Prevalence and determinants of smoke-free homes in 12 European countries: the TackSHS Survey

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Shareable abstract (@ERSpublications)
About 70% of the population of 12 European countries lived in smoke-free homes in 2017–2018. Prevalence of smoke-free homes ranged from 44% in Greece to 85% in England. Comprehensive policies are necessary to accelerate smoke-free home adoption in Europe. https://bit.ly/4efrRW9

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Abstract

Background Homes are one of the primary locations where people are exposed to second-hand smoke (SHS) in Europe. We describe the prevalence and identify the main determinants of having home-smoking restrictions in 12 European countries.

Methods Cross-sectional survey in 12 European countries conducted in 2017–2018 (TackSHS project). Approximately 1000 participants representing the general population aged ⩾15 years of each country were interviewed face to face. Individual- and country-level characteristics were explored through adjusted prevalence ratios (PRs) obtained from multilevel Poisson models with random effects.

Results Among 11 734 participants, 70.2% (95% confidence interval (CI) 69.4–71.0%) had smoke-free homes and 17.5% (95% CI 16.8–18.2%) had partial home-smoking restrictions in place. Prevalence of smoke-free homes ranged from 44.4% in Greece to 84.5% in England. Having a smoke-free home was significantly inversely associated with current (PR=0.60) or former (PR=0.95) smoking and living in a household with one (PR=0.70) or two or more (PR=0.58) people who smoke. It was also significantly associated with being ⩾65 years old (PR=1.05), being female (PR=1.07), having a high educational level (PR=1.09) and living with children (PR=1.09). Having a smoke-free home was associated with living in northern Europe, while partial home-smoking restrictions were more likely among respondents from eastern Europe and countries with lower *per capita* gross domestic product.

Conclusions The prevalence of smoke-free homes in Europe is relatively high, but with large variability across countries. European countries with a lower prevalence of smoke-free homes should implement tailored interventions targeting identified determinants and incorporate the success of other countries.

Introduction

Exposure to second-hand smoke (SHS) poses a significant public health threat, contributing to the development of severe conditions such as ischaemic heart disease, stroke, lung cancer and nasal irritation.

Exposure to SHS is also associated with an increased risk of type 2 diabetes, and the current evidence is suggestive about the SHS links to the development of breast cancer, asthma and chronic obstructive pulmonary disease [1]. In 2019, SHS exposure was responsible for approximately 690 000 deaths among women and 610 000 deaths among men globally [2]. In Europe alone, it has been estimated that approximately 24 000 adult deaths could be prevented yearly if SHS exposure at home were eliminated [3].

Children are particularly susceptible to SHS, because their lungs and airways are still developing, and they have faster breathing rates than adults. It has been estimated that about 40% of children are exposed to SHS globally [4]. In some countries of the World Health Organization (WHO) European Region, such as the Federation of Bosnia and Herzegovina, Croatia, and Serbia, up to 60% of youth are exposed to SHS at home [5]. Among children, SHS exposure is associated with acute respiratory infections, exacerbated asthma, otitis media and sudden infant death syndrome [6]. In the European Union (EU) in 2017, 35 633 disability-adjusted life-years (DALYs) were attributed to home SHS exposure among children [6].

While exposure to SHS in most public places can be addressed by smoke-free regulations promoted by the WHO Framework Convention on Tobacco Control [7], private homes remain a major place where exposure to SHS occurs. This is particularly the case for adults who do not smoke, women and children [8]. However, introduction of smoke-free regulations in public places has helped shift societal norms around smoking in enclosed indoor spaces, has had a positive impact on the introduction of voluntary smoking restrictions in homes and has improved health outcomes [9–12].

Monitoring the prevalence and determinants of smoke-free homes across European countries is of importance to better tailor actions to reduce exposure to SHS at home, and ultimately tackle its burden. Unfortunately, a multi-country standardised tobacco surveillance system in Europe, such as the Eurobarometer, no longer collects data on smoking rules at homes [13]. Some other studies that collect these data focus on a specific population, for example people who smoke [14], or are conducted only in a small number of European countries (for example, the Global Adult Tobacco Survey in Kazakhstan, Romania and Ukraine) [15]. Some European countries monitor the prevalence of smoke-free homes at a national level; however, these studies apply different methodologies and comparisons between countries is either impossible or challenging. Therefore, the TackSHS Survey was conducted to improve the understanding of exposure to SHS in Europe using a common standardised questionnaire in all the considered countries [16].

In this study, we have evaluated the prevalence of different types of home-smoking restrictions (complete, partial or none) and identified individual- and country-level factors associated with complete or partial home-smoking restrictions *versus* having no restrictions in 12 European countries.

Methods

This is a cross-sectional observational study. The data were obtained from a survey conducted as part of the TackSHS project (2017–2018), in 12 European countries: Bulgaria, England, France, Germany, Greece, Ireland, Italy, Latvia, Poland, Portugal, Romania and Spain [16]. These countries incorporate geographical, legislative and cultural diversity across Europe, and cover approximately 80% of the whole EU-28 population at the time of the survey.

In total, the survey included 11 902 respondents. In each country, approximately 1000 adult (defined as ⩾15 years) respondents participated in the study. Sampling strategies applied ensured that the samples were representative of the country's general population in terms of age, sex, habitat (geographic area and/or size of municipality), and, in some countries, socio-economic characteristics [17].

The TackSHS Survey questionnaire was developed by the Mario Negri Institute team from questionnaires used in previous national and European surveys; it was reviewed by the project expert group and is available upon request [10, 18]. Trained interviewers conducted a face-to-face, computer-assisted personal interview in each country [17].

Variables

The dependent variable of this study was the self-reported smoking restrictions in participants' homes. All participants were asked: "At your home, where can people (including anyone living in the household and guests) smoke?" with the response options: 1) everywhere, 2) in some specific indoor areas (*e.g.*, in the kitchen, in the bathroom), 3) nowhere inside. The respondents who mentioned that smoking is allowed everywhere were regarded as having "no restrictions" at their home, those who allowed smoking in some areas were regarded as having a "partial restriction" and those who answered that smoking occurs

"nowhere inside" were regarded as having a "complete restriction", in other words, having a "smoke-free home". Those participants with missing data on this variable (n=168) were excluded from the analyses.

The independent variables studied were participant age (four categories: <25, 25–44, 45–64 and ⩾65 years), sex (female or male), smoking status (never, former and current smoking) [17], educational level (low, medium and high) [17], presence of minors (⩽14 years) at the household (yes/no) and number of people who smoke in the household (none, one, two or more). The missing data for individual independent variables (three responses for educational level and one for number of people who smoke in the household) were excluded from analyses. Moreover, we analysed the country-level independent variables such as geographical area (northern, western, southern and eastern Europe) as defined by the United Nations M49 Standard [19], gross domestic product (GDP) *per capita* (⩽EUR 25 000 and >EUR 25 000) according to the World Bank [20] and country score in the 2016 Tobacco Control Scale (TCS) (<50, 50–55 or >55) [21].

Statistical analysis

We have calculated weighted prevalence as well as 95% confidence intervals (CIs) of self-reported voluntary home-smoking restrictions (complete, partial and no restrictions) overall, by country and by individual-level variables. Furthermore, we performed a multivariate Poisson regression analysis with robust variance to estimate the prevalence ratios (PRs) and their 95% CIs for having complete and partial restrictions *versus* having no smoking restrictions by individual independent variables. Finally, we fitted multilevel Poisson models with random effects to account for both individual- and country-level independent variables. PRs and their 95% CIs for complete *versus* no restrictions and partial *versus* no restrictions were calculated.

Statistical weights were used to generate representative estimates of the general population of each country (individual weights). To calculate results for the entire sample, country weights were applied that combined individual weights with an additional weighting factor, with each country contributing in proportion to its population aged ⩾15 years, as obtained by 2017 Eurostat data [22]. Analyses were performed with IBM SPSS Statistics (version 27), and figure 1 was created with MapChart.

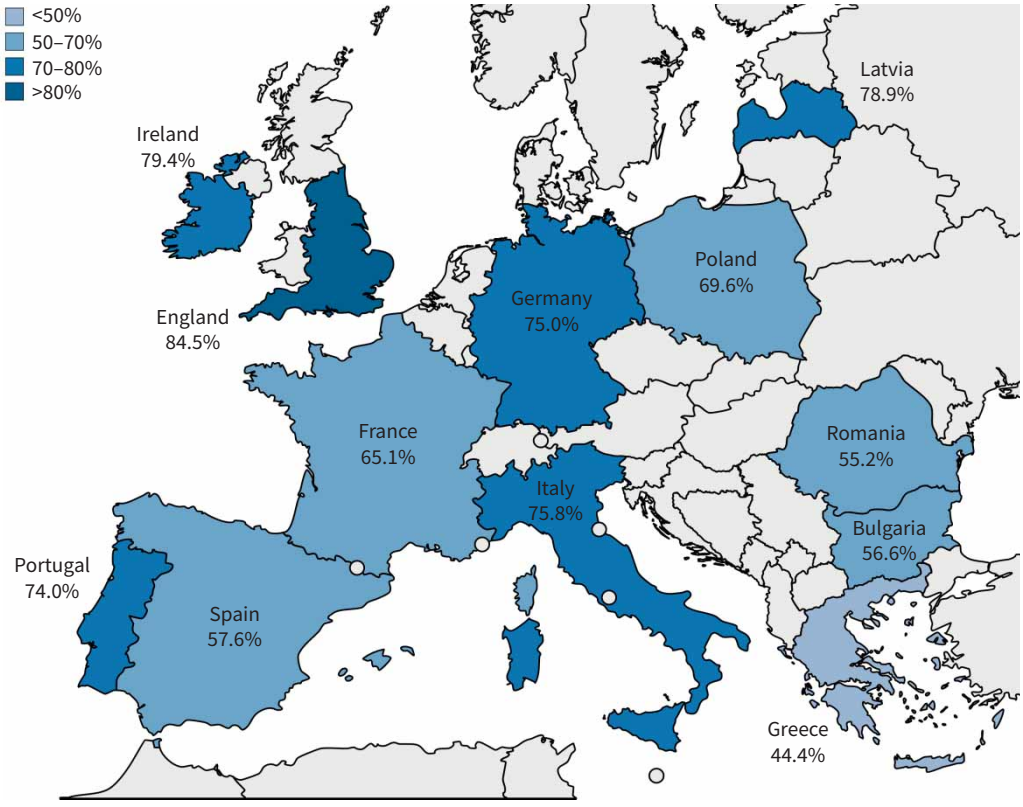

FIGURE 1 Prevalence (%) of smoke-free homes in 12 European countries (n=11 734; TackSHS Survey, 2017–2018).

Ethical considerations

The TackSHS project obtained approval from the Clinical Research Ethics Committee of the Bellvitge University Hospital (PR341/15). The TackSHS Survey was approved by the local ethics committee in each participating country [17]. The survey protocol was registered with ClinicalTrials.gov (ID: NCT02928536). All participants received detailed information about the study through the information sheet and provided their consent to participate. This research followed and endorsed the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidance for reporting observational research [23].

Results

In total, 11 734 participants (98.6% of the total sample) responded to the question regarding voluntary smoking rules in their home and were included in the current analysis. Participant characteristics in each country are presented in supplementary table 1. The overall prevalence of smoke-free homes among the 12 countries was 70.2% (95% CI 69.4–71.0%); 17.5% (95% CI 16.8–18.2%) reported having partial home-smoking restrictions and 12.3% (95% CI 11.7–12.9%; table 1) reported having no restrictions in place. The prevalence of smoke-free homes ranged from 44.4% (95% CI 41.4–47.5%) in Greece to 84.5% (95% CI 82.2–86.7%) in England (figure 1). The prevalence of homes with partial home-smoking restrictions was the highest in Romania (35.4%, 95% CI 32.5–38.4%) and the lowest in England (8.4%, 95% CI 6.8–10.2%). Homes lacking any smoking restrictions were most prevalent in Greece (23.0%, 95% CI 20.5–25.7%) and least prevalent in Latvia (3.1%, 95% CI 2.2–4.3%; supplementary table 2).

Among people who currently smoke, the prevalence of smoke-free homes was 37.3%, ranging from 25.0% in Spain to 54.8% in Latvia. Among those who do not smoke currently (former and never smoking combined), 81.7% reported having a smoke-free home, with the lowest prevalence in Greece (51.4%) and the highest in England (92.9%). The prevalence of smoke-free homes in households where only people who do not smoke live was 87.3%, ranging from 60.1% in Greece to 96.4% in Portugal. Among

TABLE 1 Prevalence (%) and 95% confidence intervals (CIs) of participants with complete, partial and no home-smoking restrictions, by participant characteristics (n=11 734; TackSHS Survey, 2017–2018)

	Participants, N	Complete restrictions		Partial restrictions		No restrictions	
		n (%)	95% CI (%)	n (%)	95% CI (%)	n (%)	95% CI (%)
All	11 734	7968 (70.2)	69.4–71.0	2394 (17.5)	16.8–18.2	1372 (12.3)	11.7–12.9
Age, years							
<25	1427	928 (68.7)	66.3–71.0	332 (19.4)	17.5–21.5	167 (11.9)	10.3–13.6
25–44	4034	2709 (70.3)	68.9–71.8	856 (17.3)	16.1–18.5	469 (12.4)	11.4–13.4
45–64	4269	2783 (66.6)	65.1–68.0	936 (19.8)	18.6–21.1	550 (13.6)	12.6–14.7
⩾65	2004	1548 (77.6)	75.8–79.3	270 (12.2)	10.9–13.6	186 (10.2)	9.0–11.5
Sex							
Female	6185	4316 (72.3)	71.2–73.4	1290 (17.8)	16.8–18.7	579 (9.9)	9.2–10.7
Male	5549	3652 (67.9)	66.6–69.1	1104 (17.2)	16.3–18.2	793 (14.9)	14.0–15.9
Smoking status							
Never	6391	5233 (83.7)	82.8–84.6	795 (10.8)	10.0–11.5	363 (5.5)	5.0–6.1
Former	2025	1467 (74.8)	72.8–76.7	366 (15.9)	14.3–17.6	192 (9.3)	8.1–10.7
Current	3318	1268 (37.3)	35.6–39.1	1233 (33.5)	31.8–35.1	817 (29.2)	27.6–30.8
Minors (⩽14 years) in the household							
Yes	3632	2600 (72.1)	70.7–73.6	768 (19.2)	17.9–20.5	264 (8.7)	7.8–9.6
No	8102	5368 (69.3)	68.3–70.3	1626 (16.7)	15.9–17.5	1108 (14.0)	13.2–14.8
Number of people who smoke in the household[#]							
None	6748	5847 (87.3)	86.5–88.1	618 (8.6)	8.0–9.3	283 (4.1)	3.6–4.5
One	3172	1516 (48.3)	46.4–50.1	1002 (27.6)	26.0–29.2	654 (24.1)	22.6–25.8
Two or more	1813	605 (34.6)	32.4–36.9	773 (38.1)	35.8–40.4	435 (27.3)	25.3–29.5
Educational level[¶]							
Low	4416	2955 (69.7)	68.3–71.0	859 (16.5)	15.4–17.6	602 (13.8)	12.9–14.9
Medium	4127	2748 (69.4)	68.0–70.8	877 (17.3)	16.1–18.4	502 (13.3)	12.3–14.4
High	3188	2262 (72.0)	70.4–73.6	658 (19.4)	18.0–20.9	268 (8.6)	7.6–9.6

Absolute prevalence (N and n) is presented using raw numbers. Relative prevalence (% and 95% CIs) was calculated using weights, combining country weights and individual weights with an additional weighting factor, with each country contributing in proportion to its population aged ⩾15 years (from Eurostat) [22]. [#]: One participant from Bulgaria did not report number of people who smoke in the households (N=11 733 for this variable). [¶]: Three participants from Romania did not report their level of education (N=11 731 for this variable).

households where at least one person who smokes lives, 43.1% reported having a smoke-free home, with the lowest prevalence in Spain (26.5%) and the highest in England (60.5%; supplementary table 3).

Table 2 presents the PRs for having a home with complete or partial smoking restrictions *versus* lacking any restrictions in place. Statistically significant direct associations with reporting a smoke-free home were found for respondents aged ⩾65, compared to those aged ⩽25 or younger (PR=1.05, 95% CI 1.01–1.10); women (PR=1.07, 95% CI 1.04–1.10); respondents with a high educational level (PR=1.09; 95% CI 1.06–1.12);

TABLE 2 Prevalence ratios (PRs) and 95% confidence intervals (CIs) of having complete or partial home-smoking restrictions, compared with not having any smoking restrictions at home, according to selected individual- and country-level characteristics (TackSHS Survey, 2017–2018)

	Complete *versus* no restrictions		Partial *versus* no restrictions	
	n (%)	PR (95% CI)	n (%)	PR (95% CI)
All	9337[#] (85.1)		3766 (58.7)	
Age, years				
<25	1095 (85.3)	1.00	499 (62.0)	1.00
25–44	3177 (85.1)	0.99 (0.95–1.03)	1325 (58.3)	0.92 (0.81–1.04)
45–64	3332 (83.1)	0.98 (0.94–1.02)	1486 (59.3)	0.95 (0.84–1.07)
⩾65	1733 (88.4)	**1.05 (1.01–1.10)**	456 (54.6)	0.89 (0.77–1.04)
p for trend		0.053		0.311
Sex				
Male	4444 (82.0)	1.00	1897 (53.6)	1.00
Female	4893 (87.9)	**1.07 (1.04–1.10)**	1869 (64.1)	**1.20 (1.11–1.30)**
Smoking status				
Never	5594 (93.8)	1.00	1158 (66.0)	1.00
Former	1659 (88.9)	**0.95 (0.93–0.98)**	558 (63.0)	0.96 (0.85–1.08)
Current	2084 (56.1)	**0.60 (0.57–0.64)**	2050 (53.4)	**0.83 (0.76–0.90)**
Minors (⩽14 years) in the household				
No	6475 (83.2)	1.00	2734 (54.4)	1.00
Yes	2862 (89.3)	**1.09 (1.05–1.12)**	1032 (68.9)	**1.25 (1.15–1.37)**
Number of people who smoke in the household[¶]				
None	6129 (95.6)	1.00	901 (67.9)	1.00
One	2170 (66.7)	**0.70 (0.67–0.73)**	1656 (53.3)	**0.80 (0.73–0.88)**
Two or more	1038 (55.8)	**0.58 (0.54–0.63)**	1208 (58.2)	**0.86 (0.77–0.95)**
p for trend		<0.001		0.005
Educational level				
Low	3557 (83.4)	1.00	1461 (54.3)	1.00
Medium	3250 (83.9)	1.02 (0.99–1.06)	1379 (56.4)	1.03 (0.93–1.14)
High	2530 (89.4)	**1.09 (1.06–1.12)**	926 (69.4)	**1.28 (1.16–1.41)**
p for trend		<0.001		<0.001
Geographic area[+]				
Northern Europe	2532 (92.1)	1.00	553 (55.3)	1.00
Western Europe	1713 (83.6)	**0.90 (0.88–0.93)**	606 (52.5)	0.97 (0.84–1.12)
Southern Europe	3121 (83.6)	**0.90 (0.88–0.93)**	1511 (61.2)	1.10 (0.96–1.26)
Eastern Europe	1971 (84.2)	**0.91 (0.87–0.95)**	1096 (66.9)	**1.22 (1.05–1.42)**
Country GDP *per capita*				
⩽EUR 25 000	4267 (83.3)	1.00	2123 (66.0)	1.00
>EUR 25 000	5070 (85.5)	1.02 (0.99–1.06)	1643 (56.0)	**0.85 (0.78–0.92)**
TCS score				
<50	3098 (84.6)	1.00	1472 (56.3)	1.00
50–55	3056 (84.8)	1.00 (0.97–1.04)	1138 (60.6)	1.04 (0.93–1.15)
>55	3183 (85.7)	1.01 (0.99–1.04)	1156 (58.1)	1.00 (0.90–1.10)
p for trend		0.331		0.823

Absolute numbers (N and n) are presented using raw numbers. Prevalence (%), PRs and the corresponding 95% CIs were calculated using weights, combining country weights and individual weights with an additional weighting factor, with each country contributing in proportion to its population aged ⩾15 years (from Eurostat) [22]. PRs were estimated using multilevel Poisson regression models with random effects after adjustment for age, sex and educational level. Figures in bold type are significant at 0.05. GDP: gross domestic product; TCS: Tobacco Control Scale. [#]: Three subjects did not report information on educational level and so were excluded from the analysis. [¶]: One subject from Bulgaria did not report the number of people who smoke at home, and so was excluded from the analysis for partial *versus* no restrictions. [+]: Countries were categorised by geographic area according to the classification by the United Nations into northern (England, Ireland and Latvia), western (France and Germany), southern (Greece, Italy, Portugal and Spain) and eastern regions (Bulgaria, Poland and Romania) [19].

and those living with children aged ⩽14 years (PR=1.09, 95% CI 1.05–1.12). Having a smoke-free home was inversely related to smoking status among those who currently smoke (PR=0.60, 95% CI 0.57–0.64) and those who formerly smoked (PR=0.95, 95% CI 0.93–0.98). Having a smoke-free home was also inversely related to the number of household members who smoke (p for trend <0.001). Regarding country-level characteristics, a smoke-free home was significantly more likely to be reported in northern European countries (table 2).

Individual-level factors for having partial home-smoking restrictions were similar to those for having smoke-free homes. Living in eastern, compared to northern, Europe (PR=1.22, 95% CI 1.05–1.42) was associated with having partial restrictions. In addition, homes with partial smoking restrictions were less likely among respondents from countries with a GDP >EUR 25 000 (PR=0.85, 95% CI 0.78–0.92). The results of the multivariate analysis including only individual-level characteristics (supplementary table 4) revealed findings similar to those of the multilevel analysis (table 2), although the strength of the association was slightly attenuated when controlling for country-level characteristics.

Discussion

This study shows that smoke-free homes are increasingly the norm across Europe, with an overall prevalence of 70.2% in 2017–2018. This suggests a considerable increase from the last available data from 2010, when the reported prevalence was 62.2% [10]. We found large variability between the countries surveyed, with the prevalence of smoke-free homes ranging from 44.4% in Greece to 84.5% in England, and being generally higher in northern Europe. We found that smoke-free homes were significantly more likely to be reported by older participants, women, participants with a high educational level and those living with children. Conversely, being a person who currently smokes or who smoked in the past and living in a household with people who smoke was significantly associated with not having a smoke-free home.

In 2010, a survey using the same methodology as the current one evaluated home-smoking restrictions in 18 European countries, with 11 of the 12 countries included in the current study (all except Germany) [10]. Overall, the prevalence of smoke-free homes reported in 2010 was lower; considering the prevalence for the 11 countries common for both surveys, it increased from approximately 58% in 2010 to about 67% in 2017–2018. The increase in the prevalence of smoke-free homes in European countries is likely to occur due to the expansion of smoke-free policies in public places, particularly at workplaces and the hospitality sector, and consequent decrease of both SHS exposure at home and the social acceptability of smoking [24–26]. Nevertheless, these results suggest an annual increase of nearly 1% in the prevalence of smoke-free homes, indicating it would take another 30 years to achieve smoke-free homes in all European homes at this rate. Therefore, accelerating progress in tobacco control –particularly strengthening and expanding smoke-free legislation in workplaces, public places and certain private settings, such as motor vehicles, as well as introducing various endgame strategies – is of utmost importance for extending smoke-free homes in Europe [25].

A survey conducted in 2016 in six European countries collected data on home-smoking restrictions among adults who smoke [14]. In that study, the overall prevalence of a smoke-free home was 26.5%, more than 10% lower than among respondents who smoke in the current survey (37.3%, supplementary table 3). In five out of six countries included in both surveys (Germany, Greece, Poland, Romania and Spain), the prevalence of a smoke-free home was higher in 2018 [14]. These results highlight an overall lower adoption of smoke-free homes among the households of those who smoke than among the general public.

The current study, in line with previous research, showed that having a smoke-free home is less prevalent among people who smoke or who have smoked in the past, and among those living with people who smoke [18, 27–29]. A systematic review on barriers to smoke-free home adoption identified that nicotine addiction was a barrier to both creating and maintaining a smoke-free home [28]. Moreover, lack of awareness about SHS health risks, denial of risk messages and perceived benefits of smoking were other obstacles detected to creating a smoke-free home [28].

Other determinants of smoke-free homes were identified in the current study. Female respondents were more likely to report smoke-free rules in their household; this contrasts with some other country-specific studies that did not detect gender differences in smoke-free home adoption [18, 30, 31]. However, previous research suggests that while women may be more likely to promote smoke-free homes, they may experience a lack of agency in changing male home-smoking behaviours [28], which has prompted calls for the development of father-inclusive, family-wide interventions [32]. Regarding age and smoke-free home adoption, there is inconsistent evidence from previous studies. Some studies report older age to be

associated with smoke-free homes [18], which is consistent with our findings, whereas other studies find them to be more likely to be adopted by middle-age and younger participants [27, 30, 31]. These differences could also be related to the stage of the cigarette epidemic in different countries (and hence the age of the majority of those who currently smoke or smoked in the past) [33]. Socio-economic status is an important predictor of health behaviours, and our study confirms that smoke-free homes are more likely to be adopted by populations with a higher socio-economic status [18, 27–31]. These findings emphasise a need for interventions promoting smoke-free homes to be tailored to vulnerable populations and for structural policies addressing social determinants to decrease existing inequalities in SHS burden [4].

In our study, participants from northern European countries (England, Ireland and Latvia) were more likely to have smoke-free homes. While a 2010 survey demonstrated that participants from the countries with strongly implemented tobacco control measures (higher TCS scores) were more likely to report smoke-free homes [10], our current study showed no significant association. Use of the TCS has potential limitations as there is low variance across the countries that have achieved a high overall tobacco control and a general lack of information regarding legislation enforcement [34]. Our results suggest that tobacco control policies (proxied through the TCS) and economic conditions (proxied through GDP *per capita*) of the studied countries are not significantly related to the adoption of smoke-free homes, whereas the geographical region is. This may reflect that adoption of smoke-free homes and shifting societal norms around smoking at home could be more related to overall regional differences, such as tobacco-free country ambitions or health literacy [35, 36].

In the current study, about 13% of respondents who live in households where no one smokes allow visitors to smoke indoors of their homes. These results may indicate a lack of awareness about the risks of smoking and SHS exposure at home among the general population [28], including those who do not smoke. There is evidence of the effectiveness of mass media campaigns for the general population in promoting smoke-free home adoption and decreasing the health burden of SHS exposure among children [37, 38]. It is important to implement successful campaigns that lead all household members to recognise the risks of smoking in the home and to actively choose to make their private spaces smoke-free, contributing to a healthier, smoke-free future for generations to come [4, 26]. Smoke-free homes not only create a healthier home environment, but also set a positive example for young generations and encourage healthy behaviours [5, 26].

In our study, a smoke-free home was defined as a one where smoking is not allowed in indoor areas. Those households where smoking is allowed only in outdoor areas, such as balconies, were considered as smoke-free homes; therefore, a more restrictive definition would probably detect a lower prevalence of smoke-free homes in Europe. Contrasting our results with other surveys is challenged by different questions asked when assessing the prevalence of smoke-free homes. Some studies ask either if smoking occurs in homes [31] or specifically about existing smoking rules [30] and if guests are allowed to smoke [18]; some questions specifically focus on indoor areas [14], whereas others do not specify explicitly indoor or outdoor areas. Asking these different questions to the same respondents would likely provide different estimates of the prevalence of smoke-free homes. Therefore, more cooperation in defining standard questions to evaluate smoke-free homes is necessary. Pan-European surveys, such as the Eurobarometer, should systematically use the same questions about home-smoking rules and home-smoking behaviour, including frequency, and clearly define current home smoking across different survey waves [39].

The current study has some limitations. Firstly, we used self-reported data in face-to-face interviews about smoking behaviour; therefore, the prevalence of smoke-free homes might be overestimated due to a social-desirability response bias. However, when the status of smoke-free homes is measured using environmental biomarkers, such as airborne nicotine, the validity of reporting home-smoking restrictions has been high [40]. Also, this study focused exclusively on conventional cigarette smoking. Future research should investigate the rules regarding the use of electronic cigarettes and other emerging tobacco or nicotine products. Other limitations include those inherent to the cross-sectional study design, which does not allow the study of causal associations. Nevertheless, the study has several strengths, such as including participants from 12 countries, the representativeness of the adult population in each country and the homogeneity of the methodology used, which allows a reliable comparison across countries. Moreover, we applied a complex weighting procedure that allowed us to obtain both country-specific and overall 12-country estimates representative of the combined population of the countries studied. Finally, the current study provides pan-European results that were not collected in other recent European surveys. Even though the TackSHS Survey was conducted in 2018, to the best of our knowledge, this is the latest pan-European survey providing comparable data on smoke-free homes across multiple countries.

Conclusions and recommendations

The prevalence of smoke-free homes in Europe is high, but there is considerable variability among the countries surveyed. The results of this study spotlight the countries where urgent actions are needed to promote the adoption of smoke-free homes. We have also identified important determinants to better target policies and interventions aimed at promoting smoke-free homes, especially to reach the most vulnerable groups: people with lower socio-economic status, those living with children and those living with people who smoke.

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Data availability: Data collected for the study, including individual participant data and a data dictionary defining each field in the set, may be made available to others upon presentation of research proposal and its approval by the TackSHS Project Board. Research proposals from the tobacco industry and its allies are not accepted. Proposals should be directed to the corresponding author. A data access agreement will be signed prior to data sharing.

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Ethics statement: The TackSHS project obtained approval from the Clinical Research Ethics Committee of the Bellvitge University Hospital (PR341/15). The TackSHS Survey was approved by the local ethics committee in each participating country [17].

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Author contributions: E. Fernández, S. Gallus, J.B. Soriano, S. Semple and M.J. López conceptualised the survey proposal and acquired the financial support for the project. E. Fernández, S. Gallus and A. Lugo developed the study methodology. All authors conceptualised the manuscript. E. Fernández, S. Gallus, A. Lugo, M. Fu and O. Tigova conducted the investigation and project administration tasks. A. Lugo curated the data and O. Tigova conducted the data analysis. Y. Castellano, C. Stival and A. Lugo supported the statistical analysis. C. Stival accessed the data and verified the data analyses. O. Tigova and C. Stival have directly accessed and verified the underlying data reported. E. Fernández, S. Gallus, C. Martínez, J.B. Soriano, R. O'Donnell, S. Semple and M.J. López supervised the research process and manuscript preparation. O. Tigova prepared the original draft, and all authors reviewed and edited multiple versions of the manuscript. All authors reviewed the manuscript and agreed on its submission.

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