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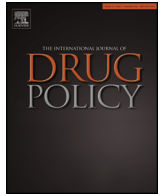
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## Research paper

# E-cigarette advertisements, and associations with the use of e-cigarettes and disapproval or quitting of smoking: Findings from the International Tobacco Control (ITC) Netherlands Survey



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## ABSTRACT

**Background:** Much attention has been directed towards the possible effects of e-cigarette advertisements on adolescent never smokers. However, e-cigarette advertising may also influence perceptions and behaviours of adult smokers. The aim of our study was to examine whether noticing e-cigarette advertisements is associated with current use of e-cigarettes, disapproval of smoking, quit smoking attempts, and quit smoking success.

**Methods:** We used longitudinal data from two survey waves of the ITC Netherlands Survey among smokers aged 16 years and older ( $n = 1198$ ). Respondents were asked whether they noticed e-cigarettes being advertised on television, on the radio, and in newspapers or magazines in the previous 6 months.

**Results:** There was a significant increase in noticing e-cigarette advertisements between 2013 (13.3%) and 2014 (36.0%), across all media. The largest increase was for television advertisements. There was also a substantial increase in current use of e-cigarettes (from 3.1% to 13.3%), but this was not related to noticing advertisements in traditional media ( $OR = 0.99$ ,  $p = 0.937$ ). Noticing advertisements was bivariately associated with more disapproval of smoking ( $Beta = 0.05$ ,  $p = 0.019$ ) and with a higher likelihood of attempting to quit smoking ( $OR = 1.37$ ,  $p = 0.038$ ), but these associations did not reach significance in multivariate analyses. There was no significant association between noticing advertisements and quit smoking success in either the bivariate or multivariate regression analysis ( $OR = 0.92$ ,  $p = 0.807$ ).

**Conclusion:** Noticing e-cigarette advertisements increased sharply in the Netherlands between 2013 and 2014 along with increased e-cigarette use, but the two appear unrelated. The advertisements did not seem to have adverse effects on disapproval of smoking and smoking cessation.

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## Introduction

Electronic cigarettes (also called e-cigarettes) aerosolize liquid mixtures that often contain nicotine, flavorants, and humectants (e.g. propylene glycol and/or vegetable glycerin). E-cigarette use significantly reduces the exposure to tobacco-related carcinogens and toxicants when used instead of regular cigarettes (McNeill, Brose, Calder, & Hitchman, 2015). However, they are not harmless (Goniewicz et al., 2014; Rom, Pecorelli, Valacchi, & Reznick, 2014). In many countries, advertising of e-cigarettes is not subject to the same restrictions as those imposed on the advertising of regular cigarettes. Advertising of e-cigarettes through media where tobacco advertising is no longer allowed – such as on the radio and on television – has attracted the attention and concern from health advocates. There are fears that such marketing may renormalize smoking and encourage adolescent never smokers to take up smoking (e.g. De Andrade, Hastings, & Angus, 2013; Fairchild, Bayer, & Colgrove, 2014; O'Dowd, 2014). However, the influence of advertising of e-cigarettes on adult smokers is often overlooked, while they are the primary target group of e-cigarette advertisements.

Advertisements for e-cigarettes frequently present these products as an alternative to regular cigarettes, that is cheaper and safer than cigarettes, can be used in places where smoking is not allowed, and may help to stop smoking (De Andrade, Hastings, Angus, Dixon, & Purves, 2013; Richardson, Ganz, Stalgaitis, Abrams, & Vallone, 2014; Richardson, Ganz, & Vollone, 2014). Through such messages e-cigarette advertisements may not only stimulate smokers to use e-cigarettes, but also to quit smoking regular cigarettes, either using e-cigarettes instead or using them as a transition to complete abstinence from nicotine. There is also a possibility that e-cigarette advertisements may stimulate e-cigarette use in conjunction with regular cigarettes, for example, using e-cigarettes where regular smoking is prohibited. Glamorous presentations of e-cigarettes in advertisements may increase approval of regular smoking because of the resemblance of cigarettes and e-cigarettes. However, it is also possible that advertisements that communicate that e-cigarettes are healthier and safer than regular cigarettes increase disapproval of regular smoking.

Various empirical studies examining the effects of e-cigarette advertisement exposure on adult smokers have emerged over the past two years. Cross-sectional studies that examined self-reported exposure to e-cigarette advertisements found that exposure was associated with more ever use of e-cigarettes (Harrington et al., 2014), more use of e-cigarettes because of health reasons (Harrington et al., 2014), and with more misconceptions about nicotine in e-cigarettes (Sanders-Jackson, Tan, Bigman, & Henriksen, 2014). Exposure was not associated with perceived harm of secondhand vapour, but positive evaluation of the advertisements was associated with lower perceived harm of secondhand vapour (Tan, Bigman, Mello, & Sanders-Jackson, 2015). Cross-sectional studies that exposed all participants to e-cigarette advertisements found that adult smokers reported an urge to smoke, thoughts about smoking, and thoughts about quitting after seeing the advertisements (Kim, Lee, Shafer, Nonnemaker, & Makarenko, 2015), and that a positive evaluation of the advertisements was associated with more intention to use e-cigarettes (Trumbo & Kim, 2015). Experimental studies among adult smokers have found that some e-cigarette advertisements elicit more interest in trying e-cigarettes (Pepper, Emery, Ribisl, Southwell, & Brewer, 2014; Pepper, Ribisl, Emery, & Brewer, 2014) and a greater urge to smoke tobacco (Maloney & Cappella, 2015) than other e-cigarette advertisements. Also, an experimental study among adult smokers and non-smokers showed that exposure to e-cigarette advertisements was associated with more interest in

e-cigarette trial than exposure to snus advertisements, particularly among smokers (Smith, Bansal-Travers, O'Connor, Goniewicz, & Hyland, 2015). To the best of our knowledge, no longitudinal studies have examined effects of exposure to e-cigarette advertisements on adult smokers. Also, no studies examined effects of exposure to e-cigarette advertisements on disapproval of smoking and quitting smoking.

Although e-cigarettes have been on the Dutch market since 2007, advertising for these products was not allowed from January 2008 to June 2012. During this period, e-cigarette use remained low among Dutch tobacco smokers, but increased four-fold between 2013 (4% current use) and 2014 (16%) which corresponds to the time when e-cigarette advertisements started to appear on television (Hummel et al., 2015). Compared to other European countries, the Netherlands had the highest percentage of people who had seen e-cigarette advertisements in the past year in 2014 (69% in the Netherlands compared to 39% average in Europe; European Commission, 2015). This difference is particularly pronounced for noticing e-cigarette advertisements on television. Contrary to e-cigarette advertisements, tobacco advertisements are not allowed on Dutch television. The Dutch tobacco law allows advertising inside and outside specialized tobacco shops, but completely bans tobacco advertising from television, radio, newspapers and magazines (Heijndijk & Willemsen, 2015). The ban on tobacco advertising does not apply to e-cigarettes because e-cigarettes are not regulated as tobacco products in the Netherlands. Tobacco smoking prevalence is slightly lower in the Netherlands (23%) than in most other European countries (26% on average) (European Commission, 2015).

In this paper, we present data from a longitudinal survey of a representative sample of adult tobacco smokers in the Netherlands followed between 2013 and 2014. We investigate the following research question: Is noticing advertisements for e-cigarettes associated with current use of e-cigarettes, disapproval of smoking, quit smoking attempts, and quit smoking success?

## Methods

### Sample

We used longitudinal data from two waves of the International Tobacco Control (ITC) Netherlands Survey. The cohort started in 2008 and included smokers aged 16 years and older who at enrollment smoked at least monthly and had smoked at least 100 factory-made cigarettes and/or roll-your-own cigarettes in their lives. The surveys were administered through the internet by the research firm TNS NIPO which used a quota sample of respondents from a large probability-based web database to get a sample that is representative of Dutch smokers (Nagelhout et al., 2010). Respondents received compensation for their participation in each survey by earning points for every answered question. The points could be exchanged for money, which ranged from five to seven Euros for each survey.

In the current study, we used data from the survey waves in May/June 2013 ('baseline survey') and May/June 2014 ('follow-up survey'). The baseline survey included 1970 respondents. For the follow-up survey, all respondents from baseline were recontacted of which 1607 participated (81.6% retention). Given the focus of the current study on adult smokers, 352 cohort members were excluded because they were former smokers at the baseline survey of the present paper. Additionally, 57 respondents were excluded because they indicated to have used e-cigarettes at baseline, but indicated to have never used e-cigarettes in the past at follow-up, which is inconsistent. The final sample included 1198 respondents who were all smokers of factory-made and/or roll-your-own cigarettes at baseline.

## Measures

The questions used for the ITC Netherlands Survey were adapted from the conceptual model and questionnaire of the ITC Four Country Survey (Fong et al., 2006). All measures were assessed at both the baseline and the follow-up survey.

*Noticing e-cigarette advertisements* was assessed by asking “In the last 6 months, have you noticed e-cigarettes being advertised in any of the following places: On television? On radio? In newspapers or magazines?” Respondents could answer with “yes”, “no”, or “don’t use television/radio/newspapers or magazines”. The three items were combined into one dichotomous variable: did not notice e-cigarettes being advertised in any traditional media (0) versus did notice e-cigarettes being advertised in any traditional media (1).

*Current use of e-cigarettes* was assessed by asking “Have you ever tried using an electronic cigarette?” Respondents who answered “yes” were asked “How often do you currently use an electronic cigarette?” Respondents who answered that they currently used e-cigarettes at least monthly were considered current users (1) and respondents who used e-cigarettes less often or not at all were not considered current users (0) (Adkison et al., 2013; Hummel et al., 2015).

*Disapproval of smoking* was assessed with three statements: “Your family disapproves of smoking”, “Your friends disapprove of smoking”, and “Society disapproves of smoking”. The last statement has been used in previous research (Hammond, Fong, Zanna, Thrasher, & Borland, 2006) and the other ones were added to gain a more complete picture of disapproval of smoking in the social environment of respondents. Respondents could indicate whether they agreed with these statements on a five-point Likert scale ranging from “strongly disagree” (1) to “strongly agree” (5). A mean score of these statements was used as an index of disapproval of smoking (Cronbach’s alpha = 0.63).

*Quit smoking attempts* were measured with the question “Have you made any attempts to stop smoking since the last survey?” (Hyland et al., 2006). Respondents who answered “yes” were defined as having made a quit smoking attempt if they also indicated that this attempt started within the last six months (1) and otherwise were defined as not having made a quit smoking attempt within the last six months (0).

*Quit smoking success* was assessed by asking respondents who had attempted to quit in the last six months whether they were back to smoking or still stopped. Respondents who were still stopped or who were back to smoking but reported smoking less than once a month, were defined as having successfully quit smoking (1), while others were defined as not having successfully quit smoking (0) (Hyland et al., 2006).

*Control variables* (all as measured at baseline) were gender, age, education, regular cigarette smoking status, e-cigarette using status, noticing anti-tobacco information, and noticing advertisements for cessation medications. Age was categorized into 16–24, 25–39, 40–54, and 55 years and older. Education was categorized in three levels: low (primary education and lower prevocational secondary education), moderate (middle prevocational secondary education and secondary vocational education), and high (senior general secondary education, pre-university education, and higher professional education). Regular cigarette smoking status was categorized into daily smoker and non-daily smoker. E-cigarette using status was categorized into current user (at least monthly), past user, and never user. Noticing anti-tobacco information was assessed with the question “In the last 6 months, how often, if at all, have you noticed advertising or information that talks about the dangers of smoking, or encourages quitting?” Noticing advertisements for cessation medications was assessed with the question “In the last month, how often, if at all, have you noticed

advertisements for cessation medications?” The last two questions could be answered on a four-point scale ranging from “never” (0) to “often” (3).

## Ethics

The ITC Netherlands Surveys were cleared for ethics by the Office of Research Ethics of the University of Waterloo in Canada.

## Analyses

All analyses were performed with SPSS version 19.0 and were weighted by age and gender to be representative of tobacco smokers in the Netherlands. Differences between respondents who were followed-up and respondents who were not followed-up were tested with Chi-square tests and *t*-tests.

Bivariate and multivariate regression analyses were used to examine correlates of current use of e-cigarettes, quit smoking attempts, quit smoking success (all with logistic regression), and disapproval of smoking (with linear regression). For each dependent variable (except for quit smoking success) three models were estimated: (A) a bivariate model in which noticing advertisements for e-cigarettes in the last six months at follow-up were correlated with the dependent variables at follow-up, (B) a model that also adjusted for the baseline value of the dependent variable (this was not done for quit smoking success), and (C) a model that also adjusted for the above described control variables as measured at baseline and for the number of waves a respondent had participated in at follow-up since the cohort started in 2008 (to correct for ‘time in sample’ effects). In the analysis for quit smoking success it was not possible to adjust for the baseline value of the dependent variable, because all respondents were smokers (not quit or not quit successfully) at baseline.

## Results

### Sample characteristics

Table 1 shows the sample characteristics at baseline for the study sample ( $n = 1198$ ) and the respondents who did not participate in the follow-up survey or who were excluded from the analyses ( $n = 772$ ). Comparing both groups, respondents from the study sample were significantly older, they were less often high educated, more often current or past users of e-cigarettes, and more often noticed anti-tobacco information and advertisements for cessation medications. Respondents did not differ on noticing advertisements for e-cigarettes at baseline.

Detailed information about changes in e-cigarette using status and regular cigarette smoking status in our sample between baseline and follow-up is given in Table 2 (unweighted data). The large majority of the study sample had never used e-cigarettes at baseline (82.2%) and still smoked regular cigarettes at follow-up (88.9%). Overall, 29.4% tried e-cigarettes but were not using them at follow-up, while 13.7% were current e-cigarette users at follow-up. About half of the current e-cigarette users at baseline remained a current e-cigarette user at follow-up, while the other half stopped using e-cigarettes. More than eight out of ten current e-cigarette users at follow-up were also smoking regular cigarettes at follow-up. Not shown in the table is that 34.9% of current e-cigarette users at baseline and 42.1% of current e-cigarette users at follow-up were daily e-cigarette users.

### Noticing e-cigarette advertisements

Table 3 shows that noticing e-cigarette advertisements increased significantly between baseline in 2013 (13.3%) and

**Table 1**

Differences in sample characteristics at baseline by whether respondents were followed up and included in the analyses or not (unweighted data).

	Respondents who were followed up and included in the analyses (n = 1198)	Respondents who were not followed up or excluded from the analyses (n = 772)	
Gender			
Female (%)	49.3	48.2	$\chi^2 = 0.25$
Male (%)	50.7	51.8	
Age group			
16–24 years (%)	17.2	15.4	$\chi^2 = 26.48^{***}$
25–39 years (%)	28.0	39.0	
40–54 years (%)	26.5	23.2	
55 years and older (%)	28.2	22.4	
Educational level			
Low (%)	26.4	23.2	$\chi^2 = 14.10^{***}$
Moderate (%)	47.2	42.5	
High (%)	26.4	34.3	
Regular cigarette smoking status (current smokers only)			
Daily smoker of regular cigarettes (%)	90.7	90.4	$\chi^2 = 0.02$
Non-daily smoker of regular cigarettes (%)	9.3	9.6	
E-cigarette using status			
Current user of e-cigarettes (%)	3.6	0.6	$\chi^2 = 61.08^{***}$
Past user of e-cigarettes (%)	14.2	4.2	
Never user of e-cigarettes (%)	82.2	95.2	
Noticed anti-tobacco information (M, SD)	1.14 (1.00)	1.05 (0.96)	$t = -2.03^*$
Noticed advertisements for cessation medications (M, SD)	1.11 (0.99)	1.01 (0.95)	$t = -2.26^*$
Noticed advertisements for e-cigarettes			
Yes (%)	12.9	13.5	$\chi^2 = 0.12$
No (%)	87.1	86.5	

\*  $p < 0.05$ .\*\*  $p < 0.01$ .\*\*\*  $p < 0.001$ .**Table 2**

Current, past, and never use of e-cigarettes at baseline by regular cigarette smoking status and e-cigarette using status at follow-up (unweighted data).

	Current user of e-cigarettes at baseline (n = 43)	Past user of e-cigarettes at baseline (n = 170)	Never user of e-cigarettes at baseline (n = 984)	Total (n = 1197)
<b>Smoker</b> of regular cigarettes and current user of e-cigarettes at follow-up (%)	41.9	16.5	9.8	11.9
<b>Smoker</b> of regular cigarettes and past user of e-cigarettes at follow-up (%)	44.2	74.7	17.5	26.6
<b>Smoker</b> of regular cigarettes and never user of e-cigarettes at follow-up (%)	0.0	0.0	61.4	50.5
<b>Former smoker</b> of regular cigarettes and current user of e-cigarettes at follow-up (%)	4.7	2.4	1.6	1.8
<b>Former smoker</b> of regular cigarettes and past user of e-cigarettes at follow-up (%)	9.3	6.5	1.9	2.8
<b>Former smoker</b> of regular cigarettes and never user of e-cigarettes at follow-up (%)	0.0	0.0	7.8	6.4

**Table 3**

Difference in noticing e-cigarette advertisement, current use of e-cigarettes, disapproval of smoking, and quit attempts between baseline and follow-up (weighted data, n = 1198).

	Baseline (May/June 2013)	Follow-up (May/June 2014)	
Noticed e-cigarette advertisements (total) (%)	13.3	36.0	$\chi^2 = 163.4^{***}$
Noticed e-cigarette advertisements on television (%)	6.6	27.4	$\chi^2 = 181.28^{***}$
Noticed e-cigarette advertisements in newspapers or magazines (%)	8.2	16.7	$\chi^2 = 17.43^{***}$
Noticed e-cigarette advertisements on the radio (%)	1.4	4.0	$\chi^2 = 168.22^{***}$
Current use of e-cigarettes (%)	3.1	13.3	$\chi^2 = 81.59^{***}$
Disapproval of smoking (M, SD) <sup>a</sup>	3.08 (0.77)	3.12 (0.79)	$t = -2.40^*$
Quit attempts (%)	12.7	19.2	$\chi^2 = 18.67^{***}$

<sup>a</sup> On a scale from 1 to 5.\*  $p < 0.05$ .\*\*  $p < 0.01$ .\*\*\*  $p < 0.001$ .

follow-up in 2014 (36.0%). The increase was especially large for noticing e-cigarette advertisements on television (from 6.6% to 27.4%). Noticing e-cigarette advertisements on the radio also increased significantly, but remained very low (4.0%) at follow-up.

#### Use of e-cigarettes

Table 3 shows that current use of e-cigarettes increased more than four-fold from 3.1% at baseline to 13.3% at follow-up one year

later. As shown in Table 4, noticing e-cigarette advertisements in the last six months at follow-up was not significantly associated with current use of e-cigarettes at follow-up (Model 1C: OR = 0.99,  $p = 0.937$ ).

In additional analyses (not shown in tables) we examined whether noticing e-cigarette advertisements was associated with starting ever use of e-cigarettes between baseline and follow-up. This association was not significant, including when adjusting for all control variables (OR = 0.86,  $p = 0.332$ ). Noticing e-cigarette

**Table 4**

Bivariate and multivariate regression analyses of correlates of current use of e-cigarettes and disapproval of smoking at follow-up (weighted data).

Baseline value of dependent variable	Current use of e-cigarettes (n = 1175)			Disapproval of smoking (n = 1134)		
	Model 1A OR (95% CI) <sup>a</sup>	Model 1B OR (95% CI) <sup>b</sup>	Model 1C OR (95% CI) <sup>c</sup>	Model 2A Beta (95% CI) <sup>a</sup>	Model 2B Beta (95% CI) <sup>d</sup>	Model 2C Beta (95% CI) <sup>e</sup>
Noticed e-cigarette advertisements in the last 6 months at follow-up						
Yes	1.11 (0.79–1.57)	1.00 (0.70–1.44)	0.99 (0.68–1.43)	0.05 (0.01–0.10) <sup>*</sup>	0.02 (–0.02 to 0.06)	0.01 (–0.03 to 0.05)
No	1.00	1.00	1.00	0.00	0.00	0.00

<sup>\*</sup>  $p < 0.05$ .<sup>\*\*</sup>  $p < 0.01$ .<sup>\*\*\*</sup>  $p < 0.001$ .<sup>a</sup> Unadjusted regression coefficient (bivariate analysis).<sup>b</sup> Adjusted for current use of e-cigarettes (measured at baseline).<sup>c</sup> Adjusted for current use of e-cigarettes, gender, age group, educational level, regular cigarette smoking status, noticed anti-tobacco information, noticed advertisements for cessation medications (all as measured at baseline), and time in sample (calculated for the follow-up survey).<sup>d</sup> Adjusted for disapproval of smoking (measured at baseline).<sup>e</sup> Adjusted for disapproval of smoking, gender, age group, educational level, regular cigarette smoking status, e-cigarette using status, noticed anti-tobacco information, noticed advertisements for cessation medications (all as measured at baseline), and time in sample (calculated for the follow-up survey).

advertisement was similarly not associated with starting current use of e-cigarettes between baseline and follow-up (OR = 0.85,  $p = 0.458$ ).

#### Disapproval of smoking

Disapproval of smoking increased between baseline and follow-up (Table 3). Table 4 shows that noticing e-cigarette advertisements was significantly associated with more disapproval of smoking in the bivariate regression analysis (Model 2A: Beta = 0.05,  $p = 0.019$ ), but not in the analysis that was adjusted for baseline disapproval of smoking (Model 2B: Beta = 0.02,  $p = 0.249$ ) or in the fully adjusted analysis (Model 2C: Beta = 0.01,  $p = 0.612$ ).

#### Quit attempts

Quit attempts in the last six months increased between baseline and follow-up (Table 3). As depicted in Table 5, respondents who noticed e-cigarette advertisements in the last six months at follow-up were more likely to have attempted to quit smoking in the last six months according to a bivariate analysis (Model 3A: OR = 1.37,  $p = 0.038$ ). However, this association was not significant when the analysis was adjusted for baseline quit attempts (Model 3B: OR = 1.27,  $p = 0.121$ ) or when the analysis was adjusted for all control variables (Model 3C: OR = 1.21,  $p = 0.243$ ).

#### Quit success

From the respondents who attempted to quit smoking in the last six months before follow-up ( $n = 254$ ), 24.1% had quit smoking successfully. Table 5 shows that noticing e-cigarette advertisements was not significantly associated with quit success (Model 4B: OR = 0.92,  $p = 0.807$ ).

#### Discussion

Advertisements for e-cigarette were not allowed in the Netherlands from January 2008 to June 2012. In August 2013, e-cigarette advertisements began to appear on television. Our study showed that awareness of e-cigarette advertisements has increased sharply among Dutch smokers between May/June 2013 and May/June 2014 from 13% to 36%. The increase was especially large for noticing e-cigarette advertisements on television: a more than four-fold increase. In parallel with the increase in noticing e-cigarette advertisements, current use of e-cigarettes also increased among adult smokers. However, in our study, noticing e-cigarette advertisements was not significantly associated with increases in current use of e-cigarettes. We found effects for disapproval of smoking and quit smoking attempts in unadjusted models, but these disappeared when baseline levels of the corresponding variables were controlled for. This suggests

**Table 5**

Bivariate and multivariate regression analyses of correlates quit attempts and quit success at follow-up (weighted data).

Baseline value of dependent variable	Quit smoking attempts (n = 1175)			Quit smoking success (n = 254)	
	Model 3A OR (95% CI) <sup>a</sup>	Model 3B OR (95% CI) <sup>b</sup>	Model 3C OR (95% CI) <sup>c</sup>	Model 4A OR (95% CI) <sup>a</sup>	Model 4B OR (95% CI) <sup>d</sup>
Noticed e-cigarette advertisements in the last 6 months at follow-up					
Yes	1.37 (1.02–1.83) <sup>*</sup>	1.27 (0.94–1.73)	1.21 (0.88–1.67)	0.86 (0.46–1.58)	0.92 (0.47–1.81)
No	1.00	1.00	1.00	1.00	1.00

<sup>\*</sup>  $p < 0.05$ .<sup>\*\*</sup>  $p < 0.01$ .<sup>\*\*\*</sup>  $p < 0.001$ .<sup>a</sup> Unadjusted regression coefficient (bivariate analysis).<sup>b</sup> Adjusted for quit smoking attempts (measured at baseline).<sup>c</sup> Adjusted for quit smoking attempts, gender, age group, educational level, regular cigarette smoking status, e-cigarette using status, noticed anti-tobacco information, noticed advertisements for cessation medications (all as measured at baseline), and time in sample (calculated for the follow-up survey).<sup>d</sup> Adjusted for gender, age group, educational level, regular cigarette smoking status, e-cigarette using status, noticed anti-tobacco information, noticed advertisements for cessation medications (all as measured at baseline), and time in sample (calculated for the follow-up survey).

that the relationships may be more of those interested in quitting or disapproving of smoking being more likely to notice the advertisements, rather than the advertisements influencing disapproval of smoking or quit attempts.

From our results, it does not appear that exposure to e-cigarette advertising is having an adverse impact on disapproval of smoking and smoking cessation among adult smokers. We found no evidence to suggest advertising is encouraging smoking, with all trends in the opposite direction. Notably, concerns have focused primarily on the influence e-cigarette advertisements have on non-smokers, especially adolescent never smokers (e.g. De Andrade, Hastings, & Angus, 2013; Fairchild et al., 2014; O'Dowd, 2014), which we did not examine in the current study.

In a previous study, we hypothesized that the large increase in current use of e-cigarettes among Dutch smokers between 2013 and 2014 was a consequence of e-cigarette advertisements that started to appear on television (Hummel et al., 2015). Thus, the lack of association between noticing e-cigarette advertisements in traditional media and current use of e-cigarettes found in the current study was unexpected. Our results are also contrary to a previous cross-sectional study which found that exposure to e-cigarette advertisements was associated with more ever use of e-cigarettes (Harrington et al., 2014), and an experimental study which found that exposure to e-cigarette advertisements was associated with interest in e-cigarette trial (Smith et al., 2015). Possible alternative explanations for the increase in current use of e-cigarettes in the Netherlands are advertisements at points of sale and on the internet, media attention other than advertisements, seeing other people using e-cigarettes or talking about them, and an increase in e-cigarette stores. In the current study, we did not take into account exposure to sources of information about e-cigarettes outside of advertisements (e.g. news stories), which are extensive, and could potentially have a more powerful influence on shaping attitudes and behaviours than product advertising. Therefore, future research should include exposure to different sources of messages about e-cigarettes.

Much of the use of e-cigarettes is experimental (or occasional use), rather than intensive continued use (Amato, Boyle, & Levy, 2015; Pepper, Emery, et al., 2014; Pepper, Ribisl, et al., 2014). Our sample was not large enough to explore patterns within subgroups of current e-cigarette users. That said, we would expect the role of advertising to be most marked in stimulating experimental use. Experimental use may be more related to curiosity than to attempts to quit tobacco (Amato et al., 2015; Pepper, Emery, et al., 2014; Pepper, Ribisl, et al., 2014).

### Limitations

We used longitudinal data to examine individual-level associations of noticing e-cigarette advertisements with changes in current use of e-cigarettes, disapproval of smoking, quit smoking attempts, and quit smoking success between baseline and follow-up. Interpretation of the observed associations needs to be treated with caution, but we can say with some certainty that there was no support for the hypothesis that e-cigarette advertising is undermining tobacco control efforts among adult smokers through decreasing disapproval of smoking, preventing quitting, or promoting relapse. We also warn that noticing advertisements is not the same as actual exposure. Exposure to advertisements may be forgotten by respondents, especially when not interested in the topic, but if this was so we might have seen significant positive associations with use of e-cigarettes. Also, we did not take the amount of exposure to advertising into account, so we could not test for dose-response relationships.

In the current study, all e-cigarette advertising was taken together. It is, however, possible that exposure to advertisements

that communicate e-cigarettes are healthier and safer than regular cigarettes may increase disapproval of regular smoking, while advertisements that communicate that e-cigarettes are suitable for use in situations where smoke-free laws apply may decrease disapproval of regular smoking. Additionally, most television advertisements for e-cigarettes in the Netherlands have promoted the use of 'first generation' (small cigarette-like disposable or rechargeable) e-cigarettes, while promotion of 'new-generation' devices (with high-capacity batteries and electronic circuits that provide high energy to a refillable atomizer and do not resemble cigarettes) may have different effects.

Finally, not all respondents who participated in the survey in 2013 were successfully followed up in 2014. Respondents who were followed up were significantly more often part of the oldest age group, were less often high educated, more often current or past users of e-cigarettes, and they noticed anti-tobacco information and advertisements for cessation medications more often. Therefore, our findings may not be fully generalizable to the population of tobacco smokers in the Netherlands.

### Conclusion

In the Netherlands, noticing e-cigarette advertisements increased sharply among Dutch tobacco smokers between 2013 and 2014, while current use of e-cigarettes also increased. However, noticing the advertisements did not seem to have influenced current use of e-cigarettes. Importantly, concerns that e-cigarette advertisements would decrease disapproval of smoking or would prevent smokers from attempting to quit or that they would promote relapse were not supported by our data.

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### Conflicts of interest statement

KMC has received grant funding from the Pfizer, Inc., to study the impact of a hospital based tobacco cessation intervention. KMC also receives funding as an expert witness in litigation filed against the tobacco industry. The other authors declare that they have no conflicts of interest.

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