

Prevalence of electronic nicotine delivery systems and waterpipe use in Brazil: where are we going?

Prevalência de uso de dispositivos eletrônicos para fumar e de uso de narguilé no Brasil: para onde estamos caminhando?

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ABSTRACT: *Objective:* To describe the prevalence of use of electronic nicotine delivery systems (ENDS) and waterpipe in Brazil, by population subgroups, and to evaluate the trend between 2013 and 2019. *Methods:* We used data from the 2019 National Health Survey to estimate the prevalence of lifetime and current use of ENDS and current use of waterpipes by socio-behavioral characteristics. Differences in prevalence over time were calculated using data from the III Brazilian Household Survey on Substance Use-2015 and the National Health Survey-2013. *Results:* For 2019, the prevalence of current use of ENDS was estimated at 0.64% (~1 million people), of which ~70% were in the age group of 15–24 years old. The highest prevalence was observed in the Midwest region, but the Southeast region concentrates half of these users. Almost 90% are non-smokers, with high prevalence among those who also use waterpipe and abuse alcohol. There was an increase in ENDS use between 2015 and 2019, particularly among younger people. The prevalence of current waterpipe use in 2019 was estimated at 0.47% (~800,000 individuals), of which ~80% were 15–24 years old. There was an increase in the prevalence of current waterpipe use between 2013 and 2019, and among young people the increase was ~300%. *Conclusions:* In Brazil, ENDS have been used mostly by young people, and by never smokers of manufactured cigarettes. The use of ENDS and waterpipe has been increasing even with the country's regulatory restrictions, which may compromise the successful history of the tobacco control policy. *Keywords:* Electronic nicotine delivery systems. Smoking water pipes. Tobacco products. Nicotine. Tobacco use disorder.

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RESUMO: *Objetivo:* Descrever as prevalências de uso de dispositivos eletrônicos para fumar e de narguilé no Brasil, por subgrupos populacionais, e avaliar tendências entre 2013 e 2019. *Métodos:* Os dados principais analisados são da Pesquisa Nacional de Saúde de 2019. Estimaram-se prevalências de uso na vida e atual de dispositivos eletrônicos para fumar e de uso atual de narguilé segundo características sociocomportamentais. Os dados da Pesquisa Nacional de Saúde-2019 sobre dispositivos eletrônicos para fumar foram comparados aos do III Levantamento Nacional sobre Uso de Drogas pela População Brasileira e os dados sobre narguilé comparados aos da Pesquisa Nacional de Saúde 2013. *Resultados:* Para 2019, estimou-se a prevalência de uso atual de dispositivos eletrônicos para fumar em 0,64% (~1 milhão de pessoas), dos quais ~70% tinham 15–24 anos. A maior prevalência está na região Centro-Oeste, mas o Sudeste concentra metade absoluta desses usuários. Quase 90% são não fumantes, e maiores prevalências foram encontradas entre quem usa também narguilé e álcool abusivo. Observou-se aumento nas estimativas de uso de dispositivos eletrônicos para fumar entre 2015 e 2019, especialmente entre os mais jovens. A prevalência de uso atual de narguilé em 2019 foi estimada em 0,47% (~800 mil indivíduos), dos quais ~80% tinham 15–24 anos. Houve aumento na prevalência de uso atual de narguilé entre 2013 e 2019, e entre jovens o aumento foi de ~300%. *Conclusões:* No Brasil os dispositivos eletrônicos para fumar têm sido utilizados majoritariamente por jovens e por nunca fumantes de cigarros industrializados. O uso de dispositivos eletrônicos para fumar e de narguilé vem aumentando, mesmo com as restrições regulatórias do país, podendo comprometer o exitoso histórico da política de controle do tabagismo.

Palavras-chave: Sistemas eletrônicos de liberação de nicotina. Narguilé. Produtos do tabaco. Nicotina. Tabagismo.

INTRODUCTION

With the reduction in the number of industrialized cigarette users worldwide¹, the tobacco industry has invested in the marketing of new products such as electronic nicotine delivery systems (ENDS) — which include electronic cigarettes, heated tobacco cigarettes and electronic waterpipes —, and also in giving greater visibility to more traditional products, such as the waterpipe.

Unlike conventional cigarettes, the release of nicotine in ENDSs does not depend on combustion to produce smoke, but on an electronic mechanism that produces steam, heating a liquid that contains nicotine and additives (electronic cigarettes) or solid tobacco sheets (heated tobacco cigarette). Therefore, they have been portrayed as a less harmful alternative to conventional cigarettes that can even help with smoking cessation². As for the traditional waterpipe, many still believe that, although it uses combustion to release smoke, it is less toxic because it is filtered in water³.

The difficulties of regulating the internet have favored the advertising of these products in this environment, attracting young people, since they are promoted as a technological novelty⁴, with different flavors⁵ and because of the social rituals involved in smoking waterpipe³. Worldwide, there was an explosion ENDS use among young people, and in the United States, where until 2016 these new products were not regulated, the prevalence of use of

electronic cigarettes has surpassed that of manufactured cigarettes among high school students (27.5 versus 5.8% in 2019)⁶.

However, studies are now showing that ENDS are not innocuous as the manufacturers claim, with indications that tobacco is actually carbonized in heated cigarettes⁷, in addition to the presence of several toxic and carcinogenic substances in electronic cigarettes^{8,9}. Besides that, systematic reviews show that electronic cigarettes significantly increase the risk of trying conventional cigarettes¹⁰ and the frequency of relapse to conventional smoking among former smokers¹¹.

As for waterpipes, studies show their association with different types of cancer¹²⁻¹⁴, given that in a one-hour session one can inhale an amount of smoke equivalent to one hundred cigarettes or more, and daily use can be equivalent to smoking ten cigarettes a day³.

In Brazil, the same restrictions imposed on conventional cigarettes are imposed on the sale of waterpipes¹⁵, while the sale of ENDS is prohibited¹⁶.

Monitoring the presence and dissemination of these tobacco products in society can contribute to the identification of gaps and threats in tobacco control policies across the country, which have been quite successful over time¹⁷. Therefore, the objective of this study was to describe the prevalence of use of electronic smoking devices and waterpipe in Brazil while characterizing the most affected population subgroups and assessing the spread between 2013 and 2019, based on data from three nationwide surveys.

METHODS

The main data analyzed come from the National Health Survey (PNS) 2019. The PNS is an integral part of the Integrated System of Household Surveys (SIPD) of the National Institute of Geography and Statistics (IBGE) and is the result of a partnership with the Ministry of Health. This is a nationwide household survey with a representative sample of the Brazilian population aged 15 years and over residing in permanent private households. The sample is clustered in three stages, with stratification of the primary sampling units (PSU), which are the census tracts or set of tracts; households are the second stage units, and residents are the tertiary units. The weight of the selected resident considers, besides selection probability, adjustments for correction of non-response by sex and calibration according to population totals by sex and age group. Details about the PNS methodology can be found elsewhere¹⁸.

To assess the use of ENDS in PNS-2019, the following question was asked: "Do you use electronic devices with liquid nicotine or chopped tobacco leaf (electronic cigarette, electronic waterpipe, heated cigarette or other electronic smoking device to smoke or vaporize)?" Current ENDS use was determined when the answers were "yes, daily" or "yes, not daily". Lifetime use included, in addition to current use, individuals who answered "no, but I have used it in the past". All others were considered individuals who never used ENDS. For the assessment of waterpipe use, the question was about the average

number of sessions per day/week, with the following answer options: “one or more per day”, “one or more per week”, “less than once a week”, “less than once a month” and “I do not use this product”. Therefore, anyone who reported using any amount was considered a current user.

Point prevalences and respective 95% confidence intervals (95%CI) of current and lifetime use of ENDS and waterpipe were calculated for Brazil and by sociodemographic and behavioral characteristics: macro-regions, age group (15–24 years; 25–39 years; 40 years and over), ethnicity/skin color (white, black [black + brown]), gender, education (zero to eight years of study [up to incomplete Elementary School]; nine to 11 years of study [Complete Elementary School to incomplete High School]; 12 or more years of study [Complete High School or more]), alcohol abuse in the last 30 days (yes, no), current use of industrialized cigarettes, ENDS and waterpipe (yes, no). Alcohol abuse was considered as the consumption of five or more doses of alcoholic beverages on a single occasion in the last 30 days. Given the low representation of indigenous and yellow people in the PNS sample, the estimates for these subgroups are not presented due to their low precision. However, important to note that whites, blacks and browns represent 98.5% of the PNS population. The absolute number of people with the selected characteristics was also estimated based on the total research population. A statistically significant difference (at 5%) was the absence of overlapping of confidence intervals in prevalence estimates.

In order to verify the relation between the use of ENDS and industrialized cigarettes in each age group, the χ^2 test with Rao-Scott correction was performed, considering a significance level of 5%. Point estimates of the prevalence of individuals who currently use ENDS, who only used it in the past, or who never used it, according to use of industrialized cigarette (current smoker, former smoker or never smoked) were also evaluated.

To assess the trend in prevalence of ENDS in Brazil, in comparison to data from the PNS-2019, data from the III National Survey on Drug Use by the Brazilian Population (III-LNUD), coordinated by the Oswaldo Cruz Foundation (Fiocruz), were used, being the first nationwide survey to address this issue¹⁹. The III-LNUD was carried out in 2015, with a representative sample of the Brazilian population aged 12–65 years. The sampling plan followed methodological criteria similar to those of the IBGE’s National Household Survey (PNAD): a stratified sampling plan for conglomerates at various stages. More details can be found elsewhere²⁰.

The subgroup aged 15–65 years was selected in both surveys to compare the results of III-LNUD-2015 and PNS-2019. Although for LNUD the question about ENDS only included the use of electronic cigarettes, back in 2015, they were the ones dominating the world market. The best-known heated tobacco cigarette brand (“IQOS”), for example, was launched only in 2014, and the brand “glo” only in 2016, that is, after the survey. The III-LNUD estimated the use of electronic cigarettes in the last 12 months, while the PNS-2019 addresses current use. As such, the 2015 estimates are expected to be more “inflated” than current use only. Thus, an increase in the period would represent a real increase in ENDS presence in the country, although one cannot directly estimate the magnitude of this increase.

To compare the use of waterpipe over time, data from the PNS-2013 were used. The sampling plan of PNS-2013²¹ is similar to that of the 2019 edition, but only residents aged 18 and over were interviewed. For the purpose of comparison, the prevalence estimates considered only individuals aged 18 years and older in both surveys. It is noteworthy that PNS-2013 had no questions about the use of ENDS.

The prevalence of ENDS and waterpipe use was estimated for Brazil, and according to macro-regions, age groups, gender and educational level, which can be obtained similarly between surveys and which, according to studies, are associated with the use of ENDS¹⁹.

The analyses were performed using the “survey” and “srvyr” packages of the R v.3.5.1 software, given the complexity of the samples.

The National Research Ethics Commission (CONEP) approved the PNS in 2013 (Certificate of Presentation for Ethical Appraisal – CAAE 10853812.7.0000.0008) and in 2019 (CAAE 11713319.7.0000.0008), and the III-LNUD-2015 was approved by Research Ethics Committee of Joaquim Venâncio Polytechnic School of Health (EPSJV/FIOCRUZ) (CAAE 35283814.4.0000.5241). This study used data from approved researches, but not that from nominal bases; therefore, there were no ethical implications for the interviewees.

RESULTS

For 2019, the prevalence of lifetime and current use of electronic devices for smoking was estimated at, respectively, 1.63 and 0.64% of the Brazilian population aged 15 years and over. This percentage varied widely by macro-region, with the highest point prevalence of current use of ENDS in the Midwest region (1.45%) and the lowest in the Northeast region (0.13%). However, in absolute numbers, the Southeast region has the largest number of current users of ENDS: around 50% (approximately 533 thousand people) (Table 1).

The subpopulation of adolescents and young people aged 15–24 years had the highest prevalence of ENDS use (5.41% for lifetime use and 2.38% for current use), accounting for about 70% of ENDS users both in lifetime and currently. The prevalence of current use of ENDS among these young people was estimated to be nearly 40 times the prevalence among adults aged 40 years and over (2.38 versus 0.06%, respectively).

White and male individuals had higher prevalence of lifetime use of ENDS than black people and women, respectively. However, for current use, there was an overlap in the confidence intervals of these estimates. The prevalence of current use of ENDS was higher both among individuals with 12+ years of study and among those with 9 to 11 years of study than among the less educated (1.25, 0.73 and 0.19%, respectively) (Table 1).

The prevalence of current use of ENDS was higher among industrialized cigarette users than among non-users (0.87 versus 0.61%, respectively), with overlapping confidence intervals (Table 1). However, in absolute numbers, the greatest portion of current users of ENDS are non-smokers (~86%). Also, waterpipe users and individuals who abuse alcohol

Table 1. Estimated prevalence of use of Electronic Nicotine Delivery Systems in lifetime and currently, according to socio-behavioral characteristics. Brazil, 2019.

| | Use of ENDS in lifetime | | | Current use of ENDS | | |
|--|-------------------------|-------------|---------|---------------------|-------------|---------|
| | % | 95%CI | Nx1.000 | % | 95%CI | Nx1.000 |
| Brazil | 1.63 | 1.43–1.83 | 2.744 | 0.64 | 0.51–0.76 | 1.070 |
| Region | | | | | | |
| North | 0.55 | 0.39–0.72 | 75 | 0.15 | 0.06–0.24 | 21 |
| Northeast | 0.58 | 0.42–0.74 | 259 | 0.13 | 0.07–0.19 | 58 |
| Southeast | 2.01 | 1.61–2.40 | 1.456 | 0.73 | 0.49–0.98 | 534 |
| South | 2.42 | 1.87–2.97 | 595 | 1.11 | 0.71–1.50 | 272 |
| Midwest | 2.80 | 2.19–3.41 | 358 | 1.45 | 1.05–1.85 | 186 |
| Age | | | | | | |
| 15–24 years | 5.41 | 4.51–6.31 | 1.695 | 2.38 | 1.78–2.97 | 745 |
| 25–39 years | 1.78 | 1.47–2.10 | 830 | 0.57 | 0.39–0.76 | 267 |
| 40 years and over | 0.24 | 0.17–0.31 | 218 | 0.06 | 0.02–0.11 | 59 |
| Ethnicity/Skin color | | | | | | |
| White | 2.00 | 1.64–2.36 | 1.448 | 0.78 | 0.54–1.01 | 563 |
| Black | 1.33 | 1.11–1.54 | 1.240 | 0.52 | 0.39–0.64 | 482 |
| Sex | | | | | | |
| Male | 2.14 | 1.82–2.45 | 1.693 | 0.77 | 0.60–0.94 | 614 |
| Female | 1.18 | 0.95–1.41 | 1.051 | 0.51 | 0.33–0.69 | 456 |
| Education (years of study) | | | | | | |
| 0–8 years | 0.53 | 0.37–0.68 | 304 | 0.19 | 0.10–0.29 | 111 |
| 9–11 years | 2.08 | 1.77–2.38 | 1.686 | 0.73 | 0.57–0.89 | 592 |
| 12 years and more | 2.57 | 1.91–3.22 | 753 | 1.25 | 0.72–1.78 | 368 |
| Current use of manufactured cigarettes | | | | | | |
| Yes | 2.77 | 2.14–3.40 | 449 | 0.87 | 0.56–1.17 | 141 |
| No | 1.51 | 1.30–1.72 | 2.295 | 0.61 | 0.48–0.75 | 929 |
| Current use of waterpipe | | | | | | |
| Yes | 34.65 | 23.22–46.08 | 276 | 23.74 | 14.00–33.48 | 189 |
| No | 1.47 | 1.29–1.66 | 2.468 | 0.53 | 0.41–0.64 | 881 |
| Alcohol abuse in the last 30 days | | | | | | |
| Yes | 4.18 | 3.49–4.88 | 1.168 | 1.74 | 1.32–2.17 | 487 |
| No | 1.12 | 0.93–1.31 | 1.576 | 0.42 | 0.29–0.54 | 583 |

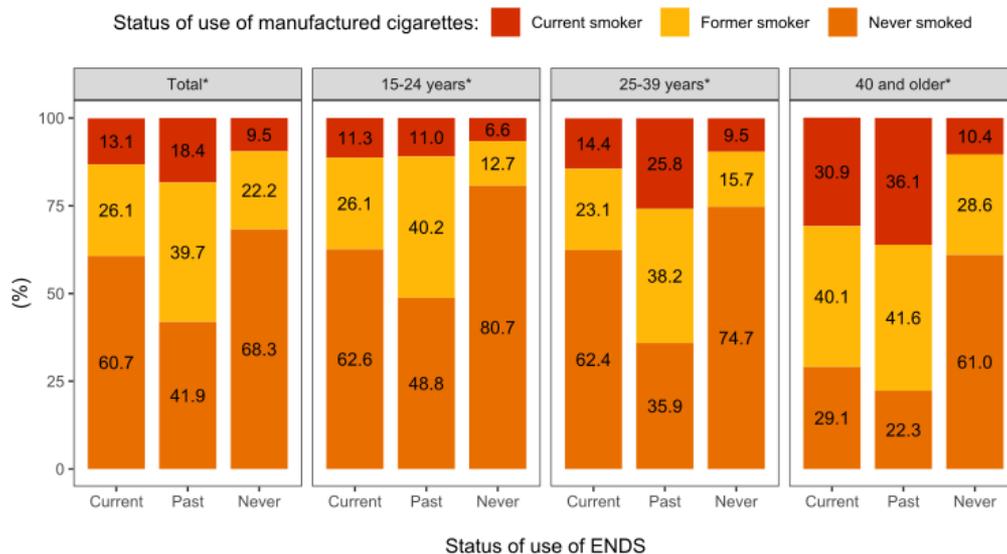
ENDS: Electronic Nicotine Delivery Systems.

had statistically higher prevalence of current use of ENDS than those who do not show these risk behaviors (23.74 *versus* 0.53% and 1.74 *versus* 0.42 %, respectively).

The status of ENDS use was associated with the use of industrialized cigarettes ($p < 0.001$) in all age groups. Figure 1 shows the use of industrialized cigarettes and the use of ENDS for each age group. Among young people aged 15–24 who currently use ENDS, 62.6% have never smoked industrialized cigarettes, while among individuals aged 40 years and over this percentage is 29.1%. The point prevalence of current use of industrialized cigarettes, for all age groups, is higher among those who currently use ENDS or have used it in the past than among those who have never used ENDS (15–24 years: 11.3 and 11.0 *versus* 6.6%; 25–39 years: 14.4 and 25.8 *versus* 9.5%; 40 years or more: 30.9–36.1 *versus* 10.4%, respectively).

When comparing the prevalence of ENDS use between 2015 and 2019 (Figure 2), we found an increase in estimates for Brazil, especially for the younger age group, 15–24 years old. The point prevalence was also inflated in all macro-regions and for all educational categories. As for sex, although there was an increase for both, among women it was even more marked.

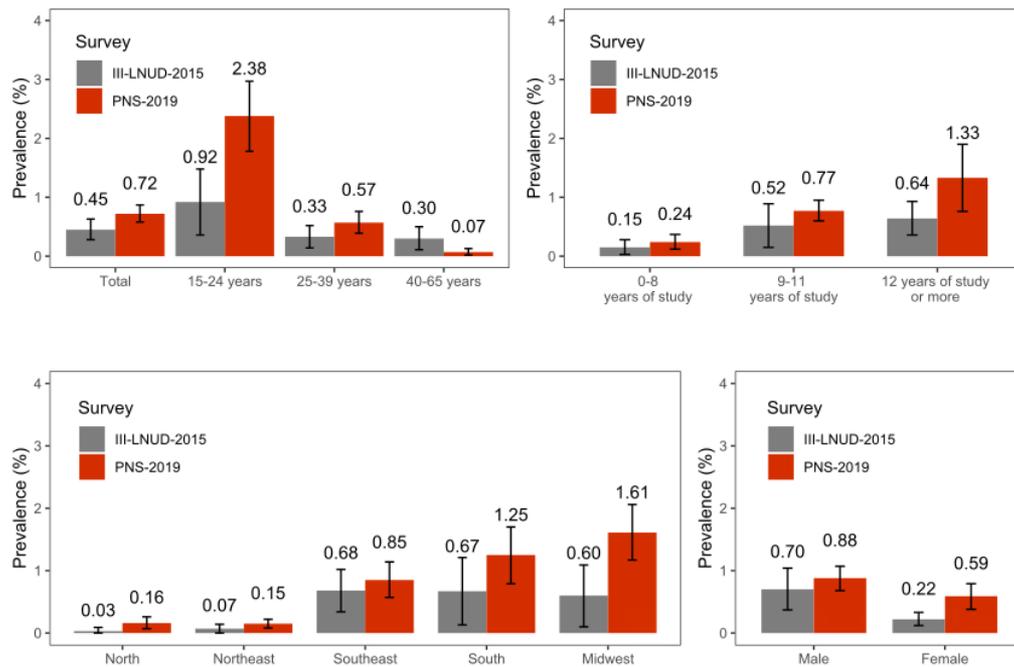
Regarding the use of waterpipe, for 2019 the prevalence of current use was estimated in 0.47%, representing about 800 thousand individuals aged 15 years or more, of which about 80% were between 15 and 24 years old. The highest values are found in the Midwest (0.94%), South (0.90%) and Southeast (0.55%) regions. Men had a statistically higher prevalence than



ENDS: Electronic Nicotine Delivery Systems.

Note: * $p < 0.001$ in the χ^2 test with Rao-Scott correction to verify the association between status of use of electronic smoking devices and status of use of industrialized cigarettes.

Figure 1. Population profile by status of use of Electronic Nicotine Delivery Systems, according to status of use of manufactured cigarettes. Brazil, 2019.



Notes: The prevalence of 2015 refers to the use of electronic cigarettes in the last 12 months and, of 2019, to the current use of electronic smoking devices in general.

Figure 2. Prevalence of use of Electronic Nicotine Delivery Systems among individuals aged 15 to 65 years, by survey, according to selected characteristics. Brazil, 2015–2019 III-LNUD-2015: III National Survey on Drug Use by the Brazilian Population, 2015; PNS: National Health Survey.

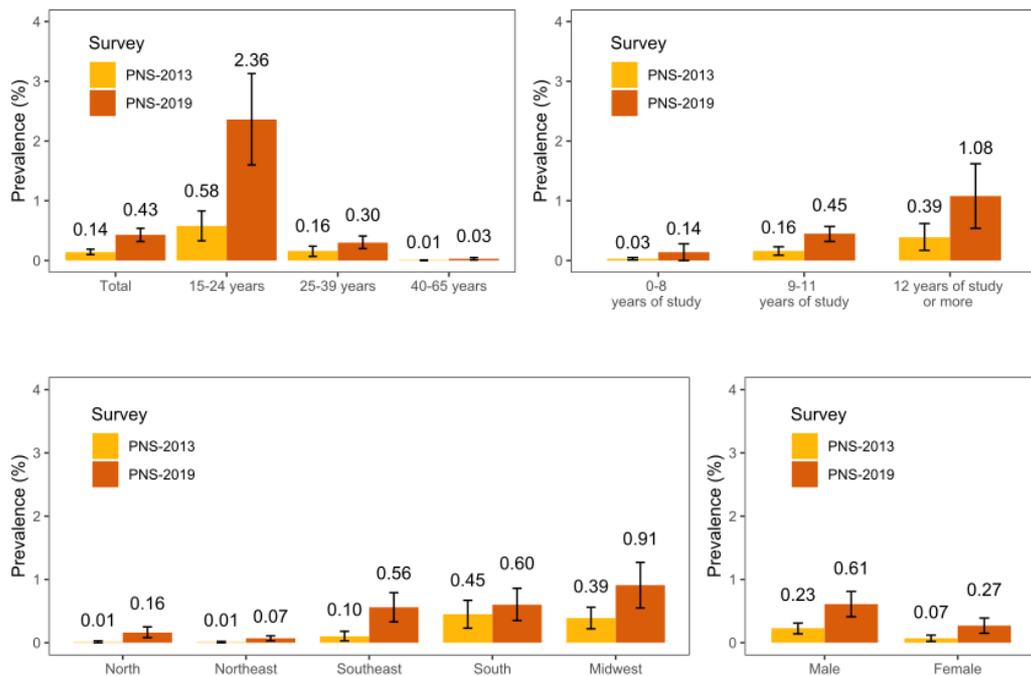
women (0.71 versus 0.26%), and people with 12 years of study or more and with nine to 11 years of study were included in statistically higher prevalences compared to people with up to eight years of study (1.14, 0.44 and 0.17%, respectively). There was no statistically significant difference in prevalence by ethnicity/skin color. The prevalence of waterpipe use was significantly higher among industrialized cigarette users (2.58 versus 0.25%), ENDS users (17.66 versus 0.36%) and people who abuse alcohol (1.85 versus 0.20%) (Table 2).

Assessing estimates of current and lifetime use of waterpipe (Figure 3), the prevalence increased from 0.14% in 2013 to 0.43% in 2019, and for the 18–24 age group the increase was around 300% in this period. In the North region, where in 2013 the use of waterpipes was quite rare (0.01%), there was a significant increase to 0.16% in 2019. Another region that experienced a statistically significant increase in the prevalence of waterpipe use was the Southeast region (from 0.10 to 0.56%). This upward trend was also noticed for both sexes; among women, the prevalence increased from 0.07% in 2013 to 0.27% in 2019. The prevalence also increased in all educational levels, and the point estimate went from 0.39 to 1.08% between the most educated (12 or more years of study) in the period.

Table 2. Estimated prevalence of current use of waterpipe, according to sociodemographic and behavioral characteristics. Brazil, 2019.

| | Current use of waterpipe | | |
|--|--------------------------|-------------|---------|
| | % | IC95% | Nx1.000 |
| Brazil | 0.47 | 0.36–0.59 | 796 |
| Region | | | |
| North | 0.16 | 0.08–0.24 | 22 |
| Northeast | 0.07 | 0.03–0.11 | 32 |
| Southeast | 0.55 | 0.33–0.78 | 400 |
| South | 0.90 | 0.51–1.29 | 222 |
| Midwest | 0.94 | 0.59–1.29 | 120 |
| Age | | | |
| 15–24 years | 2.01 | 1.42–2.61 | 631 |
| 25–39 years | 0.30 | 0.20–0.41 | 140 |
| 40 years and over | 0.03 | 0.01–0.05 | 25 |
| Ethnicity/Skin color | | | |
| White | 0.51 | 0.32–0.71 | 372 |
| Black | 0.45 | 0.31–0.59 | 423 |
| Sex | | | |
| Male | 0.71 | 0.49–0.92 | 560 |
| Female | 0.26 | 0.15–0.38 | 236 |
| Education (years of study) | | | |
| 0–8 years | 0.17 | 0.03–0.31 | 99 |
| 9–11 years | 0.44 | 0.32–0.57 | 361 |
| 12 years and more | 1.14 | 0.65–1.64 | 336 |
| Current use of manufactured cigarettes | | | |
| Yes | 2.58 | 1.74–3.42 | 418 |
| No | 0.25 | 0.16–0.34 | 378 |
| Current use of ENDS | | | |
| Yes | 17.66 | 10.23–25.09 | 189 |
| No | 0.36 | 0.26–0.47 | 607 |
| Alcohol abuse in the last 30 days | | | |
| Yes | 1.85 | 1.28–2.41 | 516 |
| No | 0.20 | 0.12–0.28 | 280 |

ENDS: Electronic Nicotine Delivery Systems.



PNS: National Health Survey.

Figure 3. Prevalence of current use of waterpipe among individuals aged 18 and over, by survey, according to selected characteristics. Brazil, 2013-2019.

DISCUSSION

Although the prevalence of use of manufactured cigarettes has been decreasing over time in Brazil²², this study shows that, between 2015 and 2019, other tobacco products such as electronic smoking devices and the waterpipe gained ground. This research shows that the vast majority of current users of electronic smoking devices and waterpipe in Brazil are adolescents and young people, or people who have never smoked industrialized cigarettes.

Since studies show an association between ENDS use and the initiation of conventional cigarettes¹⁰, and an association between ENDS and waterpipe²³, the trend of successful decline in the prevalence of smokers in Brazil is at risk of being reversed in the future. Data from the Surveillance of Risk and Protection Factors for Chronic Diseases by Telephone Survey (Vigitel)²⁴ and from the PNS already point to a stability over time (2013-2019) in the point prevalence of young smokers (18–24 years old)^{18,21}, which may already be a reflection of ENDS. So, the monitoring of the prevalence of ENDS is essential and should be highlighted. By leading never smokers to try/use nicotine on a regular basis¹⁰, these devices can contribute to forming a new group of nicotine addicts, who, in the future are assumed to be able

to seek in conventional cigarettes a more efficient and viable way to satisfy their dependence on nicotine, thus contributing to a further increase in the prevalence of smokers of industrialized cigarettes.

We found a difference in use between Brazilian regions. Considering that the sale of ENDS is prohibited in Brazil, the higher prevalence observed in the Midwest may be related to the smuggling of these products from Paraguay, following the same pattern of consumption of smuggled industrialized cigarettes²⁵⁻²⁷. This result draws attention to the need for unrestricted implementation of a protocol against the illicit trade of tobacco products²⁸.

It is also worth noting that we still lack population evidence that the use of electronic cigarettes can contribute to the cessation of use of conventional cigarettes²⁹. However, in Brazil, as most ENDS users are people who have never smoked, it is suggested that the main motivation is more related to the fad built by advertisements and the promotion of its high-tech attributes and performance than to the attempt to quit conventional smoking. And also, in young people, who represent approximately 70% of ENDS users, as a rule, nicotine dependence is still not as established as in adults³⁰, and it may even have increased with the dual use of industrialized cigarettes^{31,32}.

We also observed a large increase in the use of ENDS and waterpipe among women and also a higher prevalence among individuals with a higher level of education, which are subpopulations that historically are encompassed by lower prevalence of industrialized cigarettes than their peers^{19,33}. When the individuals are never smokers, they may evolve to dual or exclusive use of industrialized cigarettes¹⁰.

Although ENDS use in 2019 was higher among men than among women, the comparison between 2015 and 2019 suggests a greater upward trend among women, which may indicate a trend of dissemination of ENDS that follows a similar pattern historically observed in the spread of consumption of industrialized cigarettes in terms of gender. The classic descriptive model of temporal evolution of the tobacco epidemic in developed and developing countries by Lopes et al.³⁴ identified an evolutionary dynamic of initial growth among men followed by growth among women, generally maintaining a lower level of prevalence in the latter group.

ENDS have been extensively presented by manufacturers as a technological innovation to replace conventional cigarettes^{35,36}. Our study points out that ENDS use is concentrated in populations with higher educational levels, a proxy for income, which may indicate a pattern of diffusion based on social status, similar to the dynamics of spread of industrialized cigarettes in the beginning of the 20th century, which represented a technological and cultural innovation³⁷.

A recent systematic review¹¹ showed that the risk of relapse among former smokers of conventional cigarettes is higher among those who used electronic cigarettes than among those who did not. Although our study is not longitudinal, one can suggest that, among individuals aged 40 years and over who used ENDS only in the past, more than a third currently smoke cigarettes, which may indicate an attempt to use them as a cessation aid that was not successful, or that these users returned to smoking after using these devices.

The cross-sectional design of the surveys used in this study limits us to statements about the causality of events. Furthermore, in addition to the differences between PNS and III-LNUD on the issue of time and type of devices described above, they have sample differences, for example, the sample size. This means that there may be differences in the accuracy of estimates between surveys, however both have national coverage and representation so that such issues would not interfere with the findings presented here. Another limitation is the fact that it is not possible to separate ENDS by type of product in the PNS, and they are known to present different risks mainly due to their compositions, including the concentrations of nicotine in each, that can directly impact the dependency caused by them. Although the question about ENDS specifies the types of products that should be considered, there may have been a misunderstanding of respondents about the conventional waterpipe and the electronic waterpipe, leading to an overestimation of the prevalence of ENDS and, consequently, the relationship between ENDS and the waterpipe. However, the relation between the use of ENDS and other tobacco products has already been shown in other studies²³, and thus, even with some information bias, this could impact the magnitude of the problem, but would not annul the relation itself.

This study shows that ENDS have been mostly used by young people and by people who have never smoked industrialized cigarettes, and not by adults with the aim to stop using conventional cigarettes. The prevalence of ENDS and waterpipe use has been increasing in spite of the country's regulatory restrictions, which may jeopardize the successful history of tobacco control policies in Brazil.

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