Cigarette taxation and price differentials in 195 countries during 2014–2018

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ABSTRACT

Introduction Raising tobacco prices via increased taxation may be undermined by tobacco industry tactics to keep budget cigarettes on the market. Price differentials between budget and premium cigarettes allow smokers to trade down in the face of average price rises thus attenuating health benefits. This study examines global trends of price differentials and associations with taxation.

Methods Ecological analysis of country-level panel data of 195 countries' price differentials was performed and compared against total, specific excise, ad valorem and other taxation. Price differentials were expressed as the difference between budget cigarette and premium pack prices (as % of premium pack prices). Two-level linear regression models with repeated measurements (2014, 2016 and 2018) nested within each country assessed the association between country-level taxation structures and price differentials, adjusted for year, geographical region and income group.

Results Worldwide, median price differential between budget and premium 20-cigarette packs was 49.4% (IQR 25.9%–70.0%) in 2014 and 44.4% (IQR 22.5%–69.4%) in 2018 with significant regional variation. The largest price differentials in 2018 were in Africa, with the lowest in Europe. Total taxation was negatively associated with price differentials (-1.5%, 95% CI -2.5% to -0.4% per +10% total taxation) as was specific excise taxation (-2.5%, 95% CI -3.7% to -1.2% per +10% specific excise tax). We found no statistically significant association between ad valorem taxation and price differentials.

Conclusion Total levels of taxation and specific excise taxes were associated with smaller price differentials. Implementing high specific excise taxes may reduce price differentials and improve health outcomes.

BACKGROUND

Tobacco use is the single biggest preventable cause of death worldwide, with an estimated 8 million deaths per year globally.¹ It disproportionately affects low and middle-income countries compared with high-income countries (HIC).² The WHO advises implementation of a range of strategies outlined in the Framework Convention on Tobacco Control.¹ Of these policies, raising taxes on tobacco is considered the most effective and highly costeffective strategy.³ Price increases through taxation provide health benefits such as lowered incidence of cancers,⁴ immediate and gradual reductions in childhood asthma exacerbations,⁵ deaths averted and years of life gained.⁶ However, recent research evidence has shown that transnational tobacco companies have implemented strategies to counteract the increased tobacco taxation by overshifting prices of premium products while keeping budget cigarettes cheap.⁷

The presence of a large differential in pricing between budget and premium cigarettes may have negative impacts on health and inequalities, as it reflects more opportunities for smokers, especially those who are more price sensitive, to switch to cheaper options even when prices increase.⁸ Analyses in the European Union (EU) have found that larger gaps between budget and premium cigarettes were associated with increased cigarette consumption in the following year⁹ and increased infant mortality.¹⁰

There are different types of tobacco taxes which may have different impacts on cigarette prices and consumption. Previous research in 17 countries from the International Tobacco Control Policy Evaluation Project suggests that excise taxes, particularly uniform and specific excise tax structures, are the most effective in reducing consumption.¹¹ The simplest WHO-recommended structure is a specific uniform excise tax, which imposes a single, fixed amount taxation rate based on quantity, independent of the retail price. Other more complex structures, such as ad valorem excise taxes assessed as a percentage of the price, lead to greater variability in tax rates and tobacco prices.¹² This added complexity allows tobacco manufacturers opportunities to strategically circumvent taxes through pricing or product design.¹³ Specific excise taxes provide a hard-to-surmount, fixed price barrier which must be paid regardless of pricing strategy, hindering efforts by companies to manipulate prices. There is a large variability between countries' usage of excise components in their overall tobacco taxation, and even more so in the implementation of specific and ad valorem systems in their excise components.

Understanding effective methods to reduce tobacco price differentials through taxation would provide important recommendations for international authorities to implement changes and increase efficacy of their taxation policies. Such actions could lower tobacco consumption⁹ and improve health outcomes of the population,¹⁴ as well as reduce local tax avoidance via travel across borders.¹⁵ This explorative study aims to provide a global overview on current trends in cigarette price differentials across 195 countries and to assess the association between taxation structure and price differentials.

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METHODS

Data sources and measures

Cigarette prices and taxation data Country-level cigarette price and taxation data were sourced from the three most recent (2015, 2017 and 2019) official WHO reports on the global tobacco epidemic.^{1 16 17} These reports evaluate the progress of tobacco control globally every 2 years and include cigarette pricing and taxation data from July 2014 to January 2015, July 2016 to January 2017 and July 2018 to January 2019. This study will refer to data as from 2014, 2016 and 2018. For most countries, the WHO obtained these data by working directly with ministries of finance. For others, the WHO sourced data from tax law documents, decrees and other official information.^{1 16 17} The relevant reports give data on the prices of a 20-cigarette packet of 'Marlboro or another premium brand' as well as the same data for 'the cheapest brand'. Prices of the budget and premium cigarette brands were extracted for this study. Taxation data were only available as a percentage of

reflects a country's level of taxation on cigarettes. Cigarette prices were reported for a 20-cigarette pack in local currency, international dollar and US dollar prices, of which we used local currency to minimise rounding errors from currency conversions. Cigarette price differentials for each country and year were computed as the difference between premium and budget pack prices, and this was then divided by the premium pack price to give a percentage.¹⁰ This price differential could range from 0% to just below 100%, and lower price differentials indicate smaller gaps between premium and budget pack prices, and vice versa.

the retail price of the most sold brand and we assumed that this

Taxation data were reported as separate percentages for the specific excise, ad valorem excise, value-added tax, sales tax, import duties and other taxes as a percentage of the price of the most sold brand. We further combined value-added tax, sales tax, import duties and other taxes into one 'other taxes' category. Countries were classified as either low (<50%), medium (50%–75%) or high (≥75%) tax-setting countries based on the total tax as a percentage of the price of the most sold brand, following the 50% and 75% tax-level thresholds in the WHO reports.

Country-level characteristics

Countries were assigned into one of the six regions denoted by the WHO¹: African Region (AFR), Region of the Americas (AMR), Eastern Mediterranean Region (EMR), European Region (EUR), South-East Asia Region (SEAR) and Western Pacific Region (WPR). Income level of the country was categorised based on the World Bank definitions¹⁸: low-income countries (LICs), lower middle-income countries (LMICs), upper middle-income countries (UMICs) and HICs. Human Development Index (HDI) scores were obtained from the United Nations Human Development Data reports¹⁹ as a measure of country development. We used WHO data for each country and year on MPOWER (M: monitor tobacco use and prevention policies; P: protect people from tobacco smoke; O: offer help to quit tobacco smoking; W: warn about the dangers of tobacco; E: enforce bans on tobacco advertising, promotion and sponsorship; and R: raise taxes on tobacco) indicating the level of implementation of each policy: scored 0-3 for 'Monitoring of tobacco use'; and 0-4 for each of 'Protect people', 'Offer help to quit', 'Enforce bans'; whereas 'Warning about dangers' was split into 0-4 for health warnings and 0-4 for mass media campaigns. We did not use 'Raise taxes' as we had detailed data on taxation.

In total, 500 cigarette price differential measurements were calculated from 195 countries during 2014–2018. We calculated the median and IQR of cigarette price differentials for each reporting year, and by geographical region and income level. There were 559 observations of taxation data in 188 unique countries across all years, and the median and IQR of taxation rates were calculated by year and region. Descriptive analyses involved all available data, and regression analyses were performed on complete data.

A two-level linear random intercepts model with repeated measurements nested within each country was employed to assess the association between country-level taxation structures and price differentials. We present the equation in theonline supplemental material. Due to missing data points for countries' price differentials (n=85), taxation rates (n=26) and income group (n=2), the model involved a total of 479 complete observations calculated for 178 countries from 2014 to 2018. In adjusted models, we considered three continuous variables for taxation structure simultaneously: specific excise tax rate, ad valorem excise tax rate and other taxes rate. We also conducted separate analyses with total tax. An iterative approach was used to build an appropriate model using Akaike and Bayesian information criterion to assist the final model selection. All country-level variables previously described were considered as a priori potential confounders of the association between tax structures and price differentials. The final model included year of measurement, WHO region and World Bank income group, alongside tax variables. HDI and MPOWER scores did not improve the model fit, hence were not included in the final model. We also present stratified analyses by tax-level setting (low, medium and high) as defined above as well as interaction tests to assess significance of differences.

We conducted sensitivity analyses using data on the size of the tobacco market in each country and the degree of competition in markets. As a marker of market size we used the Euromonitor data on millions of cigarette sticks sold per country and year. Euromonitor also reports market shares of tobacco companies which we used to produce two measures of market competition: first, the percentage of the market controlled by the dominant company and, second, the percentage of the market controlled by the 'Big Five' companies combined. These data were available only for 99 countries.

Regression results are presented as coefficients with 95% CIs. Coefficients for categorical variables represent the percentage point change in price differentials in comparison to the reference category of the variable. Coefficients for taxation variables represent the percentage point change in price differentials for a 10 percentage point increase in taxation rate.

RESULTS

Analyses included 47 countries in AFR, 35 in AMR, 22 in EMR, 53 in EUR, 11 in SEAR and 27 in WPR. Figure 1 shows the 2018 price differentials for each country mapped in 10% intervals (figures for 2014 and 2016 shown in online supplemental figures 1 and 2). The median price differential and IQR of each region by reporting years are provided in table 1. Across the world, larger variations in price differentials were observed between and within geographical regions rather than over time. The lowest median price differentials were consistently found in EUR for all years (22.5% in 2018, IQR 18.0%–37.5%) whereas the highest median price differentials were found in SEAR for 2014 and 2016 and AFR in 2018 (72.0%, IQR 52.1%–76.9%).



Cigarette price differential defined as (Premium price - Cheapest price) / Premium price

Figure 1 Map of cigarette price differentials across the globe in 2018, grouped in intervals of 10% where $a < x \le b$ (n = 163).

The changes in median price differentials suggest a small global reduction in gaps of cigarette prices from 49.4% (IQR 25.9%–70.0%) in 2014 to 44.4% (IQR 22.5%–69.4%) in 2018.

Figure 2 further shows that overall price differentials were the highest among LICs, followed by LMICs, UMICs and HICs, and this pattern was consistently observed across all years. However, large variation in price differentials exists within each income group, particularly in UMICs and LMICs. Median price differentials in LMICs decreased from 65.2% (IQR 41.7%–78.0%) in 2014 to 56.8% (IQR 41.0%–71.9%) in 2018, and in UMICs decreased from 51.7% (IQR 36.5%–66.7%) in 2014 to 40.8% (IQR 24.0%–61.6%) in 2018. Conversely, median price differentials were mostly consistent in HICs from 24.2% (IQR 19.0%–34.5%) in 2014 to 21.5% (IQR 17.0%–33.5%) in 2018, and in LICs from 74.2% (IQR 64.8%–83.3%) in 2014 to 72.1% (IQR 58.3%–78.1%) in 2018.

The total cigarette taxes as a percentage of the price showed little movement from a worldwide median of 51.0% (IQR 30.7%–71.0%) in 2014 to 52.7% (IQR 35.9%–72.3%) in 2018, but large variation was observed between and within geographical regions, and similarly for the different types of taxation. In

Table 1	Regional median cigarette price differentials						
Region		2014	2016	2018			
		Median price differential % (IQR %)	Median price differential % (IQR %)	Median price differential % (IQR %)			
EUR		27.2 (19.2–51.9)	27.1 (17.6–43.3)	22.5 (18.0–37.5)			
AMR		40.0 (22.9–57.1)	40.0 (27.2–59.1)	37.5 (27.4–54.7)			
EMR		68.8 (50.0-85.0)	56.5 (49.2–78.5)	64.9 (57.6–79.6)			
WPR		41.7 (28.0–55.5)	33.3 (20.1–46.4)	32.9 (17.7–50.0)			
SEAR		75.7 (58.9–85.0)	76.9 (44.2–82.0)	61.0 (23.6–69.3)			
AFR		66.7 (50.0–78.9)	70.4 (51.0–78.3)	72.0 (52.1–76.9)			
World		49.4 (25.9–70.0)	43.6 (25.8–71.0)	44.4 (22.5–69.4)			

Price differential=(premium cigarette brand price-budget cigarette brand price)/ premium cigarette brand price.

IQR=displayed as first quartile to third quartile.

 $n_{EUR} = 53$, $n_{AMR} = 35$, $n_{EMR} = 22$, $n_{WPR} = 27$, $n_{SEAR} = 11$, $n_{AFR} = 47$. AFR, African Region; AMR, Region of the Americas; EMR, Eastern Mediterranean Region; EUR, European Region; SEAR, South-East Asia Region; WPR, Western Pacific Region. 2018, EUR used the highest total tax, with a median of 74.7% (IQR 64.0%–79.2%), and AFR used the lowest at 36.5% (IQR 26.5%–45.2%) (table 2). There were two regions with 0% median specific tax (AFR, EMR) and three with 0% median ad valorem tax (AMR, SEAR, WPR). There were 33 countries with high (\geq 75%) total tax in 2014, increasing to 38 in 2018, and there were 91 countries with low (<50%) total tax in 2014, decreasing to 85 by 2018. Data on taxation and price differentials for 2014 and 2016 are presented in the online supplemental tables 1 and 2.

Results of the multilevel linear regression (table 3) show that, adjusting for taxation, region and income level, price differentials have stayed similar over time. Compared with 2014, price differentials were -1.1% lower in 2016 (95% CI -3.4% to 1.2%) and -2.2% lower in 2018 (95% CI -4.5% to 0.2%). A 10% increase in the total taxation level was associated with a 1.5% reduction in price differentials (95% CI -2.5% to -0.4%). Findings for the three taxation components were similar between unadjusted and adjusted models. The multivariable model found that cigarette price differentials reduced by 2.5% (95% CI -3.7% to -1.2%) for every 10 percentage point increase in the specific excise tax component was not associated with changes in price differential (-0.4%, 95% CI -1.7% to 0.8%).

Interaction analyses by total tax level found differential associations for specific taxes, with coefficients only statistically significant in countries with total taxation between 50% and 75% (-5.5%, 95% CI -9.5% to -1.6%) (online supplemental table 3). Interaction tests did not identify differences by total tax level for ad valorem or other taxes.

Analyses additionally adjusted for millions of sticks of cigarettes sold (online supplemental table 4) and using two separate measures of tobacco market competition (online supplemental table 5) identified reductions in price differentials associated with specific taxes. In contrast to main analyses, these did not identify associations for other taxes.

DISCUSSION

This study found that globally, the median price differential between the budget and premium cigarette brand prices was



Figure 2 Price differentials grouped by World Bank income group (for all years, $n_{HIC} = 58$, $n_{UMIC} = 58$, $n_{LMIC} = 47$, $n_{LIC} = 30$, Cook Islands and Niue missing income group data). HIC, high-income countries; LIC, low-income countries; LMIC, lower middle-income countries; UMIC, upper middle-income countries.

49.4% in 2014 and 44.4% in 2018. Large variation in price differentials existed between and within regions, with AMR, EUR and WPR consistently showing narrower differentials and AFR, SEAR and EMR showing larger differentials. Price differentials were lower among higher income countries. Across 178 countries, increases in total taxation and in specific excise taxes were found to have a significant inverse association with price differentials. No such association was found for ad valorem excise tax.

We found substantial variation between regions and some indication in our maps that neighbouring countries have similar price differentials. For example, EUR maintained the highest average total tax and had small price differentials region-wide across all years, likely due to nuanced, multipronged EU tobacco policies requiring a mixed tax structure with a reliance on specific excise taxes and a combined excise tax floor.^{20 21} Learning from policies implemented by the EU may prove useful in reducing differentials in other countries and blocs.

The tobacco industry has had increasing aggressive penetration into LMICs' economies in recent years, where tobacco control policies may not be as well established as in HICs.²² While the WHO has observed improvements in taxation uptake in these countries, our study finds that price differentials remain high. This may be due to companies intentionally keeping cigarette prices affordable to retain price-sensitive customers, such as adolescents, as increased pricing and taxation have previously been successful in reducing adolescent smoking prevalence,²³ especially among LICs and LMICs.²⁴ Further research into individual countries is recommended to investigate the extent to which these differences between HICs and LICs are the result of industry influence or other factors including stage of the tobacco epidemic and other economic factors.

Increasing specific excise tax was clearly associated with lower price differentials, whereas in our main models increasing ad valorem excise tax was not. This follows expectations, as the value of specific tax is uniformly applied to cigarettes of all prices, whereas the value of ad valorem tax is scaled proportionally for budget and premium cigarettes, mostly maintaining the price difference. This suggests that using a greater specific component than ad valorem component in a country's tobacco excise tax will help reduce price differentials much more. The WHO reports found specific excise tax was overall employed more frequently than ad valorem tax worldwide, and EUR showed the highest usage of both excise tax types due to the EU requirement of a mixed tax structure.²⁵ EUR also had among the lowest price differentials.

While the EUR has a predominant focus on specific taxes, with two-thirds of countries assessed having a majority specific excise tax, this is not representative of the global situation. The majority of the world population still live in countries with

Table 2	Regional median cigarette taxation rates by component in 2018							
	Median taxation ra	ate (IQR)	Median price (IQR)					
Region	Total tax (%)	Specific excise (%)	Ad valorem excise (%)	Other taxes (%)	Budget brand (US\$)	Premium brand (US\$)		
EUR	74.7 (64.0–79.2)	31.5 (24.4–41.7)	21.7 (5.0–33.0)	16.7 (15.3–18.5)	3.61 (1.67–5.75)	4.68 (3.00-7.01)		
WPR	55.0 (42.1–70.3)	37.4 (0.0–60.4)	0.0 (0.0-0.0)	9.1 (7.4–13.0)	2.81 (2.14–5.50)	5.19 (3.50–7.50)		
SEAR	56.3 (30.0–68.7)	24.0 (0.0-40.0)	0.0 (0.0–2.3)	12.3 (2.8–18.7)	0.60 (0.30-1.60)	3.05 (2.45–4.35)		
EMR	50.6 (21.8–71.2)	0.0 (0.0–15.6)	7.8 (0.0–33.8)	14.5 (9.7–21.8)	0.88 (0.50–1.33)	2.80 (2.27–3.71)		
AMR	47.6 (36.8–66.1)	24.6 (0.0–33.8)	0.0 (0.0–20.5)	13.0 (10.7–15.3)	2.28 (1.33–3.06)	3.61 (2.64–4.91)		
AFR	36.5 (26.5–45.2)	0.0 (0.0–25.2)	7.9 (0.0–16.0)	13.3 (11.4–15.8)	0.68 (0.51–1.13)	2.25 (1.69–3.55)		
World	52.7 (35.9–72.3)	24.6 (0.0–38.3)	6.6 (0.0–25.0)	14.5 (10.7–16.8)	1.70 (0.68–3.61)	3.55 (2.24–5.38)		

Taxation was based on the percentage of retail price of the most sold cigarette brand.

IQR=displayed as first quartile to third quartile.

 $n_{EUR} = 51, n_{WPR} = 26, n_{SEAR} = 10, n_{EMR} = 21, n_{AMR} = 33, n_{AFR} = 44.$

Median price is in US\$ at official exchange rates during year of recording (2018).

AFR, African Region; AMR, Region of the Americas; EMR, Eastern Mediterranean Region; EUR, European Region; SEAR, South-East Asia Region; WPR, Western Pacific Region.

lable 3 Multilevel linear regression estimated associations between components of taxation structure and price differentials						
Characteristic	Percentage points of cigarette price differential (95% CI)					
	Unadjusted*	Adjusted†	Adjusted†			
Total tax	-3.8 (-4.9 to -2.7)	-	-1.5 (-2.5 to -0.4)			
Specific excise tax	-3.9 (-5.1 to -2.7)	-2.5 (-3.7 to -1.2)	-			
Ad valorem excise tax	-0.3 (-1.1 to 1.6)	-0.4 (-1.7 to 0.8)	-			
Other tax	-2.6 (-5.3 to 0.1)	-2.8 (-5.2 to -0.4)	-			
Year						
2014	Reference	Reference	Reference			
2016	-1.3 (-3.5 to 1.0)	-1.1 (-3.4 to 1.2)	-1.3 (-3.6 to 1.0)			
2018	-3.0 (-5.3 to -0.8)	-2.3 (-4.6 to 0.1)	-2.5 (-4.8 to -0.1)			
Region						
EMR	1.3 (-8.5 to 11.1)	9.8 (1.3 to 18.3)	9.9 (1.2 to 18.6)			
SEAR	-1.1 (-14.1 to 11.9)	4.5 (-6.6 to 15.6)	3.3 (-8.1 to 14.8)			
AFR	Reference	Reference	Reference			
WPR	-25.7 (-34.7 to -16.6)	-9.0 (-17.6 to -0.3)	-12.0 (-20.7 to -3.3)			
EUR	-31.2 (-38.8 to -23.7)	-10.6 (-18.8 to -2.4)	-11.2 (-19.7 to -2.7)			
AMR	-22.8 (-31.2 to -14.4)	-11.4 (-19.5 to -3.3)	-11.4 (-19.8 to -3.0)			
Income group						
Low income	Reference	Reference	Reference			
Lower middle income	-11.8 (-20.5 to -3.0)	-7.8 (-15.8 to 0.2)	-7.6 (-15.8 to 0.7)			
Upper middle income	-22.0 (-30.4 to -13.7)	-10.7 (-19.1 to -2.3)	-11.5 (-20.2 to -2.9)			
High income	-40.5 (-48.9 to -32.1)	-26.1 (-35.2 to -17.1)	-27.1 (-36.4 to -17.9)			

Taxation components are represented as per 10 percentage point increase in rate.

Price differential=(premium cigarette brand price—budget cigarette brand price)/premium cigarette brand price.

*Unadjusted models come from a series of univariate regressions including only the variable in question.

†Adjusted for all other factors shown in the table.

AFR, African Region; AMR, Region of the Americas; EMR, Eastern Mediterranean Region; EUR, European Region; SEAR, South-East Asia Region; WPR, Western Pacific Region.

suboptimal tobacco taxation levels and structures.¹ Our findings reinforce the importance of specific excise taxation in combating price differentials, and are relevant in encouraging other countries to adopt WHO-recommended taxation structures, as we demonstrate that using specific excise taxation can reduce price differentials.

While our novel demonstration of the link between tax structure and price differentials globally is important, the approach used is simplified in comparison to reality. We defined tax structures in narrow categories of specific excise, ad valorem excise and all other taxes. However, a number of countries employ a mixed excise taxation structure or forgo excise taxation and only use other taxes,¹ which were also negatively associated with price differentials in our main analyses. It may therefore be valuable to further evaluate these alternative taxation systems and their combined interactions on price differentials, building on the more isolated effects identified by this study.

Strengths and limitations

This study is the first to link tax type to price differentials globally. For a global comparison, measuring price differentials as a percentage of premium brand prices can be more useful than absolute differences in tobacco prices, as differentials do not depend on exchange rates; so, they are directly comparable over time and across countries. Nevertheless, totalled over all 3 years, there were 57 country-years with incalculable price differentials due to missing data. Twelve were missing data for 2 years, and seven missing for 3 years. The countries' missing data appear to be non-random, consisting of predominantly LICs and repeatedly missing data across the years. This introduces some selection bias which could misrepresent applicability in LICs. We used WHO data which were collected with a consistent methodology across countries and over time. However, these report prices of a range of premium brands and there is some local variation in collection and reporting. Only three WHO reports had appropriate data, meaning we analysed data over a 4-year study period only, which limited our ability to observe longterm trends. In our analysis, we assumed that the tax structure within each country was uniform across price bands and subnational regions. While we used the taxation data for the most sold brands which were available, some countries such as India base taxes on cigarette lengths, meaning potential differences between budget and premium brands. Our findings necessarily only provide a generalised assessment of those countries. Our analyses focused on cigarettes only and did not account for other tobacco products, including roll-your-own tobacco, which may have produced larger price differentials than seen here. Finally, we conducted sensitivity analyses to assess issues around market size and competitiveness within individual countries. This was only possible in a subset of 99 countries (vs 178 in the main analyses) in which adding these variables to the main model did not alter the tax-related findings suggesting that they are not major sources of confounding. However, this subset of countries may not be globally representative as it includes very few LICs and LMICs.

Policy implications

Our analysis explored links between price differentials and factors such as country region and income level. Price differentials are an important public health issue as they enable smokers to trade down and thus blunt the effectiveness of average price increases. Our analysis suggests that this issue is a concern worldwide although larger in Africa, the Eastern Mediterranean and South-East Asia. Our analysis also suggests that high taxation levels with high components of specific excise taxes are the most effective at reducing price differentials. Evidence from the EU is promising that decreasing the gap between budget and premium cigarettes could reduce infant mortality¹⁰ and lower cigarette consumption,⁹ and this gap could be reduced by rebalancing existing excise structures to feature more specific excise tax, alongside measures such as a specific tax floor, particularly on cheaper tobacco.²⁰ By simplifying excise taxation structures, the industry's ability to manipulate cigarette prices becomes more limited and may allow tax increases to be more effective at reducing cigarette smoking.²⁶

Our data on types of taxation used worldwide suggest that it is not currently always politically viable to use tax structures with majority specific excise tax components, but the success of many EUR countries in lowering price differentials may motivate other countries to use similar tax structures. WHO recommendations can and should be complemented by national and local advocacies to gradually build the necessary support for tobacco tax increases within countries. However, transnational tobacco companies operate at a global scale, hence cross-country cooperation and advocacy targeting regional and international organisations may also be required to thwart tobacco industry's efforts to delay and prevent tobacco tax increases.

Although existing literature primarily focuses on HICs, the strategies used to counter industry tax avoidance tactics are applicable elsewhere.²² Adapting policies implemented by HICs may reduce price differentials in lower and middle-income countries. These could include implementing a tax floor similar to EU countries,²¹ raising taxes on cheaper products such as roll-your-own tobacco in the UK,²⁷ monitoring budget brand proliferation²⁸ and engaging stakeholders to mitigate equity concerns from raised prices in Australia.²⁹

Continued further assessment of price differentials by the WHO and international bodies is vital, particularly for advising taxation rates in at-risk LICs and LMICs. Price differentials are mentioned twice in the 2019 WHO report technical notes as 'price gap' and 'price dispersion', describing them as methods to provide context to effectiveness of tax policy. We recommend increased visibility by highlighting differentials as its own measure, as an indicator for evaluation of policies. Such a move has the potential to encourage policymakers' recognition and reduction of their price differentials.

CONCLUSION

This study provides new evidence that increased specific excise taxation rates are significantly associated with decreased price differentials, and that significant regional and socioeconomic variations exist. Implementing a high level of specific excise taxes may be an effective approach to narrow price differentials. Health outcomes may result from improvements to taxation structure and subsequently reduced price differentials.

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REFERENCES

- 1 WHO. WHO report on the global tobacco epidemic 2019 Offer help to quit tobacco use. Geneva: WHO, 2019.
- 2 GBD 2015 Tobacco Collaborators. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990-2015: a systematic analysis from the global burden of disease study 2015. *Lancet* 2017;389:1885–906.
- 3 Gallus S, Lugo A, La Vecchia C, et al. Pricing policies and control of tobacco in Europe (PPACTE) project: cross-national comparison of smoking prevalence in 18 European countries. Eur J Cancer Prev 2014;23:177-85.
- 4 Hill C. [Cancer prevention and screening]. *Bull Cancer* 2013;100:547–54.
- 5 Faber T, Kumar A, Mackenbach JP, et al. Effect of tobacco control policies on perinatal and child health: a systematic review and meta-analysis. *Lancet Public Health* 2017;2:e420–37.
- 6 Summan A, Stacey N, Birckmayer J, *et al*. The potential global gains in health and revenue from increased taxation of tobacco, alcohol and sugar-sweetened beverages: a modelling analysis. *BMJ Glob Health* 2020;5:e002143.
- 7 Hiscock R, Branston JR, McNeill A, et al. Tobacco industry strategies undermine government Tax policy: evidence from commercial data. Tob Control 2018;27:488–97.
- 8 van Schalkwyk MCI, McKee M, Been JV, *et al*. Analysis of tobacco industry pricing strategies in 23 European Union countries using commercial pricing data. *Tob Control* 2019;28:e102–9.
- 9 Laverty AA, Millett C, Filippidis FT. Associations between cigarette prices and consumption in Europe 2004-2014. *Tob Control* 2021;30:111–3.
- 10 Filippidis FT, Laverty AA, Hone T, et al. Association of cigarette price differentials with infant mortality in 23 European Union countries. JAMA Pediatr 2017;171:1100–6.
- 11 Shang C, Chaloupka FJ, Fong GT, *et al*. The association between Tax structure and cigarette price variability: findings from the ITC project. *Tob Control* 2015;24 Suppl 3:iii88–93.
- 12 Shang C, Lee HM, Chaloupka FJ, et al. Association between Tax structure and cigarette consumption: findings from the International tobacco control policy evaluation (ITC) project. *Tob Control* 2019;28:s31–6.
- 13 World Health Organization. *WHO technical manual on tobacco Tax administration*. Geneva: World Health Organization, 2010.

What this paper adds

What is already known on this subject

Raising tobacco taxation is effective in increasing prices on average and reducing use. However, the tobacco industry uses a range of mechanisms to keep budget cigarettes on the market, and this can blunt the effectiveness of tax and price rises.

What important gaps in knowledge exist on this topic

The links between types of tobacco taxation and price differentials (a marker of smokers being able to trade down to cheaper cigarettes rather than quitting) have not been explored globally.

What this paper adds

- ► Worldwide median price differentials between budget and premium cigarettes were 49% in 2014 and 44% in 2018.
- The largest price differentials were in the WHO Africa Region, with the lowest in the Europe Region.
- Country-level data from 195 countries found that total taxation and specific excise taxes were linked to smaller price differentials.

Original research

- 14 Hyland A, Higbee C, Li Q, et al. Access to low-taxed cigarettes deters smoking cessation attempts. Am J Public Health 2005;95:994–5.
- 15 Agaku IT, Blecher E, Filippidis FT, et al. Impact of cigarette price differences across the entire European Union on Cross-border purchase of tobacco products among adult cigarette smokers. *Tob Control* 2016;25:333–40.
- 16 WHO. Who report on the global tobacco epidemic, 2015. raising taxes on tobacco, 2016. Available: https://apps.who.int/iris/handle/10665/178574
- 17 WHO. WHO report on the global tobacco epidemic 2017 Monitoring tobacco use and prevention policies. Geneva: WHO, 2017.
- 18 World bank country and lending groups world bank data help desk. Available: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bankcountry-and-lending-groups
- 19 Human development data (1990-2018) | human development reports. Available: http://hdr.undp.org/en/data
- 20 Blecher E, Ross H, Stoklosa M. Lessons learned from cigarette Tax harmonisation in the European Union. *Tob Control* 2014;23:e12–14.
- 21 Evaluation of the Council directive 2011/64/EU of 21 June 2011 on the structure and rates of excise duty applied to manufactured tobacco. Brussels, 2020. Available: https://ec.europa.eu/taxation_customs/system/files/2020-02/study-on-the-tobaccotaxation-directive-2019_en.pdf

- 22 Gilmore AB, Fooks G, Drope J, et al. Exposing and addressing tobacco industry conduct in low-income and middle-income countries. Lancet 2015;385:1029–43.
- 23 Kostova D, Ross H, Blecher E, et al. Is youth smoking responsive to cigarette prices? Evidence from low- and middle-income countries. *Tob Control* 2011;20:419–24.
- 24 IARC HANDBOOKS OF CANCER PREVENTION Tobacco Contol, International Agency for Research on Cancer. Effectiveness of Tax and price policies in tobacco control 2011.
- 25 Taxation and Customs Union. Excise duties on tobacco, 2011. Available: https://ec. europa.eu/taxation_customs/business/excise-duties-alcohol-tobacco-energy/exciseduties-tobacco_en
- 26 Chaloupka FJ, Kostova D, Shang C. Cigarette excise tax structure and cigarette prices: evidence from the global adult tobacco survey and the U.S. national adult tobacco survey. *Nicotine Tob Res* 2014;16 Suppl 1:S3–9.
- 27 Action on Smoking and HEalth. Timeline of tobacco taxation in the UK, 2017. Available: https://ash.org.uk/information-and-resources/taxation-illicit-trade/taxation/ ash-analysis-of-tobacco-tax-increases-in-the-united-kingdom/
- 28 Ross H, Tesche J, Vellios N. Undermining government Tax policies: common legal strategies employed by the tobacco industry in response to tobacco Tax increases. *Prev Med* 2017;105S:S19–22.
- 29 Hirono KT, Smith KE. Australia's \$40 per pack cigarette tax plans: the need to consider equity. Tob Control 2018;27:229–33.