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RESEARCH PAPER

Five in a row—reactions of smokers to tobacco tax increases: population-based cross-sectional studies in Germany 2001–2006

Reiner Hanewinkel, Barbara Isensee

Tobacco Control 2007;16:34–37. doi: 10.1136/tc.2006.017236**Objective:** To assess reactions of smokers to five waves of tobacco tax increases in Germany.**Design:** A 10-wave cross-sectional study, with assessments before and after the tax increases.**Setting:** General population of Germany.**Participants and methods:** 10 representative samples from the general population with a total number of 27 608 people aged ≥ 14 years, including 8548 smokers (31% of the total sample), were interviewed.**Outcome measures:** Reflection on smoking behaviour, and smoking behaviour (quitting, reducing, switching to a cheaper brand or no change) before and after tobacco tax increases.**Results:** Before the tax increases, one third to more than half of the smokers reflected on their smoking behaviour, 9.7–13.9% intended to quit, 23.4–34.7% intended to reduce smoking and 10.8–16.4% intended to switch to cheaper tobacco products, whereas 36.1–52.1% did not intend any change at all. After the tax increases, one fourth to more than one third reported to have reflected on their smoking behaviour, 4.0–7.9% quit smoking owing to the increase, 11.5–16.6% reduced consumption and 11.0–19.9% switched to cheaper products. Significant associations were found between the height of the price increase and the intentions and reactions of smokers.**Conclusions:** Price increases lead to a substantial reflection on smoking and intended and realised behaviour changes such as reduced consumption and switching to cheaper tobacco products. These effects are more pronounced the more the price rises. Therefore, taxation policy will lead to quitting and reducing smoking. However, complementary measures should also be taken to prevent smokers switching to cheaper tobacco products, which would reduce the effectiveness of taxation policy.

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Smoking remains the leading cause of preventable death worldwide.¹ Tax increases are regarded as the most effective single intervention to reduce demand for tobacco.² Studies on the relationship between cigarette taxes and consumption of cigarettes have shown that the higher the tax increase, the greater the reduction in sales.^{3–4} This reduction may result from non-smokers who do not initiate smoking and from smokers who reduce the number of cigarettes they smoke or who quit completely as a reaction to higher prices—that is, to limit consumption. Another way to compensate for the price increase reported by smokers is to switch to a cheaper brand, to cheaper tobacco products such as hand-rolled tobacco or to cheaper sources for cigarettes to minimise expenditures.^{5–7}

Complementary to analysis of sales data, population surveys help in getting a better insight into the various possible reactions of smokers: do price increases affect them? If yes, which reactions are intended and realised; do price increases motivate smokers to quit, to reduce smoking intensity or to compensate for the costs by switching to a cheaper brand? Although there are numerous studies on the relationship between use and price relying on individual data,^{8–14} these studies only assess current (and past) use and the intensity of smoking (usually smoking status and cigarettes per day). Until now, only Biener *et al*¹⁵ have studied perceptions of smokers on the effect of tobacco taxes in Massachusetts, USA, and their reactions to tax increases after the increase in more detail.¹⁵

This study examines the reactions of smokers before and after five steps of tobacco tax increase from 2002 to 2005 in Germany. To our knowledge, this is the first study using the population survey approach to assess both intentions before a tobacco tax increase and reactions after the tax increase, using

several indicators of smoking behaviour and not only smoking status and daily use. Further, the row of five steps of tobacco increase during a short period offered the unique opportunity to study the same question repeatedly with comparable methods. It was hypothesised that future tax increases would provoke a substantial proportion of smokers to reflect on their smoking and intent to behaviour changes, and that implemented tax increases would result in reactions such as quitting, reduced consumption and strategies to minimise expenditures at least in some smokers.

METHODS

Tax structure in Germany and price increases from 2001 to 2006

In Germany, tobacco excise tax is charged by the state. The tax rate is the same all over the country and the tax revenues flow into the national budgets,—that is, they are not earmarked for any purposes directly linked to tobacco control, prevention or the costs of smoking. The German government imposed an excise tax increase of 1.0 Eurocents per cigarette on 1 January 2002, a second increase of 1.0 Eurocents on 1 January 2003, a third increase of 1.2 Eurocents on 1 March 2004, a fourth increase of 1.2 Eurocents on 1 December 2004, and a fifth increase of 1.2 Eurocents on 1 September 2005 (tobacco tax is set and levied by the Ministry of Finance of the Federal Republic of Germany)

Table 1 shows the development of the price of cigarettes in Germany in detail for so-called original packs sold in retail and packs sold in vending machines, which is very common in Germany (about 30% of all cigarettes are sold via vending machines). Table 1 shows an estimate for the price increase per

Table 1 Development of price for cigarettes in Germany, 2001–2005; reference brand Marlboro

	Original pack, sold in retail			Pack sold in vending machines			Absolute price increase per cigarette in Cent		
	price per pack	number per pack	price per cigarette	price per pack	number per pack	price per cigarette	Original pack	Vending machine	Averaged†
	€		Eurocent	€		Eurocent			
Until December 2001*	2.81	19	14.79	3.07	20	15.35			
Until December 2002	3.00	19	15.79	3.00	19	15.79	1.00	0.44	0.83
Until March 2004	3.20	19	16.84	3.00	18	16.67	1.05	0.88	1.00
Until December 2004	3.60	19	18.95	4.00	21	19.05	2.11	2.38	2.19
Until September 2005	4.00	19	21.05	4.00	19	21.05	2.10	2.00	2.07
Since September 2005	3.80	17	22.35	4.00	18	22.22	1.30	1.17	1.26

*Price in Deutsche Mark was converted in Euro with official exchange rate (1 Euro = 1,95583 Deutsche Mark).

†Estimated by $0.3 \times$ price increase of vending machine packs + $0.7 \times$ price increase of original pack.

Prices were given by the "Bundesverband Deutscher Tabakwarengroßhändler und Automatenaufsteller" (Association of German tobacco wholesalers and vending machine operators) and verified by own investigation.

cigarette, which is merged by the two different types of distribution.

Between the end of 2001 and the end of 2005, the price of a pack of cigarettes rose by about €1 or 33%. The first two steps of the tobacco tax increase on 1 January 2002 and 1 January 2003 (each 1.0 Eurocent per cigarette plus 16% sales tax—that is, 1.16 Eurocents per cigarette) was passed on only partly to the consumer, as the price increase by the tobacco industry was lower than 1.16 cents per cigarette but ranged from 0.44 to 1.05 cents per cigarette. The three tax increases in 2004 and 2005 amounted to 1.2 cents per cigarette plus sales tax—that is, 1.392 cents per cigarette. In 2004, the price rose by a higher extent, ranging from 2 to 2.38 cents per cigarette, owing to an extra price increase by the tobacco industry. The last tax increase was also not passed on completely to the consumer.

Data assessment and sample

Computer-assisted personal face-to-face interviews with representative samples from the German population were carried out before and after each step of tax increase. The interviews were run by a nationwide acting and experienced public opinion research institution as part of a so-called omnibus survey. The basic population consisted of all German-speaking people, aged ≥ 14 years, living in private households in the Federal Republic of Germany. Of this population, representative stratified random samples were drawn with the sampling process comprising three stages (random drawing of sample points on the basis of electoral districts, selection of the target household by random route procedure, and selection of target person by next birthday). To achieve an interview with the determined target person, the target household was contacted up to three times. About 10% of all interviews were checked for correct administration.

Samples of 2000–3000 people aged 14–98 years were interviewed before and after the five steps of tobacco tax increase (each with a time lag of 1–4 months before/after the respective tax increase). Methods and questions were identical in all 10 waves of the survey. Basic demographic and socioeconomic variables of the samples were measured. The mean age of the whole sample ($n = 27\,608$) was 46.5 (standard deviation

17.7) years with 54.5% being women and 31.0% ($n = 8548$) reporting to be smokers.

Before the tax increases, smokers ($n = 4100$) were asked whether the upcoming tax increase would be a reason to reflect on their own smoking behaviour (yes/no) and whether they would intend to reduce smoking, quit smoking, switch to a cheaper brand or not to change their behaviour. After the tax increases, smokers and ex-smokers ($n = 6033$) were asked whether or not they had realised the above-mentioned strategies.

All statistical analyses were performed using Stata SE9 (version 9).

RESULTS

Table 2 shows the effects of the price increases on intentions and reactions of smokers. Before the increases, the increase led a substantial proportion of smokers to reflect on their smoking behaviour and to intend changes in smoking behaviour: one third (before 1 January 2002 until 1 January 2003) to more than half of the smokers (before 1 March 2004) indicated that they reflected on their smoking as a result of the upcoming tax increase. About 10% intended to quit, every fourth to third wanted to reduce smoking. Switching to a cheaper brand as a way to compensate for the price increase was affirmed by 10–16% of smokers. The proportion of smokers who intended not to change their smoking behaviour ranged from 36% to 52%.

After the price increases, 23–38% of respondents indicated that they have considered their smoking behaviour because of the tax increases. The rates for quitting and reduction as a reaction to the price increase also varied between the waves, but were considerably high especially in 2004, with about one quarter of respondents who indicated that they quit or reduced smoking because of the tax increase. Also, 55–72% indicated that they did not change their smoking behaviour at all.

The proportion of respondents who reported reflection or behaviour change after the price increases was almost continuously and significantly lower (see last column in table 2) than the proportion of smokers who indicated an intent to reflect or change their smoking before the tax increase—that is, the actual response after the increase was less pronounced than the intended reflections and changes. An exception is the

Table 2 Intentions and reactions before and after five waves of tax increase among German smokers

Step of tobacco tax increase	Before	After	χ^2	df	P Value
	n (%)	n (%)			
1 January 2002					
Reflect	233 (35.1)	336 (24.1)	27.34	1	0
Quitting	71 (10.7)	65 (4.7)	26.59	1	0
Reducing	175 (26.4)	161 (11.5)	72.42	1	0
Cheaper brand	72 (10.8)	153 (11.0)	0.01	1	0.937
No change	346 (52.1)	1007 (72.1)	80.06	1	0
1 January 2003					
Reflect	367 (35.9)	328 (23.0)	49.01	1	0
Quitting	99 (9.7)	57 (4.0)	32.39	1	0
Reducing	239 (23.4)	170 (11.9)	56.40	1	0
Cheaper brand	153 (15.0)	169 (11.8)	5.12	1	0.024
No change	529 (51.7)	1020 (71.4)	99.1	1	0
1 March 2004					
Reflect	297 (54.5)	277 (34.0)	56.04	1	0
Quitting	76 (13.9)	64 (7.9)	13.07	1	0
Reducing	189 (34.7)	134 (16.5)	59.79	1	0
Cheaper brand	80 (14.7)	112 (13.8)	0.23	1	0.633
No change	198 (36.3)	497 (61.1)	79.87	1	0
1 December 2004					
Reflect	443 (45.6)	458 (38.0)	12.59	1	0
Quitting	103 (10.6)	90 (7.5)	6.48	1	0.011
Reducing	327 (33.6)	195 (16.2)	89.77	1	0
Cheaper brand	159 (16.4)	240 (19.9)	4.59	1	0.032
No change	380 (39.1)	663 (55.1)	54.97	1	0
1 September 2005					
Reflect	407 (45.4)	431 (36.2)	18.02	1	0
Quitting	97 (10.8)	73 (6.1)	15.03	1	0
Reducing	239 (26.7)	198 (16.6)	31.08	1	0
Cheaper brand	139 (15.5)	219 (18.4)	3.00	1	0.083
No change	416 (46.4)	684 (57.5)	25.04	1	0

df, degree of freedom.

variation to a cheaper brand or tobacco product: here, the proportion before and after the price increase was quite stable and in the last two parts of the survey even higher after the price increase.

As the height of the price increase varied (table 1), bivariate logistic regressions were run to test the association between the size of the price increase and the intentions and reactions of smokers (table 3). The associations after the increases were found to be substantial and indicated that the more the price increases, the more smokers intend to react to it. Associations remained stable after controlling for age, sex, marital status, education and household income (data not shown).

DISCUSSION

We examined the effects of five steps of tobacco tax increase in Germany from 2002 to 2005. The price increases led to a substantial reflection on smoking as well as intended and realised behaviour changes in smokers, such as quitting,

reduction or switching to a cheaper tobacco product. These effects were higher the more the price rose.

To our knowledge, this is the first study that investigated the effects of a series of multiple price increases on smokers on the basis of individual data from representative population surveys. As the same methods were used in all 10 waves, the single waves could be analysed together and in comparison with each other. An important methodological shortcoming of the study is the cross-sectional design—that is, 10 different samples were assessed instead of one sample being followed up continuously over the years. But the kind of design is not so crucial for most of the outcomes under study—for example, the proportion of quitters as a result of the tax increase can be assessed appropriately in a cross-sectional survey.

An existing study with a comparable objective was conducted by Biener *et al.*¹⁵ who studied reactions of smokers to a 15% increase in the price of cigarettes in 1993 in Massachusetts, USA. They showed that this price increase promoted quitting and other forms of behaviour change among adult smokers: 3.5% of the adult smokers indicated that they stopped smoking owing, in some degree, to the price increases, 35% considered quitting, 19% cut the costs of smoking by changing to a cheaper brand or reducing the number of smoked cigarettes, and 46% reported no reaction at all. These reactions are quite in line with the results presented here for German smokers who had to face multiple—although each lower in relation to the increase studied by Biener *et al.*—price increases over the period of 4 years.

Complementary to these existing results, we analysed a series of price increases and assessed intentions before the tax increases as well as reactions to them, and study the intentions or reactions over time in relation to the height of price increase. We found a pronounced variation in factual price increases, although the tax increase was the same. An interpretation of this is that the tobacco industry uses tax increases as an opportunity to adjust its own price policy, which may not be in line with the tobacco tax policy, potentially resulting in diminished effects when tax increases are not passed on completely or are hidden behind the government tax increase.

A high proportion of smokers is obviously affected by tobacco tax increases and they try to control their budget for cigarettes. Limitation of consumption could be shown and also strategies minimising expenditures, such as switching to a cheaper product, both as an intention before and a reaction after the tax increase. Comparing the assessments before and after the tax increases, the rates of smokers reporting intended reflections and changes before the tax increase are higher than the rates of those who definitely reacted in the several possible ways after the tax increase. These differences between intentions and factual behaviour changes are not surprising because of the highly addictive nature of nicotine. This explanation is also supported by the result that the pre-post difference for switching to a cheaper product is the least pronounced, as only by switching to a cheaper product can smokers compensate for price increases at least partly without

Table 3 Association between size of price increase and intentions or reactions of smokers

	Before increase (n = 4100)		After increase (n = 6009)	
	OR (95% CI)	p value	OR (95% CI)	p value
Reflect	1.54 (1.36 to 1.73)	0	1.56 (1.41 to 1.73)	0
Quitting	1.16 (0.96 to 1.40)	0.109	1.58 (1.30 to 1.93)	0
Reducing	1.46 (1.29 to 1.67)	0	1.32 (1.15 to 1.51)	0
Cheaper brand	1.17 (0.99 to 1.38)	0.055	1.40 (1.23 to 1.60)	0
No change	0.63 (0.55 to 0.71)	0	0.63 (0.57 to 0.70)	0

OR, odds ratio; CI, confidence interval.

What this paper adds

- Tax increases are the most effective single intervention to reduce tobacco consumption, as higher prices lead to decreased demand.
- Most evidence relies on analysis of sales data.
- Much less is known about the individual reactions of smokers to increases in the price of tobacco products.
- A substantial proportion of smokers react to price increases of tobacco by reflection on their smoking behaviour and intended or factual behavioural changes such as price minimisation or limited consumption. These reactions are closely associated with the height of the price increase.
- This study has complemented previous evidence by individual data from a cross-sectional investigations.

having to reduce their use. Although intentions are conceptualised and proved to be a key determinant of behaviour, they are not a sufficient condition to establish and maintain behaviour and the intention-behaviour relationship is moderated by several other factors such as behavioural control and self-efficacy.¹⁶⁻²¹

The association between size of price increase and intentions and reactions of smokers can be shown impressively. At least for the range of price increase under study, it can be postulated that the higher the price increases, the more pronounced the effect.

The results of this study relying on individual data can be supported by official sales data on cigarettes and other tobacco products that are published every 3 months by the Federal Statistical Office of Germany. The overall annual consumption of cigarettes per capita (factory made and self-made, population aged ≥ 15 years) increased during the 1990s and reached a maximum in 2002 with 2418 cigarettes per year per capita, but then decreased continuously during the following years to 2302 (2003), 2126 (2004) and 2101 in 2005—the lowest value since data are available for Germany since the reunification in 1990. This reduction relies mainly on the reduced sales of factory-made cigarettes, which decreased by 34.4% from 2002 to 2005, whereas self-made cigarettes were sold—at a much lower overall level—more than twice as often in 2005 than in 2002.

Although switching to cheaper tobacco products might diminish the intended consequences of the taxation, the planning committees of future tobacco tax increases should bear these results in mind to achieve marked effects as intended. Besides validating our results, future research should try to extend the range of price increases under study. We could show a linear association between the height of a price increase and its effects for a range of a price increase from about 5% to 15%, but it is not clear whether this association is still the same for higher price increases.

In conclusion, these results suggest that taxes on tobacco can serve to promote smoking reduction. Linked to appropriate cessation, prevention and other structural tobacco-control initiatives, tobacco tax increases should be acknowledged as an effective means to reduce tobacco consumption, especially when possibilities to compensate for price increases (eg, by switching to cheaper products) are tackled at the same time.

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