Nicotine & Tobacco Research, Volume 13, Number 10 (October 2011) 903–910

Original Investigation

Socioeconomic Patterning in Changes in Child Exposure to Secondhand Smoke After Implementation of Smoke-Free Legislation in Wales

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Received February 8, 2011; accepted April 11, 2011

Abstract

Introduction: Secondhand smoke (SHS) exposure is higher among children from lower socioeconomic status (SES) households. Legislation banning smoking in public places has been linked with reduced SHS exposure in children. However, socioeconomic patterning in responses to legislation has been little explored.

Methods: A total of 3,083 children aged 10–11 years, within 75 Welsh primary schools, completed questionnaires either before legislation or 1 year later. Saliva samples were provided by 2,787 of these children for cotinine assay. Regression analyses assessed socioeconomic differences in SHS exposure, and associations of legislation with exposure among children from low, medium, and high SES households. Changes in parental smoking in the home, car-based exposure, and perceived norms were assessed.

Results: SHS exposure was highest among children from lower SES households. The likelihood of providing a sample containing an undetectable level of cotinine increased significantly after legislation among children from high [relative risk ratio (*RRR*) = 1.44, 95% *CI* = 1.04–2.00] and medium SES households (*RRR* = 1.66, 95% *CI* = 1.20–2.30), while exposure among children from lower SES households remained unchanged. Parental smoking in the home, car-based SHS exposure, and perceived smoking prevalence were highest among children from low SES households. Parental smoking in the home and children's estimates of adult smoking prevalence declined only among children from higher SES households.

Conclusions: Post-legislation reductions in SHS exposure were limited to children from higher SES households. Children from lower SES households continue to have high levels of exposure, particularly in homes and cars, and to perceive that smoking is the norm among adults.

Introduction

Early life course exposure to secondhand tobacco smoke (SHS; commonly known as "passive smoke") has been linked with a range of deleterious outcomes (Royal College of Physicians, 2010), including increased risk for respiratory problems (Pattenden et al., 2006; Vork, Broadwin, & Blaisdell, 2007), and acute damage to arterial structures by age 13 (Kallio et al., 2010). Reducing children's SHS exposure is therefore a key public health priority.

Although homes are the main source of children's SHS exposure (Akhtar, Currie, Currie, & Haw, 2007; Cook et al., 1994; The GTSS Collaborative Group, 2006), other public places contribute (Cook et al., 1994; The GTSS Collaborative Group, 2006). Legislation prohibiting smoking in public places (i.e., hospitality establishments and substantially enclosed workplaces, including company-owned vehicles) came into force in Scotland in March 2006, Wales and Northern Ireland in April 2007, and England in July 2007. Legislation aimed to protect workers and the public from SHS, and it appears to be achieving these goals (Allwright et al., 2005; Haw & Gruer, 2007). However, an additional unintended benefit observed in Scotland (Akhtar et al., 2007) and Wales (Holliday, Moore, & Moore, 2009) has been declining SHS exposure among children.

Concerns have however been expressed that impacts of legislation might not be equally distributed across socioeconomic groups (Greaves & Hemsing, 2009). Given that children from poorer families may be exposed to more SHS outside the home (Cook et al., 1994), one may expect greater impacts among these children. However, given emerging trends for legislation to reduce exposure only where parents do not smoke in the home (Akhtar et al., 2007; Holliday et al., 2009), coupled with higher indoor smoking prevalence among low-income parents (Bolte & Fromme, 2009), limited impact among children from lower socioeconomic status (SES) households is perhaps likely. Only one study has examined differential impacts of smoke-free legislation by socioeconomic status (Akhtar et al., 2010), reporting declines among children from lower SES households higher in absolute terms but lower in relative terms than among children from higher SES households.

Introduction of smoke-free legislation was met with resistance from some who argued that it would displace smoking

doi: 10.1093/ntr/ntr093
Advance Access published on May 12, 2011

into the home (Hyland et al., 2008). However, although one U.S. study (Adda & Cornaglia, 2006) and one in Hong Kong have suggested displacement effects (Ho et al., 2010), no evidence of displacement was found in Scotland or Wales (Akhtar et al., 2007; Holliday et al., 2009). Indeed, in Wales, though 1 in 3 children still reported living with a parent figure who smoked in the home after legislation, significant reductions in children's reports of parental smoking in the home were observed (Holliday et al., 2009). While encouraging, home smoking restrictions are commonly adopted by more affluent parents (Bolte & Fromme, 2009), and patterning in reductions in parental smoking in the home deserves attention.

After private homes, cars are perhaps the second most common location of children's SHS exposure (Akhtar et al., 2010; Holliday et al., 2009). One study concluded that 1 in 7 Irish 13- to 14-years-olds were exposed to smoke in cars (Kabir et al., 2009), while regular car-based exposure has been associated with nicotine dependence among 10- to 12-year-old never smokers (Belanger et al., 2008). In the Child Exposure to Environmental Tobacco Smoke study in Wales (CHETS Wales), the percentage of children reporting SHS exposure in a car the previous day remained at 7% before and after legislation. However, understanding socioeconomic patterning in car-based exposure may inform hypotheses regarding impacts of potential future policy movements such as extending legislation to cars carrying children on health inequalities.

Adolescent adoption of smoking has previously been linked to perceptions of significant others' smoking behavior and estimates of smoking prevalence (Wiium, Torsheim, & Wold, 2006). Hence, where perceived smoking norms are reduced by legislation, children may be less likely to become smokers. Given that in the United Kingdom, lower SES adults are more likely to smoke (Cavelaars et al., 2000), smoking will likely be perceived as a normative behavior to a greater extent among children from lower SES households. Furthermore, where impacts on significant others' smoking behaviors are patterned by SES, changes in perceived social norms may also be patterned.

This article reports analyses of data from the CHETS Wales study (Holliday et al., 2009), part of the Welsh Assembly Government's commissioned research program assessing impacts of smoke-free legislation. It aims to assess socioeconomic patterning in changes in salivary cotinine concentrations, reports of parental smoking in the home and car and estimates of population-level smoking prevalence following introduction of legislation.

Methods

Participants

Participants included in this study were 3,083 ten- to 11-year-old primary school children, from a nationally representative sample of 75 schools in Wales. Details of school selection are described in detail elsewhere (Holliday et al., 2009).

Measures

Smoke-Free Legislation

The year of data collection (2007 or 2008) was used as a proxy for the primary independent variable, introduction of the smoke-free legislation.

Salivary Cotinine Concentrations

Salivary cotinine (a metabolite of nicotine) is a well-validated biomarker of exposure to tobacco smoke in the previous 72 hr (Dolcini, Adler, Lee, & Bauman, 2003). Anonymous saliva samples were assayed using capillary gas chromatography with a detection limit of 0.1 ng/ml.

Socioeconomic Status

Responses to items on the Family Affluence Scale (FAS; Currie, Molcho, et al., 2008), which includes measures of bedroom occupancy, car ownership, holidays, and computer ownership, were summed and taken as a marker of SES.

Parental Smoking in the Home

Students were asked to identify whether parent figures (mother, father, stepfather or mother's partner, and stepmother or father's partner) smoked in the home. Students were subsequently categorized according to which parent figures smoked within the child's home (neither, father figure only, mother figure only, or both).

Smoke Exposure in Cars

Students were asked, "While you were in a car yesterday was anyone smoking there?" A binary variable was created comparing those who stated that someone was smoking against those who stated that no one was smoking, that they were not in a car the previous day, or that they did not know.

Perceived Smoking Prevalence

Perceptions of the prevalence of smoking in Wales were measured by asking students to estimate (a) how many children in Wales smoked and (b) how many adults in Wales smoked. Response options were (a) nearly all, (b) about three-quarters, (c) about half, (d) about a quarter, (e) hardly any, and (f) I don't know.

Visibility of Smoking Outside Public Places

Perceived visibility of smoking in public places was assessed by asking students "How often do you see people smoking in the street outside buildings (e.g., outside pubs, restaurants, or offices)?" Response options were "about every day," "sometimes," "never," or "I don't know."

Smoking Behavior

Respondent smoking behavior was measured using the Health Behaviour in School-Aged Children (HBSC) scale (Currie, Gabhainn, et al., 2008). Students who gave responses other than "I do not smoke," or with salivary cotinine concentration above 15 ng/ml (Jarvis, Primatesta, Erens, Feyerabend, & Bryant, 2003) were classified as smokers and excluded from cotinine analyses.

Age

Students were asked to indicate year and month of birth. Age in years on the day of data collection was calculated.

Time of Data Collection

The time of data collection was divided into three categories (9–11 a.m., 11 a.m. to 1 p.m., and 1–3 p.m.).

Procedures

The design of CHETS Wales is described in detail elsewhere (Holliday et al., 2009). In brief, CHETS Wales was a repeated cross-sectional study of Year 6 (10–11 years old) school children

in Wales. Data were collected immediately pre-legislation (from January 31, 2007, to March 30, 2007) and 1 year later (from January 31, 2008, to April, 28, 2008). Consent was sought via a letter to the head teacher of each selected school inviting them to participate. Parents/carers were sent a letter and information sheet and asked to inform the school if they *did not* wish their child to participate. All students were asked to complete a behavioral questionnaire and to provide an anonymous saliva sample for cotinine assay using a cotton wool swab of a Salivette®. Anonymous saliva samples were linked to questionnaires by unique identification numbers. The study protocol and consent procedures were approved by the School of Social Sciences Ethics Committee, Cardiff University.

Statistical Analysis

As almost half of children gave saliva samples below the limit of detection (0.10 ng/ml), replicating the linear analyses of population-level change presented in the CHETS Scotland study with data from Wales required imputation of random values for 47% of cases (see Holliday et al., 2009). Given the limited reliability of analyses using this volume of imputation, linear analyses were supplemented by dividing the distribution into three approximately equal tertiles (low, <0.10 ng/ml; medium, 0.10–0.50 ng/ml; and high, >0.50 ng/ml), with differences between pre- and post-legislation samples analyzed using multinomial logistic regression (favored over ordinal regression due to violation of the proportional odds assumption). The "medium" group was set as the base category. As the present study focuses upon subgroups, among some of whom up to two thirds provided samples containing an undetectable level of cotinine, linear analyses are not presented in this article, and only multinomial regression analyses are repeated by SES subgroups. All analyses were conducted using the survey settings of Stata 11, to account for the clustered nature of the sample.

Associations Between SES and SHS Exposure

Associations between SES and SHS exposure were assessed after adjustment for age, year of data collection, and time of data collection. Adjustment for time of day was made through entry of two dummy variables coded (a) 1 for mid-morning data collection (11 a.m. to 1 p.m.) and 0 for all other and (b) 1 for afternoon data collection (1–3 p.m.) and 0 for other. This model was rerun including a binary term indicating whether or not the child reported living with a parent figure who smoked in the home, in order to assess the independence of associations from socioeconomic differences in parental smoking.

An interaction term (FAS Score × Year of Data Collection) was entered in order to assess the interaction between SES and smoke-free legislation. Subsequently, children were divided into low-, medium-, and high-SES groups, according to scores on the FAS. Frequencies and percentages of children within each group assigned to each tertile of the cotinine distribution before and after legislation were calculated and separate models run for each group.

Change in Parental Smoking in the Home by SES

Frequencies and percentages of children in pre- and post-legislation samples with no parent figures who smoked in the home, a father figure who smoked in the home, a mother figure who smoked in the home, or two parent figures who smoked in the home were calculated for each SES group. The significance of change in percentages of children with parents who smoke in the home was assessed using design-adjusted chi-square analyses. To examine whether observed associations of smoke-free legislation were explained by change in parental smoking in the home, a binary term relating to parental smoking behavior was added to models examining change in cotinine concentrations over time.

Car-Based SHS Exposure

Frequencies and percentages of children in each SES subgroup exposed to SHS in a car overall and in pre- and post-legislation groups were calculated, with significance of socioeconomic difference and change in exposure assessed using design-adjusted chi-square analyses.

Change in Perceptions of Smoking as a Normative Behavior

Frequencies and percentages of children in pre- and post-legislation samples providing each of a range of estimates of (a) the proportion of children their own age, (b) the proportion of adults in Wales who smoke, and (c) perceived visibility of smoking outside public places were calculated for each SES group. The significance of changes was assessed using design-adjusted chi-square analyses.

Results

Response Rates

Sample selection and response rates are reported in detail elsewhere (Holliday et al., 2009). In 2007, 1,611 pupils of an eligible 1,761 pupils within 75 schools completed the smoking questionnaire (91.5%), compared with 1,605 of an eligible 1,775 children within the same 75 schools in 2008 (90.4%). In total, 1,447 children pre-legislation (82.2% of those eligible) and 1,461 children post-legislation (82.3% of those eligible) from 71 schools provided useable saliva samples. Given the interest of this article in SES measured in terms of family affluence, analyses are limited to children living with both parents, a parent and step-parent or a single parent, and who completed the FAS (smoking questionnaire n = 1,555/1,528; salivary cotinine n = 1,397/1,390 pre/post-legislation). Cotinine analyses are limited to children classified as non-smokers [i.e., who both reported being a non-smoker and provided saliva with a cotinine concentration <15 ng/ml (n = 1,362/1,364)].

Sample Description

Mean (and *SD*) ages of children completing the questionnaire were 11.0 (0.4) and 10.9 (0.5) years pre- and post-legislation, respectively. Pre-legislation, 51.4% (n = 804) were girls compared with 50.9% (n = 789) post-legislation. More than two thirds of children lived with both parents (pre-legislation n = 1,125, 71.2%; post-legislation n = 1,090, 70.3%), with approximately 1 in 10 living with a parent and step-parent (pre-legislation n = 159, 10.1%; post-legislation n = 170, 11.0%), 1 in 6 with a single mother (pre-legislation n = 275, 17.5%; post-legislation n = 266, 17.2%), and less than 2% with a single father. Pre-legislation, 422 (27.1%), 606 (39.0%), and 527 (33.9%) of children were assigned to low-, medium-, and high-SES tertiles, respectively. Post-legislation, a slightly smaller proportion of children were assigned to the low-SES group (n = 360, 23.6%), with 621 (40.6%) and 547 (35.8%) assigned to medium- and

high-SES groups, respectively. There were however no significant differences between characteristics of pre- and post-legislation samples, nor were there significant differences between those providing useable saliva samples and those providing only questionnaire responses.

Associations Between SES and SHS Exposure

For each point increase in FAS score, the relative risk of a child's sample containing a low level of cotinine (i.e., <0.10 ng/ml) increased by 1.16 (95% *CI* = 1.10–1.22), while the risk of a child's sample containing a high level of cotinine (i.e., >0.50 ng/ml) decreased significantly [relative risk ratio (*RRR*) = 0.82; 95% *CI* = 0.77–0.88]. After adjustment for parental smoking in the home, *RRR*s changed only marginally to 1.15 (95% *CI* = 1.10–1.22) and 0.86 (95% *CI* = 0.80–0.92), respectively.

Change in SHS Exposure by SES

An interaction between FAS score and survey year approached significance (*RRR* = 1.10; 95% *CI* = 0.98 to 1.24, $p = .09$), indicating a nonsignificant trend toward increased socioeconomic difference in the likelihood of a child's sample containing a low (i.e., undetectable) level of cotinine after legislation. There was no significant increase in inequality in the relative likelihood of a child's sample containing a high level of cotinine (*RRR* = 1.03; 95% *CI* = 0.91–1.17).

Table 1 demonstrates that where the sample is divided into three approximately equal SES groups, almost half of the lowest SES children provided samples with a high cotinine concentration prior to legislation, with little change in exposure levels after legislation. By contrast, among children in medium- and high-SES groups, percentages of children providing samples with a low concentration of cotinine increased by 8%. In children from medium-SES households, this was matched by an 8% decline in medium levels of cotinine, with the percentage of children with high cotinine levels remaining relatively static. A more linear movement was observed among children from high-SES households, with a decline of 5% in the "medium" tertile and 3% decline in the "high" tertile.

*RRR*s and 95% *CI*s presented in Table 1 indicate no significant changes in SHS exposure among the low-SES subgroup after legislation. However, the relative likelihood of a child providing a saliva sample with a low cotinine concentration increased significantly for children from medium and high-SES households. The lower *RRR* for high-SES children by comparison with children from medium-SES households is a consequence of the more linear movement described above, with a lower degree of shrinkage in the base category (medium tertile) and higher degree of shrinkage in the high tertile among children from high-SES households. The relative likelihood of providing a sample with a high cotinine concentration did not change significantly for any subgroup.

Change in Parental Smoking in the Home by SES

Slightly more than 50% of children from low-SES households reported living with a parent figure who smoked in the home pre- and post-legislation (Table 2). Among children from high-SES households, approximately 1 in 4 children lived with at least one parent figure who smoked in the home, decreasing by approximately 6% after legislation. Decreases in the percentage of children reporting that at least one parent figure smoked in the home approached significance only among children from high-SES households ($p = .05$).

After entry of a term for parental smoking in the home, associations of smoke-free legislation with SHS exposure in the high-SES subgroup became nonsignificant, with relative risk declining from 1.44 to 1.34 (95% *CI* = 0.95–1.88) indicating that lower SHS exposure in these children following legislation may be explained by lower levels of parental smoking in the home among higher SES parents after legislation. For children from medium-SES households, a significant impact of smoke-free legislation remained independent of parental smoking behavior ($p < .01$), with relative risk remaining almost identical to the figure reported in Table 1 (*RRR* = 1.66; 95% *CI* = 1.18–2.33).

Car-Based Exposure

Car-based SHS exposure was greatest among children from lower SES households, at 8.8% ($n = 69$), 6.5% ($n = 79$), and 5.4% ($n = 58$), respectively, for low-, medium-, and high-SES groups ($\chi^2 = 4.50$; $df = 1.96, 145.06$; $p = .01$). Among the lower SES group, percentages of children reporting car-based exposure increased slightly from 7.4% ($n = 31$) pre-legislation to

Table 1. Frequencies (and percentages) of Cotinine Distribution by Socioeconomic Status (SES), and Relative Risk Ratios for the Relative Likelihood of Children Being Categorized in "Low" or "High" Tertiles[a] of Salivary Cotinine Distribution Post-legislation

		Frequencies (and percentages)			Low (<0.10 ng/ml)		High (>0.50 ng/ml)	
		Low (<0.10 ng/ml)	Medium (0.10–0.50 ng/ml)	High (>0.50 ng/ml)	RRR (95% *CI*)	*p* value	RRR (95% *CI*)	*p* value
Low SES	2007	118 (32.2)	82 (22.3)	167 (45.5)	0.93 (0.62–1.40)	72	0.90 (0.63 to 1.27)	.54
	2008	97 (31.0)	74 (23.6)	142 (45.4)				
Medium SES	2007	232 (43.7)	153 (28.8)	146 (27.5)	1.66 (1.20–2.30)	<.01	1.34 (0.94 to 1.89)	.10
	2008	285 (51.4)	116 (20.9)	153 (27.6)				
High SES	2007	260 (56.0)	108 (23.3)	96 (20.7)	1.44 (1.04–2.00)	.03	1.00 (0.66 to 1.52)	.98
	2008	318 (64.0)	94 (18.9)	85 (17.1)				

[a]Medium tertile set as base category.

Table 2. Percentages of Children From Low-, Medium-, and High-Socioeconomic Status (SES) Groups Reporting That Neither Parent Figure Smokes in the Home, Father or Mother Figure Only Smokes in the Home, or Both Parent Figures Smoke in the Home

		Neither parent figure smokes in the home	Father figure only smokes in the home	Mother figure only smokes in the home	Both parent figures smoke in the home
Low SES ($p = .79$)[a]	2007	200 (48.9)	50 (12.2)	55 (13.5)	104 (25.4)
	2008	171 (49.9)	48 (14.0)	50 (14.6)	74 (21.6)
Medium SES ($p = .50$)[a]	2007	383 (65.5)	53 (9.1)	60 (10.3)	89 (15.2)
	2008	389 (67.3)	52 (9.0)	65 (11.3)	72 (12.5)
High SES ($p = .05$)[a]	2007	360 (72.4)	43 (8.7)	39 (7.9)	58 (11.1)
	2008	410 (78.1)	37 (7.1)	37 (7.1)	41 (7.8)

[a]Test of significance based on design-adjusted chi-square analysis comparing children with one or more parent figure who smokes in the home against those with no parent figures who smoke in the home.

10.6% ($n = 38$) post-legislation. Among the medium-SES group, exposure remained almost unchanged, at 6.3% ($n = 38$) pre-legislation and 6.6% ($n = 41$) post-legislation. However, among the high-SES group, exposure declined from 6.3% ($n = 33$) to 4.6% ($n = 25$). While changes were not statistically significant for any of the three subgroups, the slight increase in exposure among the low-SES group coupled with slight decrease in the high-SES group increased between group differences from 1% pre-legislation to 6% post-legislation.

Perceptions of Smoking as a Normative Behavior

Before and after legislation, most children from all SES groups thought that hardly any children their age in Wales smoked or reported that they did not know (see Table 3). While prevalence estimates declined slightly for all groups after legislation, changes were not significant. Estimates of smoking prevalence among adults in Wales also declined slightly for all groups. Estimates were highest at both timepoints for the low-SES group, with almost a quarter of children from low-SES households reporting that nearly all adults in Wales smoke. Declines in prevalence estimates after legislation were significant only for children from high-SES households, with a 9% decline in the proportion of children from high-SES households stating that nearly all adults in Wales smoke matched by a 9% increase in those stating that about half of adults smoke.

The percentage of children who reported that they saw people smoking in the street outside buildings about every day declined slightly for all three groups, with a 4% decline in the low-SES group and a 1% decline among the medium-SES group (see Table 4). The largest decline, of 7%, was among children from high-SES households. Only among high-SES children did change approach significance ($p = .08$).

Discussion

To date, smoke-free legislation has been associated with substantial benefits, while studies in Wales and Scotland have offered no evidence of displacement of smoking into the home (Akhtar et al., 2007; Holliday et al., 2009). Furthermore, this article suggests that children's SHS exposure did not worsen for

Table 3. Estimates of Smoking Prevalence in Wales Among 10- to 11-Year-Old Children in Low-, Medium-, and High-Socioeconomic Status (SES) Groups

		Nearly all	About 3/4	About ½	About 1/4	Hardly any	I don't know
How many children your age in Wales smoke?							
Low SES ($p = .40$)	2007	15 (3.6)	24 (5.7)	66 (15.8)	86 (20.6)	103 (24.6)	124 (29.7)
	2008	14 (3.9)	18 (5.0)	54 (15.0)	55 (15.3)	100 (27.9)	118 (32.9)
Medium SES ($p = .46$)	2007	11 (1.8)	28 (4.7)	80 (13.3)	138 (23.0)	165 (27.5)	179 (29.7)
	2008	6 (1.0)	22 (3.6)	78 (12.6)	156 (25.2)	186 (30.0)	172 (27.7)
High SES ($p = .28$)	2007	9 (1.7)	28 (5.4)	65 (12.4)	139 (26.6)	145 (27.7)	137 (26.2)
	2008	6 (1.1)	20 (3.7)	62 (11.4)	144 (26.4)	185 (33.9)	129 (23.6)
How many adults in Wales smoke?							
Low SES ($p = .91$)	2007	106 (25.4)	113 (27.0)	103 (24.6)	31 (7.4)	7 (1.7)	58 (13.9)
	2008	83 (23.1)	98 (27.2)	91 (25.3)	25 (6.9)	4 (1.1)	59 (16.4)
Medium SES ($p = .81$)	2007	105 (17.4)	189 (31.3)	187 (31.0)	55 (9.1)	7 (1.2)	61 (10.1)
	2008	95 (15.4)	196 (31.7)	198 (32.0)	63 (10.2)	4 (0.7)	63 (10.2)
High SES ($p < .01$)	2007	95 (18.1)	157 (30.0)	163 (31.1)	51 (9.7)	7 (1.3)	51 (9.7)
	2008	49 (9.0)	171 (31.3)	220 (40.2)	44 (8.0)	9 (1.7)	54 (9.9)

Table 4. Perceived Visibility of Smoking in the Street Outside Buildings in Wales Among 10- to 11-Year-Old Children in Low-, Medium-, and High-Socioeconomic Status (SES) Groups

		About every day	Sometimes	Never	I don't know
Low SES ($p = .18$)	2007	136 (32.5)	239 (57.0)	17 (4.1)	27 (6.4)
	2008	103 (28.8)	227 (63.4)	16 (4.5)	12 (3.4)
Medium SES ($p = .32$)	2007	184 (30.8)	376 (62.9)	23 (3.9)	15 (2.5)
	2008	184 (29.9)	387 (62.8)	19 (3.1)	26 (4.2)
High SES ($p = .08$)	2007	188 (36.2)	295 (56.7)	17 (3.3)	20 (3.9)
	2008	158 (29.0)	348 (63.9)	19 (3.5)	20 (3.7)

any SES subgroup after introduction of legislation in Wales. However, the unanticipated reductions in children's SHS exposure following legislation appear limited to children from more affluent households in Wales, whose exposure was already significantly lower prior to legislation, leading to increased socioeconomic disparity.

This article is the second to examine socioeconomic patterning in impacts of smoke-free legislation upon children's SHS exposure. The first used data from CHETS in Scotland (Akhtar et al., 2010), reporting reductions in SHS exposure across all SES groups, with the greatest absolute declines among children from lower SES households, though decline as a proportion of baseline exposure level was lowest in these children (Akhtar et al., 2010). Average cotinine concentrations among children in the Scottish study (Akhtar et al., 2007) were substantially higher than in Wales (Holliday et al., 2009) and children's SHS exposure outside of the home was perhaps greater in Scotland, with impacts of legislation therefore greater overall than in Wales and distributed among all groups.

Consistent with higher objectively measured SHS exposure among children from low-SES households, approximately half of these children reported living with a parent figure who smoked in the home, almost double the rates in their counterparts from high-SES households. Furthermore, growing disparity was observed after the introduction of legislation, with children from low-SES households almost 2.5 times more likely than children from higher SES households to live with a parent figure who smoked in the home after legislation. Significant socioeconomic patterning was also observed in car-based SHS exposure, with exposure highest among the low-SES subgroup, and again, some suggestion of a growing disparity. It is important to note however that the number of children reporting car-based exposure at both timepoints was relatively low, with changes in percentage exposure based on small changes in the frequency of children exposed.

No changes were observed in terms of subjective estimates of smoking prevalence among other children in Wales, with most estimating that hardly any children their aged smoked or stating that they did not know. Estimates of smoking prevalence among adults in Wales were however consistently higher amongst low-SES children before and after legislation, and declined significantly only among high-SES children following legislation. The percentage of children from higher SES households perceiving that nearly all adults in Wales smoked halved, while estimates remained relatively static for children from lower SES backgrounds.

The study included a large nationally representative sample of state-maintained primary schools, which together with high response rates from children at both data sweeps, ensures national generalisability. The study benefits from use of salivary cotinine as a primary outcome; a method previously endorsed as a reliable indicator of SHS exposure (Dolcini et al., 2003). However, the absence of a counterfactual weakens our ability to isolate change attributable to smoke-free legislation, from change that may have occurred without intervention. Indeed, English data show a downward trend in children's cotinine levels preceding smoke-free legislation, declining almost two thirds from 1996 to 2007 among children in smoke-free homes and one third where smoking was allowed in the home (Jarvis, Mindell, Gilmore, Feyerbrand, & West, 2009). Given the nature of the intervention, maintenance of such a counterfactual would have been impracticable. A longitudinal study, following children over time may have facilitated examination of change but would have made it impossible to distinguish between changes occurring due to increases in children's age or due to legislation. The focus on a narrow age-group is a strength in terms of internal validity, though limits generalisability. Finally, reliance upon self-reported data on some measures is perhaps liable to social desirability biases. However, children only marginally older than the sample in this study have been shown to be able to accurately report parental smoking behavior (Harakeh, Engels, Vries, & Scholte, 2006), and it is hoped that any error would have been equal at both timepoints. Furthermore, self-report scales of family affluence indicators have been shown to provide more accurate measures of household SES than alternatives such as children's reports of their parents' occupation (Wardle, Robb, & Johnson, 2002).

Nevertheless, the study suggests important differences in post-legislation changes by SES. While not associated with harms in any group, benefits appear limited to higher SES groups. Children from low-SES households continue to have high levels of exposure to SHS, particularly in the home and in cars, and to perceive that smoking is the norm among the adult population.

Given that the home is the most important source of children's SHS exposure (Akhtar et al., 2007; Cook et al., 1994; Holliday et al., 2009; The GTSS Collaborative Group, 2006) declining smoking in the home among high-SES parents perhaps contributed to reduced SHS exposure among their children. In England, the Department of Health (2010) have recently described targets of increasing the proportion of smoking parents who prohibit smoking inside their homes to two thirds by 2020. However, since legislation against smoking in the home is unlikely to prove acceptable (Chapman, 2007), reducing

inequalities in children's SHS exposure in Wales may require targeted intervention to encourage voluntary smoking restrictions in lower SES households (Priest et al., 2008; Ritchie, Amos, Phillips, Cunningham-Burley, & Martin, 2009).

Given the observed socioeconomic disparities in exposure to SHS in cars, extending legislation to cars carrying children, a move recently introduced in Australia (Freeman, Chapman, & Storey, 2008) and for which public support appears to be growing in the United Kingdom (Thomson & Wilson, 2009), may benefit children from lower SES households. Given the relatively small numbers of children exposed to SHS in cars, more in-depth analyses of trends relating to car-based exposure before and after legislation may be possible through pooling of datasets from the evaluations throughout the United Kingdom.

Finally, attention needs to be paid to socioeconomic disparities in perceptions of smoking as a normative behavior. Given that smoking prevalence is higher in lower SES adults (Cavelaars et al., 2000), their children are perhaps more likely to observe that most adults they know smoke. Children's tendency to see smoking as a normal adult behavior is perhaps based largely on observation of their parents' smoking behavior, with declines in smoking in the home among more affluent parents perhaps leading to reduced perceptions of smoking as a normative or socially acceptable behavior. Changing smoking norms and reducing smoking initiation among children and adolescents from lower SES households may require concerted efforts to reduce smoking in low-SES adults.

Funding

This work was supported by the Welsh Assembly Government Public Health Improvement Division (grant 216/2005). The Centre for the Development and Evaluation of Complex Interventions for Public Health Improvement is supported by the British Heart Foundation, Cancer Research UK, Economic and Social Research Council (RES-590-28-0005), Medical Research Council, the Welsh Assembly Government and the Wellcome Trust (WT087640MA), under the auspices of the UK Clinical Research Collaboration.

Declaration of Interests

None declared.

Acknowledgments

Thanks are due to the CHETS team: Anna Hamilton and Hayley Collicott (study administrators), Heather Rothwell, Claire Pimm, Nancy West, Ellie Byrne, Rachel Clark, Margaret Humphries, Keith Humphries, and Rosie Salazar (research assistants); all schools and students who participated in the research; ABS laboratories who analyzed salivary cotinine; and Janine Hale and Chris Roberts (Welsh Assembly Government, Public Health Branch, Social Research Division) for providing comments on a previous draft of this article. L.A.R.M. is director of the Centre for the Development and Evaluation of Complex Interventions for Public Health Improvement, a UKCRC Public Health Research Centre of Excellence.

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