

Evolution of Smoking and Incidence of Lung Cancer in Brazil (2000-2020)

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Evolução do Tabagismo e Incidência de Câncer de Pulmão no Brasil (2000-2020)

Evolución del Tabaquismo e Incidencia de Cáncer de Pulmón en el Brasil (2000-2020)

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ABSTRACT

Introduction: Lung cancer is one of the most common forms of cancer and a leading cause of death from the disease worldwide. Smoking, the primary risk factor, is responsible for about 80% of lung cancer deaths in Brazil. **Objective:** The study aims to present information on smoking and lung cancer incidence in Brazil, its Regions, Capitals, and the Federal District, stratified by sex. **Method:** Data on smoking were obtained from three main sources: the 2019 National Health Survey (PNS), the 2019 National School Health Survey (PeNSE), and the Vigitel system, with data from 2006 to 2020. Lung cancer incidence rates were calculated using data from the Population-Based Cancer Registries (RCBP) in Brazil from 2000 to 2019. Trend analyses were conducted using the Joinpoint regression model, with age adjustments and statistical analyses carried out using the Joinpoint, R, and Epi Info software. **Results:** In Brazil, the highest prevalence of adult smokers was found among men (16%), with the Southern Region showing the highest percentage of adult smokers. Overall, the incidence of lung cancer has decreased among men during the analyzed period; however, an increase in the disease rates among women is still observed. **Conclusion:** The results highlight the urgency of intensifying and adjusting tobacco control policies, with special focus on youth and women, in order to preserve public health in Brazil.

Key words: Tobacco/complications; Incidence; Lung Neoplasms.

RESUMO

Introdução: O câncer de pulmão é uma das formas mais comuns de câncer e uma das principais causas de morte pela doença no mundo. O tabagismo, principal fator de risco, é responsável por cerca de 80% das mortes por câncer de pulmão no Brasil. **Objetivo:** O estudo visa apresentar informações sobre o tabagismo e a incidência de câncer de pulmão no Brasil, Regiões, capitais e Distrito Federal, estratificadas por sexo. **Método:** As informações sobre tabagismo foram obtidas de três principais fontes: a Pesquisa Nacional de Saúde (PNS) de 2019, a Pesquisa Nacional de Saúde do Escolar (PeNSE) de 2019, e o sistema Vigitel, com dados de 2006 a 2020. As taxas de incidência de câncer de pulmão foram calculadas a partir dos Registros de Câncer de Base Populacional (RCBP) no Brasil, de 2000 a 2019. As análises de tendência foram realizadas usando o modelo de regressão *Joinpoint*, com ajustes por idade e análises estatísticas conduzidas nos softwares *Joinpoint*, *R* e *Epi Info*. **Resultados:** No Brasil, a maior frequência de fumantes adultos foi encontrada entre homens (16%), com a Região Sul apresentando o maior percentual de adultos fumantes. Em geral, a incidência de câncer de pulmão diminuiu no período analisado nos homens, entretanto, ainda é observado um aumento nas taxas da doença na população feminina. **Conclusão:** Os resultados ressaltam a urgência de intensificar e ajustar as políticas de controle do tabaco, direcionando atenção especial para os jovens e as mulheres, a fim de preservar a saúde pública no Brasil.

Palavras-chave: Tabagismo/complicações; Incidência; Neoplasias Pulmonares.

RESUMEN

Introducción: El cáncer de pulmón es una de las formas más comunes de cáncer y una de las principales causas de muerte por la enfermedad en el mundo. El tabaquismo, principal factor de riesgo, es responsable de aproximadamente el 80% de las muertes por cáncer de pulmón en el Brasil. **Objetivo:** El estudio tiene como objetivo presentar información sobre el tabaquismo y la incidencia de cáncer de pulmón en el Brasil, sus regiones, capitales y el Distrito Federal, estratificada por sexo. **Método:** Los datos sobre tabaquismo se obtuvieron de tres fuentes principales: la Encuesta Nacional de Salud (PNS) de 2019, la Encuesta Nacional de Salud del Escolar (PeNSE) de 2019 y el sistema Vigitel, con datos de 2006 a 2020. Las tasas de incidencia de cáncer de pulmón se calcularon a partir de los Registros de Cáncer de Base Poblacional (RCBP) en el Brasil, de 2000 a 2019. Los análisis de tendencias se realizaron utilizando el modelo de regresión *Joinpoint*, con ajustes por edad y análisis estadísticos realizados en los programas *Joinpoint*, *R* y *Epi Info*. **Resultados:** En Brasil, la mayor frecuencia de fumadores adultos se encontró entre los hombres (16%), siendo la Región Sur la que presenta el mayor porcentaje de adultos fumadores. En general, la incidencia de cáncer de pulmón ha disminuido en los hombres durante el período analizado; sin embargo, aún se observa un aumento en las tasas de la enfermedad en la población femenina. **Conclusión:** Los resultados destacan la urgencia de intensificar y ajustar las políticas de control del tabaco, prestando especial atención a los jóvenes y a las mujeres, para preservar la salud pública en el Brasil.

Palabras clave: Tabaquismo/complicaciones; Incidencia; Neoplasias Pulmonares.

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INTRODUCTION

Lung cancer is one of the most frequent forms of cancer, in addition to being the leading cause of death of this disease in men and women globally. One lung cancer case is expected for every eight cancer cases diagnosed around the world, representing 12.4% of all cases¹. For the year 2022, around 2.5 million new lung cancer cases were estimated for the world population, with approximately 1.8 million deaths related to the disease (18.7% of all cancer deaths). If no measures are taken and the current pattern of the disease remains unchanged, an increase of more than 65% in incidence and 74% in mortality is expected over the next 20 years¹. Most incidences are found in East Asia (men: 51.4/100 thousand; and women: 28.4/100 thousand), in Eastern Europe (men: 49.8/100 thousand; and North America (women: 30.4/100 thousand). In most countries, lung cancer incidence rates in women are increasing¹.

In Brazil, the situation is not so different, with high incidence and mortality associated with lung cancer. The National Cancer Institute (INCA) predicts that, in 2024, the country will have over 32 thousand new cases of the disease². There is a clear distinction between the country's Regions. The South Region has the greatest population risk for lung cancer development, in both men and women, reflecting the significant impact of the tobacco epidemic in this area over the last decades, in terms of smokers and non-smokers ratio, and also intensity of tobacco intake throughout life.

Smoking is the main risk factor for lung cancer development and mortality in Brazil, being associated with approximately 85% of deaths by the disease among men and almost 80% of deaths among women³. The relative risk (RR) for lung cancer among former smokers remains higher than for those who never smoked, even many years after quitting, reinforcing the lasting impact of smoking in the disease's global burden. For example, in the study by Rezende et al. with former women smokers, the risk of developing lung cancer was estimated as almost six times greater than the risk for women that never smoked⁴. Geographic and temporal patterns of incidence and mortality of lung cancer broadly reflect the smoking epidemic in each country. Furthermore, they also show historical differences in tobacco exposure, such as intensity and duration of smoking, and types of cigarettes¹.

In addition to causing severe diseases, like lung cancer and heart disease, smoking is one of the leading preventable causes of premature death and represents a global challenge for public health. Over 80% of the 1.1 billion smokers live in low and medium income countries⁵.

In Brazil, the use of tobacco has a long history, having increased in the 20th century. In response to the several impacts of smoking in public healthcare, the country implemented several initiatives to reduce the number of smokers through the years. Since the late 1980s, with the aim of promoting health, many integrated national actions were developed in the National Program of Tobacco Use Control (PNCT). Moreover, in 2005, Brazil ratified the World Health Organization Framework Convention on Tobacco Control (WHO/FCTC), the first international public health treaty dedicated to containing the global tobacco epidemic⁶.

The implementation of the PNCT aims to align the country to the WHO/FCTC guidelines, targeting reduction on tobacco demand and offer. As a result from those initiatives, Brazil stands out globally for reaching a greater reduction in the ratio of smokers in both men and women since 1990⁷.

The importance of implementing public policies for tackling this risk behavior lies in not only lowering the disease's burden, but also in reducing costs for the health system. Reduction in the proportion of smokers is achieved through increased taxes on tobacco products, banning smoking in closed collective spaces, educational campaigns, restrictions on advertising, among other actions⁸. With the introduction of electronic cigarettes, also known as vaping pods, it is essential to look out for the younger population with the aim of preventing early addiction to nicotine. In addition to this, doctors and health professionals need to work in an integrated manner to also support smoking cessation, thus contributing to the promotion of public healthcare in the country.

The aim of this study is to present information on smoking and lung cancer incidence in Brazil, its Regions, Capitals, and the Federal District, stratified by sex.

METHOD

This publication will present information on smoking and lung cancer (ICD-10: C33-34) incidence in Brazil, its Regions, Capitals, and the Federal District, stratified by sex. The information on smoking was extracted from population-based surveys conducted in the country, and their results constitute scientific proof that bases the formulation of public policies, such as:

- the 2019 National Health Survey (PNS) collected information on people aged 15 or older; in this study, only information on people aged 18 or older (adult population) was used⁹.
- the 2019 National School Health Survey (PeNSE). The studied population includes students aged 13 to 17 who attend from the 6th to the 9th grade of elementary school and in the 1st to 3rd year of high school¹⁰.



c) the Surveillance of Risk and Protective Factors for Chronic Diseases by Telephone Survey (Vigitel) for the 2006 to 2020 period. The studied population is composed of smokers aged 18 or older¹¹.

Information on incidence was obtained from the databases of existing and active Population-Based Cancer Registries (RCBP) in Brazil, for the period between 2000 and 2019, with historical series of at least 10 years of information available at INCA's incidence tabulator¹². Incidence rates were calculated by sex and for each Capital city.

Incidence rates were age-adjusted to the 1960 world standard population^{13,14}. Census (2000-2010) and intercensal (2001-2020) population data from the selected capitals were used as denominators to calculate incidence rates¹⁵.

The Joinpoint¹⁶ regression model, that adjusts, on a logarithmic scale, linear trends and changes in those trends (inflection points) was used for trend analysis (incidence and smoking). The values presented in this study correspond to the values estimated by the statistical adjustment test, that uses the Monte Carlo permutation method. The direction and magnitude of the trend, in the whole period, were estimated through average annual percent change (AAPC), considering a statistical significance level of 0.05.

Statistical analyses were performed using the Joinpoint regression (version 5.20)¹⁶, R (version 4.3.2)¹⁷ and Epi info (version 7.2)¹⁸ software.

According to the Resolution of the National Health Council (CNS) no. 510/2016¹⁹, studies with publicly available secondary data are exempt from ethical analysis.

RESULTS

In Brazil, the greatest incidence of adult smokers was found in men (16%). Among the students researched, boys showed a greater proportion of cigarette use over the last 30 days (7%), in addition to a greater proportion in trying out vaping pods at some point in their lives (19%).

There is a variation between the regions of the country in relation to smoking, with the South Region having the highest percentage of adult smokers, for both sexes. Among the students, the Middle West Region was identified to have the greatest proportion of smokers over the last 30 days among male students (9%). In addition, a relevant number of students who have tried vaping pods at some point in their lives were observed in both sexes (over 20%) (Figure 1).

In the North Region, the greatest proportions of adults who use electronic tobacco devices were found in Palmas (6.3%) and Rio Branco (3.4%). In the Northeast

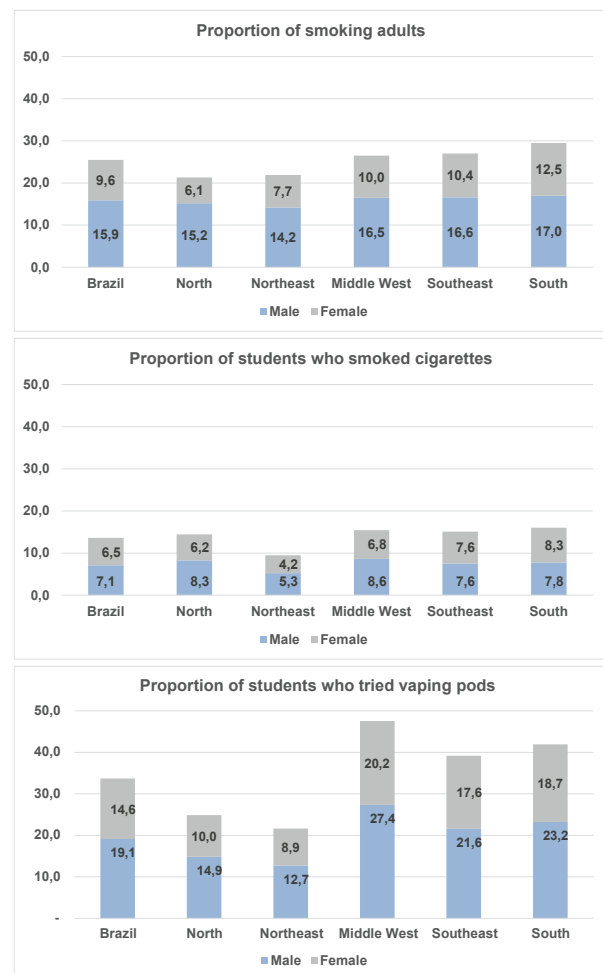


Figure 1. Proportion of smoking adults, who have smoked cigarettes over the last 30 days and have tried vaping pods, Brazil and Regions, 2019

Sources: PNS⁹, PeNSE¹⁰.

Region, the greatest proportion was found in men from most capitals, except for Salvador (0.8%), Teresina (0.5%) and João Pessoa (0.3%). In the Middle West Region, the greatest proportion was observed in men, especially in Goiânia (7.1%). Regarding women, the Federal District showed the greatest percentage (4.7%). For the Southeast Region, the proportion varied from 0.2% to 5.2%. The city of São Paulo showed greater proportions for both men (5.2%) and women (2.4%). Lastly, the greatest proportion in the South Region was found in men, specifically in Florianópolis (5.4%). In women, the city of Curitiba presented the highest percentage (2.4%) (Figure 2).

The trend analysis of proportion of smoking adults reveals that there was a significant decline per year for all Brazilian capitals and Regions over the 2006-2020 period. The North Region showed the greatest decline in smoking for men (-9%, Macapá) and women (-9%, Manaus). In the Northeast Region, the trend varied: -9% in Teresina and -4% in Salvador for the male population, and -8% in



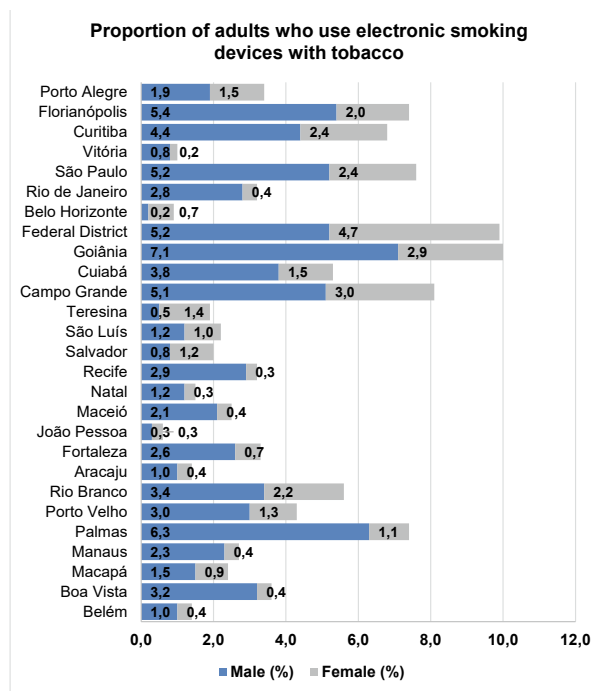


Figure 2. Proportion of adults who use electronic smoking devices with tobacco, both sexes, Brazilian Regions Capitals and Federal District, 2019

Source: Vigitel¹¹.

Teresina and -4% in Fortaleza for the female population. The Middle West Region showed that, for both men and women, there was a significant decline per year (ranging from -6% to -3%) for all capitals. In the Southeast Region, the city of Vitória showed the lowest reduction (around -5%/year in men and -6%/year in women). Lastly, in the South Region, an expressive decline was observed for all capitals and both sexes, ranging on average from -2% to -6%/year. (Table 1 and Figure 3). When analyzing the RCBP for the North Region, lung cancer incidence trend rates in Belém and Manaus had an average decline of 3%/year for the referred period among men, while for women, the incidence rates remained stable.

The Northeast Region RCBP showed that the city of Aracaju had the greatest decline in lung cancer incidence, with an average -4%/year among men for the 2000-2016 period, while women, in the city of João Pessoa, showed the greatest average increase of 7%/year in the 2000-2017 period (Figure 4 and Table 1).

The Middle West Region RCBP demonstrated that, among men, the city of Cuiabá presented an average decline of -4%/year in the lung cancer incidence rate. As for women, the Federal District had an average increase of 6%/year in the 2000-2018 period (Figure 4 and Table 1).

The South Region RCBP observed that the city of São Paulo showed a -7%/year reduction in the incidence rate for men and -2%/year for women in the 2000-2015

period. In the city of Belo Horizonte, there was an average reduction of -3%/year for men and an average increase of 2%/year for women in the 2000-2019 period (Figure 4 and Table 1).

The South Region RCBP showed that both men and women in the city of Porto Alegre had an average reduction of -7%/year and -2%/year, respectively, in the lung cancer incidence rates (Figure 4 and Table 1).

DISCUSSION

The evolution of smoking over the last decades directly affects the incidence and mortality of tobacco-related diseases, especially lung cancer. Although Brazil has achieved significant progresses in reducing the proportion of smokers thanks to the implementation of public policies, as proven by the presented information for each capital city in the country, the impact of decades using tobacco products is still visible in some health statistics, especially regarding chronic illnesses. This is more noticeable in women, for whom the lung cancer incidence and mortality rates still show an upwards trend in some Regions, contrasting with the downwards trend among men²⁰. This phenomenon reflects the expected pattern of the tobacco epidemic curve by sex in developed countries that, initially, shows a rapid increase in tobacco use by men, later followed by women²¹. As a result, the beginning of the decline in the proportion of smokers among women is subsequent to that of men, starting, however, from a peak reached in this prevalence that is lower compared to that of men. This dynamic decrease in the users of tobacco-derived products is fueled by public healthcare actions towards reducing smoking initiation and stimulating cessation, encompassing the whole population, thus preventing premature and preventable deaths related to tobacco²².

The information presented here highlights the importance of continuous and robust prevention actions and health promotion to reduce smoking initiation and/or stimulate cessation. While the proportion of male smokers in the North and Northeast Regions is the lowest and not so far from those in other Regions in the country, the proportion of women smokers is considerably higher in the South Region. It is also worth noting that the average annual decline trend in the proportion of smokers for both sexes from 2006 to 2020 does not accurately capture the drop in the actual price of conventional cigarettes pack and, consequently, the increase in access to this product since 2017 in Brazil²³.

Recent information from 2019 shows that 12.6% of the adult population are currently smokers (15.9% men and 9.6% women). Associated with the reduction in the

Table 1. AAPC of the proportion of smoking adults, both sexes, Brazilian Regions and Federal District, 2006-2020. AAPC in the age-adjusted incidence rates¹ of lung cancer, both sexes, RCBP, according to the reference period

Capital and FD (2006 a 2020)	Proportion of smoking adults		RCBP reference period	Adjusted incidence rates	
	Male: AAPC (95%CI)	Female: AAPC (95%CI)		Male: AAPC (95%CI)	Female: AAPC (95%CI)
Belém	-6.31*(-8.65;-4.69)	-7.47*(-12.49;-5.33)	2000-2019	-3.35*(-5.43;-1.57)	-0.62(-2.59;1.32)
Boa Vista	-4.01*(-7.56;-2.45)	-4.41*(-7.54;-2.16)	NA	-	-
Macapá	-8.68*(-11.07;-6.91)	-8.29*(-9.37;-7.44)	NA	-	-
Manaus	-7.48*(-10.65;-5.04)	-8.63*(-11.63;-6.39)	2000-2016	-2.60*(-4.54;-0.98)	-0.55(-2.25;1.17)
Palmas	-4.43*(-7.41;-2.27)	-5.04*(-12.1;-1.59)	2000-2017	-1.66(-9.09;4.49)	-2.06(-8.65;3.4)
Porto Velho	-6.40*(-8.89;-4.41)	-6.59*(-8.74;-4.92)	NA	-	-
Rio Branco	-5.40*(-8.14;-3.15)	-6.81*(-9.45;-4.71)	NA	-	-
Aracaju	-5.97*(-9.55;-2.93)	-7.51*(-9.61;-5.86)	2000-2016	-3.95*(-6.93;-1.45)	-1.01(-3.78;1.77)
Fortaleza	-7.17*(-9.25;-5.47)	-4.22*(-8.26;-2.20)	2000-2015	-1.88*(-3.41;-0.5)	2.13*(0.34;4.11)
João Pessoa	-5.22*(-8.3;-2.51)	-5.23*(-7.27;-3.35)	2000-2017	2.28(-1.34;7.55)	6.95*(2.71;18.76)
Maceió	-5.66*(-7.85;-3.78)	-7.40*(-9.11;-6.01)	NA	-	-
Natal	-5.63*(-8.43;-3.26)	-5.93*(-9.44;-3.21)	NA	-	-
Recife	-4.52*(-5.71;-3.41)	-4.89*(-6.26;-3.70)	2000-2018	-1.55*(-2.88;-0.27)	1.81*(0.66;3.03)
Salvador	-4.15*(-7.08;-2.26)	-5.67*(-8.34;-3.51)	NA	-	-
São Luís	-8.55*(-12.95;-6.55)	-5.51*(-8.16;-3.30)	NA	-	-
Teresina	-8.73*(-10.58;-7.36)	-8.17*(-10.95;-6.11)	NA	-	-
Campo Grande	-4.47*(-5.77;-3.33)	-5.62*(-7.03;-4.47)	NA	-	-
Cuiabá	-4.17*(-5.95;-2.58)	-5.22*(-6.87;-3.8)	2000-2018	-3.63*(-5.19;-2.28)	0.37(-1.51;2.35)
Goiânia	-3.18*(-4.69;-1.75)	-4.86*(-6.95;-3.05)	2000-2013	0.06(-4.33;4.45)	3.57(-1.02;8.81)
Federal District	-4.13*(-5.97;-2.53)	-4.78*(-6.45;-3.35)	2000-2018	1.82(-1.89;6.75)	6.28*(4.57;11.07)
Belo Horizonte	-4.33*(-5.83;-3.03)	-4.34*(-6.98;-2.21)	2000-2019	-2.47*(-3.88;-1.24)	1.83*(0.51;3.29)
Rio de Janeiro	-3.47*(-5.03;-2.04)	-4.34*(-5.33;-3.42)	NA	-	-
São Paulo	-3.31*(-4.77;-2.01)	-3.55*(-5.07;-2.19)	2000-2015	-6.90*(-8.67;-5.51)	-2.21*(-4.05;-0.52)
Vitória	-4.52*(-6.93;-2.41)	-6.11*(-8.26;-4.28)	2000-2012	0.22(-5.99;6.50)	1.35(-3.97;7.28)
Curitiba	-3.88*(-6.00;-1.91)	-4.98*(-6.92;-3.30)	2000-2018	-3.10*(-4.13;-2.19)	-0.14(-1.65;1.36)
Florianópolis	-2.06*(-3.63;-0.93)	-5.66*(-8.19;-3.63)	NA	-	-
Porto Alegre	-3.75*(-5.60;-2.12)	-3.01*(-5.35;-1.33)	2000-2017	-6.54*(-7.91;-5.5)	-2.12*(-3.92;-0.46)

Source: Vigitel¹¹ RCBP¹².

Captions: ¹ = Age-adjustment to the 1960 world population; AAPC = annual average percent change; *Statistically significant = $p < 0.05$; NA = No information on the incidence of cancer available for the selected period; FD = Federal District; RCBP = Population-Based Cancer Registry.

number of smokers, a reduction in the proportion trend of adult smokers from both sexes per year is observed in every Brazilian capital city. There is also a decrease in incidence rate trends, especially among men/year for the RCBP capital cities.

Parallel to the reduction of conventional smoking, a new form of nicotine consumption arises: electronic cigarette or vaping pods. This device, often and erroneously perceived as a less harmful alternative to the conventional cigarette, is becoming popular especially among young people²⁴. The popularity of those devices may directly influence future lung cancer incidence rates

and general long-term impacts on health. Thus, a better understanding of the use of vaping pods dynamics in Brazil may contribute to the assessment of emerging patterns that may affect public health policies aimed at reducing smoking damage.

In Brazil, despite the Brazilian Health Surveillance Agency (Anvisa) regulation having banned commercialization of those products in 2009^{25,26}, according to PeNSE information, the proportion of students (19.1% boys and 14.6% girls) that tried vaping pods at some point in their lives is concerning. This new trend represents an additional global challenge for



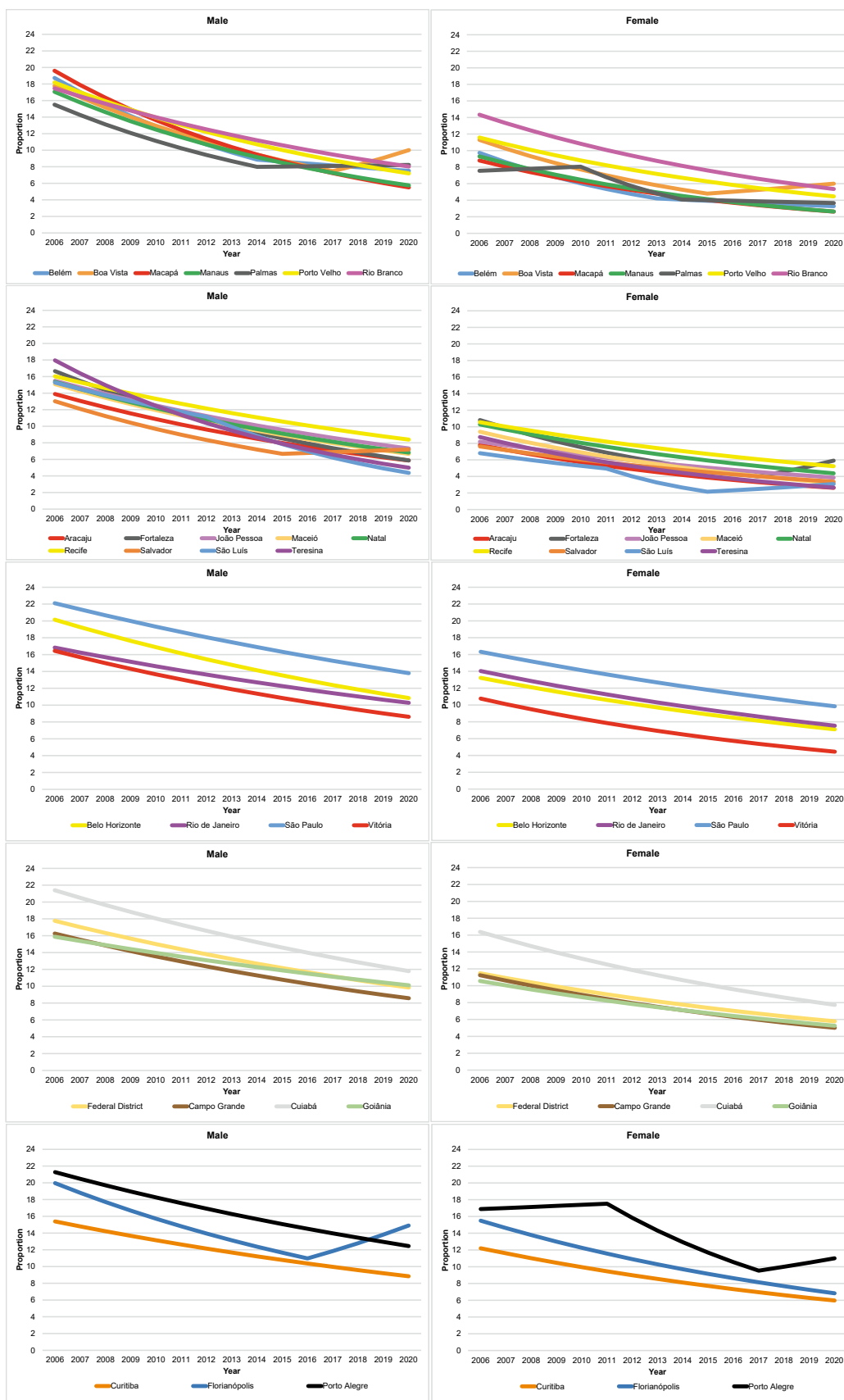


Figure 3. Trend in the proportion of smoking adults, both sexes, Brazilian Regions and Federal District, 2006-2020

Source: Vigitel¹¹.



public healthcare policies, since the long-term effects of the use of electronic cigarettes, in isolation or along with conventional cigarettes, are not yet fully understood²⁴.

Moreover, the low price of conventional packs of cigarettes in Brazil, the second cheapest in the Americas Region, makes it even easier for users to migrate from vaping

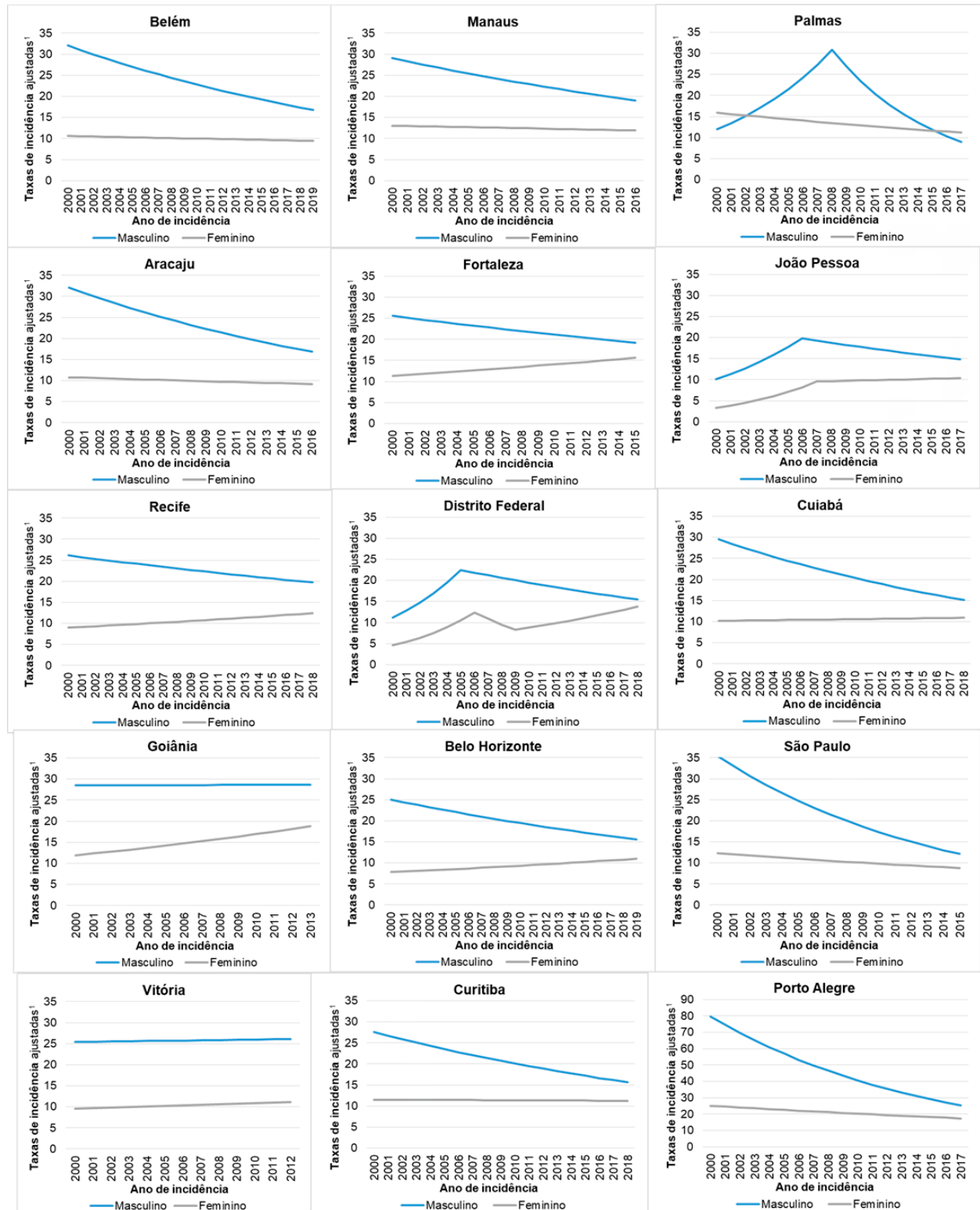


Figure 4. Trend in the age-adjusted incidence rates¹ of lung cancer, both sexes, RCBP of Brazilian Regions, according to the reference period.

Caption: ¹ = Age-adjusted to the 1960 world population

Source: RCBP¹².



pods to regular conventional cigarettes in their nicotine addiction initiation²⁷.

In fact, the use of cigarettes over the last 30 days among adolescents was concerning in every Region, with the Northeast Region presenting the lowest intake proportion. Among young people, the use of vaping pods was also alarming, especially in the South, Southeast and Middle West Regions. The popularization of electronic cigarettes in this age group reflects the main target of the nicotine industry marketing to replace part of the current adult users that will inevitably pass away³.

The findings from this study reinforce the concern with a possible increase in experimenting and daily use of electronic cigarettes as a new pathway to nicotine addiction. The proportion of smokers over 15 years old showed a decline from 22.8% in 2007 to 17.0% in 2021 in the world, with Brazil showing the greatest reduction in the proportion of smokers from 1990 to 2019 for both sexes^{7,28,29}.

The literature has documented that these new vaping pods have been used mainly by adolescents, as the industry has created special devices targeted at this age group³⁰.

In a study conducted in Los Angeles involving high school students aged 14 years old, those who have tried electronic cigarettes were twice as likely to have patterns of excessive tobacco use at six-month follow-up³¹.

A meta-analysis revealed that, in 17 studies involving people aged up to 18 years old, the use of electronic cigarettes approximately tripled the risk of smoking conventional cigarettes (RR=3.29; 95%CI = 2.65-4.09). Moreover, six studies done with the same age group observed that the use of electronic cigarettes almost quadrupled the later risk of using conventional cigarettes (RR=3.76; 95%CI = 2.64-5.33)³².

Some research indicate that the health hazards associated to the use of electronic cigarettes go beyond the neurological effects of nicotine, including cardiovascular damage, for example^{33,34}. In 2019, an epidemic of e-cigarette or vaping product use-associated lung injury (EVALI) affected millions of users in the USA, resulting in serious health issues. Patients with EVALI presented respiratory, gastrointestinal and general symptoms. This outbreak shows the variety of liquid components of electronic cigarettes and raises questions on the safety of their use in the long-term³⁵.

In view of those findings, it is important to analyze how these trends behave over the years to better understand the global and local effects of smoking control measures, thus identifying the areas where precise interventions are needed in terms of access to diagnosis and treatment, in order to reduce the burden of diseases and deaths caused by tobacco.

A relevant limitation to this study is the use of secondary information on the use of tobacco-derived products, which can introduce bias, such as under-notification or errors in self-reporting, impacting the precision of data on tobacco use. Furthermore, a specific methodological analysis correlating reduction in the proportion of smokers with lung cancer, considering latency time and use patterns, was not conducted. This aspect may be approached in future research that focuses on deeper statistical modeling.

CONCLUSION

The conclusion of this study reinforces the importance of public policies for smoking control in Brazil, evidencing a general trend of reducing smoking rates and lung cancer incidence. However, the observed variations between capital cities and sexes indicate the need for a more targeted approach, considering regional and demographic specifics. The more accented decline among men, in comparison to women, and the increase in the use of electronic tobacco devices, demand special attention in the formulation of policies that approach these emerging challenges, including the younger population.

Moreover, the alarming increase in the incidence of lung cancer among women in certain Regions highlights the urgency of adaptive strategies that prioritize this group. Prevention and control campaigns must be intensified, especially targeting young people and women, to contain the increasing use of new tobacco products such as electronic cigarettes, to ensure a continuous reduction in the incidence of lung cancer in the country. This study helps understand the smoking dynamics in Brazil and reinforces the need for continuous and innovative efforts to protect public healthcare, adapting to ever-evolving challenges.

CONTRIBUTIONS

Fernanda Cristina da Silva de Lima, Darlan Henrique Nascimento da Silva and Rejane de Souza Reis contributed to the study design, planning, acquisition, analysis and interpretation of data, wording and critical review. André Salem Szklo contributed to data analysis and interpretation, wording and critical review. Alfredo José Monteiro Scaff has contributed to the study design, analysis and interpretation of data, wording, and critical review. All the authors approved the final version for publication.

DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interest to declare.

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None.

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