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ORIGINAL PAPER

Moderators of Establishing a Smoke-Free Home: Pooled Data from Three Randomized Controlled Trials of a Brief Intervention

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Abstract

Interventions to create smoke-free homes typically focus on parents, involve multiple counseling sessions and blend cessation and smoke-free home messages. Smoke-Free Homes: Some Things are Better Outside is a minimal intervention focused on smokers and nonsmokers who allow smoking in the home, and emphasizes creation of a smoke-free home over cessation. The purpose of this study is to conduct moderator analyses using pooled data from three randomized controlled trials of the intervention conducted in collaboration with 2-1-1 contact centers in Atlanta, North Carolina and Houston. 2-1-1 is a strategic partner for tobacco control as it connects over 15 million clients, largely socio-economically disadvantaged, to social and health resources each year. A total of 1506 2-1-1 callers participated across the three intervention trials. Outcomes from 6 months intent-to-treat analyses were used to examine whether sociodemographic variables and smoking-related characteristics moderated effectiveness of the intervention in establishing full home smoking bans. Intervention effectiveness was not moderated by race/ethnicity, education, income, children in the home or number of smokers in the home. Smoking status of the participant, however, did moderate program effectiveness, as did time to first cigarette. Number of cigarettes per day and daily versus nondaily smoking did not moderate intervention effectiveness. Overall, the intervention was effective across socio-demographic groups and was effective without respect to daily versus nondaily smoking or number of cigarettes smoked per day, although smoking status and level of nicotine dependence did influence effectiveness.

Keywords Moderators · Secondhand smoke · Intervention · Tobacco control

Introduction

The widespread adoption of smoke-free policies in public settings has left the home as a major source of exposure to secondhand smoke among nonsmokers and children [1, 2]. With the exception of some multi-unit housing, household smoking rules are generally voluntary at the household level [3, 4]. Until recently, relatively few community-based interventions to promote smoke-free homes for both adults and children had been rigorously tested. Most intervention studies have focused on households with children, often with asthma, combine cessation and SHS reduction messages and have been relatively intensive with multiple counseling sessions [5–9]. Moderator analyses within the smoke-free homes intervention literature are rare despite the importance of understanding for whom these interventions work.

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Smoke-Free Homes

Some Things are Better Outside is a brief intervention that has been shown to be highly effective in promoting adoption of smoke-free home rules among low-income households in three randomized controlled trials (RCTs) [10–12]. The first RCT was an efficacy trial in which university staff delivered the intervention to clients of United Way of Greater Atlanta's 2-1-1 information and referral (I & R) center [10]. The second was an effectiveness trial in which 2-1-1 I & R specialists delivered the intervention to clients of United Way of North Carolina 2-1-1 [11]. The third was a generalization trial in which I &R specialists from the Texas/United Way Helpline Gulf Coast 2-1-1 delivered the intervention to a more ethnically diverse set of callers than in the two earlier trials [12]. 2-1-1 is a strategic partner for implementation of smoke-free home interventions given that 2-1-1 I &R specialists connect over 15 million clients to community social and health resources per year, with most of their clients socioeconomically disadvantaged, and therefore, more likely to smoke and less likely to live in a smoke-free home [13, 14]. All three trials documented significant intervention effects, with 40.0–62.9% of clients reporting a smoke-free home when reached for follow-up at 6 months post-intervention [10–12].

The current paper presents moderator analyses using pooled data from the three trials.

Given strong associations between sociodemographic characteristics, household composition and establishment of smoke-free home rules [15–17] we were interested to learn whether the intervention demonstrated similar levels of effectiveness across subpopulations.

Methods

The three trials were RCTs with 2-1-1 I&R specialists recruiting and enrolling callers between 2012 and 2015. Eligible participants allowed smoking in the home at baseline and either smoked and lived with ≥ 1 nonsmoker or child, or was a nonsmoker living with ≥ 1 smoker, were ≥ 18 years of age and could speak and understand English. Data collection was completed via telephone at baseline by 2-1-1 I & R specialists and by university staff at 3 and 6 months post-baseline. An online tracking tool was used to manage all aspects of data collection, participant contact, and intervention mailings across all trials and coaching calls in the effectiveness and generalization trials. Study protocols for the three RCTs have been approved by Emory University, University of North Carolina, and University of Texas Health Sciences Center Institutional Review Boards.

Intervention

The intervention included three sets of print materials mailed at 2 week intervals with a 15–20 min coaching call after the first mailing [10]. Based on social cognitive theory and stages of change, it uses persuasion, goal setting, modeling through a photo story, written and oral reinforcement and environmental cues (e.g., no smoking signs) to move participants through a five-step process for establishing household smoking rules. The coaching call focuses on goal setting tied to the five steps, and working through problem solving actual and anticipated barriers to creating smoke-free home rules.

Measures

Self-reported full home smoking ban, validated in the Atlanta trial, was the primary outcome, assessed using standard wording from the CDC Behavioral Risk Factor Surveillance System: "Which statement best describes the rules about smoking inside your home: smoking is not allowed anywhere inside your home; smoking is allowed in some places or at some times; smoking is allowed anywhere inside your home; or there are no rules about smoking inside your home" [18].

Covariates and potential moderators included smoking status, race/ethnicity, gender, household income, and household composition (i.e., number of smokers, number of children and adults). Household income, calculated household size, and year of baseline data collection were used to categorize participants as below or above federal poverty level. Number of cigarettes smoked per day and time to first cigarette were collected from smokers only. All measures were consistent across trials.

Data Analysis for Moderator Analysis

All analyses were run in SAS version 9.4. Differences among demographic and household characteristics across the three trials were conducted through chi square tests. Moderator analyses were conducted using logistic regression models using available data, i.e., listwise deletion modeling full versus no ban as the outcome. Models included an interaction effect for group assignment and the moderator of interest, while controlling for a direct effect of the intervention, the moderator, site effects, and an interaction between the intervention and site due to significant difference in intervention effectiveness across sites (Table 1). Moderator variables and categories are detailed in Fig. 1. To assess the impact of the coaching call, we used logistic regression models including only intervention participants, controlling for study site.

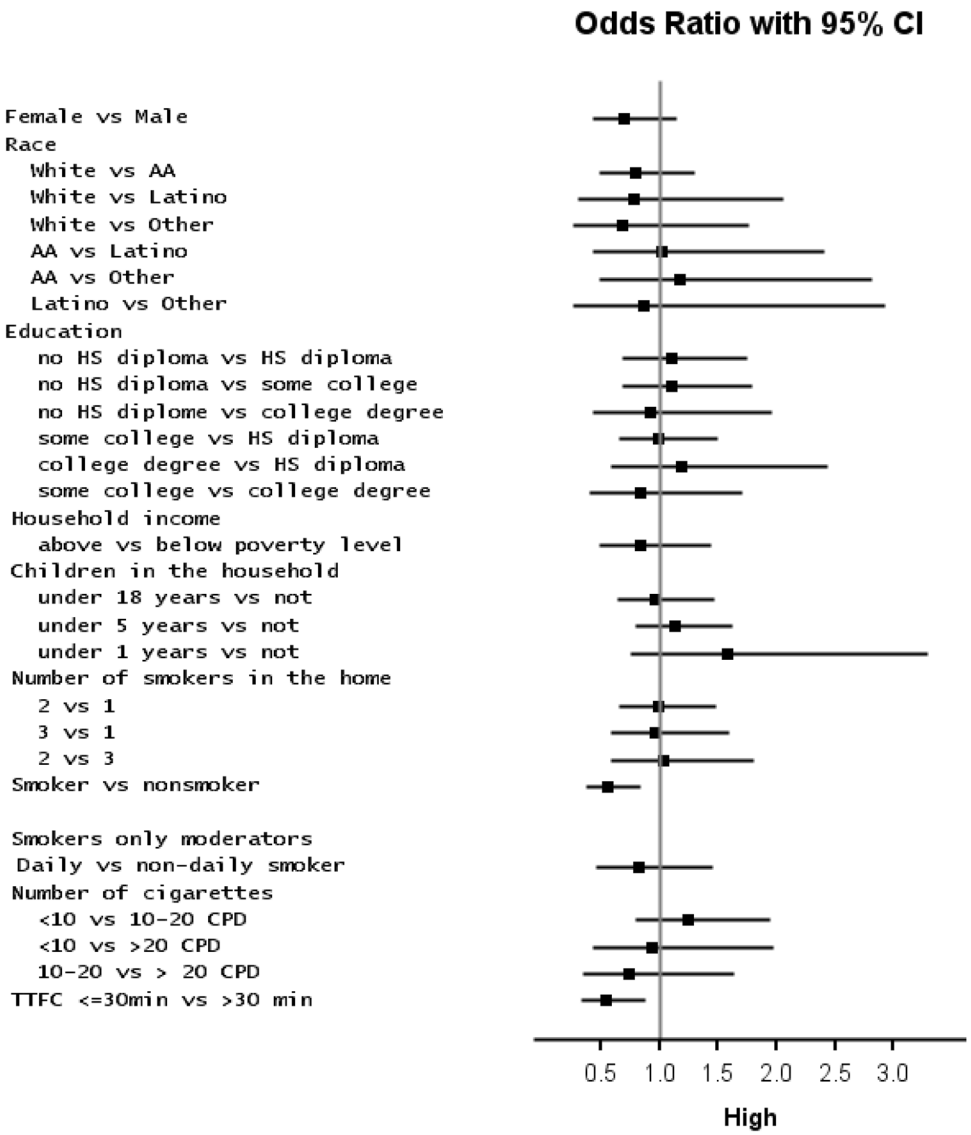
Table 1 Description of participants in three smoke-free homes trials

Characteristic	Atlanta		North Carolina		Texas		p-value
	N	(%)	N	(%)	N	(%)	
Demographics	498	100	500	100	508	100.0	
Gender							
Male	86	17.3	64	12.8	87	17.1	
Female	412	82.7	436	87.2	421	82.9	0.0875
Race/ethnicity							
White	57	11.5	151	30.8	96	18.9	
African American/Black	415	83.3	301	61.3	331	65.2	
Hispanic	8	1.6	6	1.2	61	12.0	
Other	18	3.6	33	6.7	20	3.9	< 0.0001
Employment							
Employed	117	23.5	162	32.4	146	28.7	
Unemployed/homemaker/retired/disabled/other	381	76.5	338	67.6	362	71.3	0.0072
Income							
Below federal poverty level	308	86.5	279	82.3	294	78.8	
Above federal poverty level	48	13.5	60	17.7	79	21.2	0.0237
Education							
Less than/some high school	124	24.9	99	19.8	109	21.5	
High school graduate/GED	197	39.6	181	36.2	213	41.9	
Vocational/technical school/some college	140	28.1	180	36.0	161	31.7	
College graduate or higher	37	7.4	40	8.0	25	4.9	0.0166
Marital status							
Not married, living w/partner	137	27.5	143	28.6	114	22.4	
Married	83	16.7	105	21.0	97	19.1	
Single	278	55.8	252	50.4	296	58.3	0.0471
	Mean	SD	Mean	SD	Mean	SD	
Age	40.2	10.87	39.7	11.65	41.1	12.65	0.7022
Household composition	N	%	N	%	N	%	
Number of smokers in the home							
1	248	50.0	240	48.0	388	76.4	
2	176	35.5	180	36.0	56	11.0	
3 or more	72	14.5	80	16.0	64	12.6	< 0.0001
Number of nonsmoking adults in the home							
0	173	34.7	205	41.0	129	25.4	
1	231	46.4	207	41.4	275	54.1	
2 or more	94	18.9	88	17.6	104	20.5	< 0.0001
Children in the home (yes reported)							
Children under 18 in the home	393	78.9	399	79.8	347	68.3	< 0.0001
Children under 5 in the home	192	38.6	179	35.8	166	32.7	0.1433
Children under 1 in the home	49	9.8	28	5.6	50	9.8	0.0205
Smoker characteristics	N	%	N	%	N	%	
Smoking status							
Nonsmoker	101	20.3	117	23.5	146	28.7	
Smoker	397	79.7	382	76.6	362	71.3	0.0066
Daily smoker	349	87.9	341	89.3	282	77.9	
Nondaily smoker	48	12.1	41	10.7	80	22.1	< 0.0001

Table 1 (continued)

Smoker characteristics	N	%	N	%	N	%	
Cigarettes per day							
1–10	225	56.8	196	51.4	226	62.6	
11–20	140	35.4	149	39.1	109	30.2	
More than 20	31	7.8	36	9.5	26	7.2	0.0491
Time to first cigarette	N	%	N	%	N	%	
Within 30 min	302	76.3	298	78.2	248	69.1	
More than 30 min	94	23.7	83	21.8	111	30.9	0.0112
Intervention effect							
6 month ITT odds ratio	1.56		1.72		2.19		

Statistical tests were chi-squared tests for categorical variables, *t* tests for continuous variables, and Kruskal Wallis test for ordinal variables



AA: African American; CPD: Cigarettes per day; TTFC: Time to first cigarette

Fig. 1 Moderators of smoke-free home intervention effectiveness

Results

Description of Study Participants and Trial Outcomes

Overall, participants were predominantly female, African American and low income (Table 1). There were significant differences in the participant profiles by trial across a range of demographic characteristics, including race/ethnicity, employment status, proportion living below the federal poverty level, education, marital status, and household composition by smoking status and presence of children. Among participants who smoked, there were significant differences in percentage of nondaily smokers, cigarettes per day, and time to first cigarette. Several of these differences are noteworthy. In the Atlanta trial, 83.3% of participants were African American, with 61.3% of North Carolina and 65.2% of Texas participants being African American. The Texas trial was the most ethnically diverse with 12.0% of participants Hispanic. Texas also had a higher proportion of households with just one smoker (76.4%) than did North Carolina (48%) and Atlanta (50%).

Moderation Analysis

Figure 1 presents odds ratios for the moderator analyses. None of the sociodemographic variables moderated intervention effectiveness, including race/ethnicity, education, income, children in the home or number of smokers in the home (Fig. 1). Smoking status of the participant, however, did moderate program effectiveness; participants who were smokers themselves were less likely to establish a household smoking ban than nonsmoking participants (OR 0.56, 95% CI 0.38, 0.84).

Among smokers only, participants who reported usually smoking their first cigarette less than 30 min from waking were less likely to establish a household smoking ban than those who smoked their first cigarette more than 30 min after waking (OR 0.54, 95% CI 0.33, 0.88). Number of cigarettes per day and daily versus nondaily smoking did not moderate intervention effectiveness.

The analysis modeling the impact of the coaching call on intervention participants did not show a statistically significant difference ($p=0.44$) in smoke-free home status in those who received the call ($N=477$, 89.3%) compared to those who were not reached ($N=57$, 10.7%).

Discussion

This paper examined whether sociodemographic characteristics and smoking-related variables moderated the effectiveness of a brief smoke-free homes intervention. Contrary to our expectations, the intervention was not more effective for higher income households, households with children or for a particular race/ethnicity. As expected, the intervention was more effective when the participant enrolled was a nonsmoker, or a smoker who did not smoke shortly after waking up in the morning. Nonsmokers are personally affected by SHS in the home and are likely more motivated to negotiate a smoke-free home than are smokers [19, 20]. Moreover, many of the smokers in the study were the only adult in the home and may not have had social pressure from other adults in the home to go smoke-free. Time to first cigarette also moderated intervention effectiveness, with those who had a short latency before smoking after waking and presumed more addicted, less likely to ban all smoking in the home. Similar to a moderation analysis conducted by Collins et al., we did not find that additional smokers in the home moderated effectiveness [6].

We did not find that completion of the coaching call moderated intervention effectiveness. This may be due to the high completion rate among those also reached for follow-up. Alternatively, it may be that the coaching call and the telephone-administered data collection interviews served a similar purpose. We observed a significant proportion of control group participants creating a smoke-free home (25.4–38.4%). Other recent intervention studies focused on smoke-free homes have similarly seen large changes in proportions of control group households establishing household bans and similarly speculated about reactivity to the data collection measures [7, 8, 21].

All study participants were recruited from 2-1-1 call centers, which generally serve a low-income population. We may have found moderation by sociodemographic characteristics if we had recruited a more socioeconomically diverse sample. However, given the concentration of smoking and SHS exposure in low-income populations, it is valuable to explore how a brief intervention may work within this high-risk population. Our moderator analyses shows the intervention was effective across socio-demographic groups, and most effective for nonsmokers and less addicted smokers.

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Compliance with Ethical Standards

Conflict of interest The authors have no conflicts of interest to report.

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