Smoking environments and adolescent smoking: evidence from the Liverpool Longitudinal Smoking Study

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Abstract

A variety of risk factors for adolescent smoking have been identified and explored, but few have focused on the influence of second-hand tobacco smoke on smoking initiation. Consideration of exposure to second-hand tobacco smoke, and the influence this has on smoking initiation, is particularly important in the home and the school environment, as this is where young people spend the majority of their time. The Liverpool Longitudinal Smoking Study (LLSS) is a unique study funded by the Roy Castle Lung Cancer Foundation, established to investigate children’s knowledge, experiences and attitudes towards smoking using a wide range of innovative tools. The LLSS has tracked a single birth cohort of 253 young people from age five throughout their compulsory education. Using quantitative data from the secondary school phase of the study, this paper aims to address: Whether environmental smoking indicators (i.e. home smoking rules, perceived peer smoking and being in other smoky environments) predict (a) adolescents smoking trial, and (b) whether they have smoked in the last week. Data were analysed using Chi-Squared tests to test the strength of association, and logistic regression analysis to estimate the adjusted odds ratio and 95% confidence interval for each potential risk factor. Children who attended schools with higher deprivation scores and had household rules that advocated smoking were found to be significant predictors of smoking trial. Significant predictors of weekly smoking were found to be higher home deprivation scores and household rules that advocated smoking. Although public smoking bans may prove successful in reducing adolescent smoking trial, our findings suggest there is a need to target socially deprived groups. Smoke-free home interventions should be used and supplemented by school-based initiatives to reduce adolescent transition to regular smoking.

Key words: Smoking prevention, smoking interventions, adolescent health, second-hand tobacco smoke

Introduction

Most adult smokers begin to smoke regularly during their teenage years (McKinley, 2003); thus, gaining an understanding of the factors that predict smoking uptake during this period is a key public health priority. A variety of risk factors have been identified and explored, including socio-demographic influences (such as socio-economic status and gender), social learning factors (such as family and peer smoking) and personal factors (such as self-esteem and personality variables). However, few studies have focussed specifically on the influence of second-hand tobacco smoke, and the related predictors of, and influences on, smoking initiation. Those studies that have focused on second-hand tobacco smoke have tended to be cross sectional in nature (Jackson & Henriksen, 1997; Henriksen & Jackson, 1998; Farkas, et al., 2000; Wakefield, et al., 2000). Studies that have employed a longitudinal methodology were often limited to one follow-up (Huver, et al., 2006) or report limited findings (Engels, et al., 2005).

A number of interventions have been undertaken in an attempt to tackle the prevention and reduction in the incidence of smoking among adolescents, but it is evident that more research is required to create effective programmes to prevent and reduce smoking uptake among adolescents (Huver, et al., 2006; Thomas, et al., 2008). Although tobacco control policies in England and Wales have recently increased the legal age to buy cigarettes from sixteen to eighteen, and a complete smoking ban is now in place, it is crucial that the environments where exposure to smoke may influence adolescent smoking uptake are examined (Levy, et al., 2004).

Exposure to second-hand tobacco smoke is high among adolescents (Christophi, et al., 2008), and the health implications of this have been well documented (Vines, et al., 2007; Carlson and Carlson, 2008). The home and the school environments have been identified as key arenas for exposure to tobacco smoke and the relationship between the influences of familial and peer smoking behaviours on smoking uptake have been established (Vink, et al., 2003).

Numerous studies have found support for the strong influence that parental smoking has on children’s smoking initiation (Flay, et al., 1998; O’Loughlin, et al., 1998; Vink, et al., 2003) and the uptake of regular smoking (Leatherdale, et al., 2005). Household smoking practices have been found to significantly influence whether an adolescent’s home environment advocates or inhibits smoking (Leatherdale, et al., 2008). Research has found that household smoking bans are significantly associated with reduced adolescent smoking prevalence (Farkas, et al., 2000). Furthermore, there is evidence to demonstrate that smoke-free homes may be a more important predictor of adolescent non-smoking than other smoke-free environments adolescents may encounter (Farkas, et al., 2000; Wakefield, et al., 2000). While smoking rules in
households are predominantly subject to the smoking status of the parent (Kodl & Mermelstein, 2004), the rules themselves have been shown to influence smoking prevalence in adolescence regardless of their parents’ current smoking status (Farkas, et al., 2000; Wakefield, et al., 2000; Huver, et al., 2006)

Research findings suggest the existence of a direct link between the prevalence of cigarette smoking and social disadvantage, with evidence indicating that parents living in areas of social deprivation have a higher probability of becoming a smoker (Milton, et al., 2004; Thomas, et al., 2008). Explanations for this include the use of smoking as a method of coping with stress, to relieve boredom and frustration (Bancroft, et al., 2003). The implications of these findings for the children who live and attend schools in socially deprived areas are likely to include a predisposition to experiment with cigarettes, potentially leading to regular smoking uptake (Lader & Meltzer, 2001).

The impact of smoking within the school environment also needs to be addressed in further depth. Significant associations have been found between peer influences and smoking behaviours (Vink, et al., 2003). It is important to consider the impact that perceived peer smoking has upon smoking uptake, and whether children and adolescents who observe smoking behaviours within their school environment subsequently view smoking as a positive entity, and consequently experiment with cigarettes or become smokers themselves (Vink, et al., 2003; Leatherdale, et al., 2006).

Evidence has shown that well-designed school smoking bans can reduce smoking prevalence (Penz, et al., 1989; Reid, et al., 1995); however, this only occurs if restrictions are strongly enforced (Wakefield, et al., 2000). Some argue that leniency on school smoking rules may affect adolescents’ perceptions, deeming smoking behaviours as more normal (Poulsen, et al., 2002).

Longitudinal assessment of the impact of second-hand tobacco smoke on adolescent smoking behaviours is an important step in understanding how smoking behaviours develop across time in order to design effective smoke-free health promotion initiatives. This study aimed to address: whether second-hand tobacco smoking indicators (i.e. home smoking rules, perceived peer smoking and being in other smoky environments) predict (a) adolescents smoking trial, and (b) whether they have smoked in the last week. Prospective analyses were carried out for all years of secondary education (aged twelve to sixteen) and accounted for the moderating influence of socio-deprivation scores (Index of Multiple Deprivation (IMD), 2007).

Method

Study sample

The study sample was drawn from the second phase of the Liverpool Longitudinal Smoking Study (LLSS). The LLSS was established in 1995, and has been funded by the Roy Castle Lung Cancer Foundation throughout. Between 1995 and 2001, the LLSS tracked 253 children within six primary schools across Liverpool. These schools were chosen to reflect the range of socio-economic conditions found in the city (Porcellato, 1998; Milton, 2002). In 2001 the participants moved to more than 30 secondary schools across Merseyside. This second phase of the study was undertaken between 2002 and 2006 when participants were tracked annually from age twelve until they were sixteen years old. Participation rates throughout primary school data collection were high, but attrition rates increased every year of secondary school for varying reasons such as absence from school on the day of the study, pupil exclusions and non-consent. Participant rates ranged from 215 (85%) at age twelve, to 109 (43%) at age sixteen, with the highest attrition rate occurring in the final year of the study.

Measures

The LLSS has employed a wide range of tools throughout the study, to enable the children to express their views through the research. Methods include self-report questionnaires gathering both quantitative (Thinking About Smoking) and qualitative (Describing Smoking Exercise) data that were administered to the whole class, one-to-one interviews, focus groups, parental questionnaires and a Draw and Write Exercise (Williams, Wetton and Moon, 1989). These methods evolved accordingly over time to reflect changes in the cohort’s development and experiences, and to incorporate innovative techniques. This paper draws on the findings from the quantitative class questionnaires.

A semi-structured self-report questionnaire was administered with appropriate confidentiality measures in place. The questionnaire was divided into sections labelled ‘About you’, ‘About your family’, ‘About smoking and you’, ‘About other people’ and ‘About your secondary school’. The same questionnaire was distributed in each of the study years. While each year
introduced additional methodologies, for the purpose of this study we will focus on the ‘core’ questions asked every year.

Within the ‘About smoking and you’ section, the smoking behaviour questions asked were “are you ever offered cigarettes?”; “have you ever tried a cigarette?”; “how many times have you tried a cigarette?”; and “have you smoked a cigarette in the last week?” Socio-demographic questions were asked in the ‘About you’ section, including gender and postcode. There were categorical response choices for each question and options for further description of their answers. Similarly within the ‘About other people’ section, participants were asked “are people allowed to smoke in your home?” and “Are you ever in places, other than your home, where people smoke?” A further section labelled ‘About your secondary school’ included questions about other pupils smoking. All of the questions we are including in our analysis have categorical outcomes.

This article presents statistical analyses of quantitative data at five time points, collected between 2002 (T1), when the cohort was twelve years of age, and 2006 (T5), when the cohort was sixteen years of age. Data were analysed using Chi-Squared tests to test the strength of association and logistic regression analysis to evaluate the extent to which one variable predicts another, using SPSS (Version 11.0). Home and school postcodes were recoded into Index of Multiple Deprivation (IMD) scores. The IMD combines a number of indicators, chosen to cover a range of economic, social and housing issues, into a single deprivation score for each small area in England. This allows each area to be ranked relative to one another according to their level of deprivation. No differences were reported between the 2007 and 2004 IMD scores for the home and school postcodes; therefore the 2007 score was used for all of this analysis.

**Results**

At the beginning of the second phase of the study, 44% of the cohort was female and 56% was male. Despite the range of primary schools being selected in 1995, by T1 the data suggests that 74% of the cohort is within the highest deprivation quintile according to the Index of Multiple Deprivation (IMD Quintile 5). Findings at this stage showed that 35% of participants’ mothers smoked and 36% of participants’ fathers smoked, higher than the national statistics for men and women (Action on Smoking and Health, 2008). Furthermore, 57% of the cohort lived in households where people were allowed to smoke in the house and 85% spend time in places other than the home that they consider smoky. For 40% of these participants, the ‘other’ smoky place was another family member’s house; for others smoky places included public transport, pubs and cafes and other public places. The majority of adolescents regularly saw pupils from their school smoking (76%, n=162).

Unsurprisingly, the number of adolescents experimenting with cigarette smoking increased annually. At T1 23% of adolescents had tried smoking and by T5 51% of the cohort had tried. The number of smoking trials each participant had experienced also increased. While 52% of triers had only tried once at T1 and none of the participants smoked weekly or daily, by T5, 34% of triers had tried at least two to five times and 28% of the cohort smoked every day.

**Temporal associations with smoking trial**

Chi-Square analysis was undertaken to examine the temporal associations between second-hand tobacco smoking factors at T1 and subsequent smoking behaviours at T2, T3, T4 and T5. Table 1.0 shows a significant association between people being allowed to smoke in the home at T1, and having tried smoking at T2-5. Spending time in smoky places at T1 was significantly associated with having tried smoking T2, but at no other ages. Seeing pupils smoking at school at T1 was significantly associated with having tried smoking T2, but at no other age. School deprivation was significantly associated with having tried a cigarette at T3, T4 and T5. Strong associations were found between home deprivation and having tried a cigarette at T3, T4 and T5. Strong associations were also found between school deprivation and smoking trial, with the strongest association occurring at T5.

**Temporal associations with weekly smoking**

Table 2.0 shows that significant associations were found between smoking being allowed in the home at T1, and having smoked in the last week at T3 and T4. No significant associations were found between spending time in other smoky places or seeing pupils smoke at school at T1, and having tried smoking in the last week. Home deprivation levels were found to be significantly associated with having smoked in the last week at T5. Strong associations were found to exist between home deprivation and having smoked in the last week across all years; This association was however, only significant at
School deprivation was found to be significantly associated with having smoked in the last week at T4, and a strong association was found throughout all of the years, with the strongest occurring at T5.

**Predicting smoking trial**

A logistic regression analysis was carried out to determine which risk factors predicted subsequent experimentation across all ages of the study. A model incorporating IMD scores, and environmental variables including smoking in the home, external smoking environments and school smoking environment as predictors of smoking trial was constructed by entering all the variables in a backwards stepwise procedure.

The focus of the study was on which risk factor predicted subsequent behaviour. Table 3.0 shows estimates of the influence of each risk factor on the probability the adolescent will try smoking at different ages. At the age of thirteen the model highlights household smoking rules and spending time in other smoky places as significant predictors of smoking trial.

**Table 1.0**
Second-hand tobacco smoking factors temporally associated with smoking trial

<table>
<thead>
<tr>
<th></th>
<th>Trial T1</th>
<th>Trial T2</th>
<th>Trial T3</th>
<th>Trial T4</th>
<th>Trial T5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are people allowed to smoke in your home</td>
<td>3.59</td>
<td>0.13</td>
<td>5.79*</td>
<td>0.18</td>
<td>8.41**</td>
</tr>
<tr>
<td>Are you ever in places other than home where people smoke</td>
<td>1.12</td>
<td>0.07</td>
<td>13.72***</td>
<td>0.27</td>
<td>2.45</td>
</tr>
<tr>
<td>Do you see many pupils from your school smoking</td>
<td>2.33</td>
<td>0.11</td>
<td>5.81*</td>
<td>0.18</td>
<td>1.12</td>
</tr>
<tr>
<td>Home IMD2007 Score</td>
<td>50.7</td>
<td>0.48</td>
<td>45.95</td>
<td>0.47</td>
<td>45.31</td>
</tr>
<tr>
<td>School IMD 2007 Score</td>
<td>24.77</td>
<td>0.34</td>
<td>28.64</td>
<td>0.37</td>
<td>45.78***</td>
</tr>
</tbody>
</table>

*p<.05; **p<.01; ***p<.001

**Table 2.0**
Second-hand tobacco smoking factors temporally associated with having smoked in the last week

<table>
<thead>
<tr>
<th></th>
<th>Smoked in last week T1</th>
<th>Smoked in last week T2</th>
<th>Smoked in last week T3</th>
<th>Smoked in last week T4</th>
<th>Smoked in last week T5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are people allowed to smoke in your home</td>
<td>0.19</td>
<td>0.06</td>
<td>0.27</td>
<td>0.06</td>
<td>3.97*</td>
</tr>
<tr>
<td>Are you ever in places other than home where people smoke</td>
<td>0.13</td>
<td>0.05</td>
<td>0.94</td>
<td>0.11</td>
<td>0.003</td>
</tr>
<tr>
<td>Do you see many pupils from your school smoking</td>
<td>1.83</td>
<td>0.18</td>
<td>0.105</td>
<td>0.04</td>
<td>0.08</td>
</tr>
<tr>
<td>Home IMD2007 Score</td>
<td>9.67</td>
<td>0.42</td>
<td>28</td>
<td>0.56</td>
<td>39.7</td>
</tr>
<tr>
<td>School IMD 2007 Score</td>
<td>14.97</td>
<td>0.52</td>
<td>24.56</td>
<td>0.52</td>
<td>25.6</td>
</tr>
</tbody>
</table>

*p<.05; **p<.01; ***p<.001
significant predictors of smoking trial. The model suggests that adolescents from households where smoking is advocated are 44% more likely to smoke and spending time in smoky places other than the home leaves them at 13% more risk of smoking trial. From age fourteen to sixteen IMD school score is a significant predictor of smoking trial, increasing the risk of trial by around 95%. During later adolescence household smoking rules also predict trial, particularly at age sixteen where rules increase the risk of trial by 95%. Perceived pupil smoking is only a risk factor at age sixteen when seeing other pupils smoking increases the risk of smoking trial by 21%.

Predicting weekly smoking

Table 4.0 shows estimates of each risk factor on the probability that adolescents will have smoked in the last week. None of the factors significantly predicted smoking at ages twelve, fourteen and sixteen. The table highlights two key predictors. IMD deprivation scores increase the risk of having smoked in the last week by 96% at age thirteen. Household smoking rules increase the risk of smoking in the last week at age fifteen by 17%.

| Smoking environments and adolescent smoking: evidence from the Liverpool Longitudinal Smoking Study |

<table>
<thead>
<tr>
<th>Trial T2</th>
<th>Trial T3</th>
<th>Trial T4</th>
<th>Trial T5</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td>95% CI</td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Are people allowed to smoke in your home</td>
<td>.637*</td>
<td>(.227-.841)</td>
<td>ns</td>
</tr>
<tr>
<td>Are you ever in places other than home where people smoke</td>
<td>.134**</td>
<td>(.030-.606)</td>
<td>ns</td>
</tr>
<tr>
<td>Do you see many pupils from your school smoking</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>IMD2007 Score</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>IMD 2007 Score</td>
<td>ns</td>
<td>ns</td>
<td>.961***</td>
</tr>
</tbody>
</table>

*p<.05; **p<.01; ***p<.001, ns=non-significant

Table 3.0

Adjusted odds ratio (OR), and 98% confidence intervals (CI), of adolescents smoking trial in relation to environmental variables.

<table>
<thead>
<tr>
<th>Smoked in last week T2</th>
<th>Smoked in last week T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Are people allowed to smoke in your home</td>
<td>ns</td>
</tr>
<tr>
<td>Are you ever in places other than home where people smoke</td>
<td>ns</td>
</tr>
<tr>
<td>Do you see many pupils from your school smoking</td>
<td>ns</td>
</tr>
<tr>
<td>Home IMD2007 Score</td>
<td>.962*</td>
</tr>
<tr>
<td>School IMD 2007 Score</td>
<td>ns</td>
</tr>
</tbody>
</table>

*p<.05; **p<.01; ***p<.001, ns=non-significant

Table 4.0

Adjusted odds ratio (OR), and 98% confidence intervals (CI), of adolescents having smoked in the last week, in relation to environmental variables.
Discussion

Our findings illustrate that trying smoking is strongly influenced by a number of environmental factors, of varying degrees, at all ages of adolescence. Smoking trial at T2 (age thirteen) is most significantly associated with time spent in other smoky places, but also predicted by household smoking rules. From T3 (aged to fourteen) to T5 (age sixteen) household rules and school IMD scores show consistent and significant associations with trial and further predict trial. Findings for weekly smoking highlight home IMD scores and home smoking rules as key associations and having significant predictive value.

Smoking rules within the home are often dependent on the smoking status of the parent (Kodl & Mermelstein, 2004), and numerous studies have found support for the strong influence that parental smoking in general has on children’s smoking initiation (Flay, et al., 1998; O’Laughlin, et al., 1998) and regular smoking (Simons-Morton, et al., 2001; Leatherdale, et al., 2005). However, research has illustrated that parents can reduce the prevalence of these influences by adopting an anti-smoking stance. Setting smoke-free household rules has shown to be effective in reducing the strength of these associations, even if the parents smoke themselves (Jackson & Henrikson, 1997). Our findings from the LLSS support previous studies that have found a relationship between household smoking rules and adolescent smoking prevalence (Chassin, et al., 1998; Farkas, et al., 2000). Some studies suggest this relationship is indirect, and that anti-smoking practices are associated with the adolescent cognitions that predict smoking behaviour (i.e. attitude, self-efficacy and expectations) (Huver, et al., 2006).

Therefore, growing up in a smoking environment may lead to the development of a normative smoking view. This normative view may subsequently increase the likelihood that an adolescent will try smoking and eventually become a regular smoker. However, our study has found that household rules also clearly act as direct predictors of smoking trial and weekly smoking. A recent review of family based tobacco control interventions concluded that there is a need for well designed and well executed randomised controlled trials in this area (Thomas, et al., 2008). Therefore, while existing interventions may focus on changing normative beliefs and attitudes, our evidence certainly suggests the focus should be more directly targeted towards the catalyst of those regular smoking cognitions, household smoking practices.

Perceptions of peer smoking did not consistently predict smoking trial and did not predict weekly smoking. These findings support the results of previous research, which concluded that observing peers smoking does not significantly influence smoking trial or regular smoking (Poulsen, et al., 2002). However, our findings did distinguish an important increase in the number of adolescents reporting seeing pupils smoking at school, increasing from 76% at T1, to 99% at T5 (aged sixteen). As group sizes for analysis were small, however, it is likely there was not enough statistical power to render significant findings.

Our study did not account for the influence of teachers as role models, and how their smoking behaviours may have impacted upon the adolescents. Poulsen, et al., (2002), found that exposure to teachers smoking outdoors was a significant predictor of adolescent daily smoking. However, the authors of this study report a lenient attitude towards smoking in their sample of Danish schools and this leniency may also have an impact on teacher smoking prevalence. Future studies examining the impact of environmental factors should consider the influence of teachers smoking behaviours, the smoking rules within the school and the extent to which these rules are adhered to. A review of the effectiveness of school-based smoking interventions concluded that many studies had failed to detect any positive intervention effects (Thomas & Perera, 2006). Our findings show that the school has a fundamental influence on smoking trial, but not necessarily on the uptake of regular smoking, suggesting that while school interventions shouldn’t be the focus of new adolescent prevention programmes, new approaches within schools are required to address trial, especially in light of the limited success of existing interventions.

The majority of our cohort lived in households classified as within the most deprived IMD quintile and over half of the cohort live in households where smoking rules are not in place. Our findings illustrate the important relationship between deprivation and cigarette smoking, not just in the home, but also in the school, and are in keeping with previous studies (Dorsett & Marsh, 1998; Lader & Melzer, 2001; Milton, Cook, Dugdill, Porcellato, Springett & Woods, 2004). A recent review of the effectiveness of tobacco control programmes highlighted the significance of the existing relationship between social inequalities and smoking, and concluded that smoking interventions should be specifically directed at disadvantaged areas of society, a stance that our findings support (Thomas, et al., 2008).
Our study relied on the self-reported smoking status of the participants. This information would have been enhanced if another test for smoking status was used to validate the self-reported responses. Researchers have successfully used measures of cotinine in saliva samples to verify self-reported smoking status (Montalto & Wells, 2007).

This longitudinal study provides valuable information, which has facilitated a more complex exploration of the environmental factors associated with smoking attitudes and behaviours. Furthermore, the LLSS data has enabled the identification of progressions and key elements of change that has been unattainable in previous studies. Previous evidence has demonstrated that school-based intervention and education programmes are not efficient in the prevention or reduction of smoking in the longer term. Our findings show that the majority of pupils see other people smoking at school, and that over half have tried smoking by the age of sixteen, supporting the notion that existing smoking and health education programmes are not effective. We suggest that smoking trial is influenced by school-related environmental factors, whereas regular smoking is influenced by home smoking practices, and that deprivation plays a fundamental role in this. Given the strongly significant influence that parental smoking has on children’s smoking initiation (Vink, et al., 2003; Leatherdale, et al., 2005), tobacco control initiatives should reflect the need to target socially deprived groups and introduce a focus on smoke-free home interventions, supplemented by school-based initiatives. Public smoking bans may prove successful in reducing adolescent smoking trial; however our findings strongly suggest that smoke-free home initiatives are necessary to reduce the transition to regular smoking.

Conclusions

- Deprivation at both home and school (Index of Multiple Deprivation (IMD), 2007) has a significant association with cigarette smoking among adolescents.
- Smoking trial is influenced by school-related environmental factors.
- Smoking trial at age thirteen is most significantly associated with time spent in smoky places, and also predicted by household smoking rules.
- From age fourteen to sixteen household smoking rules and school deprivation (IMD, 2007) predicted smoking trial.
- Regular smoking is influenced by home smoking practices.
- Home smoking rules and home deprivation (IMD, 2007) are significant predictors of weekly smoking.
- Public smoking bans and school-based initiatives may reduce adolescent smoking trial; however our findings suggest that smoke-free home initiatives are required to reduce the transition to regular smoking.

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