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Impact of tobacco control policies on socioeconomic inequalities in smoking prevalence and quit ratios: an ecological study in the European Union (2009–2020)

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ABSTRACT

Background Tobacco control efforts have succeeded in reducing smoking prevalence and increasing smoking cessation rates in the European Union Member States (EU27). However, the impact of these policies has been unequal across different income groups.

Methods Ecological study with the country as unit of analysis. We used the Tobacco Control Scale (TCS) in EU27 in 2010 and the prevalence of smoking and quit ratios from the Eurobarometer surveys (2009, n=27 788; and 2020, n=28 288). We analysed the relationship between the TCS scores (2010) and smoking indicators and their relative changes (between 2009 and 2020) using scatter plots and multiple linear regression models.

Findings In the EU27, high inequalities exist among different income groups. High-income residents had lower smoking prevalence (19 vs 40%) and higher quit ratios (55 vs 32%) compared with the low-income group. Positive changes in smoking indicators from 2009 to 2020 were stronger in the high-income group. There was a stronger negative correlation between TCS scores and smoking prevalence in high-income groups ($r_{sp}=-0.615$, p<0.01; $r_{sp}=-0.498$; p=0.01) and between its relative changes but only in the high-income group ($r_{sp}=-0.478$; p=0.01). A positive correlation was observed between TCS scores and quit ratios ($r_{sp}=0.580$, $r_{sp}=0.548$, both p<0.01) in high- and moderate-income populations.

Conclusions Declines in smoking prevalence and increases in quit ratios were considerably lower in moderate- and low-income groups. Tailoring tobacco control policies to address financial, social and structural barriers, such as ensuring free access to cessation services, implementing targeted outreach programmes, adopting culturally and linguistically appropriate interventions, among others, is essential for making these measures more equitable, which is key for the EU27 to achieve its tobacco-free goal by 2040.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Implementation of comprehensive, evidence-based tobacco control policies has successfully contributed to reducing tobacco-related health burden. Yet, despite an overall drop in smoking prevalence, many high-income countries have seen the emergence of significant social inequalities in tobacco use. Few studies have assessed how country-level policies impact on smoking prevalence and quit ratios across socioeconomic groups. Previous studies have addressed this topic by assessing the equity impact of interventions at the individual level and not with a cross-national perspective, which our study is the first to offer.

WHAT THIS STUDY ADDS

⇒ This study uses population-based secondary data from the Special Eurobarometer waves 72.3 (2009) and 93.2 (2020) and the Tobacco Control Scale report from 2010. Unlike previous research, this ecological study reports data at the country level rather than at the individual level, providing findings directly relevant to EU Member States (MS). It helps identify which tobacco control policies contribute to increasing inequalities and assist EU MS' governments in reducing social inequalities in tobacco use to ensure no one is left behind while moving towards a tobacco-free future.

INTRODUCTION

Tobacco smoking remains a major public health problem. The WHO Framework Convention on Tobacco Control[1] established tobacco control as a global public health priority. In 2008, the WHO introduced a package of six evidence-based tobacco control demand reduction multifaceted interventions known as the MPOWER strategy, which has proven to reduce tobacco use.[2][3] The European Union (EU) and its Member States (MS), as parties to this treaty, have made substantial progress in implementing evidence-based tobacco control measures

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HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Tobacco control policies have had a differential impact across gender and income groups in the EU, unintentionally exacerbating health inequalities in the region. Our findings highlight the need for governments to implement policies that are both income- and gender-responsive to promote health equity in smoking. Further research is essential to better understand the specific challenges these groups face, enabling the design of tailored interventions to address their needs. Ensuring inclusive and equitable policies is essential to achieving a smoke-free Europe.

over the past decades.[4] However, the implementation of tobacco control policies varies widely across EU MS,[5] including differences in policy strength, timing of implementation and enforcement.[6]

Comprehensive tobacco control policies, such as tobacco taxation, smoke-free laws, advertising bans, labelling and health warnings, and access to cessation support, have proven successful in reducing smoking prevalence and tobacco-attributable disease burden across EU MS,[7] with a greater decline in high-income countries with stronger regulatory frameworks. Yet, despite the overall declines in tobacco use, income-based disparities in smoking have increased.[8] Tobacco consumption remains disproportionately high among individuals with middle- and low-socioeconomic status (SES) in the EU[9] compared with high-SES groups. Relative inequalities have widened in recent years and are projected to continue increasing. For example, Teshima *et al*[10] reported that smoking rates in EU MS were twice as high among individuals facing financial difficulties. Therefore, accelerating the decline of smoking across all population groups should remain a priority in Europe.[6]

Consequently, it has been hypothesised that although population-based tobacco control policies have been effective in reducing overall smoking prevalence, they may have inadvertently contributed to exacerbating social inequalities in tobacco use. However, their impact on socioeconomic inequalities in smoking varies depending on the specific intervention. Indeed, taxation is the only intervention consistently shown to have an equity-positive impact.[9] While previous studies have demonstrated that comprehensive tobacco control policies reduce smoking prevention and increase quit ratios in EU MS over time,[11 12] little is known about their differential impact on smoking indicators across SES. Understanding the equity impact of these policies is therefore crucial for minimising unintended consequences and promoting health equity.[13] Hence, the aim of this study was to evaluate the differential association between tobacco control policy implementation levels and smoking prevalence and quit ratios in 27 EU MS over time (2009–2020) according to SES.

METHODS

Ecological study with the EU MS as the unit of analysis. We used the Tobacco Control Scale (TCS) by Joossens and Raw[14] to evaluate tobacco control policy implementation. Data from all EU MS, including the United Kingdom (UK), were used, except for Croatia. The TCS is a scale that systematically monitors tobacco control policy implementation level according to the most cost-effective policies every three years.[15] Data on smoking indicators and sociodemographic characteristics were obtained from waves 72.3 (2009)[16] and 93.2 (2020)[17] of the Special Eurobarometer on tobacco. The Eurobarometer is a cross-sectional study of a representative sample of the adult population (≥15 years old) conducted by the European Commission in all EU MS. The fieldwork was conducted in October 2009 (n=27 788) and August–September 2020 (n=28 288). The final samples were representative of the population aged 15 years and above in each country (about 1000 persons/year in each country, except for Cyprus, Luxembourg and Malta, with approximately 500 respondents). The sample was weighted for sociodemographic variables (sex, age, region and size of locality). The Eurobarometer sampling methods and sampling size are consistent across EU MS and in the different waves used, ensuring comparability.[18]

Variables
Smoking
Smoking prevalence was determined based on the proportion of adult respondents who answered 'I smoke at the present time' in 2009 and 'I currently smoke' in 2020 to the question: 'Regarding smoking cigarettes, cigars, cigarillos or a pipe, which of the following applies to you?'. We also calculated the prevalence of former smokers and never smokers using the proportion of respondents who answered 'I used to smoke but now I have stopped' and 'I have never smoked', respectively.

Smoking cessation
Quit ratios were calculated as the ratio of former smokers to the number of ever-smokers (current and former smokers). Ever-smokers included former smokers and respondents who answered 'I currently smoke' (2020)/'I smoke at the present time' (2009) in the preceding question.

Tobacco control policies
The TCS (www.tobaccocontrolscale.org) assesses the national-level implementation of tobacco control policies using a scoring system developed by a panel of experts. The scale was developed by means of a questionnaire sent to European Network for Smoking and Tobacco Prevention tobacco control focal points in participating EU MS. The six components of the TCS are: price (30 points), smoke-free policies (22 points), public spending per capita on tobacco control (15 points), tobacco advertising, promotion and sponsorship (TAPS) bans (13 points), health warnings (10 points)

and treatment (10 points) (online supplemental Table S1). The score of each of these six cost-effective policies is weighted according to its reported effectiveness, based on scientific evidence on tobacco control. The total score increases with the strength of tobacco control policies, with a maximum possible score of 100 points, indicating full implementation of all strategies considered.[14] For this study, we used data from the 2010 TCS report,[19] the first report published immediately after the start of our study period (2009), to allow for an adequate time window for policies to be effectively implemented and adopted by the population. The component 'tobacco control public spending' was excluded from our analysis due to missing data in 18 out of 27 EU MS. We used only the TCS scores from the 2010 report and not from the whole period because the scoring standards used to calculate each component changed over time, making the scores not comparable across years.[20]

Sociodemographic data

We used income as a proxy of SES, defined as a person's position within the social and economic structure of society, as it is a direct measure of financial conditions and is sensitive to inequalities.[21] For this purpose, we used the variable *difficulties paying bills in the last 12 months,* as previous studies have shown that individuals experiencing financial difficulties have higher odds of being hard-core smokers[22] and consistently bear a higher burden of smoking,[10] both key indicators of smoking-related health inequalities. Adult respondents who answered 'almost never', 'from time to time' and 'most of the time' to the question 'During the last twelve months, would you say you had difficulties to pay your bills at the end of the month…?' were classified into the high, moderate and low income, respectively. We also used information about sex (male and female) and age.

Statistical analysis

We weighted calculated age-standardised and sex-standardised prevalence of never, former and current smokers and quit ratios overall and by income groups in each EU MS in 2009 and 2020, using the direct method of standardisation with the European population of 2013 as the standard. Age-standardised rates and quit ratios by sex were also computed.

We mapped smoking prevalence and quit ratios in 2020, as well as relative changes in smoking prevalence and quit ratios between 2009–2020 across EU MS by income group. The relative change expresses the absolute change as a percentage of the indicator in the earlier period. We used relative rather than absolute change because baseline values of both indicators differed across EU MS.

We analysed the association between the TCS score in 2010 (total and by components) as independent variables and smoking prevalence rates and quit ratios in 2020 as dependent variables by means of scatter plots and Spearman rank correlation coefficients (r_{sp})

with corresponding 95% confidence intervals (CI). We considered this 10-year time lag sufficient to observe any effect of the tobacco control policies on smoking prevalence rates and quit ratios. Additionally, we examined the correlation between relative changes in smoking prevalence rates and quit ratios from 2009 to 2020.

The UK was excluded from the analysis of the relative changes in quit ratios as it was identified as an influential value, meaning it had a disproportionately large impact on the results, potentially distorting associations by either exaggerating or weakening them, which could lead to misleading conclusions.

All tests of statistical significance were two-sided, and p values less than 0.05 were considered statistically significant. Analyses were performed using Stata V.17.0, incorporating the weights provided in the Eurobarometer dataset to account for the complex survey design.

RESULTS

In 2020, smoking prevalence in the EU was 19.0% (16.1% to 22.3%) in the high-income population, 31.0% (25.0% to 37.7%) in the moderate-income population and 39.9% (28.9% to 52.2%) in the low-income population (figure 1A). The prevalence of current smokers in the EU decreased by 42.8%, 11.2% and 9.0%, respectively, from 2009 to 2020 (figure 1B).

The quit ratio was 55.0% (45.2% to 64.4%) in the high-income population, 39.0% (30.0% to 48.8%) in the moderate-income population and 32.1% (23.8% to 41.8%) in the low-income population. Smoking cessation rates in the EU showed an increasing trend in all population groups over the last decade (27.7%, 8.1% and 7.7%, respectively) (figure 2).

Association between smoking prevalence and tobacco control policy implementation

High-income group

In the high-income group of the EU population, there was a strong inverse association between the total TCS score in 2010 and the overall prevalence of smokers in 2020 (r_{sp}= −0.615; p value <0.001; figure 3A); as well as in both men (r_{sp}= −0.643; p value <0.001) and women (r_{sp}= −0.399; p value=0.040) (online supplemental Table S2). Among the different TCS components, higher scores on smoke-free policies (r_{sp}= −0.633; p<0.001), TAPS bans (r_{sp}= −0.397; p=0.040) and smoking cessation treatment (rsp= −0.435; p=0.023) exhibited stronger negative correlations with smoking prevalence rates in the EU in 2020 (online supplemental Table S2).

Regarding relative changes in smoking prevalence, we observed a moderate positive association with the TCS total scores in 2010 from 2009 to 2020 (r_{sp}= −0.478, 95% CI −0.726 to −0.119; p=0.012; figure 3B). Higher TCS scores and greater changes in the prevalence of current smokers were strongly correlated among men (r_{sp}= −0.479, p value=0.012), but not among women (online supplemental Table S2). By components, higher TCS
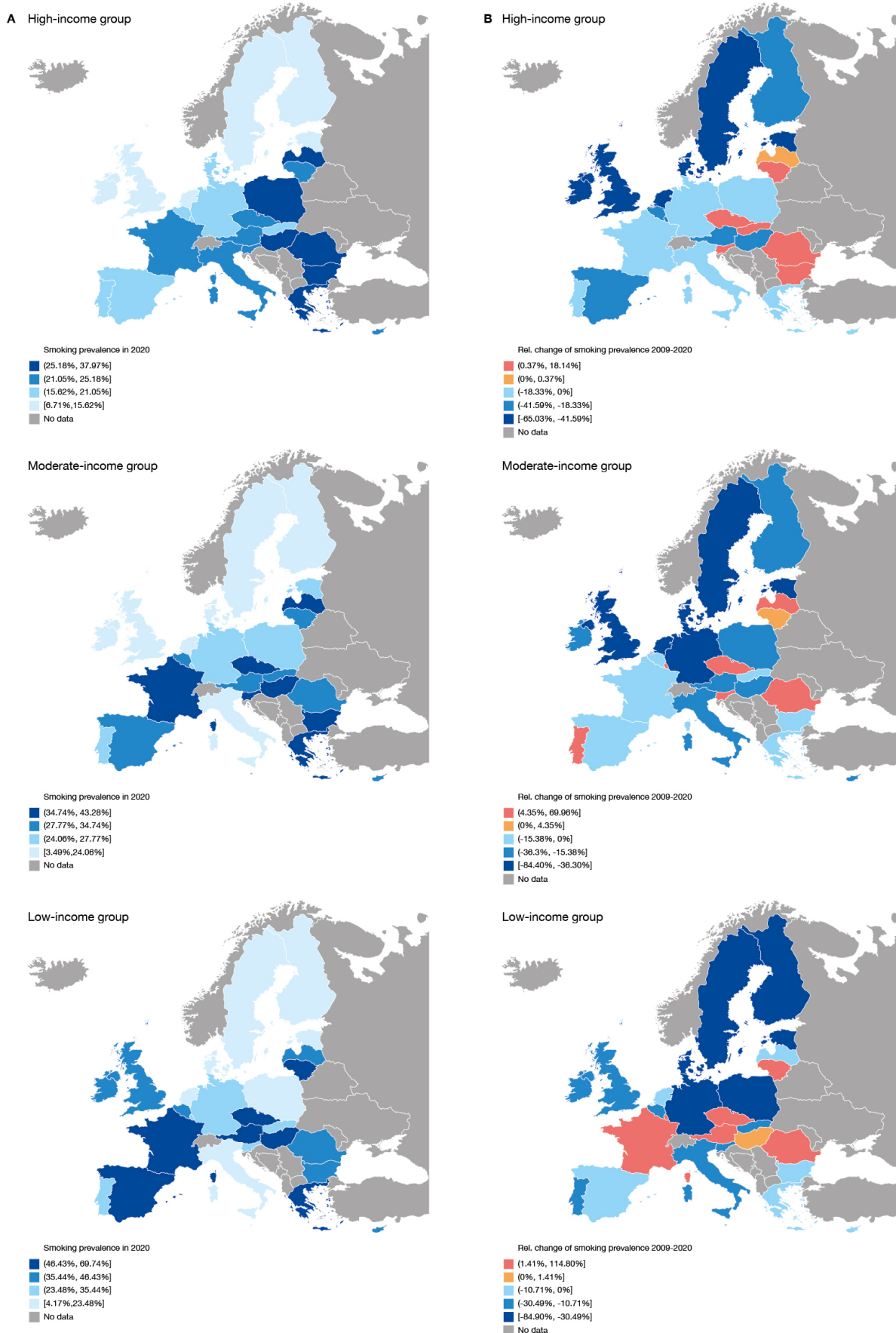
Figure 1 (A) Smoking prevalence in 2020 by income group and (B) relative change in smoking prevalence from 2009 to 2020 in the 27 European Union Member States (EU27). For relative changes, intervals have been determined by quartiles from 0%.
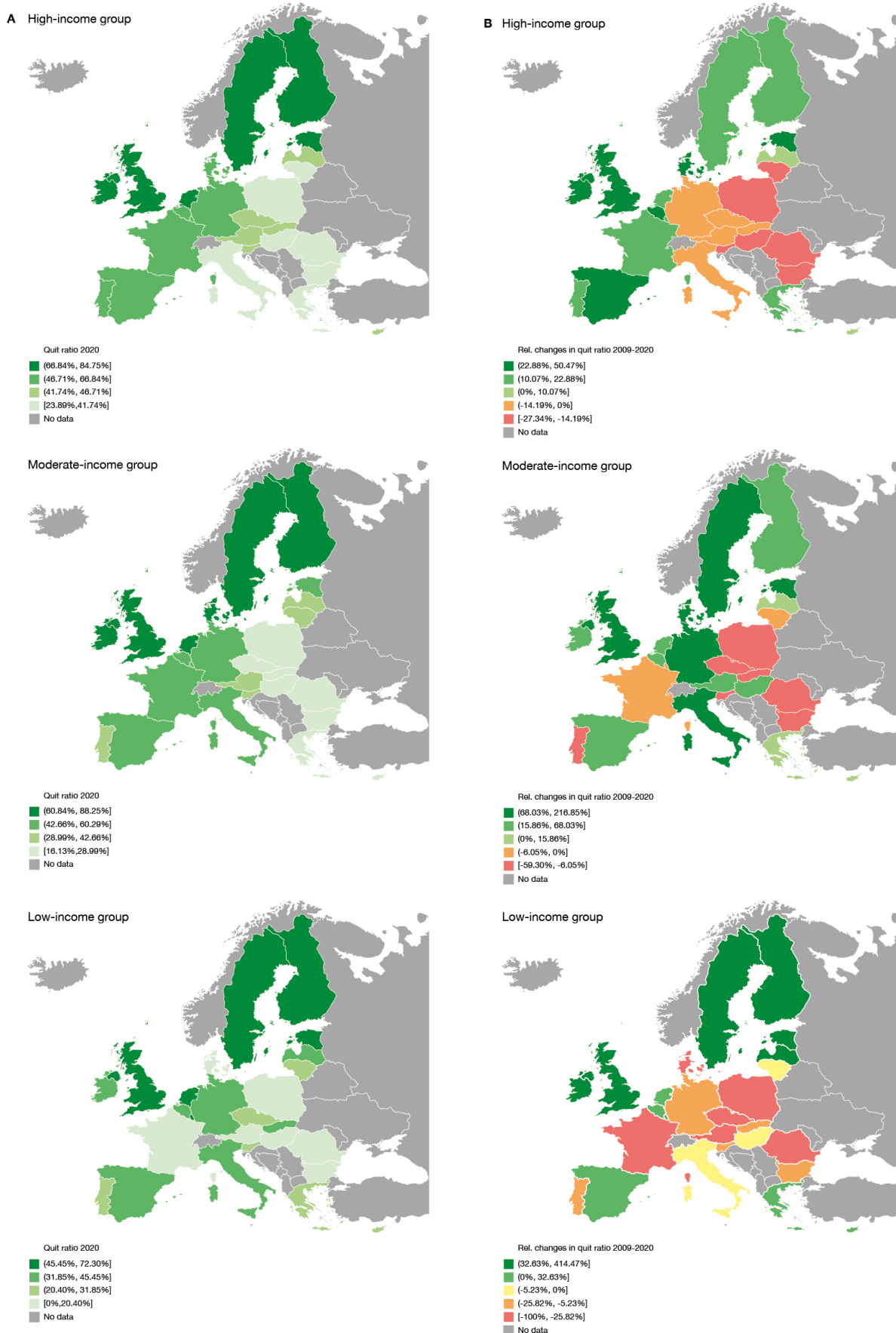
Figure 2 (A) Quit ratio in 2020 by income group and (B) relative change in quit ratio from 2009 to 2020 in the 27 European Union Member States (EU27). For relative changes, intervals have been determined by quartiles from 0%.
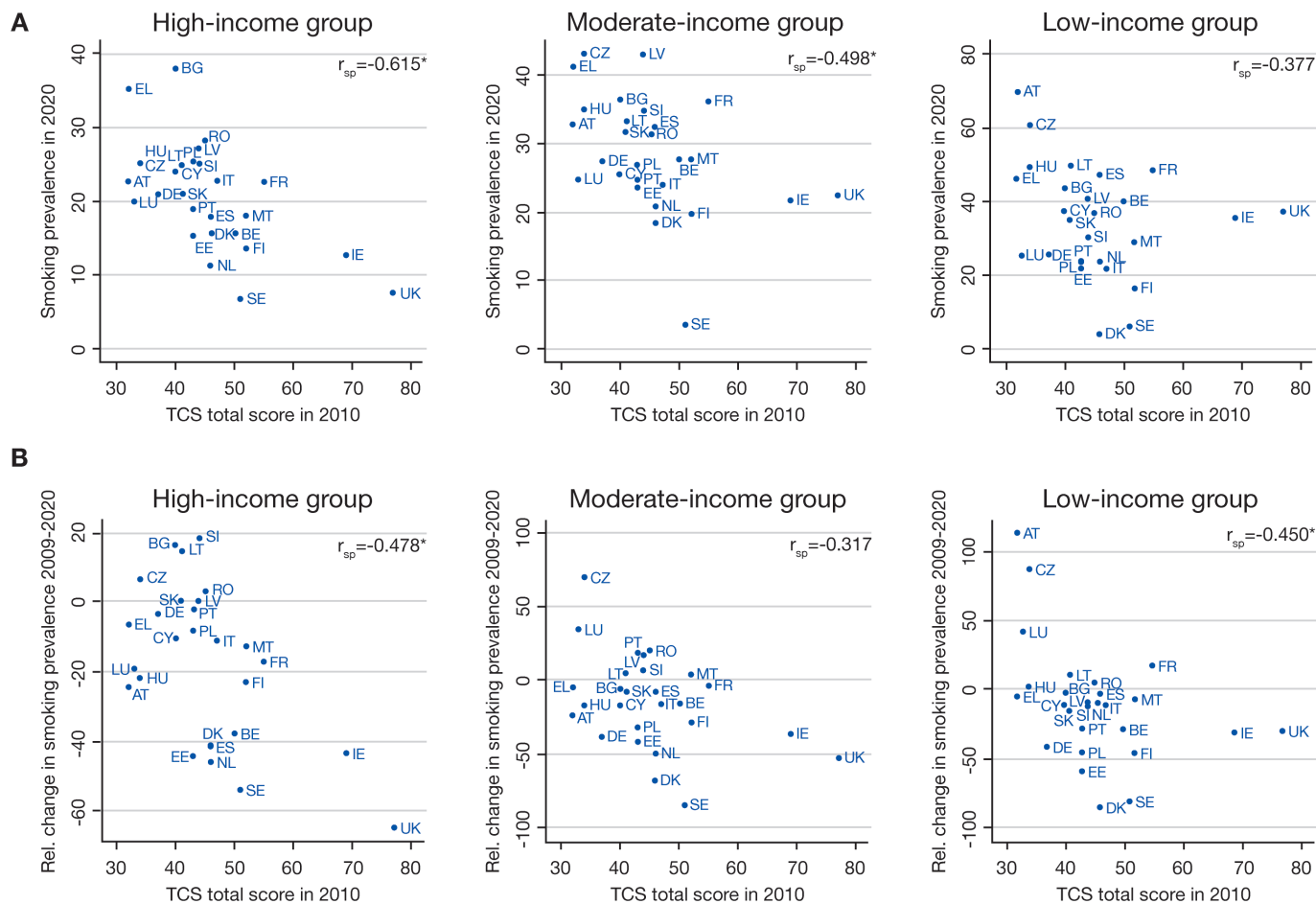
Figure 3 (A) Correlation between Tobacco Control Scale (TCS) total scores in 2010 and smoking prevalence in 2020 (top), and (B) correlation between TCS total scores in 2010 and the relative change in smoking prevalence between 2009 and 2020 (bottom) in the EU27, stratified by income group. *p<0.05. EU, European Union; r_{sp}, Spearman's rank correlation coefficient. AT, Austria; BE, Belgium; BG, Bulgaria; CY, Cyprus; CZ, Czechia; DE, Germany; DK, Denmark; EE, Estonia; EL, Greece; ES, Spain; FI, Finland; FR, France; HU, Hungary; IE, Ireland; IT, Italy; LT, Lithuania; LU, Luxembourg; LV, Latvia; MT, Malta; NL, Netherlands; PL, Poland; PT, Portugal; RO, Romania; SE, Sweden; SI, Slovenia; SK, Slovakia; UK, United Kingdom.

scores for smoke-free policies ($r_{sp}= -0.459$; p=0.016) and smoking cessation treatment ($r_{sp}=-0.418$; p=0.030) correlated with greater changes in smoking prevalence in the EU27 from 2009 to 2020 within the population with a high income (online supplemental Table S2).

Moderate-income group
Within the moderate-income group, we also observed an inverse association between the total TCS score in 2010 and the overall prevalence of smokers in 2020, although this association was moderate ($r_{sp}= -0.498$; p value=0.008; figure 3A). The association was strong for men ($r_{sp}= -0.669$, p value<0.001), but not significant for women (online supplemental Table S2). Among the TCS components, higher scores on smoke-free policies ($r_{sp}=-0.439$; p=0.022) and smoking cessation treatment ($r_{sp}=-0.532$; p=0.004) showed the strongest negative correlations with smoking prevalence. We also observed a moderate negative association with the relative change in smoking prevalence in EU MS from 2009 to 2020, but only in men ($r_{sp}= -0.407$; p=0.035) (online supplemental Table S2).

Low-income group
In the low-income group, however, no significant associations were found between the total TCS score and smoking prevalence. Conversely, a strong negative association was found for both sexes combined for relative changes in smoking prevention ($r_{sp}= -0.450$; p=0.019) (figure 3B).

Price and health warnings components had the weakest correlations with smoking prevalence across all population groups (online supplemental Table S2).

Association between quit ratios and tobacco control policy implementation
High-income group
As shown in online supplemental Table S3, there was a strong positive association between total TCS scores in 2010 and quit ratios in 2020 ($r_{sp}=0.580$, p value=0.002) (figure 4A, online supplemental Table S2) and a weak non-significant positive association with changes in the quit ratios from 2009 to 2020 ($r_{sp}=0.382$, p=0.055; figure 4B, online supplemental Table S3). Higher TCS scores were strongly
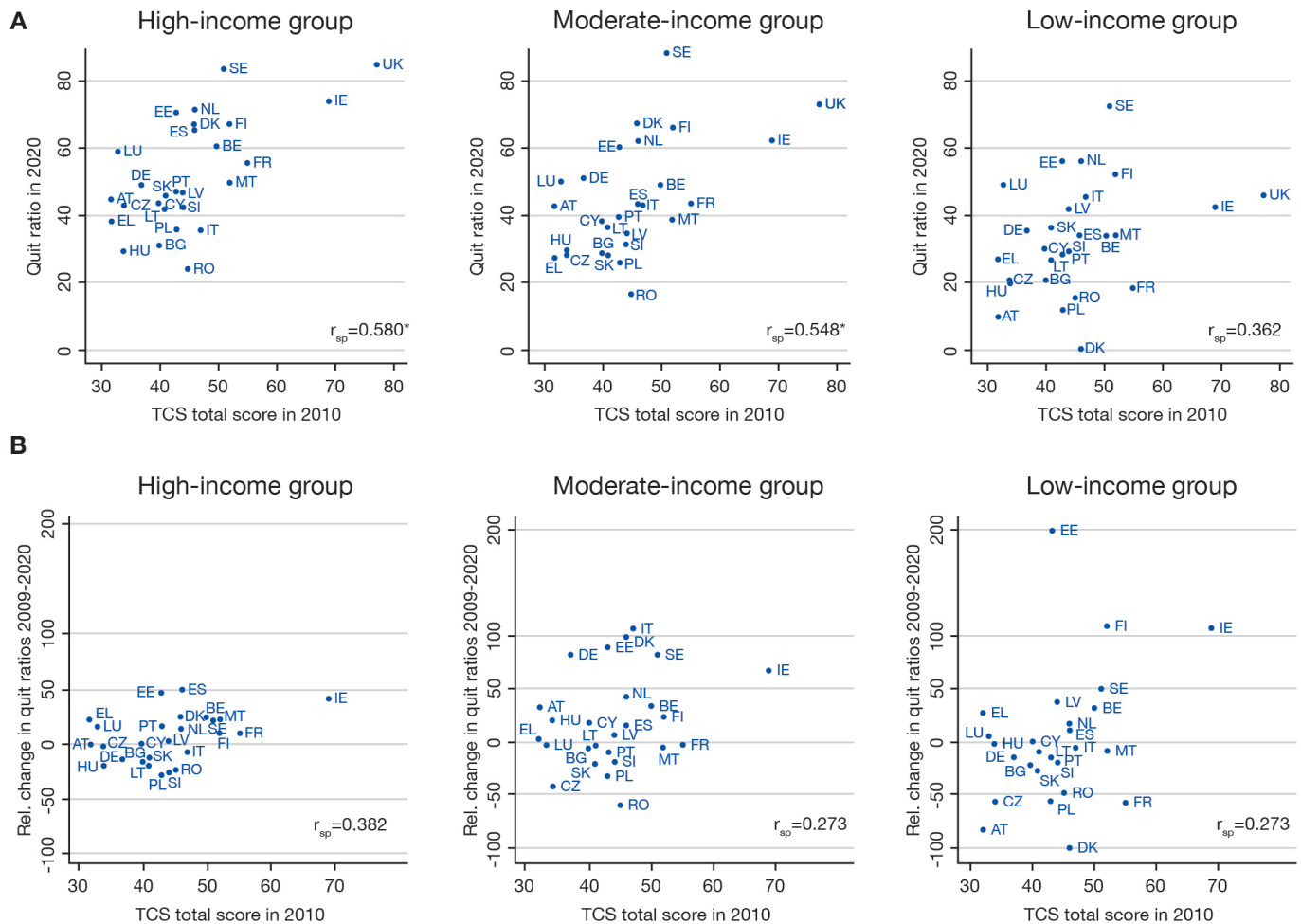
Figure 4 (A) Correlation between Tobacco Control Scale (TCS) total scores in 2010 and quit ratios in 2020 (top), and (B) correlation between TCS total scores in 2010 and the relative change in quit ratios between 2009 and 2020 (bottom) in the EU27, stratified by income group. *p<0.05. EU, European Union; r_{sp}, Spearman's rank correlation coefficient. AT, Austria; BE, Belgium; BG, Bulgaria; CY, Cyprus; CZ, Czechia; DE, Germany; DK, Denmark; EE, Estonia; EL, Greece; ES, Spain; FI, Finland; FR, France; HU, Hungary; IE, Ireland; IT, Italy; LT, Lithuania; LU, Luxembourg; LV, Latvia; MT, Malta; NL, Netherlands; PL, Poland; PT, Portugal; RO, Romania; SE, Sweden; SI, Slovania; SK, Slovakia; UK, United Kingdom.

correlated with both higher quit ratios (r_{sp}=0.587, p value=0.001) and changes in quit ratios from 2009 to 2020 among men (r_{sp}=0.441, p value=0.025), but not among women. Among all the TCS components, higher TCS scores for smoke-free policies (r_{sp}=0.635; p<0.001) and TAPS (r_{sp}=0.475; p=0.012) were highly correlated with higher quit ratios in 2020. We also observed a strong positive correlation between higher TCS scores for smoke-free policies (r_{sp}=0.439; p=0.026) and relative changes in quit ratios during the study period (online supplemental Table S3).

Moderate-income group

Moreover, in the moderate-income group, there was a strong positive association between total TCS scores in 2010 and quit ratios in 2020 (r_{sp}=0.548, p value=0.003). Higher TCS scores and higher quit ratio were highly correlated in both men (r_{sp}=0.555, p value=0.003) and women (r_{sp}=0.481, p value=0.011). By components, higher TCS scores on smoke-free policies (r_{sp}=0.610; p<0.001) were the only ones strongly correlated with higher quit

ratios in 2020 (online supplemental Table S3). We did not observe any association between TCS scores in 2010 and the relative change in quit ratios (figure 4B, online supplemental Table S3).

Low-income group

In the low-income group, there was a moderate non-significant association between total TCS scores in 2010 and quit ratios in 2020 (r_{sp}=0.362, p value=0.064). By components, higher TCS scores on smoke-free policies (r_{sp}=0.560, p value=0.028) and TAPS bans (r_{sp}=0.509, p value=0.007) showed a strong association with quit ratios in 2020. We did not observe any association between TCS scores in 2010 and the relative change in quit ratios in EU MS from 2009 to 2020. However, by components, we found high direct associations between TCS scores on smoke-free policies (r_{sp}=0.452, p value=0.021) and TAPS bans (r_{sp}=0.436, p value=0.027) and changes in quit ratios from 2009 to 2020 in the low-income group (figure 4, online supplemental Table S3).

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DISCUSSION

Summary of findings

Our findings reveal that in 2020, smoking prevalence in the EU was twice as high among low-income residents compared with those with high income. Similarly, quit ratios were notably higher among high-income populations and exhibited a fourfold increase over the period (2009–2020) compared with low-income groups. These results highlight a clear increase in social inequalities in smoking in the region over the past decade.

Moreover, when evaluating the association between policy implementation levels and smoking indicators, we observed that higher implementation of tobacco control policies was associated with lower smoking prevalence among the EU population with high and moderate income in 2020, as well as with changes in prevalence across the entire period (2009–2020). However, the magnitude of association was lower for those with moderate income. Similarly, higher implementation levels were moderately associated with higher quit ratios in 2020 among the high- and moderate-income groups; however, no association was found when correlating TCS scores with changes in quit ratios across the entire period.

Implications for public health and policy

Tobacco control policy implementation efforts over the past decade have successfully reduced smoking prevalence and increased cessation rates overall. However, socioeconomic inequalities in tobacco use have persisted across the region. Our results are consistent with previous studies in the EU, which have shown that individuals without financial difficulties consistently had a lower burden of smoking compared with those who were more deprived.[10] Unfortunately, if no action is taken, these social inequalities in smoking will continue to grow in the region.

MS with higher levels of tobacco control policy implementation had both lower smoking prevalence and higher quit ratios in 2020. This trend was observed among populations with high and moderate income, both overall and for both sexes; however, no correlation was observed in low-income groups. Our findings align with studies showing that tobacco control policies were associated with a decrease in the number of cigarettes smoked per day among middle- and higher-educated respondents.[23] Likewise, other studies have observed that in EU MS where smoking prevalence has decreased over the past decade, lower-educated groups were more likely to continue heavy smoking.[22 24]

Moreover, our results show stronger associations in men compared with women across all income groups, suggesting a potential gender gap in the impact of tobacco control policies. Previous studies have also revealed gender differences in responsiveness to these policies.[25 26] Psychological, social and economic conditions experienced by women may influence their response to tobacco control policies and the effect these measures have on different groups of women, especially those who

are more disadvantaged.[27] For example, Dieleman et al[28] found that the main barriers to smoking cessation among women are psychological factors, such as emotions, stress, lack of family support and low self-esteem, while men face predominantly environmental barriers (eg, availability and social connections to smoking). These findings suggest that men and women may require different interventions to overcome these barriers. Until recently, tobacco control policies paid little attention to gender and its role in smoking initiation, maintenance and quitting, a concern that WHO has addressed by providing gender-responsive strategies to tackle gender-specific issues when adopting tobacco control policies.[29]

The TCS components showing the strongest correlation with lower smoking prevalence in 2020, when implemented at the highest level, were smoke-free policies, TAPS and smoking cessation support. However, the strength of these associations varied across different income groups. While TAPS and smoke-free regulations had a noticeable effect only on smoking prevalence among high- and moderate-income populations, smoking cessation support also influenced consumption levels among the low-income group. In this regard, studies assessing smoke-free policies found greater effects in high-SES compared with low-SES groups,[7] although our study did not yield conclusive results for TAPS regulations. A study conducted in EU MS assessing whether tobacco control policies were associated with socioeconomic inequalities in smoking also found a differential association strength between the implementation levels of smoke-free laws and both a decrease in smoking prevalence and an increase in quit attempts in the past months among high-income groups,[23] in agreement with previous research conducted in several European countries.[30 31] Other studies also support our findings regarding targeted cessation support, suggesting that smoking cessation measures have an equity-positive impact on smoking,[9] indicating that low-SES groups are also responsive to these interventions. Research in the EU MS has demonstrated that after the implementation of a government-reimbursed cessation intervention, including pharmacotherapy and behavioural therapy, the number of quit attempts was similar across all income groups.[32]

Despite tobacco taxation and price increases being proven effective in reducing tobacco consumption,[33] our study found only a low correlation between TCS scores for price and both smoking prevalence and quit ratios, likely due to the limited variability in price scores, as suggested elsewhere.[12] Other possible explanations for this weak association are (1) the increasing use of roll-your-own tobacco during the study period,[34] which remained cheaper than manufactured cigarettes and is not accounted for in TCS price scores; (2) the potential attenuation of long-term price effects on smoking, as seen in studies where quitting rates spike after tax increases but later decline;[35] and (3) cross-border shopping and illicit trade, which may counteract the impact of higher taxation by maintaining affordability.[36]

Population-based interventions have proved to reduce smoking prevalence and increase quit ratios in Europe over the past decade;[11 12] however, this effect has been different by gender and SES groups, increasing social inequalities in smoking in the EU. Hence, our findings highlight the need for future tobacco control policies to be tailored to overcome the social and structural barriers faced by women and low-SES individuals, among other vulnerable groups. Strategies such as providing access to free or subsidised cessation services,[37] implementing women-centred programmes,[38] providing financial incentives[39] or addressing social determinants of health[40] are essential to eliminating tobacco-related health disparities. Ensuring equitable tobacco control policies is critical to achieving a 'Tobacco-Free Generation', where less than 5% of the population uses tobacco by 2040.[41]

Strengths and limitations

This is an ecological study, and consequently, establishing any causal relationship between tobacco control policies and the outcomes assessed (smoking prevalence and quit ratios) is challenging. However, the results of our study are aligned with previous research. We are not trying to infer the relationship at the individual level but rather assessing an ecological effect. Other limitations of our study are the reduced number of EU MS introduced in the analysis as it reduces the statistical power and the lack of information about the stage of the tobacco epidemic across the different countries.[42] However, we were able to analyse the correlations with separate strata of sex, as we computed the prevalence rates and quit ratios from the original Eurobarometer database (n=1000 per MS). This information can provide a better understanding of the relationships under study, compared with using the crude prevalence and quit ratios estimates.

The use of self-reported data from questionnaires could introduce bias, although self-reports on smoking status have acceptable validity.[43] The small sample size in each EU MS could be another limitation. However, the sample design of the Eurobarometer guarantees the representativeness by country.[44] Given the limited sample size (n=27 EU MS), the correlation coefficients could also be affected by some outlier observations. We excluded the UK from the analysis of relative changes in quit ratios for being an influential value to our sample.

Another limitation may have been using 'ability to pay the bills in the last 12 months' to measure income as a proxy for SES instead of other socioeconomic determinants such as educational attainment, healthcare access, employment, insurance coverage and housing, among others, as it may not fully capture all dimensions of SES. While educational level is often used as an SES indicator, it is not the only relevant factor, and significant variations in educational systems across EU MS[45] may pose challenges for cross-country comparisons. Moreover, this variable 'ability to pay the bills in the last 12 months' has been used in previous studies also assessing

inequalities in smoking,[10 22] supporting its relevance despite its limitations.

Finally, using the TCS as a measure of the level of implementation of tobacco control policies in each EU MS has also some limitations:[20] first, its scores do not account for the level of enforcement of such policies, except for smoke-free policies[19] and, second, its comparability is not ensured among countries across years. Therefore, longitudinal approaches were not possible for this study. Admittedly, TCS scores in 2010 may not fully reflect tobacco control policies implemented in subsequent years that could in turn also affect the prevalence of smoking in 2020. However, the ranking of countries according to TCS scores has been relatively consistent across different editions of the scale.

Our study is the first to introduce a longitudinal perspective to the analysis of the effect of tobacco control policies in the EU focusing on a social inequalities perspective. It evaluates the association between TCS scores and smoking indicators (prevalence of tobacco consumption and quit ratios) across time using an adequate time-lag of 10 years between the implementation of policies and the impact indicators. Moreover, our study introduces the use of relative changes as an outcome variable taking into account the difference in the starting point of each EU MS. This approach aims to prevent underestimating the effect.

CONCLUSION

Our study demonstrates that, at the ecological level, higher implementation of tobacco control policies is associated with a lower prevalence of smoking and higher quit ratios over the last decade with differences across socioeconomic strata. Stronger associations are found both in high- and middle-income groups compared with low-income ones. Our findings should encourage the European Commission to incorporate this equity and gender perspective into the new (or revised) Tobacco Products Directive. Moreover, these results should prompt the EU MS to tailor future tobacco control policies to the needs of the most vulnerable groups of smokers, including women and the poor. Adoption of fairer measures is key if EU MS are to achieve their tobacco-free goal by 2040 set by Europe's Beating Cancer Plan.[41]

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Patient consent for publication Not applicable.

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