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Citation for published version (APA):

Springvloet, L., Willemsen, M. C., Mons, U., van den Putte, B., Kunst, A. E., Guignard, R., Hummel, K., Allwright, S., Siahpush, M., de Vries, H., & Nagelhout, G. E. (2015). Educational differences in associations of noticing anti-tobacco information with smoking-related attitudes and quit intentions: findings from the International Tobacco Control Europe Surveys. *Health Education Research*, 30(5), 719-730. <https://doi.org/10.1093/her/cyv037>

## Document status and date:

Published: 01/10/2015

## DOI:

[10.1093/her/cyv037](https://doi.org/10.1093/her/cyv037)

## Document Version:

Publisher's PDF, also known as Version of record

## Document license:

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# Educational differences in associations of noticing anti-tobacco information with smoking-related attitudes and quit intentions: findings from the International Tobacco Control Europe Surveys

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Received on April 1, 2015; accepted on August 6, 2015

## Abstract

This study examined educational differences in associations of noticing anti-tobacco information with smoking-related attitudes and quit intentions among adult smokers. Longitudinal data ( $N = 7571$ ) from two waves of six countries of the International Tobacco Control (ITC) Europe Surveys were included. Generalized estimating equation analyses and multiple linear and logistic regression analyses were conducted. Higher educated smokers noticed anti-tobacco information slightly more often than lower educated smokers ( $F(2) = 25.78, P < 0.001$ ). Noticing anti-tobacco information was associated with more negative smoking-related attitudes ( $\beta = 0.05, P < 0.001$ ) and more quit intentions ( $OR = 1.08, P < 0.001$ ). Among smokers without a quit intention at baseline, a positive association was found for noticing anti-tobacco information at baseline with follow-up quit intention ( $OR = 1.14, P = 0.003$ ). No other longitudinal associations were found. No educational differences

were found in the association of noticing anti-tobacco information with smoking-related attitudes but associations with quit intentions were found only among low ( $OR = 1.12, P = 0.001$ ) and high educated respondents ( $OR = 1.11, P < 0.001$ ) and not among moderate educated respondents ( $OR = 1.02, P = 0.43$ ). Noticing anti-tobacco information may positively influence quit intentions and possibly smoking-related attitudes. Lower educated smokers were as likely to be influenced by anti-tobacco information as higher educated smokers but noticed anti-tobacco information less often; increasing reach of anti-tobacco information may increase impact in this group.

## Introduction

Smoking cessation can reduce the risks for adverse health outcomes that are associated with smoking [1]. Smokers with a low educational level, however, quit smoking less often [2, 3]. One strategy to

influence quitting behaviour in populations is changing smokers' cognitions about smoking such as attitudes towards smoking and intentions to quit smoking [4–9]. However, in many countries, people with a low educational level report low intentions to quit [10, 11] and have less favourable smoking-related attitudes [12, 13]. To decrease educational differences in smoking behaviour, it is therefore important that smoking-related attitudes and quit intentions among smokers with a low educational level are improved. Anti-tobacco information could be useful to influence smoking-related attitudes and increase quit intentions but educational differences in the impact of anti-tobacco information on attitudes and quit intentions among adults are not clear yet.

Anti-tobacco information can be provided via, e.g. (mass media) campaigns or anti-smoking warnings at the point-of-sale. Exposure to these forms of anti-tobacco information is associated with increased quit intentions among adult smokers [14–16]. Anti-tobacco information can also increase anti-smoking attitudes [17, 18].

We are not aware of studies that examine educational differences in the effects of anti-tobacco information on smoking-related attitudes and quit intentions among adult smokers. In addition, only few studies focussed on educational differences in associations of anti-tobacco information with smoking cessation and the results are inconsistent [19]. One review showed that most mass media campaigns that promote smoking cessation are less effective, some equally effective and only a few were more effective among people with a low educational level compared with people with a high educational level [20]. The type and content of messages might be important for educational differences. For example, emotionally evocative or personal testimonial advertisements were more effective among people with a low and moderate educational level than people with a high educational level [21]. Sufficient population exposure, especially among lower educated people, is also suggested to be important for impact [22].

This study assessed educational differences in the associations of noticing anti-tobacco information

with smoking-related attitudes and quit intentions in six European countries: France, Germany, Ireland, the Netherlands, Scotland and the rest of the United Kingdom. Based on levels of government spending on public information campaigns aimed at tobacco control, it is apparent that all these countries invest in anti-tobacco marketing [23]. However, the level of this marketing differs between countries. In the United Kingdom, the investment is relatively high, in Germany and France the investment is relatively low and the Netherlands and Ireland are in between. The aim of this study is to examine educational differences in the associations of noticing anti-tobacco information with attitudes towards smoking and quit intentions among adult smokers in these six countries.

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## Materials and methods

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### Design and sample

Six countries of the International Tobacco Control (ITC) Europe Surveys were included in this study: France, Germany, Ireland, the Netherlands, Scotland and the rest of the United Kingdom. The number of total surveys conducted differs per country (e.g. eight for the United Kingdom and two for Scotland). Two consecutive survey waves were selected for each country for the analyses in this article (Table I). The two waves that were closest to 2007 were selected, because the last wave of the ITC Ireland surveys was conducted in 2006, while the ITC Netherlands surveys started in 2008.

Data were collected with computer-assisted telephone interviewing in France, Germany, Ireland, Scotland and the rest of the United Kingdom. In the Netherlands, both computer-assisted telephone interviewing and computer-assisted web interviewing were used in both waves. Telephone respondents were recruited using probability sampling methods with fixed line telephone numbers randomly selected from the population of each country. Dutch web respondents were recruited from a large probability-based database with respondents who had indicated their willingness to regularly participate in research. Because some differences exist between

**Table I.** Fieldwork periods and number of respondents for each country of the ITC Europe surveys

Country	Wave 1 fieldwork period	Wave 2 fieldwork period	Number of respondents (smokers at first wave) included in analyses
France	December 2006–February 2007	September 2008–November 2008	1694
Germany	July 2007–November 2007	July 2009–October 2009	1437
Ireland	December 2004–January 2005	February 2006–March 2006	734
The Netherlands	March 2008–April 2008	March 2009–May 2009	1819
			(web: 1443; telephone: 376)
Scotland	February 2006–March 2006	February 2007–April 2007	488
United Kingdom (w/o Scotland)	September 2007–February 2008	October 2008–July 2009	1399
Total			7571

the web and telephone sample [24], the analyses were adjusted for survey mode. Respondents in all countries were eligible to be included in the cohort if they had smoked at least 100 cigarettes in their lifetime and were currently smoking at least once a month.

The population of this study consisted of adults who were classified as smokers in the first wave ( $n = 8412$ ). Of these respondents, 7571 (90.0%) answered all questions that were used in this study in the first wave and were therefore included in the analyses (Table I).

## Measurements

The questions of the ITC Europe Surveys were derived from the ITC Four Country Survey [25]. Outcome measures were negative attitude towards smoking and quit intention. Negative attitude towards smoking was measured by questioning ‘What is your overall opinion about smoking?’. Answers ranged from very positive (1) to very negative (5) on a 5-point scale [9]. Intention to quit smoking was measured by questioning ‘Are you planning to quit smoking in the future?’. Answering categories were: within the next month, within the next 6 months, sometime in the future beyond 6 months and not planning to quit [26]. Subsequently, quit intention was dichotomized into planning to quit smoking within 6 months (1) versus not planning to quit smoking within 6 months (0).

Respondents who answered ‘don’t know’ were categorized as having no quit intention.

Noticing anti-tobacco information was the independent variable and was measured with the item ‘Now I would like you to think about advertising or information that talks about the dangers of smoking or encourages quitting. In the last 6 months, how often, if at all, have you noticed such advertising or information?’ [27]. Answers ranged from never (1) to very often (5) on a 5-point scale.

Education was categorized into three levels: low (no education, elementary school and lower secondary education), moderate (secondary vocational education and middle secondary education) and high (upper secondary education, university and post-graduation). However, due to differences in educational systems, educational levels were not completely comparable across countries.

Control variables were sex, age group (18–24, 25–39, 40–54, 55+) and heaviness of smoking index (HSI). HSI was calculated as the sum of the categorized number of cigarettes per day (0–10, 11–20, 21–30, 31+) and time to the first cigarette of the day (61+ min, 31–60 min, 6–30 min, 5 min or less). HSI values ranged from 0 to 6 with higher values indicating stronger nicotine dependence [28]. In addition, analyses were controlled for mode of interviewing (i.e. telephone or web) and time in sample (i.e. the number of survey waves the respondent participated in).

## Ethics

All surveys were cleared for ethics by the Office of Research Ethics of the University of Waterloo, Canada, and by the appropriate institutions in each country, if needed.

## Analyses

ANOVA and chi-square tests were used to analyse differences between countries in background characteristics and differences between educational levels in noticing anti-tobacco information, attitude towards smoking and quit intention. Dropout was examined with logistic regression analyses.

Generalized estimating equations (GEE) regression analyses were used to examine associations of noticing anti-tobacco information with attitudes towards smoking and quit intentions and to examine differences according to educational level in these associations. GEE analyses can handle multiple measurements while accounting for intra-individual correlation in observations over time [29]. In the GEE analyses, all available measurements of each respondent who was smoking at baseline ( $N=7571$ ) was treated as one single observation so that up to two observations (or smoking episodes) per respondent were included in the analyses. This resulted in 12 141 observations for the outcome smoking-related attitudes and 12 138 observations for the outcome quit intention. Quit intention was a dichotomous outcome measure, and therefore the binomial distribution and the logit link were used. Attitude towards smoking was included as a continuous outcome variable, and therefore the normal distribution and the identity link were used [30]. Survey wave was used as the repeated measures variable (i.e. to define the intra-correlation between measurements of a respondent) and the unstructured correlation structure was used because this closely approximates the true correlation structure in large study samples [31].

First, main associations of noticing anti-tobacco information with smoking-related attitudes and quit intentions were examined by including anti-tobacco information as a time-varying independent variable

in the analyses. Next, educational differences in associations were examined using a 2-way interaction term (i.e. education\*noticing anti-tobacco information). Analyses were conducted using one model per outcome measure for the main associations. The interaction term was examined in a separate model. If the overall test for the interaction term was significant, the analyses were stratified by educational level but these stratified parameters were not reported in the tables. All GEE models controlled for time-varying (i.e. education, HSI, time in sample and wave) and time-invariant control variables (i.e. sex, age group at baseline, mode of interviewing and country). The analyses regarding quit intention were additionally adjusted for attitude towards smoking.

In addition to the GEE regression analyses, ordinary multiple regression analyses were conducted among continuing smokers, using first wave predictor and covariates and second wave outcome measures. This was done to study longitudinal associations of noticing anti-tobacco information at baseline with smoking-related attitudes (linear regression) and quit intentions (logistic regression) at follow-up. As in the GEE regression analyses, educational differences in associations were examined with interaction terms. In addition, these analyses were conducted among smokers with a positive or neutral attitude towards smoking and without a quit intention at baseline, because these smokers are an important target group for anti-tobacco information. Both ordinary regression analyses were adjusted for baseline outcome measures and the same control variables as in the GEE regression analyses. Only continuing smokers who were successfully followed-up were included in these analyses, resulting in a sample of 4692 continuing smokers for the analyses on attitude towards smoking and 4727 for the analyses on quit intention.

All analyses were weighted by age and sex, to be representative for the populations in the different countries. Tests were two-sided and alpha was set at  $<0.05$ . Analyses were conducted with SPSS, version 22 (IBM Corp, Armonk, NY, USA).

**Table II.** Characteristics of study sample at first wave, stratified by country<sup>a</sup>

	Total ( <i>N</i> = 7571)	France ( <i>n</i> = 1694)	Germany ( <i>n</i> = 1437)	Ireland ( <i>n</i> = 734)	Netherlands ( <i>n</i> = 1819)	Scotland ( <i>n</i> = 488)	United Kingdom (w/o Scotland) ( <i>n</i> = 1 399)	Differences between countries
Educational level, %								
High	37.7	47.0	40.6	35.0	21.0	42.9	44.7	$\chi^2(10) = 378.89, P < 0.001^{***}$
Moderate	37.2	36.4	37.3	32.5	44.8	34.0	31.7	
Low	25.1	16.6	22.1	32.5	34.2	23.1	23.6	
Age, %								
18–24	14.7	17.7	14.3	20.0	11.4	12.3	13.7	$\chi^2(15) = 155.09, P < 0.001^{***}$
25–39	32.5	35.8	31.1	34.9	28.5	26.6	35.7	
40–54	32.8	32.3	36.0	26.4	35.0	33.2	30.4	
55+	20.0	14.2	18.6	18.7	25.1	27.9	20.2	
Sex, %								
Female	45.8	44.4	42.5	47.1	45.9	45.8	49.8	$\chi^2(5) = 16.86, P = 0.01^*$
Male	54.2	55.6	57.5	52.9	54.1	54.2	50.2	
Smoking status, %								
Daily	92.4	91.5	91.6	89.0	92.5	93.0	95.9	$\chi^2(5) = 40.10, P < 0.001^{***}$
Occasionally	7.6	8.5	8.4	11.0	7.5	7.0	4.1	
HSI, mean (SD) <sup>b</sup>	2.20 (1.54)	1.72 (1.52)	2.00 (1.53)	2.29 (1.41)	2.41 (1.56)	2.76 (1.62)	2.50 (1.44)	$F(5) = 71.05, P < 0.001^{***}$
Time in sample, mean (SD)	1.43 (1.12)	1.00 (0.0)	1.00 (0.0)	1.66 (0.48)	1.00 (0.0)	1.00 (0.0)	2.96 (1.89)	$F(5) = 1265.61, P < 0.001^{***}$

Note. <sup>a</sup>Analyses weighted by age and sex. <sup>b</sup>Measured on a 6-point scale, with higher values indicating stronger nicotine dependence. \*Significant at  $P < 0.05$ . \*\*\*Significant at  $P < 0.001$ .

## Results

### Characteristics of the study sample

A total of 7571 smokers were included in the analyses. Five thousand four hundred nine respondents were included in the follow-up wave (28.6% drop-out), of which 4734 (87.5%) were still smoking. Compared with respondents 18–24 years of age, older respondents were less likely to drop out ( $OR_{25-39y} = 0.73, P < 0.001$  /  $OR_{40-54y} = 0.50, P < 0.001$  /  $OR_{55+} = 0.42, P < 0.001$ ). Respondents who noticed anti-tobacco information more often were also less likely to drop out ( $OR = 0.95, P = 0.02$ ). Compared with United Kingdom (w/o Scotland), respondents in Scotland were more likely to drop out ( $OR = 1.63, p < 0.001$ ) and respondents in the Netherlands were less likely to drop out ( $OR = 0.58, P < 0.001$ ). No differences between respondents who were and were not included in the follow-up wave were found for sex, educational level, HSI, smoking status, attitude towards smoking and quit intention.

In total, 37.7% respondents of the study sample had a high educational level, 37.2% a moderate educational level and 25.1% a low educational level. The baseline characteristics of the respondents, stratified by country, are shown in Table II. Differences between countries were found for all background characteristics (i.e. age, sex, educational level, HSI, smoking status and time in sample).

Table III shows the baseline descriptives of noticing anti-tobacco information, negative attitude towards smoking and quit intention stratified by educational level. Noticing anti-tobacco information differed according to educational level ( $F(2) = 25.78, P < 0.001$ ) and was highest among smokers with a high educational level.

### Negative attitudes towards smoking

Univariate analyses (Table III) showed significant educational differences in negative attitudes towards smoking ( $F(2) = 84.64, P < 0.001$ ), with least negative attitudes among respondents with a low educational level. Noticing anti-tobacco information was correlated with attitude towards smoking at baseline

**Table III.** Descriptive statistics of noticing anti-tobacco information, negative attitudes towards smoking and quit intention at first wave, stratified by educational level<sup>a</sup>

	Total (N = 7571)	High-educated (n = 2851)	Moderate-educated (n = 2814)	Low-educated (n = 1905)	Difference between educational levels
Noticing anti-tobacco information, mean (SD) <sup>b</sup>	3.02 (1.28)	3.14 (1.27)	2.98 (1.27)	2.88 (1.30)	$F(2) = 25.78, P < 0.001^{***}$
Negative attitude towards smoking, mean (SD) <sup>c</sup>	3.36 (0.91)	3.52 (0.88)	3.31 (0.89)	3.19 (0.94)	$F(2) = 84.64, P < 0.001^{***}$
Intention to quit, % yes	30.6	33.9	30.5	26.0	$\chi^2(2) = 33.66, P < 0.001^{***}$

Note. <sup>a</sup>Analyses weighted by age and sex. <sup>b</sup>Measured on a 5-point scale, ranging from not at all (1) to very often (5). <sup>c</sup>Measured on a 5-point scale, ranging from very positive (1) to very negative (5). <sup>\*\*\*</sup>Significant at  $P < 0.001$ .

**Table IV.** Correlation matrix of baseline variables (Pearson correlation coefficients; N = 7571)<sup>a</sup>

	Education	Noticing anti-tobacco information	Negative attitude towards smoking	Quit intention
Education	—			
Noticing anti-tobacco information	0.08 <sup>***</sup>	—		
Negative attitude towards smoking	0.15 <sup>***</sup>	0.17 <sup>***</sup>	—	
Quit intention	0.07 <sup>***</sup>	0.11 <sup>***</sup>	0.24 <sup>***</sup>	—

Note. <sup>a</sup>Analyses weighted by age and sex. <sup>\*\*\*</sup>Significant at  $P < 0.001$ .

(Pearson Correlation Coefficient ( $r$ ) = 0.17,  $P < 0.001$ ) (Table IV).

Multivariate GEE regression analyses (Table V) showed a significant association of education with negative attitudes towards smoking ( $P < 0.001$ ). Respondents with a low ( $\beta = -0.18, P < 0.001$ ) and moderate ( $\beta = -0.10, P < 0.001$ ) educational level had less negative attitudes towards smoking compared with respondents with a high educational level. Compared with United Kingdom (w/o Scotland), respondents in France ( $\beta = 0.29, P < 0.001$ ), Ireland ( $\beta = 0.25, P < 0.001$ ) and Scotland ( $\beta = 0.13, P = 0.02$ ) had more negative attitudes toward smoking, but respondents in Germany ( $\beta = -0.29, P < 0.001$ ) and the Netherlands ( $\beta = -0.15, P = 0.003$ ) had less negative attitudes towards smoking. Noticing anti-tobacco information more often was associated with a more negative attitude towards smoking ( $\beta = 0.05, P < 0.001$ ). No educational differences in this association were found ( $P_{\text{interaction}} = 0.08$ ).

The longitudinal ordinary linear regression analysis among continuing smokers (Table V) showed

that negative attitudes towards smoking at follow-up were not different according to educational level at baseline ( $P = 0.58$ ). Compared with the United Kingdom, respondents in Germany ( $\beta = -0.11, P \leq 0.001$ ) and the Netherlands ( $\beta = -0.07, P = 0.03$ ) had less negative attitudes towards smoking at follow-up. No association between noticing anti-tobacco information at baseline and attitude towards smoking at follow-up ( $\beta = 0.02, P = 0.13$ ) and no educational differences in this association were found ( $P_{\text{interaction}} = 0.77$ ). These results were similar among smokers with a positive or neutral attitude towards smoking at baseline ( $n = 2791$ ).

### Quit intentions

Univariate analyses (Table III) showed that baseline quit intentions differed between educational levels ( $\chi^2(2) = 33.66, P < 0.001$ ), with the highest percentages of quit intentions among respondents with a high educational level. Noticing anti-tobacco information more often was correlated with having a quit intention at baseline ( $r = 0.11, P < 0.001$ ) (Table IV).

**Table V.** Results of GEE analyses and linear regression analyses for negative attitude towards smoking (pooled across countries)<sup>a</sup>

	GEE linear regression (12 141 observations) <sup>b</sup> Beta [95%-CI]	Ordinary least square linear regression predicting attitude at follow-up (4692 respondents) <sup>c</sup> Beta [95%-CI]	Ordinary least square linear regression predicting attitude at follow-up among respondents with a positive or neutral attitude at baseline (2791 respondents) <sup>d</sup> Beta [95%-CI]
<b>Main effects</b>			
Noticing anti-tobacco information	0.05 [0.03, 0.07] <sup>***</sup>	0.02 [-0.01, 0.05]	0.001 [-0.03, 0.03]
Country <sup>e</sup>	<i>P</i> < 0.001 <sup>***</sup>	<i>P</i> < 0.001 <sup>***</sup>	<i>P</i> < 0.001 <sup>***</sup>
France	0.29 [0.21, 0.36] <sup>***</sup>	0.02 [-0.02, 0.06]	0.11 [0.05, 0.16] <sup>***</sup>
Germany	-0.29 [-0.37, -0.21] <sup>***</sup>	-0.11 [-0.15, -0.07] <sup>***</sup>	-0.14 [-0.16, -0.06] <sup>***</sup>
Ireland	0.25 [0.17, 0.33] <sup>***</sup>	0.03 [-0.001, 0.06]	0.08 [0.03, 0.12] <sup>**</sup>
The Netherlands	-0.15 [-0.25, -0.05] <sup>**</sup>	-0.07 [-0.13, -0.01] <sup>*</sup>	-0.07 [-0.12, 0.01]
Scotland	0.13 [0.02, 0.24] <sup>*</sup>	0.004 [-0.03, 0.04]	0.02 [-0.03, 0.06]
United Kingdom (w/o Scotland)	0	0	0
Education <sup>f</sup>	<i>P</i> < 0.001 <sup>***</sup>	<i>P</i> = 0.58	<i>P</i> = 0.26
Low	-0.18 [-0.23, -0.13] <sup>***</sup>	-0.02 [-0.05, 0.01]	-0.001 [-0.04, 0.04]
Moderate	-0.10 [-0.14, -0.06] <sup>***</sup>	-0.01 [-0.04, 0.02]	0.03 [-0.01, 0.06]
High	0	0	0
<b>Interaction effects<sup>g</sup></b>			
Anti-tobacco <sup>h</sup> education	<i>P</i> = 0.08	<i>P</i> = 0.77	<i>P</i> = 0.37

Note. <sup>a</sup>Analyses weighted by age and sex. <sup>b</sup>Analyses among all smoking episodes of baseline smokers, adjusted for age, sex, HSI, time in sample, wave and survey mode. <sup>c</sup>Analyses among continuing smokers present in wave 1 and wave 2, adjusted for age, sex, HSI, time in sample, attitude at first wave and survey mode. <sup>d</sup>Analyses among continuing smokers present in wave 1 and wave 2 with a positive or neutral attitude at baseline, adjusted for age, sex, HSI, time in sample, attitude at first wave and survey mode. <sup>e</sup>*P*-value for overall 4 df test for country. <sup>f</sup>*P*-value for overall 2 df test for education. <sup>g</sup>*P*-values for 2 df interaction term (separate analyses). CI, confidence interval; df, degrees of freedom. <sup>h</sup>Significant at *P* < 0.05. <sup>\*</sup>Significant at *P* < 0.01. <sup>\*\*</sup>Significant at *P* < 0.001. <sup>\*\*\*</sup>Significant at *P* < 0.001.

Multivariate GEE regression analyses (Table VI) also showed an association between education and quit intention (*P* = 0.001) and showed that respondents with a low educational level were less likely to intend to quit within 6 months than respondents with a high educational level (OR = 0.80, *P* < 0.001). Compared with United Kingdom (w/o Scotland), respondents in Ireland (OR = 1.54, *P* < 0.001) and Scotland (OR = 1.49, *P* < 0.001) were more likely to intend to quit. Noticing anti-tobacco information more often was positively associated with quit intentions (OR = 1.08, *P* < 0.001). The association between noticing anti-tobacco information and quit intentions differed according to educational level (*P*<sub>interaction</sub> = 0.003). Stratified analyses showed that noticing anti-tobacco information more often was positively associated with quit intentions among respondents with a low (OR = 1.12,

*P* = 0.001) and high educational level (OR = 1.11, *P* < 0.001) but not among respondents with a moderate educational level (OR = 1.02, *P* = 0.43).

Among continuing smokers, no significant longitudinal association of educational level at baseline with quit intention at follow-up (*P* = 0.21) was found (Table VI). Compared with United Kingdom, respondents in France (OR = 0.72, *P* = 0.02), Germany (OR = 0.56, *P* < 0.001), the Netherlands (OR = 0.61, *P* = 0.02) and Scotland (OR = 0.63, *P* = 0.02) were less likely to intend to quit at follow-up. The association of noticing anti-tobacco information at baseline with quit intention at follow-up was not significant (OR = 1.01, *P* = 0.68) and no educational differences in this association were found (*P*<sub>interaction</sub> = 0.48). Among smokers without a quit intention at baseline (*n* = 3418), there was a positive association between



**Table VI.** Results of GEE analyses and logistic regression analyses for intention to quit (pooled across countries)<sup>a</sup>

	GEE logistic regression (12 138 observations) <sup>b</sup>	Maximum likelihood logistic regression predicting quit intention at follow-up (4727 respondents) <sup>c</sup>	Maximum likelihood logistic regression predicting quit intention at follow-up among respondents without quit intention at baseline (3418 respondents) <sup>d</sup>
	OR [95%-CI]	OR [95%-CI]	OR [95%-CI]
<b>Main effects</b>			
Noticing anti-tobacco information	1.08 [1.04, 1.11] <sup>***</sup>	1.01 [0.95, 1.08]	1.14 [1.05, 1.24] <sup>**</sup>
Country <sup>e</sup>	$P < 0.001$ <sup>***</sup>	$P = 0.002$ <sup>**</sup>	$P = 0.01$ <sup>*</sup>
France	1.13 [0.96, 1.33]	0.72 [0.54, 0.95] <sup>*</sup>	0.62 [0.43, 0.88] <sup>**</sup>
Germany	0.95 [0.80, 1.13]	0.56 [0.42, 0.76] <sup>***</sup>	0.57 [0.39, 0.84] <sup>**</sup>
Ireland	1.54 [1.30, 1.83] <sup>***</sup>	0.97 [0.72, 1.30]	0.74 [0.50, 1.10]
The Netherlands	0.81 [0.63, 1.06]	0.61 [0.40, 0.93] <sup>*</sup>	0.50 [0.28, 0.89] <sup>*</sup>
Scotland	1.49 [1.20, 1.84] <sup>***</sup>	0.63 [0.43, 0.92] <sup>*</sup>	0.38 [0.20, 0.71] <sup>**</sup>
United Kingdom (w/o Scotland)	1	1	1
Education <sup>f</sup>	$P = 0.001$ <sup>**</sup>	$P = 0.21$	$P = 0.58$
Low	0.80 [0.71, 0.90] <sup>***</sup>	0.84 [0.68, 1.03]	0.90 [0.68, 1.19]
Moderate	0.92 [0.84, 1.02]	0.90 [0.76, 1.06]	1.04 [0.83, 1.31]
High	1	1	1
<b>Interaction effects<sup>g</sup></b>			
Anti-tobacco <sup>*</sup> education	$P = 0.003$ <sup>**</sup>	$P = 0.48$	$P = 0.36$

Note. <sup>a</sup>Analyses weighted by age and sex. <sup>b</sup>Analyses among all smoking episodes of baseline smokers, adjusted for age, sex, HSI, time in sample, attitude, wave and survey mode. <sup>c</sup>Analyses among continuing smokers present in wave 1 and wave 2, adjusted for age, sex, HSI, time in sample, survey mode and attitude and intention at first wave. <sup>d</sup>Analyses among continuing smokers present in wave 1 and wave 2 with no baseline intention to quit, adjusted for age, sex, HSI, time in sample, survey mode and attitude and intention at first wave. <sup>e</sup> $P$ -value for overall 4 df test for country. <sup>f</sup> $P$ -value for overall 2 df test for education. <sup>g</sup> $P$ -values for 2 df interaction term (separate analyses). OR, odds ratio; CI, confidence interval; df, degrees of freedom. \*Significant at  $P < 0.05$ . \*\*Significant at  $P < 0.01$ . \*\*\*Significant at  $P < 0.001$ .

noticing anti-tobacco information more often at baseline and having developed a quit intention at follow-up (OR = 1.14,  $P = 0.003$ ). This association was not different according to educational level ( $P_{\text{interaction}} = 0.36$ ).

## Discussion

In this study, noticing anti-tobacco information more often was associated with a more negative attitude towards smoking and a higher intention to quit among adult smokers in a pooled analysis of data from six European countries with varying levels of anti-tobacco marketing. In addition, noticing anti-tobacco information more often at baseline was positively associated with having developed a quit intention at follow-up among continuing smokers

without an intention to quit at baseline. Regarding educational disparities, it was found that associations with negative attitudes towards smoking were similar for people with a high, moderate and low educational level. However, associations of noticing anti-tobacco information with quit intentions were only found for people with a low or high educational level but not for the ones with a moderate educational level. However, this educational difference was only small and not shown in the longitudinal association of noticing anti-tobacco information at baseline with quit intention at follow-up.

## Potential of anti-tobacco information

Associations of anti-tobacco information with attitude towards smoking and quit intentions among adult smokers are also found in other studies

[15–18]. This is promising, because attitudes and quit intentions are important determinants for smoking cessation [4–9]. Although the associations of noticing anti-tobacco information at baseline with attitudes towards smoking and quit intention at follow-up were in the same direction, on the whole sample of continuing smokers these longitudinal associations were not significant. This may indicate that the results of the associations could partly reflect reversed causality (people who are willing to quit may notice anti-tobacco information more often). Additionally, differences in the analyses samples need to be considered. The longitudinal associations were examined among continuing smokers only, while in the GEE analyses associations were examined among both continuing smokers and those who quit smoking between waves. Assuming that attitudes towards smoking and quit intentions are associated with smoking cessation, then weaker associations of noticing anti-tobacco information with these measures are to be expected when solely examining continuing smokers. However, because other studies with a longitudinal design and shorter follow-up periods found significant effects on attitudes and quit intentions [14, 17, 18], the results of this study on the other hand may indicate that noticing anti-tobacco information more often may positively influence attitudes towards smoking and quit intentions on the short-term. This would highlight the importance of repeated or continued exposure to anti-tobacco information, as is also recommended in other studies [22, 32, 33]. This implies that anti-tobacco information, such as campaigns, should be sustained over time.

An important finding of this study is that noticing anti-tobacco information more often was associated with developing an intention to quit smoking at follow-up among continuous smokers without quit intention at baseline. Because intention to quit is a major predictor of smoking cessation [4–6, 9], exposure to anti-tobacco information may, eventually, lead to smoking cessation among this group.

Although significant associations were found, these associations were quite small, as is also seen in other studies on quit intentions [15, 16]. However, because population-level campaigns can have a large reach, population impact may still be relevant [34].

## Educational differences

Pooled across the six countries, people with a low and moderate educational level had slightly less negative attitudes towards smoking and were less likely to intend to quit compared with people with a high educational level. This is in line with the findings of previous studies [10–12]. The associations of anti-tobacco information with attitude did not differ according to educational level. Some significant educational differences were found for the association with quit intention but these were only small and only differences with the moderate educated group were found. In addition, educational differences were not present in the longitudinal analyses among continuing smokers. The practical importance of these educational differences is, therefore, negligible.

Finding similar associations for respondents with a high and low educational level indicates that noticing anti-tobacco information may be as beneficial for people with a low educational level as for those with a higher education. We are not aware of previous studies that focus on educational differences in the association of anti-tobacco information with attitude towards smoking or quit intention. However, this finding is in line with a review that showed that, when exposure is sufficient, anti-tobacco information can equally influence smoking behaviour of people with a low and high educational level [22]. Because smokers with a lower educational level are an important target group for smoking cessation, this is a promising result. However, it also indicates that anti-tobacco information is not likely to contribute to a decrease in educational differences in (determinants of) smoking cessation.

This study did not distinguish between different delivery modes or content components of anti-tobacco information, which may have different effects according to educational level. For example, emotionally evocative or personal testimonial advertisements are suggested to be more effective among people with a low or moderate educational level compared with people with a high educational level [21]. Focussing on different content components and delivery modes in future studies may

provide more insight into how anti-tobacco information can be most effectively provided to smokers with a lower educational level, which may contribute to decreasing educational differences in (determinants of) smoking cessation.

Self-reported noticing of anti-tobacco information was slightly lower among smokers with a lower educational level. Explanations might be that there are educational differences in remembering or awareness of anti-tobacco information. One study, e.g. showed that smokers with a lower educational level less often recalled advertisements that focus on how to quit compared with advertisements on why to quit [35]. Although the difference in noticing anti-tobacco information was small, this may imply that when exposure among smokers with a low educational level is increased, this could increase the population impact of anti-tobacco information in this group. This may prevent increasing educational differences in (determinants of) smoking cessation. Future research should therefore focus on channels of delivering anti-tobacco information that are most effective in reaching smokers with a lower educational level.

### **Strengths and limitations**

An important strength of this study is that we examined anti-tobacco information in six countries with varying levels of anti-tobacco marketing. This ensures that there is sufficient variance in the primary independent variable. Another strength was the use of longitudinal and population data.

However, some limitations of the study also need to be mentioned. The study relied on self-reported measurements and all concepts were measured with one item. In addition, the item to measure exposure to anti-tobacco information was quite broad and, consequently, it is not known to which anti-tobacco information respondents were exactly exposed. Stop-smoking medication advertisements and warning labels on cigarette packages can, for example, also be part of anti-tobacco information. Also, it was only measured whether respondents noticed anti-tobacco information and not whether they have understood the information. Next, recall bias may have been a problem, because people were asked

whether they have seen anti-tobacco information in the last six months. Last, dropout between the two waves was high and selective to age, country and noticing anti-tobacco information. Respondents who noticed anti-tobacco information more often were less likely to drop out. This implies that the findings overestimate the extent of noticing anti-tobacco information. However, this is not expected to have an influence on the associations with attitude, intention and education, which was the focus of this study. By including all smoking episodes of baseline smokers in the GEE regression analyses and by adjusting the analyses for predictors of dropout, an attempt to reduce bias was made.

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### **Conclusion and practical implications**

In the six countries studied, on average, people with a low educational level have less negative attitudes towards smoking and are less likely to have quit intentions compared with people with a high educational level. Acknowledging that the observational design of this study does not allow for establishing causality, the results are in line with other studies and suggest that noticing anti-tobacco information more often is associated with increased negative attitudes towards smoking and increased quit intentions at the short-term. However, anti-tobacco information is not likely to contribute to a decrease in educational differences in these determinants of smoking cessation. Increasing reach of anti-tobacco information among people with a lower educational level may prevent increasing educational differences due to anti-tobacco information on the population level.

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### **Acknowledgements**

Several members of the ITC Project team at the University of Waterloo have assisted in all stages of conducting the ITC Europe surveys, which we gratefully acknowledge. In particular, we thank Geoffrey Fong (Chief Principal Investigator of the ITC Project) and Thomas Agar (Project Manager of ITC Europe).

## Funding

The ITC Europe surveys were supported by grants from the French Institute for Health Promotion and Health Education (INPES), the French National Cancer Institute (INCa), Observatoire Français des drogues et toxicomanies (OFDT) (06/2d0708/191-2-LL) (France), The Netherlands Organization for Health Research and Development (ZonMw) (The Netherlands), German Federal Ministry of Health, Dieter Mennekes-Umweltstiftung and Germany Cancer Research Center (DKFZ) (Germany), US National Cancer Institute (R01 CA090955 and P50 CA111236), Cancer Research United Kingdom (C312/A3726 and C312/A6465), and Pfizer (Ireland), Cancer Research United Kingdom (C312/A6465/A11039) (UK), NHS Health Scotland (RE065), Flight Attendants' Medical Research Institute (FAMRI), Cancer Research United Kingdom (C312/A6465) (Scotland). The ITC Project is supported by the US National Cancer Institute (P50 CA111236, R01 CA100362 and P01 CA138389) and the Canadian Institutes of Health Research (57897, 79551, 115016). This article is a deliverable within the SILNE Project 'Tackling socioeconomic inequalities in smoking: Learning from natural experiments by time trend analyses and cross-national comparisons'. The SILNE Project is funded by the European Commission through (FP7 HEALTH-F3-2011-278273). The funders had no involvement in the design of the study, the collection, analysis and interpretation of the data, the writing of the article or the decision to submit the article for publication.

## Conflict of interest statement

None declared.

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