenario\ n\ G1})] \times [1 - (\beta_{TransFat} \times TransFat_{Baseline\ G1} - TransFat_{Scenario\ n\ G1})] \times [1 - (\beta_{Added\ Sugar} \times Added\ Sugar_{Baseline\ G1} - Added\ Sugar_{Scenario\ n\ G1})]$$

where n is the respective scenario proposed.

Step 3: Calculate the CHD DPPs (Equation 3). Stroke DPPs were calculated likewise.

Equation 3:

$$CHD\ DPPs = Expected\ Deaths\ from\ CHD \times CMC1 + Expected\ Deaths\ from\ CHD \times CMC2 \dots + Expected\ Deaths\ from\ CHD \times CMCn$$

Sensitivity analysis

We implemented sensitivity analysis using the Excel add-in Ersatz software, which allows Monte Carlo simulation. This allows us to calculate 95% uncertainty intervals (95% UI) for all model outputs, based on 5000 draws from specified probabilistic distributions for the model input variables. The Erpert (Pert standard distribution function) was used in the model.

RESULTS

Nutrient levels in different food groups

In 2017–2018, the daily energy intake mean was 1572.2 kcal in Brazilian men and 1904.9 kcal in Brazilian women. G1 provided 53.4% of the daily energy intake, while G4 provided 19.7% (table 1). The mean percentage of daily energy related to the consumption of saturated fat, trans fat and added sugar was 9.87% (2.0), 0.72% (0.3) and

Table 2 Average daily intakes of dietary salt, saturated fat, trans fat and added sugar, estimated from consumption of adults from the Household Brazilian Survey 2017–2018

	Salt	Saturated fat	Trans fat	Added sugar
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Average intake in grams (g/day)	6.56 (2.42)	18.62 (7.12)	1.38 (0.82)	28.63 (25.14)
Unprocessed or minimally processed foods (G1)	0.91 (0.49)	8.04 (3.83)	0.22 (0.13)	NA
Processed culinary ingredients (G2)	2.75 (1.27)	3.33 (2.51)	0.12 (0.11)	17.14 (20.39)
Processed foods (G3)	1.90 (1.49)	3.22 (3.60)	0.36 (0.30)	0.51 (3.24)
Ultra-processed food and drink products (G4)	1.60 (1.05)	5.30 (3.41)	0.82 (0.71)	11.14 (10.35)
% of total calorie intake	–	9.87 (2.00)	0.72 (0.32)	6.49 (5.22)
Unprocessed or minimally processed foods (G1)	–	4.34 (1.68)	0.12 (0.07)	NA
Processed culinary ingredients (G2)	–	1.79 (1.19)	0.06 (0.05)	4.00 (4.49)
Processed foods (G3)	–	1.64 (1.63)	0.18 (0.14)	0.11 (0.63)
Ultra-processed food and drink products (G4)	–	2.76 (1.47)	0.43 (0.31)	2.57 (2.19)

Values are presented as mean and SD in grams per day, or percentage of total calorie intake (%), as specified.

6.49% (5.2), respectively (table 2). Most of the mean intake, in grams per day, of salt and sugar came from G2, while most of the mean saturated fat intake came from G1 and trans fat intake from G4 (table 2).

Expected mortality reduction

In 2018, approximately 215 028 CVD deaths were reported in Brazil, 115 229 CHD deaths and 99 799 stroke deaths. We estimated that approximately 371 993 CVD deaths could be expected in 2048, 215 889 from CHD

and 156 104 from stroke, which would represent a 73% increase.

As detailed in table 3, dietary changes modelled in the optimistic scenario may prevent or postpone approximately 196 436 (95% UI: 160 973–232 858) CVD-related deaths in 2048, a 52.8% reduction in CVD mortality. Of these, more deaths would be prevented or postponed among men (58%) (113 157; 95% UI: 93 101–133 023) than women (42%) (83 279; 95% UI: 67 873–99

Table 3 Estimated cardiovascular diseases deaths prevented or postponed by achievement of scenarios reducing consumption of saturated fat, trans fat, salt and added sugar from culinary ingredients, processed and ultra-processed foods in the adult Brazilian diet by 2048, while encouraging consumption of unprocessed or minimally processed foods

		Optimistic scenario	Minimal scenario	Modest scenario	Intermediary scenario	Advanced scenario
Men	CVD	113 157 (93 101–133 023)	22 890 (17 859–27 919)	59 674 (45 349–73 887)	66 972 (53 729–80 123)	82 813 (65 254–100 516)
	CHD	79 586 (64 474–94 225)	16 749 (12 984–20 492)	42 417 (31 793–52 732)	46 698 (37 241–55 832)	59 336 (46 153–72 504)
	Stroke	33 571 (28 627–38 798)	6 141 (4 875–7 427)	17 257 (13 556–21 155)	20 274 (16 488–24 291)	23 477 (19 101–28 012)
Women	CVD	83 279 (67 873–99 835)	14 724 (10 897–18 605)	46 033 (33 651–59 157)	49 788 (39 125–60 704)	60 605 (46 540–75 738)
	CHD	49 795 (40 015–60 649)	9 494 (7 075–11 923)	27 695 (19 839–36 050)	29 390 (23 211–35 638)	37 091 (28 024–46 971)
	Stroke	33 484 (27 858–39 186)	5 230 (3 822–6 681)	18 338 (13 812–23 107)	20 398 (15 914–25 066)	23 514 (18 516–28 767)
All	CVD	196 436 (160 973–232 858)	37 614 (28 757–46 525)	105 707 (79 001–133 044)	116 760 (92 845–140 827)	143 418 (111 795–176 255)
	CHD	129 381 (104 489–154 874)	26 242 (20 059–32 416)	70 111 (51 632–88 782)	76 089 (60 452–91 470)	96 427 (74 177–119 475)
	Stroke	67 055 (56 485–77 984)	11 371 (8 698–4 109)	35 595 (27 368–44 262)	40 672 (32 402–49 357)	46 991 (37 617–56 780)

Values are presented as the number of deaths prevented or postponed and 95% uncertainty interval (95% UI). CHD, Coronary Heart Disease; CVD, Cardiovascular Diseases.

835. We estimated approximately 129 381 (95% UI: 104 489–154 874) fewer CHD deaths and 67 055 (95% UI: 56 485–77 984) fewer stroke deaths.

In the minimal scenario, changes modelised could result in a 10.1% reduction in CVD mortality in 2048: approximately 37 614 (95% UI: 28 757–46 525) fewer CVD-related deaths, of which almost 61% are related to men (22 890; 95% UI: 17 859–27 919).

The changes into the modest scenario would prevent or postpone approximately 105 707 (95% UI: 79 001–1 33 044) CVD-related deaths, of these almost 56% are related to men (59 674; 95% UI: 45 349–73 887). A 28.4% reduction in CVD mortality.

Applying the intermediary scenario could result in approximately 116 760 (95% UI: 92 854–140 827) fewer CVD-related deaths in 2048, of these almost 57% are related to men (66 972; 95% UI: 53 729–80 123). A 31.4% reduction in CVD mortality.

Finally, dietary changes in the advanced scenario may prevent or postpone approximately 143 418 (95% UI: 111 795–176 255) CVD-related deaths in 2048, of these almost 58% are related to men (82 813; 95% UI: 65 254–100 516). A 38.6% reduction in CVD mortality.

DISCUSSION

Our study estimates that between 10% and 53% of the 2048 CVD mortality can be prevented or postponed by reducing intakes of salt, saturated fat, trans fat and added sugar through lower consumption of culinary ingredients, processed and ultra-processed foods, and higher consumption of minimally processed food in Brazil. The most effective scenario consists in increase the energy intake provided by the G1, returning to the consumption levels of the Brazilian population in 2008–2009, and a reduction in the energy intake provided by the G2, G3 and G4 to the levels of 2002–2003.

Our results for the minimal scenario are consistent with previous modelling studies developed in Brazil, Switzerland and the UK estimating the number of CVD, CHD and stroke deaths that could be avoided if the population followed national dietary recommendations.^{18 19 25} In Switzerland, about 14% of CVD deaths could be prevented each year if adults adhered to a diet with 250 g of fruit, 250 g of vegetables, 30 g of fibre, 6 g of salt and 9 g of saturated fat.²⁵ In the UK, about 13% of CVD deaths could be prevented, being consistent with our findings.¹⁹ In Brazil, Moreira *et al*¹⁸ achieved under three scenarios (modest, ideal and optimistic) reductions of 5.5%, 11.0% and 29.0% in relation to CVD deaths. The main difference between the Moreira *et al*'s study and the data found in this study is related to the fact that in the first one, we used food acquisition data and, in the second one, we used actual food intake data and all analysed nutrients were original data from HBS food intake study.²¹ Furthermore, in this study, we work with more plausible scenarios when compared with the first one. In the previous one, there was probably an underestimation

of the reductions due to the division into age groups followed the English standard¹⁸ and in this study the data are primary.

Achieving a bigger change in food consumption in the modest, intermediate and advanced scenario, all involving substantial reductions in salt and sugar intake, can prevent up to more than a third of CVD deaths by 2048. Our optimistic scenario resulted in the most significant mortality reduction (potentially halving the number of CVD deaths). This scenario illustrates what could happen if the Brazilian diet returned to levels when the contribution of processed and ultra-processed food was substantially lower. However, the current trends in food purchases suggest that this is unlikely to happen, as a substantial decrease from 2002 in the share of food purchases of minimally processed products alongside an increase in the share of processed and ultra-processed food.¹⁰ These changes in the purchasing habits of Brazilians are worrying since intakes of ultra-processed foods are notably associated with the development of obesity, diabetes mellitus, hypertension, CVD and mortality.^{11 13 15 26 27}

In all scenarios for CVD, more deaths would be prevented or postponed among men. This greater impact on reduction deaths from CVD, after the changes suggested by the scenarios, can be explained by the fact that men have a higher average consumption of salt, saturated fats, trans fats and added sugar than women. Furthermore, the number of deaths estimated for 2048 is higher for men when compared with women.

Strengths and limitations

One of this study strengths is to have built scenarios to be realistic and reasonably plausible, modelling changes that target levels of consumption that were previously achieved in the Brazilian population, particularly regarding consumption of processed and ultra-processed food. We simulated gradual changes, first targeting the consumption of ultra-processed foods (G4), and then targeting other groups with lower levels of processing.

As in any study, our analysis has limitations. Although all food intake data are representative of the Brazilian population, the scenarios were set up based on home purchase data, due to the lack of intake data using the NOVA classification in previous years.

We assumed no 'lag time' between dietary risk factor change and mortality reduction. However, rapid mortality changes can result from dietary changes at the population level, suggesting that these changes are plausible over the time horizon of the simulation.

The model does not track future risk factor trends, and this might result in overestimating or underestimating the potential reduction, mainly if concurrent changes in smoking or physical activity occur and modifies overall cardiovascular risk. However, given the size of the reductions, the model seems to offer conservative estimates of potential future gains.

Policy implications

Our scenarios highlight the substantial potential to reduce CVD mortality by modifying current Brazilian dietary trends, mainly targeting processed and ultra-processed food.

Our results support targeting sodium intake as a crucial policy option. Reducing salt in diet is thus an important lever to reducing CVD morbidity and mortality as it has a direct, independent and additive effect on blood pressure, such as reducing the risk of stroke.^{28 29} More than half of the Brazilian adult population has a mean sodium intake above 2300 mg/day (5.5 g of salt/day) with 13.5% declare adding salt to food.²¹ According to Nilson *et al*, more than 46000 deaths could have been prevented in 2017 in Brazil if sodium intake did not exceed 2 g/day.³⁰ The economic losses in productivity attributable to excessive sodium intake have been estimated at more than 700 million dollars.³⁰ In Costa Rica, based on the recommendations of the WHO and a National strategy for the comprehensive approach of non-communicable diseases and obesity, Vega-Solano *et al* simulated scenarios reducing the average salt intake of that country (9 g/day) by 46% and 15%, respectively.³¹ It was observed that, even in the modest reduction (15%), 5% of CVD deaths could be avoided, while in the ideal scenario (46%), 2.5 times more deaths could be avoided (13%).

Our modelling also highlights sugar as an essential policy target. The average daily intake of added sugar has increased in Brazil, regardless of age and sex.³² According to the 2017–2018 HBS, the addition of sugar to preparations was reported by 85.5% of the Brazilian population. Also, a study conducted on 2008–2009 HBS data shows that more than half (55.3%) of the added sugar calories came from table sugar (part of the culinary ingredients NOVA group (G2)), while 34.3% came from ultra-processed foods, 8.9% from fresh or minimally processed and only 1.1% from processed foods.³² The three major contributions to the intake of added sugars by the Brazilian population came from sugars added to coffees, teas and sweetened beverages.³² Although there was a reduction in the purchase of sweetened juices and soft drinks between 2008–2009 and 2018–2019 HBSs, these foods are still among those with the highest average daily intake per capita.^{9 10}

Our results also suggest that benefits can still be substantial, even if the WHO recommendations are not met (up to 5 g/day of salt, and the intake of free sugars to less than 10% of total energy intake),^{33 34} suggesting that any action towards improving diets and reduce the share of ultra-processed food in Brazilian diet will pay off. Our results for the optimal scenario (the optimistic scenario) illustrate a maximum plausible gain by setting an ambitious target to guide policy progress towards a healthier Brazilian diet.

Marketing and nutritional information powerfully influence food choices. Food marketing is a powerful driver of ultra-processed food consumption campaigns,^{35 36} with social and new media resulting in a closer interaction

between consumers and brands.^{37–39} This is a potential policy area to develop in Brazil, building on an initiative such as the UK national 21:00 TV ban or advertising in public transport in London.⁴⁰ In terms of labelling, the 2020 Brazilian National Health Surveillance Agency rules on nutritional labelling can play a central role to strengthen consumer analysis and food choice capacity; however, they only come into effect 24 months after their publication.^{41 42}

Finally, fiscal measures can have a powerful influence on consumer and producer behaviour. For example, a 1.0% increase in the prices of ultra-processed foods can reduce the prevalence of obesity by 0.6%, mainly in people with lower income in Brazil.⁴³ Yet, there is still no fiscal policy formulated in Brazil despite the public debate on the subject started to take shape in recent years, including the presentation of legislative proposals in the National Congress, proposing an indirect fiscal intervention to reduce the production of ultra-processed food.⁴⁴

Policy progress is still difficult and slow. Although Brazil was one of the first countries to make as part of the United Nations Decade of Action on Nutrition (UN) 2016–2025,⁴⁵ a little evidence on the implementation of regulations exists, with substantial conflicts of interest concerning the ultra-processed food industries and the Brazilian government, making it even more challenging to achieve these goals.⁴⁶ There is a light at the end of the tunnel, the new plan to fight non-communicable diseases (2021–2030) recently launched in the country that proposes strategic actions for health promotion, prevention, production of care and assistance for addressing risk factors for diseases and non-commissible appeals.⁴⁷

CONCLUSIONS

A plausible reduction in dietary intakes could substantially reduce cardiovascular events and target Brazilian food policies. Even modest changes focusing on highly processed food groups can result in substantial health gains.

Author affiliations

¹Department of Nutrition, Paraíba Federal University, João Pessoa, Paraíba, Brazil

²Department of Economy, Paraíba Federal University, João Pessoa, Paraíba, Brazil

³Department of Nutrition, University of São Paulo, São Paulo, Brazil

⁴Technical School of Health, Paraíba Federal University, João Pessoa, Paraíba, Brazil

⁵Department of Public Health and Policy, University of Liverpool, Liverpool, UK

Contributors Guarantor: PVLM. Conceived and designed the experiments: PVLM, ACPAN and MO. Performed the experiments: PVLM ACPAN, JMA, MLCL and MO. Analysed the data: PVLM, ACPAN, JMA and MLCL. Wrote the paper: PVLM, ACPAN, FELLF, MLCL, RLFCL, RPTV, JMSN, ZC and MO.

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Data availability statement Data are available in a public, open access repository. All data relevant to the study are included in the article or uploaded as supplementary information. The microdata used for this research are available on the website of the Brazilian Institute of Geography and Statistics (<https://www.ibge.gov.br/estatisticas/sociais/saude/24786-pesquisa-de-orcamentos-familiares-2.html?=&t=microdados>). The authors also provide a technical appendix as supplementary material where all the methodology and data used for the modeling are described in detail.

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ORCID iDs

Patrícia Vasconcelos Leitão Moreira <http://orcid.org/0000-0002-1940-6540>
 Jevuks Matheus de Araújo <http://orcid.org/0000-0002-5618-4502>

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