doi:10.1111/j.1360-0443.2007.02086.x

Smoking status of step-parents as a risk factor for smoking in adolescence

Jennifer A. Fidler, Robert West, Cornelia H. M. van Jaarsveld, Martin J. Jarvis & Jane Wardle

Cancer Research UK Health Behaviour Research Centre, Department of Epidemiology and Public Health, University College London, UK

ABSTRACT

Aim To examine the extent to which smoking by step-parents and biological parents predicts adolescent smoking. **Design** Five-year cohort study. **Setting** Thirty-six schools in South London, England. **Participants** A subset of 650 students participating in the Health and Behaviour In Teenagers Study (HABITS), who reported living in step-families, were assessed annually from age 11–12 to age 15–16 years. **Measurements** Students reported their smoking status, which was cotinine-verified, as well as whether their parents smoked and, if they lived with a step-parent, whether that step-parent smoked. Analyses also controlled for gender, ethnicity and deprivation. **Findings** Students who reported that just their step-parent smoked at age 11–12 were significantly more likely to report current smoking at any time-point from age 11–16 than those who reported having neither biological parents nor a step-parent who smoked [odds ratio (OR) 2.72, 95% confidence interval (CI) = 1.36–5.47], as were those with both a parent and a step-parent who smoked (OR 2.23, 95% CI = 1.46–3.41). While the association between smoking in students and smoking in biological parents in this subsample did not reach statistical significance (OR 1.39, 95% CI = 0.88–2.19), these students were no more or less likely to smoke than those with just a step-parent who smoked. **Conclusion** Smoking by a non-biological parent appears at least as influential as smoking by biological parents. This confirms the importance of social influence on smoking initiation and suggests that attempts to work with parents in smoking prevention should involve, and perhaps pay particular attention to, step-parents who smoke.

Keywords Adolescent, parents, risk factors, smoking, step-parents.

Correspondence to: Jennifer Fidler, Health Behaviour Research Centre, Department of Epidemiology and Public Health, University College London, 2–16 Torrington Place, London WC1E 6BT, UK. E-mail: j.fidler@ucl.ac.uk
Submitted 2 August 2007; initial review completed 7 September 2007; final version accepted 30 October 2007

INTRODUCTION

The influence of smoking by parents on smoking in their children is well documented; adolescents with one or more parent who smokes are more likely to smoke themselves than those with no smoking parents [1–3] although effects are often small, with odds ratios (OR) consistently below 2.0 [4,5].

A number of mechanisms have been proposed to explain how this influence might be transmitted, including direct modelling of behaviour, the transmission of norms and attitudes towards smoking, parenting styles and controlling access to certain friendship networks and contacts [6]. Another potential mechanism is that adolescents could inherit a genetic predisposition to smoke, as evidence suggests that smoking in adulthood is determined, at least in part, by genetic factors [7,8]. However, research in the adolescent age range is much less clear and although heritability appears to play a greater role as age increases [3,5,9], genetic determination of smoking behaviour at younger ages may be a consequence of indirect influences, such as peer choice [9].

Avenevoli & Merikangas called for research to investigate the comparative risk of smoking by biological and non-biological relatives [5]. Such assessment of biological versus step-parent figures may help to determine the extent to which environmental and biological mechanisms are involved in the development of adolescent smoking. A large number of studies report that children from step-families are more likely to show problem behaviour, including smoking [10–13], with proposed explanations including reduced income, more limited parent–child interactions, higher stress and increased residential mobility [14]. However, to our knowledge, no study has

as yet examined the extent to which the smoking behaviour of step-parents predicts adolescent smoking. This study uses biological- and step-parent smoking behaviour data from the HABITS (Health and Behaviour In Teenagers) study to address this issue.

METHODS

A total of 5863 students from 36 schools in South London, England took part in the HABITS study, a 5-year longitudinal study designed to track the development of health behaviours across adolescence in a socio-economically and ethnically diverse sample. Data collection began in 1999 when students were aged 11–12 years and in school year 7, with assessments repeated on an annual basis until students were aged 15–16 (school year 11). At each school year students present in the classroom on the day of data collection completed questionnaires and provided a saliva sample for cotinine assay, with response proportions ranging from 74% to 85% throughout the study. Parents could withdraw their child from the study and adolescents themselves could decide not to take part. Ethical approval was granted by the University College London/University College London Hospital Medical Ethics Committee. Further details of the sampling frame and methodology used are reported elsewhere [15].

Measures

Smoking behaviour

To determine self-reported smoking behaviour, students were asked at each study year which of the following statements best described them: 'I have never smoked', 'I have only ever tried smoking once', 'I used to smoke sometimes but I never smoke cigarettes now', 'I sometimes smoke cigarettes now but I don't smoke as many as one a week', 'I usually smoke between one and six cigarettes a week' and 'I usually smoke more than six cigarettes a week'. A check question asked students to confirm 'I have never tried smoking a cigarette, not even a puff or two', 'I did once have a puff or two of a cigarette, but I never smoke now' or 'I do sometimes smoke cigarettes'. Current smoking was defined as smoking sometimes, or more frequently. Self-reported non-smokers whose cotinine value exceeded a cut-point of 15 ng/ml were reclassified as current smokers [16].

Parental smoking

At each study year participants were asked 'Does your mother smoke' and 'Does your father smoke'? Participants were also asked whether they lived with a step-mother and whether they lived with a step-father, and if so whether or not that step-parent smoked.

Demographic variables

Student reports of post (zip) codes were matched with census-level data to provide Townsend scores of area-level deprivation, which are based on car ownership, housing tenure, unemployment and overcrowded living conditions [17]. These scores were standardized according to the distribution of Townsend scores across London and split into quintiles ranging from most to least deprived. Ethnic background was reported according to the 1991 and 2001 census and categorized into white, black or mixed black, Asian or mixed Asian, and 'other'.

Data analysis

A composite variable was constructed categorizing those who reported living with a step-parent as having no parent figures who smoked, just a step-parent who smoked, just a biological parent who smoked or having both a biological parent and a step-parent who smoked, at baseline (year 7). This meant that only those students who reported living with a step-parent were included in analyses to avoid confounding of any observed effects of step-parent smoking with having a step-parent *per se*. As the number of participants living in step-families was comparatively small, the smoking responses across the 5 years of the study were collapsed together to increase power. Current smoking (smoking sometimes or more often) at any time-point across the study was then used to identify smokers. Although this measure will include both students who are consistent regular smokers and those who report current smoking on just one occasion, it highlights students who are at increased risk of smoking uptake, while allowing the inclusion of students who were not present at every year of the study.

Cross-tabulations run in SPSS 14 were first used to describe the pattern of smoking behaviour in each of the parent/step-parent smoking categories. Logistic regression analyses were used to test the impact of step-parent and biological parent smoking, first comparing the odds of being a current smoker if neither a parent nor a step-parent smokes to other family smoking categories (model 1), then reversed so that other groups are compared in reference to just having a step-parent who smokes (model 2). Univariate analyses were performed first, then the associations were tested controlling for gender and the demographic factors deprivation and ethnicity which may explain both adolescent smoking and parent/step-parent smoking. Regression analyses were then repeated using complex logistic regression procedures which take account of school clustering.

Table 1 Demographic characteristics of subsample of students living in step-families ($n = 650$).

	%	n
Gender		
Boys	64.2	417
Girls	35.8	233
Ethnicity		
White	57.3	366
Black/mixed black	29.1	186
Asian/mixed Asian	7.7	49
Other	5.9	38
Deprivation		
Least deprived	16.2	103
2nd quintile	16.2	103
3rd quintile	17.0	108
4th quintile	21.7	138
Most deprived	29.0	185

When a step-parent is present it is reasonable to suppose that the family home is split into two, with one parent living with the child and potentially another parent living elsewhere, although varying degrees of contact and visiting may occur. Although numbers are small, further analyses were run to establish the extent to which having parents who smoke in the home and absent from the home predicts adolescent smoking compared with having step-parents who smoke. To assess this an eight-category variable of the smoking behaviour of biological parents at home, step-parents and absent parents was constructed (see Table 3 for categories). If participants reported living with a step-father it has been assumed here that they also lived with their mother, and that their father (if applicable) was absent from the family home. Conversely, if they reported living with a step-mother, it was assumed they did not also live with their biological mother. A total of 248 participants reported living with both a step-mother and a step-father. Therefore, in order to determine with which biological parent students were residing, data were restricted to those reporting living with one step-parent only ($n = 402$). However, as families are complex and numbers were low, if just one of these step-parents were recorded as smoking they were included as living with a smoking step-parent in the main analyses described above. Basic cross-tabulations and logistic regressions were then run as before on this extended eight-category variable.

RESULTS

At baseline 15% (650) of students reported living with a step-parent, 64.2% of whom were boys and 57.2% were white. Further demographic characteristics of this sample are shown in Table 1. The majority of step-parents reported were step-fathers (566) rather than step-mothers (332), and a greater percentage of step-fathers were smokers than step-mothers (34.1% versus 13.6%). Of biological parents, 48.5% in this subsample of students living in step-families smoked, which was no higher than the percentage of parents who smoked in non-step-families (48.5 versus 45.4%, $\chi^2 = 2.14$, df = 1, $P = 0.143$). Current smoking at any time-point was observed in 35.8% ($n = 232$) of participants in this reduced subsample of the HABITS study, compared to 32.1% ($n = 1169$) of participants who do not have step-parents ($\chi^2 = 3.35$, df = 1, $P = 0.067$).

A total of 294 participants (45.2%) of this sample of students with a step-parent had neither a biological parent nor a step-parent who smoked; 41 (6.3%) reported a step-parent who smoked but no smoking by biological parents, 136 (20.9%) had a biological parent who smoked, but their step-parent did not smoke and 179 (27.5%) reported both a biological and a step-parent who smoked. Current smoking at any point throughout the study was less prevalent if neither a biological parent nor a step-parent smoked (26.9%, $n = 79$) than if just a step-parent smoked (51.2%, $n = 21$), just a biological parent smoked (36.3%, $n = 49$) or both a biological parent and a step-parent smoked (46.6%, $n = 83$), $\chi^2 = 23.54$, df = 3, $P < 0.0001$.

Table 2 shows the results of logistic regression analyses. Students living in homes where just their step-parent smoked were significantly more likely to smoke than those who reported having neither parents nor a step-parent who smoked (OR 2.72, $P < 0.01$, 95% CI = 1.36–5.47), as were those who lived with both a parent and a step-parent who were smokers (OR 2.23, $P < 0.001$, 95% CI = 1.46–3.41). Having just a biological parent who smoked was associated with current smoking in unadjusted analyses, although once demographic variables were included this association was not significant in this subsample. However, having a biological parent who smokes was associated significantly with adolescent smoking in the total sample of students in adjusted analyses, i.e. those both with and without step-parents [OR 1.70, $P < 0.001$, 95% confidence interval (CI) = 1.48–1.94], with a similar effect size to that observed in the reduced sample of only those adolescents with step-parents.

Model 2, with having just a step-parent who smokes now as the reference category, clarifies that those students who live in a home where only their step-parent smokes are at a greater risk of current smoking than those who have neither a biological parent nor a step-parent who smoke, but are no more or less likely to be smokers than those with just a biological parent who smokes or both a biological parent and a step-parent who smokes (although there was a trend towards having just a biological parent who smokes being less important than having just a step-parent who smokes; OR = 0.51, 95%

Table 2 Year 7 parent/step-parent smoking predicting current smoking at any study year among students living in step-families ($n = 650$), unadjusted and adjusted odds ratios.

	Neither smoke	*Just step-parent smokes*	*Just parent smokes*	*Both smoke*
Unadjusted OR (95% CI)				
n	294	41	135	178
Model 1	1	2.86** (1.47–5.55)	1.55* (1.00–2.40)	2.38*** (1.61–3.52)
Model 2	0.35** (0.18–0.68)	1	0.54 (0.27–1.10)	0.83 (0.42–1.64)
Adjusted† OR (95% CI)				
n	284	39	131	174
Model 1	1	2.72** (1.36–5.47)	1.39 (0.88–2.19)	2.23*** (1.46–3.41)
Model 2	0.37** (0.18–0.74)	1	0.51 (0.24–1.06)	0.82 (0.40–1.67)

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.
†Analyses are adjusted for gender, ethnicity and deprivation. CI: confidence interval.

Table 3 Percentage of current smokers in each parent/step-parent/absent parent smoking category among students living in step-families ($n = 402$).

	No parent figure smokes	*Just step-parent smokes*	*Just absent parent smokes*	*Step- and absent parent smoke*	*Just parent at home smokes*	*Parent at home and step-parent smoke*	*Parent at home and absent parent smoke*	*All parent figures smoke*
Total *n*	130	29	47	35	35	37	19	69
Current smoking at any year % (*n*)	27.7 (36)	55.2 (16)	38.3 (18)	42.9 (15)	40.0 (14)	45.9 (17)	21.1 (4)	52.2 (36)

CI = 0.24–1.06). The above analyses were repeated using complex logistic regression procedures to take account of school clustering and results were unchanged.

Table 3 displays the number of students in each of the eight combinations of parent, step-parent and absent parent smoking, and the percentage of students reporting current smoking at any time-point in each of these categories. Although numbers here are low, the greatest percentage of adolescent smokers is seen in those who live in a family where just the step-parent smokes.

Logistic regression analyses controlling for confounding factors gender, ethnicity and deprivation confirm that adolescents who have just a step-parent who smokes are more likely to smoke than those with no parental figure who smokes (see Table 4). Having just a parent who smokes, present in or absent from the home was not associated significantly with current smoking behaviour. These findings were repeated when using complex logistic regression procedures which take account of school clustering.

Student reports of living with a step-parent who does or does not smoke were inconsistent from year to year, with as many as 50% of those reporting living with a step-parent at baseline not going on to report living with a step-parent 1, 2, 3 and 4 years later. Some degree of changing family structure is to be expected, but to ensure that this did not distort results analyses were repeated using data from those who reported living with a step-parent at least twice across the 5 years of the study, taking the parent/step-parent smoking behaviour from the first year that these data were available. Using this method, and controlling for gender, deprivation and ethnicity, the above findings were confirmed; a significant effect of just a step-parent smoking remained (OR = 1.82, $P = 0.041$, 95% CI = 1.03–3.24), having both a parent and a step-parent who smoked was also still associated with adolescent current smoking at any point (OR = 2.45, $P < 0.001$, 95% CI = 1.66–3.63), and the association between student smoking and smoking by just a biological parent again did not reach significance in this subsample (OR = 1.40, $P = 0.12$, 95% CI = 0.92–2.13). Similar analysis using the eight-category variable of parents at home, step-parents and absent parents also replicated the above findings, with a significant effect of just step-parent smoking (OR = 2.47, $P = 0.008$, 95% CI = 1.27–4.82) and of smoking by all parent figures (OR = 3.52, $P < 0.001$, 95% CI = 2.04–6.06), with smoking by a step-parent and an absent parent, and smoking by a parent and a step-parent also predicting current smoking at any time-point (OR = 1.97, $P = 0.044$, 95% CI = 1.02–3.82, OR = 2.01, $P = 0.027$, 95% CI = 1.08–3.73). There was a significant effect of reporting living with a step-parent for 2 or more years on smoking behaviour, with those living with step-parents

Table 4 Year 7 parent/step-parent/absent parent smoking predicting current smoking at any study year among students living in step-families ($n = 402$), unadjusted and adjusted odds ratios (OR).

	No parent figure smokes	*Just step-parent smokes*	*Just absent parent smokes*	*Step- and absent parent smoke*	*Just parent at home smokes*	*Parent at home and step-parent smoke*	*Parent at home and absent parent smoke*	*All parent figures smoke*
Unadjusted								
n	130	29	47	35	35	37	19	69
OR	1	3.21**	1.62	1.96	1.74	2.22*	0.70	2.85**
(95% CI)	–	(1.41–7.34)	(0.80–3.27)	(0.91–4.24)	(0.80–3.79)	(1.05–4.71)	(0.22–2.24)	(1.55–5.24)
Adjusted†								
n	126	27	46	34	33	36	19	68
OR	1	3.50**	1.47	1.93	1.74	2.13	0.59	2.99**
(95% CI)	–	(1.44–8.50)	(0.70–3.10)	(0.85–4.36)	(0.76–4.00)	(0.96–4.75)	(0.17–1.98)	(1.53–5.83)

*$P < 0.05$, ** $P < 0.01$. †Analyses are adjusted for gender, ethnicity and deprivation. CI: confidence interval.

more likely to smoke than those not living with step-parents or reporting living with a step-parent only once (45.6% versus 33.0%, $P < 0.001$).

DISCUSSION

These results have shown that smoking by parental figures, biological or non-biological, is associated with a higher incidence of smoking in adolescents. The failure to detect a significant association between adolescent smoking and biological parent smoking might, at first, be thought surprising. However, the effect size of parental smoking in this reduced sample of students living in step-families is similar to that observed in the whole population of students, i.e. those both with and without step-parents, which was significant. What these results suggest is that smoking by step-parents is at least as influential as smoking by biological parents. This might explain partially the higher rates of smoking often observed in children from step-families [10,11], and suggests that the role parents play in influencing adolescent smoking can be explained by either a biological or non-biological influence mechanism.

Taking into account the high level of inconsistent reports of living with step-parents and restricting analyses to include those reporting step-parents on at least two occasions weakened the strength of this finding. However, a similar pattern of results was observed and there remained a strong effect of step-parent smoking in contrast to smoking by biological parents in the home and absent from the home, suggesting that the effect of step-parent smoking observed is unlikely to be due to an artefact of misreporting.

Another explanation for the findings presented is that the step-parent effect observed is simply a function of the gender of the smoking parents. As the majority of step-parents present in the home were step-fathers, it is plausible that the effect is due simply to fathers having a greater impact on smoking behaviour than mothers. However, analysis of parental influence on smoking by parent gender in the whole sample showed that it is mothers who had a greater influence on smoking among both boys and girls, suggesting that this is not a likely explanation (results not presented). Furthermore, if the effect was due to male smoking role models, then some effect of absent parent smoking (by default also mainly fathers) would be expected. However, smoking by absent parents did not predict adolescent smoking behaviour, again supporting an environmental model of influence (although the sample size here is very low).

The availability of such a large data set from which these data have been drawn has allowed examination of the role played by smoking step-parents in smoking behaviour. Even so, numbers were limited and the use of current smoking behaviour by adolescents at any point across the study is an obvious limitation when smoking data were available at each of the 5 study years. Assessment of persistence of smoking or increased dependence is therefore not possible, yet these conceptualizations of smoking behaviour are known to show greater heritability [8,18]. The small sample size also restricted the inclusion in the models of a larger number of factors that could, potentially, explain the association between step-parent smoking and adolescent smoking. Although analyses were adjusted for gender, ethnicity and deprivation other potential confounding variables, such as stress or problem behaviour, restricted the sample size still further and were consequently not included in the models. Other limitations include the self-reported nature of parental smoking status by students, which may have resulted in inaccurate classification of parent smoking behaviour, and the lack of information regarding the marital status of these step-families. It is plausible that non-smoking step-parents were more likely to be married to the biological parent and

this relative stability of family structure could explain the effect as opposed to the smoking behaviour of step-parents *per se*. Similarly, we did not have explicit information as to with which biological parents participants were living, although we have inferred that if a participant is living with a step-father they are also living with their biological mother and not their biological father. The analyses based on these assumptions should therefore be interpreted with this in mind.

More research is needed to investigate why step-parent smoking appears to have such a strong impact on adolescent smoking behaviour comparative to that of biological parents. Perhaps step-parents try actively to make 'friends' with their step-children and play less of a 'parent' role, which might result in increased modelling by adolescents. Perhaps there is less concern by step-parents about the negative impact of their smoking behaviour on their step-children. Although we do not know when the step-parents had entered the home, this may also be at a time when adolescents are more vulnerable to the behaviour of other smokers, or perhaps the movement of someone new into the home who smokes sanctions smoking in a way that might not arise in those whose parents already smoke.

In conclusion, smoking by step-parents has at least as great an association with adolescent smoking behaviour as smoking by biological parents, both those present in, and absent from, the family home. This suggests strongly a social mode of smoking initiation transmission between parents and children, although does not preclude a role for biological predisposition. What is clear is that within step-families, where smoking incidence among adolescents is typically high, smoking by step-parents was associated with an increased risk of smoking behaviour. Attempts to work with parents in smoking prevention should therefore involve, and perhaps even pay particular focus to, step-parents who smoke.

Acknowledgements

This study was funded by the charity Cancer Research UK and the UK Government Department of Health, who had no involvement in the study itself or its interpretation. The participation of the 36 schools and all students is gratefully acknowledged, as is the work of all those involved in the collection of data. We also thank David Boniface, who advised on the analysis of the data.

Declaration of interest

Robert West undertakes research and consultancy for developers and manufacturers of smoking cessation treatments such as nicotine replacement products. No other authors have any competing interests.

References

1. Exter Blokland E. A., Engels R. C., Hale W. W. III, Meeus W., Willemsen M. C. Lifetime parental smoking history and cessation and early adolescent smoking behavior. *Prev Med* 2004; **38**: 359–68.
2. Jackson C., Henriksen L., Dickinson D., Messer L., Robertson S. B. A longitudinal study predicting patterns of cigarette smoking in late childhood. *Health Educ Behav* 1998; **25**: 436–47.
3. Vink J. M., Willemsen G., Boomsma D. I. The association of current smoking behavior with the smoking behavior of parents, siblings, friends and spouses. *Addiction* 2003; **98**: 923–31.
4. Conrad K. M., Flay B. R., Hill D. Why children start smoking cigarettes: predictors of onset. *Br J Addict* 1992; **87**: 1711–24.
5. Avenevoli S., Merikangas K. R. Familial influences on adolescent smoking. *Addiction* 2003; **98**: S1–20.
6. Darling N., Cumsille P. Theory, measurement, and methods in the study of family influences on adolescent smoking. *Addiction* 2003; **98**: S21–36.
7. Li M. D., Cheng R., Ma J. Z., Swan G. E. A meta-analysis of estimated genetic and environmental effects on smoking behavior in male and female adult twins. *Addiction* 2003; **98**: 23–31.
8. Sullivan P. F., Kendler K. S. The genetic epidemiology of smoking. *Nicotine Tob Res* 1999; **1**: S51–S57.
9. White V. M., Hopper J. L., Wearing A. J., Hill D. J. The role of genes in tobacco smoking during adolescence and young adulthood: a multivariate behaviour genetic investigation. *Addiction* 2003; **98**: 1087–100.
10. Bjarnason T., Davidaviciene A. G., Miller P., Nociar A., Pavlakis A., Stergar E. Family structure and adolescent cigarette smoking in eleven European countries. *Addiction* 2003; **98**: 815–24.
11. Griesbach D., Amos A., Currie C. Adolescent smoking and family structure in Europe. *Soc Sci Med* 2003; **56**: 41–52.
12. Tyas S. L., Pederson L. L. Psychosocial factors related to adolescent smoking: a critical review of the literature. *Tob Control* 1998; **7**: 409–20.
13. Anda R. F., Croft J. B., Felitti V. J., Nordenberg D., Giles W. H., Williamson D. F. *et al.* Adverse childhood experiences and smoking during adolescence and adulthood. *JAMA* 1999; **282**: 1652–8.
14. Hoffmann J. P. Family structure, community context, and adolescent problem behaviors. *J Youth Adolesc* 2006; **35**: 867–80.
15. Wardle J., Jarvis M. J., Steggles N., Sutton S., Williamson S., Farrimond H. *et al.* Socioeconomic disparities in cancer-risk behaviors in adolescence: baseline results from the Health and Behaviour in Teenagers Study (HABITS). *Prev Med* 2003; **36**: 721–30.
16. McNeill A. D., Jarvis M. J., West R., Russell M. A., Bryant A. Saliva cotinine as an indicator of cigarette smoking in adolescents. *Br J Addict* 1987; **82**: 1355–60.
17. Townsend P., Phillimore P., Beattie A. *Health and Deprivation: Inequalities and the North*. London: Croom Helm; 1998.
18. Fowler T., Lifford K., Shelton K., Rice F., Thapa A., Neale M. C. *et al.* Exploring the relationship between genetic and environmental influences on initiation and progression of substance use. *Addiction* 2007; **102**: 413–22.

