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Environmental determinants of smoking behaviors: The role of policy and environmental interventions in preventing smoking initiation and supporting cessation

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Abstract

Tobacco control strategies have contributed to substantial declines in smoking in the United States. However, smoking still remains the single largest preventable cause of disease and premature deaths in the country. Despite the continuing challenges of implementing tobacco control strategies and the pervasive influence of the tobacco industry to undermine such strategies, there are now unprecedented opportunities to prevent smoking initiation, facilitate cessation, and protect nonsmokers from secondhand smoke. In this paper, we briefly review the most recent literature discussing key strategies that have proven effective in tobacco control including regulations on sales and marketing of tobacco products, taxation, and smoke-free legislation. We focused on these three tobacco control strategies because of their potential to positively influence the environment of both minors and adults regardless of their smoking status. Although research has identified significant individual and social predictors of tobacco use, environmental influences are also important risk factors for tobacco use.

Keywords

Tobacco control; smoking prevention; smoke-free policy; tobacco product taxation; tobacco advertising; smoking initiation; built environment; smoking cessation

Introduction

The large body of evidence establishing the massive burden of illness, death, and economic costs associated with smoking is, “clear, incontrovertible, and convincing [1].” Despite having made much progress in reducing the prevalence of smoking in the United States, smoking remains the leading cause of preventable morbidity and mortality [2]. Tobacco use is responsible for nearly 1 in 5 deaths in the United States, amounting to approximately

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Compliance with Ethics Guidelines

Conflict of Interest

William A. Calo declares that he has no conflict of interest. Sarah E. Krasny declares that she has no conflict of interest.

Human and Animal Rights and Informed Consent

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440,000 premature deaths annually, of which 49,000 are in none smokers as a result of exposure to second hand smoke [3]. Smoking is also responsible for nearly one third of all cancer deaths [4]. Beyond these negative health effects, tobacco use has pervasive social and economic consequences such as consuming national health care budgets and depriving families of wage earners [5].

Despite the numerous challenges that public health officials face in implementing smoking prevention and control activities, substantial evidence indicates that policy and environmental interventions can substantially reduce smoking rates [2, 6–7]. To successfully address smoking behaviors in real world contexts, we must first understand the underlying dynamics of initiating, using, and quitting smoking with respect not only to individual-level characteristics of smokers, but also to their living and working environments [8]. As stated by Smedley and Syme [9], “It is unreasonable to expect that people will change their behavior easily when so many forces in the social, cultural, and physical environment conspire against such change.” Thus, providing smokers with the motivation and skills to quit smoking cannot be effective if environments make it difficult or almost impossible to change their behavior.

In 2007, the Institute of Medicine (IOM) recommended a two-strategy plan to end the tobacco problem in the United States [10]. Both strategies encompass policy and environmental interventions aimed at shaping the environment of the smokers and nonsmokers alike. The first strategy was to increase the implementation of traditional evidence-based tobacco control strategies, including tobacco product taxation and smoke-free policies. The second strategy was to permit stronger federal regulation of tobacco product content, design, marketing, and distribution. In June 2009, the federal government enacted the Family Smoking Prevention and Tobacco Control Act (FSPTCA) granting the U.S. Food and Drug Administration (FDA) authority to broadly regulate tobacco products.

This paper provides an overview of the role of policy and environmental interventions in influencing smoking behavior. The review is divided in three sections covering various tobacco control strategies that have proven effective in reducing initiation of tobacco use by minors and young adults, motivating smokers to quit, and protecting nonsmokers from secondhand smoke. First, we review the literature of tobacco product marketing and sales regulations and discuss how the FSPTCA positively influences the built environment to protect minors from tobacco products and advertising. Next, research on cigarette excise taxes is reviewed, and a discussion is provided of how price minimization strategies may be undermining the public health benefits of tobacco product taxation. Finally, the evidence on the association between smoke-free policies and smoking behaviors is reviewed. It is important to note that in this review, we attempted to provide an overview of the most recent literature rather than providing an exhaustive listing or systematic evaluation of all available studies. In addition, given the voluminous literature on tobacco control, we draw heavily from studies conducted in the United States. We covered some research conducted in other countries, but unless otherwise noted, the reader should presume that the study is from the United States.

Regulations on tobacco product marketing and sales

In the United States, about 3,800 adolescents between 12 and 17 years old initiate smoking every day, and 1,000 adolescents become daily cigarette smokers [11]. National estimates for cigarette smoking among students in grades 9–12 are shockingly high: 44.7% of students have smoked at least one cigarette and 18.1% of students are current cigarette smokers [12]. Despite significant declines previously observed, the prevalence of current smoking among youth has remained stalled since 2003 [13]. Recent studies report an increased use of

smokeless tobacco products among adolescents [14] and a strong association between smoking and smokeless tobacco use [15]. Nationwide, 7.7% of students in grades 9–12 are current smokeless tobacco users [12]. Among adolescents who use smokeless tobacco products, 64% use only conventional products (i.e., dry snuff, moist snuff, plug/twist, loose-leaf chewing tobacco), 9.2% use only novel products (i.e., Swedish-style snus and dissolvable tobacco products), and 26.8% use a combination of conventional and novel products [16].

Given that the majority of first time tobacco use occurs during young adulthood, the issue of smoking initiation among youth is paramount to prevention efforts. In fact, data show that of all adult smokers who smoke daily, 88% report having started by the age of 18 and 99% by the age of 26 [17]. Therefore, adolescents and young adults who become smokers early on are setting the stage for a deadly addiction that can last a lifetime. They expose themselves to long-term diseases such as chronic obstructive lung disease, coronary heart disease, stroke, and to at least 15 different cancers, including cancers of the lung, pharynx, lip, oral and nasal cavities, esophagus, stomach, pancreas, kidney, bladder and cervix [4].

To reduce smoking initiation and prevalence among minors and young people, the U.S. Surgeon General's *Preventing Tobacco Use Among Youth and Young Adults* 2012 report recommends using coordinated, multicomponent interventions that combine mass media campaigns, price increases including those that result from tax increases, school-based policies and programs, and statewide or community-wide changes in smoke-free policies and norms [17]. These recommendations address multiple social and environmental determinants that lead youth and young adults to use tobacco; however, we will focus our discussion to those determinants associated with the built environment.

Research has shown that distal cues, such as the environments in which smoking occurs, can function as stimuli that evoke strong subjective reactivity and cravings to smoke; this is true even when the environment is devoid of any proximal cues such as viewing or holding a lit cigarette [18–19]. As a result, our built environment plays an important role in triggering a desire to use tobacco. Advertising and promotional activities by tobacco companies are considered key risk factors for smoking initiation among adolescents [20]. Evidence shows that even brief exposure to tobacco advertising influences adolescents' attitudes and perceptions about smoking as well as their intentions to smoke [21]. As a result of the 1998 Master Settlement Agreement, tobacco advertising has been banned in TV, radio, billboard and transit ads; however, youth are still exposed to pro-tobacco advertising at the point-of-sale [22]. Point-of-sale promotional materials are often placed in "friendly and familiar" locations behind the cashier, near candy and other staple items [23]. In fact, it is estimated that 85% of youth are routinely exposed to tobacco advertising at the point-of-sale [24]. Internationally, adolescent exposure to pro-tobacco advertisements from different sources including movies, TV, newspapers, magazines and outdoor events remains high in low and middle-income countries [25]. A recent review by Henriksen describes the ways in which cigarette marketing is restricted around the world and the tobacco industry's efforts to subvert such regulation [26].

The FSPTCA grants the FDA the authority to implement the "final rule" on restrictions to the sales and marketing of tobacco products set forth by the Secretary of Health and Human Services in the August 28, 1996, issue of the *Federal Register*. Broadly defined, the FDA's authorities relate to six major areas: 1) regulation of the production and manufacturing of tobacco products to limit the public's exposure to harmful and potentially harmful constituents in tobacco and tobacco smoke; 2) regulation of the advertising, marketing and promotion of tobacco products to dissuade individuals from initiating smoking and to support cessation; 3) restrictions on the distribution and sale of tobacco products to young

people; 4) enforcement of the FSPTCA in retail establishments and on the internet; 5) implementation of science and research programs to inform regulatory decisions made by the FDA; 6) and education of the public through warning labels and the dissemination of information [27].

The FSPTCA contains twelve new provisions that alter the point-of-sale environment. These changes are important because they restrict the sale and marketing of certain tobacco products, especially as it relates to reducing the exposure to and appeal of advertisements that target youth [28••]. The “final rule” calls for tobacco companies to limit their cigarette and smokeless tobacco advertising in outdoor spaces, at the point-of-sale (e.g., convenience stores and supermarkets), and in publications with significant teen readership to black-and-white text only that is devoid of any human figures, cartoons or images. The only variation that is allowed is in text size, fonts, and written words. In addition, all branded nontobacco gifts and accessories (e.g., clothing, lighters) are banned. In spite of these tobacco control efforts, adolescents continue to be exposed to pro-tobacco advertisements in stores, magazines and on the Internet [29•]. A recent study conducted by Rose et al. [30] reported that 15.7% of retailers in three North Carolina counties did not adhere to at least one of the FSPTCA provisions. The most frequently violated provisions were the ban on sales of cigarettes with modified-risk labels (e.g., “light” cigarettes) and the ban on self-service for cigarettes and smokeless tobacco. Two other studies found that nonadherence rates were below 10% [31–32]. The first study found no difference in adherence rates between retailers in high and low income neighborhoods in one county in Ohio [31] while the other found significant decreases in the provision of self-service cigarettes and smokeless tobacco in three rural Appalachian Ohio counties [32].

There is significant evidence to support the assertion that exposure to tobacco advertising increases the susceptibility of youth to smoking initiation. A 2011 Cochrane review found that nonsmoker adolescents who are more aware of or receptive to tobacco advertising are more likely to experiment with cigarettes or become smokers [33]. In addition, Morgenstern et al. [34] found that among a sample of sixth to eighth grade students in Germany, each additional 10 tobacco advertising contacts increased the adjusted relative risk for established smoking by 38% and for daily smoking by 30%.

Under the 1996 rules, the FDA also banned all outdoor cigarette or smokeless tobacco advertising displayed within 1,000 feet of any public playground or playground area in a public park, elementary school or secondary school. The U.S. Supreme Court in *Lorillard Tobacco, Co. v. Reilly*, 533 U.S. 525 (2001), however, declared a similar 1,000 foot rule enacted in Massachusetts to be unconstitutional. Therefore, any future FDA rule on outdoor advertising has to take into account the ruling set in *Lorillard*. Nonetheless, other restrictions such as graphic warning labels (e.g., a man exhaling cigarette smoke through a tracheotomy hole in his throat), a ban on tobacco-branded merchandise and free samples of tobacco products have been upheld by the U.S. Court of Appeals for the Sixth Circuit [35].

Although the FDA has yet to issue final rules on outdoor advertising near public parks, playgrounds and schools, geographic information systems (GIS) spatial analyses of Missouri and New York have produced data to demonstrate how restriction zones ranging from 350 to 1,000 feet would affect retailers [36••]. These analyses also explore the effects of a hybrid policy that mixes smaller buffer zones in densely populated urban areas with larger buffer zones for retailers located in rural areas. In spite of not having reached a consensus on the size of tobacco-free outdoor advertising buffer zones near schools and recreation spaces, across the United States, there are 22,477 municipalities, covering 81.4% of the population, with a smoke-free policy in non-hospitality workplaces, restaurants, and/or bars, by either a state law or local ordinance [37]. For youth who are developing and refining their

perceptions of what normal behavior is, smoke-free policies support a normative message that smoking is unsafe and that nonsmokers have the right to be protected [38]. Moreover, youth are less likely to progress from experimental to regular smoking if they live in towns with smoke-free indoor laws [39]. Although further research is needed, it is likely that the impact of smoke-free outdoor spaces will be similar.

In addition to advertising, proximity to tobacco retailers is also an important risk factor for smoking initiation. Closer proximity translates into less cost in terms of transportation and travel time, both important factors for youth who have little disposable income [40]. Adolescents who live closer to tobacco retailers are more likely to use tobacco [41]. Similarly, the smoking prevalence among adolescents who go to school in a neighborhood with a high density of tobacco outlets is higher than in neighborhoods without any tobacco outlets [22]. One study found that the probability of smoking initiation increases significantly for adolescents exposed to tobacco retail outlets two times or more a week compared with those exposed less often [42].

Taxation

Cigarettes are taxed by federal, state, and local governments in various ways, including through excise taxes, which are currently imposed by all fifty states and the District of Columbia [2]. State cigarette excise tax data is presented elsewhere [43]. Numerous studies have documented that increasing the price of cigarettes through taxation reduces the demand for cigarettes, thereby reducing both adult and youth smoking [44–47]. The price elasticity of demand is -0.3 to -0.5 , meaning that if cigarette prices increase by 10%, demand for cigarettes among adults decreases by 3%–5% [48]. Research also shows that children are more responsive to cigarette price increases than adults and that lower socioeconomic status (SES) individuals are more price responsive than their higher SES counterparts [44•]. Furthermore, excise taxes on tobacco products also provide governmental revenue that can be used to fund comprehensive tobacco control programs [49].

Some smokers, however, use price minimization strategies to reduce their cigarette costs in order to continue their usual smoking behaviors [50–51]. New evidence suggests that large price reductions can be obtained by seeking cheaper sources of cigarettes from legal and illicit channels. For example, Xu et al. [52••] conducted a study using 2009–2010 National Adult Tobacco Survey data to evaluate the state and national prevalence of five common cigarette price minimization strategies and the size of price reductions obtained from these strategies. The study found that 55.4% of adult smokers used one or more price minimization strategies. Among the strategies asked by the survey, the most frequently used were purchasing generic brands (25.0%), purchasing cigarettes by the carton (24.3%) and making use of coupons or other price-related promotions (19.8%). The study also found that, among smokers who used at least one strategy, the average price reduction per cigarette pack was \$1.27 or 22%. Pesko et al. [53] also found that price reductions are larger in states with higher cigarette excise taxes, and increase as cigarette excise taxes rise.

Studies also report that cigarette price increases lead to increased illegal tax-avoidant behaviors among smokers, including smuggling from lower tax jurisdictions [7]. For example, Coady et al. [54] examined the relationship between cigarette excise tax increases and tax-avoidant purchasing behaviors among New York City adult smokers. The authors found that following the 2008 tax increase, which increased the per-pack price by \$1.25, 21% of smokers reported buying cigarettes from illegal vendors on the street. The study also found that low-income, younger, Black, and Hispanic smokers were more likely than respondents with other sociodemographic characteristics to purchase more cigarettes on the street. Another recent study conducted by Fix et al. [55] estimated the prevalence of tax

evasion obtained from packs of cigarettes sent by a sample of adult smokers who participated in the 2009 and 2010 International Tobacco Control United States surveys. The authors found that one in five cigarette packs were untaxed with rates higher in states with higher-excise taxes. These studies suggest that both legal and illicit price minimization strategies limit the positive public health impact of cigarette excise tax increases.

Several policy mechanisms at both the federal and state levels are in place to limit the flow of untaxed, cheap cigarettes into the United States. At the federal level, the Prevent All Cigarette Trafficking Act of 2009, requires all Internet tobacco vendors to verify the age and identity of customers and to pay all applicable taxes. It also bans the U.S. Postal Service from delivering cigarettes to consumers, but some exemptions exist. One example at the state level is the ban enacted by the State of New York prohibiting Internet or mail order sales of cigarettes into the state [56]. In addition, a voluntary agreement between the major credit card companies, the state attorneys general, and the Bureau of Alcohol, Tobacco, Firearms, and Explosives was achieved in March 2005 to stop processing credit card payment of Internet cigarette sales [57]. There are unprecedented opportunities to strengthen the existing policies in order to decrease both legal and illicit cigarette cost-reduction opportunities. Policy strategies include enacting minimum price laws (which typically require cigarette wholesalers and retailers to charge a minimum percentage mark-up for cigarette sales) in all states, prohibiting the use of manufacturers' discounts or coupons, and expanding state-level negotiations with Indian reservations for collecting state excise taxes [52–53, 58–59]. In addition, researchers have suggested that harmonizing cigarette tax rates across all states may reduce the incentive for smokers to seek out cheaper cigarettes [55].

Smoke-free policies

The effectiveness of smoke-free policies in protecting people's health is well established in the literature [60]. Smoke-free policies, which ban smoking in workplaces and communities, reduce exposure of nonsmokers to secondhand smoke and create an environment that helps smokers to quit smoking [61]. Studies also report that after smoke-free policies are implemented overall smoking rates decrease, indoor air quality improves, smokers are more likely to quit, and the number of cigarettes consumed decreases [62–63]. For example, one recent systematic review from the Task Force on Community Preventive Services reviewed a total of 37 studies assessing the effectiveness of smoke-free policies in reducing tobacco use [64]. A subset of 21 studies measured absolute differences or changes in tobacco-use prevalence with a median effect of –3.4% points. Eleven studies also measured differences in tobacco use cessation among tobacco users exposed to a smoke-free policy compared with tobacco users not exposed to a smoke-free policy. The median absolute change was an increase in cessation of 6.4% points. The systematic review also evaluated differences or changes in self-reported attempts to quit smoking from 6 studies; the median absolute percentage change was an increase of 4.1% points. Another subset of 18 studies measured the changes in cigarettes smoked per day. The median estimate in this subset of studies was a reduction of 2.2 cigarettes smoked per day. Results from this systematic review provide up-to-date evidence that smoke-free policies reduce cigarette consumption by continuing smokers, increase smoking cessation attempts, increase the number of smokers who successfully quit, and reduce the prevalence of tobacco use among workers.

Another important consideration when examining the effectiveness of smoke-free policies is the overall implementation time period because it may have a differential effect on smoking behaviors. Studies suggest that the longer smoke-free policies are in place, the greater the impact on smoking behavior [65]. For example, Hahn et al. [66] examined the association between time since implementation of a smoke-free law (6 – 8, 18, and 36 months) and cessation behaviors among current and former smokers living in four communities in

Kentucky. The study found that compared with those with a more recent law (6 – 8 months), adults who lived in a community with a smoke-free law for 36 months were more 3.4 times more likely to be former smokers and were 2.8 times more likely to have tried to quit since the law was implemented. The authors concluded that maintaining the integrity of smoke-free laws over time is an important population-based quit strategy.

The importance of smoke-free policies is also indicated by studies that examine the effect of such policies on health outcomes. There is a wealth of research demonstrating that smoke-free legislation not only protects workers, but also entire populations from the pervasive health consequences of second hand smoke. Numerous studies have found a strong causal relationship between second-hand smoke and cardiovascular and respiratory disease in adults, respiratory and infectious disease in children, and negative reproductive outcomes in women [67–68]. With regard to health outcomes, a recent meta-analysis from Tan and Glantz [69] assessed changes in hospital admissions or deaths in the presence of a smoke-free policy from 45 studies of 33 smoke-free laws. This meta-analysis found that smoke-free legislation was associated with significantly lower rates of hospital admissions or deaths from coronary events, other heart disease, cerebrovascular accidents, and respiratory disease. The authors also reported a dose-response relationship between the strength of the law and health outcomes. They found that more comprehensive laws that ban smoking in workplaces, restaurants, and bars had the greatest health benefits. This study provides up-to-date evidence not only of the health benefits associated with implementing smoke-free laws, but also of the need to adopt comprehensive laws without exceptions.

A major barrier faced by many local governments that try to enact comprehensive laws is the passage of preemptive state laws [70–71]. Thus, eliminating preemption statutes is one of the tobacco objectives of Healthy People 2020. The only effective way to protect people from secondhand smoke is to create 100% smoke-free environments [61]. Although compliance with smoking bans in worksites, bars, restaurants, and other public places has generally been high, more government enforcement is needed to increase compliance. Other approaches to expand the coverage of smoke-free environments include smoke-free apartment policies and prohibiting smoking in vehicles in which children are present [6]. “Novel” policy interventions to continue fighting against tobacco are described in great detail elsewhere [7].

Conclusion

There is more evidence than ever before on the effectiveness of proven tobacco control strategies in curbing smoking initiation, facilitating smoking cessation, and protecting nonsmokers from secondhand smoke. An increased role of the federal government in tobacco control issues (e.g. cigarette tax increases, FDA regulations of tobacco products, restrictions on Internet sales) hold great promise for advancing the national tobacco control agenda. We want to highlight that the enactment of the FSPTCA by itself will not eliminate the tobacco problem in the United States, but so far, it is the biggest step the federal government has ever taken to promote tobacco control [2]. Additionally, policy interventions implemented by states (e.g. comprehensive smoking bans) have played an important role on decreasing the prevalence of smoking. Although we focused this review on individual tobacco control strategies, the most successful strategy involves multiple strategies implemented as part of a comprehensive tobacco control plan.

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