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# BMJ Open

## Decline of Adolescent Smoking in Ireland 1995-2015: Trend Analysis and Associated Factors

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10 **Corresponding Author:** Shasha Li  
11  
12

13 Address for all authors: TobaccoFree Research Institute Ireland,  
14

15 Focas Research Institute,  
16

17 DIT, Kevin Street,  
18

19 Dublin 8, Ireland  
20  
21

22 Email: [shashali@tri.ie](mailto:shashali@tri.ie)  
23

24 Tel: +35312601966  
25  
26

27 **Co-authors:**  
28  
29

30 1. Sheila Keogan  
31  
32

33 2. Keishia Taylor  
34  
35

36 3. Luke Clancy  
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## ABSTRACT

### Objectives

The study examines trends in smoking among Irish adolescents of 15-16 years old between 1995 and 2015 and the factors associated with their smoking behaviours between 2007 and 2015.

### Methods

Data were obtained from the European School Survey Project on Alcohol and Other Drugs (ESPAD) Ireland between 1995 and 2015. To examine the gender gap, two-sample proportion tests were used. Multivariate logistic regression was performed to examine the factors associated with smoking behaviours. Dependent variable is whether a respondent is a smoker in last-30 day. Independent variables includes gender, survey years, perceived ease of access to cigarettes, perceived risk of smoking, perceived relative wealth, parental monitoring, maternal relationship, family structure, truancy and peer smoking.

### Results

Smoking prevalence has dropped from 41% in 1995 to 13% in 2015. The prevalence was much higher among girls than boys in 1995. The gender gap was closed by 2015.

Multivariate regression results show that peer smoking, perceived access to cigarettes, perceived risks of smoking, parental monitoring, truancy, maternal relationship, perceived relative wealth and family structure were all significantly associated with adolescent smoking, and some of the factors had different effects for female and male students.

### Conclusion

Ireland has successfully achieved a considerable decrease of adolescent smoking from 1995 to 2015, during which various tobacco control policies have been implemented. In addition,

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3 the gender gap on adolescent smoking has been closed during the period. Adolescent  
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5 smoking could be further improved through strengthening enforcement on adolescent access  
6  
7 to cigarettes and maintaining a high-intensity tobacco control media campaign targeting  
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9 adolescent. Parents could also contribute by enhancing monitoring.  
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11  
12 **Keywords:** Public health; Epidemiology; Preventive medicine  
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### Strengths and limitations of this study

- The data is from the best available survey on Irish adolescents from 1995-2015 using an internationally validated survey instrument, including comprehensive measurement for smoking-related factors. The data sets in different years are comparable in data collection and questions.
- The study is based on multivariable logistic regression, which controls for confounders.
- The factors associated with the changing gender gap in adolescent smoking was examined.
- Other factors potentially related to adolescent smoking were not included in the surveys, such as parental smoking.
- Limited data availability for some of the ESPAD waves are acknowledged.

## INTRODUCTION

People who take up smoking at a younger age become more dependent and find it harder to quit than smokers who start later in their lives,<sup>1 2</sup> so policies designed to discourage adolescent from starting to smoke have been at the forefront of tobacco prevention in recent years. In Ireland, the Tobacco Free Ireland (TFI) report of 2013 stated that the protection of children must be prioritised in all of the initiatives outlined in the policy.<sup>3</sup>

The parties to the 2003 WHO Framework Convention on Tobacco Control stated their “deep concern” regarding tobacco consumption by children and adolescents, emphasising price and tax measures as an effective means of reducing tobacco consumption among young people.<sup>4</sup>

Between 1995 and 2015, the real retail price per package of 20 cigarettes in Ireland has been increased almost every year (See Appendix I). The European Tobacco Products Directive (2014/40/EU) places restrictions on the use of tobacco packaging designed to appeal to children and prohibits flavoured cigarettes and roll-your-own tobacco.<sup>5</sup> In Ireland, stronger legislation regarding the complete standardisation of tobacco packaging came into force in September 2017 and should reduce further the effect of tobacco advertising on adolescents.<sup>6</sup>

Between 1995 and 2015, a series of national level tobacco control policies were introduced (see Appendix II), although there were no school-specific tobacco control policies implemented in Ireland. For example, the implementation of age limit law under Public Health (Tobacco) Act 2002 was not fully implemented until April 2007. It is an offence to sell cigarettes or other tobacco products to persons aged under 18 years. In addition, since 2009 retailers are required to register with the National Tobacco Control Office. Vending machines were banned except in licensed establishments.

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3 There has been a large volume of research conducted regarding interventions against  
4 adolescent smoking, including studies evaluating policies to restrict access and raise  
5 awareness of risk, with mixed results.<sup>7 8 9</sup> Some studies have examined perceptions of risk  
6 and its association with smoking and the majority reported a negative association between  
7 risk perception and smoking.<sup>10 11</sup> Other studies have investigated correlates in the domestic  
8 and social sphere, including associations with parental monitoring, relationships with parents,  
9 family structure, truancy from school, and peer smoking.<sup>12 13 14 15 16</sup> It is also established  
10 that adolescents from a lower socioeconomic background are more likely to smoke.<sup>17 18</sup> This  
11 study first establishes the declining trends in smoking among Irish 15 and 16 year olds  
12 between 1995 and 2015 and the closing of the gender gap. Secondly, we examine potential  
13 factors associated with their smoking behaviours. Based on the factors mentioned in existing  
14 literature and taking account of availability in the dataset, we explored the relationship to  
15 smoking prevalence of gender, survey years, perceived ease of access to cigarettes, perceived  
16 risk of smoking perceived relative wealth, parental monitoring, maternal relationship, family  
17 structure, truancy and peer smoking., also discussed the changes of the factors over time.

## 38 **METHODS**

### 40 **Data source and sample**

41 This study used data from the European School Survey Project on Alcohol and Other Drugs  
42 (ESPAD) Ireland. The main purpose of the survey was to collect comparable data on  
43 substance use among 15- and 16-year-old students across Europe, in order to monitor trends  
44 within and between countries, including Ireland.<sup>19</sup> ESPAD surveys were conducted every  
45 four years between 1995 and 2015, resulting in six waves of data from 26 countries, and 35  
46 countries participating in 2015.



The sampling procedures, data collection and questionnaire used in Ireland were consistent with the international ESPAD study protocol.<sup>19</sup> School students born in specific calendar years were eligible and selected using stratified random sampling. Data were collected anonymously through paper-and-pencil, self-completion questionnaires administered in the classroom. After standardised cleaning procedures, the datasets were obtained from the ESPAD official database. Full accounts of the methodology of the study in each survey year could be found in the respective reports of the ESPAD project.<sup>19 20 21</sup>

Smoking prevalence for all six ESPAD waves is available and used for the trend analysis. The raw 1999 and 2003 survey dataset are unavailable and the 1995 dataset did not include most of the measures used in the study. Therefore, only the 2007, 2011 and 2015 studies were used to assess the associated factors of smoking. Sample characteristics are reported in Table 1.

**Table 1** Sample characteristics of the ESPAD Ireland surveys (Between 1995 to 2015)

Years	1995	1999	2003	2007	2011	2015
Sample size	1849	2277	2407	2221	2207	1470
Male (%)	49	49	51	45	50	51
Response rate (%)	96	92	96	94	94	86

## Measures

Respondents were asked how frequently they had smoked in the last 30 days, with answers ranging from “not at all” to “more than 20 cigarettes per day”. Those who answered ‘not at all’ are non-smokers and those who had smoked at least once in the last 30 days are smokers. Current or 30-day smoking prevalence rate is the proportion of smokers.

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3 The questionnaire included items about respondents' awareness of and experience with  
4 cigarette smoking, perceived family wealth, parent monitoring, relationship with parents,  
5 family structure, truancy and peer smoking.  
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10 Students were asked how difficult it would be to get cigarettes if they wanted them and to  
11 what extent people risk harming themselves (physically or in other ways) if they smoke  
12 occasionally. The majority of students thought it would be easy to get cigarettes and about  
13 half of the students perceived a moderate/great risk from smoking occasionally.  
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16  
17  
18 Socioeconomic status was estimated by how well off students perceived their family to be  
19 compared to other families on 4 points from "much better off" to "less well off". Respondents  
20 were also asked whether their parents know where they spend Saturday nights (always, quite  
21 often, sometimes or usually don't know) and whether they were satisfied with their  
22 relationship with their mother. Students also listed the members of their household and  
23 around 14% of the students were from one-parent families.  
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28 Respondents were asked about truancy by reporting the number of days on which they had  
29 skipped one or more days during the last 30 days. In addition, they were asked how many of  
30 their friends smoked cigarettes.  
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35 The frequencies of responses for each predictor category are shown in Table 2. Most  
36 responses were relatively stable across the survey years but notable changes include  
37 perceived access to cigarettes, parental monitoring and peer smoking. Particularly, in 2007  
38 and 2011, only about 12% of the students reported that none of their friends smoked, but by  
39 2015 it had increased to 34%. The proportion of students who claimed most/all of their  
40 friends smoked had decreased from 20% in 2007 to 11% in 2015. Access to cigarettes had  
41 become more difficult across the three survey waves, with students who reported that it was  
42 difficult to obtain cigarettes increasing from 12% in 2007 to 28% in 2015. More students  
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3 claimed that their parents always know where they spend Saturday nights, from 48% in 2007  
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5 to 63% in 2015.  
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### 8 **Statistical analysis**

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10 To examine the gender gap in smoking prevalence between 1995 and 2015, two-sample  
11  
12 proportion tests were used and p-values are reported. The main analysis examined the factors  
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14 associated with adolescents' smoking behaviours across the last three survey waves using  
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16 multivariate logistic regression. The dependent variable was whether or not a student had  
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18 smoked in the last 30 days. Independent variables included gender, survey years, and the  
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20 measures listed in Table 2. The analysis was then repeated for each gender individually to  
21  
22 detect if any factors played different roles between female and male students. All of the  
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24 statistical analysis was conducted in IBM SPSS Statistics 22.  
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**Table 2** Summary of the key measures

		ESPAD Year		
		2007	2011	2015
Access to cigarettes	Difficult	12.0%	16.2%	28.1%
	Easy	41.7%	41.9%	42.4%
	Don't know	46.3%	41.9%	29.5%
Risk of smoking cigarettes	No/slight risk	39.6%	43.0%	41.6%

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3	occasionally	Moderate/great risk	58.0%	54.2%	55.8%
4		Don't know	2.3%	2.8%	2.5%
5					
6	Perceived family relative	Much better off	15.8%	10.8%	15.8%
7	wealth	Better off	32.4%	27.7%	25.8%
8		About the same	46.2%	56.2%	48.6%
9		Less well off	5.5%	5.3%	9.8%
10					
11	Parents knowing where	Know always	47.4%	49.6%	62.7%
12	students spend Saturday	Know quite often	30.0%	30.3%	23.3%
13	nights	Know sometimes	15.4%	14.9%	8.9%
14		Usually don't know	7.2%	5.3%	5.1%
15					
16	Relationship with mother	Satisfied	83.4%	87.4%	87.4%
17		Neither Nor	7.8%	5.0%	5.2%
18		Not satisfied	8.8%	7.5%	7.3%
19					
20	One-parent family	Two or more parents	87.0%	86.1%	86.0%
21		One parent	13.0%	13.9%	14.0%
22					
23	Skipping school in the last	None	73.6%	80.4%	80.2%
24	30 days	1-4 days	21.2%	16.7%	16.1%
25		5 days+	5.2%	2.9%	3.8%
26					
27	Peer smoking	None	12.4%	11.9%	33.5%
28		A few/some	67.6%	69.7%	55.8%
29		Most/All	20.0%	18.4%	10.6%
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## RESULTS

### Trend of adolescent smoking and the closing of gender gap

30-day smoking prevalence among boys and girls for each survey wave is shown in Table 3 and Figure 1. In 1995, female students had a 30-day smoking prevalence of 44.9%, much higher than the prevalence of male students of 36.7% ( $P < 0.001$ ). Along the survey years the prevalence for both genders dropped significantly, with girls achieving a greater decline. By

2015, the female and male smoking prevalence is 12.8% and 13.1%, respectively. With slightly fewer female students smoking than male students, the gender gap was closed by 2015, which is confirmed by the p-value of 0.83.

**Table 3** 30-day smoking prevalence (%)

Year	1995	1999	2003	2007	2011	2015
Male	36.7	32	28	19.3	18.6	13.1
Female	44.9	42	37	26.8	23.2	12.8
Total	40.9	37	33	23.4	20.9	13
P value*	<0.001	<0.001	<0.001	<0.001	0.009	0.83

\* The null hypothesis is that female and male students had the same smoking prevalence.

### Predictors of adolescent smoking

Table 4 presents the multivariate logistic regression results taking account of the potential factors associated with adolescent smoking. Peer smoking, perceived access to cigarettes, perceived risk of smoking, parental monitoring, truancy, maternal relationship, perceived relative wealth, family structure were all significantly associated with adolescent smoking, and some of the factors had different effects for female and male students.

Peer smoking had the strongest effect. A student with a few/some friends who smoked was 4 times more likely to smoke than a student who had no smoking friends. If most/all their friends smoked, the odds of smoking were 27 times higher for female students and 14 times higher for male students.

Students who reported a lower risk from smoking occasionally were twice more likely to smoke than those reported greater risk from smoking. For female students, those who

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2  
3 reported 'easy to access' cigarettes were about twice as likely to smoke as those who reported  
4 it 'difficult'. However, for male students, there was no significant difference. Interestingly,  
5 for both genders, those who reported "don't know" if it is easy or difficult to access cigarette,  
6 are about 3 times more likely to smoke than those who reported it as difficult.  
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11 Family appears to play an important role in adolescent smoking. Students whose parents  
12 usually do not know their whereabouts on Saturday nights are about 3 times more likely to  
13 smoke than the ones whose parents always know. For male students, the odds are even larger,  
14 at close to 5. For students who were not satisfied with their relationship with their mother, the  
15 odds of smoking are about 2 times higher than for students who were satisfied. Being from a  
16 one-parent family did not have significant effect on male smoking. However, female students  
17 from a one-parent family were about twice as likely to smoke.  
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27 Truancy was also associated with 30-day smoking, with students who skipped more days off  
28 school being more likely to smoke.  
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32 Female students were more likely to smoke than male students when controlling for the listed  
33 predictors.  
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37 Perceived family relative wealth did not matter for female students. For male students who  
38 perceived their families to be "better off" were less likely to smoke than those who answered  
39 "about the same". Adolescents from "less well off" families were not significantly more  
40 likely to smoke than those who answered "about the same", when controlling for the named  
41 factors. Moreover, when including both genders, students who perceived their families to be  
42 "much better off" were, however, more likely to smoke than those from average families.  
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51 ***Table 4 Multivariate logistic regression results***

	OR (95% CI)		
	Total	Male	Female

Gender				
Male	1	NA	NA	NA
Female	<b>1.50 (1.25 to 1.80)</b>	NA	NA	NA
ESPAD year				
2007	1	1	1	1
2011	1.05 (0.85 to 1.28)	1.20 (0.89 to 1.62)	0.93 (0.70 to 1.23)	
2015	0.91 (0.70 to 1.18)	1.17 (0.80 to 1.70)	0.72 (0.50 to 1.03)	
Access to cigarette				
Difficult	1	1	1	
Easy	<b>1.44 (1.01 to 2.07)</b>	1.12 (0.65 to 1.93)	<b>1.69 (1.04 to 2.74)</b>	
Don't know	<b>2.88 (2.02 to 4.10)</b>	<b>2.54 (1.51 to 4.29)</b>	<b>3.04 (1.87 to 4.92)</b>	
Perceived risk of smoking				
Great/moderate risk	1	1	1	
No/slight risk	<b>1.90 (1.58 to 2.28)</b>	<b>1.65 (1.26 to 2.16)</b>	<b>2.16 (1.67 to 2.80)</b>	
Don't know	0.66 (0.27 to 1.59)	0.45 (0.09 to 2.16)	0.86 (0.28 to 2.61)	
Perceived family well off				
About the same	1	1	1	
Much better off	<b>1.33 (1.02 to 1.73)</b>	1.15 (0.78 to 1.69)	1.42 (0.97 to 2.08)	
Better off	0.84 (0.68 to 1.05)	<b>0.68 (0.49 to 0.93)</b>	1.01 (0.75 to 1.36)	
Less well off	1.07 (0.74 to 1.56)	0.92 (0.52 to 1.61)	1.20 (0.73 to 1.99)	
Parents know where students are on Saturday nights				
Know always	1	1	1	
Know quite often	<b>1.46 (1.18 to 1.82)</b>	<b>1.78 (1.28 to 2.47)</b>	1.19 (0.88 to 1.61)	
Know sometimes	<b>2.43 (1.89 to 3.13)</b>	<b>2.28 (1.58 to 3.29)</b>	<b>2.59 (1.81 to 3.70)</b>	
Usually don't know	<b>3.24 (2.29 to 4.59)</b>	<b>4.79 (2.95 to 7.75)</b>	<b>2.04 (1.23 to 3.36)</b>	
Relationship with mother				
Satisfied	1	1	1	
Neither nor	1.33 (0.96 to 1.84)	1.36 (0.80 to 2.31)	1.34 (0.87 to 2.06)	
Not satisfied	<b>1.82 (1.36 to 2.44)</b>	<b>1.93 (1.19 to 3.14)</b>	<b>1.81 (1.24 to 2.63)</b>	
Family structure				
Two parents or more	1	1	1	
One Parent	1.25 (0.97 to 1.61)	0.92 (0.62 to 1.38)	<b>1.57 (1.12 to 2.20)</b>	
Skipping school				
None	1	1	1	

1-4 days	<b>1.93 (1.57 to 2.38)</b>	<b>1.99 (1.47 to 2.69)</b>	<b>1.89 (1.42 to 2.52)</b>
5 days+	<b>2.80 (1.91 to 4.11)</b>	<b>2.46 (1.40 to 4.32)</b>	<b>3.46 (2.00 to 5.99)</b>
Friends that smoke			
None	1	1	1
A few/some	<b>3.77 (2.32 to 6.13)</b>	<b>3.63 (1.89 to 6.98)</b>	<b>4.23 (2.02 to 8.86)</b>
Most/all	<b>18.85 (11.39 to 31.22)</b>	<b>14.06 (7.09 to 27.87)</b>	<b>26.81 (12.51 to 57.48)</b>

Bold numbers indicate statistical significance at the 0.05 level.

## DISCUSSION

This study confirms the decline in smoking among 15-16 year olds and the closing of the gender gap. This study also supports research showing that perceived ease of access to cigarettes, lower perceived risk of smoking, lower parental monitoring, unsatisfied family relationships, truancy, peer smoking are associated with increased adolescent smoking.

The prevalence of smoking in the past 30 days declined between 1995 and 2015, with smoking rates among girls reducing more steeply than boys, thus closing the gender gap.

However, when controlling for the variables shown in Table 4, no significant change across the three survey years was found and girls had higher odds of smoking than boys did. This suggests that the factors included in the model may explain the decline in smoking prevalence; in particular those factors which have changed between data waves, namely perceived access to cigarettes, parental monitoring and particularly peer smoking.

Perceived ease of access to cigarettes decreased between 2007 and 2015. Students claiming that it was difficult to get cigarettes increased from 12% in 2007 to 28% in 2015. Several policies introduced during this period might contribute to the increase in difficulty accessing to cigarettes. In particular, the implementation of age limit law under Public Health (Tobacco) Act 2002 has officially started since April 2007. It is an offence to sell cigarettes or other tobacco products to persons aged under 18 years. In addition, since 2009 retailers are required to register with the National Tobacco Control Office. Vending machines were banned except



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3 in licensed establishments. These measures followed a 2007 ban on packets containing less  
4 than 20 cigarettes and a number of substantial increases to the excise duty on tobacco  
5 products, a known effective strategy to reduce prevalence among adults and children.<sup>22</sup>  
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10 Parents who “know always” students’ whereabouts on Saturday nights increased from 48% in  
11 2007 to 63% in 2015. This may point to family dynamics or family culture as an important  
12 aspect of reducing adolescent smoking, although it should not be assumed that simply asking  
13 adolescents where they are going would affect their behaviour. Correlations between parental  
14 monitoring and how much caring and support they think they got may in fact be a proxy for  
15 other aspects of home and social life needing further exploration.  
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24 Peer smoking, the strongest factor for predicting adolescent smoking, has also improved  
25 between 2007 and 2015. Students with no smoking friends significantly increased from 12%  
26 to 34%, and students claiming most/all friends smoked dropped from 20% to 11%. According  
27 to the results, the odds of smoking are 27 times higher for female students who report that  
28 most/all their friends smoke than for those with no smoking friends. However, the direction  
29 of causality is not necessarily clear due to the limitation of cross-sectional study. Adolescents  
30 who smoke may seek out other smokers as friends, but equally, adolescents may imitate the  
31 behaviours of their friends, including starting to smoke.  
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42 Despite the introduction of a number of policy measures, there was little change in perceived  
43 risk associated with smoking tobacco between 2007 and 2015. Textual health warnings on  
44 cigarette packaging were introduced in 2003 and were further expanded in 2008. Further,  
45 mandatory graphic health warnings on tobacco products were introduced in 2013, so that a  
46 text-only warning occupies at least 32% of the front and a pictorial warning occupies at least  
47 45% of the back of the pack. These measures were intended to increase awareness of the  
48 health risks associated with smoking. However, no school-based programs were developed in  
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3 Ireland aiming to raise the awareness of risks associated with smoking during this period.

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5 The fact that perceived risk of smoking did not increase among these respondents between  
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7 2007 and 2015 suggesting that this effect was not the mode of action of existing population-  
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9 wide interventions.

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12 There is a wealth of evidence to link adolescent smoking and low socioeconomic status, but  
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14 this study has found that perceived lower relative wealth was not linked to an increase  
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16 likelihood of smoking. There are some explanations for the absence of effect. First, although  
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18 we meant to capture socioeconomic status by perceived family wealth compared to other  
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20 student, the measure is not objective, which might raise bias on the estimation of  
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22 socioeconomic effect. For example, if most of a student's friends are from very wealthy  
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24 families, despite of the student's real family wealth, the student might feel he is less well off  
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26 than them, which will make the measure far from the true socioeconomic status. Second, the  
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28 association between low socioeconomic status and smoking may have been accounted for  
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30 using other factors that were in the model. However, the reasons for the finding that  
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32 'perceived much better off family wealth' was associated with higher rates of smoking may  
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34 be related to increased disposable income which is known to lessen the effects of price in  
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36 adults.<sup>23 24</sup>

## 37 38 39 40 41 **CONCLUSION**

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43 Ireland has successfully achieved a considerable decrease in adolescent smoking from 1995  
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45 to 2015. In addition, the gender gap on adolescent smoking has been closed during the period.  
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48 Adolescent smoking could be further reduced through strengthening enforcement on  
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50 adolescent access to cigarettes and maintaining high-intensity tobacco control media  
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52 campaigns targeting adolescent to change perception of risk. Parents could contribute by  
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3 enhancing monitoring of offspring. It is likely that adolescent smoking will reach the  
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5 Tobacco Free Ireland target of 5 percent by 2025.  
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**Contributors:** L C had the idea for the study, organised the team, secured the funding,  
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39 helped with data collection, analysis, data interpretation, and writing. S L expanded the  
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41 databases, did the final analyses and wrote a draft of paper. K T compiled the original  
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43 datasets and did the initial analyses and initial draft writing. S K organised the data collection,  
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45 helped with initial analysis and writing of all drafts.  
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51

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12 **Data sharing statement:**  
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15 The data was from the European School Survey Project on Alcohol and Other Drugs  
16 (ESPAD) and various official reports available from <http://www.espad.org/reports->  
17 documents.  
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21 With the 2003 data collection as a starting point it was decided that all country datasets  
22 should be merged into a common database. After that also data from 2007 and 2011 are  
23 available in separate databases. Initially, these databases were stored and maintained by the  
24 Databank Manager ‘Thoroddur Bjarnson. During the 2015 wave of ESPAD, the international  
25 database was compiled and standardized by CAN (Stockholm).  
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30 Even though, since 2007, countries are obliged to deliver their national datasets to the  
31 database there are - as stated in the Database Rules - no obligations to let other researchers  
32 use the national data without permission.  
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37 In order to obtain a copy of a Database an application form has to be filled in and posted to  
38 the coordinators for further distribution to the ESPAD Application Committee. The  
39 composition of the Committee as well as restrictions around the database and its use are  
40 described and explained in the ESPAD Database Rules (Database Rules for ESPAD  
41 Researchers and Database Rules for Non-ESPAD Researchers).  
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46 When an application is approved a contract is signed before a copy of the database is  
47 delivered. Approved applications are presented in a list, which also displays the deadline of  
48 the projects.  
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53 ESPAD researchers are allowed to apply for the most recent database once the International  
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3 ESPAD Report has been released.

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5 Non-ESPAD researchers are also allowed to work with ESPAD data. Access for Non-

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7 ESPAD Researchers is allowed after an embargo period determined by an Assembly:

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9 ESPAD 2003 Database: Accessible now

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11 ESPAD 2007 Database: Was accessible since July 1, 2013

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13 ESPAD 2011 Database: Was accessible since July 1, 2015

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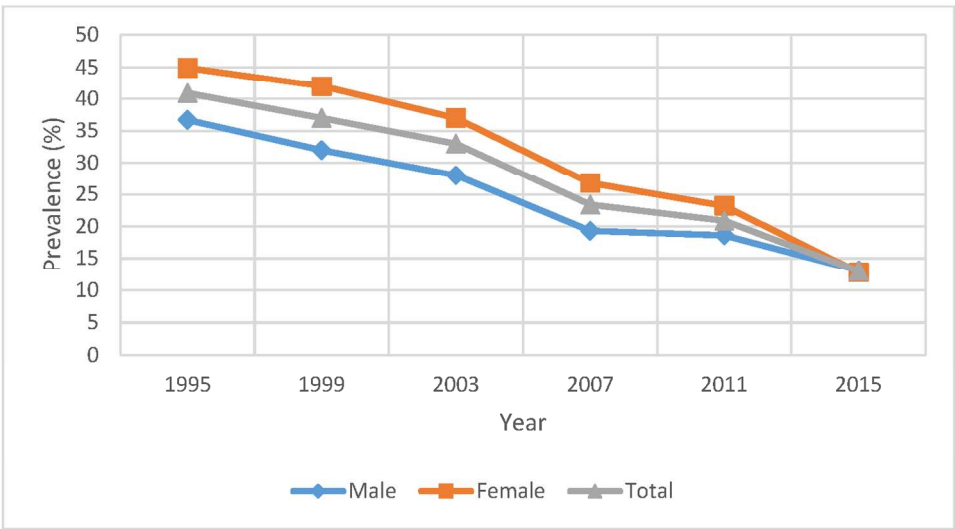


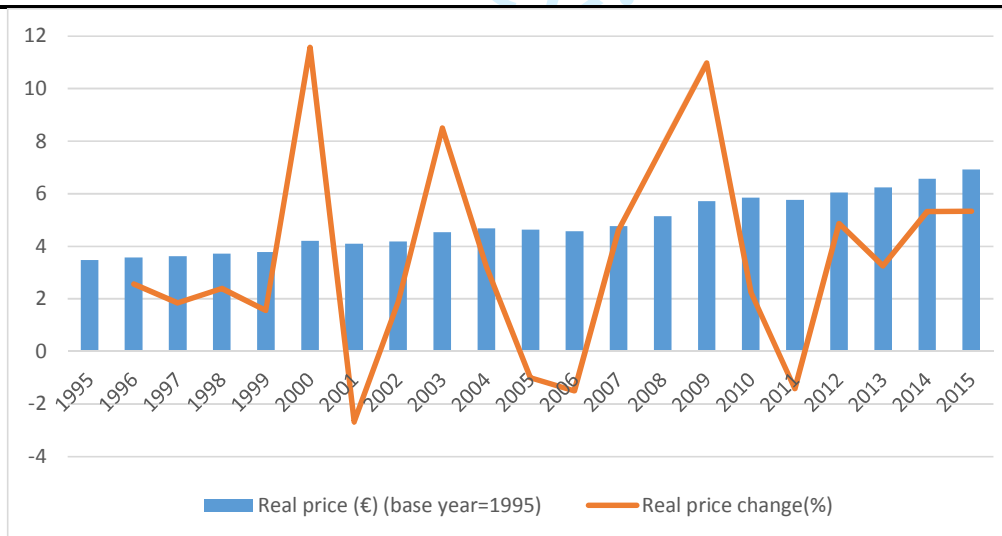
Figure 1 Trend of adolescent smoking prevalence: 1995-2015

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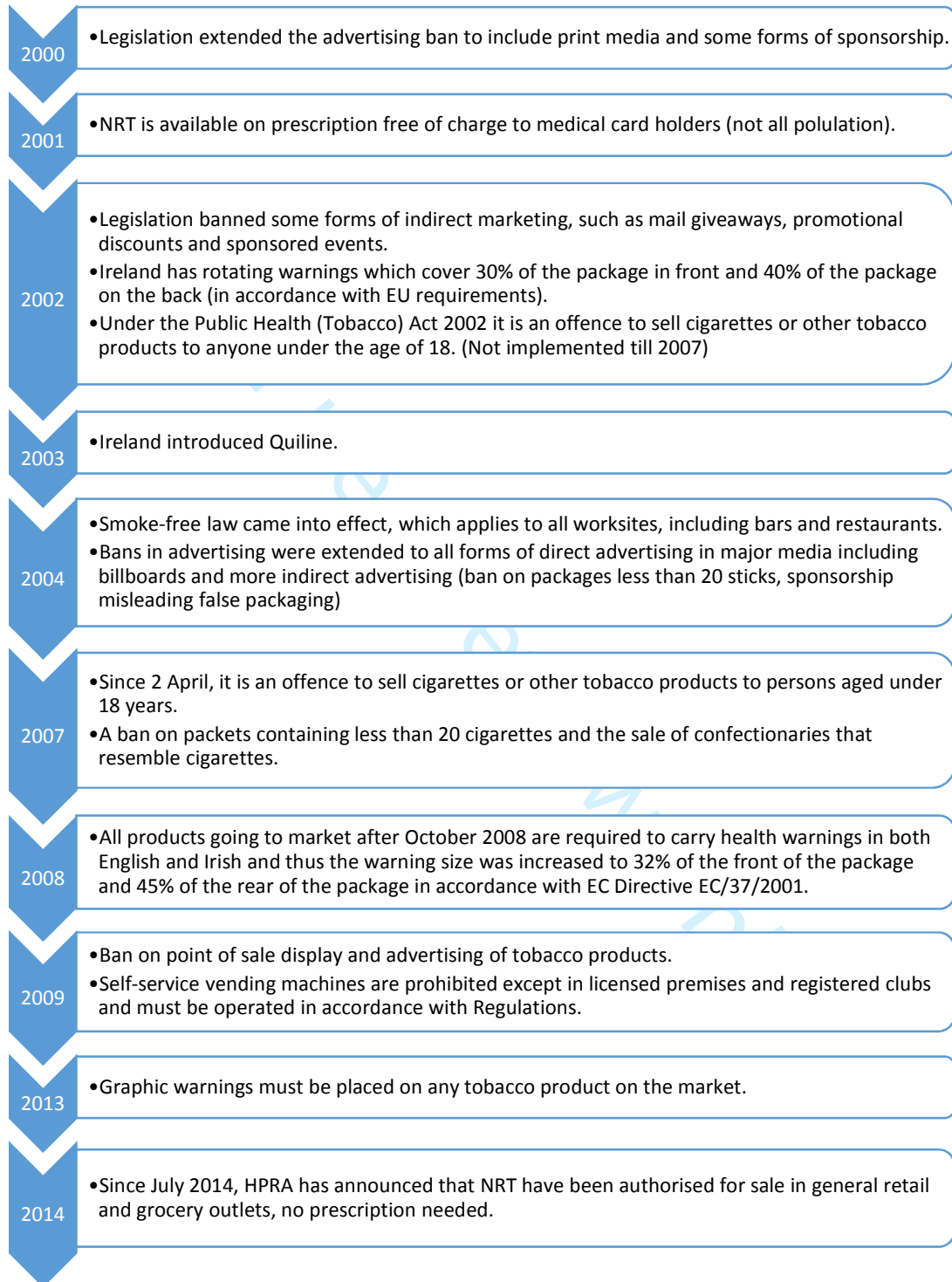
Review only

**Appendix I: Real price per package of 20 cigarettes in Ireland, 1995-2015**

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Retail price	3.5	3.6	3.8	3.9	4.1	4.8	4.9	5.2	5.8	6.2	6.3	6.4	7.0	7.9	8.4	8.5	8.6	9.1	9.5	10.0	10.5
CPI (year 1995=100)	100	102	103	106	107	113	119	124	129	131	135	140	147	153	146	145	148	151	152	152	151
Real price(base year=1995)	3.5	3.6	3.6	3.7	3.8	4.2	4.1	4.2	4.5	4.7	4.6	4.6	4.8	5.2	5.7	5.8	5.8	6.0	6.2	6.6	6.9
Real price change (%)		2.6	1.9	2.4	1.6	11.6	-2.7	1.9	8.5	3.2	-1.0	-1.5	4.6	7.8	11.0	2.2	-1.4	4.9	3.3	5.3	5.3



## Appendix II: Timestamps of Tobacco Control Policies in Ireland, 1995-2015



## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	7
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-9
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9
		(b) Describe any methods used to examine subgroups and interactions	9
		(c) Explain how missing data were addressed	
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	

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60**Results**

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	7-8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	7-10
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	8-9
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	11-13
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12

**Discussion**

Key results	18	Summarise key results with reference to study objectives	14-16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Generalisability	21	Discuss the generalisability (external validity) of the study results	16

**Other information**

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17
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\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Decline of Adolescent Smoking in Ireland 1995-2015: Trend Analysis and Associated Factors

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<b>Primary Subject Heading</b>:	Smoking and tobacco
Secondary Subject Heading:	Smoking and tobacco, Epidemiology, Public health, Health policy
Keywords:	PUBLIC HEALTH, EPIDEMIOLOGY, PREVENTIVE MEDICINE

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Peer Review Only

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3 **Title:** Decline of Adolescent Smoking in Ireland 1995-2015:  
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6 Trend Analysis and Associated Factors  
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9  
10 **Corresponding Author:** Shasha Li  
11

12  
13 Address for all authors: TobaccoFree Research Institute Ireland,  
14

15 Focas Research Institute,  
16

17 DIT, Kevin Street,  
18

19 Dublin 8, Ireland  
20

21  
22 Email: [shashali@tri.ie](mailto:shashali@tri.ie)  
23

24 Tel: +35312601966  
25

26  
27 **Co-authors:**  
28

29  
30 1. Sheila Keogan  
31

32  
33 2. Keishia Taylor  
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36 3. Luke Clancy  
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## ABSTRACT

### Objectives

The study examines trends in smoking among Irish adolescents of 15-16 years old between 1995 and 2015 and the factors associated with their smoking behaviours between 2007 and 2015.

### Methods

Data were obtained from the European School Survey Project on Alcohol and Other Drugs (ESPAD) Ireland between 1995 and 2015. To examine the gender gap, two-sample proportion tests were used. Multivariate logistic regression was performed to examine the factors associated with smoking behaviours. Dependent variable is whether a respondent is a smoker in last-30 day. Independent variables include gender, survey years, perceived ease of access to cigarettes, perceived risk of smoking, perceived relative wealth, parental monitoring, maternal relationship, family structure, truancy and peer smoking.

### Results

Smoking prevalence has dropped from 41% in 1995 to 13% in 2015. The prevalence was much higher among girls than boys in 1995. The gender gap was closed by 2015.

Multivariate regression results show that peer smoking, perceived access to cigarettes, perceived risks of smoking, parental monitoring, truancy, maternal relationship, perceived relative wealth and family structure were all significantly associated with adolescent smoking, and some of the factors had different effects for female and male students.

### Conclusion

Ireland has successfully achieved a considerable decrease of adolescent smoking from 1995 to 2015, during which various tobacco control policies have been implemented. In addition,



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3 the gender gap on adolescent smoking has been closed during the period. Adolescent  
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5 smoking could be further improved through strengthening enforcement on adolescent access  
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7 to cigarettes and maintaining a high-intensity tobacco control media campaign targeting  
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9 adolescents. Parents could also contribute by enhancing monitoring.  
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11  
12 **Keywords:** Public health; Epidemiology; Preventive medicine  
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### Strengths and limitations of this study

- The data is from the best available survey on Irish adolescents from 1995-2015 using an internationally validated survey instrument, including comprehensive measurement for smoking-related factors. The data sets in different years are comparable in data collection and questions.
- The study is based on multivariable logistic regression, which controls for confounders.
- The factors associated with the changing gender gap in adolescent smoking were examined.
- Other factors potentially related to adolescent smoking were not included in the surveys, such as parental smoking.
- Limited data availability for some of the ESPAD waves are acknowledged.

## INTRODUCTION

People who take up smoking at a younger age become more dependent and find it harder to quit than smokers who start later in their lives,<sup>1 2</sup> so policies designed to discourage adolescents from starting to smoke have been at the forefront of tobacco prevention in recent years. In Ireland, the Tobacco Free Ireland (TFI) report of 2013 stated that the protection of children must be prioritised in all of the initiatives outlined in the policy.<sup>3</sup>

The parties to the 2003 WHO Framework Convention on Tobacco Control stated their “deep concern” regarding tobacco consumption by children and adolescents, emphasising price and tax measures as effective means of reducing tobacco consumption among young people.<sup>4</sup>

Between 1995 and 2015, the real retail price per package of 20 cigarettes in Ireland has been increased almost every year (See Appendix I). The European Tobacco Products Directive (2014/40/EU) places restrictions on the use of tobacco packaging designed to appeal to children and prohibits flavoured cigarettes and roll-your-own tobacco.<sup>5</sup> In Ireland, stronger legislation regarding the complete standardisation of tobacco packaging came into force in September 2017 and should reduce further the effect of tobacco advertising on adolescents.<sup>6</sup>

Between 1995 and 2015, a series of national level tobacco control policies were introduced (see Appendix II), although there were no school-specific tobacco control policies implemented in Ireland. For example, the implementation of age limit law under Public Health (Tobacco) Act 2002 was not fully implemented until April 2007. It is an offence to sell cigarettes or other tobacco products to persons aged under 18 years. In addition, since 2009 retailers are required to register with the National Tobacco Control Office. Vending machines were banned except in licensed establishments.

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3 There has been a large volume of research conducted regarding interventions against  
4 adolescent smoking, including studies evaluating policies to restrict access and raise  
5 awareness of risk, with mixed results.<sup>7 8 9</sup> Some studies have examined perceptions of risk  
6 and its association with smoking and the majority reported a negative association between  
7 risk perception and smoking.<sup>10 11</sup> Other studies have investigated correlates in the domestic  
8 and social sphere, including associations with parental monitoring, relationships with parents,  
9 family structure, truancy from school, and peer smoking.<sup>12 13 14 15 16</sup> It is also established  
10 that adolescents from a lower socioeconomic background are more likely to smoke.<sup>17 18</sup> This  
11 study first establishes the declining trends in smoking among Irish 15 and 16 year olds  
12 between 1995 and 2015 and the closing of the gender gap. Secondly, we examine potential  
13 factors associated with their smoking behaviours using the 2007-2015 surveys. Based on the  
14 factors mentioned in existing literature and taking account of availability in the dataset, we  
15 explored the relationship to smoking prevalence of gender, survey years, perceived ease of  
16 access to cigarettes, perceived risk of smoking, perceived relative wealth, parental monitoring,  
17 maternal relationship, family structure, truancy and peer smoking, and also discussed the  
18 changes of the factors over time. We cannot assess the effects of the use of electronic(e)-  
19 cigarettes on trends using these data as we only have data on e-cigarette from the 2015 survey  
20 and they were only introduced in 2013. We have expressed our fears concerning e-cigarette  
21 and the need for close monitoring elsewhere.<sup>19 20</sup>

## 22 **METHODS**

### 23 **Data source and sample**

24 This study used data from the European School Survey Project on Alcohol and Other Drugs  
25 (ESPAD) Ireland. The main purpose of the survey was to collect comparable data on  
26 substance use among 15- and 16-year-old students across Europe, in order to monitor trends  
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3 within and between countries, including Ireland.<sup>21</sup> ESPAD surveys were conducted every  
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5 four years between 1995 and 2015, resulting in six waves of data from 26 countries, and 35  
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7 countries participating in 2015.  
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10 The sampling procedures, data collection and questionnaire used in Ireland were consistent  
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12 with the international ESPAD study protocol.<sup>19</sup> School students born in specific calendar  
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14 years were eligible and selected using stratified random sampling. Data were collected  
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16 anonymously through paper-and-pencil, self-completion questionnaires administered in the  
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18 classroom. After standardised cleaning procedures, the datasets were obtained from the  
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20 ESPAD official database. Full accounts of the methodology of the study in each survey year  
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22 could be found in the respective reports of the ESPAD project.<sup>21 22 23</sup>  
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28 Smoking prevalence for all six ESPAD waves is available and used for the trend analysis.  
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30 The raw 1999 and 2003 survey datasets are unavailable and the 1995 dataset did not include  
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32 most of the measures used in the study. Therefore, only the 2007, 2011 and 2015 studies were  
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34 used to assess the associated factors of smoking. Sample characteristics are reported in Table  
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45 **Table 1** Sample sizes, gender and response rates of the ESPAD Ireland surveys (1995-2015)  
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48 Years	1995	1999	2003	2007	2011	2015
49 Sample size	1849	2277	2407	2221	2207	1470
50 Male (%)	49	49	51	45	50	51
51 Response rate (%)	96	92	96	94	94	86

## Measures

Respondents were asked how frequently they had smoked in the last 30 days, with answers ranging from “not at all” to “more than 20 cigarettes per day”. Those who answered ‘not at all’ are non-smokers and those who had smoked at least once in the last 30 days are smokers. Current or 30-day smoking prevalence rate is the proportion of smokers.

The questionnaire included items about respondents’ awareness of and experience with cigarette smoking, perceived family wealth, parent monitoring, relationship with parents, family structure, truancy and peer smoking.

Students were asked how difficult it would be to get cigarettes if they wanted them and to what extent people risk harming themselves (physically or in other ways) if they smoke occasionally. The majority of students thought it would be easy to get cigarettes and about half of the students perceived a moderate/great risk from smoking occasionally.

Socioeconomic status was estimated by how well off students perceived their family to be compared to other families on 4 points from “much better off” to “less well off”. Respondents were also asked whether their parents know where they spend Saturday nights (always, quite often, sometimes or usually don’t know) and whether they were satisfied with their relationship with their mother. Students also listed the members of their household and around 14% of the students were from one-parent families.

Respondents were asked about truancy by reporting the number of days on which they had skipped one or more days during the last 30 days. In addition, they were asked how many of their friends smoked cigarettes.

The frequencies of responses for each predictor category are shown in Table 2. Most responses changed significantly across the survey years, notably in perceived access to cigarettes, parental monitoring and peer smoking. Particularly, in 2007 and 2011, only about

12% of the students reported that none of their friends smoked, but by 2015 it had increased to 34%. The proportion of students who claimed most/all of their friends smoked had decreased from 20% in 2007 to 11% in 2015. Access to cigarettes had become more difficult across the three survey waves, with students who reported that it was difficult to obtain cigarettes increasing from 12% in 2007 to 28% in 2015. More students claimed that their parents always know where they spend Saturday nights, from 48% in 2007 to 63% in 2015.

### Statistical analysis

To examine the gender gap in smoking prevalence between 1995 and 2015, two-sample proportion tests were used and p-values are reported. The main analysis examined the factors associated with adolescents' smoking behaviours across the last three survey waves using multivariate logistic regression. The dependent variable was whether or not a student had smoked in the last 30 days. Independent variables included gender, survey years, and the measures listed in Table 2. The analysis was then repeated for each gender individually to detect if any factors played different roles between female and male students. All of the statistical analysis was conducted in IBM SPSS Statistics 22.

**Table 2** Summary of the results and changes in key measures associated with smoking in

Irish ESPAD surveys 2007-2015

		ESPAD Year		
		2007	2011	2015
Access to cigarettes*	Difficult	12.0%	16.2%	28.1%
	Easy	41.7%	41.9%	42.4%

	Don't know	46.3%	41.9%	29.5%
Risk of smoking cigarettes occasionally	No/slight risk	39.6%	43.0%	41.6%
	Moderate/great risk	58.0%	54.2%	55.8%
	Don't know	2.3%	2.8%	2.5%
Perceived family relative wealth*	Much better off	15.8%	10.8%	15.8%
	Better off	32.4%	27.7%	25.8%
	About the same	46.2%	56.2%	48.6%
	Less well off	5.5%	5.3%	9.8%
Parents knowing where students spend Saturday nights*	Know always	47.4%	49.6%	62.7%
	Know quite often	30.0%	30.3%	23.3%
	Know sometimes	15.4%	14.9%	8.9%
	Usually don't know	7.2%	5.3%	5.1%
Relationship with mother*	Satisfied	83.4%	87.4%	87.4%
	Neither Nor	7.8%	5.0%	5.2%
	Not satisfied	8.8%	7.5%	7.3%
One-parent family	Two or more parents	87.0%	86.1%	86.0%
	One parent	13.0%	13.9%	14.0%
Skipping school in the last 30 days*	None	73.6%	80.4%	80.2%
	1-4 days	21.2%	16.7%	16.1%
	5 days+	5.2%	2.9%	3.8%
Peers smoking*	None	12.4%	11.9%	33.5%
	A few/some	67.6%	69.7%	55.8%
	Most/All	20.0%	18.4%	10.6%

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\* Chi Square statistically significant at 0.05 level.

## RESULTS

### Trend of adolescent smoking and the closing of gender gap

30-day smoking prevalence among boys and girls for each survey wave is shown in Table 3 and Figure 1. In 1995, female students had a 30-day smoking prevalence of 44.9%, much higher than the prevalence of male students of 36.7% ( $P < 0.001$ ). Along the survey years the



prevalence for both genders dropped significantly, with girls achieving a greater decline. By 2015, the female and male smoking prevalence is 12.8% and 13.1%, respectively. With slightly fewer female students smoking than male students, the gender gap was closed by 2015, which is confirmed by the p-value of 0.83.

**Table 3** 30-day smoking prevalence (%) in Irish ESPAD surveys from 1995-2015

Year	1995	1999	2003	2007	2011	2015
Male	36.7	32	28	19.3	18.6	13.1
Female	44.9	42	37	26.8	23.2	12.8
Total	40.9	37	33	23.4	20.9	13
P value*	<0.001	<0.001	<0.001	<0.001	0.009	0.83

\* The null hypothesis is that female and male students had the same smoking prevalence.

### Predictors of adolescent smoking

Table 4 presents the multivariate logistic regression results taking account of the potential factors associated with adolescent smoking. Peer smoking, perceived access to cigarettes, perceived risk of smoking, parental monitoring, truancy, maternal relationship, perceived relative wealth, family structure were all significantly associated with adolescent smoking, and some of the factors had different effects for female and male students.

Peer smoking had the strongest effect. A student with a few/some friends who smoked was 4 times more likely to smoke than a student who had no smoking friends. If most/all their friends smoked, the odds of smoking were 27 times higher for female students and 14 times higher for male students.

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3 Students who reported a lower risk from smoking occasionally were twice more likely to  
4 smoke than those reported greater risk from smoking. For female students, those who  
5 reported 'easy to access' cigarettes were about twice as likely to smoke as those who reported  
6 it 'difficult'. However, for male students, there was no significant difference. Interestingly,  
7 for both genders, those who reported "don't know" if it is easy or difficult to access cigarette,  
8 are about 3 times more likely to smoke than those who reported it as difficult.  
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16 Family appears to play an important role in adolescent smoking. Students whose parents  
17 usually do not know their whereabouts on Saturday nights are about 3 times more likely to  
18 smoke than the ones whose parents always know. For male students, the odds are even larger,  
19 at close to 5 times. For students who were not satisfied with their relationship with their  
20 mother, the odds of smoking are about 2 times higher than for students who were satisfied.  
21 Being from a one-parent family did not have significant effect on male smoking. However,  
22 female students from a one-parent family were about twice as likely to smoke.  
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32 Truancy was also associated with 30-day smoking, with students who skipped more days off  
33 school being more likely to smoke.  
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37 Female students were more likely to smoke than male students when controlling for the listed  
38 predictors.  
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42 Perceived family relative wealth did not matter for female students. For male students who  
43 perceived their families to be "better off" were less likely to smoke than those who answered  
44 "about the same". Adolescents from "less well off" families were not significantly more  
45 likely to smoke than those who answered "about the same", when controlling for the named  
46 factors. Moreover, when including both genders, students who perceived their families to be  
47 "much better off" were, however, more likely to smoke than those from average families.  
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**Table 4** Multivariate logistic regression results of various factors potentially associated with smoking from Irish ESPAD surveys 2007-2015

	OR (95% CI)		
	Total	Male	Female
Gender			
Male	1	NA	NA
Female	<b>1.50 (1.25 to 1.80)</b>	NA	NA
ESPAD year			
2007	1	1	1
2011	1.05 (0.85 to 1.28)	1.20 (0.89 to 1.62)	0.93 (0.70 to 1.23)
2015	0.91 (0.70 to 1.18)	1.17 (0.80 to 1.70)	0.72 (0.50 to 1.03)
Access to cigarette			
Difficult	1	1	1
Easy	<b>1.44 (1.01 to 2.07)</b>	1.12 (0.65 to 1.93)	<b>1.69 (1.04 to 2.74)</b>
Don't know	<b>2.88 (2.02 to 4.10)</b>	<b>2.54 (1.51 to 4.29)</b>	<b>3.04 (1.87 to 4.92)</b>
Perceived risk of smoking			
Great/moderate risk	1	1	1
No/slight risk	<b>1.90 (1.58 to 2.28)</b>	<b>1.65 (1.26 to 2.16)</b>	<b>2.16 (1.67 to 2.80)</b>
Don't know	0.66 (0.27 to 1.59)	0.45 (0.09 to 2.16)	0.86 (0.28 to 2.61)
Perceived family well off			
About the same	1	1	1
Much better off	<b>1.33 (1.02 to 1.73)</b>	1.15 (0.78 to 1.69)	1.42 (0.97 to 2.08)
Better off	0.84 (0.68 to 1.05)	<b>0.68 (0.49 to 0.93)</b>	1.01 (0.75 to 1.36)
Less well off	1.07 (0.74 to 1.56)	0.92 (0.52 to 1.61)	1.20 (0.73 to 1.99)
Parents know where students are on Saturday nights			
Know always	1	1	1
Know quite often	<b>1.46 (1.18 to 1.82)</b>	<b>1.78 (1.28 to 2.47)</b>	1.19 (0.88 to 1.61)
Know sometimes	<b>2.43 (1.89 to 3.13)</b>	<b>2.28 (1.58 to 3.29)</b>	<b>2.59 (1.81 to 3.70)</b>
Usually don't know	<b>3.24 (2.29 to 4.59)</b>	<b>4.79 (2.95 to 7.75)</b>	<b>2.04 (1.23 to 3.36)</b>
Relationship with mother			
Satisfied	1	1	1
Neither nor	1.33 (0.96 to 1.84)	1.36 (0.80 to 2.31)	1.34 (0.87 to 2.06)
Not satisfied	<b>1.82 (1.36 to 2.44)</b>	<b>1.93 (1.19 to 3.14)</b>	<b>1.81 (1.24 to 2.63)</b>
Family structure			

Two parents or more	1	1	1
One Parent	1.25 (0.97 to 1.61)	0.92 (0.62 to 1.38)	<b>1.57 (1.12 to 2.20)</b>
Skipping school			
None	1	1	1
1-4 days	<b>1.93 (1.57 to 2.38)</b>	<b>1.99 (1.47 to 2.69)</b>	<b>1.89 (1.42 to 2.52)</b>
5 days+	<b>2.80 (1.91 to 4.11)</b>	<b>2.46 (1.40 to 4.32)</b>	<b>3.46 (2.00 to 5.99)</b>
Friends that smoke			
None	1	1	1
A few/some	<b>3.77 (2.32 to 6.13)</b>	<b>3.63 (1.89 to 6.98)</b>	<b>4.23 (2.02 to 8.86)</b>
Most/all	<b>18.85 (11.39 to 31.22)</b>	<b>14.06 (7.09 to 27.87)</b>	<b>26.81 (12.51 to 57.48)</b>

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Bold numbers indicate statistical significance at the 0.05 level.

## DISCUSSION

This study confirms the decline in smoking among 15-16 year olds and the closing of the gender gap. This study also supports research showing that perceived ease of access to cigarettes, lower perceived risk of smoking, lower parental monitoring, unsatisfied family relationships, truancy, peer smoking are associated with adolescent smoking.

The prevalence of smoking in the past 30 days declined between 1995 and 2015, with smoking rates among girls reducing more steeply than boys, thus closing the gender gap.

However, when controlling for the variables shown in Table 4, no significant change across the three survey years was found and girls had higher odds of smoking than boys did. This suggests that the factors included in the model may explain the decline in smoking prevalence.

In support of this we find that, most of the factors have changed significantly in a favourable direction between data waves, including perceived access to cigarettes, parental monitoring and peer smoking.

Perceived ease of access to cigarettes decreased between 2007 and 2015. Students claiming that it was difficult to get cigarettes increased from 12% in 2007 to 28% in 2015. Several policies introduced during this period might contribute to the increase in difficulty accessing

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3 to cigarettes. In particular, the implementation of age limit law under Public Health (Tobacco)  
4 Act 2002 has officially started since April 2007. It is an offence to sell cigarettes or other  
5 tobacco products to persons aged under 18 years. In addition, since 2009 retailers are required  
6 to register with the National Tobacco Control Office. Vending machines were banned except  
7 in licensed establishments. These measures followed a 2007 ban on packets containing less  
8 than 20 cigarettes and a number of substantial increases to the excise duty on tobacco  
9 products, a known effective strategy to reduce prevalence among adults and children.<sup>24</sup>

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19 Parents who “know always” students’ whereabouts on Saturday nights increased from 48% in  
20 2007 to 63% in 2015. This may point to family dynamics or family culture as an important  
21 aspect of reducing adolescent smoking, although it should not be assumed that simply asking  
22 adolescents where they are going would affect their behaviour. Correlations between parental  
23 monitoring and how much caring and support they think they got may in fact be a proxy for  
24 other aspects of home and social life needing further exploration.

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33 Peer smoking, the strongest factor for predicting adolescent smoking, has also improved  
34 between 2007 and 2015. Students with no smoking friends significantly increased from 12%  
35 to 34%, and students claiming most/all friends smoked dropped from 20% to 11%. According  
36 to the results, the odds of smoking are 27 times higher for female students who report that  
37 most/all their friends smoke than for those with no smoking friends. However, the direction  
38 of causality is not necessarily clear due to the limitation of cross-sectional study. Adolescents  
39 who smoke may seek out other smokers as friends, but equally, adolescents may imitate the  
40 behaviours of their friends, including starting to smoke. The fact that there are fewer smokers  
41 in the population may, at least partially, account for the fact that the students reported fewer  
42 friends as smokers but this would perhaps suggest a more passive or coincidental occurrence  
43 than the perceived role of peers in adolescent smoking.<sup>25</sup>

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3 Despite the introduction of a number of policy measures, there was little change in perceived  
4 risk associated with smoking tobacco between 2007 and 2015. Textual health warnings on  
5 cigarette packaging were introduced in 2003 and were further expanded in 2008. Further,  
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7 mandatory graphic health warnings on tobacco products were introduced in 2013, so that a  
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9 text-only warning occupies at least 32% of the front and a pictorial warning occupies at least  
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11 45% of the back of the pack. These measures were intended to increase awareness of the  
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13 health risks associated with smoking. However, no school-based programs were developed in  
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15 Ireland aiming to raise the awareness of risks associated with smoking during this period.  
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17 The fact that perceived risk of smoking did not increase among these respondents between  
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19 2007 and 2015 suggesting that this effect was not the mode of action of existing population-  
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21 wide interventions.  
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27 There is a wealth of evidence to link adolescent smoking and low socioeconomic status, but  
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29 this study has found that perceived lower relative wealth was not linked to an increase  
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31 likelihood of smoking. There are some explanations for the absence of effect. First, although  
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33 we meant to capture socioeconomic status by perceived family wealth compared to other  
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35 student, the measure is not objective, which might raise bias on the estimation of  
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37 socioeconomic effect. For example, if most of a student's friends are from very wealthy  
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39 families, despite of the student's real family wealth, the student might feel he is less well off  
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41 than them, which will make the measure far from the true socioeconomic status. Second, the  
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43 association between low socioeconomic status and smoking may have been accounted for  
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45 using other factors that were in the model. However, the reasons for the finding that  
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47 'perceived much better off family wealth' was associated with higher rates of smoking may  
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49 be related to increased disposable income which is known to lessen the effects of price in  
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51 adults.<sup>26 27</sup>  
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3 The closing of the gap between females and males is not fully explained by the changes in the  
4 variables examined alone and may be due to a differential effect of the changes in legislation  
5 which will be examined in other data sources.  
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## 10 **CONCLUSION**

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12 Ireland has successfully achieved a considerable decrease in adolescent smoking from 1995  
13 to 2015. In addition, the gender gap on adolescent smoking has been closed during the period.  
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15 Decreased access to cigarettes has been associated with decreased smoking and the results  
16 show that better implementation of legislation is possible and should lead to further declines  
17 in the prevalence of smoking. The perception of the risks of smoking however has not  
18 increased suggesting that targeted high-intensity tobacco control media campaigns may help  
19 and should be implemented.  
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28 The results also suggest that parents could contribute to further declines in smoking by  
29 enhancing monitoring of offspring. It is likely that adolescent smoking will reach the  
30 Tobacco Free Ireland target of 5 percent by 2025 given the rate of decline in this age group.  
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46 **Contributors:** L C had the idea for the study, organised the team, secured the funding,  
47 helped with data collection, analysis, data interpretation, and writing. S L expanded the  
48 databases, did the final analyses and wrote a draft of paper. K T compiled the original  
49 datasets and did the initial analyses and initial draft writing. S K organised the data collection,  
50 helped with initial analysis and writing of all drafts.  
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4

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15  
16 contract CC.14.SDI.032 who compiled a common ESPAD Trend database (1995-2015)  
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19 **Data sharing statement:**  
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22 The data was from the European School Survey Project on Alcohol and Other Drugs  
23  
24 (ESPAD) and various official reports available from <http://www.espad.org/reports->  
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26 documents.  
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28 With the 2003 data collection as a starting point it was decided that all country datasets  
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30 should be merged into a common database. After that also data from 2007 and 2011 are  
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32 available in separate databases. Initially, these databases were stored and maintained by the  
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34 Databank Manager ‘Thoroddur Bjarnson. During the 2015 wave of ESPAD, the international  
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36 database was compiled and standardized by CAN (Stockholm).  
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39 Even though, since 2007, countries are obliged to deliver their national datasets to the  
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41 database there are - as stated in the Database Rules - no obligations to let other researchers  
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43 use the national data without permission.  
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45 In order to obtain a copy of a Database an application form has to be filled in and posted to  
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47 the coordinators for further distribution to the ESPAD Application Committee. The  
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49 composition of the Committee as well as restrictions around the database and its use are  
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51 described and explained in the ESPAD Database Rules (Database Rules for ESPAD  
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53 Researchers and Database Rules for Non-ESPAD Researchers).  
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3 When an application is approved a contract is signed before a copy of the database is  
4 delivered. Approved applications are presented in a list, which also displays the deadline of  
5 the projects.  
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9 ESPAD researchers are allowed to apply for the most recent database once the International  
10 ESPAD Report has been released.  
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13 Non-ESPAD researchers are also allowed to work with ESPAD data. Access for Non-

14 ESPAD Researchers is allowed after an embargo period determined by an Assembly:  
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16 ESPAD 2003 Database: Accessible now  
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18 ESPAD 2007 Database: Was accessible since July 1, 2013  
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20 ESPAD 2011 Database: Was accessible since July 1, 2015  
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22 ESPAD 2015 Database: At present it is only accessible to ESPAD Researchers  
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12 **Figure 1** Trend of adolescent smoking prevalence: 1995-2015  
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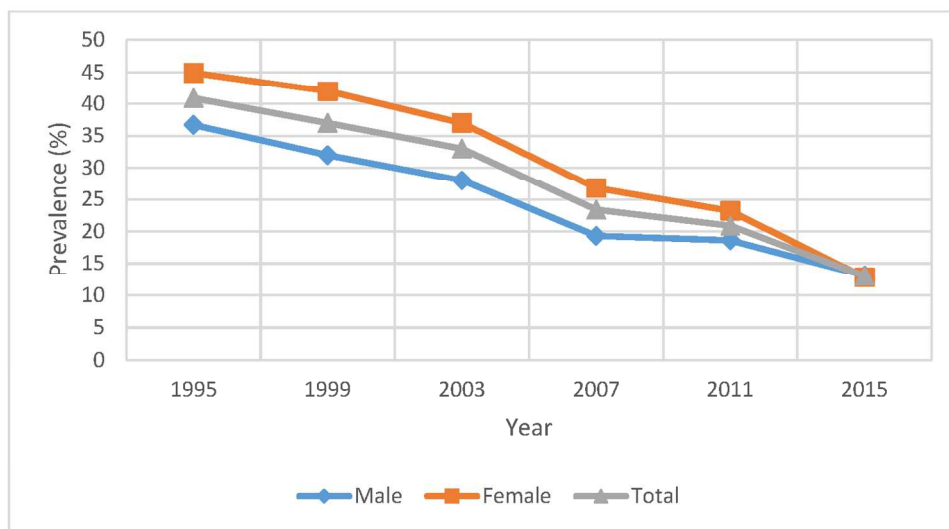


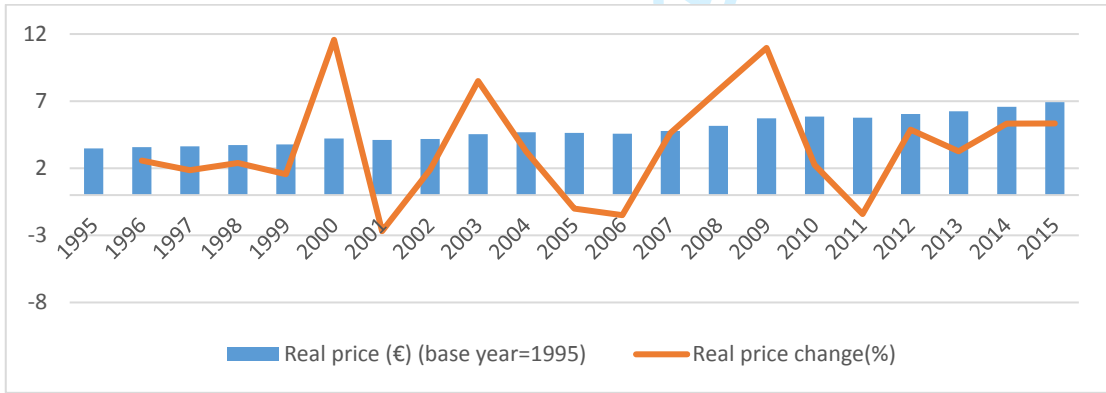
Figure 1 Trend of adolescent smoking prevalence: 1995-2015

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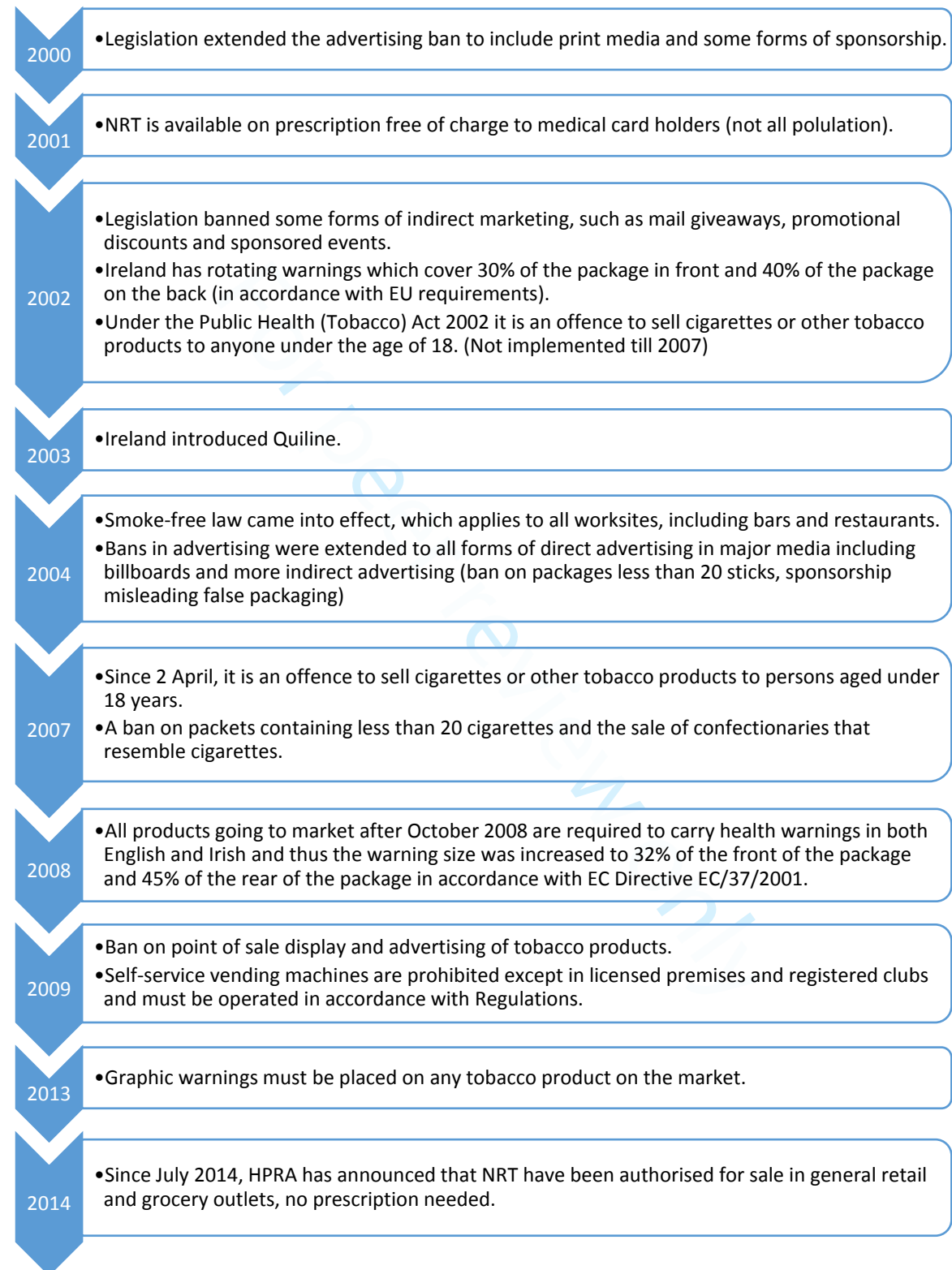
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### Appendix I: Real price per package of 20 cigarettes in Ireland, 1995-2015

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Retail price	3.5	3.6	3.8	3.9	4.1	4.8	4.9	5.2	5.8	6.2	6.3	6.4	7.0	7.9	8.4	8.5	8.6	9.1	9.5	10.0	10.5
CPI (year 1995=100)	100	102	103	106	107	113	119	124	129	131	135	140	147	153	146	145	148	151	152	152	151
Real price(base year=1995)	3.5	3.6	3.6	3.7	3.8	4.2	4.1	4.2	4.5	4.7	4.6	4.6	4.8	5.2	5.7	5.8	5.8	6.0	6.2	6.6	6.9
Real price change (%)		2.6	1.9	2.4	1.6	11.6	-2.7	1.9	8.5	3.2	-1.0	-1.5	4.6	7.8	11.0	2.2	-1.4	4.9	3.3	5.3	5.3



## Appendix II: Timestamps of Tobacco Control Policies in Ireland, 1995-2015





## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	7
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-9
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9
		(b) Describe any methods used to examine subgroups and interactions	9
		(c) Explain how missing data were addressed	
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	

<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	7-8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	7-10
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	8-9
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	11-13
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	14-16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).