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## ORIGINAL ARTICLE

## Prevalence of behaviors related to cigarette-caused fires: a survey of Ontario smokers

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See end of article for authors' affiliations

Correspondence to:  
Dr R J O'Connor,  
Department of Health  
Behavior, Division of Cancer  
Prevention and Population  
Sciences, Roswell Park  
Cancer Institute, Elm and  
Carlton Streets, Buffalo, NY  
14263, USA; richard.  
oconnor@roswellpark.org

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**Objective:** To identify the prevalence and correlates of behaviors related to the risk of cigarette-caused fires.  
**Design and setting:** Random-digit-dialed telephone survey in Ontario, Canada, July–September, 2005.

**Subjects:** 596 current cigarette smokers.

**Outcome measures:** Prevalence of fire-risk events and behaviors such as burning clothing or objects in the home, leaving lit cigarettes unattended, dozing while smoking, and smoking in bed and correlates of these behaviors. Respondents were also asked if they ever worry about cigarette-caused fires.

**Results:** One in four smokers admitted to leaving lit cigarettes unattended in the last 30 days, while 15% admitted to smoking while in bed. Leaving lit cigarettes unattended was independent of demographic, socioeconomic or nicotine dependence indicators, but was related to worry about burning other persons with a cigarette (OR 1.72, 95% CI 1.04 to 2.85) and smoking inside the home (OR 2.98, 95% CI 1.66 to 5.35). Persons who were not white (OR 3.97, 95% CI 1.80 to 8.80), aged 18–24 years (OR 3.75, 95% CI 1.41 to 9.96), who had high nicotine dependence (OR 9.13, 95% CI 2.22 to 37.52) and worried about burning objects in their home (OR 2.43, 95% CI 1.31 to 4.52) were more likely to smoke in bed. 10 (1.7%) smokers reported having ever had a fire in their home started by a cigarette.

**Conclusions:** Smokers engage in behaviors such as smoking in bed and leaving lit cigarettes unattended that may place them at an increased risk of cigarette-caused fires. As governments move to regulate cigarette ignition propensity, it is important to establish surveillance for behaviors related to fire risk.

Cigarette smoking is a leading cause of fires that cause injuries and deaths across the globe.<sup>1</sup> For example, in Canada between 1980 and 1999 there were 3929 smoking-material fires, which resulted in 278 injuries and 67 deaths. This translates to 7.1 injuries and 1.7 deaths for every 100 smoking-material fires.<sup>2,3</sup> Therefore, the risks from smoking-material fires represent a significant public health concern. In June 2004, New York State became the first jurisdiction in the world to regulate cigarette ignition propensity, requiring reduced ignition propensity (RIP) cigarettes in an effort to reduce the number of smoking-material fires.<sup>4</sup> On 1 October 2005, Canada became the first country in the world to enact such regulations.<sup>5,6</sup> Early results from New York State RIP law evaluations show a reduction in cigarette-caused fires with little adverse effect on consumer's smoking patterns or behaviors.<sup>7–9</sup>

Most cigarette-caused fires begin when a smoldering cigarette ignites a mattress or bedding.<sup>10</sup> Therefore, smoking while in bed is an identifiable risk factor for having a cigarette-related fire. Similarly, mishandling of lit cigarettes may facilitate ignition of a fuel source, such as upholstered furniture or carpets, as traditionally manufactured cigarettes continue to burn when left unattended.<sup>11</sup> Thus, previous incidents such as burning furniture or clothing might serve as markers of future fire risk.

The cigarette industry has argued that RIP regulations may cause a false sense of security among smokers, encouraging careless handling of cigarettes and perhaps unintentionally encouraging fire-risk behaviors like smoking in bed.<sup>12</sup> There are few empirical data to support such a claim and data on the extent of such fire-risk behaviors are limited; nevertheless, regulators have cited these concerns as a potential barrier to ignition-propensity legislation.<sup>13</sup> In 2006, Health Canada released results from their 2005 Canadian Tobacco Use

Monitoring Survey which, for the first time, recorded fire-risk data. They reported that 12% of current smokers had smoked in bed in the past week, and 10% of smokers had fallen asleep with a lit cigarette at least once, 24% of these in the past year.<sup>14</sup> This study was undertaken to explore these, as well as other cigarette-caused fire risk behaviors and events, and their correlates in a random sample of smokers in Ontario before the Canadian RIP law was implemented.

## METHODS

A random digit dialed (RDD) telephone survey of adult smokers living in the Province of Ontario, the most populous province in Canada (approximately 39% of the total population) was initiated.<sup>15</sup> The survey was conducted between 5 July and 3 September 2005 using an RDD list obtained from ASDE Survey Sampler (Gatineau, Quebec, Canada), a geographically stratified random sampling generated a sample of random numbers distributed across all eligible blocks in proportion to their density of listed telephone households (ie, Random B).<sup>16</sup> With a target number (n) of 600, the survey was designed to have 87% power to examine changes over time in key items, with an effect size of eight percentage points. This translates to a relative odds ratio of 1.4 using McNemar's test (as the survey is designed for two waves, pre- and post-law).

Eligible participants were those aged  $\geq 18$  years who had smoked 100 cigarettes in their lifetime, and who were currently smoking everyday or on some days. Respondents were compensated C\$15 in appreciation for their time completing the 15 min survey. The protocol received ethics clearance from the Roswell Park Cancer Institute Institutional Review Board.

**Abbreviations:** HSI, Heaviness of Smoking Index; RDD, random-digit-dialed; RIP, reduced ignition propensity

## Participants and response rate determination

This paper examines 596 smokers recruited for the main survey. An additional 54 smokers were recruited from the same sampling frame for a test–retest evaluation of selected survey items (described below). Survey response rate was computed using the Response Rate 4 method of the American Association for Public Opinion Research.<sup>17</sup> A total sample of 10 000 household phone numbers was used. There were 8213 households categorized as ineligible (eg, no smokers aged >18 years; communication barriers; non-residential number), a further 842 numbers were retired when a live person was not reached after repeated attempts. There were 295 refusals by eligible respondents. Of households with unknown eligibility, we assumed that 14.9%, or 125, would have contained eligible smokers. We arrived at 14.9% by selecting the midpoint between the prevalence of smoking in Ontario (19%)<sup>14</sup> and the percentage of smoking households found in the current RDD study (10.8%). Finally, 650 smokers completed the survey. Thus, response rate was 650/(650+295+125), or 61%.

## Survey items

The survey was designed to assess a range of tobacco-use behaviors to establish a baseline from which to assess changes due to the introduction of RIP cigarettes in Canada. Validated survey items used in the International Tobacco Control Four Country Survey assessed smoking behaviors, purchasing patterns and quitting behaviors.<sup>18</sup> A set of items (table 1) was developed for this study to assess fire-risk behaviors based on the literature on cigarette-caused fires, and was tested for understanding on a small group of smokers (n = 11) before fielding the survey.

We performed a test–retest reliability check of our fire-risk measures among 54 smokers in Ontario. These smokers completed the same baseline survey, and then 2 weeks later completed a shortened version featuring the key fire-risk-related measures. In all, 45 smokers completed both the initial survey and the 2-week follow-up (83%). Overall, agreement (percentage giving the same answer at both interviews) and Phi coefficient values for selected items are shown in table 1. Our incident measures (eg, cigarettes go out, burned clothing or furniture, started a fire) showed high consistency across 2 weeks, with acceptable phi coefficient values.

**Table 1** Agreement and Phi coefficient values for key survey items, Reduced Ignition Propensity Survey test–retest evaluation, Ontario, Canada, 2005 (n = 45)

Item	Agreement (%)	Phi
Do you ever smoke inside your home?	91.1	0.81
Have you ever scorched or burned furniture with a cigarette?	93.3	0.84
Have you ever dozed off or fallen asleep while smoking a cigarette?*	95.6	0.83
Have you ever scorched or burned your clothes with a cigarette?	86.7	0.73
Has a cigarette ever started a fire in your home?	97.8	0.70
Have you ever smoked a cigarette in bed?	84.4	0.68
Do you ever worry about starting a fire with a cigarette?	80.0	0.40
Do you ever worry about burning yourself with a cigarette?	88.9	0.24
Do you ever worry about burning others around you with a cigarette?	84.4	0.44
Do you ever worry about burning objects in your home with a cigarette?	91.1	0.62

\*Combination of two items ("dozed off" and "fell asleep"), which had substantial overlap.

Data were analyzed using SPSS V.13.0 software. Statistical analyses include means and percentages to describe fire-risk behaviors, and cross-tabulations and logistic regression to identify correlates of fire-risk behaviors. For skewed dependent variables, non-parametric Wilcoxon and Kruskal–Wallis tests were used. We calculated post-stratification weights by age (three categories) and gender (two categories), based on the distributions of smokers in Ontario in the 2003 Canadian Community Health Survey,<sup>19</sup> and all analyses were performed on weighted data (results were similar when data were unweighted).

## RESULTS

### Respondent characteristics

Respondents were 596 current cigarette smokers residing in Ontario, Canada. The mean age of participants was 43.8 (SD14.3, range 18–82) years. A total of 91% (n = 542) participants were daily smokers. Table 2 shows other respondent characteristics.

### Worry about fires

Of the smokers interviewed, 22.3% expressed any worry about starting a fire with a cigarette, 12.7% worried about burning themselves with a lit cigarette, 22.7% worried about burning other people with a lit cigarette and 19.0% expressed worry about burning objects in their home with a cigarette. Overall, 45.7% of smokers reported at least one of the worries, but only 1.6% reported that they worried about all four. Reporting at least one worry was associated with greater age (p<0.02), greater alcohol use (p<0.03), and fewer minutes to the first cigarette after waking (p<0.03), but was not significantly associated with sex, race/ethnicity, education, income or type of residence. Only 5 (0.8%) smokers reported having no smoke detector in their home; 80.4% reported having 1–3 detectors in their home, whereas the remainder (18.8%) reported having ≥4 detectors.

### Cigarette-caused fires and fire events

Of the 596 Ontario resident smokers surveyed, 10 (1.7%, 95% CI 0.8 to 2.3) reported "Yes" to ever experiencing a fire in their home that was started by a cigarette. Of these 7 were able to put the fire out by themselves, and 4 reported that the fire department came to their home because of the fire. None of them reported having experienced multiple fires. None of these incidents had occurred in the past 30 days; two incidents had occurred in the past year, and eight occurred >1 year ago. We also examined what might be termed "near-fire" events, that is burning clothes or furniture which, if not dealt with quickly, could have become fires. Burning clothes with a lit cigarette was reported by 48% of smokers in their lifetime, with 7.5% reporting such an event in the past 30 days. Burning furniture was less frequent, with lifetime prevalence of 29%, and 2.6% reporting burning furniture in the last 30 days. Because of the small number of fires and low rates of these fire events, we lacked the statistical power to examine correlates.

### Fire-risk behaviors

Figure 1 shows the lifetime and 30-day prevalence of four fire-risk behaviors—leaving lit cigarettes unattended, dozing off while smoking, falling asleep while smoking and smoking in bed. Leaving cigarettes unattended and smoking in bed were particularly common, especially in the 30 days preceding the survey, while smokers were less likely to admit to dozing off or falling asleep while smoking.

### Correlates of fire-risk behaviors

We examined demographic, socioeconomic, and smoking behavior correlates of engaging in the two most commonly reported fire-risk behaviors: leaving lit cigarettes unattended

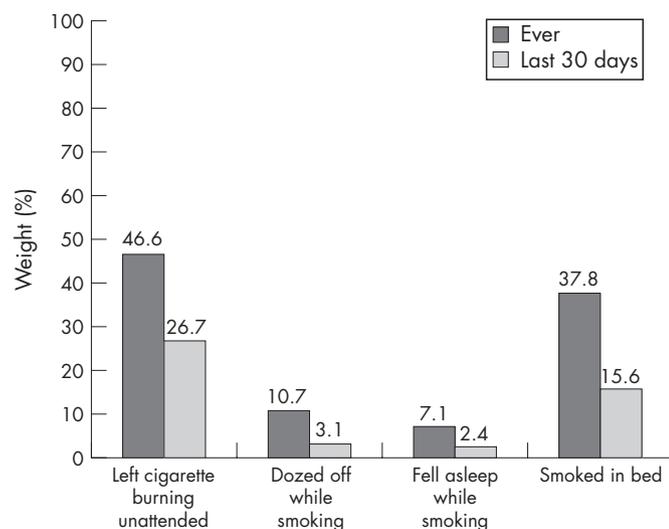
**Table 2** Demographic and smoking behavioral characteristics of respondents, Reduced Ignition Propensity Survey, Ontario, Canada, 2005 (n = 596)

Basic demographics	n	(%)	Smoking behaviors	n	(%)
Sex (one refused)			Cigarettes per day		
Male	283	54.9	1–10	189	32.5
Female	312	45.1	11–20	248	41.3
Age category (years)			21–30	119	19.5
18–24	58	14.2	>31	40	6.7
25–39	170	31.7	Minutes to first cigarette		
40–54	231	35.9	0–5	128	20.8
>55	137	18.2	6–30	233	38.5
Race/ethnicity			31–60	126	21.3
White	538	88.8	>60	109	19.3
Other	58	11.2	Smoking behavior at home		
SES indicators			Never smoke inside	228	40.9
Level of education			Sometimes smoke inside	169	28.6
Less than HS	81	13.7	Always smoke inside	199	30.6
HS graduate	215	35.5			
Some university/technical	179	30.3			
University Graduate +	121	20.5			
Income (C\$)					
<30 000	127	23.3			
30 000–60 000	161	29.1			
60 000–90 000	143	28.2			
>90 000	100	19.4			
Refused	40				
Type of residence					
House	455	76.6			
Apartment	120	20.5			
Other	18	2.9			
Rent or own					
Rent	202	35.2			
Own	366	59.4			
Other	26	5.5			

HS, high school; SES, socioeconomic status.

Percentages weighted to Ontario smoker population's age and gender.

and smoking in bed (table 3). We chose to examine correlates of engaging in these two behaviors in the last 30 days as this should be most reflective of current behavior. Those who customarily smoked inside their home and those who worried about burning other people with a cigarette were more likely to admit to having left a cigarette unattended in the last 30 days. Leaving cigarettes unattended was not significantly related to

**Figure 1** Lifetime and 30-day prevalence of fire-risk events among current smokers, Ontario, Canada, 2005. Percentages weighted to Ontario smoker population's age and gender.

demographics, socioeconomic status, alcohol use, worry about burning objects in the home or indicators of cigarette dependence. For smoking in bed, race/ethnicity, income, and age emerged as risk factors, with non-whites, those with a yearly income of C\$30 000–60 000, and those aged 18–24 years all nearly three times more likely to report smoking in bed in the last 30 days. Other income levels (ie, <C\$30 000 and C\$60 000–90 000), while not achieving statistical significance, also showed elevated odds of smoking in bed relative to the highest income group, suggestive of an overall trend. At the same time, those with the highest Heaviness of Smoking Index (sum of categorized cigarettes per day and time to first cigarette)<sup>20</sup> scores (ie, 5 or 6) had much higher odds of smoking in bed in the last 30 days. In contrast, reported worry about burning others with a cigarette was associated with lower odds of smoking in bed, while reported worry about burning objects was associated with significantly increased odds of smoking in bed. The two worry items did not show a significant interaction in a separate model ( $p > 0.60$ ; data not shown). Smoking in the home was omitted from the “smoking in bed” model for logical reasons: of those who said they “Never” smoke inside their home, only 2.2% ( $n = 5$ ) reported smoking a cigarette in bed in the last 30 days, compared with 18.3% of those who “Sometimes” smoke inside their home, and 25.6% of those who “Always” smoke inside their home ( $p < 0.001$ ).

## DISCUSSION

Cigarette smoking is an important cause of fire-related injuries and deaths in Canada.<sup>2–8</sup> However, there have been few studies on fire-risk behaviors among smokers. This study describes the results of a random-digit-dialed telephone survey of current smokers in Ontario, Canada, just before the implementation of

**Table 3** Demographic and behavioral correlates of leaving cigarettes unattended and smoking in bed

	Leaving cigarette unattended				Smoking in bed			
	n	%	Adjusted OR*	95% CI	n	%	Adjusted OR	95% CI
Age (years)								
18–24	58	23.8	0.78	0.34 to 1.79	58	29.4	3.75	1.41 to 9.96
24–39	168	27.3	0.87	0.46 to 1.66	170	12.7	1.59	0.68 to 3.74
40–54	231	26.6	0.84	0.46 to 1.51	231	14.6	1.42	0.64 to 3.13
>55	136	28.7	REF		137	11.1	REF	
Sex								
Male	282	28.9	1.31	0.84 to 2.05	283	16.6	0.95	0.55 to 1.62
Female	310	24.3	REF		312	14.5	REF	
Race/ethnicity								
White	536	25.9	REF		538	14.9	REF	
Other race/ethnicity	57	34.8	1.25	0.63 to 2.51	58	20.9	3.97	1.80 to 8.80
Education								
Less than HS	80	24.7	1.08	0.54 to 2.17	81	18.3	1.04	0.46 to 2.35
HS graduate	214	22.7	REF		215	18.5	REF	
More than HS	299	23.1	1.48	0.75 to 2.94	300	18.5	1.12	0.49 to 2.54
Income								
<C\$30K	126	35.0	1.24	0.60 to 2.54	127	20.8	2.69	0.94 to 7.68
30–60K	160	21.4	0.67	0.35 to 1.28	161	19.2	3.15	1.20 to 8.29
60–90K	142	22.3	0.56	0.30 to 1.03	143	15.2	2.13	0.81 to 5.60
>C\$90K	100	32.0	REF		100	6.8	REF	
Rent/own								
Rent/other	384	27.1	1.38	0.83 to 2.31	385	12.5	0.91	0.51 to 1.64
Own	206	26.7	REF		209	21.5	REF	
Alcohol use last 30 days								
None	163	26.8	REF		164	16.7	REF	
Some days	363	28.4	1.31	0.79 to 2.19	365	15.3	1.21	0.66 to 2.20
Daily	55	21.4	0.72	0.31 to 1.70	55	12.5	0.79	0.26 to 2.35
HSI								
0	83	21.3	REF		85	11.0	REF	
1	63	21.0	1.01	0.40 to 2.53	63	8.1	0.62	0.15 to 2.65
2	123	24.6	1.36	0.62 to 2.98	124	13.5	1.97	0.68 to 5.69
3	136	26.0	1.29	0.59 to 2.82	136	14.4	2.46	0.88 to 6.88
4	100	34.0	1.56	0.68 to 3.56	100	15.0	2.79	0.94 to 8.22
5	65	36.5	1.65	0.66 to 4.14	65	30.2	6.19	2.01 to 19.05
6	23	22.7	0.69	0.18 to 2.68	23	36.4	9.13	2.22 to 37.52
Smoking at home								
Never	227	20.7	REF		—	—	—	—
Sometimes	168	24.7	1.50	0.85 to 2.63	—	—	—	—
All the time	198	37.0	2.98	1.66 to 5.35	—	—	—	—
Worry about burning other people								
Yes	135	36.3	1.72	1.04 to 2.85	135	10.4	0.36	0.17 to 0.76
No	457	24.1	REF		460	17.2	REF	
Worry about burning objects in home								
Yes	113	39.8	1.56	0.92 to 2.63	113	23.0	2.43	1.31 to 4.52
No	481	23.9	REF		482	13.7	REF	
Number of smoke detectors (continuous)	—	—	0.95	0.79 to 1.15	—	—	0.83	0.65 to 1.05

HS, high school; HSI, Heaviness of Smoking Index.

\* ORs adjusted for all covariates listed in the table.

Canada's RIP law. The results suggest that smokers in Ontario are not particularly worried about cigarette-related fires, although many smokers admit to engaging in behaviors that may increase the occurrence of cigarette-caused fires, such as burning furniture or clothing, falling asleep while smoking, smoking while in bed, or leaving lit cigarettes unattended. Smoking while in bed or leaving lit cigarettes unattended were particularly prevalent in the last 30 days, suggesting that these behaviors are fairly common among smokers.

Of those surveyed, only 10 (1.7%) smokers reported having had experienced a fire in their home started by a cigarette, with

the majority of these fires not generating a response from the fire department. This low rate is consistent with larger national surveys assessing fire risks, such as the British Crime Survey.<sup>21</sup> Many cigarette-caused fires seem to go unreported to fire departments, and thus may not be reflected in official fire statistics. One might infer that the effect of the Canadian RIP law could be greater than the statistics of fire department suggest, if those statistics reflect only a portion of actual fires.

Leaving lit cigarettes unattended was the most commonly reported fire-risk behavior, with nearly half of smokers admitting to leaving lit cigarettes unattended, and one in four

doing so in the last 30 days. Those who worried about cigarette fires were actually significantly more likely to engage in the behavior, suggesting that the behavior may be driving the worry, rather than vice versa. Leaving lit cigarettes unattended seemed to be independent of sociodemographic and smoking behavior covariates, with the exception of rules about smoking at home. Those who reported “always” smoking at home were three times as likely to leave cigarettes unattended. These findings may be indicative of a “self-exempting” belief that a cigarette fire “won’t happen to me,” akin to smokers’ beliefs that they will not have lung cancer or other smoking-related illnesses.<sup>22 23</sup>

Smoking in bed was strongly associated with heaviness of smoking, suggesting that this behavior could be a marker of nicotine dependence. Indeed, one of the items on the Fagerstrom Test for Nicotine Dependence is “Do you smoke if you are so ill you are in bed all day?”<sup>24</sup> Smoking in bed is particularly dangerous from the standpoint of fire ignition, in that bedding and mattresses are often the first materials ignited in fires.<sup>10 25</sup> Why racial/ethnic minorities, younger people and those with lower incomes were more likely to report smoking in bed is unknown and could represent an avenue of future investigation, as well as potential targets for public health or fire safety interventions.

Intuitively, one might expect education, living situation and/or alcohol use to be related to fire-risk behaviors, as they do predict actual fire risk.<sup>11 25 26</sup> However, the data suggest that, at least in this sample, there is no significant relationship between these indicators of socioeconomic status and fire risk behaviors.

Limitations are the same as for any cross-sectional telephone survey. Although we attempted to obtain a truly random sample of smokers, some biases in response to telephone surveys inevitably occur. Our sample reflects the bias towards participation of women in telephone surveys,<sup>16</sup> and is somewhat older and had less minority participation. Also, as a caveat, behaviors of Ontario smokers may not necessarily be reflective of Canadians in general. Although most of our measures showed acceptable to good test-retest reliability in our small reliability study, the items require further validation. Our response rate, while only 61%, is typical of current telephone survey work, which is experiencing diminishing cooperation and response rates.<sup>27 28</sup> This proportion was also a function of the short survey field time (approximately 8 weeks), owing to the need to finish collecting any baseline data several weeks before the law came into effect (to account for the possible early introduction of complaint cigarettes to the market).

These data show that smokers in Ontario, Canada, engage in behaviors that place them at increased risk of cigarette fires, such as leaving cigarettes unattended or smoking in bed, with surprising frequency. As more governments implement laws aimed at reducing the ignition propensity of cigarettes,<sup>29</sup> it is important to establish surveillance of such behaviors so that behavioral changes in response to regulations might be evaluated. Indeed, Health Canada is assessing smoking in bed and leaving cigarettes unattended in its evaluation of the Canadian RIP law, and our findings are generally consistent with their baseline estimates. A follow-up survey of this cohort, underway as of this writing, will help to examine the effect of the ignition propensity standards on fire-risk behaviors and outcomes among smokers in Ontario.

### Implications for prevention

Cigarette-caused fires represent a significant proportion of fire-related deaths and injuries, so much so that Canada and many US states (New York, Vermont, California, Illinois and New Hampshire) have enacted laws regulating the ignition propensity of cigarettes. In addition, the US Fire Administration had

### Key points

- Approximately 25% of smokers admitted to leaving lit cigarettes unattended in the last 30 days
- Approximately 15% of smokers admitted to smoking while in bed in the last 30 days
- Leaving lit cigarettes unattended was independent of demographic, socioeconomic or nicotine dependence indicators, but was related to worry about fires and smoking inside the home
- Persons who were younger, not white, and who had high nicotine dependence were more likely to smoke in bed
- Significant numbers of smokers in Ontario, Canada, engage in behaviors that may place them at increased risk of cigarette fires
- As governments move to regulate cigarette ignition propensity, it is important to establish surveillance for behaviors related to fire risk.

issued a report on mitigating behavioral antecedents of cigarette-caused fires, focusing on consumer messages.<sup>25</sup> They recommend messages related to types of ashtrays, favoring RIP cigarettes, not smoking in homes with oxygen tanks, checking furniture for discarded butts and making sure butts are truly extinguished when finished smoking. The findings of this study, however, suggest that messages discouraging smoking while in bed and leaving lit cigarettes unattended may be more important, as significant numbers (15–26%) of smokers engage in these behaviors in the last 30 days. As governments move to adopt ignition propensity regulations and/or enact educational campaigns around the issue of cigarette-caused fire prevention,<sup>25 29</sup> it may be important to establish surveillance of fire-risk behaviors to evaluate the effect of these programs on smoker behavior.

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### Authors' affiliations

**R J O'Connor, J E Bauer\*, G A Giovino†, A Hyland, K M Cummings,** Department of Health Behavior, Roswell Park Cancer Institute, Buffalo, New York, USA

**D Hammond,** Department of Health Studies & Gerontology, University of Waterloo, Waterloo, Ontario, Canada

**G T Fong,** Department of Psychology, University of Waterloo, Waterloo, Ontario, Canada

\*Now with Statistics & Evaluation Center, American Cancer Society, Atlanta, Georgia, USA

†Now with Department of Health Behavior, State University of New York at Buffalo, Buffalo, New York, USA

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