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Risk Factors for Tobacco Susceptibility in an Orthodontic Population: An Exploratory Study

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Abstract

Introduction—Tobacco use is related to increased periodontal disease, tooth loss, decreased success of orthodontic appliances, and may inhibit orthodontic tooth movement. Most smokers start during adolescence. As most cessation attempts fail, prevention appears necessary.

Methods—A cross-sectional sample of orthodontic patients reported hypothesized risk factors for smoking and susceptibility to tobacco use initiation. Exploratory analyses regressed susceptibility to tobacco initiation on each hypothesized predictor variable in a separate logistic model that included a standard set of covariates.

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Results—Significant odds ratios (OR) were found for the presence of a smoker in the home (OR=2.168; 95% confidence interval (CI), 1.144–4.107), a friend having no-smoking rules in their home and car (OR=0.337; 95% CI, 0.128–0.886), having been offered a cigarette (OR=4.526; 95% CI, 1.190–17.207), and exposure to tobacco advertisements (OR=1.910; 95% CI, 1.044–3.496).

Conclusions—Peer, family, and environmental factors appear to increase children's susceptibility to smoking in orthodontic populations. Attention to such factors could help dental clinicians more effectively identify susceptible young patients in need of anti-smoking advice. Prospective and experimental studies are required to confirm the role dental clinicians might play in youth smoking prevention.

INTRODUCTION

Smoking remains the number one cause of preventable death, disease, and disability in the United States¹ and costs the nation over \$300 billion annually in direct medical expenditures and lost productivity.² Early intervention is needed to prevent tobacco use initiation among youth since 88% of adult smokers start by age 18.³ While youth tobacco use has been declining for decades, the decline is slowing,³ with 2% of middle school and 9% of high school students smoking cigarettes.⁴ Prevention efforts appear necessary as only 5–10% of cessation attempts result in long-term abstinence.⁵

General risk factors for smoking initiation among youth include, but are not limited to, exposure to tobacco advertising and media portrayal of smoking, family and peer's use or approval of tobacco, low socioeconomic status, low academic achievement, low self-esteem, aggressive behavior, and a lack of tobacco refusal skills.⁶ While physicians are often tasked with preventing smoking among their young patients,⁷ pediatric dentists and orthodontists are in a good position to do the same, due to frequent contact with their patients,⁸ and predominantly younger patient population. Tobacco prevention is relevant for dental clinicians as tobacco use damages oral health through increased periodontal disease,⁹ tooth loss,^{9,10} and decreased success of orthodontic appliances.¹¹ Further, inhibited orthodontic tooth movement from exposure to tobacco smoke has been demonstrated in animal models.¹²

A systematic review of four studies of youth tobacco initiation prevention by clinicians showed that all four produced lower initiation rates in the intervention group.¹³ However, reductions were statistically significant in only one study, while the study implemented by orthodontists found a significant protective intervention effect among patients whose peer group found smoking socially desirable.^{13,14}

Minimal research has evaluated risk factors for tobacco initiation among youth orthodontic patients to inform dental clinician based interventions. As smoking rates among orthodontic patients are lower than in the general population,¹⁵ it is possible that a unique set of risk factors influence their smoking initiation. One cross-sectional study of a youth orthodontic sample found that at baseline an increased odds of tobacco use was associated with older age, Caucasian race, abnormal weight, alcohol use, not wearing a seatbelt, not getting eight hours of sleep, not regularly brushing or flossing, a tobacco user in the home, and having friends who thought smokers were cool.¹⁶ A two year follow-up study from the same sample

found that male gender, considering oneself overweight, engaging in risk behaviors such as drinking alcohol/no seat belts, not engaging in healthy behaviors such as flossing, peer influences, and increased age promoted smoking initiation.¹⁷ Similarly, a third study found alcohol and marijuana use, insufficient sleep, poor academic performance, and poor dental hygiene to be linked with tobacco use in orthodontic populations.¹⁸ Poor academic performance, peer influence, and family influence were risk factors observed in both the general population and orthodontic studies discussed above. Understanding whether the two populations have other risk factors in common is limited due to few studies measuring the same risk factors. A more thorough understanding of potential risk factors would better inform which patients are most in need of future orthodontist delivered intervention.

Researchers have defined individuals as susceptible to becoming smokers if they do not report that they will not smoke in the future. Those categorized as susceptible have been found to be at increased risk for experimenting with tobacco.¹⁹ Studies have assessed the relationships between risk factors and likely future tobacco smoking by using a susceptibility to initiation measure.^{20–22} This study used a cross-sectional analysis of baseline data from an orthodontia-based health promotion trial to explore risk factors for susceptibility to future tobacco initiation among orthodontic patients in parts of Southern California and Mexico. Identifying the most at-risk orthodontic patients might maximize the potential of clinician-based tobacco prevention interventions.

MATERIAL AND METHODS

Healthy Smiles: An Orthodontist Program, was an NIH-funded, randomized, controlled trial designed to test a *minimal intervention* to improve diet and activity practices, or to reduce tobacco use and exposure, of 8–16 year old youth. Orthodontic practices from Southern California, United States (US) (San Diego, Orange, and Riverside Counties) and the Northern border region of Baja California, Mexico (MX) were recruited to deliver the program to their patients. All study procedures were approved by the San Diego State University Institutional Review Board. All participants provided informed consent, or informed assent, for participation in the experimental research.

Participants

Orthodontic practices were identified using the American Association of Orthodontists' membership directory, online searches, telephone directory advertisements, and referrals from participating orthodontists. Of the US and MX orthodontists with whom contact was attempted between 2009 and 2013, by telephone, letter and/or in-person, 32 (8%) enrolled in the program. The low rate of enrollment stemmed from orthodontist lack of time or interest, exclusion due to retirement or part-time work status, and unsuccessful contact.

Enrolled orthodontic practices informed their patients of the research study by letter or in person. Patients permitting contact by researchers were screened for eligibility. Patients were excluded if they were not between 8–16 years old, had plans to move within a year, had less than one year remaining in treatment, were unable to care for themselves, had been diagnosed with severe depression or an eating disorder, had participated in organized sports or activities three or more times per week for nine or more months of the year, or had been

prohibited by a physician from engaging in regular physical activity. Of 4,737 age-eligible patients receiving treatment at one of the 32 orthodontic offices enrolled in the Healthy Smiles Program, 2,982 were contacted (63%), 858 (18%) refused to be screened, 990 (21%) qualified, and 693 (15%) enrolled. Twenty-two US offices were private practices (participant n = 519), two US offices were part of a large dental health maintenance organization (DHMO) (participant n = 32), and eight orthodontic offices were in Tijuana, Mexico (participant n = 142). Participants received \$10 for completion of baseline measures and parents were included in a quarterly raffle for \$100.

Measures

Research staff conducted baseline measures upon completion of the in-person parent and child consent process. Demographic data were collected through a self-administered questionnaire completed by the child's parent. Child prior day tobacco exposure recalls, tobacco use, susceptibility, reported norms, tobacco rules, and peer influence, as well as parent tobacco use and exposure were collected as part of a 3-day series of computer-assisted telephone interviews.

Dependent Variable—The dependent variable, susceptibility to future smoking, was computed from responses to the three questions shown in Figure I, similar to those used by Lessov-Schlagger et al.^{21,22}. Response options for each question were “Definitely yes”, “Probably yes”, “Probably not”, and “Definitely not”. The sampling frame was first reduced by including only those without a smoking history, i.e., those who responded ‘no’ to the question “Have you ever tried or experimented with cigarettes?”. Then, following the logic originally introduced by Evans, Farkas, Gilpin, Berry, and Pierce,²⁰ never smokers were categorized as susceptible to future smoking if they responded with anything other than “Definitely not” to all three questions; they were defined as not susceptible only if they responded “Definitely not” to all three questions. This three-question approach to measuring resulted in a susceptibility variable correlated with later tobacco initiation.¹⁹

Independent Variables—Independent variables were assessed using the questions from Figure II. Additionally, the presence of a smoker living in the home was reported by the parent. The child's family and friends finding smoking to be uncool was assessed with questions one and two, and was dichotomized as both family and friends thought smoking was uncool versus at least one did not. Question three asked whether the child had ever been offered a cigarette. Child exposure to no-smoking rules was assessed with questions four through seven. For both the child's and friend's environments, no-smoking rules were coded as present only if the child responded “no one is allowed to smoke inside, ever” for both the home and car. The presence of no-smoking rules were coded as absent if the child reported other response choices such as “smoking is ok only for some people, places, or times.” Question eight assessed reported norms, and was then dichotomized according to whether their reported number of perceived smokers was above or below the average number of youth in California who smoke at their school level (i.e., middle school or high school).²³ Questions nine and ten assessed whether the child had been advised by their orthodontist or another healthcare worker not to smoke. Question 11 assessed exposure to tobacco advertisements and was dichotomized as ‘no exposure’ or ‘exposure’ to tobacco advertising.

Lastly, questions 12–16 assessed peer influence to smoke. Children with two or more affirmative responses were categorized as subject to high influence while those with one or less were categorized as subject to low influence.

Analysis

Analyses were performed using SPSS version 22.0 (SPSS, Inc., 2013). Descriptive analyses of the study sample at baseline included child race/ethnicity, child age, child smoking status, child smoking susceptibility, family income, and home smoking status. Means and standard deviations were calculated for age, while categorical percentages were calculated for all other descriptive variables. Controlling for a smoker living in the home was considered as it would likely have a strong influence on the child's susceptibility to tobacco use initiation and could be related to other study variables. A smoker living in the home was significantly related to susceptibility to tobacco initiation (chi square, $p < .05$), and was therefore included with basic demographics as a covariate in all regression models.

Logistic regression was used to explore the relationship of each hypothesized risk factor to susceptibility of future smoking while controlling for whether a smoker lived in the home, child gender, child age, family income, and non-Hispanic white status. Each risk factor was run in a separate logistic regression model along with the five covariates, as opposed to one full model containing all risk factor variables. Large variation in the cases having missing values for the different risk factors resulted in a drastically reduced sample size when all variables were analyzed in a single model, leading to the decision to run separate analyses on each independent variable of interest.

RESULTS

The study sample had a mean age of 12.1 years ($SD = 1.9$). Frequency statistics for the demographic variables gender, race, ethnicity, income, smoking status, smoker living in the home, and susceptibility to smoking can be found in Table I. Presence of a smoker in the home was significantly associated with a child's susceptibility to future smoking ($\chi^2 (1, N = 340) OR = 2.168$; 95% confidence interval (CI), 1.144–4.107). The sample (57% of households having income $> \$70,000$) was more affluent than San Diego County as a whole (50% of households having income $> \$63,996$).²⁴ Frequencies for the independent variables are found in Table II.

Significant relationships with susceptibility to future smoking were found for a friend having no-smoking rules in their home and car ($OR = 0.337$; 95% CI, 0.128–0.886), having been offered a cigarette ($OR = 4.526$; 95% CI, 1.190–17.207), and exposure to tobacco advertisements ($OR = 1.910$; 95% CI, 1.044–3.496). Non-significant associations were found for all other study variables. Each model in Table III represents a separate logistic regression of susceptibility on the named predictor and a standard set of covariates—smoker residing in the home, child gender, child age, family income, and non-Hispanic white status.

DISCUSSION

This study examined youth tobacco initiation susceptibility and identified a collection of peer, family, and environmental risk factors among a youth orthodontic population. Understanding the risk factors for tobacco initiation among youth orthodontic patients could help oral health care practitioners implement tobacco prevention interventions among their susceptible patients.

Significant relationships of a friend having no-smoking rules in their home and car, having been offered a cigarette, exposure to tobacco advertising, and presence of a smoker in the home with susceptibility to future smoking suggest that peer, family, and environmental influences are important factors in youth smoking initiation. The negative association of youth smoking initiation with dental clinician advice, though non-significant, was in the therapeutic direction, and may point toward more effective approaches for dental clinicians to implement with their patients. Other studies have found structured orthodontist-delivered tobacco prevention interventions to have positive effects on tobacco control among high susceptibility patients. The differences in findings in the present study may stem from the orthodontist advice variable reflecting any efforts implemented by the orthodontist, while other studies tested more specific advice interventions. We found susceptibility to tobacco initiation was significantly associated with absence of a no-smoking rule in a friend's home and with having been offered a cigarette—consistent with past studies demonstrating peer influence on risk practices,²⁵ including smoking.²⁶

The significant relationship between a smoker living in the home and the child's tobacco susceptibility provides evidence that orthodontic samples experience the same negative effects of family tobacco use noted in more general youth populations,⁶ even among this more affluent sample. Though non-significant, the association between no-smoking rules in the child's home and car with the child's susceptibility was in the direction of other research suggesting reduced tobacco initiation due to the presence of "no-smoking rules" among adolescents and young adults even after controlling for smokers living in the household.²⁷ The significant relationship between exposure to tobacco advertising and tobacco susceptibility in this orthodontic sample also appears to corroborate similar relationships found in national youth samples.⁶ Though young orthodontic patients may come from more affluent backgrounds, and may smoke less often than their peers not receiving orthodontic treatment,¹⁵ similar societal and peer influences appear to operate on susceptibility in both populations. Finding these risk factors among a relatively affluent sample of orthodontic patients is notable, even in an exploratory analysis, as it suggests another venue for tobacco prevention efforts that is currently underutilized.

Understanding the risk factors for susceptibility to tobacco initiation among orthodontic patients could help dental health practitioners more comprehensively care for the oral health of their patients as well as address the largest public health problem in the US.¹ Though the relationship of orthodontic advice to not smoke with decreased tobacco susceptibility was not significant, possibly due to insufficient power, other studies of physicians' anti-smoking advice have found protective effects against tobacco use among adults and older adolescents.^{28,29} More research is needed to determine if protective effects are found in

younger and orthodontic populations. Oral health practitioners actively advising their patients could help counteract tobacco advertising, which often pairs tobacco with other reinforcing experiences such as sex, fun, and power.

Advising all patients not to smoke is a straightforward and sensible approach, but oral health practitioners may shy away from extending anti-smoking advice due to constraints on time, fear of negative patient reactions, and to emphasize dental care issues. However, these impediments can be mitigated by oral health practitioners focusing their advice on those most susceptible to smoking in the future. Including questions from the present study (e.g. “Have you ever been offered a cigarette?”; “Do you think in the future you might experiment with cigarettes?”) on an intake form would allow the practitioner to identify potentially susceptible patients. Assessing these risks periodically and providing brief advice to not smoke if concerns arise would likely maximize the practitioner’s ability to intervene when it is most necessary. Focusing on the riskiest time periods of their patients’ lives could increase the likelihood that practitioners observe the benefits of their advice and thus sustain the intervention.³⁰

Though any individual practitioner may influence only a limited number of youth, many practitioners collectively could have a large impact on preventing tobacco initiation and promoting the oral health of those accessing oral health services.²⁹ Given the associations found for family variables, oral health practitioners may do well to briefly counsel parents of patients to protect their children by quitting smoking or implementing strict no-smoking rules in the home. Increasing the density of anti-smoking messages delivered to children and their parents by health practitioners of all types would likely have a compounding effect that could substantially reduce the rate of tobacco initiation during youth.¹⁷

Limitations

The questions used to assess the smoking susceptibility measure had slightly different wording than the questions used in the Lessov-Schlagger studies.^{21,22} When excluding participants due to a previous smoking history, the present study only used the question “Have you ever smoked a cigarette?” and didn’t use the second question “Have you tried smoking, even a few puffs?” used in the Lessov-Schlagger studies.^{21,22} As mentioned in the Methods, missing data led to running a separate model for each independent variable of interest, which increased the likelihood of type I error. However, finding relationships between the independent variables and the susceptibility outcome using different subsets of the sample (due to missing data), serves as type of construct validity test of the outcome variable. Future investigators should compare our results with those from samples having more complete data.

CONCLUSION

Peer, family, and environmental influences appear to increase children’s susceptibility to future smoking in orthodontic populations through smoking rules, offering cigarettes, tobacco advertising, and smoking in the home. Understanding the risk factors experienced by orthodontic youth may inform more effective approaches for clinician advice to not smoke, thus counterbalancing the influences of peers, family, and tobacco advertising on

young patients and decreasing their susceptibility to future smoking. Advising parents to not smoke and to implement strict no-smoking rules in the home may also help clinicians protect their young patients from tobacco initiation. Prospective and experimental studies are required to confirm the role dental clinicians can play in addressing smoking prevention in youth populations.

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Highlights

- Factors appear to increase susceptibility to smoking in orthodontic populations.
- Understanding these risk factors may help clinicians prevent youth smoking.
- More studies are needed to confirm the role clinicians can play in tobacco control.

Survey Questions	Response Options
How likely is it that you will smoke or use cigarettes, even a few puffs, in the next year?	4 point Likert
Do you think in the future you might experiment with cigarettes?	4 point Likert
If one of your best friends were to offer you a cigarette, would you smoke it?	4 point Likert

Figure 1.

Survey questions for dependent variable, susceptibility to future smoking

Survey Questions	Response Options
(1) Did anyone in your family tell you or do something that made you think smoking is uncool?	Yes/No
(2) Did any of your friends tell you or do something that made you think smoking is uncool?	Yes/No
(3) Have you ever been offered a cigarette?	Yes/No
(4) What are the smoking rules or restrictions in your household, if any?	4 point categorical
(5) Now think about the friend whose home you visit the most often. What are the smoking rules or restrictions in their household, if any?	4 point categorical
(6) What are the smoking rules in the car?	4 point categorical
(7) Now think about the friend whose home you visit the most often. What are the smoking rules in their car?	4 point categorical
(8) Out of every 10 students your age, how many do you think smoke cigarettes once a month or more?	Numeric
(9) In the past month, have you been told by your orthodontist not to smoke?	Yes/No
(10) In the past month, have you been told by another healthcare worker such as doctor, dentist, nurse, hygienist not to smoke?	Yes/No
(11) In the last 12 months, when you visited a store near where you live, how often have you seen advertisements for brands of cigarettes or chewing tobacco?	3 point ordinal
(12) Do most of your friends think people who smoke look cool?	Yes/No
(13) Do most of your friends think people who smoke look more grown-up?	Yes/No
(14) Do most of your friends make fun of people who smoke?	Yes/No
(15) Do most of your friends avoid people who smoke?	Yes/No
(16) Would you be embarrassed if your friends thought that you smoke cigarettes?	Yes/No

Figure 2.
Survey questions for independent variables

Table 1**Demographic Variable Frequencies**

Demographic Variables		n	%	Independent Variables		n	%
Gender				Family Income			
Female		388	56%	<\$20,000		102	18%
Male		305	44%	\$20,000–\$69,999		145	25%
Race				\$70,000–\$134,999		219	38%
Caucasian		465	67%	>\$135,000		112	19%
Multiracial		43	6%	Current Smoker			
Asian		36	5%	Yes		5	1%
Black		17	3%	No		583	99%
Pacific Islander		3	0.4%	Smoker Lived in Home			
Native American		1	0.1%	Yes		96	14%
Hispanic Status				No		570	86%
Hispanic		279	43%	Susceptible to Smoking			
Non-Hispanic		374	57%	Yes		90	26%
				No		259	74%

Table II**Independent Variable Frequencies**

Independent Variables	n	%	Independent Variables	n	%
Child's Rules			Advertisement Exposure		
No rule	55	13%	No Exposure	203	35%
Explicit rule	369	87%	Exposure	375	65%
Friend's Rules			Been Offered Cigarette		
No rule	47	13%	No	23	4%
Explicit rule	304	87%	Yes	567	96%
Orthodontist Advice			Friend Influence		
No	493	85%	Low Risk	317	64%
Yes	84	15%	High Risk	175	36%
Other Clinician Advice			Friend/Family Think Uncool		
No	439	76%	At least one doesn't	366	64%
Yes	138	24%	Both do	205	36%
Reported Norms					
Below CA Average	315	64%			
Above CA Average	176	36%			

Table III

Logistic Regression Models

Model	Crude OR	Adjusted OR	SE	95% CI	p	n
Child's Rules	0.349	0.389	0.500	(0.146, 1.036)	0.059	198
Friend's Rules	0.333	0.337	0.493	(0.128, 0.886)	0.027*	159
Orthodontist Advice	0.517	0.489	0.42	(0.214, 1.115)	0.089	267
Other Clinician Advice	1.122	1.201	0.327	(0.632, 2.281)	0.576	268
Reported Norms	2.002	1.799	0.391	(0.836, 3.869)	0.133	230
Advertisement Exposure	1.616	1.910	0.308	(1.044, 3.496)	0.036*	272
Been Offered Cigarette	4.284	4.526	0.681	(1.190, 17.207)	0.027*	274
Friend Influence	1.183	1.432	0.332	(0.747, 2.742)	0.279	238
Friend/Family Uncool	1.304	0.938	0.296	(0.525, 1.674)	0.827	269

Crude ORs reflect the relationships not controlled for any covariates, while the adjusted ORs are controlled for a smoker residing in the home, child gender, child age, family income, and non-Hispanic white status. Significant p-values ($p < .05$) are accompanied by an asterisk. Sample sizes varied by model due to missing data.