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## Changes in Smoking-Related Symptoms during Enforced Abstinence of Incarceration

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### Abstract

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**Background**—Tobacco use among prisoners is much higher than among the general population. Little is known about changes in smoking-related symptoms during periods of incarceration. The objective of this study is to evaluate changes in smoking-related symptoms during incarceration.

**Methods**—We recruited 262 inmates from a tobacco-free prison. At baseline, participants were asked about smoking-related symptoms prior to incarceration and then asked about recent symptoms.

**Results**—All symptom scores on the American Thoracic Society Questionnaire (ATSQ) improved during incarceration. Higher ATSQ scores were associated with asthma, depressive symptoms, stress, higher addiction and more pack years of smoking. Greater improvement in symptoms was not associated with smoking status after release.

**Conclusion**—Forced tobacco abstinence leads to significant improvements in smoking-related symptoms. However, improvements in symptoms are not associated with smoking behavior changes. Addressing changes in symptoms during incarceration will require further evaluation in smoking cessation interventions for incarcerated populations.

### Keywords

Smoking cessation; public health; disparities; prison

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Tobacco smoking remains the leading cause of preventable death in America, claiming 450,000 lives annually.<sup>1</sup> Efforts to reduce tobacco use in the United States (U.S.) have generally taken the form of tax policy, restrictions on smoking in private and public settings,<sup>2</sup> education, and advertising campaigns. Policies also compel sustained forced abstinence from tobacco in certain settings. The U.S. military, for example, prohibits smoking during basic training<sup>3</sup> and on all submarines.<sup>4</sup> Long-term mental health facilities, once well-established settings for smoking, have developed restrictions on tobacco use.<sup>5,6</sup> In addition, approximately 60% of U.S. correctional facilities have total tobacco bans and an additional 27% have indoor tobacco bans.<sup>7</sup>

When allowed, smoking among prison and jail inmates is estimated to be 60–80%, compared with 20% in the general population, and each year an estimated 12% of all smokers in the U.S. leave correctional institutions.<sup>8</sup> In the absence of interventions, previous smokers released from jail were found to report abstinence rates of only 37% the first day after release and just 3% six months later.<sup>8</sup>

Important work has been conducted to assess how inmates adjust to and view forced abstinence from smoking.<sup>9–11</sup> However, we found no studies on changes in smoking-related symptoms over time during enforced smoking abstinence and such changes have an impact on remaining tobacco-free after release. The overall burden of tobacco in a corrections population, the overall prevalence of incarceration in general, and the opportunities for intervention make such an investigation important as a matter of both individual health and public policy.

The Rhode Island Department of Corrections (RI DOC) banned tobacco use in 2003 with no tobacco product allowed anywhere on site by inmates or staff. In the context of this

established policy and using a well-validated respiratory instrument,<sup>12</sup> we investigated participants' self-reported smoking-related symptoms for the time immediately prior to incarceration and during the past two weeks while incarcerated. This was done as part of a smoking cessation<sup>13</sup> using personalized feedback that targeted negatives of smoking (respiratory difficulty) and positives of not smoking (respiratory improvement) in order to motivate continued abstinence after release. Therefore, the aims of this study were to assess if smoking-related physical symptoms or change in symptoms are associated with plans to remain abstinent from smoking, priority of smoking cessation, and sustained abstinence following release from incarceration. We hypothesized that symptoms would improve during incarceration and that greater improvement in symptoms would be associated with plans to remain abstinent from smoking after release and remaining abstinent after release.

## Methods

### Study site

The Rhode Island Department of Corrections (RI DOC) is a unified correction system serving as a combined prison and jail and holds all pretrial and sentenced inmates in the state. The average daily population is about 3,000 men and women, most (69%) of whom have been charged with nonviolent crimes.<sup>14</sup> Approximately 69% return to the community within six months.

This paper includes data from an intervention study called "Project WISE" (Working Inside for Smoking Elimination). Project WISE is a randomized clinical trial evaluating an intervention (the WISE intervention) to increase sustained tobacco abstinence after release from incarceration. Details of this study are described elsewhere.<sup>13</sup> The study was approved by the Institutional Review Board of Memorial Hospital of Rhode Island, the Office for Human Research Protections, and the RI DOC.

### Participant recruitment

Potential participants were recruited by research assistants (RAs) in the housing units at the RI DOC-sentenced women's facilities and men's medium security facility. No tobacco products are allowed anywhere on site by inmates or staff, a rule that is strictly enforced. Research assistants identified themselves as research staff and informed potential participants that study participation was completely voluntary and confidential and would not affect probation or parole status. Research assistants called soon-to-be-released inmates to a private area to tell them about the study. Individuals interested in participating were screened for eligibility (18 years or older, smoked at least 10 cigarettes per day in the 30 days prior to incarceration, spoke English, and were scheduled to be released within eight weeks of study enrollment). If eligible and willing to participate in the study, the informed consent process was completed (study explained, consent form read to the individual, questions answered, and forms signed). Audio Computer-Assisted Self-Interviews (A-CASI) was used to collect information.<sup>15</sup>

With A-CASI, survey respondents listen to questions on headphones, see them on a computer screen, and answer them directly on the computer. An RA was available to assist

in case of technical difficulties and to answer participant questions. All study information was kept confidential and not shared with RI DOC staff. The assessment took approximately 60 minutes and was completed prior to any intervention activities. Participants then had an in-person follow-up three weeks after released from prison during which their smoking status was assessed.

Recruitment occurred from March 2010 to July 2011. A total of 312 inmates were approached; 273 (87.5%) met the eligibility criteria, and 262 (96%) agreed to participate. An additional 15 participants were excluded because they were not released by the completion of the study (n=6) or did not complete the baseline assessment (n=9) leaving a final sample size of 247.

## Measures

Questionnaires were administered with A-CASI at baseline and three weeks post-release. At the three-week post release follow-up, smoking status, days to first cigarette, and the number of cigarettes smoked daily was assessed. Plans to remain tobacco abstinent were assessed with a single question (“Which ONE statement BEST describes your plans for smoking?”) scored on a six-point scale that was dichotomized. Not planning to remain abstinent responses ranged from “I plan to smoke when I get out of here and I never plan to quit” to “I will probably smoke when I get out of here;” planning to remain abstinent responses ranged from “I probably won’t smoke when I get out of here” to “I have made plans to not smoke when I get out and I will never smoke again.” To measure the priority of smoking cessation, participants were asked, “If you were to make a list of all the things you think or worry about, where would smoking fall on this list?” They were given four response options: “top of the list,” “middle of the list,” “bottom of the list,” and “not on the list.” Nicotine dependence was assessed using the Fagerstrom Test for Nicotine Dependence (FTND);<sup>16</sup> however, because participants do not have access to cigarettes during incarceration, the timeframe was changed to reflect the period just prior to incarceration. *Pack-years* of smoking was defined as years of smoking minus years in prison multiplied by the number of packs of cigarettes smoked per day prior to incarceration. Participants were asked about other drug use using the Addiction Severity Index (ASI), and a new variable (“smoked other drugs prior to incarceration”) was created from this which included the smoking of any drug listed in the ASI during the 30 days prior to incarceration.<sup>17</sup> Depressive symptoms were measured using the 10-item short form of the Center for Epidemiologic Studies Depression Scale (CESD).<sup>18</sup> The Perceived Stress Scale (PSS) was used to measure stress.<sup>19</sup> Asthma history was assessed by self-report. Time since last cigarette was assessed by the question, “How long has it been since you smoked daily?” While the answer to this question is most likely to equal the length of incarceration, we used this measure because people may smoke while in minimum security work-release. Smoking status was assessed at the three-week post-release follow-up using the Timeline Follow-Back<sup>20</sup> technique. The number of cigarettes smoked on each day since release from prison was recorded, and then a urine cotinine test was performed on all participants. Participants were counted as non-smokers if they reported no smoking in the past seven days and had a negative urine cotinine test.

Smoking-related symptoms were measured using the eight-item American Thoracic Society Questionnaire (ATSQ).<sup>12,21</sup> First, participants were asked about the frequency of their symptoms for the two weeks just before they were incarcerated. Next, they were asked the same set of questions for the two weeks of incarceration just prior to the interview. Response options ranged from 1=Never, 2=Less than once per week, 3=1–2 times per week, 4=Several times per week, to 5=Every day.

## Analyses

The sample population was characterized using descriptive statistics—means and standard deviations for continuous variables and counts and percentages for categorical variables. Item cohesiveness for the ATSQ at each time point was assessed using Cronbach's alpha. Total symptoms scores were calculated by summing the responses to the ATSQ for each time point. A change score was calculated by subtracting the total ATSQ for the in-prison timeframe from the pre-incarceration timeframe. We examined in-prison ATSQ and the change in ATSQ scores by participant demographics, smoking-related measures, and participant stress and depression measures. Analysis of variance (ANOVA) was used to test the association between the ATSQ scores and categorical variables (treatment group, race/ethnicity, average daily number of cigarettes smoked prior to incarceration, participation in-prison drug treatment program, incarceration longer than six months). In analyses where the homogeneity of variance assumption was violated, a Kruskal-Wallis test was used to examine the ATSQ scores by the categorical variables. Pearson correlations were used to examine the association of the ATSQ scores with continuous variables (CESD, PSS, FTND score).

In addition, we also examined the impact ATSQ scores would have on smoking outcome (smoking status at three weeks post-release, days to first cigarette, number of cigarettes smoked per day after release, and plans to remain abstinent upon release). Logistic regression was used to model categorical outcomes (smoking status at three weeks post-release and intentions to remain abstinent). Days to first cigarette and number of cigarettes smoked per day were examined using linear regression. Initial models only included symptom scores to examine the unadjusted association of symptoms on our smoking outcomes. A second level of regression analysis was conducted to examine the added impact of symptoms after adjusting for a number of variables that have been previously shown to predict smoking outcomes in this sample.<sup>22</sup> These covariates include treatment group, average number of cigarettes per day prior to incarceration, ethnicity, participation in a drug treatment program while in prison, and length of incarceration longer than six months. All analyses were performed using IBM SPSS Statistics for Windows, version 20.0 (Armonk, NY).

## Results

Participant demographic characteristics are displayed in Table 1. One-sixth of the participants remained abstinent at three weeks after release. The Cronbach's alphas for the ATSQ scores for the prior to incarceration and in-prison timeframes were 0.88 and 0.91 respectively. All symptoms from the ATSQ revealed a significant improvement from prior to

incarceration to the in-prison (smoke free) timeframe (Table 2). The smallest differences were noted in “getting very tired in a short time” and “pain or tightness in the chest.” The greatest changes were noted in “cough first thing in the morning” and “phlegm production.”

In-prison ATSQ scores and changes in ATSQ scores were not associated with gender, education, age, plans to quit smoking, or time since the respondent had smoked regularly. Participants reporting asthma had higher ATSQ scores in prison than nonasthmatics, but showed no greater improvements in ATSQ scores than people without asthma. Depression and stress were also associated with higher in prison ATSQ scores but not with changes in ATSQ scores. Higher FTND scores and pack-years were associated with higher in-prison ATSQ and greater improvements in ATSQ.

Three variables were associated with greater improvements in ATSQ scores but not in-prison ATSQ scores. Participants who smoked other drugs prior to incarceration had greater improvement in overall symptom scores (decrease in scores by  $-9.1$  vs.  $-7.6$ ) than people who did not report smoking other drugs. Level of “worry” about smoking was also not associated with in prison ATSQ scores, but greater improvements in ATSQ scores were associated with higher levels of worry about smoking. Those placing smoking at “the top of the list” of things they worry about had a decrease in ATSQ scores of  $-12.1$ , while those stating that smoking was “not on the list” of things they worry about had a smaller change in ATSQ scores of  $-5.6$  ( $p < .001$ ). Changes in ATSQ scores and in prison ATSQ scores were not associated with any of the smoking outcomes (smoking status, days to first cigarette or number of cigarettes smoked) three weeks after release even after covariate adjustment in the regression models (see Table 3).

## Discussion

This is the first report to document significant improvements in smoking-related symptoms among smokers experiencing enforced tobacco abstinence. When study participants were asked about smoking-related symptoms (retrospectively) just prior to incarceration and the two weeks just prior to the interview (in-prison tobacco-free), there were significant improvements in every ATSQ symptom. So even when asked about symptoms retrospectively participants are recalling and reporting fewer symptoms during this smoke-free period.

While changes in symptoms were not associated with any of the post-release smoking variables or plans to quit smoking, there was a strong linear association with those most worried about smoking and reporting the greatest level of symptom improvement. This did not extend to changes in smoking practices after release from prison but suggests that people notice changes in smoking-related symptoms and that it is not baseline symptoms but rather levels of improvements that are associated with worrying about smoking. It is possible change in physical symptoms is a factor that can be used in motivating people to sustain tobacco abstinence after release. While basic military training is only six weeks it is likely that this population also notes significant changes in physical symptoms and it may be valuable to study symptom changes as a motivation to quit smoking in that population.

The symptoms of “getting very tired in a short time” and “pain or tightness in the chest” are more general than the other symptoms of the ATSQ and improved the least. It is possible that those may be secondary to the stress or anxiety of incarceration. Both PSS stress scores and CES-D depression scores were associated with higher in-prison ATSQ scores but not with changes in ATSQ scores. Because PSS and CES-D only used a timeframe of the past two weeks, we cannot assess for changes in stress and depression from the period prior to incarceration. However, symptoms of stress and depression are likely to increase during incarceration and given the improvements of “getting very tired in a short time” and “pain or tightness in the chest,” it is likely that stress and depression have little impact on the ATSQ scores. Conversely, increased respiratory symptoms may cause increases in stress and depressive symptoms.

The mean length of time since the last cigarette and entering the prison was 1.5 years (SD 3.4) and there were no significant differences in baseline symptoms or changes in symptoms by length of incarceration. Even though data are collected retrospectively, and participants are experiencing non-voluntary tobacco abstinence, they reported significant improvements in ATSQ that were not influenced by the recall incarceration time.

This analysis has several limitations. First we did not assess plans to quit smoking again after the ATSQ questions were administered as the responses to the ATSQ questions may have influenced plans to quit smoking. Second this was part of a randomized controlled trial of a smoking cessation intervention which utilized changes in physical symptoms as a motivator to quit smoking and the study was not powered to examine differences in smoking cessation by level of symptom improvement. Symptoms were reported retrospectively; however, time since last smoked regularly was not associated with level of symptoms or changes in symptoms. Finally, results may be related to the order of questions administered. Participants were asked questions in the following order: 1st plans to quit smoking, 2nd symptoms during the 2 weeks before they were incarcerated, 3rd symptoms during the past 2 weeks and 4th worry about smoking. Answering questions about symptoms may have caused those with greater symptom improvements to rank smoking higher on the list of things that they worry about.

Even though our hypothesis was not born out (i.e., symptomatic change was not associated with smoking intentions) results may still be useful for intervention purposes. We recommend raising inmate awareness of improved symptoms in order to raise concern about health risk behaviors such as smoking. Although this did not affect smoking after release, it may be a step towards motivating people to remain smoke-free after release. This is consistent with some conceptualizations of behavior change interventions that motivate people to change by helping them recognize their own reasons and need to change.<sup>22</sup> More work is needed on factors that contribute to return to smoking, even when concern has been raised, and how to remedy such factors. Clearly smoking bans alone do not lead to substantial decreases in smoking after release. Smoking bans should be accompanied by interventions to encourage continued tobacco abstinence after release.

## Acknowledgments

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**Table 1**

**PARTICIPANT DEMOGRAPHICS AND RESPIRATORY SYMPTOMS**

	Total N (%)	In Prison /tobacco free ATSQ score (SD)	Changes in ATSQ score (In prison minus 2 weeks before prison) (SD)
Gender			
Male	162 (65.2)	12.7 (7.1)	-8.87 (7.64)
Female	86 (34.8)	12.5 (5.7)	-8.22 (8.64)
Race			
White	127 (52.0)	12.4 (6.6)	-9.57 (7.90)
Non-white	117 (48.0)	12.9 (6.7)	-7.63 (8.00)
Education			
Less than high school	157 (64.6)	13.1 (6.8)	-8.91 (7.93)
high school	49 (20.2)	11.8 (6.1)	-9.00 (8.70)
More than high school	37 (15.2)	12.2 (6.7)	-6.70 (7.04)
Asthma			
No	185 (77.1)	11.6 (5.6) ***	-8.68 (7.62)
Yes	55 (22.9)	15.8 (8.7)	-8.73 (9.37)
Smoked other drugs prior to incarceration			
No	80 (32.4)	12.58 (6.9)	-7.61 (8.64) *
Yes	167 (67.6)	12.7 (6.5)	-9.12 (7.66)
Worry about smoking			
Top of the list	61 (25.4)	13.5 (7.5)	-12.13 (9.81) ***
Middle of the list	108 (45.0)	12.4 (6.1)	-8.86 (7.27)
Bottom of the list	46 (19.2)	11.3 (6.0)	-5.46 (5.12)
Not on the list	25 (10.4)	12.9 (6.5)	-5.560 (6.21)
Plans to quit			
Low	126 (51.2)	12.7 (6.1)	-8.1 (7.69)
High	120 (48.8)	12.5 (7.1)	-9.3 (8.30)
Smoking Status 3 weeks post release			
Not smoking	40 (16.2)	13.4 (7.5)	-7.5 (8.7)
Smoking	207 (83.8)	12.5 (6.5)	-8.9 (7.9)

	Mean (SD)	Corr	Corr
Age	35.6 (9.2)	0.05	.03
Addiction score (FTND)	5.1 (2.3)	** .19	*** -.26
Pack Years	20.8 (15.9)	** .19	* -.15
Days to first cigarette	6.88 (9.25)	0.05	0.05
Average # of cigarettes in the past 7 days	8.48 (9.02)	-0.02	-0.04
Time in prison/time since last cigarette	1.5 (3.4)	0.06	0.07
Depression score (CES-D)	12.7 (5.4)	*** .24	-0.06
Stress Score (PSS)	21.8 (6.3)	* .14	-0.07

\* p-value <.05  
 \*\* p-value <.01  
 \*\*\* p-value <.001

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**Table 2**

## ATSQ INDIVIDUAL ITEM SCORES

	Prior to Prison	In- Prison	Difference *
Cough first thing in the morning	2.92	1.68	-1.24
Cough frequently throughout the day	2.73	1.68	-1.05
Wheezing	2.36	1.5	-.86
Shortness of breath when walking	2.74	1.79	-.95
Shortness of breath during exercise or walking up stairs	3.15	2.14	-1.01
Phlegm or mucus <i>brownish liquid you may cough up</i> when you cough	2.7	1.56	-1.14
Pain or tightness in the chest	2.14	1.53	-.61
Getting very tired in a short time	2.86	2.07	-.79
Total Score	21.28	12.64	-8.64

Scores: 1=Never; 2=Less than once per week; 3=1-2 times per week; 4=Several times per week; 5=Everyday

Total range 8-40

\*  
p-value for all <.001

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REGRESSION MODELS USING CHANGE IN ATSQ SCORE AND IN-PRISON ATSQ SCORE AS PREDICTOR

Table 3

*Table A. Categorical Outcomes*

Model	In-prison ATSQ Score			Change in ATSQ Score		
	b (SE)	p-value	OR (95% CI)	b (SE)	p-value	OR (95% CI)
Remains abstinent						
Crude	0.020 (0.025)	.414	1.02 (0.97–1.07)	0.022 (0.023)	.347	1.02 (0.98–1.07)
Treatment adjusted model	0.028 (0.026)	.273	1.03 (0.98–1.08)	0.030 (0.024)	.213	1.03 (0.98–1.08)
Fully adjusted model <sup>a</sup>	0.026 (0.028)	.357	1.03 (0.97–1.09)	0.024 (0.028)	.390	1.02 (0.97–1.08)
Plans to remain abstinent						
Crude	-0.005 (0.016)	.788	1.00 (0.96–1.03)	-0.019 (0.016)	.231	0.98 (0.95–1.01)
Treatment adjusted model	-0.006 (0.019)	.764	0.99 (0.96–1.03)	-0.020 (0.016)	.215	0.98 (0.95–1.01)
Fully adjusted model <sup>a</sup>	-0.014 (0.021)	.512	0.99 (0.95–1.03)	-0.024 (0.017)	.172	0.98 (0.94–1.01)

*Table B. Categorical Outcomes*

Model	In-prison ATSQ Score			Change in ATSQ Score		
	b (SE)	p-value	b (SE)	p-value	b (SE)	p-value
Average # cigarettes/day at 3 weeks post incarceration						
Crude	0.004 (0.085)	.967	-0.026 (0.069)	.702		
Treatment adjusted model	0.001 (0.083)	.997	-0.042 (0.067)	.532		
Fully adjusted model <sup>a</sup>	-0.025 (0.082)	.756	-0.005 (0.067)	.946		
# Days to 1st cigarette post incarceration						
Crude	0.077 (0.100)	.440	0.053 (0.080)	.506		
Treatment adjusted model	0.087 (0.098)	.375	0.073 (0.078)	.351		
Fully adjusted model <sup>a</sup>	0.082 (0.097)	.394	0.053 (0.078)	.496		

<sup>a</sup>Covariates include treatment group, ethnicity, average daily number of cigarettes smoked prior to incarceration, participation in-prison drug treatment program, incarceration greater than 6 months