ORIGINAL INVESTIGATION

Complete Home Smoking Bans and Antitobacco Contingencies: A Natural Experiment

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ABSTRACT

Introduction: The California antitobacco culture may have influenced home smoking bans in Mexico. Based on the Behavioral Ecological Model, exposure to socially reinforcing contingencies or criticism may explain adoption of home smoking bans in Tijuana, Mexico, approximating rates relative to San Diego, California, and higher than those in Guadalajara, Mexico.

Methods: A representative cross-sectional population survey of Latinos ($N = 1,901$) was conducted in San Diego, Tijuana, and Guadalajara between June 2003 and September 2004. Cities were selected to represent high-, medium-, and low-level exposure to antitobacco social contingencies of reinforcement in a quasiexperimental analysis of possible cultural influences across borders.

Results: Complete home smoking ban prevalence was 91% in San Diego, 66% in Tijuana, and 38% in Guadalajara ($p < .001$). Sample cluster-adjusted logistic regression showed significantly lower odds of complete home smoking bans in Guadalajara (odds ratio [*OR*] = .048) and in Tijuana (*OR* = .138) compared to San Diego after control for demographics. Odds of complete home smoking bans in both Guadalajara and Tijuana in comparison with San Diego were weakened when mediators for bans were controlled in predictive models. Direction of association was consistent with theory. When theoretical mediators were explored as possible moderators, weak and nonsignificant associations were obtained for all interaction terms. Bootstrap analyses demonstrated that our multivariable logistic regression results were reliable.

Conclusions: Results suggest that California antismoking social contingencies mediate complete home smoking bans in all 3 cities and may account for the greater effects in Tijuana contrasted with Guadalajara.

INTRODUCTION

Secondhand smoke exposure (SHSe) is a human carcinogen for which there is no safe level (U.S. Department of Health and Human Services [HHS], 2006; U.S. Environmental Protection Agency, 1992). Estimates suggest that 1% of worldwide premature mortality in 2004 can be attributed to SHSe (Oberg, Jaakkola, Woodward, Peruga, & Prüss-Ustün, 2011). Between 1999–2004, about 18% of low-income people in the United States reported SHSe in the home compared to about 6% of higher income people (Centers for Disease Control and Prevention [CDC], 2008a). Children are especially vulnerable to SHSe, with most exposure occurring in the home (Ashley & Ferrence, 1998) and car (Leatherdale, Smith, & Ahmed, 2008; Sly, Deverell, Kusel, & Holt, 2007). Children from low-income or lower educated parents are more likely to be exposed to secondhand smoke in their homes (CDC, 2008a; Spencer, 2005). Nonsmoking children aged 3–19 years have higher levels of serum cotinine (a metabolite of nicotine and biomarker of SHSe in nonsmokers) than nonsmoking individuals aged 20 years and older (CDC, 2008a) with median cotinine levels twice that of adult nonsmokers (HHS, 2006). Evidence suggests that SHSe is more than twice as high in Mexico as in the United States (Martínez-Donate et al., 2005; Valdés-Salgado, Reynales-Shigematsu, Lazcano-Ponce, & Hernández-Avila, 2007). Emerging evidence shows that SHSe leads to thirdhand

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smoke contamination from which families may be exposed to residual tobacco toxins even when no one is smoking in the home (Matt et al., 2011). These findings indicate a need for public health interventions to reduce acute and cumulative SHSe in both low-income U.S. and Mexican homes.

Residents can reduce SHSe by establishing rules to restrict smoking in private residences, analogous to government policies restricting smoking in public buildings or worksites (Forster, Widome, & Bernat, 2007). Home, school, and work bans are associated with lower levels of SHSe, less smoking, and more cessation attempts (CDC, 2008b; Forster et al., 2007). These benefits are similar to those from governmental restrictions for smoking in public buildings (Albers, Biener, Siegel, Cheng, & Rigotti, 2008; CDC, 2007). However, unlike governmental regulations, home bans are not enforced by governmental agencies. Health benefits of home bans have been shown in high-income countries (Borland et al., 2006), but limited research has determined the use or benefits of home bans for middle-income countries. Our research indicated a low prevalence of complete home smoking bans in Mexico (Martínez-Donate et al., 2008); however, homes with complete bans provided residents with protection from SHSe (Martínez-Donate, Johnson-Kozlow, Hovell, & Gonzalez Perez, 2009). No prior studies have explored whether differential exposure to antitobacco cultures may result in differential exposure to social determinants that could mediate the likelihood of implementing home smoking bans (Escoffery, Kegler, & Butler, 2009).

The Behavioral Ecological Model (BEM) provides a conceptual foundation for determinants of complete home smoking bans among residents with systematically different exposure to tobacco control culture (Hovell, Wahlgren, & Adams, 2009; Hovell, Wahlgren, & Gehrmann, 2002). The BEM extends previous ecological models (Baum, 2005; Grzywacz & Fuqua, 2000; HHS, 2005; Sallis, Owen, & Fisher, 2009) by emphasis on operant principles that select behavior at the individual, social, and cultural levels of analysis. According to the BEM, people in our social environment differentially reinforce behaviors (e.g., home smoking bans), which results in the "survival" of some behaviors and the extinction of other behaviors, in a process analogous to Darwinian selection. This process of behavioral selection operates not only at the individual level, but for the aggregate behavior at the organized group level, including whole populations or cultures (Hovell et al., 2009). At the cultural level, additive and synergistic contingencies (i.e., cues and reinforcement that select behavior) may initiate a cascade of behavior change across individuals, which results in new cultural norms. These new norms can then alter behavior at the family and individual level by providing models to be imitated and by providing greater density of socially reinforcing consequences for avoidance of smoking in homes. These norms (Adams et al., 2006; Conley, Siegel, Winickoff, Biener, & Rigotti, 2005; Hamilton, Biener, & Brennan, 2008) may be responsible for cultural change across national populations. Consistent with this hypothesis, a study of Korean and Korean American families found that public bans are "enforced" by social criticism more than by government policing (Hofstetter, Hovell, et al., 2010) and smoking behavior is impacted by social contingencies (Hofstetter, Ayers, et al., 2010). Furthermore, recently demonstrated, short-term changes in tobacco practices may be produced by formal media interventions (Thrasher et al., 2011). These results suggest that social and cultural contingencies and media programs can prompt compliance with bans and preclude the need for police enforcement.

In California, a state tobacco excise tax enacted in 1989 resulted in the development of a tobacco control program to prevent and reduce tobacco use across the population (Bal, 1998). The California Tobacco Control Program (CTCP) exemplifies the adoption of a behavioral ecological approach to influence tobacco-related behaviors at the population level. The CTCP encouraged smoking cessation by funding mass media campaigns, English and Spanish telephone-based cessation counseling, efforts to restrict tobacco advertising, and initiatives to restrict smoking in public places (Roeseler & Burns, 2010). Thus, laws and regulations changed the population's use of social sanctions (i.e., contingencies) in a manner that suppressed tobacco use and has generalized to settings absent explicit enforced laws or fines (Adams et al., 2006; Sallis et al., 2009). The CTCP has resulted in a shift in tobacco use and public norms toward tobacco and SHSe among California residents (Gilpin, Lee, & Pierce, 2004). Based on the BEM, norms represent a high relative density of models. This high density of nonsmoking models likely promotes imitation by others, which facilitates reinforcement for the imitated behavior by the growing normative group.

Until recently, Mexico had employed few policies to reduce smoking (Meneses-González, Márquez-Serrano, Sepúlveda-Amor, & Hernández-Avila, 2002; Thrasher et al., 2006). Enforcement of bans on tobacco sales to minors had been limited, tobacco advertising in public venues was permitted, and sponsorship of events and use of promotional tobacco-related items were legal and widespread (CDC, 1997, 1999; Kuri-Morales, Cortés-Ramírez, & Cravioto-Quintana, 2005; Thrasher et al., 2006). Efforts to change tobacco control policies have been progressively strengthened since Mexico ratified the World Health Organization Framework Convention on Tobacco Control in 2004 (Thrasher et al., 2008, 2010), but during the course of this study, the CTCP remained the most prominent antitobacco policy influence in the California/Mexico region.

Few experiments have been conducted to examine how policy and cultural change in one region can influence cultural change in another region. This limited research may be due to limitations in feasibility, including difficulties assessing long-latency outcomes. In absence of controlled trials, it is possible to conduct analyses that reflect "natural experiments" or quasi-experimental analyses (Shadish, Cook, & Campbell, 2002). These analyses rely on markers of change in culture (e.g., social contingencies) and test associations with key outcomes (e.g., home smoking bans). Most studies of cultures and their influence on behavior provide limited details about the probable mechanisms by which cultural factors influence behavior (Hruschka, 2009). The "natural experiment" provided by the CTCP offered the opportunity to explore theoretical mediators of home smoking bans based on the BEM.

This study examined theoretical social contingencies that may mediate adoption of complete home smoking bans among three Mexican populations representing three different levels of exposure to the California antitobacco culture: Mexican-descent adults living in San Diego, CA; Mexican adults living in Tijuana, Baja California Norte, Mexico; and Mexican adults living in Guadalajara, Jalisco, Mexico. We hypothesized that social contingencies promoted in California function as mediators of adoption of home bans in Mexican populations in

all three cities and that differential "dose" of exposure to social contingencies accounts for differential adoption of complete home smoking bans by city.

METHODS

Design

To evaluate the CTCP and California antitobacco culture's influence across contexts, three populations exposed to different levels of the CTCP based on proximity to San Diego were selected and assessed using a quasiexperimental design (i.e., natural experiment) without baseline measures (i.e., posttest only). A cross-sectional population survey was administered between June 2003 and September 2004 in San Diego (population 1,305,736), Tijuana (population 1,210,820), and Guadalajara (population 1,646,319) (Martínez-Donate et al., 2008; U.S. Census Bureau, 2000). Tijuana is located immediately south of San Diego on the Mexican side of the California–Mexico border, and Guadalajara is located in Western Central Mexico, more than 1,400 miles from the Mexico–California border.

Cross-Culture Exposure

Tijuana residents are exposed to CTCP (e.g., media campaigns) and the California antitobacco culture by visitors (e.g., smoke-free dining preference) from California to Tijuana and by Tijuana residents who visit California. The San Diego/Tijuana border is the world's busiest border. At the time of this survey about 50,000 northbound vehicles and 25,000 northbound pedestrians cross per day (U.S. General Services Administration, 2008). In 2003 and 2004, at all border crossings between California and Mexico, there were 48 and 51 million northbound passenger and truck vehicles, and pedestrian crossings, respectively (San Diego Association of Governments, 2008). About 80% of San Diego residents visit Tijuana at least once per year and about 67% of Tijuana residents with U.S. visas visit San Diego at least once per year (Kada & Kiy, 2004). California-based mass media, particularly radio and TV stations broadcasting in Spanish, were accessible to Tijuana residents. In contrast, residents of Guadalajara had limited exposure to California tobacco control media and less incidental exposure to California residents.

Sampling Procedures

Details of the representative sampling procedures have been reported previously (Martínez-Donate et al., 2008). Of the respondents in San Diego, 79.5% completed the survey in Spanish and 20.5% in English. About 75% of San Diego respondents were born in Mexico. San Diego respondents of Mexican descent were recruited using random sampling of commercially available residential phone numbers for Latino names, stratified by zip codes containing relatively high numbers of Latinos according to census information (InfoUSA). Tijuana and Guadalajara residents were recruited using a probability-based multistage sampling design (with census tracks, city blocks, and households as sampling units). Interviewers recruited the adult with the most recent birthday in each selected household. Newly selected households in Mexico systematically replaced nonresponders and new numbers called in San Diego. Sampling and recruitment procedures continued until the target sample size was achieved. Subsamples of both phone and door-to-door interviews were conducted by the alternate recruitment strategy, and differences in population characteristics suggested little sampling bias (Borland et al., 2006). All respondents in Mexico reported in Spanish.

Cooperation rates (i.e., percent of eligible participants that completed an interview) were 41% in San Diego, 59% in Tijuana, and 64% in Guadalajara resulting in 1,103 (San Diego), 398 (Tijuana), and 400 (Guadalajara) respondents. Informed consent was obtained from participants, and study approval received from the authors' institutional review boards.

Sample Characteristics

The sociodemographic profile of the three samples (i.e., gender, age, marital status, employment status, and level of education) was closely related to the populations in San Diego, Tijuana, and Guadalajara, respectively, according to the 2000 U.S. and Mexico Census (Martínez-Donate et al., 2008).

Measures: Dependent and Control Variables

Dependent Variable: Home Smoking Ban

Individuals were asked if they had a complete ban, allowed smoking in some areas or by selected people (e.g., grandparent), or did not restrict smoking in the home. Answers were dichotomized as a complete home smoking ban (scored 1) versus some or no restrictions (scored 0) based on previous research indicating that partial bans are ineffective means of reducing SHSe (Martínez-Donate et al., 2007).

Control Variable: Sociodemographic Variables

Participants' age, gender, marital status, education level, and employment status were measured by self-report.

Measures: Independent Variables and Theoretical Mediators

Acculturation

An adapted version of the Marin and colleagues (Marin, Sabogal, Marin, & Otero-Sabogal, 1987) acculturation scale was used to measure degree of adoption of U.S. and California cultural practices (range 1–5, Cronbach's $\alpha = .91$). This scale focused on language and social preferences (e.g., "What languages do you read and speak?"). Answers ranged from 1 = *only Spanish* to 5 = *only English*.

Presence of Children

"Children" in the home was coded as 1 if anyone 18 years or younger was reported as being present, 0 otherwise. While demographic factors are usually employed as control variables (CVs) for sampling bias, we included children explicitly to test possible moderation, mediation, and predictor functions of social contingencies of reinforcement from family, friends, and the larger society that hold parents accountable for protecting children from harm. Thus, we explored the role of "children" as a correlate, CV, as a possible moderator of SHSe contingencies (Liles, Hovell, Matt, Zakarian, & Jones, 2009; Rosen, Noach, Winickoff, & Hovell, 2012), and as a marker of

social contingencies that could function as mediators of home smoking bans, as has been reported for similar theoretical mediators such as smoking cessation (Martínez-Donate et al., 2008), which demonstrated partial support.

Smoking Status

Nonsmokers were participants who never tried cigarettes (i.e., never smoker) or smoked less than 100 cigarettes in their lifetime (i.e., small amount smoker). Former smokers were participants who had smoked at least 100 cigarettes in their lifetime, but reported that they no longer smoked (i.e., not at all). Current smokers were participants who reported having smoked at least 100 cigarettes in their lifetime and reported that they still smoked (i.e., some days, every day). Two dichotomous variables were created "nonsmoker" and "former smoker." In the first dichotomy, participants who were nonsmokers were coded 1, 0 otherwise. In the second dichotomy, participants who were former smokers were coded as 1, 0 otherwise. The "former smoker" dichotomy was created because we assumed that former smokers might socially promote home bans due to their successful smoking cessation and sensitivity to harm from smoking or exposure. We viewed this as analogous to the role of children and home smoking bans.

Presence of Other Smoking Residents

Smokers in the home were considered models and markers of prosmoking social contingencies and theoretically expected to decrease bans. Participants were asked about the smoking status of other residents in the home. The presence of "other smokers" in the home was defined based on the above smoking status criteria and dichotomized as current smokers 1, 0, otherwise.

Aversion to SHSe

A scale measuring aversion to SHSe was developed. Items required participants to rate from 1 (*do not agree at all*) to 3 (*strongly agreed*) the degree to which they (1) feel bothered when someone smokes around them, (2) prefer smoke-free workplaces and venues, and (3) support laws banning smoking inside public venues, including (a) workplaces, (b) restaurants, (c) public transportation, (d) schools, and (e) health centers. A total score was computed by the mean of the items. Higher values indicated greater SHSe aversion (range 1–3, Cronbach's $\alpha = .83$).

Antitobacco Social Pressure

Social criticism (i.e., socially punishing consequences for allowing others to smoke in the home) was measured by responses to the following questions: (a) "How likely is it that you would be criticized by your spouse or partner for smoking?"(1 = *very likely*, 2 = *somewhat likely*, 3 = *not likely at all*); (b) "How many of your relatives that do not live in your home ban smoking in their homes?" (1 = *most*, 2 = *some*, 3 = *none*); (c) "How many of your friends tolerate smoking from others?" (1 = *most*, 2 = *some*, 3 = *none*); and (d) "Would your spouse support more laws prohibiting smoking in public places?" (1 = *yes*, 0 = *no*). Items were standardized and scores summed to generate an index of antitobacco social pressure, with higher scores indicating greater exposure to social pressure against indoor smoking and SHSe (range 0–28.34, Cronbach's $\alpha = .71$).

Exposure to a Smoke-Free Policy in the Workplace

Bans at work were measured by reports of "No one is allowed to smoke inside the workplace" (1 = *yes*, 0 = *otherwise*).

Statistical Analysis

Descriptive statistics for home smoking bans by city were reviewed. A multiple mediator causal steps approach guided the statistical analyses following Baron and Kenny (1986). Accordingly, several criteria must be met to infer mediation: (a) the independent variable (i.e., city as a marker of exposure to the CTCP) must be associated with the dependent variable (DV; i.e., home smoking bans); (b) the independent variable (city) must be associated with the hypothesized mediators (e.g., social contingencies of reinforcement); (c) the mediators (social contingencies) must be associated with the DV (home smoking bans); (d) the mediators (social contingencies) must remain associated with the DV (bans) after controlling for the independent variable (city); and (e) the effect size of the relationship between the independent variable (city) and the DV (bans) must be smaller when controlling for mediators. Finally, mediators should be theoretically plausible.

Complete home smoking ban (*yes* = 1, *no* = 0) was regressed on dummy variables representing the city (with San Diego as the reference category) to test for a direct effect. Chi-square tests examined differences in demographic and mediator variables by city. Spearman rho associations between cities ranked (*San Diego* = 1, *Tijuana* = 2, *Guadalajara* = 3) on proximity to California, and demographics and theoretical mediators were also examined. Logistic regression models regressed smoking ban on each of the demographic and theoretical mediator variables described above to examine the association between the DV bans and mediator variables. Finally, the relative contribution of theoretical mediators to the likelihood of having a smoking ban in the home was estimated by random intercept regression models in order to adjust for cluster sampling and to improve fit due to variation in intercepts among sample clusters (Hovell & Hughes, 2009; Rabe-Hesketh & Skrondal, 2008). Models were examined to test whether theoretical mediators remained associated with the DV, after controlling for city and demographics, and to determine if reduction in the direct effect between the independent variable and the DV was observed when controlling for mediation variables, consistent with evidence of mediation (Baron & Kenny, 1986; Kraemer, Kiernan, Essex, & Kupfer, 2008). All mediators were also explored for possible moderation functions, but all interaction terms were small and not significant (data not shown). Computations used STATA (version 11.1 and 12.1).

RESULTS

Prevalence and Correlates of Complete Home Smoking Bans

As previously reported, overall 74% of participants reported complete home smoking bans, but the prevalence differed significantly among the three cities, with 91% of those in San Diego, 66% of those in Tijuana, and 39% of those in Guadalajara reporting a complete home smoking ban ($\chi^2_{(2)} = 73.93$, $N = 1{,}861$, $p < .001$) (Martínez-Donate et al., 2008).

Table 1 presents the demographic and mediating variables by city. Significant differences between pairs of cities were found for age, education, and marital status. Participants in San Diego were older than those in the two Mexican cities, educational attainment was lower in Tijuana than the other two cities, and fewer were married in Guadalajara than the other two cities.

San Diego participants were more likely to be nonsmokers than those in the Mexican cities and more likely to be former smokers than those in Guadalajara but not those in Tijuana. The two Mexican cities were more likely to have smokers residing in the household, and each city differed in aversion to secondhand smoke with San Diego having the highest aversion rate and Guadalajara the lowest aversion. The same pattern appeared for antitobacco social pressure and work bans.

Table 1 also presents correlations between cities ranked by distance from San Diego with demographic and mediating variables. The farther from San Diego, the less likely respondents reported a complete home ban. For theoretical mediators, participants living farther from San Diego were less likely to be: acculturated; nonsmokers; former smokers; report an aversion to secondhand smoke; report social contingencies against secondhand smoke; and report smoking bans at work. Participants living farther from San Diego were more likely to report a smoking resident in the home.

Table 2 presents the bivariate associations between a complete home smoking ban and demographic and theoretical mediating variables. Generally, mediating variables were more likely than demographics to be related to complete home smoking bans. Education and single marital status were the only demographic variables related to a complete ban. The odds of a complete ban were greater for nonsmokers, those with children in the home, those more acculturated to the U.S. culture, those with greater aversion to secondhand smoke, and those that reported social contingencies against smoking and bans at work. Participants who reported other smokers in the home were less likely to report complete home smoking bans.

Table 3 presents multivariable logistic regressions of complete home bans on demographic variables in Model 1 (absent "children"). Demographic variables and "children" (considered independently) results are shown in Model 2. All potential mediators (including children) are added to the CVs in Model 3. Using San Diego as a referent, participants in both Tijuana and Guadalajara were less likely to report having a complete home ban controlling for other demographic variables. The model with all available predictors proved significant ($p < .001$). Because "children" failed to reach significance in relation to City (Table 1), we explored the variable as a predictor in Model 2 without mediators included and in Model 3 with mediators included. Notably, the odds ratio (*OR*) for "children" increased from an *OR* of 1.63 to almost 2.0 in Model 3, suggesting that "children" was a stronger predictor variable when controlling for mediators.

Evidence of mediation is present where an association between city and complete home bans diminished when potential mediators were controlled. After adjusting for city clusters,

Table 1. Demographics of Participants in San Diego, Tijuana, and Guadalajara (*N* = 1,901), and Associations Between Cities' Proximity to San Diego and Demographic and Mediator Variables

	All cities	San Diego	Tijuana	Guadalajara		Ranked city distance from San Diego[a]	
	(*N* = 1,901)	(*N* = 1,103)	(*N* = 398)	(*N* = 400)			
		City 1	City 2	City 3	*p* value	*Rho*	*p* value
Demographic variables							
Complete home smoking bans						−.47	<.001
Age[b]	39.8 (15.7)	41.0[2,3] (15.6)	38.4[1] (15.0)	38.1[1] (16.4)	.001	−.06	.027
Gender (% male)	48.1%	47.9%	46.9%	49.9%	.683	.00	.909
Employed	53.9%	53.8%	56.5%	51.5%	.374[a]	.02	.402
Education[b]	5.0 (1.9)	5.2[2] (1.9)	4.2[1,3] (1.8)	5.1[2] (2.0)	<.001	−.12	<.001
Marital status (% married or cohabiting)	60.1%	62.8%[3]	61.4%[3]	51.6%[1,2]	<.001	.07	.007
Mediator variables							
Nonsmoker	65.1%	68.4%[2,3]	59.9%[1]	61.2%[1]	<.002	−.08	.001
Former smoker	18.4%	21.2%[3]	16.4%	12.8%[1]	<.002	−.08	.003
Other smoker in home	25.8%	18.6%[2,3]	33.1%[1]	38.3%[1]	<.001	.17	<.001
Children	67.5%	67.5%	69.1%	66.0%	NS	.03	.290
Acculturation to United States	1.8	2.3[2,3]	1.4[1]	1.3[1]	.00	−.58	<.001
SHSe aversion	2.8 (.3)	2.9 (.3)[2,3]	2.8 (.3)[1,3]	2.7 (.4)[1,2]	<.001	−.23	<.001
Antismoking pressure	16.3 (5.9)	18.0 (5.6)[2,3]	16.1 (5.2)[1,3]	12.3 (5.1)[1,2]	<.001	−.37	<.001
Work bans	33.2%	40.7%[2,3]	28.6%[1,3]	17.8%[1,2]	<.001	−.21	<.001

Notes. NS = nonsignificant; SHSe = secondhand smoke exposure.
[a]Statistics are Spearman rho associations between cities ranked (San Diego = 1, Tijuana = 2, Guadalajara = 3) on proximity to California and selected predictors.
[b]Numbers in cells are means, standard deviations or percentages, and associated probabilities. Superscripted numbers refer to differences between cities corrected by Scheffe procedures for multiple testing with $\alpha = .05$. Contrasts not referenced were not statistically significant, $p > .05$.

Table 2. Bivariate Associations Between Demographic and Mediator Variables and Complete Home Smoking Bans

	Complete home smoking bans[a]		
	OR	*p* value	95% CI
Demographic variables			
Age	1.000	.879	.99 1.01
Gender	.781	.063	.60 1.01
Employment	.969	.659	.84 1.11
Education	.868	.000	.81 .93
Single	.617	.000	.48 .80
Mediator variables			
Nonsmoker	2.318	.000	1.78 3.02
Former smoker	1.012	.943	.72 1.42
Other smoker in home	0.319	.000	.24 .42
Children in home	1.740	.000	1.33 2.28
Acculturation to United States	1.310	.008	1.07 1.60
SHSe aversion	5.160	.000	3.53 7.55
Antitobacco social pressure	1.160	.000	1.13 1.19
Work bans	1.620	.001	1.21 2.17

Notes. CI = confidence interval; *OR* = odds ratio; SHSe = secondhand smoke exposure.
[a]Statistics are bivariate *OR*s, associated probabilities, and 95% CI between demographic and mediating predictors and complete home smoking bans.

Table 3. Random Intercept Logistic Regression of Complete Home Smoking Bans on Predictors in San Diego, Tijuana, and Guadalajara[a] (*n* = 1,554)

	Model 1			Model 2			Model 3		
Predictors	*OR*	95% CI		*OR*	95% CI		*OR*	95% CI	
Tijuana resident	**.138**	.088	.216	**.139**	.088	.218	**.229**	.134	.389
Guadalajara resident	**.048**	.030	.074	**.046**	.029	.073	**.119**	.067	.209
Age	.992	.983	1.001	.997	.987	1.007	.990	.979	1.002
Gender	.735	.548	.986	.778	.579	1.047	.916	.652	1.285
Employed	.867	.721	.995	.862	.733	1.014	.947	.775	1.002
Education	.818	.758	.883	.823	.763	.889	.753	.686	1.285
Single marital status	.592	.450	.780	.691	.514	.927	1.033	.738	1.157
Children				1.625	1.179	2.241	**1.920**	1.349	2.732
Nonsmoker							**2.271**	1.499	3.441
Former smoker							1.574	.947	2.616
Other smoker in home							**.503**	.364	.696
Acculturation to United States							**1.538**	1.177	2.011
SHSe aversion							**2.636**	1.637	4.243
Antitobacco society pressure							**1.123**	1.088	1.159
Work bans							1.226	.831	1.808
Constant	92.399	39.673	215.201	46.755	18.137	120.529	.133	.024	.729
	$\chi^2_{(7)} = 192.81, p < .001$			$\chi^2_{(8)} = 197.62, p < .001$			$\chi^2_{(15)} = 245.31, p < .001$		

Notes. CI = confidence interval; *OR* = odds ratio; SHSe = secondhand smoke exposure. The difference in fit from Model 1 to Model 2 is statistically significant $\chi^2_{(1)} = 197.62 - 92.81 = 4.81$, $p < .05$. The difference in fit from Model 1 to Model 3 is statistically significant $\chi^2_{(8)} = 245.31 - 192.81 = 52.5$, $p < .001$. The difference in fit from Model 2 to Model 3 is statistically significant $\chi^2_{(7)} = 245.31 - 197.62 = 47.69$, $p < .001$. Bold-faced values are statistically significant across all models in which they were included.
Numbers in cells are *OR*s adjusted for other covariates, associated two-sided probabilities, and 95% CI based on random intercept logistic regressions of complete home ban. Total sample *N* was 1,103 in San Diego, 398 in Tijuana, and 400 in Guadalajara, although the *N* for analysis was 1,554 after missing data were deleted in 374 sample clusters. Analysis was conducted using mixed model employing random intercepts based on primary sampling units. Rho, the intraclass correlation within each analysis, was equal to .04. A random intercept approach was used in analysis using primary sampling units. Cities of residence were dummy coded with San Diego serving as referent in this model.
[a]Model 1 includes demographics. Model 2 adds presence of children to Model 1. Model 3 adds the additional potential mediators to Model 2.

demographics, and reciprocal control for all mediator variables, Model 3 showed that nonsmokers, those with children in the home, more acculturated, an aversion to secondhand smoke, and those reporting antitobacco social pressure, were more likely to report complete smoking bans in the home. Presence of another person in the household who smokes was negatively associated with bans. The odds of a complete ban were weakened by 65% for Tijuana (Model 1 *OR* = .138 to Model 3

OR = .229) and by 148% for Guadalajara (Model 1 *OR* = .048 to Model 3 *OR* = .119), meeting mediation standards. Model 2 resulted in almost identical *ORs* for Tijuana and Guadalajara and home bans, as did Model 1, when controlling only for children (*OR* = 1.63). All theoretical mediators resulted in *OR*s in the expected direction, and all but two were significant when controlling for city, intraclass correlations, demographics, and one another. Bootstrap analyses were completed for each hypothesis tested using multivariate logistic regression modeling with 100 repeated samples using STATA version 12.1. Results confirmed the initial multivariable regression models shown in Table 3, providing evidence of reliable findings.

DISCUSSION

This study was predicated on theory and observations that California antitobacco culture and policies may have increased the unwillingness of the public in other states and countries to tolerate tobacco. These observations led to exploratory analyses of the degree to which the CTCP and resulting culture could influence populations across state and federal borders. Located directly across the border from San Diego, the city of Tijuana was expected to have greater exposure to antitobacco-related social contingencies that increasingly are part of the California culture, compared to the more distant city of Guadalajara. Our primary aim was to determine if theoretical mediators of home bans were related to differential rates of home bans by city after controlling for city cluster effects and demographic characteristics. Consistent with our hypotheses, we found the expected and statistically significantly higher prevalence of home bans in Tijuana relative to Guadalajara. These results are also consistent with our earlier report showing similar relationships for smoking in these cities (Martínez-Donate et al., 2008). The current and previous report offer evidence that social contingences can mediate two qualitatively different tobacco-related outcomes, smoking and home smoking bans. These findings suggest that policy and cultural change can lead to social contingencies that generalize across, and influence, multiple behaviors related to tobacco control.

These results suggest that the California antitobacco culture may be contagious and influence other cultures across national borders, regions, and languages. This "contagion" is especially important as it provides support for the work of World Health Organization Framework Convention on Tobacco Control and tobacco control worldwide.

The present results are also important because they suggest that exposure to social contingencies may be an important mechanism by which new norms are acquired and serve as the "policing" function that bring families to adopt antitobacco practices, including restricting all smoking in their home. This may be the primary mechanism by which the private microenvironment may be influenced while protecting the rights to privacy and avoiding invasive government intervention. Although we assume that government policies, taxation, and laws could magnify and even speed the adoption of antitobacco cultures, our results suggest that the difference in culture may be the antecedent for government change in promoting safety from tobacco risks as often as vice versa. Ultimately, when the density or prevalence of community members who are likely to avoid tobacco and criticize others for SHSe represents a majority, the likelihood increases that most smokers will routinely encounter criticism for smoking. This model suggests that when antitobacco sentiments become normative, they are likely to support government regulations that restrict the sale and use of tobacco, leading to synergistic antitobacco policies that reflect contingencies (e.g., taxation, fines) that define a more complete and powerful antitobacco culture (Glantz, 1993). Hovell and Hughes (2009) have suggested that engineering changes in culture that result in fewer and fewer microenvironments in which smokers can smoke, may be the most powerful means of preventing smoking population wide.

Taxation, media, and government restrictions on smoking in public settings have been associated with greater quit rates, lower initiation rates, and decreasing prevalence rates of smoking (Glantz, 1993; Goldman & Glantz, 1998; Levy, Mumford, & Gerlowski, 2007; Levy, Romano, & Mumford, 2005; Reed, Anderson, Vaughn, & Burns, 2008). These findings suggest that the most powerful means of reducing prevalence of smokers is culture change that includes policy regulations that increase costs and decrease smoking in public and private microenvironments. These cultural changes will lead to a high density of social reinforcement for avoiding tobacco and criticism for smoking around nonsmokers.

Government policies have not (and possibly should not) encroached on the private domain of family homes. This means that smokers, especially smokers under more pressure not to smoke at work or in other public venues, may smoke proportionately more in their home. Evidence for increased smoking in homes following public tobacco restrictions remains to be confirmed, but it appears plausible for smokers encountering cultures that discourage smoking community wide. This may lead to increased exposure to all family members, with special liabilities to nonsmokers, children, seniors, and the medically vulnerable (Matt, Bernert, & Hovell, 2008). To reduce harm from tobacco, home bans may provide important protection for both smokers and nonsmokers and may be critical for the medically vulnerable. Home bans may help smokers quit without formal clinical services or quit for longer following such services.

Promoting home bans specifically is critical for protecting nonsmokers. Even when a smoker quits, it is likely that their friends and other family members who smoke will remain sources of SHSe for both nonsmokers in the home and the former smokers. Indeed, SHSe from smoking friends and family may be one of the major reasons for former smokers to relapse. These social dynamics support promotion of complete bans in the home.

This study was based on a quasiexperimental design and reported measures, which raises concerns about measurement fidelity. Zhang and colleagues reported parental agreement on home smoking bans, suggesting such measures are reliable (Zhang, Martínez-Donate, Kuo, Jones, & Palmersheim, 2012). Our reported measures in other studies that included objective measures of SHSe have demonstrated cross-measure validity, suggesting that the present measures were reliable and valid, even if not without error (Hovell et al., 2009, 2011). This study also used proxy measures of social contingencies as mediators, and these were associated in the theoretically expected direction with complete home smoking bans, suggesting construct validity. Although we could not measure all possible contingencies, our measures have been employed in previous studies and were found to be reliable and predictive while also providing evidence of construct validity. Proxy measures, or markers, are

indirect measures of contingencies and are required because it is difficult to capture complete observational measures of complex social contingencies of reinforcement in free-living populations. Despite relying on markers of contingencies, almost all remained significant predictors of complete home smoking bans, except "former smoker" and "work bans," even when entered along with city, demographic variables, and interactions with each other. Only "former smoker" and "work bans" failed to reach significance. It is possible that "former smoker" could have reached significance if the definition had included a confirmation of cessation for 6 or more months. More importantly, introduction of theoretical mediators weakened the relative odds of complete bans in both Tijuana and Guadalajara compared to San Diego. This finding suggests powerful relationships between these social mediators and complete home smoking bans.

Since the *OR* for city remained significant in the context of these social contingencies, it is clear that a more complete set of mediators is yet to be identified in order to more fully explain how bans are created and sustained. Idiosyncratic exposure to physician advice, friends from California, or selected and antitobacco media might add to the social influences assessed in this study. Thus, mechanisms by which families adopt and enforce bans remain to be fully specified. This study was based on three representative probability cross-sectional surveys with cities selected purposefully to create a quasiexperimental design contrasting plausibly different exposures to antitobacco cultural contingencies. We did not measure all possible contingencies and we did not measure direct exposures to known or reported contingencies. We also did not obtain objective measures of exposure (e.g., cotinine assays). Thus, the inferential logic employed should be replicated with more direct measures of exposure to specific contingencies and environmental or biological markers of relative SHSe. Future studies that meet these additional fidelity standards will offer greater specification of theoretical causal processes, potentially confirming theory and enhancing population-level control of SHSe in private homes.

Using cross-sectional survey procedures raises concerns about the inability to determine temporal order between the contingencies hypothesized as leading to change in bans and the subsequent adoption of bans. We conducted analyses to explore possible temporal order issues concerning the presence of children. These analyses were conducted because children may be viewed as a demographic control for sampling bias, as a moderator of protobacco contingencies, or as a theoretical mediator of smoking bans based on presumed social contingencies that require parents to protect children from harm. Since we cannot guarantee temporal order, we relied on theory. In this case, we employed "children" as a possible moderating, control/predictive, and mediating variable. None of the interaction terms computed for theoretical moderators or for CVs reached significance and removed from our models. However, when "children" was included as a CV, an *OR* of about 1.6 was observed for bans, and controlling for this influence did not alter the relationships between Tijuana or Guadalajara compared to San Diego, for predicting home smoking bans. This result suggests that "children" is a marker for contingencies operating to support home bans but does not meet standards for moderation or mediation. Children appear to have an independent effect on home bans that generalized across participants in all three cities. Similar to "children," "former smoker" did not meet standards for mediation, because this variable was not significantly related to home bans. Thus, the mediational role of these variables remains to be confirmed in future trials that offer more direct measures of the social contingencies that former smokers and children may represent. For both of these variables, it may be critical to assess the *actual* social contingencies related to protecting children and the actual social behavior of former smokers that may be directed to supporting a home ban. It also may be critical to consider multiple roles for each of these variables, where they could serve as both moderators and mediators, depending on their occurrence in the causal temporal order. Absent longitudinal data it was not possible to test temporality in this study.

Kraemer and colleagues (2008) argue for more longitudinal and experimental studies that explicitly define the temporal order of candidate moderating and mediating variables. This recommendation is important, as most studies explore main effects with minimal a-priori and theoretically based attention to moderating or mediating functions. Kraemer and colleagues (2008) also note that a given moderator may also serve mediational functions and vice versa. Thus, the theoretical role and the temporal order of information must be considered carefully in order to plan appropriate research designs and interpret findings, as the same variable may serve a moderating role in one position in the temporal order and a mediating role in another position in the temporal order. By implication, this also means that cross-sectional studies that explore mediation, moderation, and control functions may be confounded when one measure of a given variable (e.g., children) can play multiple roles in an unmeasured causal sequence. Thus, results from this study and others like it, are under-specified and require confirmation by longitudinal designs that test a-priori causal models.

Although enhanced research design should provide greater specificity, including more information about temporal order, traditional longitudinal and experimental studies do not usually have financial support for testing cultural exposures occurring over decades, and should such support be forthcoming, the fidelity of decades-long cohort or experimental studies might be compromised by the logistic difficulties of long-term studies. The difficulties involved in high-fidelity designs for testing the effects of long-term cultural contingencies argues for the research community to replicate this type of study with stronger evidence of exposure and nonexposure, and with careful documentation of timing of initiation of bans in relation to exposure to contingencies, even if embedded in a cross-sectional design. For instance, replication of our findings for immigrants moving into or out of cultures that support bans might offer opportunities to show little change in home ban status for those not moving compared to those that immigrated, after controlling for demographic and confounding factors (Ayers et al., 2010a, 2010b). When the "bronze" standard of longitudinal studies and the "gold" standard of randomized clinical trials are not feasible, creative and high-fidelity cross-sectional studies that capitalize on "natural experiments" should be used to provide the best evidence for theoretically plausible relationships that can inform future tobacco control policies.

Conclusions

This article provides evidence of the transfer of an antitobacco culture across a national border to another city. Based on the BEM, results suggest that social contingencies are important public health mechanisms that might be engineered for tobacco

control in populations across nations. Reported findings can guide public health policies that aim to promote antitobacco cultures. This study also highlights the importance of natural experiments as an alternative to randomized trials to test long-duration cultural effects.

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DECLARATION OF INTERESTS

There are no competing interests for any of the authors.

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