



## Early View

Original article

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# **Are smokers “hardening” or rather “softening”? An ecological and multilevel analysis across 28 European Union countries**

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## **Summary**

This study does not support the hardening hypothesis in the European Union, but suggests a softening of the smoking population. However, social inequalities in heavy smoking underline the need for interventions targeting smokers in vulnerable groups.

## **ABSTRACT**

**Background:** Tobacco control policies can reduce smoking prevalence. These measures may be less effective where smoking prevalence has significantly declined, as the remaining smokers have “hardened”. Our aim was to empirically evaluate the “hardening hypothesis” at the population-level in the European Union (EU) and explore factors associated with hardcore smoking.

**Methods:** We conducted two separate analyses in the EU using data on smoking from the Eurobarometer surveys (2009–2017, n=112,745): a) A panel-data fixed-effects linear regression to investigate changes over time in the percentage of hardcore smokers in relation to standardized smoking prevalence at the country-level. b) A multilevel logistic regression analysis with hardcore (daily smokers,  $\geq 15$  cigarettes per day (cpd) that have not attempted to quit in the last 12 months) and light ( $< 5$ cpd) smoking as dependent variable and time as the main independent variable, controlling for individual and ecological variables.

**Results:** We studied 29,010 current smokers (43.8% hardcore and 14.7% light smokers). The prevalence of hardcore smoking among adult smokers increased by 0.55% (0.14–0.96) per each additional percentage point in the overall smoking prevalence. The odds of being a hardcore smoker increased over time and were higher in middle-aged men and people with financial difficulties, while the odds of being a light smoker significantly declined among women.

**Conclusion:** This study does not support the “hardening hypothesis” in the EU between 2009 and 2017, but suggests a softening of the smoking population. Existing tobacco control policies are likely to be suitable to further decrease smoking prevalence in Europe.

## BACKGROUND

Tobacco is the largest preventable health hazard in the European Union (EU)[1]. Despite the decline in tobacco smoking prevalence over the past decades, Europe remains the region with the highest smoking prevalence among adults (28%: 38% male, 19% female) and some of the highest prevalence of tobacco use by adolescents[2].

To address the tobacco epidemic the EU ratified the WHO Framework Convention on Tobacco Control[3] and developed a Tobacco Product Directive, which was revised in 2014[4]. Subsequently, all EU Member States (MS) have implemented key tobacco control policies[5]; however, large differences still exist in the implementation and enforcement levels of tobacco control policies across the EU[6, 7].

Established tobacco control policies have been shown to reduce smoking prevalence[6, 8]. However, it has been suggested that tobacco control measures are less effective in countries where a significant decline in smoking prevalence has been observed, as the population of smokers becomes more “hardened”[9]. This is known as the “hardening hypothesis” which proposes that when the prevalence of smoking decreases, smokers who quit first are those less dependent, and hence the remaining smokers in the population are “hardcore smokers”, including inveterate smokers with high consumption, high cigarette dependence, and low motivation to quit[10, 11]. The confirmation of the hardening hypothesis in a population would have important implications since this group may represent a difficult-to-reach, special population, for whom tobacco control efforts may need to be specifically tailored[12]. Thus, the feasibility of tobacco endgame strategies, which suggest moving beyond tobacco control toward a tobacco-free future[13], would be compromised, given that they would be effective only assuming a transition from combustible tobacco to alternative forms of nicotine delivery systems[14].

The evidence is not yet conclusive to support or refute the hardening hypothesis[15]. Few previous studies have supported the hardening hypothesis; however, they are either cross-sectional analyses based on ecological data[16], individual-level data from a single country[17] with their known limitations[9], or meta-analyses of clinical trials that only include selected subpopulations of patients[10]. Other studies reject the hardening hypothesis[10, 18–23] and suggest that smokers could be softening instead[10, 11, 24]. Most of these studies have used data from one country at a time, except for two studies that have addressed this question jointly in several European countries together with the US[10, 11]; however, none has systematically addressed this question across all 28 EU MS. The EU provides a suitable context to explore this question, as there have been substantial declines in smoking prevalence over the past ten years, in a background of common regulations[4], but also considerable variation among MS.

The aims of this study were to empirically evaluate whether the hardening hypothesis can be confirmed at the population level in the 28 EU MS, and to analyse the determinants of hardcore and light smoking considering both individual and contextual country-level characteristics.

## **METHODS**

We conducted a study in the 28 EU MS by performing two separate analyses, one with individual and contextual data and one with ecological data. We used data on smoking from waves 72.3 (2009), 77.1 (2012), 82.4 (2014) and 87.1 (2017) of the Eurobarometer survey[25–28]. The Eurobarometer is a cross-sectional study of representative samples of the adult population ( $\geq 15$  years old) conducted by the European Commission. The fieldwork was conducted in October 2009 (n=27,788), February–March 2012 (n=26,751), November–December 2014 (n=27,801) and March 2017 (n=27,901). Samples are independently selected in each wave. Each Eurobarometer survey uses a random, multi-stage sampling method and post-stratification sample weighting is applied independently in each wave. As a result, samples are representative of the population by age, sex and area of residence, both at a country and at the EU level.

### **Data sources and variables**

#### Tobacco consumption

Smoking prevalence was estimated from respondents answering, “I currently smoke” to the question “Regarding smoking cigarettes, cigarillos, cigars or a pipe which of the following applies to you?” Smoking prevalence in 2009 was obtained from the proportion of respondents who gave the answer “I smoke at the present time” to the same question. We also calculated the prevalence of former and never smokers using the proportion of respondents that answered, “I used to smoke but now I have stopped” and “I have never smoked” respectively.

All smokers were also asked to report whether they smoke manufactured and roll-your-own cigarettes daily or occasionally; how many cigarettes they smoke per day (cpd), and whether they had ever tried to quit (“yes, in the last 12 months”, “more than a year ago” or “no, never”).

“Hardcore smokers” were defined as 1) current smokers, 2) who smoked manufactured cigarettes or roll-your-own daily, 3) who smoked on average at least 15 cpd and 4) who reported not having made any quit attempt in the last 12 months. There is no universally accepted definition of hardcore smokers[15]; therefore we conducted a sensitivity analysis including an additional criterion to our definition: age  $\geq 26$  years as younger smokers may not have reached a stable level of average daily consumption or solidified their intentions regarding quitting[12, 24]. This criterion reflects the assumption that younger smokers may not have reached a stable level of average daily consumption[24, 29]. We defined “light smokers” as occasional or daily current smokers who reported smoking less than 5 cpd[30].

### Tobacco control policies

The Tobacco Control Scale (TCS, [www.tobaccocontrolscale.org](http://www.tobaccocontrolscale.org)) is a scoring system developed by a panel of experts to quantify the national-level implementation of tobacco control policies. The six components of the TCS are: price (30 points), public place bans (22 points), public information campaigns spending (15 points), advertising bans (13 points), health warnings (10 points) and treatment (10 points). The score increases with the strength of tobacco control policies up to a possible maximum of 100 points, indicating a full implementation for all strategies considered. For each year, we used the most recent TCS report published before the year of the survey (TCS for 2007, 2010, 2013, and 2016).

### Gross-Domestic Product per capita

We obtained the Gross-Domestic Product (GDP) per capita in 2009, 2012, 2014 and 2017 from the Eurostat which is the official statistical office of the EU[31].

### Socio-demographic data

We also used information about sex (male, female), age (15-24, 25-34, 35-44, 45-54, 55-64 and  $\geq 65$  years), difficulties to pay the bills in the last 12 months (most of the time, from time to time and almost never or never), age when they stopped full-time education (up to 15, 16-19, 20 years or more), marital status (married, single, divorced and other), and type of community (rural area, small-middle town and large town) as collected by Eurobarometer.

### **Statistical analysis**

We calculated the age- and sex-standardized prevalence of current, former, never, hardcore and light smokers in each EU MS (2009, 2012, 2014 and 2017) by means of the direct method of standardization using the European population of 2013 as the standard population.

Time-trends of standardized prevalence of smoking status (never, former, current, hardcore and light smokers) separately by each EU MS were graphically described (2009-2017).

We conducted an ecological analysis with the country as the unit of analysis to assess the association between the relative change in the prevalence of hardcore or light smokers among current smokers (dependent variables) and the relative change in smoking prevalence (independent variable) from 2009 to 2017. We conducted an analysis in the total population, and by sex, by means of scatter-plots and Spearman rank-correlation coefficients with the corresponding 95% confidence intervals (CI). The relative change was calculated as a percentage of the prevalence in the earlier period. We used relative and not absolute change to account for the baseline differences between EU MS.

We conducted a panel-data fixed-effects linear regression analysis both in the total population and stratified by sex with the proportion of hardcore smokers among current smokers as the

dependent variable and smoking prevalence as the main independent variable to investigate how the percentage of hardcore smokers in relation to the smoking prevalence. We adjusted the panel-data regression for time to account for underlying trends and the total TCS score of each EU MS. GDP per capita was not included in the model as it did not improve the fit of the model. The fixed-effects specification accounts for time-invariant unobserved factors within each country[32].

We conducted a multilevel logistic regression analysis with two levels of analysis (individual-country) to account for clustering of observations within countries to assess the association of being a hardcore or a light smoker (dependent variable) with time (continuous variable, by calendar year) age, sex, difficulties to pay the bills, marital status, education and type of community (independent variables) adjusting for TCS score (per 10 points change) and GDP per capita (per €1,000 change). We used Akaike and Bayesian information criterion (AIC and BIC) to determine the optimal specification of the logistic regression model. We observed a statistically significant effect-modification between time and education for hardcore smokers and between time and sex for light smokers and, therefore, we stratified the analysis by education and sex, respectively.

A sensitivity analysis was conducted with the alternative definition of hardcore smokers using age  $\geq 26$  years old for the main analyses.

## RESULTS

Our sample had 29,010 current smokers (26.6%) from which 43.8% were hard-smokers and 14.7% were light smokers across the four waves of the Eurobarometer surveys. By age group, young smokers (15-24 years old) had the lowest rate of hardcore smokers (27.2%), whilst middle-aged smokers (45-54 years old) had the highest (50.6%) (Table S1).

In the EU, as a whole, age- and sex-standardized smoking prevalence decreased from 28.7% in 2009 to a 26.5% in 2017, while hardcore smoking increased from 36.7% to 41.6% and light smoking decreased from 19.2% to 16.9% among current smokers (Figure 1). In most countries where the prevalence of hardcore smokers has decreased, light smokers have increased and vice versa, although there was variation among MS (Figures 1 and 2).

At the ecological level, we explored the association between the relative change in hardcore and light smoking prevalence among current smokers, and the relative change in smoking prevalence from 2009 to 2017. A decreasing smoking prevalence was associated with a decreasing proportion of hardcore smokers among all current smokers ( $r_{sp}=0.432$ ,  $p=0.019$ , Fig 3; men:  $r_{sp}=0.270$ ,  $p=0.158$ ; women:  $r_{sp}=0.366$ ,  $p=0.051$ ) and an increasing prevalence of light smokers ( $r_{sp}=-0.334$ ,  $p=0.076$ , Fig 3; men:  $r_{sp}=-0.289$ ,  $p=0.128$ ; women:  $r_{sp}=-0.044$ ,  $p=0.819$ ).

The sensitivity analysis with the alternative definition of hardcore smokers showed a correlation in the same direction ( $r_{sp}=0.253$ ,  $p=0.185$ ) although it did not reach statistical significance.

The panel-data regression analysis showed that per each additional percentage point in smoking prevalence, the prevalence of hardcore smoking increased by 0.55 percentage points (0.32 percentage points in men and 0.72 in women). The prevalence of light smokers decreased by 0.26 percentage points for each percentage point increase in overall smoking prevalence, adjusting for time and TCS scores (Table 1). The sensitivity analysis showed similar results with an increase of 0.29 percentage points in the prevalence of hardcore smokers per each additional percentage point in the prevalence of smoking in the general population, although the association was not statistically significant.

**Table 1** Panel-data linear regression analysis for hardcore and light smoking prevalence as a function of smoking prevalence, time (year), TCS and GDP. Overall and stratified by sex analyses are presented. change in smoking prevalence total and by sex.

	Hardcore smoking			Light smoking		
	1 year change			1 year change		
	$\beta$	95% CI		$\beta$	95% CI	
<b>Total</b>						
Smoking prevalence	<b>0.550</b>	0.137	0.963	<b>-0.297</b>	-0.547	-0.044
Year	<b>0.664</b>	0.277	1.052	-0.084	-0.322	0.153
TCS	-0.222	-0.495	0.051	0.149	-0.018	0.317
<b>Men</b>						
Smoking prevalence	0.320	-0.092	0.732	-0.176	-0.434	0.082
Year	<b>0.616</b>	0.123	1.109	-0.039	-0.348	0.270
TCS	-0.158	-0.499	0.184	0.184	-0.031	0.398
<b>Women</b>						
Smoking prevalence	<b>0.717</b>	0.162	1.273	-0.164	-0.607	0.279
Year	<b>0.627</b>	0.105	1.149	<b>-0.035</b>	-0.451	0.381
TCS	-0.251	-0.633	0.131	0.070	-0.235	0.374

The multilevel logistic regression analysis showed a significant interaction between time (by calendar year) and education when assessing hardcore smoking as the dependent variable and between time and sex when analysing light smoking as the dependent variable. Therefore, all analyses are presented stratified by education level and sex, respectively.

As shown in Table 2, the odds of being a hardcore smoker increased over time among all education groups. Middle-aged individuals (35 to 64 years old) were the most likely to be hardcore smokers. Among the highest-educated groups, we observed that individuals having some or many difficulties paying the bills had also higher odds of being hardcore smokers. Finally, among individuals who stopped full-time education when they were 20 or older, being divorced, separated or widowed also increased the odds of hardcore smoking. Conversely, odds of hardcore smoking were lower for women compared to men in all groups and, in the lower-



educated group, it also decreased among residents of countries with a higher TCS score (OR=0.88, 0.81 to 0.95). The sensitivity analysis showed that the odds of hardcore smoking did not increase over time in any group, but it showed similar results for age, sex and difficulties to pay bills.

The odds of being a light smoker did not significantly change over time among men and declined over time among women (OR=0.98, 0.96 to 0.99). Consistent to the findings about hardcore smoking, middle-aged individuals and those having difficulties to pay bills had lower odds of being light smokers. Men and women with higher education were more likely to be light smokers compared to those with low or no formal education. In men, the odds of being a light smoker were also higher in countries with a higher GDP and higher TCS scores (Table 2).

**Table 2** Multilevel logistic regression analysis stratified by age when stopped full-time education for hardcore smoking and by sex for light smoking. Note: p<0.05 are bold.

	Hardcore smoking						Light smoking								
	Up to 15 years			16-19 years			20+ years			Men			Women		
	OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
<b>Time</b>	<b>1.04</b>	1.02	1.07	<b>1.03</b>	1.02	1.05	<b>1.02</b>	1.01	1.03	1.00	0.98	1.02	<b>0.98</b>	0.96	0.99
<b>Age</b>															
15-24	1			1			1			1			1		
25-34	1.29	0.94	1.77	<b>1.80</b>	1.57	2.07	<b>1.70</b>	1.54	1.88	<b>0.62</b>	0.51	0.75	<b>0.68</b>	0.57	0.81
35-44	<b>1.49</b>	1.10	2.03	<b>2.26</b>	1.97	2.59	<b>2.30</b>	2.08	2.55	<b>0.47</b>	0.39	0.58	<b>0.56</b>	0.47	0.67
45-54	<b>1.62</b>	1.20	2.19	<b>2.50</b>	2.17	2.87	<b>2.72</b>	2.45	3.01	<b>0.44</b>	0.36	0.55	<b>0.57</b>	0.47	0.68
55-64	<b>1.38</b>	1.02	1.86	<b>2.43</b>	2.10	2.82	<b>2.60</b>	2.34	2.90	<b>0.47</b>	0.38	0.58	<b>0.55</b>	0.45	0.66
65+	1.01	0.74	1.38	<b>1.64</b>	1.38	1.95	<b>1.93</b>	1.71	2.17	<b>0.71</b>	0.56	0.89	<b>0.65</b>	0.52	0.81
<b>Sex</b>															
Men	1			1			1								
Women	<b>0.56</b>	0.49	0.63	<b>0.48</b>	0.45	0.52	<b>0.50</b>	0.48	0.53						
<b>Difficulties paying bills</b>															
Almost never or never	1			1			1			1			1		
From time to time	1.13	0.97	1.31	<b>1.32</b>	1.17	1.37	<b>1.23</b>	1.16	1.31	<b>0.68</b>	0.59	0.77	<b>0.74</b>	0.67	0.83
Most of the time	1.11	0.94	1.32	<b>1.25</b>	1.06	1.30	<b>1.23</b>	1.14	1.32	<b>0.70</b>	0.59	0.84	<b>0.59</b>	0.51	0.68
<b>Marital status</b>															
Married	1			1			1			1			1		
Single	1.03	0.85	1.24	0.92	0.84	1.02	0.96	0.89	1.03	1.06	0.92	1.21	1.03	0.90	1.17
Divorced	1.10	0.94	1.30	1.10	0.99	1.21	<b>1.12</b>	1.04	1.21	0.84	0.70	1.01	0.94	0.83	1.07
Others	1.38	0.68	2.80	0.85	0.58	1.24	0.79	0.60	1.03	0.85	0.52	1.40	1.03	0.60	1.78
<b>Years of education</b>															
Up to 15 years										1			1		
16-19 years										1.17	0.98	1.39	1.13	0.97	1.31
20+years										<b>1.83</b>	1.52	2.21	<b>1.74</b>	1.48	2.04
<b>Type of community</b>															
Rural area or village	1			1			1			1			1		
Small or middle town	1.07	0.93	1.24	0.98	0.90	1.06	0.99	0.93	1.05	1.00	0.88	1.14	1.01	0.90	1.13
Large town	1.11	0.95	1.31	1.05	0.96	1.15	0.99	0.93	1.06	1.05	0.91	1.21	1.04	0.92	1.17
<b>GDP (€1,000)</b>	1.00	0.99	1.01	1.00	0.99	1.01	1.00	0.99	1.00	<b>1.01</b>	1.00	1.02	1.00	0.99	1.01
<b>TCS (10 points)</b>	<b>0.88</b>	0.81	0.95	0.97	0.92	1.03	<b>0.92</b>	0.84	1.00	<b>1.08</b>	1.00	1.17	1.04	0.97	1.12

## DISCUSSION

## **Main results**

Our study shows that the hardcore smoking prevalence is not increasing in those EU MS where the smoking prevalence is declining and that, contrarily to the “hardening hypothesis”, is the prevalence of light smoking the one increasing. Moreover, our findings show that the odds of being a hardcore smoker are higher among middle-aged men whom had difficulties to pay the bills in the last 12 months and lower in countries with a stronger tobacco control policies. Hardcore smoking was also associated with marital status and education.

## **Interpretation of the results**

The smoking prevalence has decreased overall over time in the EU; however, in some countries it has increased (for example, in France and Croatia)[6]. In these countries, the prevalence of hardcore smokers has also increased except for Latvia, where the prevalence increases in young cohorts (and mainly in women) who are less likely to become hardcore smokers at short-term. Our results suggest that, despite an overall increase of the hardcore smoking prevalence, smokers in the EU are not hardening since hardcore smoking is decreasing and not increasing for each percentage point decrease in the smoking prevalence. These results are in line with previous cross-sectional studies conducted in Europe that conclude that the smoking prevalence was correlated to a higher heavy smoking index (HSI) and number of cigarettes smoked per day[10, 11].

European countries are at different stages of the tobacco epidemic based on the comparative levels of smoking prevalence and smoking-attributed mortality in men and women[33]. Most Eastern European countries are at stage 3 that involves a flattening or downturn of men smoking prevalence with some convergence of smoking prevalence in both sexes and a steep increase of deaths attributable to smoking; with the rest of countries at late stages 3 and 4 where, although prevalence is decreasing, smoking-attributable mortality continue to rise . Hereto, our analysis was stratified by sex to account for such differences as Gallus et al. suggested that countries at an earlier stage of the epidemic had a relatively high male-to-female smoking prevalence ratio[34]. Our findings showed that in women the relation between an increased smoking prevalence and a higher hardcore smoking prevalence was stronger than in men despite the fact that women are already at advanced stages of the epidemic in high-income countries, and even though the uptake of smoking among women is generally delayed compared to men[33]. Consistently, Fernandez et al. observed that the relation between dependence and smoking prevalence was higher in women[10].

Despite an overall increase in the prevalence of hardcore smokers, our findings do not support the hardening hypothesis in the EU at a population-level. Instead, the increase of light smoking among smokers implies a softening of the smoking population. This softening of the smoking population suggests that current tobacco control policies (such as smoke-free policies, tobacco

taxation and advertising bans) have been effective not only in motivating light smokers to quit smoking, but also influencing hardcore smokers to quit smoking or to reduce their daily cigarette consumption[6, 11, 24]. Other explanations could be that social denormalisation of smoking over time has fuelled quitting across the smoking population[24], or that light smokers, which are less addicted to nicotine, continue to smoke because of psycho-social factors rather than a physical addiction[10].

In addition, at an individual level, our findings suggest that the odds of hardcore smoking in the EU have increased over time after adjusting for socio-demographic and environmental factors; however, these results have not accounted for the changes in smoking prevalence, therefore should not be interpreted as evidence suggesting hardening[35].

Both hardcore and light smoking are associated with tobacco control policies as the stronger its implementation, the lower the odds of hardcore smoking. Our results are consistent with a previous study conducted also in the EU that concluded that higher tobacco control efforts are correlated with higher quit ratios (% former smokers over ever-smokers)[6]. Disaggregating the effects of individual tobacco control policies was beyond the scope of this analysis, but future analyses could provide more insight into the issue.

Moreover, hardcore and light smoking can be associated to individual socioeconomic and demographic characteristics. Hardcore smoking was more prevalent among men, 35 to 64 years-old, lower educated groups and individuals with more difficulties to pay bills. Conversely, light smoking was more frequent in women and high educated individuals. These results are consistent with previous studies which also observed that smokers today belong to more deprived population groups than in the past[29, 36]. Therefore, regardless of whether the population of smokers is hardening or not, the social gradient in heavy smoking highlights the socioeconomic inequalities and the increased burden of smoking related diseases among people in low socioeconomic groups[37]. To increase health equity, tobacco control policies should tailor subgroups of heavy smokers (including, social deprived and psychiatric distressed smokers[38]) to succeed to continue softening the population of smokers. **Limitations and strengths**

While we analysed data from 28 EU MS that allowed us to detect time trends across the EU, our ecological analyses were essentially based on a relatively small sample. EU MS differ in several social, cultural, and other factors such as the stage of the tobacco epidemic[33]. Our efforts to account for differences across countries included stratifying analyses by sex since countries at an earlier stage of the epidemic present a higher male-to-female smoking prevalence ratio[34], as well as using a fixed-effects specification for our panel regression to control for unobserved country-level factors that may influence the results.

Our study might have overestimated the prevalence of hardcore smokers compared to previous studies, as we could not include a measure of nicotine dependence [39,40] nor long-term smoking history (being a smoker for at least 5-years) of current smokers that are frequently used criteria as the Eurobarometer survey did not record this information in all four waves. However, to account for this possible limitation we conducted a sensitivity analysis including only smokers at least 26 years old[24, 29]. Moreover, we used secondary data from the smoking supplement of the Eurobarometer that is a periodic survey to monitor smoking indicators in the EU but lacks detailed information on other participant's characteristics, including factors potentially related to smoking and quit attempts. The use of self-reported data from questionnaires could be a source of bias, although self-reports on smoking status have acceptable validity[41].

Our study is the first to systematically approach the hardening hypothesis in all the EU MS, which are subject to common regulations, and, to introduce a longitudinal perspective to this approach, including data from four cross-sectional surveys with consistent methods across countries and over time.

## **CONCLUSION**

In conclusion, our study does not support the “hardening hypothesis” in the EU between 2009 and 2017, but rather suggests a softening of the smoking population over this period. These findings indicate that existing tobacco control policies may be suitable to further decrease smoking prevalence in Europe as we gradually move toward endgame strategies. However, social inequalities in heavy smoking underline the need for tailored interventions targeting smokers in vulnerable socioeconomic groups who may find it more difficult to quit or reduce smoking[35, 36].

**Contributors** Study design: AF, FF and EF. Collected data and prepared database for analysis: AF and FF. Contributed to strategy of analysis: AF, FF and EF. Analysed data: AF. Interpreted data results: AF, FF, CM and EF. Drafted manuscript: AF. Critically revised manuscript: All authors. Approved final manuscript version: All authors. Guarantor: EF and FF.

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## SUPPLEMENTARY TABLES AND FIGURES

**Table S1** Descriptive analysis of the percentage of hardcore and light smokers among the sample in total and by age, sex, difficulties to pay the bills, marital status, age when stopped full-time education and type of community.

	Current smokers				
	Total	Hardcore smokers		Light smokers	
	(N=112,745)	N	Freq. (%)	N	Freq. (%)
Total	29,010	12,711	43.82%	4,265	14.70%
Age					
15-24	3,513	954	27.16%	815	23.20%
25-34	5,558	2,224	40.01%	873	15.71%
35-44	5,984	2,803	46.84%	758	12.67%
45-54	6,067	3,069	50.59%	742	12.23%
55-64	4,854	2,396	49.36%	598	12.32%
65+	3,034	1,265	41.69%	479	15.79%
Sex					
Men	15,577	7,871	50.53%	1,731	11.11%
Women	13,433	4,840	36.03%	2,534	18.86%
Difficulties to pay bills					
Low	4,935	2,373	48.09%	521	10.56%
Middle-Low	9,408	4,399	46.76%	1,167	12.40%
Middle-High	14,185	5,732	40.41%	2,506	17.67%
Marital status					
Married <sup>1</sup>	17,647	8,060	45.67%	2,426	13.75%
Single	6,283	2,377	37.83%	1,127	17.94%
Divorced <sup>2</sup>	4,662	2,151	46.14%	634	13.60%
Other	368	103	27.99%	73	19.84%
Age when stopped full-time education					
Up to 15 years	4,589	2,319	50.53%	483	10.53%
16 to 19 years	15,490	7,218	46.60%	1,960	12.65%
20+ years	7,573	2,792	36.87%	1,502	19.83%
Type of community					
Rural area or village	9,283	4,147	44.67%	1,291	13.91%
Small-middle town	10,756	4,540	42.21%	1,639	15.24%
Large town	8,927	3,995	44.75%	1,331	14.91%

<sup>1</sup>Or living with a partner

<sup>2</sup>Or separated or widow

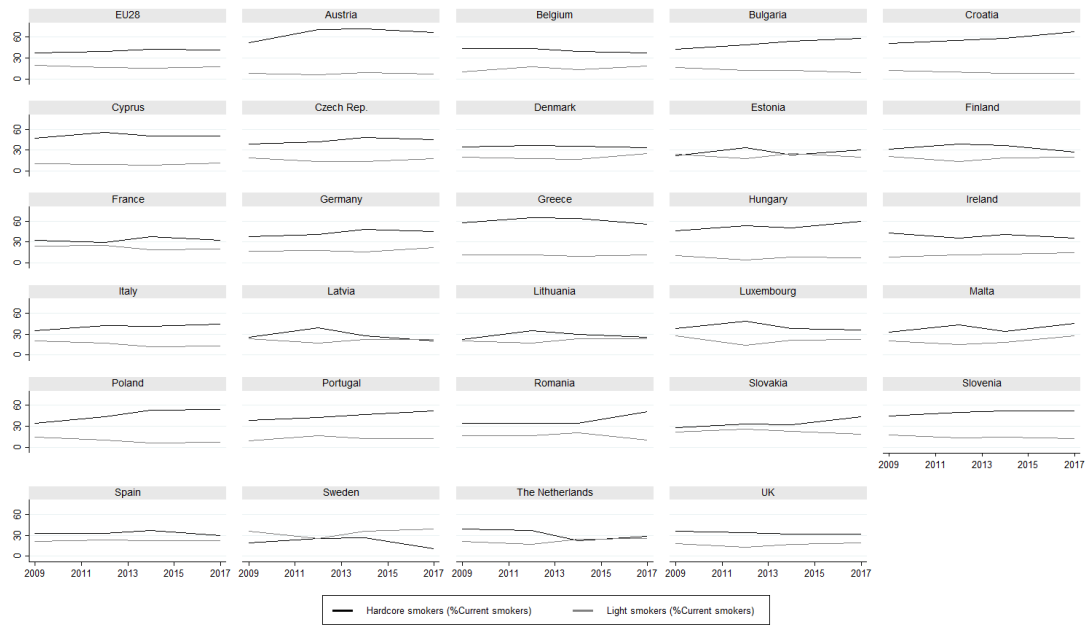


Figure 1 Time-trends of current, former and never smokers' prevalence among the population in the 28 EU MS from 2009 to 2017.

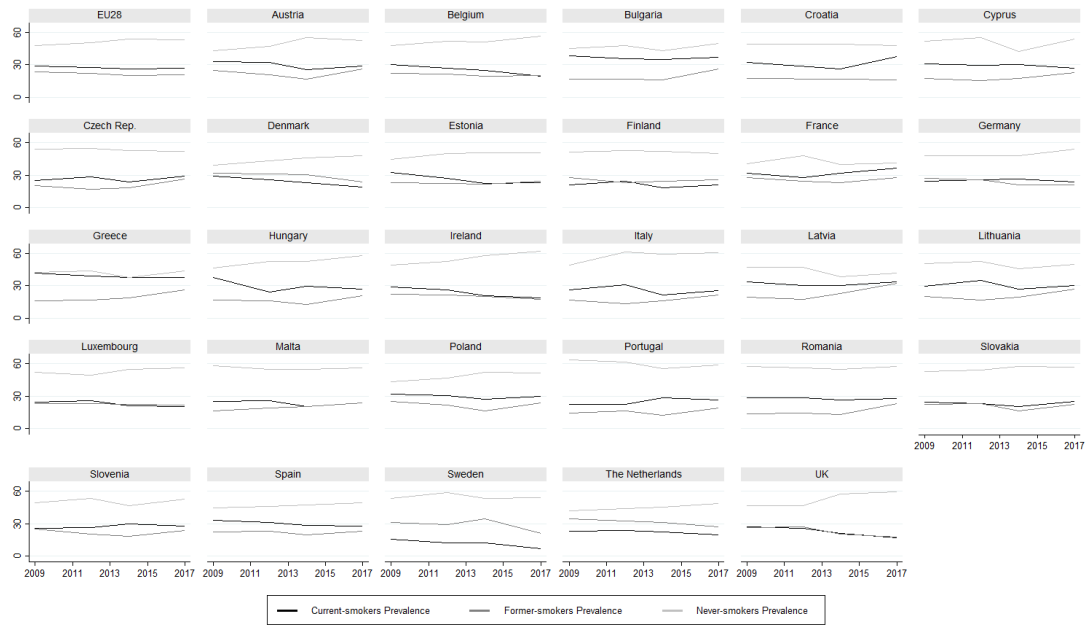


Figure 2 Time-trends of hardcore and light smoking prevalence among current smokers in the 28 EU MS from 2009 to 2017.

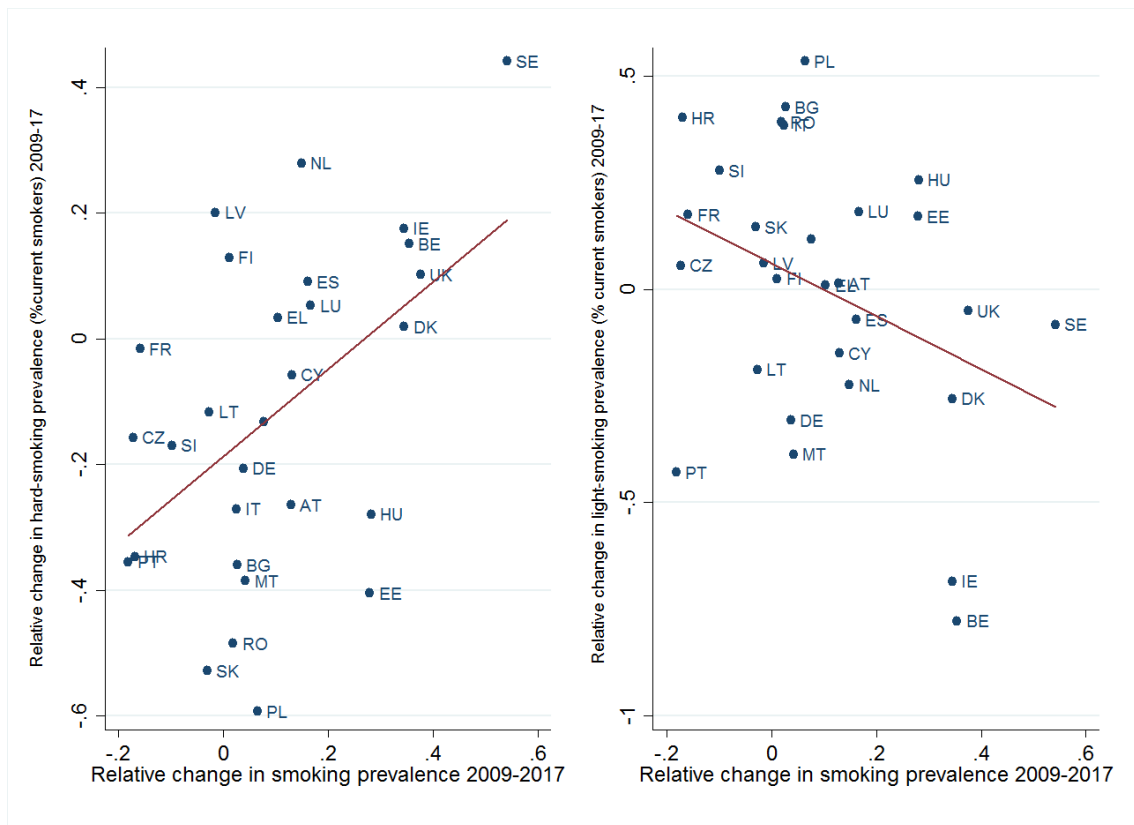


Figure 3 Correlation between changes in relative hardcore smoking prevalence among current smokers and in smoking prevalence from 2009 to 2017 (left) and the correlation between relative changes in light smoking prevalence among current smokers and in smoking prevalence from 2009 to 2017 (right). Prevalence relative changes were calculated as a percentage of the prevalence in the earlier period. Note: Fitted values (line). Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Cyprus (CY), Czech Rep. (CZ), Denmark (DE), Estonia (EE), Finland (FI), France (FR), Greece (EL), Hungary (HU), Ireland (IE), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Malta (MT), Poland (PL), Portugal (PT), Romania (RO), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE), The Netherlands (NL), Germany (DE) and United Kingdom (UK).