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Smoking restrictions in the home and secondhand smoke exposure among primary schoolchildren before and after introduction of the Scottish smoke-free legislation

P C Akhtar,¹ S J Haw,² D B Currie,¹ R Zachary,³ C E Currie¹

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¹ Child and Adolescent Health Research Unit (CAHRU), University of Edinburgh, Edinburgh, UK; ² Scottish Collaboration for Public Health Research (SCPHRP), Western General Hospital, Edinburgh and NHS Health Scotland, Edinburgh, UK; ³ Edinburgh Napier University, Edinburgh, UK

Correspondence to: Dorothy B Currie, Child and Adolescent Health Research Unit (CAHRU), University of Edinburgh, St Leonard's Land, Holyrood Road, Edinburgh EH8 8AQ, UK; dorothy.currie@ed.ac.uk

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ABSTRACT

Objective: To examine change in home smoking restrictions one year after introduction of Scottish smoke-free legislation, and whether type of restriction impacts upon secondhand smoke (SHS) exposure among children.

Design: Comparison of nationally representative, cross-sectional, class-based surveys carried out in the same schools before and after legislation.

Participants: 2527 primary schoolchildren (aged around 11 years) surveyed in January 2006 and 2379 in January 2007.

Outcome measures: Self-reported home smoking restrictions, salivary cotinine concentrations.

Results: Children surveyed after implementation of legislation were more likely than those surveyed before its introduction to report complete home smoking restrictions as opposed to partial (relative risk ratio (partial vs complete) 0.75 (95% CI 0.63 to 0.89) or no restrictions (RR (no restrictions vs complete) 0.50 (0.40 to 0.63)). Children living with smokers were less likely to have stringent restrictions in place compared with children living with non-smokers (for both vs neither parents smoke: RR (partial vs complete) 18.29 (13.26 to 25.22) and RR (no restrictions vs complete) 104.73 (70.61 to 155.33)). Among smoking households, restriction type varied according to the number and gender of parents who smoke. In both smoking and non-smoking households, children's SHS exposure was directly related to type of home smoking restriction, with lowest exposures among those reporting complete restrictions.

Conclusion: This study has shown an increase in the proportion of children reporting a complete ban on smoking in their household after the introduction of smoke-free legislation and supports growing evidence of the wider impact smoke-free legislation can have on smoker behaviour. However, quitting smoking combined with complete home smoking bans will still afford children the best protection from SHS exposure.

There is growing evidence that smoke-free legislation has been effective in protecting both adults and children from the harmful effects of secondhand smoke (SHS) exposure while in public places.¹⁻⁶ Such legislative protection cannot extend to private dwellings, which remain an important source of exposure for some groups of children^{6,7} as parents often have only a moderate understanding of the risks posed to children by SHS exposure.⁸⁻¹²

Smoking restrictions in the homes of smokers are known to be related to the presence of children, the absence of daily smokers in the home¹³ and

awareness of the harm of SHS.¹⁴ Smoke-free homes are associated with decreased tobacco use and increased successful quitting among smokers,^{15,16} a reduction in smoking uptake among children and adolescents^{17,18} and a preference for smoke-free residences on leaving home among young adults.¹⁹

There is evidence of considerable support among the general public for smoke-free public and work places^{1,20,21} and an increase over recent years in the number of households with complete smoking bans in the United Kingdom, Ireland and North America.^{1,15,22-24} Although some research suggests that the presence of smoke-free policies in work and public places has stimulated the adoption of smoke-free homes,^{25,26} a recent qualitative study found little influence on smoking behaviour in the home following the introduction of smoke-free legislation.²⁷ In all such studies it is difficult to distinguish a causal relation between work and home smoking bans and tobacco control policies, from long-term trends towards smoke-free homes and workplaces, which are linked to naturally changing norms and knowledge and awareness of the risks of active and passive smoking. Fong *et al* found an increase in smoke-free homes among adult smokers in the Republic of Ireland following implementation of smoke-free legislation; however, they reported a similar increase in the UK where no such smoke-free laws were in place.¹ The rate of change towards smoke-free homes may also vary in different countries depending on regional differences in smoking prevalence, health promotion initiatives and varying types of tobacco control laws.^{15,24}

To our knowledge there is no literature on the links between smoke-free legislation and smoking restrictions specifically in the homes of children. Evidence gathered in the context of children's exposure to SHS in Scotland⁶ is relevant to our understanding of smoking restrictions in households with children. In the year following implementation of the Scottish smoke-free legislation, there was a dramatic reduction in children's exposure to SHS (39%) at a population level. This change was an order of magnitude higher than the average annual (secular) change seen in two English studies which covered the 15-year period from 1988 to 2003.^{7,28} In Akhtar *et al*'s study fewer children reported being exposed to SHS in other people's homes after legislation,⁶ perhaps indicating a shift in adults' attitudes towards exposing others to SHS. However there was no

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evidence of a change in the reported prevalence of parental smoking and little evidence to suggest a change in prevalence of children being exposed in their own homes and cars post legislation.

From the perspective of protecting health, total bans appear to be the only certain method of protecting household members from secondhand smoke.^{29–31} Any exception to complete restrictions—for example, smoking near an open door or kitchen fan, reduces the protection offered by a ban.^{29, 32, 33} In practice, however, it is more usual to find that a range of restrictions are reported to be in place in the homes of smokers.^{14, 27} In households with children, rules may vary according to which parent smokes^{28, 34} and which parent has most influence over daily care of children. Kegler and colleagues have shown that policies are most common when only the father smokes and least common when both parents smoke, with female caregivers exerting most influence over household smoking rules.³⁴

This paper focuses on smoking restrictions in the homes of 11-year-old children, examining whether smoking restrictions (in non-smoking and smoking households) changed post legislation, and whether such restrictions impact on children's exposure to secondhand smoke as measured by salivary cotinine.

METHODS

The changes in child exposure to environmental tobacco smoke (CHETS) study is part of a national evaluation of Scottish smoke-free legislation.³⁵ Its aim was to assess changes in SHS exposure in children after implementation of the legislation. The CHETS study used objective (salivary cotinine) and self-reported measures of exposure to SHS. Only the main design features are described here. Full details of methods and measures used are in the online appendix to this paper and in the study by Akhtar *et al.*⁶

Two nationally representative class-based surveys of children in their final year of primary school in Scotland (primary 7) were conducted in the same schools one year apart, before (January 2006) and after (January 2007) smoke-free legislation, to assess changes in exposure to SHS. Children were around 11 years of age.

The survey instrument included questions on pupil's own smoking status and that of their friends and "parent figures" (defined as parents or step-parents whom the children reported living with all or most of the time). Children were also asked to provide a saliva sample for testing for cotinine.

Ethical approval and permissions

Ethical approval was obtained from the School of Education Ethics Committee, University of Edinburgh. Appropriate permissions to approach schools were obtained and pupils received opt-out parental consent letters before the survey and had the option to withdraw on the day of the survey.

Cotinine

Cotinine is a major metabolite of nicotine and is a sensitive indicator of the absorption of tobacco smoke and in non-smokers is a valid measure of recent (3–4 days) exposure to SHS.³⁶ The concentration of salivary cotinine was determined using capillary gas chromatography with a specific nitrogen/phosphorus detector from a 100- μ l sample.³⁷ The assay had a detection limit of 0.1 ng/ml. Pupils who reported being current

smokers or who had cotinine concentrations above 15 ng/ml, the accepted cut-off point for active smoking, were excluded.³⁸

Parental smoking status

Parent figures were classified as smokers when described by their children as smoking "every day" or "sometimes". Using data on family structure and reported parental figures' smoking status, children were classified as living with "none", "one (father figure only)", "one (mother figure only)" or "two" smokers.

Restrictions on smoking in the home

A three-category variable on restrictions on smoking in the home was derived from children's responses to the question "Is smoking allowed inside your home (where you live all or most of the time)?" Children were classified as having complete restrictions on smoking in their home if they reported "No, smoking is not allowed at all" in their home, partial restrictions if they reported either that "smoking is allowed only on special occasions" or "smoking is allowed in certain places only", and no restrictions if they reported that "smoking is allowed anywhere" in their home. Children who reported either that they did not know what restrictions were in place in their home, or left the question blank were excluded from the analysis (9.1% (n = 231) of pupils in 2006; 11% (n = 261) in 2007).

Socioeconomic status

The family affluence scale (FAS) was used to measure socioeconomic status.^{39–41} The FAS scale is derived from measures of family car ownership, bedroom occupancy, family holidays and computer ownership. A final family affluence scale score was calculated for each pupil and the sample was split into tertiles corresponding to those living in low, medium and high affluence families.⁴²

Statistical analysis

Log transformed values were used in all analyses involving cotinine concentration, as the distribution of cotinine values was positively skewed. We assigned cotinine values below the limit of detection (0.1 ng/ml) an imputed value randomly sampled from the left tail of a truncated log normal distribution. We report geometric mean cotinine concentrations and their 95% confidence intervals.

χ^2 Tests were used to test differences in proportions. Multinomial logistic regression was used to examine the association of parental smoking and survey year with smoking restriction category. The category "complete restrictions" was used as the reference for comparison with "partial" and "no restrictions". Results are presented as relative risk ratios (RR) with 95% confidence intervals. Linear regression analysis was used to examine the association between restrictions on smoking in the home, number of parent figures who smoke and mean cotinine concentration before and after legislation. Both regression models were adjusted for age and family affluence (FAS).

As individual children within a school class may be more similar with respect to restrictions on smoking in the home, SHS exposure or other measures than randomly selected children, all analyses reported take account of the survey design (clustering and stratification). The statistical analyses were performed using SAS v 9.1 for Windows.

Table 1 Description of sample before and after smoke-free legislation in Scotland

Characteristic	2006 (n = 2527)	2007 (n = 2379)
Mean age (years)	11.5 (SD 0.36)	11.4 (SD 0.36)
Boys	1285 (50.9)	1221 (51.3)
Family affluence scale*:	(n = 2443)	(n = 2251)
Low	908 (37.2)	765 (34.0)
Medium	732 (30.0)	701 (31.1)
High	803 (32.9)	785 (34.9)
Cotinine confirmed smoking status†:	(n = 2527)	(n = 2379)
Non-smokers	2335 (92.4)	2210 (92.9)
Smokers	45 (1.8)	35 (1.5)
Missing‡	147 (5.8)	134 (5.6)
Family structure (parent figures that sample lives with):	(n = 2527)	(n = 2379)
Both parents	1722 (68.1)	1596 (67.1)
Parent and step-parent	240 (9.5)	229 (9.6)
Single mother	451 (17.8)	431 (18.1)
Single father	45 (1.8)	40 (1.7)
Others§	36 (1.4)	35 (1.5)
Unclassifiable	16 (0.6)	33 (1.4)
Missing	17 (0.7)	15 (0.6)

Values are numbers (%) unless stated otherwise.

*Pupils who reported living in both parent, step or single parent families only.

†Non-smokers, self reported non-smokers with cotinine concentrations ≤ 15 ng/ml; smokers, cotinine concentrations >15 ng/ml regardless of self-reported smoking status.

‡Pupils who did not answer the smoking question or have a cotinine concentration assigned to them by the laboratory.

§Pupils who reported to be living in a foster home or children's home or some other arrangement.

RESULTS

Response rates

One hundred and sixteen (68%) of 170 schools approached agreed to take part in the study before the legislation and 111 of the original 116 schools also participated at follow-up in 2007 (65% of schools originally approached). Schools that declined to participate were not significantly different from participating schools with respect to denomination, urban/rural classification, school size and socioeconomic deprivation based on the proportion of pupils receiving free school meals. In each survey year, participating schools were also representative of Scottish schools with respect to these indicators.

The final data sets contained 2527 pupil questionnaires in 2006 (85% pupil response rate) and 2379 in 2007 (83% pupil response rate), after excluding individuals for whom information on age and gender were missing and primary 6 pupils who were taught in a composite primary 6/primary 7 class. Of pupils in the final data set, over 95% in each survey year (n = 2403 in 2006 (95%); n = 2270 in 2007 (98.6%)) provided a saliva sample which was of sufficient volume for testing and gave a valid cotinine concentration. Less than 2% of children did not provide a saliva sample. Further details on response rates can be found in the paper by Akhtar *et al.*⁶

Sample characteristics

Table 1 details the characteristics of the samples. The mean age of pupils, proportion of boys and girls and proportion of pupils living in each family structure and in each family affluence group were not significantly different before and after legislation. Most pupils in both years were classified as non-smokers based on self-report and cotinine concentrations equal to or below 15 ng/ml.

Smoking restrictions in the home, parental smoking and change following smoke-free legislation

In each survey year there was an association between type of smoking restriction and number and gender of parents who smoke. Higher levels of restriction were associated with fewer smoking parents, and greater restrictions occurred where only fathers rather than only mothers, smoked. Overall, reported smoking restrictions in the home changed following the smoke-free legislation, with a lower proportion of children reporting "no restrictions" after introduction of legislation (table 2).

Table 3 presents the results for the multinomial logit model with relative risk ratios for children living in households with "partial" or "no" smoking restrictions compared with those living in households with "complete" smoking restrictions. As there is evidence that smoke-free homes are related to the age of children,^{26 43} we included age in the analysis, despite the relatively small range in this study. After adjusting for age, type of household smoking restriction was associated with survey year, number of smoking parents and family affluence. After legislation, pupils were at less risk of being in households with no or partial restrictions (rather than complete) compared with before legislation. When compared with children who reported living with non-smoking parents, children from homes where both parents smoked or only a mother smoked were at greater risk of being in households with partial or no restrictions (rather than complete). Children from homes where only the father smoked were also more likely to report partial restrictions and no restrictions than complete restrictions compared with children who lived with non-smoking parents. However, the relative risks were much lower than those for children who had two parents who smoked or a mother only who smoked (table 3). An interaction term between survey year and number of smoking parents was included in the model to test whether change in relative risk of restrictions between survey years was equivalent in all parental smoking groups. However, this did not reach significance (p = 0.196). Compared with high affluence children, children from low and medium affluence families were more likely to have "partial" or "no" restrictions than a "complete" smoking ban.

Exposure to SHS and household smoking restrictions and change following smoke-free legislation

Exposure to SHS as measured by salivary cotinine concentration was significantly associated with level of smoking restriction. Children who reported complete restrictions in their home had the lowest mean cotinine concentration and children who reported no restrictions had the highest. This pattern was repeated in both survey years (table 4).

Previous research indicates that smoking restrictions differ by social/occupational status^{27 44 45} and also by the presence of smokers in the home.^{13 43} Exposure to SHS by type of restrictions before and after legislation was modelled including a binary term denoting the presence or absence of a parental smoker, family affluence and adjusting for age. Exposure, as measured by cotinine concentration, was associated with restriction type, survey year, presence of a parental smoker in the home and family affluence. In addition there was a significant interaction between smoking restrictions and presence of a parental smoker as well as between smoking restrictions and survey year (table 5).

For clarity we have also presented predicted mean cotinine concentration by restriction group before and after legislation separately for children who reported living with non-smoking

Table 2 Parental smoking by smoking restrictions in the home before and after smoke-free legislation, Scotland

Restriction type	2006*						2007*						Total*					
	Number of smoking parent figures			Total†			Number of smoking parent figures			Total			Number of smoking parent figures			Total		
	Neither smoke	One, father only	One, mother only	Two smoke	% (95% CI)	% (95% CI)	Neither smoke	One father only	One mother only	Two smoke	% (95% CI)	% (95% CI)	Neither smoke	One father only	One mother only	Two smoke	% (95% CI)	% (95% CI)
Complete	71.2 (67.7 to 74.5)	20.1 (14.9 to 26.5)	10.8 (7.7 to 15.1)	9.0 (5.8 to 13.6)	47.3 (43.9 to 50.8)	50.8	79.3 (76.0 to 82.2)	29.7 (23.6 to 36.6)	10.0 (7.0 to 14.2)	8.0 (5.4 to 11.7)	51.8 (48.1 to 55.4)	55.4	75.0 (72.4 to 77.5)	24.9 (20.9 to 29.3)	10.4 (8.2 to 13.2)	8.5 (6.3 to 11.5)	49.5 (46.3 to 52.6)	
Partial	24.9 (21.7 to 28.5)	51.5 (44.0 to 58.9)	49.2 (42.9 to 55.4)	43.3 (37.1 to 49.6)	34.2 (31.5 to 36.9)	36.9	18.4 (15.8 to 21.3)	50.0 (42.7 to 57.3)	58.3 (52.3 to 64.0)	55.9 (49.8 to 61.9)	34 (31.5 to 36.7)	36.7	21.8 (19.4 to 24.5)	50.7 (45.2 to 56.3)	53.7 (49.3 to 58.0)	49.3 (44.8 to 53.7)	34.1 (32.0 to 36.2)	
None	3.8 (2.8 to 5.2)	28.4 (21.2 to 37.0)	40.0 (33.2 to 47.2)	47.8 (41.2 to 54.4)	18.5 (16.0 to 21.3)	21.3	2.4 (1.5 to 3.6)	20.3 (14.8 to 27.3)	31.7 (26.1 to 37.9)	36.0 (30.4 to 42.1)	14.2 (12.1 to 16.5)	16.5	3.1 (2.5 to 3.9)	24.4 (19.8 to 29.7)	35.9 (31.5 to 40.6)	42.2 (37.8 to 46.7)	16.4 (14.6 to 18.5)	
Total	1147	204	295	289	1935	1935	1018	202	290	261	1771	1771	2165	406	585	550	3706	

*Pearson $\chi^2 = 767.423$ (2006); 793.631 (2007); $df = 6$, $p < 0.001$ (association between type of restriction and number/gender of smoking parents).†Pearson $\chi^2 = 14.23$, $df = 2$, $p < 0.001$ (association between type of restriction and survey year).

Cotinine confirmed non-smoking pupils who reported living with both parents, step or single parents.

Table 3 Relative risk ratios and 95% confidence intervals (CI) for proportion of pupils reporting partial and no restrictions (vs complete restrictions) in their home by survey year, number of smoking parents and family affluence, Scotland

Effect	Relative risk ratios (RR)	
	Partial vs complete	None vs complete
	RR (95% CI)	RR (95% CI)
Survey year		
2007	0.75 (0.63 to 0.89)	0.50 (0.40 to 0.63)
2006	1.00 (-)	1.00 (-)
Parental smoking		
Both parents smoke	18.29 (13.26 to 25.22)	104.73 (70.61 to 155.33)
Mother only smokes	17.18 (12.80 to 23.06)	78.17 (53.61 to 113.96)
Father only smokes	6.80 (5.26 to 8.80)	22.96 (15.96 to 33.01)
Neither parent smokes	1.00 (-)	1.00 (-)
Family affluence		
Low	1.89 (1.53 to 2.33)	3.28 (2.43 to 4.43)
Medium	1.29 (1.06 to 1.58)	1.80 (1.33 to 2.44)
High	1.00 (-)	1.00 (-)
Age	0.81 (0.63 to 1.03)	0.78 (0.56 to 1.07)

Cotinine confirmed non-smoking pupils who reported living with both parents, step or single parents.

parents and those living with at least one parent who smokes (table 6).

In each survey year, children who reported living with non-smokers had lower exposure to SHS, as measured by mean cotinine concentration, than those living with at least one smoker, in each restriction group. In both survey years, and in each type of household (non-smokers and smokers), exposure to SHS varied significantly by type of smoking restriction in the home; mean cotinine concentration increased as fewer restrictions were reported.

Change in exposure to SHS, post legislation, was not equivalent in each restriction group, as indicated by the significant survey year by type of restriction interaction term in the model. Both for children with non-smoking parents and those living with at least one smoking parent, there were greater reductions in mean cotinine concentration among those with complete restrictions and less evidence of change in exposure among households with no smoking restrictions (table 6).

DISCUSSION

This paper describes the patterns of household smoking restrictions reported by 11-year-old (primary 7) schoolchildren in Scotland both before and after the introduction of smoke-free legislation.

The study provides evidence that after implementation of smoke-free legislation, children were more likely to report complete restrictions on smoking in the home as opposed to only partial or no restrictions. This difference was independent of parental smoking status and may suggest a change in attitudes towards exposing children to SHS. Although Phillips *et al* did not find evidence of change in how adults restricted smoking in their homes, following the Scottish legislation, our findings based on households with children fitted with their finding that children were thought to be important considerations in the development and modification of household smoking restrictions.²⁷ Although the change in the present study cannot necessarily be directly attributed to the legislation, the findings are consistent with studies that report evidence of smoke-free public places stimulating the adoption of smoke-free homes,^{43 26} and that numbers of completely smoke-free homes are

Table 4 Geometric mean cotinine concentrations and 95% confidence intervals (CI) by smoking restrictions, before and after smoke-free legislation in Scotland

Restriction group	2006		2007		Ratio (95% CI) of mean cotinine concentration on 2007:2006
	Mean (95% CI) cotinine concentration (ng/ml)	No (%)	Mean (95% CI) cotinine concentration (ng/ml)	No (%)	
Complete	0.14 (0.13 to 0.16)	994 (47)	0.07 (0.06 to 0.08)	985 (50.9)	0.50 (0.42 to 0.59)
Partial	0.55 (0.47 to 0.63)	726 (34.3)	0.49 (0.41 to 0.59)	674 (34.8)	0.90 (0.71 to 1.14)
None	1.53 (1.29 to 1.82)	395 (18.7)	1.39 (1.17 to 1.67)	278 (14.4)	0.91 (0.71 to 1.16)
Total	0.35 (0.32 to 0.38)	2115	0.21 (0.19 to 0.23)	1937	0.61 (0.54 to 0.68)

Cotinine confirmed non-smokers.

Pupils who live in both, step or single parent families only.

Unadjusted figures.

increasing.^{15 22-24 43} In addition to the direct effect of laws to prohibit smoking in public places requiring strict work-based bans, tobacco control policies as a whole may also impact on the prevalence of smoking restrictions in private locations by shifting social norms about the acceptability of exposing others to SHS.

In line with other research our findings confirm that children who reported living with smokers were less likely to have stringent restrictions in place at home compared with children who lived with non-smoking parents.¹⁴ However, among smoker households the extent of restrictions varied according to the number and gender of parents who smoke. Those living with only a father who smoked were more likely to live in a household with a complete ban compared with children who lived with two parents or only a mother who smoked. This suggests that non-smoking mothers may have a strong influence on rules that restrict smoking around the home in line with Kegler *et al's* work, which found that females in a household first brought up the idea of restricting smoking in

the home and had most influence in deciding on a complete ban.³⁴

This study also confirms that children's SHS exposure as measured by salivary cotinine was directly related to the type of home smoking restriction reported, with lowest exposure found among those who reported complete restrictions. This is consistent with other studies,²⁸ and understandable given that most children in our study spent most of their time at home⁶ and strongly suggests that, for children in this age group, the home is the most important source of SHS exposure.⁴⁶ The relation between type of restrictions and exposure to SHS was found in both smoking and non-smoking households. From this we conclude, like others,²⁹⁻³¹ that complete restrictions are the most beneficial method of reducing exposure to SHS among household members.

Research by Beiner and colleagues⁴⁷ found, however, that even complete household smoking bans were not completely effective at eliminating home SHS exposure among adolescents

Table 5 Multiple linear regression analysis of the relation between cotinine concentration (ln) and smoking restriction type, survey year, presence of a parental smoker, family affluence and age, Scotland

	Coefficient	Linearised standard error	t	p>t	95% CI
Parental smoking status					
At least one parental smoker	1.201	0.107	11.19	<0.001	0.988 to 1.415
None	–				
Survey year					
2007	–0.693	0.071	–9.71	<0.001	–0.835 to –0.551
2006	–				
Type of smoking restriction					
Partial	0.405	0.098	4.13	<0.001	0.210 to 0.600
None	0.719	0.237	3.04	0.003	0.248 to 1.190
Complete	–				
Family affluence					
Low	0.411	0.061	6.70	<0.001	0.289 to 0.533
Medium	0.080	0.065	1.23	0.220	–0.049 to 0.210
High	–				
Restriction type by survey year interaction					
Partial × 2007	0.403	0.111	3.62	0.001	0.181 to 0.625
None × 2007	0.560	0.133	4.19	<0.001	0.295 to 0.825
(Complete restrictions and 2006 are reference categories)					
Restriction type and presence of parental smokers interaction					
Partial × at least one parental smoker	0.630	0.134	4.71	<0.001	0.364 to 0.896
None × at least one parental smoker	0.782	0.253	3.09	0.003	0.280 to 1.284
(Complete restrictions and no parental smokers are reference categories)					
Age (years)					
Constant	–0.080	0.067	–1.19	0.238	–0.214 to 0.054
Constant	–1.331	0.771	–1.73	0.088	–2.863 to 0.202

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Table 6 Geometric mean cotinine concentrations and 95% confidence intervals (CI) by smoking restrictions, adjusted for age and FAS, for children before and after smoke-free legislation in Scotland

Restriction group	2006		2007		Ratio (95% CI) of mean cotinine concentration on 2007:2006
	Mean (95% CI) cotinine concentration (ng/ml)	No (%)	Mean (95% CI) cotinine concentration (ng/ml)	No (%)	
Children who live with non-smoking parents					
Complete	0.12 (0.11 to 0.13)	808 (71.4)	0.06 (0.05 to 0.07)	806 (79.4)	0.49 (0.42 to 0.57)
Partial	0.19 (0.16 to 0.22)	280 (24.7)	0.14 (0.12 to 0.17)	186 (18.3)	0.76 (0.58 to 0.98)
None	0.26 (0.16 to 0.41)	44 (3.9)	0.24 (0.15 to 0.30)	23 (2.3)	0.92 (0.49 to 1.76)
Total	0.14 (0.13 to 0.15)	1132	0.07 (0.06 to 0.08)	1015	0.52 (0.45 to 0.59)
Children who live with at least one smoking parent					
Complete	0.40 (0.32 to 0.51)	98 (12.7)	0.21 (0.17 to 0.26)	108 (14.8)	0.52 (0.38 to 0.71)
Partial	1.23 (1.06 to 1.42)	366 (47.5)	0.92 (0.78 to 1.08)	404 (54.4)	0.75 (0.61 to 0.93)
None	2.05 (1.80 to 2.33)	307 (39.8)	1.75 (1.48 to 2.08)	217 (29.8)	0.86 (0.69 to 1.06)
Total	1.31 (1.17 to 1.45)	771	0.90 (0.79 to 1.02)	729	0.69 (0.58 to 0.81)

Cotinine confirmed non-smokers.

Pupils who live in both, step or single parent families only.

living with smokers. It is probable that this is because children or adolescents who live with smokers are around at least one smoker much of the time and therefore continue to be exposed to SHS when their parents smoke outside, in the car or in other people's homes; or from visitors and parents smoking in the home without their children's knowledge. There is also evidence that dust and surfaces in the homes of smokers contain environmental tobacco smoke, even when household members report no indoor smoking.⁴⁸ Therefore, exposure to SHS through ingesting nicotine-laden dust via hand-mouth contact and peri-oral transfer may still occur.

Smoking rules in the car also influence children's exposure to SHS. This study shows these were related to smoking rules in the home (analysis not shown). This is consistent with Phillips *et al*'s findings that adults (both smokers and non-smokers) reported having a mixture of total and partial smoking restrictions in their cars, and that these restrictions could increase in the presence of children.²⁷ Reports of the car becoming smoke-free after legislation may also be because of the dual use of the car for private use and work, with its confined space encouraging stricter rules.²⁷ Nevertheless, it is important to note that parents who smoke can substantially reduce SHS exposure among their children by imposing restrictions on smoking in the home where their children spend most of their time.

Our study has demonstrated that partial smoking restrictions can reduce children's SHS exposure, but the benefits of a complete household smoking ban far outweigh those of other types of restriction. However, as we have seen, even complete restrictions in the home are not optimally protective if at least one parent continues to smoke. Instead, quitting smoking appears to be the most effective way of minimising children's exposure to SHS. Our study has also shown an increase in the proportion of households with a complete ban on smoking after introduction of smoke-free legislation and may suggest a shift towards greater health benefits for children as a result of more homes having stricter restrictions on smoking. Although the effect cannot be directly attributed to the introduction of the legislation, the finding is of significance and supports the growing body of evidence of the wider influences that legislation may have on smoker behaviour.

Limitations

Our findings show that for children living with non-smokers and at least one smoker, the drop in mean cotinine concentra-

Future work

Future work could examine the extent to which levels of home smoking restrictions reflect smokers' concerns over exposing household members to secondhand smoke (SHS). Barriers to adopting household smoking restrictions among parents would also warrant further study.

What this paper adds

- ▶ Children surveyed one year after the implementation of smoke-free legislation reported more stringent home smoking restrictions than those surveyed before. The difference post legislation was independent of parental smoking status and suggests a shift in attitudes towards exposing children to secondhand smoke (SHS). This finding supports other evidence of the wider influences that legislation can have on smoker behaviour.
- ▶ The relation between SHS exposure and home smoking restrictions (less exposure to SHS with more stringent restrictions) existed irrespective of parental smoking status, indicating that all parents can reduce their children's exposure to SHS by implementing even partial restrictions. However, our findings lend support to the suggestion that encouraging parents to quit smoking, combined with complete home smoking bans, will afford the highest protection for children from SHS exposure.

tion was not equivalent in each restriction group. This finding should be treated with caution, as the data containing at least one smoking parent are a composite group. For example, among children living with at least one smoker, those with complete restrictions before legislation might be made up mainly of children with both parents who smoke, whereas those after legislation might be made up of children with one parent who smokes. This study was not designed to have the power to examine this aspect in detail and numbers were too small to examine the breakdown of smoking parents. Therefore we cannot tell if the change we see across time is a change across equivalent groups.

We do not know how children interpreted the survey questions. "Smoking is not allowed anywhere in our home" could include a parent standing by an open door/window for example, and any exposure may include this.

Although there is evidence of a move towards more stringent restrictions among all families in this study, these parents' motivations are not known. We do not have trend data on smoking restrictions in Scotland, only data covering two time points, which happen to cover a period when smoke-free legislation was introduced. It is already known that there was no change in the proportion of parents who smoke before and after legislation⁶; however we are not able to say whether the effect we see is solely because of the smoke-free legislation or a secular change.

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Research paper

APPENDIX

Pupils' family structure was determined using the following question:

Think of the home where you live all or most of the time now, tick all of the adults who live there. (Adapted from Health Behaviours in School Aged Children (HBSC) 2001/2 Protocol (Currie C, Samdal O, Boyce W, Smith R, eds. Health behaviour in school-aged children: a WHO Cross-National Study (HBSC), research protocol for the 2001/2002 survey. Child and Adolescent Health Research Unit (CAHRU), University of Edinburgh. (for further information about the 2001/02 HBSC Protocol, email: publications@hbsc.org)

Mother

Father

Stepmother (or father's partner)

Stepfather (or mother's partner)

Grandmother

Grandfather

I live in a foster home

Someone or somewhere else, please write it down

Each parental figure's smoking status was determined using the following question:

Do any of the following people smoke?

Father

Mother

Stepfather (or mother's partner)

Stepmother (or father's partner)

Possible responses:

1. Smokes everyday
2. Smokes sometimes
3. Does not smoke
4. Don't know
5. Don't have or see this person

Family affluence scale was determined using the following questions:

Do you have your own bedroom for yourself?

(Possible responses):

1. Yes
2. No

Does your family own a car, van or truck?

(Possible responses):

1. No
2. Yes, one
3. Yes, two or more

During the past 12 months, how many times did you travel away on holiday with your family?

(Possible responses):

1. Not at all
2. Once
3. Twice
4. More than twice

How many computers (PCs, Macs or laptops) does your family own?

(Possible responses):

1. None
2. One
3. Two
4. More than two

Reported restrictions on smoking in the home were determined using the following question:

Is smoking allowed inside your home (where you live all or most of the time)?

(Possible responses):

1. No, smoking is not allowed at all
2. Smoking is allowed in certain places only
3. Smoking is allowed anywhere in our home
4. Smoking is only allowed on special occasions in our home
5. Don't know