



Never-smoking adolescents' perceived accessibility of cigarettes following an increase in the tobacco age-of-sale from 16 to 18: A quasi-experimental study of two cities in the Netherlands and Belgium

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HIGHLIGHTS

- Never-smokers' access to cigarettes decreased in the Netherlands and Belgium.
- Increasing the age-of-sale was not associated with a greater decrease in accessibility.
- Results were similar across subgroups of sex, age and friend or family smoking.
- The impact of age-of-sale laws on adolescent never-smokers remains uncertain.

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ABSTRACT

Background: The Netherlands increased the tobacco age-of-sale from 16 to 18 in 2014, paired with mass-media campaigns. We evaluated changes in perceived accessibility of cigarettes between 2013 and 2016 among adolescent never-smokers in the Netherlands compared with Belgium, where the age-of-sale remained 16 and no campaigns were conducted.

Methods: Repeated cross-sectional surveys were conducted in 2013 and 2016 among 4112 13–17-year-olds at a total of 22 schools in Amersfoort (the Netherlands) and Namur (Belgium). Multilevel Poisson regression quantified changes over time in prevalence of easy perceived accessibility to cigarettes (i.e., thinking it would be fairly/very easy to get cigarettes). Interaction terms were used to test whether changes differed between the Netherlands and Belgium. Analyses were stratified by age (13–15 and 16–17 years), sex (male and female), family smoking (0 and ≥ 1 smoking family members), and friend smoking (no and at least some smoking friends).

Results: Perceived accessibility to cigarettes decreased in the Netherlands (Prevalence Ratio (PR): 0.82; 95% CI: 0.72–0.93) and Belgium (PR: 0.78; 95% CI: 0.70–0.87), to a similar extent (PR interaction: 1.04; 95% CI: 0.90–1.21). Results by sex, age, and family/friend smoking were similar to those for the total population; there were no significant differences in the decrease in perceived access over time between the Netherlands and Belgium within each of these subgroups.

Conclusion: This study found approximately the same rate of decline between 2013 and 2016 in adolescent never-smokers' perceived access to cigarettes in the Netherlands as in Belgium. This implies that we did not find clear evidence for an effect of the 2014 increase in legal age of tobacco sales from 16 to 18 years in the Netherlands.

1. Introduction

Most European countries have adopted age-of-sale laws to prevent smoking initiation among young people, by limiting access to

commercial sources of cigarettes (Rights EUAF, 2017). Examining access to cigarettes is important as it has been shown to be a predictor of future smoking (Doubeni et al., 2008; Gilpin et al., 2004; Speizer et al., 2008). Previous studies that examined the effects of a change in age-of-

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sale on adolescents' access to cigarettes have primarily focused on smokers, and found that such laws have been effective in reducing accessibility of cigarettes among smoking adolescents, when properly enforced (Stead and Lancaster, 2000; Lantz et al., 2000; Friend et al., 2011; Kwan et al., 2015). However, studies have also found that adolescent smokers often find ways to continue accessing commercial sources or find other sources of cigarettes (e.g. social sources) (Nuyts et al., 2018).

Never-smokers have generally not been examined as a separate group (Nuyts et al., 2018; Rimpelä and Rainio, 2004; Fidler and West, 2010; Millett et al., 2011; Kuipers et al., 2017), while the effect of age-of-sale laws on never-smokers is important in light of the prevention of smoking. Never-smokers may respond to an increase in legal sales age differently than those with smoking experience, as they are much less likely to have bought tobacco. Never-smokers may therefore not be directly affected by the change in age-of-sale, but rather indirectly. Never-smokers' perceived access may be influenced by an age-of-sale law via reduced visibility of tobacco products, reduced prevalence of smoking by family and peers, and denormalisation of adolescent smoking. Evidence on the effect of age-of-sale laws among never-smoking youth is limited (Gilpin et al., 2004). One study examined perceived accessibility among never smokers before and after increased enforcement of an age-of-sale law in California, and found a reduction in perceived accessibility (Gilpin et al., 2004). In addition, reduced perceived accessibility was associated with reduced risk of transition to experimental smoking (Gilpin et al., 2004).

Never-smoking adolescents may have different perceptions of accessibility depending on the context in which they reside. Subgroups who have more smokers in their social network have more access to social sources of cigarettes and are more likely to initiate smoking (Nuyts et al., 2018). An increase in age-of-sale may be less effective in these subgroups. Previous research, primarily among the smoking population, has highlighted that girls may be more likely to rely on social sources of cigarettes whereas boys make more use of commercial sources (Robinson et al., 1998; Gratiyas et al., 1999; Castrucci et al., 2002; Leatherdale, 2005). Adolescents who are friends with smokers are also more likely to have access to cigarettes from social sources and to perceive accessibility to cigarettes as easy (Borland and Amos, 2009; DiFranza and Coleman, 2001; Marsh et al., 2013). A previous study also found that exposure to smokers at home, school or within a community is associated with easy perceived accessibility (Speizer et al., 2008).

In this study we focus on the Netherlands, where the tobacco age-of-sale was increased from 16 to 18 years old in 2014. This ban was paired with two mass media campaigns between 2013 and 2016, that may have enhanced the potential impact of the ban on perceived access to cigarettes. The government and health organisations ran the 'Actually pretty crazy, huh?' (translated from 'Eigenlijk best gek, hè?') and 'NIX18' mass media campaigns. The 'Actually pretty crazy, huh?' campaign was aimed at denormalising tobacco and smoking by addressing the high availability of tobacco. In the campaign materials, children explained that it is pretty crazy that tobacco is sold among more retail outlets than bread (Gezondheid et al., 2015). The NIX18 campaign raised awareness of the increasing age-of-sale (NIX18, 2017). In addition, the smoke-free generation movement was adopted in 2015 paired with a campaign to raise awareness of the initiative (Longfonds, 2015).

The aim of this study was to assess changes in perceived accessibility of cigarettes among never-smoking adolescents following the increase in the age-of-sale from 16 to 18 in the Netherlands. We used a quasi-experimental design in which we compared changes between 2013 and 2016 in the Netherlands to those in Belgium. Belgium serves as a control country, because the age-of-sale remained 16 and no campaigns were run, and the Netherlands and Belgium are similar in terms of political history, geographic location, economic development, social welfare system, and public health policies. Additionally, we examined these changes within subgroups according to age (13–15- and

16–17-year olds), gender (girls and boys), and the number of friends and family members who are smokers.

2. Methods

2.1. Study and data collection

Repeated cross-sectional surveys were conducted in 2013 and 2016 as part of the SILNE and SILNE-R projects, among adolescents aged 14–19 years old in 22 schools in Amersfoort (the Netherlands) and Namur (Belgium). These cities were chosen because they have a population size, income and employment rate comparable to the national average. The surveys were completed in the classroom under surveillance of a research assistant and/or teacher. In each school, students were included from two grades enrolling mostly 15–16-year-olds. Details on the survey design and data collection were previously published (Lorant et al., 2015). Ethical approval for data collection in Belgium was obtained from the Comité d'éthique Hospitalo-Facultaire des Cliniques Universitaires Saint-Luc (reference 2012/09OCT/461N° B403201215182). The Medical Ethics Review Committee of the Academic Medical Center in the Netherlands confirmed that the Medical Research Involving Human Subjects Act (WMO) did not apply to the survey study and that official approval was therefore not required (reference W16.252 # 16.297).

In total, survey data of 8657 adolescents was collected. In this study we only included data on never-smokers aged 13–17 years old ($N = 4295$). We excluded 183 missings (13 on sex, 27 on friend smoking, 33 on migrant background, 54 on academic performance, and 79 on perceived accessibility). This resulted in a final study population of 4112 participants.

2.2. Variables

2.2.1. Dependent variable

Perceived accessibility to cigarettes was the dependent variable and was measured among never-smokers with the question: 'How difficult do you think it would be for you to get cigarettes if you wanted?'. The variable was dichotomised into very/fairly difficult (coded as 0) and fairly/very easy (coded as 1).

2.2.2. Independent variables

Year represented the year of the survey (2013 = 0 and 2016 = 1) and country distinguished respondents from Belgium (coded 0) and the Netherlands (coded 1).

Age was measured in years and was dichotomised into 13–15 (coded 0) and 16–17-year olds (coded 1). The group of 16–17 year olds in the Netherlands was able to legally buy tobacco in 2013, but not in 2016 as the legal age was increased from 16 to 18 in 2014. Sex distinguished male (coded 1) vs. female (coded 0).

Family smoking was measured as the number of family members who were current smokers among parents, step-parents, brothers and sisters. This variable was dichotomised as having 0 or ≥ 1 smoking family members. Friend smoking was defined by the question 'do any of your best and closest friends smoke cigarettes?'. The variable was dichotomised as none (coded 0) and some/most/all (i.e., at least some; coded 1).

Academic performance was determined by the question 'which of the following best describes your marks during the past year?'. In each country the five response categories reflected the national grading system. This was categorised into low and high academic performance, by defining those with a score under 3 as having low academic performance and those with a score of 3 or higher as having high academic performance.

Adolescents were considered to have a migrant background when the adolescent reported that at least one of the parents was born in a country outside the country of residence (i.e., the Netherlands or Belgium).

Two variables were measured at the school level. From the adolescent survey data, the smoking prevalence in each school was determined. Smoking was defined as having smoked at least one cigarette in the last 30 days. We collected survey data among school staff (total $N = 200$) on the strength of the school's tobacco policy. Each staff respondent was asked whether 1) smoking was prohibited in the school building, 2) smoking was prohibited on school grounds, 3) smoking was prohibited during off-campus school activities, and 4) there was no smoking area on the school grounds. For each question respondents reported whether this applied to a) students and b) staff. The sum of these items yielded a maximum score of 8 points. Scores of all individual staff members within a school were aggregated to a mean score of school tobacco policy.

The decision to dichotomise variables was made to maintain sufficient numbers of respondents in all subgroups that were compared in the analysis. There were, for example, too few respondents with more than one smoking family member to treat this variable as continuous.

2.3. Statistical analysis

We described the prevalence of perceived accessibility of cigarettes in 2013 and 2016, in the samples in the Netherlands and Belgium. Prevalence is presented for the total population and stratified by age, sex, family smoking, and friend smoking.

All association analyses were conducted in Stata version 15.1. To estimate the association between year and perceived accessibility, we conducted multilevel Poisson regression analyses. Robust standard errors were applied. The Stata command 'meglm' was used, specifying family 'Poisson', with a 'log' link-function, and variance-covariance matrix ('vce') specified as 'robust'. Associations were expressed as prevalence ratios (PR), by exponentiating the regression coefficients (using the 'irr' option). The multilevel structure included schools at level 2 and students at level 1. We ran a crude, unadjusted model, and a model adjusted for age, sex, family smoking, academic performance, migrant background, school tobacco control policy score and school smoking prevalence.

To test whether the change over time (i.e., between 2013 and 2016) was different in the sample in the Netherlands than in Belgium, we included a term for interaction between country and year in the adjusted model. Lastly, we included a three-way interaction with age, sex, family smoking, and friend smoking respectively (e.g., year $\times$ country $\times$ age), to quantify differences between countries in the change over time within subgroups and to test whether this varied between subgroups.

Two sensitivity analyses were performed to test the robustness of results. The first sensitivity analysis included the variable 'friend smoking' as a confounder. This variable was not included in the main analysis as it is a possible mediator in the association between year and perceived accessibility, given the potential impact of the age-of-sale law and campaigns on peer-smoking. The second sensitivity analysis contained only the 18 schools that were included in both 2013 and 2016 (N students = 3246). Both sensitivity analyses resulted in similar findings compared with the main analysis (see [Supplementary Table 1](#)).

3. Results

[Table 1](#) presents the characteristics of the study population. A total of 4112 participants were included in the analyses. There were more 13–15-year olds (74.6%) than 16–17 year olds (25.4%) included in the sample. In both 2013 and 2016, the percentage adolescents reporting that at least some of their friends were smokers was higher in the Belgian sample than in the sample from the Netherlands. This corresponds with the smoking prevalence in schools which, in 2016, was 14.0% in the sampled schools in the Netherlands and 22.5% in the sampled schools in Belgium. A similar pattern was also seen for smoking of family members.

Table 1

Description of the study population in percentage ($N = 4112$).

	Total population	Netherlands		Belgium	
		2013	2016	2013	2016
N	4112	1170	1236	804	902
Age					
13–15 years	74.6	79.1	79.4	64.6	70.8
16–17 years	25.4	20.9	20.6	35.4	29.2
Sex					
Girls	51.2	52.9	49.3	50.7	51.9
Boys	48.8	47.1	50.7	49.3	48.1
Family smoking					
0 family members	65.8	71.3	74.0	56.7	55.7
≥ 1 family members	34.2	28.7	26.0	43.3	44.3
Friend smoking					
No smoking friends	53.5	67.2	63.6	31.2	41.7
At least some	46.5	32.8	36.4	68.8	58.3
Migrant background					
No	89.5	94.2	88.5	90.4	83.9
Yes	10.5	5.8	11.5	9.6	16.1
Academic performance					
Low	41.8	48.1	32.8	47.8	40.6
High	58.2	51.9	67.2	52.2	59.4
Smoking prevalence in school		17.9	14.0	28.8	22.5
Prevalence of perceived access		65.4	54.7	66.7	53.0
School tobacco policy score ^a		4.11	4.20	6.38	5.95

^a School tobacco policy score provided refers to the mean score out of 8 points.

In the sample from Netherlands, the prevalence of easy perceived access to cigarettes was 65.4% in 2013 and 54.7% in 2016 (see [Supplementary Table 2](#)). Similarly, in the Belgian sample prevalence rates were 66.7% and 53.0%, respectively. [Fig. 1](#) shows the prevalence of perceived easy access to cigarettes per subgroup, by country (see [Supplementary Table 2](#) for exact prevalence figures). Downward trends are observed in all subgroups. Within the sample of 16–17 year olds, the downward trend seemed stronger in the sample from the Netherlands than in the Belgian sample. The downward trends for girls were similar in both countries, but for boys they were stronger in the Belgian sample. Trends were similar for adolescents with at least one smoking friend and no smoking friends. The downward trend for those with smoking family members seemed stronger in the Belgian sample.

[Table 2](#) shows results of the regression analysis on the total sample. The adjusted model shows a significant decrease in prevalence of perceived easy access between 2013 and 2016 (PR: 0.80; 95% CI: 0.73–0.89). There was no significant difference in prevalence between the Netherlands and Belgium (PR: 1.04; 95% CI: 0.91–1.19). The prevalence was higher in older than younger adolescents (PR: 1.25; 95% CI: 1.17–1.34), boys than girls (PR: 1.24; 95% CI: 1.15–1.34), and adolescents with smoking family members than those without smoking family members (PR: 1.21; 95% CI: 1.13–1.29). The unadjusted model shows that the prevalence of easy accessibility was higher in adolescents with smoking friends than those without smoking friends (PR: 1.50; 95% CI: 1.40–1.62).

[Table 3](#) presents the results of the logistic regression analysis for changes in perceived accessibility between 2013 and 2016 in the Netherlands and Belgium. Prevalence of perceived easy accessibility in the total population decreased significantly over time in both the Netherlands (PR: 0.82; 95% CI: 0.72–0.93) and Belgium (PR: 0.78; 95% CI: 0.70–0.87). There was no significant difference in this decline between both countries (PR interaction: 1.04; 95% CI: 0.90–1.21). This pattern was also found for subgroups of sex, family smoking and friend smoking. The observed differences between the Netherlands and Belgium within specific age-groups were not statistically significant. However, the three-way interaction of age $\times$ year $\times$ country showed that there was a significant difference between the countries in the difference in PR for the change over time between 13 and 15 and

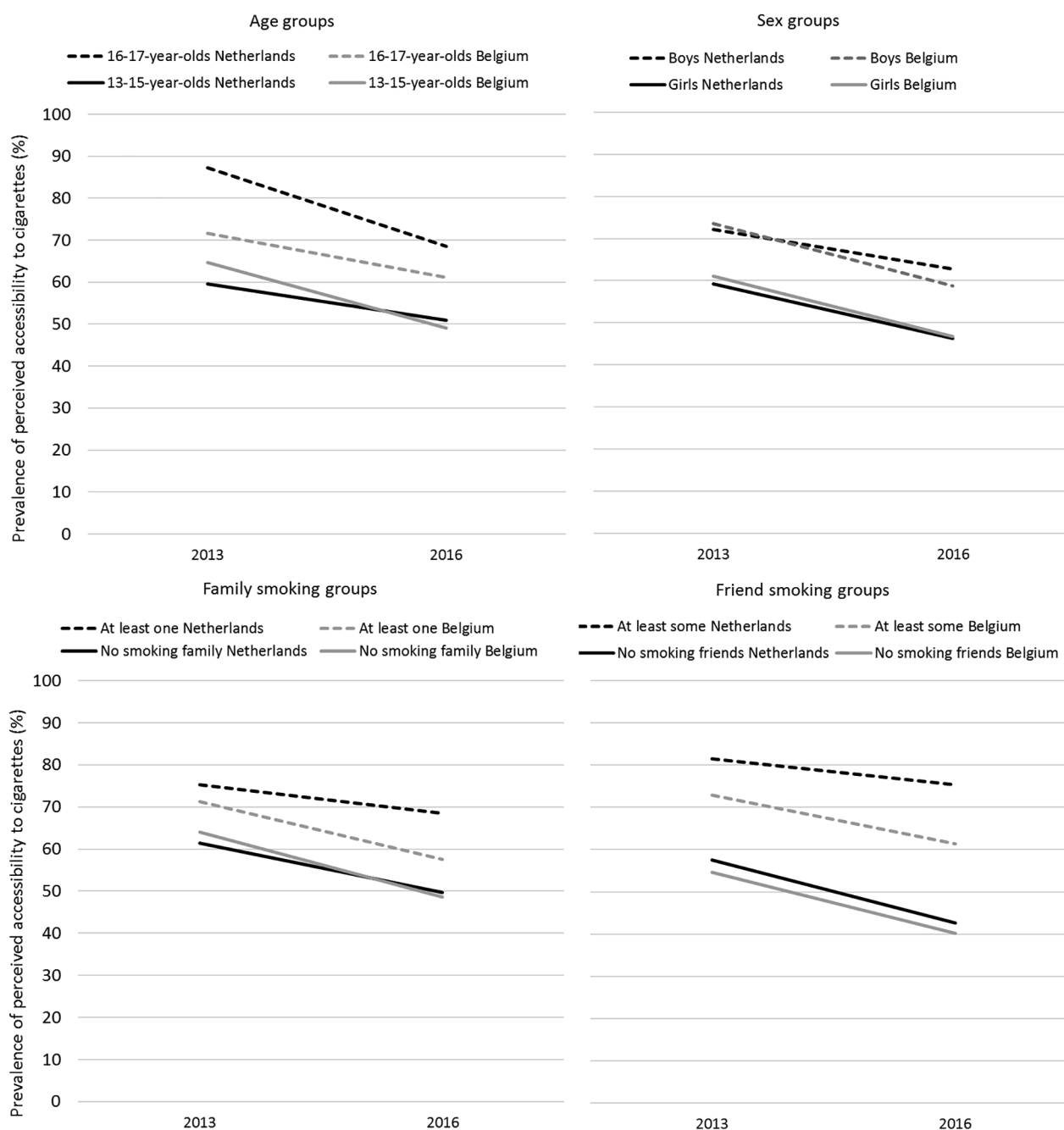


Fig. 1. Prevalence of perceived accessibility to cigarettes (in %) in 2013 and 2016, in the Netherlands and Belgium, stratified by age, sex, family smoking, and friend smoking.

16–17-year-olds (PR three-way interaction: 1.22, 95% CI: 1.05–1.41). The decrease in prevalence among 16–17 year olds tended to be larger in the Netherlands than in Belgium (PR interaction: 0.92; 95% CI: 0.82–1.03), while it tended to be the other way around among 13–15 year olds (PR interaction: 1.12; 95% CI: 0.94–1.33).

4. Discussion

4.1. Key findings

In 2014, the Netherlands increased the legal age of tobacco sales from 16 to 18 and ran two mass media campaigns targeting the de-normalisation of smoking. The perceived accessibility of cigarettes

among never-smoking adolescents in the Netherlands decreased between 2013 and 2016. However, a similar decrease was found among adolescents in Belgium. This pattern was found in the total population and across subgroups of boys and girls, and adolescents with and without smokers among their friends and family members. The results suggested differential trends between countries among 16–17-year-olds, but this could not be demonstrated with statistical significance.

4.2. Evaluation of potential study limitations

This study has some potential limitations to be considered. First, we applied a repeated cross-sectional design. The same sampling methods were used in both countries and both survey years. Moreover, response

Table 2

Prevalence of perceived accessibility to cigarettes by year, country, and subgroups. Associations presented as prevalence ratios derived from unadjusted and adjusted multilevel Poisson regression models (N = 4112).

	Prevalence (%)	Prevalence ratios with 95% CI	
		Unadjusted	Adjusted ^a
Year			
2013	66.1	Ref	Ref
2016	53.7	0.81 (0.74–0.89)*	0.80 (0.73–0.89)*
Country			
Belgium	59.4	Ref	Ref
The Netherlands	59.9	1.01 (0.93–1.09)	1.04 (0.91–1.19)
Age			
13–15 years	55.5	Ref	Ref
16–17 years	71.9	1.30 (1.20–1.39)*	1.25 (1.17–1.34)*
Sex			
Girls	53.1	Ref	Ref
Boys	66.6	1.25 (1.17–1.34)*	1.24 (1.15–1.34)*
Family smoking			
0 family members	55.5	Ref	Ref
≥ 1 family members	67.7	1.22 (1.14–1.30)*	1.21 (1.13–1.29)*
Friend smoking			
No smoking friends	48.9	Ref	^b
At least some	72.0	1.50 (1.40–1.62)*	

* Indicates statistical significance ($\alpha \leq 0.05$).

^a Adjusted model included age, sex, migrant background, academic performance, family smoking, and school tobacco policy score, and smoking prevalence in schools.

^b Not included in the model because friend smoking is a mediator rather than a confounder to the association between perceived access and the other covariates.

rates were similar. None the less, we cannot rule out that part of the differences, or lack thereof, between countries or over time were due to problems of comparability. This calls for caution in drawing causal conclusions.

Second, data was collected in one city per country, which may limit its generalisability to the national level. It is especially important to note that, in this study, data collection in Belgium took place in Namur, a city representing Wallonia rather than Belgium as a whole. Findings may differ for Flanders. In nationally representative data from the 2015 ESPAD (European School Survey Project on Alcohol and Other Drugs) survey, the prevalence of easy perceived obtainability was 61% in both the Netherlands and in Belgium (Group TE, 2015). This is similar to the 59% we found in this study for 2013 and 2016 combined.

Third, the accessibility of cigarettes was self-reported in a survey. This generally increases the risk of reporting bias, because participants

may not honestly respond and may selectively disclose information. However, this study focused on changes in this self-reported measure over time. Due to the use of the exact same sampling and data collection methods in 2013 and 2016 in both countries, the risk of reporting bias is similar in both survey years. We therefore consider it unlikely that this has affected our key findings on the trends in perceived access in the two countries.

4.3. Interpretation of findings

Contrary to our expectations, we did not find clear differences between the Netherlands and Belgium in the decrease in perceived accessibility of cigarettes among never-smoking adolescents. This finding contradicts previous studies among the general adolescent population and smoking adolescents, for whom an effect on accessibility has been found. (Rimpelä and Rainio, 2004; Kuipers et al., 2017; Borland and Amos, 2009; Forster et al., 1998) For example, Kuipers et al. found a larger decrease in perceived obtainability in countries with an increased age-of-sale compared to European countries where the age remained the same (Kuipers et al., 2017). Similarly, Forster et al. found a larger decrease in perceived accessibility to commercial sources of cigarettes in intervention communities compared to controls (Forster et al., 1998). Below we discuss three potential explanations as to why we did not find a difference in trends between the Netherlands and Belgium.

First, data was collected in 2013 and 2016, with campaigns running between 2013 and 2015 and an age-of-sale increase in 2014. Time between the ‘interventions’ and the follow-up measurement in 2016 is therefore relatively short. Although adolescents’ lives and their behaviours may change quite rapidly, two years may not have provided enough time to observe changes in perceived accessibility among never smokers. An impact of an age-of-sales ban may develop more gradually among never-smoking youth compared to smoking youth, as it may take time for the visibility of smoking to decrease and for social norms to change. If so, a longer follow-up time would be required. However, evidence on the exact ways and the timeframe in which never-smokers respond to age-of-sale laws is lacking, as the current evidence applies almost exclusively to youth with smoking experience (Nuyts et al., 2018).

Second, although the age-of-sale increased from 16 to 18 in the Netherlands, compliance to this law may not have been sufficient. A report from the Netherlands from 2015 found that a ‘disappointing’ 32.4% of retailers were compliant with the age-of-sale of tobacco (Staten Generaal). If smokers continued to be able to access cigarettes, then never-smokers may have continued perceiving cigarettes as a normal commodity and may continue to view cigarettes as accessible.

Table 3

Changes in perceived accessibility to cigarettes between 2013 and 2016, in the Netherlands and Belgium. Presented for the total population and by age, family smoking, and friend smoking. Prevalence ratios with 95% CI derived from adjusted multilevel Poisson regression models (N = 4,112).

	Netherlands	Belgium	Interaction year × country ^a
Total population	0.82 (0.72–0.93)*	0.78 (0.70–0.87)*	1.04 (0.90–1.21)
Age subgroups			
13–15-year-olds	0.83 (0.72–0.95)*	0.74 (0.66–0.84)*	1.12 (0.94–1.33)
16–17-year-olds	0.78 (0.72–0.84)*	0.85 (0.77–0.94)*	0.92 (0.82–1.03)
Sex subgroups			
Girls	0.77 (0.65–0.90)*	0.77 (0.67–0.88)*	1.00 (0.81–1.24)
Boys	0.85 (0.73–0.99)*	0.80 (0.71–0.90)*	1.07 (0.91–1.25)
Family smoking subgroups			
0 family members	0.78 (0.65–0.95)*	0.75 (0.68–0.83)*	1.04 (0.86–1.26)
≥ 1 family members	0.89 (0.84–0.94)*	0.82 (0.73–0.93)*	1.08 (0.94–1.25)
Friend smoking subgroups			
No smoking friends	0.71 (0.60–0.85)*	0.70 (0.56–0.86)*	1.03 (0.78–1.35)
At least some	0.89 (0.79–1.01)	0.82 (0.74–0.90)*	1.09 (0.96–1.24)

* Indicates statistical significance ($\alpha \leq 0.05$).

^a Prevalence ratio for year × country: reflects the extent to which the association between year and access was different between countries within a subgroup (e.g. among 13–15-year-olds, we found a 1.12 times higher prevalence ratio in the Netherlands than in Belgium).

Third, the NIX18 campaign, which was intended to raise awareness of the increase in the age-of-sale, may not have realised its potential effect among youth. An evaluation of the NIX18 campaign showed that the social norm towards smoking changed among parents, but stayed the same among young people and the general public (Kantar Public, 2017). This may be because the primary target group for this campaign was parents with children between the ages of 12 and 17, while young people and the general public were secondary target groups. In addition, the impact of the NIX18 campaign may have been diluted because the age-of-sale for alcohol increased from 16 to 18 at the same time, and the campaign addressed both substances.

Perceived accessibility decreased in both Belgium and the Netherlands suggesting that other factors may have played a greater role in this decrease. We were unable to take into account any potential activities undertaken within the two selected cities or the 22 schools, other than the school's tobacco policy. At the national and European level, general denormalisation trends could have influenced adolescents' perceived accessibility. Data from the 2011 and 2015 ESPAD surveys shows a general decrease in perceived accessibility to cigarettes across 25 European countries (Group TE, 2015; Hibell, et al., 2011). Many western or northern European countries showed decreases of a similar magnitude as found for the Netherlands and Belgium (Group TE, 2015; Hibell, et al., 2011). This may reflect a general denormalisation taking place across Europe and affecting never-smoking youth in Belgium as well as the Netherlands.

4.4. Implications

In our data, we found no demonstrable effect of the increase in age of tobacco sales on perceived accessibility among non-smoking adolescents in the Netherlands. Insufficient compliance of retailers may have contributed to this potential lack of effect. Strict enforcement of the age-of-sale law is therefore recommended. Previous interventions that included mass media campaigns have also focused on educating retailers (Forster et al., 1998; Biglan et al., 1996). These interventions have proven to be effective in reducing illegal sales to minors (Forster et al., 1998; Biglan et al., 1996; Keay et al., 1993). Therefore, when paired with mass media campaigns directed towards adolescents and retailer education on law compliance, strict enforcement could prove to be effective in reducing illegal sales to minors and thereby perceived accessibility among never-smoking youth.

5. Conclusion

We expected the increase in the age-of-sale and corresponding campaigns in the Netherlands to be associated with a decrease in never-smoking adolescents' perceived accessibility of cigarettes. However, in our study, this decrease was not greater in the Netherlands than in Belgium. Based on the wider literature, we suggest that additional measures such as increased enforcement via retailer education as well as mass media campaigns targeting young people may improve the effectiveness of age-of-sale laws.

Ethical approval statement

The ethical approval reference for Belgium: REF 2012/09OCT/461N° enregistrement belge B403201215182 – Comité d'éthique Hospitalo-Facultaire des Cliniques Universitaires Saint-Luc. The ethical approval information for the Netherlands: the Medical Ethics Review Committee of the Academic Medical Center confirmed that the Medical Research Involving Human Subjects Act (WMO) does not apply to the SILNE-R study and that official approval was therefore not required: reference number W16_252 # 16.297, 11 August 2016.

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8. Contributors

MAGK and AEK designed the methodology for this paper. MAGK and PAWN performed the statistical analyses. PAWN drafted the manuscript. PAWN, MAGK, MCW, VL and AEK contributed to the interpretation of the findings and the writing of the final manuscript. All authors contributed to and have approved the final manuscript.

CRediT authorship contribution statement

Paulien A.W. Nuyts: Formal analysis, Writing - original draft, Writing - review & editing. **Mirte A.G. Kuipers:** Conceptualization, Methodology, Formal analysis, Writing - review & editing, Supervision. **Marc C. Willemsen:** Writing - review & editing. **Vincent Lorant:** Funding acquisition, Writing - review & editing. **Anton E. Kunst:** Funding acquisition, Conceptualization, Methodology, Writing - review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.addbeh.2020.106288>.

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