



Is youth smoking responsive to cigarette prices? Evidence from low- and middle-income countries

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ABSTRACT

Objective To estimate the price elasticity of cigarette demand among youth in low- and middle-income countries (LMIC).

Data The Global Youth Tobacco Survey was used to obtain data on the smoking behaviour of 315 353 adolescents from 17 LMIC.

Design Two-part model of cigarette demand with country fixed effects. The first part estimates the impact of prices on smoking participation while the second part estimates the impact of prices on the number of cigarettes smoked among current smokers. Besides controlling for individual characteristics such as Age, Gender, Parental Smoking and availability of Pocket Money, the authors control for confounding environmental factors such as anti-smoking sentiment, the prevalence of cigarette advertising and anti-tobacco media messages, and ease of purchasing cigarettes. All countries in this study are represented with at least two observations over time, which allows us to control for unobserved country characteristics and/or policies that may influence smoking patterns within countries.

Results Cigarette price is an important determinant of smoking. The estimated price elasticity of smoking participation is -0.74 , and the estimated price elasticity of conditional cigarette demand is approximately -1.37 . The total price elasticity of cigarette demand is -2.11 , implying that an increase in price of 10% would reduce youth cigarette consumption by 21.1% at the mean.

INTRODUCTION

Tobacco consumption is a leading cause of preventable death, with 100 million deaths attributed to it during the 20th century and nearly one billion deaths projected during the 21st century.¹ Low- and middle-income countries (LMIC) are likely to carry a disproportionate part of the world's tobacco-associated health burden due to a combination of growing tobacco consumption and substandard healthcare. Tobacco use in LMIC is on the rise and can begin very early in life. It is estimated that, worldwide, one in seven teenagers smokes, and a quarter of them have tried their first cigarette before the Age of 10.² Prevention of tobacco use among adolescents is particularly important for tobacco control because smoking habits are established primarily in youth.

Although youth tobacco use is a global problem, virtually all evidence on the economic determinants of youth smoking comes from high-income countries (HIC) and primarily from US data. US estimates of the total price elasticity of cigarette demand for youth range from -1.44 ,³ -1.31 ,⁴ -1.11 ,⁵ -0.83 ,⁶ -0.77 ⁸ to statistically zero.⁹ To the best of our knowledge, no prior studies provide

estimates of cigarette price elasticities among youth in LMIC although there is limited evidence on adults from some LMIC.^{10–11} Lance *et al* (2004) estimate the effect of price on adult male smoking in China and Russia and find very weak price responsiveness. Chapman and Richardson (1990) rely on aggregate country data, which raises concerns about the ability to identify a causal price effect in a model where cigarette prices and cigarette demand are simultaneously determined.

A common concern with evaluating the impact of price in studies that pool data from different geographical locations is confounding bias from unobserved country or state characteristics. An example of an unobserved country-specific confounder is anti-smoking sentiment. For instance, countries with higher prevalence of anti-smoking sentiment are likely to have lower cigarette consumption, and, at the same time, they may be more likely to pass heavier cigarette taxation and to have higher prices. In such case, unless anti-smoking sentiment is controlled for, we cannot be certain that the observed negative correlation between cigarette prices and cigarette consumption represents a true price effect as it may merely be a reflection of the local attitudes towards smoking. Recent US studies that control for differences in anti-smoking sentiment across US states disagree regarding the importance of cigarette price as a determinant of youth smoking.^{9–12–13} This mixed evidence hinders the extrapolation of US-based results to other countries. Even if uniform evidence on US price effects had been available, US results cannot be easily generalised to other countries due to a variety of differences among the populations.

Our study addresses the current need for evidence regarding the impact of prices on youth cigarette consumption in LMIC and provides estimates of the price elasticity of cigarette demand. Bias from country-specific unobservable factors is reduced by including (1) country fixed effects that control for unobserved time-invariant country characteristics and (2) a proxy for local anti-smoking sentiment. We further reduce estimation bias by controlling for confounding environmental factors such as rates of exposure to cigarette advertising and anti-tobacco media messages, and ease of purchasing cigarettes.

DATA AND METHODS

The Global Youth Tobacco Survey (GYTS) provides individual-level data on youth smoking behaviour, their personal characteristics and environments. GYTS is a school-based survey developed by the WHO and Centers for Disease Control and Prevention (CDC) to track tobacco use among

young people across countries with a common methodology. It has been conducted in 135 LMIC from the six WHO world regions (Africa, Europe, Pan-American, Southeast Asia, Middle East and Western Pacific) in various years since 1999. It captures prevalence, access, media exposure and attitudes related to tobacco use among individuals in school grades corresponding to Ages 13–15, although in practice the Age range of the survey is wider and covers individuals between the Ages of 11 and 19 with an average Age of 14 years. The survey is designed to be a random sample of schoolchildren, and a major limitation is that it does not capture children who are not enrolled in school.

We constructed our final dataset by merging individual-level data from GYTS with country-level data on local cigarette prices obtained from the Economist Intelligence Unit's (EIU) World Cost of Living Survey. The final dataset has observations on 315 353 individuals from 17 countries corresponding to 113 local sites (ie, cities/provinces). The number of countries used in this study is smaller than the total number of GYTS countries for the following reasons. First, we excluded countries for which cigarette price data were unavailable (82 countries excluded). Second, we kept only countries that were surveyed in multiple years, allowing the use of country fixed effects (33 countries excluded). Finally, we excluded three more countries due to their classification as HIC (Kuwait, United Arab Emirates and Poland). Descriptive statistics of the sample and variables used in this study are shown in table 1. Sample means with country-level detail are shown in table 2.

Smoking participation is captured by a binary variable equal to 1 if an individual smoked at least one cigarette in the past month and 0 otherwise. The highest smoking prevalence in our sample is observed in Russia (23%) and Chile (24%). Smoking intensity among smokers is calculated by multiplying the average number of smoking days by the average number of cigarettes smoked per day in the past month, both of which are obtained from GYTS responses. In this sample, the average cigarette consumption ranges from 1.5 to 630 cigarettes per month. On average, the highest consumption is concentrated among a minority of individuals, and more than half of our LMIC youth sample smokes less than a pack per month (table 3). Individual control variables include Age, Gender, Parental Smoking status and availability of Pocket Money. The

latter is captured by a binary indicator equal to 1 if the subject receives Pocket Money/personal income and serves as a proxy for personal and family income that is not otherwise available in GYTS. Education is not included since the level of education across survey participants is fairly constant and represents middle-school grades only.

Cigarette prices are obtained from the EIU World Cost of Living Survey, which collects retail price data for a wide range of consumer products from multiple cities worldwide.¹⁴ Cigarette prices are available for two different brands, a local brand and a foreign brand (usually Marlboro) collected from one or more cities in each country. If cigarette prices come from multiple cities in one country, we use the average national price. Where the GYTS city survey site matches the EIU city survey site, local city prices are used instead of the nationally averaged price. Prices are expressed in real 2000 US dollars and are adjusted using purchasing power parity conversion factors obtained from the World Bank's World Development Indicators database.¹⁵ Purchasing power parity adjusts prices for the local standard of living and allows for more accurate price comparison between countries. Prices are log-transformed so that we can directly estimate the impact of a per cent change in price.

The environment of each subject is captured by the level of anti-smoking sentiment (*Sentiment*), the local prevalence of cigarette advertising (*Cigarette Advertising*), the local prevalence of anti-tobacco media messages (*Anti-Tobacco Media*) and a general measure of the ease of purchasing cigarettes (*Youth Access*). All of these are constructed by aggregating individual survey responses at the site level.

Sentiment is defined as the percentage of non-smokers in each survey site who favour bans on smoking in public places. Anti-smoking sentiment has been recognised as an important factor for smoking behaviour.^{9 16} We exclude smokers from the construction of anti-smoking sentiment because smokers are disproportionately more likely than non-smokers to disapprove of smoking bans and would inflate the relationship between sentiment and smoking by virtue of their weight alone.^{9 13} If *Sentiment* included smokers, *Sentiment* would appear to have a larger impact on smoking because it would be difficult to disentangle what part of the impact is driven by true differences in sentiment across sites and what part is driven merely by

Table 1 Sample means and variable definitions

Variable type	Variable name	Variable description	Full sample (n = 315 353)			Smokers only (n = 29 782)		
			Mean	Min	Max	Mean	Min	Max
Individual level	Current smoker	1 if smoked at least one cigarette in past month, 0 otherwise	0.09	0	1	1	1	1
	Cigarette demand	Number of cigarettes smoked in past month	6.3	0	630	66.5	1.5	630
	Age	Age in years	14.0	8.7	19.4	14.5	10.1	19.0
	Male	1 if male, 0 otherwise	0.50	0	1	0.63	0	1
	Pocket money	1 if receives pocket money/income, 0 otherwise	0.61	0	1	0.84	0	1
	Parental smoking	1 if at least one parent smokes, 0 otherwise	0.47	0	1	0.64	0	1
Site level	Anti-smoking sentiment	Proportion of non-smokers who support bans on public smoking	0.83	0.40	0.96			
	Cig. advertising exposure	Proportion of survey respondents who report recent exposure to cigarette advertising in print media	0.87	0.44	0.99			
	Anti-tobacco media exposure	Proportion of survey respondents who report recent exposure to anti-smoking media messages	0.83	0.61	1.00			
	Youth access	Proportion of survey respondents who report being unable to buy cigarettes due to age	0.36	0.05	0.87			
Country level	Price, local brand	Real price of local-brand cigarettes, PPP-adjusted, constant year 2000 USD	2.44	1.08	5.16			
	Price, foreign brand	Real price of foreign-brand cigarettes, PPP-adjusted, constant year 2000 USD	3.32	1.45	8.94			

PPP, purchasing power parity.

Table 2 Sample means by country and region

Region*	Country	Years	Smoking prevalence†	Cond. cig. demand‡	Pocket money§	Parental smoking¶	Anti-smoking sentiment**	Cig. advertising††	Anti-tobacco media‡‡	Youth access§§	Cig. price, local brand¶¶	Cig. price, foreign brand***
Africa	South Africa	1999, 2002	17.3%	96.9	0.43	0.45	0.58	0.84	0.78	0.35	2.97	3.02
Mideast	Egypt	2001, 2005	3.3%	72.7	0.64	0.52	0.87	0.75	0.76	0.44	3.46	3.53
	Jordan	1999, 2003	12.2%	90.0	0.70	0.52	0.80	0.79	0.73	0.33	1.57	3.58
	Morocco	2001, 2006	3.7%	96.1	0.40	0.27	0.81	0.69	0.70	0.43	2.68	5.26
	Pakistan	2003, 2004	1.0%	82.7	0.67	0.32	0.96	0.81	0.78	0.58	2.23	3.60
Mideast average			5.4%	87.8	0.62	0.42	0.87	0.77	0.75	0.46	2.48	3.81
Europe	Russia	2002, 2004	22.8%	123.3	0.79	0.63	0.91	0.81	0.87	0.47	1.95	3.74
Americas	Brazil	2002, 2004, 2005, 2006	9.8%	89.4	0.58	0.37	0.89	0.87	0.88	0.19	1.60	1.78
	Chile	2000, 2003	23.6%	45.2	0.75	0.63	0.88	0.89	0.80	0.17	2.98	3.62
	Costa Rica	1999, 2002	14.6%	56.0	0.66	0.31	0.90	0.95	0.81	0.35	1.39	1.73
	Mexico	2000, 2005, 2006	12.4%	40.9	0.64	0.40	0.89	0.91	0.85	0.49	2.01	2.59
	Peru	2000, 2002, 2003	11.8%	24.5	0.63	0.41	0.91	0.88	0.90	0.28	2.76	3.32
	Venezuela	1999, 2001, 2003	4.1%	36.0	0.56	0.37	0.88	0.86	0.81	0.33	2.37	2.64
Americas average			11.5%	51.3	0.62	0.41	0.89	0.88	0.85	0.31	2.15	2.56
Southeast Asia	India	2000, 2001, 2002, 2003, 2004, 2006	5.5%	59.4	0.47	0.45	0.76	0.92	0.79	0.49	3.33	4.80
	Indonesia	2000, 2004, 2005, 2006	11.8%	35.4	0.93	0.57	0.91	0.96	0.91	0.37	1.70	2.02
	Sri Lanka	1999, 2003	1.5%	34.1	0.68	0.48	0.93	0.88	0.87	0.59	4.92	7.35
Southeast Asia average			6.2%	52.7	0.54	0.47	0.79	0.92	0.81	0.47	3.05	4.30
Western Pacific	China	1999, 2001, 2005	4.7%	88.8	0.75	0.64	0.62	0.66	0.78	0.16	2.40	3.43
	The Philippines	2000, 2004	11.9%	58.5	0.58	0.58	0.66	0.91	0.87	0.49	1.17	1.63
Western Pacific average			7.3%	71.3	0.69	0.62	0.63	0.70	0.79	0.22	1.91	2.71

*Regions follow WHO geographical designation.
 †% survey respondents who smoked at least one cigarette in past month.
 ‡Number of cigarettes smoked in past month.
 §Proportion of survey respondents who reported receiving pocket money or income.
 ¶Proportion of survey respondents who have at least one parent who smokes.
 **Proportion of non-smokers who support bans on public smoking.
 ††Proportion of survey respondents who report recent exposure to cigarette advertising in print media.
 ‡‡Proportion of survey respondents who report recent exposure to anti-smoking media messages.
 §§Proportion of survey respondents who report being unable to buy cigarettes due to age.
 ¶¶Real price of local-brand cigarettes, PPP-adjusted, constant 2000 USD.
 ***Real price of foreign-brand cigarettes, PPP-adjusted, constant 2000 USD.

variability in the proportion of smokers. By contrast, a sentiment variable constructed from the aggregated attitudes of non-smokers is less likely to contain simultaneity bias when modelled against smoking rates, and its impact on smoking is less likely to be overestimated (this is confirmed by a sensitivity analysis we conducted comparing smokers-inclusive to non-smokers-only *Sentiment* estimates).

Cigarette Advertising represents the local prevalence of cigarette advertising and is calculated as the proportion of survey participants who have been recently exposed to cigarette ads on billboards, newspapers or magazines. *Anti-Tobacco Media* represents the local prevalence of anti-tobacco media campaigns and is determined by the proportion of respondents who have recently been exposed to anti-smoking messages in broadcast

and print media. *Youth Access* is calculated as the proportion of survey participants who have recently tried to purchase cigarettes but were turned away by vendors due to their age. *Cigarette Advertising*, *Anti-Tobacco Media* and *Youth Access* are not intended to represent the effects of underlying tobacco-control policies such as tobacco advertising bans or sales bans to minors, although, under certain assumptions, they can be used to provide a glimpse into the potential impact of such policies. *Youth Access*, in particular, cannot be interpreted as a proxy for sales bans to minors because some countries did not have such bans at the time of the survey (Chile, Indonesia, Morocco, the Philippines) and because some survey participants may be above the legal Age limit in countries where bans were present. Instead, the role of *Youth Access* is to account for differences across countries in the ease of obtaining cigarettes from points of sale and can reflect the extent to which the habits of young smokers can be enabled by vendors.

We use a two-part model to estimate the impact of price on youth smoking. This model allows for independence between the decision to smoke and the decision of how much to smoke. The first part estimates the probability of smoking participation using a logit model. The second part estimates the amount of cigarettes smoked by smokers with a generalised linear model. We present results from two specifications. The first specification provides a baseline estimate of the price effect without controlling for environmental characteristics. The second

Table 3 Distribution of conditional cigarette demand

	Number of cigarettes per month
Mean	66.5
Min	1.5
10th percentile	1.5
25th percentile	3.8
Median	14.0
75th percentile	84.0
90th percentile	224.8
Max	630.0

specification adds controls for *Anti-Smoking Sentiment*, *Cigarette Advertising*, *Anti-Tobacco Media* and *Youth Access*. Each specification is estimated using both local-brand and foreign-brand cigarette prices. Models using foreign-brand cigarette prices contained one country less than models using local-brand prices because one country (Morocco) did not have data on foreign-brand prices. All specifications control for *Age* in quadratic form, *Gender*, *Parental Smoking*, *Pocket Money*, and year and country fixed effects.

RESULTS

Smoking participation

Results from the smoking participation models are presented in table 4 for local-brand prices and table 5 for foreign-brand prices. A comparison between the baseline and inclusive specifications in tables 4 and 5 shows that accounting for environmental characteristics such as anti-smoking sentiment, media effects and youth access reduces the magnitude of the impact of cigarette price on the probability of smoking but does not reduce its statistical significance. The estimated price elasticity of participation in the baseline specification is -1.01 for local-brand cigarettes and -1.62 for foreign-brand cigarettes. In the inclusive specification, after controlling for environmental factors, elasticity is reduced to -0.74 and -1.09 for local- and foreign-brand cigarettes, respectively. This implies that a 10% increase in price would correspond to a 7.4% average decline in smoking participation using local-brand prices and 10.9% decline in participation using foreign-brand prices.

Anti-smoking sentiment is shown to be a significant predictor of participation and has the expected negative sign, confirming that higher anti-smoking sentiment is indeed associated with lower youth smoking prevalence. However, unlike DeCicca *et al* (2002, 2008), and more in line with Carpenter and Cook (2008), we find that although controlling for *Sentiment* is necessary for improving the precision of the price estimates, it does not remove the effect of price (tables 4 and 5).

The local prevalence of cigarette advertising is associated with higher youth smoking participation and the local prevalence of anti-tobacco media messages is found to reduce smoking participation. Using simple linear extrapolation from the local-brand cigarette model in table 4, we estimate that if cigarette advertising was successful in reaching every single individual (so that the proportion of youth exposed to advertising approached 100% from the current mean of 87%), the average smoking

Table 4 Logit models of smoking participation (local-brand cigarettes)

	Baseline†	Inclusive of environmental site-specific controls†‡
Log price (local brand)	-0.065*** (0.019)	-0.043*** (0.015)
Anti-smoking sentiment		-0.094*** (0.026)
Cigarette advertising		0.126*** (0.045)
Anti-tobacco media		-0.088* (0.046)
Youth access		-0.102*** (0.028)
Price elasticity of smoking participation	-1.101***	-0.741***

Coefficients represent the marginal effect of each variable on the probability (rate) of smoking participation.
SEs clustered by survey site.
SEs in parentheses.
* $p < 0.1$; *** $p < 0.01$.
†All specifications include *Age*, *Age Squared*, *Gender*, *Parental Smoking*, *Pocket Money* and year and country dummy variables.
‡Inclusive specifications include the following environmental controls: *Anti-Smoking Sentiment*, *Cigarette Advertising*, *Anti-Tobacco Media* and *Youth Access*.

Table 5 Logit models of smoking participation (foreign-brand cigarettes)

	Baseline†	Inclusive of environmental site-specific controls†‡
Log price (foreign brand)	-0.093*** (0.023)	-0.061*** (0.020)
Anti-smoking sentiment		-0.090*** (0.026)
Cigarette advertising		0.112** (0.046)
Anti-tobacco media		-0.089* (0.051)
Youth access		-0.105*** (0.028)
Price elasticity of smoking participation	-1.617***	-1.088***

Coefficients represent the marginal effect of each variable on the probability (rate) of smoking participation.
SEs clustered by survey site.
SEs in parentheses.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
†All specifications include *Age*, *Age squared*, *Gender*, *Parental Smoking*, *Pocket Money*, and year and country dummy variables.
‡Inclusive specifications include the following environmental controls: *Anti-Smoking Sentiment*, *Cigarette Advertising*, *Anti-Tobacco Media* and *Youth Access*.

prevalence rate would be higher by 1.6% points. Similarly, if anti-tobacco messages were to reach 100% of youth as compared with the reported 83%, smoking prevalence would be lower by about 1.5% points.

We find that youth are more likely to smoke in areas where it is easier for them to purchase cigarettes, as shown by the negative and statistically significant coefficient of *Youth Access* in tables 4 and 5. Extrapolating from the local-brand cigarette model (table 4), we estimate that if the proportion of youth unable to buy cigarettes increased from the observed mean of 36% to a hypothetical 100% (for instance, if bans on selling cigarettes to youth were implemented and fully enforced in all countries), the average smoking participation rate would be lower by 6.5% points.

Cigarette demand among smokers (conditional demand)

We find that price is a significant predictor of the intensity of smokers' consumption of both local-brand cigarettes (table 6) and foreign-brand cigarettes (table 7). In models inclusive of environmental controls, the price elasticity of conditional demand is -1.37 for local-brand and -1.71 for foreign-brand cigarettes, implying that a 10% increase in the price of local-brand cigarettes would correspond to a 13.7% decrease in the average number of cigarettes consumed by smokers. Similarly, a 10% increase in the

Table 6 Generalised linear models of conditional cigarette demand (local-brand cigarettes)

	Baseline†	Inclusive of environmental site-specific controls†‡
Log price (local brand)	-1.280*** (0.241)	-1.365*** (0.392)
Anti-smoking sentiment		-0.110 (0.312)
Cigarette advertising		0.861 (0.680)
Anti-tobacco media		-1.256** (0.537)
Youth access		0.185 (0.339)
Price elasticity of conditional demand	-1.280***	-1.365***

Coefficients represent the marginal effect of each variable on log cigarettes per month.
SEs clustered by survey site.
SEs in parentheses.
** $p < 0.05$; *** $p < 0.01$.
†All specifications include *Age*, *Age Squared*, *Gender*, *Parental Smoking*, *Pocket Money*, and year and country dummy variables.
‡Inclusive specifications include the following environmental controls: *Anti-Smoking Sentiment*, *Cigarette Advertising*, *Anti-Tobacco Media* and *Youth Access*.

Table 7 Generalised linear models of conditional cigarette demand (foreign-brand cigarettes)

	Baseline†	Inclusive of environmental site-specific controls‡‡
Log price (foreign brand)	−1.547*** (0.327)	−1.714*** (0.511)
Anti-smoking sentiment		−0.152 (0.314)
Cigarette advertising		0.989 (0.739)
Anti-tobacco media		−1.370** (0.544)
Youth access		0.211 (0.346)
Price elasticity of conditional demand	−1.547***	−1.714***

Coefficients represent the marginal effect of each variable on log cigarettes per month. SEs clustered by survey site.

SEs in parentheses.

p<0.05; *p<0.01.

†All specifications include *Age*, *Age Squared*, *Gender*, *Parental Smoking*, *Pocket Money*, and year and country dummy variables.

‡Inclusive specifications include the following environmental controls: *Anti-Smoking Sentiment*, *Cigarette Advertising*, *Anti-Tobacco Media* and *Youth Access*.

price of foreign-brand cigarettes would correspond to a 17.1% decrease in consumption among existing smokers.

We find no evidence that *Anti-Smoking Sentiment*, *Cigarette Advertising* or *Youth Access* influence the consumption of current smokers. This may indicate that once the decision to smoke is made, environmental factors other than cigarette prices are less powerful in determining how many cigarettes are smoked. One exception is *Anti-Tobacco Media*, which is shown to be a significant albeit modest determinant of smoking intensity. Extrapolating from table 6, we estimate that extending the *averAge* exposure to anti-tobacco media from the reported 82% to 100% of current smokers may lower the *averAge* smoker's demand for cigarettes by 22.6%, about half a cigarette per day.

DISCUSSION

This study provides an insight into the factors that shape cigarette consumption among youth in LMIC. We find that cigarette prices have a significant impact on youth cigarette demand in terms of both smoking participation and smoking intensity among smokers. We report price elasticities based on both local-brand and foreign-brand cigarette prices; however, we prefer specifications using local-brand prices because these prices are cheaper and more likely to be considered when youth make consumption decisions. Using local-brand prices, we estimate that the price elasticity of smoking participation is -0.74 and the price elasticity of conditional demand is -1.37 . The implication is that a 10% increase in the price of local-brand cigarettes reduces *averAge* smoking participation by 7.4% and reduces the *averAge* number of cigarettes consumed by smokers by 13.7%. The total elasticity of cigarette demand (ie, the sum of the elasticities of participation and conditional demand) is approximately -2.1 , implying that cigarette demand in our sample of countries is highly price elastic. The total price elasticity using foreign-brand prices is even larger at -2.9 . Since foreign brands are more expensive than local brands (table 1), this suggests that youth may be more responsive to price increases when prices are already high to begin with.

Since this study is the first to estimate price elasticities of youth cigarette demand in LMIC, we are unable to discuss our results in relation to comparable estimates from other LMIC studies. We can, however, compare them with the results from US data. Our estimate of youth price elasticity is higher than the estimates from the US youth data, which range from -0.77 ⁸ to

What this paper adds

This paper shows that higher cigarette prices are able to reduce both smoking participation and conditional cigarette demand among youth in our sample of low- and middle-income countries (LMIC). Furthermore, youth are more responsive to price increases in LMIC than high-income countries.

-1.44 .³ This is perhaps not surprising, for two reasons. First, the *averAge* Age in our sample is 14 years, which is generally lower than the Age ranges examined in the literature on US youth smoking. Since younger Age groups have been shown to be more sensitive to prices,^{3–5 17 18} it is reasonable to expect that our sample may exhibit higher price responsiveness. Second, income constraints are tighter for individuals from LMIC, which is also likely to result in higher price responsiveness. The argument that people in LMIC are more sensitive to prices than people in HIC is consistent with the findings from a sensitivity analysis we performed in the course of this research. In this sensitivity analysis, we changed the sample of countries so that, in addition to the 17 LMIC in our primary analysis, the sample also included three HIC for which GYTS data were available (Poland, Kuwait and United Arab Emirates). We found that the total price elasticity computed after including the HIC was smaller than the price elasticity of the LMIC sample alone (-1.8 vs -2.1), confirming that prices can be a more potent tool for controlling consumption in countries with lower incomes.

Although we cannot directly interpret the environmental control variables *Cigarette Advertising*, *Anti-Tobacco Media* and *Youth Access* as indicators for the performance of policies like advertising bans or sales bans to minors, we can, under some assumptions, use them to make an inference about the potential effects of such underlying policies. For instance, we can extrapolate from the *Youth Access* coefficient in table 4 to estimate that in the hypothetical scenario where youth access bans were universally enforced and no youth were able to purchase cigarettes, the *averAge* smoking participation rate would drop by 6.5% points to under 3%. This illustrates the importance of compliance with anti-tobacco policies and highlights the discrepancy in outcomes between actual and desired policy that could arise from inadequate compliance. Indeed, studies from the USA and elsewhere have been inconclusive as far as the impact of youth access policies and their enforcement on youth tobacco use are concerned and highlight the difficulty of enforcing youth access policies.¹⁹

This study finds that prices are effective policy tools for reducing both smoking participation and conditional cigarette demand among youth in LMIC. While we find evidence that smoking participation rates may also be affected by advertising exposure, anti-tobacco media exposure and ease of purchasing cigarettes, these associations would benefit from further investigation as causal determinants of smoking participation. Among existing smokers, the intensity of cigarette consumption does not appear to be influenced by non-price factors such as advertising exposure and ease of purchasing cigarettes, is mildly influenced by exposure to anti-tobacco media and remains strongly influenced by cigarette prices.

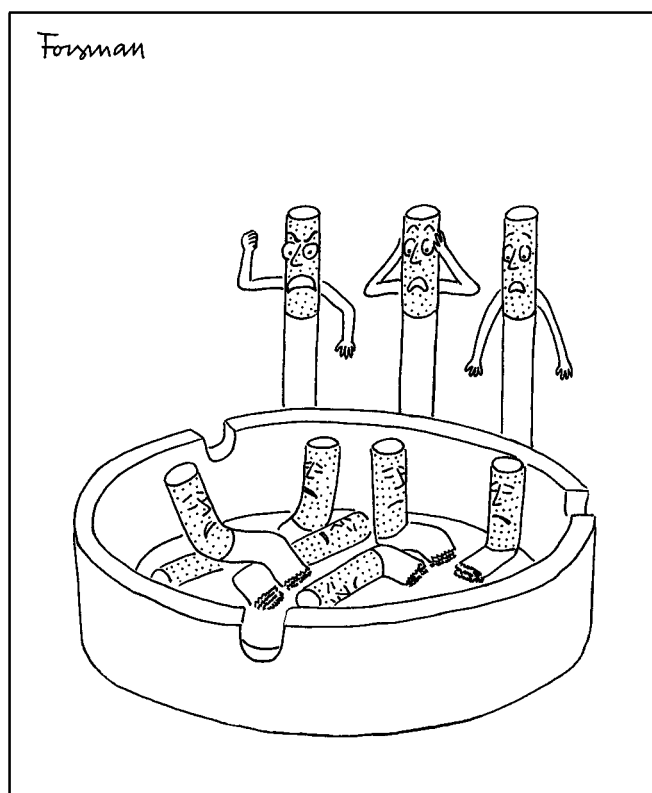
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The Lighter Side



"We will KILL whoever did this!"



Figure 3 Internet ad for Chaini Khaini illustrating packaging in youth-appealing fashion as well as the use of Indian spices and flavouring.

Co-optation of cultural attributes may be a new avenue for multinational tobacco companies to enter largely untapped markets. For India specifically, hybridisation of emerging products, which capitalise on the cultural value of indigenous tobacco, is a potential concern worthy of monitoring. Tobacco

control advocates must be vigilant to ensure that these strategies are adequately countered.

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Correction

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). In their literature review, the authors neglected to mention that there are a number of working and discussion papers which examine the relationship between cigarette prices and youth smoking in several lower and middle income countries. These studies use the Global Youth Tobacco Survey and focus on India (Joseph, 2010), Poland (Ross and Prezwonziak, 2004), Russia (Ross, 2004) and Ukraine (Ross, 2005). The IARC Handbook (currently in print) provides the most up-to-date and comprehensive review of the existing research on the impact of cigarette prices and taxes on smoking behaviour globally. The authors apologise for these omissions.

The list of papers are as follows:

International Agency for Research on Cancer (in press). IARC Handbooks of Cancer Prevention, Tobacco Control, Vol 14: Effectiveness of Tax and Price Policies in Tobacco Control. Lyon, France: International Agency for Research on Cancer.

Joseph RA. *The Economics of Youth Tobacco Use in India.* Chicago: University of Illinois, 2010

Ross H, Prezwonziak K. Poland 1999 Global Youth Tobacco Survey: Economic Aspects. HNP Discussion Paper Series, Economics of Tobacco Control Paper No. 22. Washington DC: The World Bank, 2004.

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