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Coronary heart disease mortality, cardiovascular disease mortality and all-cause mortality attributable to dietary intake over 20 years in Brazil

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ABSTRACT

Background/objectives: In the last two decades, in Brazil, there has been a decreasing trend of consumption of in natura or minimally processed food, while intake of ultra-processed food has markedly increased. We estimated the contribution of dietary intake in trends from coronary heart disease mortality (CHDM), cardiovascular disease mortality (CVDM), and all-cause mortality (ACM) over 20 years in Brazil.
Methods: We used a representative sample of Brazilian households located in metropolitan areas to estimate dietary intake in 1987/88 and 2008/09. For both periods, we estimated fractions of CHDM, CVDM, and ACM attributable to healthy (fruits and vegetables) and unhealthy food items (sugar-sweetened beverages, processed and red meat). We also estimated the number of prevented or postponed deaths attributable to these food items.
Results: The fraction of CHDM attributable to all food items increased from 28.6% in 1987/88 to 38.7% in 2008/09. CVDM attributable to food items increased from 13.7% in 1974 to 19.3% in 2008/09. ACM attributable to all food items increased from 20.1% in 1987/88 to 27.3% in 2008/09. Without the decrease in healthy food item consumption, and the increase in unhealthy food items, 3195 deaths from coronary heart disease, 5340 from cardiovascular disease, and 16,970 from all causes could have been prevented or postponed.
Conclusions: The burden of cardiovascular diseases and mortality attributable to dietary intake has increased over the last 20 years in Brazil. These findings suggest a need for a population prevention approach, focused on dietary intake to reduce the burden of disease.

1. Introduction

Cardiovascular disease mortality (CVDM), mostly coronary heart disease mortality (CHDM) and stroke, accounted for almost two thirds of all deaths in 2013 [1]. Despite the high burden of CVDM, age-standardized death rates have fallen since 1990, especially in high-income countries [1]. In many middle-income countries, including Brazil, CVDM rates also declined in the last decade [2]. These CVDM rate trends might be partially explained by changes in modifiable risk factors such as smoking, alcohol consumption, physical inactivity, and dietary consumption.

Many studies have shown the association between different food items (i.e. fruits and vegetables, sugar-sweetened beverages, processed and red meat) with CVDM [3–7]. In the last two decades, there has been slightly greater consumption of healthy food worldwide, although, by contrast, intake of unhealthy food items increased to a greater extent [8]. In Brazil, a worse trend was observed. In the last two decades, there has been a decreasing trend in the consumption of in natura and minimally processed food in total caloric intake from 44.0 to 38.9%. In addition, consumption of ultra-processed food, such as ready-to-eat or drink formulations with a high content of sugar, salt, fat and additives, increased in total caloric intake from 18.7 to 29.6% [9].

In this study, we aimed to estimate the contribution of dietary intake trends for coronary heart disease mortality (CHDM), CVDM, and all-cause mortality (ACM) over 20 years in Brazil.

2. Methods

2.1. Estimation of dietary intake

We obtained data on the average intake of healthy (fruits, vegetables) and unhealthy food (sugar-sweetened beverages, processed and red meat) from the National Household Budget Survey (*Pesquisa de Orçamentos Familiares* — POF) carried out in two periods: March 1987 to February 1988 [10] and May 2008 to May 2009 [11]. These food

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items were selected based on the evidence of association with CHDM, CVDM, and ACM [3–7].

POF 1987/88 and POF 2008/09 were representative samples of Brazilian households located in 11 metropolitan areas distributed around the five regions of the country (Belem in the North; Fortaleza, Recife and Salvador in the Northeast; Belo Horizonte, Rio de Janeiro and Sao Paulo in the Southeast; Curitiba and Porto Alegre in the South; and the Federal District and the municipality of Goiania in the Mid-west). The total sample of households in these areas was 13,611 in 1987/88 and 15,399 in 2008/09 [10,11]. These 11 metropolitan regions together represent around a third of the total Brazilian household population [10–12], but present higher socioeconomic status, urbanization, and income inequality when compared to the whole country [24]. Despite the national coverage of POF 2008/09, which included 55,970 households, we decided to analyze only the data from the 11 metropolitan areas (15,399 households) in order to follow the same sampling criteria as the POF 1987/88 survey. We also chose to analyze these metropolitan areas because mortality data are better registered.

Both surveys used complex multi-stage, clustered sample design, involving geographic and socioeconomic stratification among all the census tracts of the country, followed by random sampling of sectors (first stage) and households (second stage). Data collection was performed over 12 months, distributed uniformly among tracts, in order to assure representation in the four quarters of the year. Further details regarding the sampling procedures are available elsewhere [10,11].

For both surveys, we extracted the purchase data for each food item, and quantities were converted and expressed in grams per capita per day (g/day). We considered all types of fruits, vegetables (excluding tubers) and sugar-sweetened beverages (cola, *guaraná*, orange, lemon, apple, grape, non-specified, other sodas). We defined red meat as beef, pork, and lamb as fresh, chilled or frozen. We defined processed meat as salted or cured meat and sausages (e.g. sausage, ham, salami, and bologna).

2.2. Effects of dietary intake on coronary heart disease mortality, cardiovascular disease mortality and all-cause mortality

The magnitude of association of each food item with outcomes of interest was retrieved through a literature review. We searched for recent meta-analysis on the Medline database using keywords related to exposures (vegetables, fruits, sugar-sweetened beverages, processed and red meat) and outcomes of interest (CHDM, CVDM, and ACM). When more than one meta-analysis was eligible for the exposure–outcome relationship, we retrieved relative risks (RRs) from the most recent study. The RRs retrieved from published meta-analysis are given in Table A.1. Further details of the search strategy and included meta-analysis are given in Table A.2.

2.3. Calculation of population attributable fraction

We estimated the population attributable fraction (PAF) for CHDM, CVDM, and ACM associated with each food item. Our estimates were based on a theoretical minimum risk, a risk factor elimination perspective, according to international recommendations for dietary intake [13,14].

We estimated the percentage of CHDM, CVDM, and ACM attributable to each food item for 1987/88 and 2008/09 using the following equation:

$$\mathrm{PAF} = \frac{\mathrm{R}-1}{\mathrm{R}}$$

where $\mathrm{R} = \exp[\mathrm{In}(\mathrm{RR}_{\mathrm{unit}}) \times \bar{x}]\mathrm{RR}_{\mathrm{unit}}$ = relative risk for each unit increment in the exposure$\bar{x}$ = average exposure in the population.

We used the following levels of consumption to determining risk: consumption of red meat above the recommended 70 g/day; any consumption of processed meat and sugar-sweetened beverages, since only no consumption was considered to be risk free; and consumption lower than 400 g for fruit and vegetable intake (of which 2/3 should be from vegetables (240 g) and 1/3 from fruits (160 g/day)) [15].

Finally, the joint impact of all food item consumption was estimated based on the following equation:

$$\mathrm{PAF} = 1 - \prod_{\mathrm{i}=1}^{n} (1 - \mathrm{PAF_i})$$

where $\mathrm{PAF_i}$ is the PAF of each food marker, when applicable.

2.4. Deaths prevented or postponed attributable to food items

We estimated deaths prevented or postponed attributable to food items using a similar model to previous publications [16,17].

Data on the total metropolitan area population and age distribution from 1987/88 (average) and 2008/09 (average) were obtained from the Brazilian Census Bureau. Age-standardized rates from CHDM (CID 9: 410 to 414; CID 10: I20 to I25), CVDM (CID 9: 390 to 459; CID 10: I00 to I99), and ACM were obtained from the Brazilian National Mortality Database — DATASUS [18], for 1987/88 (average) and 2008/09 (average). Multiplying the age-specific mortality rates for 1987/88 by the population in each age stratum in 2008/09, we calculated the number of deaths from the three outcomes that would have been expected in 2008/09 if the mortality rates in 1987/88 had remained unchanged. In addition, we subtracted the number of deaths observed in 2008/09 from the number expected in 2008/09, achieving the total number of deaths prevented or postponed in this period.

Finally, to estimate the number of deaths prevented or postponed attributable to food items, we multiplied the number of deaths for each of the three outcomes in 1987/88 by the difference between the PAF in 2008/09 and 1987/88.

3. Results

From 1987/88 to 2008/09, the age-standardized mortality rates (per 1000) for CHDM sharply decreased from 1.23 to 0.66, CVDM from 3.69 to 1.97, and ACM from 9.13 to 6.59. The total number of deaths from CHDM, CVDM, and ACM prevented or postponed in the period was 31,611, 96,213, and 133,839, respectively (Table 1).

The fraction of CHDM attributable to all food items increased from 28.6% in 1987/88 to 38.7% in 2008/09 in Brazilian metropolitan areas (Table 2). Approximately 3195 deaths from coronary heart disease (10% of the CHDM rate reduction between 1987/88 and 2008/09) were not prevented or postponed because of the decreased consumption of fruits and vegetables, and the increased consumption of processed meat and sugar-sweetened beverages, between 1987/88 and 2008/09 (Table 3).

CVDM attributable to all food items in Brazilian metropolitan areas increased from 13.7% in 1987/88 to 19.3% in 2008/09 (Table 2). Approximately 5340 deaths from CVD (5.5% of the CVDM rate reduction between 1987/88 and 2008/09) were not prevented or postponed because of the decreased consumption of fruits and vegetables and the increased consumption of processed meat between 1987/88 and 2008/09 (Table 3).

ACM attributable to all food items increased from 20.1% in 1987/88 to 27.3% in 2008/09 in Brazilian metropolitan areas (Table 1). Approximately 16,970 deaths from all causes (12.7% of the ACM rate reduction between 1987/88 and 2008/09) were not prevented or postponed because of the decreased consumption of fruits and vegetables and the increased consumption of processed meat between 1987/88 and 2008/09 (Table 3).