



## Association of parent and best friend smoking with stage of adolescent tobacco smoking

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### Abstract

**Objective** compare the effect of parental and best friend smoking across the stages of adolescent smoking, from being a never smoker susceptible to smoking, to being a daily smoker

**Method** national cross-sectional annual survey (2002-2006 combined) of 157,637 Year 10 students aged 14 and 15 years who answered an anonymous self-administered questionnaire.

**Results** the effects of smoking by parents and best friend varied with stage of adolescent tobacco smoking. Attributable risk calculations showed that parental and best friend smoking explained only 6.3% of susceptibility to smoking among never smokers, and 21.7% of non-smoking students who had ever experimented with cigarettes. The attributable risk for parental and best friend smoking progressively increased with smoking frequency, up to 78.7% for daily smoking. The effect of best friend smoking was stronger than parental smoking, although there was a synergistic effect of both variables on the risk of daily smoking.

**Conclusion** smoking by best friend and parents are strongly associated with current smoking by adolescents, but unrelated to susceptibility to smoke among those who are non-smokers.

The majority of adult tobacco smokers take up smoking during adolescence. A number of stages in the pathway to becoming a regular smoker during adolescence have been described including 'triers', 'experimenters', 'regular users' and 'dependent users'.<sup>1</sup> Cohort studies of adolescents have identified various trajectories through these stages to adult smoking, which combine measures of stability in smoking status over time along with early/rapid or late/slow adopters of smoking.<sup>2-6</sup> However, once adolescents start trying or experimenting with smoking, the transition is mostly a one way process towards regular smoking,<sup>7</sup> although some smokers start quitting in their early 20s.<sup>2,5</sup>

An early review of the predictors of youth smoking concluded that there was a high level of support for social learning variables, such as peer and family smoking, being involved in the initiation of tobacco smoking.<sup>8</sup> In particular, the review found stronger evidence for an effect from peer smoking than for parental smoking. However, subsequent reports have provided conflicting evidence with regard to this conclusion. A Californian cohort study observed that friends' smoking had a stronger effect on adolescent smoking behaviour, particularly initiation, than parental smoking;<sup>9</sup> although a subsequent report from this study found that, while smoking by friends was important in the transition from trial to experimental smoking, parental smoking predicted the transition from experimental to regular smoking.<sup>10</sup>

The latter finding is supported by a US Mid-West cohort study which found that parental smoking was associated with regular smoking in adolescence and adulthood, but not with adolescent smoking experimentation; although the parental effects were not as strong as peer effects.<sup>2</sup>

In contrast, a New Zealand cohort study observed that parental smoking predicted smoking experimentation by age 13 years, while smoking at age 16 years was most strongly predicted by affiliation with smoking peers at 15 years.<sup>11</sup> Further, the US National Longitudinal Study of Adolescent Health concluded that adolescent smoking is more influenced by friend smoking than parent smoking, after comparing the relative sizes of the risk ratios for these two variables.<sup>12</sup>

A recent review has concluded, based on the strengths of relative risks, that peer or friend smoking is more strongly related to adolescent smoking than parental smoking.<sup>13</sup> However, this conclusion has recently been challenged by the argument that the preferred measure of effect for ranking public health risk factors is the population attributable risk, which integrates into a single measure both the strength of a risk factor (i.e. the relative risk) and its frequency (prevalence).<sup>14</sup> The population attributable risk (or fraction) can be interpreted as the proportion of outcome events (e.g. adolescent smoking) that can be attributed to (or explained by) an exposure variable (assuming the latter is causative).<sup>15</sup>

Applying this calculation to a national sample of New Zealand Year 10 students produced attributable risk values of 67% for best friend smoking and 64% for parental smoking combined with exposures under parental control such as allowing smoking in the home or amount of pocket money.<sup>14</sup> Further, the influence of parents precedes that of peers, and previous studies which have controlled for the effect of friend and older sibling smoking in multivariate analyses will have underestimated the effect of parental smoking.<sup>16 17</sup>

In this current paper we extend earlier results from the national Year 10 (aged 14 -15 years) surveys by comparing the relative importance of the influence of parental smoking and best friend smoking on the various stages of adolescent smoking, along the continuum from being a never smoker susceptible to smoking, to becoming a daily smoker.

## Method

Annual national surveys of tobacco smoking by Year 10 (4th form) students (ages 14-15 years) have been carried out yearly since 1999.<sup>18</sup> Each year, all New Zealand schools with Year 10 students were invited to participate in the survey by administering a short questionnaire to their Year 10 students in November. The current paper reports data from the 2002-2006 surveys which collected information on smoking by parents and best friend of students. The annual school response rate was 67% in 2002 ( $n = 309$ ), 66% in 2003 ( $n = 312$ ), 65% in 2004 ( $n = 319$ ), 58% ( $n = 278$ ) in 2005, and 78% ( $n = 291$ ) in 2006. The Ethics Committee of the Ministry of Health in Auckland granted a waiver of the formal review and consenting processes.

School principals gave permission for teachers to supervise students while they completed the anonymous self-administered questionnaires in class. To maintain confidentiality, teachers did not examine the surveys for completeness.

Students answered a two-page questionnaire, which included questions on age, sex and ethnicity (self-assigned). Because students could choose more than one ethnic group, a priority system was used to classify any student choosing Māori as such, then any Pacific student as such, followed by any Asian

student as such, followed by European. Students answered whether their mother, father or best friend smoked; and whether people were allowed to smoke inside their house.

With regard to their own smoking status, students were asked "Have you ever smoked a cigarette, even just a few puffs?", and if they answered "yes", they were asked "how often do you smoke now?" Those who answered "no" to both questions were classified as never smokers, while those who answered "yes" to the first question and "no" to the second were classified as experimenters. Those who answered "yes" were queried about the frequency of their current smoking (*at least once a day, at least once a week, at least once a month, less often, never*).

Susceptibility to future smoking was assessed by asking "Do you think you will smoke a cigarette at any time during the next year?" Respondents were classified as non-susceptible only if they answered 'definitely not'. Similar measures of susceptibility have been shown to predict experimentation with tobacco smoking in previous youth cohort studies.<sup>19,20</sup> Students smoking monthly or more often were asked their age (in years) when they first started smoking monthly (for the years 2003-2005).

The total number of completed questionnaires returned by schools during the 5 year period was 167,488 (30,972 in 2002, 34,812 in 2003, 33,279 in 2004, 34,038 in 2005, and 34,387 in 2006), out of 229,240 on school rolls (73.1% student response). Analyses were restricted to 162,931 students who were 14 and 15 years old. We further excluded students with missing data for gender (n=509), ethnicity (n=1283), student smoking status (n=1,291), and parent or best friend smoking status (n=2,211). This left 157,637 students available for analyses.

All statistical analyses were made using SAS callable SUDAAN (Release 9.0.1, 2005) which corrects standard errors and confidence intervals for any design effect from clustering of students by school. The CROSSTAB procedure was used to calculate relative risks, and the MULTLOG procedure was used to calculate adjusted odds ratios (OR) while adjusting for age, gender and ethnicity, and to test for interaction. The population attributable risk was calculated by estimating the attributable proportion for the exposed cases within each exposure category using standard methods.<sup>21</sup>

## Results

The distribution of smoking status, by level of demographic variable and smoking status of parents and best friend, is shown in Table 1. Age was associated with an increased risk of smoking, with a higher proportion 15-year-old students distributed in the smoking categories than 14-year-old students ( $p<0.0001$ ). Girls were more likely to be smokers than boys, who had a higher proportion of never smokers (49.3% v. 43.3%,  $p<0.0001$ ). With regard to ethnicity, smoking levels were highest among Māori students, followed in order by Pacific, European and Asian ( $p<0.0001$ ). Students who lived in a house where smoking was allowed were three times more likely to be daily smokers than those who did not (20.7% v. 6.3%,  $p<0.0001$ ).

When students were categorised by the smoking status of their parents and best friend, student smoking levels were highest among those with both parents and best friend being smokers (41.1% daily smokers), followed by students who had non-smoking parents but their best friend smoked (19.1% daily smokers), and by students with smoking parents but best friend a non-smoker (5.4% daily smokers), while smoking was lowest among students with neither parents nor best friend being smokers (1.8% daily smokers). Students were more likely to be exposed to parental smoking (40%) than best friend smoking (25%).

Table 2 shows the relative risk of never smoking students being susceptible to smoking in the next year, associated with parental and best friend smoking. Students of non-smoking parents with a best friend who smoked were most likely to think they would smoke during the next year (47.9%), followed by students with both parents and best friend being smokers (41.4%).

**Table 1. Distribution of student tobacco smoking status, by demographic status and parental and best friend smoking**

Variable	N	Never smoked		Not smoking now	Smokers				
		Not susceptible	Susceptible	Experimenters	Less than monthly	Monthly	Weekly	Daily	
		%*	%	%	%	%	%	%	
<b>Age (years)</b>									
14	85,157	33.3	15.1	26.7	8.1	3.8	3.7	9.2	
15	73,068	30.5	13.2	27.3	9.0	4.2	4.3	11.5	
<b>Sex</b>									
Male	76,914	35.7	13.6	28.9	7.6	3.0	2.9	8.2	
Female	80,311	28.4	14.9	25.2	9.4	4.9	5.0	12.2	
<b>Ethnicity</b>									
European	103,392	32.5	16.6	26.7	9.1	4.2	3.7	7.3	
Maori	28,496	16.6	7.8	32.4	9.5	4.6	5.9	23.2	
Pacific	10,813	30.3	9.9	30.5	8.1	3.7	4.6	13.1	
Asian	14,524	60.1	13.7	15.9	3.3	1.3	1.6	4.1	
<b>People smoke in house</b>									
Yes	42,459	18.3	10.5	29.6	10.1	5.0	5.9	20.7	
No	113,162	37.3	15.7	26.0	7.9	3.6	3.3	6.3	
<b>Parents smoke</b>	<b>Friend smokes</b>								
Yes	Yes	22,770	5.7	4.0	20.0	11.7	7.2	10.2	41.1
Yes	No	40,349	29.8	13.5	36.5	8.7	3.3	2.7	5.4
No	Yes	16,879	10.4	9.6	24.3	15.8	10.1	10.8	19.1
No	No	77,231	45.6	18.7	24.6	5.9	2.0	1.3	1.8

\*Row percents.

**Table 2. Relative risk, and attributable risk, of a never smoker being susceptible to smoking in next year.**

Parent smokes	Best friend smokes	Susceptible		Relative Risk (95% CI)#	Attributable cases	Population attributable risk+
		Yes N (%)*	No N			
Yes	Yes	918 (41.4%)	1297	1.45 (1.37–1.53)	285	1.3%
Yes	No	5449 (31.2%)	12,041	1.10 (1.06–1.13)	495	2.2%
No	Yes	1615 (47.9%)	1755	1.63 (1.57–1.70)	624	2.8%
No	No	14,413 (29.0%)	35,219	1.00	–	–
<b>Total</b>		<b>22,395</b>	<b>50,312</b>		<b>1404</b>	<b>6.3%</b>

\*Percent of total of each parent-friend smoking category; # Adjusted for age, sex and ethnicity; +Attributable cases / total number of susceptible.

The effect of parental smoking by itself was weak, with only a 10% relative increase in the risk of being susceptible (to 31.2%) compared with the reference category of students with neither parents nor best friend being smokers (29.0% susceptible). The population attributable risk, which gives the proportion of susceptible students that can be explained by parental and/or best friend smoking, was only 6.3%, indicating that susceptibility is explained primarily by other risk factors.

A stronger effect from parental and best friend smoking was seen on the risk of current non-smokers having ever experimented with cigarettes (Table 3). The relative risk (RR) of being an experimenter was highest for students with both parents and best friend being a smoker (RR = 2.01) or with best friend only being a smoker (RR = 1.83). However, the attributable risk value was highest for students with parents only being smokers (11.9%) because students in this category made up a greater proportion (29%) of all students not currently smoking compared to the previous two categories (each 6%). Collectively, 21.7% of current non-smoking students who had ever experimented with cigarettes could be explained by parental and/or best friend smoking.

The relative and attributable risks of current student smoking associated with parent and best friend smoking are shown in Table 4. The general pattern for less than daily smoking by students was for the effect to be strongest for best friend smoking alone, followed by both parent and best friend smoking, with parent smoking alone having the lowest relative risks within each of these student smoking categories. In contrast, for daily smoking, the effect of both parent and best friend smoking combined (RR = 14.29) was more than the sum of the net effect of parent smoking alone (RR = 2.19) and best friend alone (RR = 8.25). This interaction was statistically significant ( $p < 0.0001$ ).

More than half of student daily smokers (53.9%) could be attributed to the combined effect of parent and best friend smoking. The other important feature of the results in this table is the progressive increase in the population attributable risk values with increasing frequency of smoking: from 28.3% for students smoking less than monthly up to 78.7% for those smoking daily. The pattern in Table 4 occurred within each sex,

with parental and best friend smoking, separately and together, being significantly ( $p < 0.01$ ) associated with all frequencies of adolescent smoking (data not shown).

**Table 3. Relative risk, and attributable risk, of a non-smoker having ever experimented with cigarettes**

Parent smokes	Best friend smokes	Experimented		Relative Risk (95% CI)#	Attributable cases	Population attributable risk+
		Yes N (%)*	No N			
Yes	Yes	4553 (66.9%)	2250	2.01 (1.94–2.07)	2288	5.4%
Yes	No	14,742 (45.6%)	17,610	1.52 (1.49–1.55)	5043	11.9%
No	Yes	4098 (54.7%)	3401	1.83 (1.78–1.89)	1859	4.4%
No	No	19,028 (27.6%)	49,858	1.00	-	-
<b>Total</b>		<b>42,421</b>	<b>73,119</b>		<b>9190</b>	<b>21.7%</b>

\*Percent of total of each parent-friend smoking category; #Adjusted for age, sex and ethnicity; +Attributable cases / total number of experimenters.

**Table 4. Relative risk and attributable risk of smoking, associated with smoking by parent and best friend, by frequency of student smoking.**

Parent smokes	Best friend smokes	N (%)* in smoking category	Relative Risk (95% CI)#	Attributable cases	Population attributable risk+
<b>Smoking &lt; Monthly</b>					
Yes	Yes	2672 (11.7%)	1.82 (1.72–1.93)	1204	9.0%
Yes	No	3519 (8.7%)	1.41 (1.34–1.48)	1023	7.6%
No	Yes	2665 (15.8%)	2.44 (2.32–2.58)	1573	11.7%
No	No	4589 (5.9%)	1.00	-	-
<b>Total</b>		<b>13,445</b>		<b>3800</b>	<b>28.3%</b>
<b>Monthly smoking</b>					
Yes	Yes	1648 (7.2%)	3.15 (2.90–3.42)	1125	18.0%
Yes	No	1344 (3.3%)	1.54 (1.43–1.67)	471	7.5%
No	Yes	1707 (10.1%)	4.43 (4.10–4.79)	1322	21.2%
No	No	1549 (2.0%)	1.00	-	-
<b>Total</b>		<b>6248</b>		<b>2918</b>	<b>46.7%</b>
<b>Weekly smoking</b>					
Yes	Yes	2321 (10.2%)	5.83 (5.28–6.44)	1923	30.7%
Yes	No	1084 (2.7%)	1.72 (1.57–1.89)	454	7.2%
No	Yes	1821 (10.8%)	6.69 (6.13–7.30)	1549	24.7%
No	No	1035 (1.3%)	1.00	-	-
<b>Total</b>		<b>6261</b>		<b>3926</b>	<b>62.7%</b>
<b>Daily smoking</b>					
Yes	Yes	9361 (41.1%)	14.29 (13.1–15.6)	8706	53.9%
Yes	No	2170 (5.4%)	2.19 (2.03–2.36)	1179	7.3%
No	Yes	3214 (19.0%)	8.25 (7.57–8.99)	2824	17.5%
No	No	1398 (1.8%)	1.00	-	-
<b>Total</b>		<b>16,143</b>		<b>12,709</b>	<b>78.7%</b>

\* Percent of total of each parent-friend smoking category; #Adjusted for age, sex and ethnicity; +Attributable cases / total number of smokers in same smoking frequency category.

Controlling for smoking in the house greatly reduced the relative risks associated with parental smoking, with this confounding effect weakening with reducing frequency of

student smoking. For example, compared to students not exposed to parent nor to best friend smoking, the RR of daily smoking in students exposed to both parent and best friend smoking decreased from 14.49 shown in Table 4 to 9.51 (95%CI: 8.74–10.36) with additional adjustment for smoking in the house; while the RR of smoking less than monthly for the same exposure declined from 1.82 in Table 4 to 1.67 (95%CI: 1.57–1.79) with additional adjustment for smoking in the house.

There was an inverse association between age of starting smoking and frequency of smoking (Table 5). Students who smoked daily were nearly twice as likely to have started smoking by the age of 9 years (18.2%) than students smoking weekly (11.8%) or monthly (10.1%).

**Table 5. Distribution of age students started smoking monthly, up to 13 years, by current frequency of smoking: 2003–2005**

Age started smoking monthly (years)	Smoking frequency		
	Daily	Weekly	Monthly
<9	18.2%	11.8%	10.1%
10	11.1%	9.4%	7.9%
11	14.4%	12.5%	11.4%
12	25.0%	25.7%	25.9%
13	31.3%	40.6%	44.7%
(N)	(8030)	(2533)	(2487)

The increased risk of early initiation in cigarette smoking for daily smokers remained statistically significant after controlling for demographic variables ( $p < 0.0001$ ). This finding is consistent with the results in Figure 1 which show that students with both parents and best friends who smoke have a higher prevalence of smoking at all ages, followed by students with only their best friend being a smoker, followed by students with only their parents being smokers, while students with both parents and best friends who are non-smokers have the lowest smoking prevalences at all ages.

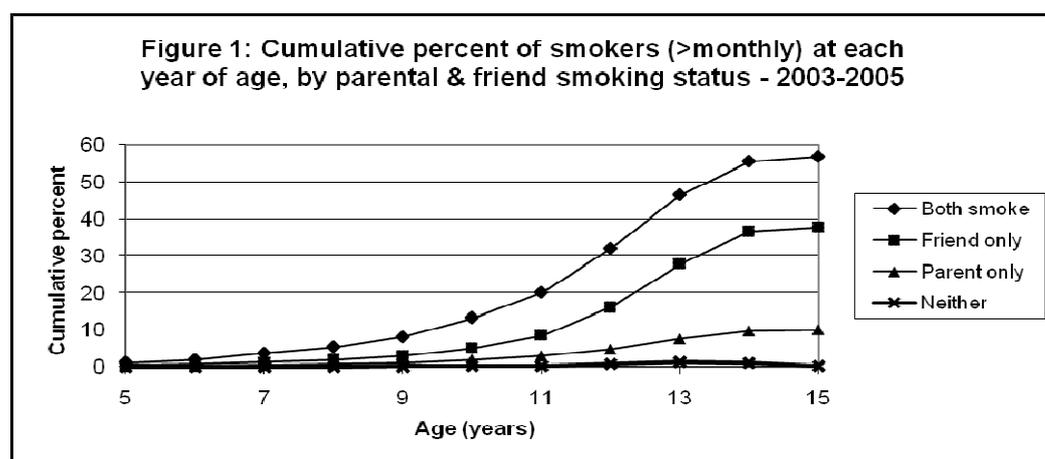
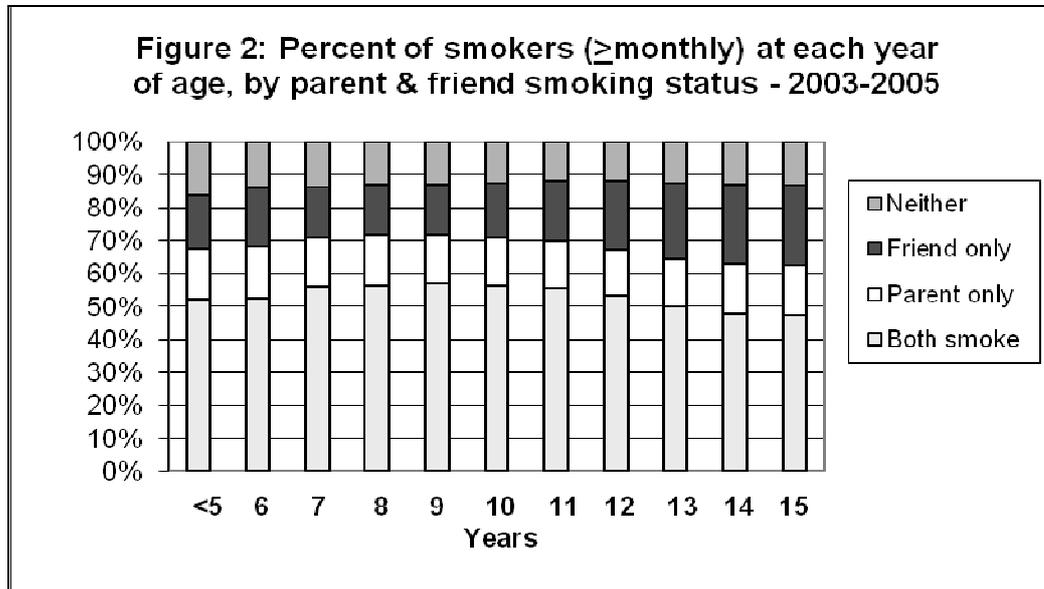


Figure 2 shows that the proportion of student smokers with a parent who smokes was higher in their younger years (age < 12 years), when it ranged from 68-72%, compared with 63% at ages 14 and 15 years.



## Discussion

We have shown with data collected in 5 national surveys of New Zealand Year 10 students that the effects of smoking by parents and best friends vary with stage of adolescent tobacco smoking. The effects were found to be weakest in the earliest stage along the smoking trajectory, which is susceptibility to smoking among never smokers (Table 2), and progressively increasing with smoking frequency to be strongest among daily smokers (Table 4).

The very weak contribution of parental and best friend smoking to smoking susceptibility among never smokers indicates that other factors, such as possibly risk taking, family conflict and low self-esteem,<sup>8 10</sup> are influential in this first step once children reach adolescence.

Our results in Table 3 showing a stronger relative risk of experimental smoking from exposure to friend smoking alone (RR = 1.83), than parental smoking alone (RR = 1.52), is consistent with previous studies which have reported larger relative risks or mean smoking levels for peer smoking compared with parental.<sup>2 6 10</sup> However, our attributable risk calculations show that parental smoking, because it is more common than best friend smoking in this age group, is a more important contributor to experimental smoking, explaining 11.9% by itself, plus 5.4% in combination with best friend smoking, for a total parental effect of 17.3% (Table 3).

Thus, our results indicate that parental smoking has a key role, and along with peer smoking, collectively explains about one fifth of smoking experimentation among adolescents who are not current smokers.

At the other end of the smoking trajectory, parental and best friend smoking explain a large proportion of adolescent smoking, varying from 28.3% of less than monthly smokers up to 78.7% of daily smokers (Table 4). While best friend smoking has stronger relative risks and attributable risks than parental smoking, the latter is still an important contributor to adolescent smoking. Parental smoking is most strongly associated with daily smoking, with the attributable risk calculations showing that it explains 61.2% of daily smoking either by itself or in combination with best friend smoking (Table 4). The interaction (or synergistic effect) observed with daily smoking, whereby the combined effect of parental and best friend smoking ( $RR = 14.29$ ) is more than the sum of the net effect for parental smoking alone ( $RR = 2.19$ ) plus the net effect of best friend smoking alone ( $RR = 8.25$ ), indicates that the combined effect of exposure to both parent and peer smoking contributes in part to daily smoking.

We have previously reported that students with parents who smoke are more likely to have best friends who smoke.<sup>14</sup> The confounding effect from smoking in the home on the relative risk of daily smoking associated with parent and best friend smoking emphasizes the importance of the home environment in facilitating adolescent smoking.<sup>14</sup> It is plausible that parents who smoke, by allowing smoking in the home, for example, create an environment where their children are more likely to interact with, and befriend, peers who smoke. Thus, part of the parental effect may be transmitted through peer smokers. Where there is joint exposure, the influence of parents typically can be expected to precede that of peers, with the consequence that parental influences are likely to be involved in the types of friends selected by adolescents.<sup>17</sup>

The finding of a strong association between parental smoking and daily adolescent smoking is complemented by the earlier age of starting smoking by students who smoke daily compared with students who smoke less often (Table 5). This finding is consistent with previous research.<sup>22</sup> Further, the proportion of adolescent smokers with a parent who smokes is highest for ages <12 years, after which the proportion of smokers exposed to friend smoking (alone) increases (Figure 2).

Overall, this pattern is consistent with the interpretation that students with parents who smoke, start smoking earlier than other smokers, so that they are more likely to be daily smokers in their mid-teens. Further, because many of these students with smoking parents socialise with other students who smoke, together they drive the spread of the smoking epidemic among the wider student body.

A major limitation of this study is the cross-sectional design which cannot distinguish cause and effect. The timing of when parental and peer effects occur can only be properly studied by cohort studies, which can determine, for example, whether perceptions by youth that smoking is the norm for children of their age precede the onset of susceptibility. Moreover, students defined as susceptible or experimenter at ages 14 and 15 years may not represent the experience of students who are smokers when they passed through these stages at younger ages.

Another limitation is that our measure of parental smoking did not allow for single parent and extended family households. However, such measurement error, if random, is likely to have resulted in under-estimation of the effects associated with parental smoking. In addition, we did not examine the full range of personal variables

associated with adolescent smoking (e.g. personality, attitudes, parent attachment), which could potentially confound the association with parental smoking.

In summary, we have found that smoking by both best friend and also parents explain a high proportion of adolescent smokers. However, given evidence showing the limited success of school-based interventions against the effects of peer-smoking,<sup>23</sup> our findings support efforts to prevent youth tobacco smoking by targeting parents who smoke, which may have a double benefit of reducing both adult and adolescent smoking. In contrast, neither parental nor peer-smoking are related to smoking susceptibility among adolescent non-smokers, which suggests other factors may be involved in the progression to smoking once children reach adolescence.

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