Trends in Illicit Cigarette Use in Brazil Estimated From Legal Sales, 2012–2016

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Objectives. To estimate the proportions of illicit cigarette consumption in Brazil from 2012 to 2016, a period of sharp increases in cigarette taxes.

Methods. We used an approach based on legal sales provided by the Secretariat of Federal Revenues and self-reported consumption data from an annually conducted telephone survey (VIGITEL) to estimate the changes over time in illegal cigarette use in Brazil. For that purpose, we also used available information on the proportion of illegal cigarette consumption from a nationwide household survey conducted in 2013 to calculate a constant proportion of underreporting from VIGITEL in relation to total consumption and sales in Brazil.

Results. There was an increase in the estimated proportion of illicit cigarette use from 2012 to 2013 (from 28.6% to 32.3%), then a decrease from 2013 to 2014 (32.3% to 28.8%), and then a sustained trend of increase from 2014 to 2016 (28.8% to 42.8%).

Conclusions. Novel and feasible approaches to estimate changes over time in the illegal market are important for helping the effective implementation of tobacco excise tax policy. (*Am J Public Health.* 2018;108:265–269. doi:10.2105/AJPH.2017.304117)

See also Bialous and Glantz, p. 161.

In 2012, a new cigarette excise tax structure went into effect in Brazil, which resulted in a 31% increase in inflation-adjusted cigarette prices from 2011 to 2014.[1,2] Consequently, Brazil was one of the most successful countries at reducing tobacco prevalence in recent years (from 18.2% in 2008 to 14.7% in 2013), particularly among smokers with a low level of education (from 23.4% to 19.7%) compared with those with a high level (from 13.8% to 11.5%).[3]

Although the tobacco industry claims that evidence-based tobacco control policies or innovative regulations, such as standardized packaging and product display bans, will result in an increased illicit market, a large body of evidence demonstrates that the industry is only attempting to weaken or delay implementation of effective tobacco control policies.[4–6] However, given this tax and price increase[1] and the presence of illicit cigarette products in Brazil,[2] smokers may have indeed migrated to cheaper illicit cigarettes to save money.[7] It is therefore important to understand the expansion of the size of the illegal market, as it may undermine efforts to further reduce smoking prevalence, mostly among underprivileged smokers.[8,9]

In many low- and middle-income countries, the illicit cigarette market is overestimated because the tobacco industry is the only source of estimates on its size.[10,11] For instance, the tobacco industry estimated that in Brazil in 2001 to 2003, illicit trade comprised 30% of the market—similar to its estimates for the late 1990s in a completely different scenario. This allegedly occurred despite real reductions at that time (2001–2003) in average excise taxes and prices per pack as well as the introduction of several measures to fight smuggling.[2,12]

In 2008, a comprehensive survey for tobacco control in Brazil, the Global Adult Tobacco Survey Brazil (GATS-Brazil) was included in a national health-related survey conducted every 5 years.[13,14] By comparing purchasing prices obtained from GATS-Brazil and a defined threshold retail price (including all production and distribution costs and taxes), it was possible to estimate the proportion of illicit cigarette use among smokers in Brazil in 2008 (and in 2013).[2] The rationale was that below that threshold price, cigarette products would be covering production and distribution costs, but prices would not include tax payments. The results indicated that the total proportion of illicit consumption increased from 16.9% in 2008 to 32.3% in 2013.[2]

Available information on cigarette consumption from VIGITEL,[15] a telephone survey conducted annually since 2006 among adults with landlines living in Brazilian state capitals, encourages further assessment of the implementation of effective measures to prevent smoking initiation or to stimulate cessation, such as the price and tax policy. Our aim was therefore to estimate the annual change in illicit cigarette consumption in Brazil from 2012 to 2016. For that purpose, we present a new approach to measure the illicit trade.

METHODS

We combined available information on cigarette consumption from different surveys (GATS-Brazil and VIGITEL) and on official legal sales (Secretariat of Federal Revenues, or SFR) that could be used in a novel approach of the Merriman methodology to estimate

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total illicit cigarette consumption in Brazil. In Merriman's methodology,[16] self-reported consumption from a specific survey is used to calculate a single "intrinsic" underreporting constant of the country's "real" consumption for a baseline year with known figures of illegal consumption. By knowing the self-reported consumption for a different year of that same specific survey, it is therefore possible to estimate the amount of total sales (legal plus illegal cigarette sales) in the country and, after deducting official legal sales, obtain the amount and proportion of illegal sales for a different year in the country.[2,16]

In our study, we estimated this constant underreporting proportion for the year 2013 because we could use a known figure of illegal consumption among residents in urban areas derived from purchasing prices obtained from GATS-Brazil 2013.[2,14] We also based this underreporting parameter on self-reported consumption from VIGITEL conducted in 2013 and from official legal sales provided by the SFR, as follows. First, we multiplied the self-reported consumption data from VIGITEL by the estimated proportion of legal consumption from GATS-Brazil 2013. To calculate the underreporting parameter, we then divided the "estimated legal consumption from VIGITEL" by the official legal sales provided by the SFR.[17] Unlike in the original Merriman methodology, we calculated the underreporting parameter stratified by educational level (< 8 years vs ≥ 8 years) to take into account the likely differential information bias related to conducting phone surveys across different socioeconomic status groups.[18–20] As official legal sales are not provided by educational level, we used the percentage distribution of legal cigarette consumption by educational level from the nationwide representative GATS-Brazil survey conducted in 2013 to obtain the estimates of legal sales for each educational level (Appendix A, available as a supplement to the online version of this article at http://www.ajph.org).

Information on cigarette consumption from VIGITEL was based on the following 2 questions: (1) "Do you currently smoke?," categorized as "daily," "less than daily," or "not at all"; and, if respondent reported current smoking ("daily" or "less than daily"), (2) "On average, how many cigarettes do you smoke per day (or per week)?" We divided the total number of cigarettes smoked per week by 7 to obtain the daily consumption among occasional smokers. We also multiplied daily consumption from VIGITEL by 365.25 to obtain the total yearly consumption.

To estimate the proportions of illicit cigarette use for years other than the baseline year (2013), and years for which continuous cigarette consumption from VIGITEL was available (i.e., 2012, 2014, 2015, and 2016), first we used (1) the self-reported consumption data from VIGITEL for years other than the baseline year by educational level and (2) the constant estimates of the proportion of underreporting of VIGITEL in relation to consumption and sales in Brazil to calculate the "new" estimates of overall sales (legal and illegal cigarette sales) in Brazil by educational level (Appendix A). (3) We then obtained the amount and proportion of illegal sales for a different year in the country by deducting overall official legal sales from the sum of the "new" estimates of overall sales by educational level (Appendix A).

Data on smokers living in urban areas (GATS-Brazil) may not be consistent with data on smokers with landlines in state capitals (VIGITEL), as the latter may have higher socioeconomic status.[19] For this reason, we also conducted sensitivity analyses using lower baseline proportions of illegal cigarette consumption. We used Stata version 12.0 (StataCorp LP, College Station, TX) for the statistical analysis, taking into account the complex sample design.

RESULTS

There was an increase in estimates of the overall proportion of illicit cigarette use from 2012 to 2013 (28.6% to 32.3%: +12.9%), then a decrease from 2013 to 2014 (32.3% to 28.8%: –10.8%), and then a sustained trend of increase from 2014 to 2016 (from 2014 to 2015, 28.8% to 36.5%: +26.7%; from 2015 to 2016, 36.5% to 42.8%: +17.3%; Table 1). The total yearly illicit cigarette consumption increased slightly, from 35.8 billion units in 2012 to 36.2 billion units in 2013 (+0.4 billion units). It then decreased from 36.2 billion units in 2013 to 29.3 billion units in 2014 (–6.9 billion units), and then there was a sustained increasing trend from 2014 to 2016 (+6.9 billion units from 2014 to 2015, and +3.6 billion units from 2015 to 2016; Table 1).

Sensitivity analyses that used higher baseline proportions of legal cigarette consumption (i.e., that used lower baseline proportions of illegal cigarette consumption) to calculate the underreporting parameters revealed a similar trend of changes over time in the extent of illicit cigarette use.

Further information on the sources of parameters used in the analysis can be found in Table A (available as a supplement to the online version of this article at http://www.ajph.org). Moreover, in Appendix B (available as a supplement to the online version of this article), we explain how we expanded the methods to allow the estimation over time of the proportion and amount of illicit cigarette consumption, also by educational level; in Tables B and C (available as a supplement to the online version of this article), we present our findings. We observed the same pattern of changes over time in the proportion of illicit cigarette consumption for smokers of both high and low educational level. For each year, the latter had higher baseline proportions of illegal cigarette use.

DISCUSSION

The changes in the extent of illicit cigarette use in Brazil highlight the close relationship between the tax and price policy implemented in recent years and the fluctuations in the economic and political scenarios in Brazil. After implementation of the new cigarette excise tax structure and the establishment of a minimum price for a pack of cigarettes in 2012,[1] we observed an increase in the proportion of illicit consumption, overall and across 2 socioeconomic groups of smokers who did not stop smoking. Shortly before and during the presidential elections held in 2014, Brazil experienced a temporary increase in the purchase power of the population,[21–23] which likely explains the observed decline in the net migration to cheaper illicit cigarettes to save money. However, from the beginning of 2015 onwards, economic and political crises have ensued (e.g., inflation has spiked up, consumer confidence has plummeted, and the president was impeached by the Brazilian Congress),[21–23] resulting in a sharp increase of the illicit market. Official data of

TABLE 1—Estimates of the Proportion and Amount of Illegal Cigarette Use According to Different Scenarios: Brazil, 2012–2016

Scenario	% Decrease in Illegal Cigarette Consumption (From VIGITEL 2013)	% of Illegal Cigarette Consumption (From VIGITEL 2013)[a,b]		Estimated % of Illegal Cigarette Use					Amount (in Billions of Units) of Illegal Cigarette Use				
		Low Educational Level[c]	High Educational Level	2012	2013[d]	2014	2015	2016	2012	2013[d]	2014	2015	2016
1	0 (Baseline)	41.9	21.2	28.6	32.3	28.8	36.5	42.8	35.8	36.2	29.3	36.2	39.8
2	2	41.1	20.8	27.9	32.3	28.1	35.8	42.2	34.5	36.2	28.4	35.2	38.8
3	4	40.2	20.3	27.2	32.3	27.5	35.2	41.7	33.3	36.2	27.4	34.2	38.0
4	6	39.4	19.9	26.5	32.3	26.8	34.6	41.2	32.1	36.2	26.5	33.3	37.1
5	8	38.5	19.5	25.8	32.3	26.2	34.0	40.6	31.0	36.2	25.7	32.4	36.3

[a]Based on the proportion of illegal cigarette consumption from GATS-Brazil 2013 among residents in urban areas.

[b]The proportion of illegal cigarette consumption was used to calculate a constant proportion of underreporting of VIGITEL (annual telephone survey) cigarette consumption in relation to total sales in Brazil, by educational level.

[c]Low level of education = less than 8 y of education; High level of education = 8 y or more of education.

[d]Based on estimates obtained directly from the GATS-Brazil 2013 survey, a proxy for Brazil 2013.[2]

the total volume of illegal cigarettes seized between 2012 and 2016 on terrestrial borders and highways by the Brazilian authority in charge of fiscal and law enforcement corroborate our findings.[24]

There are several recognized methodologies to assess the size of the illicit tobacco trade (e.g., customs seizure data, comparison of import and export statistics, comparisons between household survey estimates of tobacco products consumption and government statistics of tax-paid sales, survey of tobacco users' purchase behaviors, and empty discarded pack data), as different approaches might be necessary to meet potential budget restrictions, particularly in low- and middle-income countries.[9,16] Thus, a combination of methods (including expert opinion) is often necessary to cross-validate estimates and minimize the possible methodological weaknesses and limitations of single methods, such as the lack of systematic ways to collect primary data, underreporting of individual consumption levels, lack of high-quality data on legal cigarette sales in the country, or lack of representativeness of the samples.

In 2008, a system to counteract domestic tax evasion by uniquely identifying each pack of cigarettes was implemented in Brazil.[2,12] It included assembly line controls, thus eliminating any possibility of underreporting by legal factories in the country, and consequently increased the quality of data on tax-paid sales. Moreover, the implementation of an integrated surveillance system to track the tobacco epidemic, based on regular and standardized data collection measures for GATS-Brazil (every 5 years) and VIGITEL (annually), provided representative samples of smokers at the country, region, and state capital level.[3,13–15] The strength of the proposed novel approach is therefore the possibility of using robust data on tobacco behavior, and of incorporating the intrinsic underreporting of self-reported cigarette consumption from smokers living in Brazilian state capitals, to annually compare Brazil's tax-paid sales with individually reported consumption, instead of generating a single point estimate of illicit consumption. Moreover, starting in 2018, and for every 5 years, Brazil will also have the opportunity to cross-validate the national estimates derived from the method presented in this report with the estimates based on purchasing prices obtained from GATS-Brazil,[2] and make adjustments in the underreporting parameter if necessary.

In Brazil, cigarettes are subjected to a tax levied on the manufacturing of products (IPI). From December 1, 2016, the IPI was updated to be calculated by a 10.0% ad valorem rate (vs the previous 9.5% ad valorem rate) applicable to the products' retail price added with a US $0.44 per pack ad rem rate (vs the previous US $0.41 per pack ad rem rate).[25] In addition, the recent political and economic crises are both still far from ending.[21,22] Thus, it is important to keep monitoring the expansion of the illegal market, particularly among underprivileged individuals.

A tobacco taxation policy that has resulted in high retail prices relative to consumer income (low affordability) will not maximize its impact on the reduction of smoking prevalence unless the country also increases law enforcement, changes the culture of accepting illicit product, and increases international collaboration, particularly with neighboring countries with lower retail prices.[9,12] The results of the method presented here are therefore important for raising the awareness of the authorities and the general public about the seriousness of the problem, and they can serve to influence the allocation of resources.

In this sense, our findings may also create opportunities to the health sector in Brazil (and in other countries) to promote and push the World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC) multisectoral measures by fully implementing article 15 of the WHO FCTC and ratifying the FCTC Protocol to Eliminate Illicit Tobacco Trade.[26] Moreover, because our method provides an indication of the continuous changes in illicit trade, it also offers useful information for evaluating the effectiveness of policies to combat smuggling. This is important because the modus operandi for the supply of illegal tobacco products may change over time, as smugglers, encouraged by the direct or indirect involvement of the tobacco industry in the illicit trade, may adapt their practices in response to government actions.[4,5,9]

Limitations

Cigarette consumption in our study was self-reported. Furthermore, we did not correct our underreporting parameters by a likely

increase over time in social stigma, irrespective of educational level.[27] This may have resulted in an underestimation of the proportion of illicit cigarette use for the years 2014 through 2016 and overestimation for 2012. However, when we applied the same methodology to estimate illegal cigarette consumption in 2013, using the baseline parameters from the GATS-Brazil 2008 survey, the findings were very similar to the "real" figure obtained directly from the GATS-Brazil 2013 survey (within 3% accuracy), suggesting there was no need to correct for social stigma (Table D, available as a supplement to the online version of this article at http://www.ajph.org). Still, smokers living in Brazilian state capitals may experience a larger (or smaller) reduction over time in either cessation rates or quantity of cigarettes smoked compared with smokers living in other parts of the country, which may modify the constant underreporting parameter. Thus, it is important to periodically cross-validate our annual national estimates of illicit consumption with figures of illegal consumption from the GATS-Brazil survey conducted every 5 years and, if appropriate, to update the underreporting parameter.

We were unable to calculate the underreporting constants for the baseline year by also considering the consumption of illegal cigarette from VIGITEL, as, obviously, information on the "official illegal sales provided by the SFR" was not available. As underreporting parameters varied markedly by educational level (a proxy for socioeconomic status), and smokers who use illegal cigarettes likely belong to an even lower socioeconomic level than smokers who use legal cigarettes, we may have underestimated their respective underreporting constants and, consequently, also estimates of overall proportion of illicit cigarette use for years other than 2013.

The "official legal sales provided by the SFR" may also include consumption by those younger than 18 years, which implies that we may have overestimated our underreporting parameters. However, recent national data for individuals aged 12 to 17 years show that both smoking prevalence and average daily cigarette consumption among smokers are much lower than cigarette consumption among adults.[3,28] Therefore, even if we had been able to deduct legal cigarette consumption among adolescents from the overall legal sales, the underreporting constants would have remained virtually unchanged.

Conclusions

The promotion of independent studies using feasible methodologies to estimate changes over time in the amount of illicit consumption in the country is of paramount importance to help effectively implement tobacco excise tax policy. For that purpose, as stated in article 20 of the WHO FCTC,[26] the establishment of a sustained national system for the epidemiological surveillance of tobacco consumption and related social and economic indicators makes it also possible to conduct such studies.

Public Health Implications

We propose an approach to estimate changes in the extent of illicit cigarette use in Brazil from 2012 to 2016. The changes in the proportion and amount of illicit cigarette use in Brazil highlight the close relationship between the tax and price policy implemented in the last few years and the fluctuations in the economic and political scenarios in Brazil. There was a sharp increase in the proportion of illicit cigarette use from 2014 to 2016 (+48.6%), which also contributed to an increase in the number of illegal cigarettes consumed in the country (+10.5 billion units) for the same period. Novel and feasible methods to estimate the changes in the illegal market over time are important for helping to effectively implement tobacco excise tax policy. AJPH

CONTRIBUTORS

A. Szklo and M. C. de Souza participated in data processing, data analysis, and the elaboration and preparation of the article. R. M. Iglesias participated in the consultancy for data analysis and the elaboration and preparation of the article. M. Szklo and L. M. de Almeida participated in the elaboration and preparation of the article.

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HUMAN PARTICIPANT PROTECTION

The VIGITEL survey was approved by the Brazilian National Commission of Ethics in Research (CONEP), register no. 13081/2008 as updated June 26, 2013 (No. 355.590).

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