VOLUNTARY HOUSEHOLD BANS ON TOBACCO AND NICOTINE USE

PhD thesis book

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Budapest

2026

1. Introduction

The major share of secondhand smoke (SHS) exposure occurs in private homes. Since smoke-free legislation currently only cover workplaces and public indoor environments, private households have become the major remaining source of involuntary exposure to smoke and aerosol. Apart from few exceptions (smoke-free rules in US federally subsidized public housing and bans on smoking in private vehicles carrying children introduced in 25 countries) tobacco and nicotine use in private residences remains outside the scope of regulation. WHO FCTC Article 8 does not currently extend to the private home, although an Expert Group report to the eleventh Conference of the Parties identified the extension of smoke-free protection to private homes, vehicles and multi-unit housing as a forward-looking legal measure. Until such regulation is adopted, in-home exposure reduction depends on voluntary household rules. Voluntary in-home bans have accordingly been described as the final frontier of smoke-free policies.

In this dissertation, a voluntary in-home ban denotes a self-imposed, negotiated household rule that completely prohibits indoor smoking and/or aerosol use. Electronic devices for tobacco or nicotine aerosol delivery (EDTNAD) collectively denote e-cigarettes and heated tobacco products, the two aerosol-generating product categories relevant to secondhand exposure in Hungary. Clean air rules denote a complete in-home smoking ban and a complete in-home EDTNAD-use ban held simultaneously.

Voluntary in-home bans are consistently patterned by household smoking composition, educational attainment, financial deprivation and the presence of minors in Western countries. They are, however, household-level outcomes: they emerge from negotiation between household members who may differ in smoking status, education and decision-making power. Most quantitative studies nevertheless rely on respondent-level characteristics alone, which cannot capture this complexity.

Four research gaps motivated this dissertation. First, national estimates of the prevalence and temporal development of voluntary in-home smoking bans in Hungary had been lacking since 2010, and national estimates of in-home EDTNAD-use ban prevalence were absent. Second, despite documented social and ethnic disparities, quantitative evidence on ban adoption among the Roma population was lacking in Europe. Third, quantitative research had not systematically examined how gendered educational disparities between household members, or shared household decision-making, are associated with

household-level ban adoption. Fourth, quantitative evidence on recalled intra-household decision-making patterns was limited, and evidence on the prevalence of proposed-but-not-adopted bans was absent.

2. Objectives

Corresponding to the four research gaps, this dissertation has four objectives. Because full household composition data are rarely feasible owing to non-response and reporting limitations, the cohabiting couple is used as the unit of analysis for the household-level objectives: it is analytically tractable, demographically prevalent, and represents a key child-rearing context.

1. To estimate the prevalence of individuals living in homes with smoking bans and EDTNAD-use bans in Hungary, and to explore plausible adoption trajectories under assumptions.
2. To examine the prevalence of voluntary in-home smoking bans and EDTNAD-use bans among the Roma population in Hungary, adjusting for established socioeconomic determinants.
3. To examine how gendered educational disparities between cohabiting partners and shared decision-making are associated with voluntary in-home smoking bans and EDTNAD-use bans, while adjusting for established determinants.
4. To quantify recalled intra-household decision-making patterns underlying the adoption of voluntary in-home smoking bans among cohabiting couples, and to estimate the prevalence of proposed but not yet adopted bans.

3. Methods

All analyses are observational. The dissertation draws on four cross-sectional surveys conducted in Hungary between 2009 and 2025 (Table 1). In all surveys the unit of observation is the individual respondent; three units of analysis are used. Analyses using different units of analysis are complementary, not directly comparable, and analyses across datasets within the same objective are not pooled.

3.1. Surveys and measures

The Social Determinants of Smoking Survey (February 2009) is a two-stage sampled paper-and-pencil survey of Hungarian residents aged 16–70 years, representative by age, gender, education and region. Secondary data analysis was applied.

The Hungarian subsample of Eurobarometer 72.3 (October 2009) used stratified multistage probability sampling and computer-assisted personal interviewing (CAPI); analyses were restricted to respondents aged 18 years and older, with post-stratification weights applied. Secondary data analysis was applied.

The Online Health Survey (November 2022) was a quota-sampled computer-assisted web interviewing (CAWI) survey of adults. This survey contained a question block designed for this research.

The Online Cohabiting Couples Survey (September 2025) was a CAWI survey designed for this dissertation among cohabiting adults.

The 2022 and 2025 data collections received ethical approval from the Hungarian Medical Research Council (ETT-TUKEB).

Survey	**Mode; n**	**Unit of analysis**	**Objective**
Social Determinants of Smoking Survey, Feb 2009	Paper-and-pencil; n = 2,250	Individual	2
Eurobarometer 72.3 (Hungarian subsample), Oct 2009	CAPI; n = 1,015 (≥18 y)	Individual	1
Online Health Survey, Nov 2022	CAWI; n = 1,500 (couples: 623)	Individual; cohabiting couple	1, 3
Online Cohabiting Couples Survey, Sep 2025	CAWI; n = 807*	Cohabiting home-owner couple	2, 3, 4

Table 1. Data sources by objective. Analyses across datasets within the same objective are not pooled. Table source: author. * different analyses used different subsets

A complete in-home smoking ban was defined as smoking not being allowed anywhere in the home; permissive responses were grouped as no complete ban. The complete EDTNAD-use ban was operationalised analogously, requiring that neither e-cigarettes nor heated tobacco products were permitted. In 2025, analyses were restricted to home-owning couples, because only home-owners can be assumed to exercise autonomous authority over indoor rules. Roma status was assessed by self-identification (2009) and at household level (2025), reflecting that ethnic categorisation in everyday social contexts often operates at household level and on perceived ethnicity.

3.2. Data quality and missing data

In the 2022 and 2025 surveys one partner reported on both members of the couple. Requiring both partners to participate was deliberately avoided, because such designs underrepresent higher-risk households, and single-respondent reports of household smoking rules show acceptable concordance with partner-reported data. For the 2022 survey an external validity check compared current tobacco and/or nicotine use prevalence (37.0%, 95% CI 34.5–39.5) with the nationally representative Hungarostudy 2021 estimate (34.1%, 95% CI 33.0–35.2); the difference was judged as acceptable. Missing data were handled by listwise deletion (2009), by simple substitution (2022), and by multiple imputation using chained equations (MICE) with 20 imputed datasets (2025), from which a single analysis dataset was derived by majority rule for the penalised regression analyses.

3.3. Statistical analyses

Prevalence estimates were weighted where weights were available and compared using two-sample Z-tests, with Cohen's h as effect size (for proportions); within-household differences between the two ban types were tested with McNemar's test for paired binary outcomes. Exploratory logistic growth modelling was applied by grid search, with the carrying capacity fixed at 0.929, to the Hungarian (2 data points), US (10 data points) and Scottish (11 data points) series; solutions with a residual sum of squares below 0.001 were retained.

Social and ethnic stratification was analysed by binary logistic regression (2009) and by a joint binary outcome model (2025), in which two simultaneous logistic equations were linked by a conditional log-odds ratio capturing the residual association between the two bans. Model fit was assessed by likelihood ratio test and discrimination by receiver operating characteristic area under the curve (ROC-AUC) and precision–recall area under the curve (PR-AUC).

Intra-household configuration was analysed by binomial logistic least absolute shrinkage and selection operator (LASSO) regression, chosen because it performs embedded variable selection under multicollinearity among conceptually related predictors. The penalty parameter was selected by fourfold cross-validation repeated over 100 iterations; predictors were classified as stable when non-zero and directionally consistent in at least

95 of 100 iterations. Variable importance was quantified by Shapley additive explanations (SHAP). Recalled patterns were described by frequencies and proportions with 95% CI, after recoding respondent-relative responses to gender-absolute codes. Analyses were conducted in R 4.5.3.

4. Results

4.1. Prevalence and trends

The weighted prevalence of complete in-home smoking bans was 61.7% (95% CI 58.5–64.9) in 2009 and 75.6% (95% CI 73.4–77.8) in 2022; the 13.9 percentage-point increase was statistically significant and moderate ($\chi^2 = 46.0$, $p < 0.001$, Cohen's $h = 0.28$). In 2022 the prevalence of complete in-home EDTNAD-use bans was 72.5% (95% CI 70.2–74.8). The two ban types differed significantly within households (McNemar's $\chi^2 = 12.0$, $p < 0.001$): among individuals living in smoke-free homes, 11.7% (95% CI 9.9–13.8) reported that EDTNAD use was nevertheless permitted. Clean air rule prevalence was 61.7% (95% CI 58.5–64.9) in 2009 and 67.1% (95% CI 64.7–69.5) in 2022. This increase was not statistically significant ($\chi^2 = 3.3$, $p = 0.07$). In 2022, 25.0% (95% CI 21.3–30.0) of minors lived in households permitting smoking, 28.2% (95% CI 24.7–33.6) in households permitting EDTNAD use, and 33.9% (95% CI 30.4–39.8) in households without clean air rules.

In the exploratory logistic growth modelling, best-fit growth rates differed markedly: $r = 0.19$ (inflection 2005) for Scotland, $r = 0.14$ (1994) for the United States and $r = 0.06$ (1998) for Hungary. Across the 1,395 acceptable Hungarian trajectories, the projected year at which prevalence would reach 99% of the assumed 92.9% ceiling was 2075 (IQR 2067–2085), conditional on the assumed logistic form and fixed ceiling.

4.2. Social and ethnic stratification

In 2009, 35 of 2,185 respondents (1.6%) self-identified as Roma. Among households with at least one smoker (n = 1,133), the prevalence of a complete in-home smoking ban was 42.5% (95% CI 39.6–45.5) among non-Roma and 9.1% (95% CI 0.0–18.9) among Roma respondents (OR = 0.14, 95% CI 0.04–0.45; $\chi^2 = 13.42$, $p < 0.001$, Cohen's $h = -0.81$). The adjusted model fitted significantly better than the null model ($\chi^2(5) = 53.1$, $p < 0.001$; ROC-AUC 0.62, 95% CI 0.58–0.65).

In 2025, 35 of 750 households (4.7%) were classified as Roma households. Smoking ban prevalence was 80.5% (95% CI 77.4–83.2) in non-Roma and 54.5% (95% CI 38.0–70.2) in Roma households (OR = 0.29, 95% CI 0.14–0.59; $\chi^2 = 13.0$, $p < 0.001$, Cohen's h = −0.57). EDTNAD-use ban prevalence was 68.8% (95% CI 65.2–72.1) versus 44.1% (95% CI 28.9–60.5) (OR = 0.36, 95% CI 0.18–0.72; $\chi^2 = 8.99$, $p = 0.003$). In the joint binary outcome model (n = 707; $\chi^2(16) = 247.76$, $p < 0.001$), Roma household status remained associated with lower odds of a complete smoking ban (adjusted odds ratio, aOR = 0.38, 95% CI 0.15–0.94, p = 0.04), while the association with the EDTNAD-use ban was not significant (p = 0.10). Presence of at least one smoker and of at least one EDTNAD user were the strongest negative correlates; presence of minors was positively associated with both bans. The residual conditional odds ratio between the two bans was 20.36 (95% CI 11.45–36.20), indicating a shared household-level propensity to adopt clean air rules beyond the measured determinants.

4.3. Intra-household educational configuration

Among 623 cohabiting couples in 2022, 19.6% (95% CI 16.6–23.0) allowed in-home smoking and 25.0% (95% CI 21.7–28.7) allowed in-home EDTNAD use (McNemar's $\chi^2 = 13.61$, $p < 0.001$). Allowing in-home smoking was least prevalent in dual secondary-or-higher-education (SoHE) couples (10.3%, 95% CI 6.9–15.0) and most prevalent in male-only secondary or higher education (SoHE) couples (32.1%, 95% CI 20.6–46.1). In LASSO regression (ROC-AUC 0.84), dual SoHE ($\beta = -0.14$) and female-only SoHE ($\beta = -0.16$) were stably associated with lower probability of allowing in-home smoking, while male-only SoHE showed no stable association.

Among 726 cohabiting home-owner couples in 2025, 81.1% (95% CI 78.0–83.9) reported a complete smoking ban and 68.9% (95% CI 65.3–72.2) a complete EDTNAD-use ban (McNemar's $\chi^2 = 50.61$, $p < 0.001$). Roma household status was stably associated with lower probability of both bans ($\beta = -0.14$ and -0.15), and shared financial decision-making with higher probability of both ($\beta = 0.10$ and 0.08). Presence of minors was stably positive for the smoking ban ($\beta = 0.24$), and presence of at least one smoker or EDTNAD user stably negative for both. Equal income share, joint home ownership, dual employment, financial deprivation and village residence showed no stable association with either outcome.

4.4. Recalled motivations and household decision patterns

Among home-owning cohabiting respondents (n = 807), 53.3% (95% CI 45.7–60.8) of households without a complete smoking ban (n = 168) reported that a complete ban had previously been proposed; proposals were most often joint (23.6%), then by women (17.6%) and by men (12.1%). Among households with a complete ban (n = 639), 77.0% (95% CI 73.6–80.1) reported that smoking had never been permitted indoors, and 23.0% (95% CI 19.9–26.4) that the ban was adopted after smoking had previously been allowed. Among households reporting ban adoption (n = 147), initiation was most often joint (65.0%, 95% CI 56.9–72.4); unilateral initiation by women (24.5%, 95% CI 18.2–32.1) was more common than by men (10.5%, 95% CI 6.5–16.6). Conflict was uncommon: 89.1% reported no conflict, 9.5% minor disagreement and 1.4% serious conflict. The most frequently recalled motivation was the unpleasant smell of tobacco smoke (57.9%, 95% CI 49.8–65.7), followed by protection of children (25.5%, 95% CI 19.1–33.2), quitting smoking (9.7%) and a doctor's recommendation (4.8%). EDTNAD-specific patterns were not analysed in detail, because only 34 households reported EDTNAD ban adoption.

5. Discussion

The prevalence of complete in-home smoking bans increased substantially between 2009 and 2022, but remains below levels reported for England (84.5% in 2018) and the United States (91.2% in 2022). Approximately 25% of Hungarian minors still lived in homes permitting smoking in 2022, whereas Scotland reduced children's exposure at home to 3% in 2022. Complete EDTNAD-use bans were less prevalent than smoking bans, consistent with international evidence that vaping is more frequently permitted indoors than smoking. Because roughly 12% of individuals in smoke-free homes still permit EDTNAD use, the increase in clean air rules was not statistically significant: indoor rules have not fully adapted to the changing product landscape.

Roma status was associated with lower likelihood of a complete smoking ban across three complementary analyses using different units of analysis, covariate structures and time periods. Ethnicity is not interpreted as the operative mechanism: Roma households are disproportionately characterised by the factors that most strongly predict absence of bans in every model of this dissertation (high smoking prevalence, low educational attainment and financial deprivation) and the residual association after adjustment likely reflects

unmeasured structural factors, including institutional racism, institutional and residential segregation and stigmatisation.

The finding that the female partner's education is more consequential for in-home smoking ban adoption than the male partner's appears novel in the quantitative literature; most prior studies used respondent-level education only. It is consistent with qualitative evidence documenting women's role in initiating and negotiating in-home bans, and with bargaining models of household decision-making. Of the four couple-level equality indicators examined in 2025, only shared financial decision-making was stably associated with both bans, suggesting that the process of joint decision-making matters more for ban adoption than structural equality indicators per se. The estimate that over half of households without a ban had previously proposed one appears to be the first quantitative estimate of proposed-but-not-adopted in-home smoking bans, and identifies an addressable population in which motivation has been expressed but implementation has not occurred.

5.1. Strengths and limitations

This dissertation provides the first temporal comparison of voluntary in-home smoking ban prevalence in Hungary since 2010, the first national estimates of in-home EDTNAD-use ban prevalence, and what appears to be the first quantitative evidence on in-home smoking bans among Roma populations. Methodologically, it appears to be the first study to deliberately use the cohabiting couple as the unit of analysis for this outcome.

All analyses are cross-sectional; causal inference is not possible. All data are self-reported, and self-reported bans do not perfectly correspond to actual SHS or secondhand aerosol exposure. Online panel surveys systematically exclude individuals with limited internet access or low digital literacy, precisely the groups in which ban prevalence is lowest. Roma sample sizes were small in both datasets (n = 33–35). Restriction to home-owner couples in 2025 improves interpretability but produces a more socioeconomically advantaged sample. Question wording and data-collection mode differed across surveys; datasets were therefore analysed separately and not pooled. The logistic growth projection rests on two Hungarian data points and on assumptions about functional form and ceiling. Recalled decision-making patterns are subject to recall and social desirability bias.

6. Conclusions

1. The prevalence of complete voluntary in-home smoking bans in Hungary increased from 61.7% in 2009 to 75.6% in 2022, but remains below levels reported in several Western European countries and the United States. Complete in-home EDTNAD-use bans were less prevalent than smoking bans, and the increase in comprehensive clean air rules was not statistically significant. Approximately 25% of minors lived in households permitting smoking in 2022 in Hungary (whereas in Scotland the corresponding value in 2022 is 3%). Exploratory modelling indicates a slower adoption trajectory than in Scotland or in the United States.

2. Roma households had significantly lower prevalence of complete in-home smoking bans than non-Roma households in both 2009 and 2025, after adjustment for household smoking composition and socioeconomic determinants. The disparity reflects structural determinants concentrated in Roma households rather than ethnicity as an operative mechanism.

3. Among cohabiting couples, the female partner's educational advantage was associated with voluntary in-home smoking ban adoption, whereas the male partner's was not. Shared financial decision-making was stably associated with both bans, while structural equality indicators were not.

4. Among households without a complete in-home smoking ban, over half reported that a ban had previously been proposed. Bans were most often adopted jointly, women initiated unilaterally more often than men, and conflict during adoption was uncommon. The most frequently recalled motivation was the unpleasant smell of tobacco smoke, followed by protection of children.

These findings support three practical directions. Surveillance should be initiated in Hungary and cover both in-home smoking and EDTNAD-use bans, because monitoring smoking bans alone overestimates indoor air protection. Interventions should address the structural determinants concentrated in disadvantaged and Roma households, and should target the population in which a ban has been proposed but not adopted. Health promotion should account for gendered power dynamics of household decision-making.

7. Bibliography of the candidate's publications

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