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## Cigarette smoking and subsequent risk of suicidal ideation among National Guard Soldiers

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### Abstract

**BACKGROUND**—Suicide rates are alarmingly high among military personnel, and particularly Army National Guard soldiers. Smoking is also disproportionately common in the military. In this study, we intend to investigate the relationship between cigarette smoking and suicidal ideation among a representative sample of national guard soldiers.

**METHODS**—A representative sample of Ohio Army National Guard soldiers were followed prospectively and information was gathered on smoking, suicidal ideation and depression at baseline and one year later.

**RESULTS**—Smoking at baseline was associated with significantly increased likelihood of suicidal ideation at follow-up (OR=2.0 (1.3, 3.2)). This association persisted after adjusting for demographics and history of depression at baseline, but was no longer statistically significant after adjusting for depression at follow-up.

**LIMITATIONS**—Measurement of smoking was somewhat limited.

**CONCLUSIONS**—Army National Guard soldiers who smoke have a greater risk of subsequent suicidal ideation. Depression concurrent with suicidal ideation appears to explain this relationship. If these results are replicated, screening of soldiers who smoke may be recommended as a proactive step towards mitigating the high risk of suicide in military personnel.

### Keywords

military; smoking; suicide; epidemiology; depression

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#### CONTRIBUTORS

RG and SG conceived of the study, RG wrote original manuscript, MP conducted the statistical analyses, MT, JC and IL collected data and contributed to the interpretation of results and manuscript writing.

#### CONFLICT OF INTEREST

The authors report no conflicts of interest.

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## INTRODUCTION

Military populations are at high risk for suicidal behavior and suicide rates in the military continue to rise (Kuehn, 2009). Suicide rates in the US military have increased in recent years, and the most dramatic increase has been among Army National Guard members (Griffith, 2012). Suicide rates in the Army National Guard are now higher than rates among active duty army personnel (U.S Army Office of the Chief of Public Affairs, 2010).

Smoking is also disproportionately prevalent among soldiers (Smith and Malone, 2009). Cigarettes were included as part of meal rations during World War I and II and the Vietnam War (2010). It was not until the early 1970s that the United States (US) Department of Defense issued policies aimed at preventing and treating substance abuse; by 1975 cigarettes were no longer rationed to soldiers (Ames et al., 2007, 2010). Trend data show that over the past 28 years cigarette smoking in the US military has decreased; however, the prevalence of cigarette smoking has remained higher among military personnel compared to the general population: approximately 32% of active duty military personnel are smokers compared to 21% of US adults (Bray and Hourani, 2007).

Results from numerous epidemiologic studies have consistently documented a strong association between cigarette smoking and suicide-related outcomes among adults in the community (Breslau et al., 2005; Kessler et al., 2007; Kessler et al., 2009). Only one study has examined this relationship among military personnel. Miller and colleagues (2000) found that smoking was associated with completed suicide among active duty male army soldiers. The study did not consider key potentially mediating factors, such as depression.

Since that study, several things have changed. Active military conflicts over the past decade have led to increased military personnel; each year the US military brings in 300,000 new recruits. Since the start of Operation Iraqi Freedom and Operation Enduring Freedom, National Guard members have been called upon increasingly to serve in combat situations. As of January 2010, there were over 1.1 million active duty personnel serving in the four branches of the US military and 131,066 personnel serving in the National Guard. National Guard members are a distinct and sizable subset of the military, increasingly relied upon for active duty deployments. However, compared with active/full-time military, relatively little is known about mental health risks in this group. In addition, National Guard members are outside the support structures provided to regular military personnel and are, therefore, exposed to an especially heavy burden of chronic civilian stressors post-deployment (e.g., family conflict, job loss) without the benefit of adequate resources to cope with such stressors. Finally, as noted above, the rate of suicide among National Guard members has increased substantially in the past few years (Griffith, 2012).

To our knowledge, no previous study has examined the potential impact of smoking on subsequent suicide-related outcomes in a reservist population. The current study examined the relationship between smoking and subsequent risk of suicidal ideation in 2010 in a representative sample of Army National Guard soldiers.

## METHODS

### Study population and survey

Data were drawn from the Ohio Army National Guard Mental Health Initiative (OHARNG MHI). The OHARNG MHI is a longitudinal cohort of Ohio Army National Guard Soldiers who are interviewed annually to assess mental health, substance use and life experiences. All soldiers were asked to participate in the study with the option to opt out. Between June

2008 and February 2009, 11,212 soldiers did not opt out of the study, and accurate contact information was available for 58.1% of participants (n=6,514). This group was further reduced to a final baseline sample of 2,616 after eligibility, language proficiency, and desire to participate were taken into account; survey response rate was 43.2%. Participants were contacted for follow-up interviews in November of 2009, within 12 months of their original interview, and given 12 months to respond. 67.7% of the original 2,616 soldiers responded to follow-up surveys (n=1,770). This study included the 1,770 soldiers who participated in both baseline and follow-up surveys. After giving written informed consent, soldiers participated in computer- assisted telephone interviews that obtained information on mental health, substance use, military experiences, and life events history. The investigation was carried out in accordance with the latest version of the Declaration of Helsinki. The study design was reviewed by University of Michigan and Case Western IRB and informed consent of the participants was obtained after the nature of the procedures had been fully explained.

Our main dependent variable of interest was whether or not an individual reported having suicidal thoughts, or thoughts of being better off dead or wanting to hurt themselves, at some point between the baseline survey and the follow-up survey. Suicidal ideation was assessed via the question from the Patient Health Questionnaire-9 (PHQ-9) which asked if individuals ever thought of harming themselves or that they would be better off dead (Kroenke et al., 2001).

Our main independent variable of interest was whether or not individuals reported that they smoked within 30 days of the baseline survey. Smoking status was also recorded at follow-up assessing if participants reported smoking at any point between their baseline and follow-up survey.

Other covariates included presence of suicidal behavior at baseline and depression at baseline, smoking status at follow-up and depression at follow-up, and age and gender. Depression was assessed using the Patient Health Questionnaire-9 (Kroenke et al., 2001). To have had a history of depression at baseline, individuals had to have at least 2 co-occurring symptoms at some point in the past (Kroenke et al., 2001). To have depression at follow-up, the individual had to have had the same number of symptoms but they must have occurred between the baseline survey and follow-up survey. A concurrent clinical reappraisal conducted with the OHARNG MHI found the PHQ to be highly specific, when compared to clinician- administered interviews (Calabrese et al., 2011). The presence of the conditions (Yes vs No), gender (female vs. male) and age were included as indicator variables (18–24 (reference), 25–34, 35–44, 45+).

### Statistical analysis

First, for everyone who completed a baseline and follow-up survey (N=1770), we compared the distribution of suicidal ideation at follow-up according to baseline and follow-up characteristics using bivariable logistic regression. Second, we used multivariable logistic regression to estimate the relation between smoking status at baseline, and suicidal ideation at follow-up. We ran three multivariable models: (a) we adjusted for potential confounders including age and gender, (b) we adjusted for possible confounders of the effect of baseline smoking on subsequent suicidal ideation including age, gender, depression at baseline and suicidal thoughts at baseline, and (c) to isolate the effect of smoking on subsequent suicidal ideation, we used logistic regression adjusting for age, gender, suicidal ideation at baseline, depression at baseline, smoking status at follow-up and depression at follow-up. We also performed a mediation analyses with the third model (c) examining the mediation effects of smoking and depression during follow-up. Finally, we performed sensitivity analysis using the PHQ-8, omitting the suicidal ideation question from the PHQ-9. All analyses were carried out using SAS 9.2.

## RESULTS

The distribution (number (%)) and the association (crude odds ratio, 95% CI) of suicidal ideation at follow-up by baseline and follow-up characteristics is shown in Table 1. 30.5% of the sample reported smoking at baseline, the majority of the sample was male (86.1%) and below the age of 35 (64.3%). At baseline, 21.2% of soldiers had a lifetime history of depression and 10.2% had a history of suicidal ideation. At follow-up, 29.6% of soldiers smoked, 12.3% had depression in the past year, and 4.2% reported suicidal ideation in the past year. In bivariable associations, smoking status at baseline was associated with suicidal ideation at follow-up (crude odds ratio COR=2.01, 95% confidence interval CI: 1.3–3.2). In addition, history of depression at baseline (COR=5.1, 95% CI: 3.2–8.2), suicidal ideation at baseline (COR=8.0, 95% CI: 4.9–13.0), smoking status at follow-up (COR=2.2, 95% CI 1.4–3.6), and depression at follow-up (COR=19.2, 95% CI: 11.5–32.1) were all associated with suicidal ideation at follow-up.

The adjusted associations (adjusted odds ratio AOR, 95% CI) for the effect of smoking status at baseline and subsequent suicidal ideation are presented in Table 2. Adjusting for age and gender, those who smoked at baseline were more likely to have suicidal thoughts at follow-up (AOR=2.0, 95% CI: 1.3–3.2). However, this effect was not robust and was minimal once we controlled for depression (AOR=1.1, 95% CI: 0.5–2.7) and smoking at follow-up. Sensitivity analysis excluding suicidal ideation as a symptom of depression did not show any differences from these findings (data not shown).

## DISCUSSION

The prevalence of suicide in Army National Guard members has been increasing since 2006 and in 2010 exceeded the rate among active duty army personnel (Griffith, 2012). Suicidal ideation is a significant predictor of future suicide behavior, but is also associated with substantial impairment and distress even when it does not lead to suicide behavior (Olfson et al., 1996). To our knowledge, this is the first study to examine the relationship between smoking and subsequent suicidal ideation in a National Guard population. Our results suggest that active smoking is associated with increased suicidal ideation at follow-up among National Guard soldiers.

There are a number of plausible explanations for this association. One possibility is that smoking leads to increased depression that then increases the risk of suicidal ideation. There is a well-documented relationship between cigarette smoking and increased levels of inflammation (Garbin et al.). A relationship between major depression and inflammation is also well-documented (Glover et al., 2009; Halder et al., 2010; Miller, 2010; Miller et al., 2009; Pace and Miller, 2009; Su et al., 2009). It is thought that the release of specific inflammatory markers and activation of the immune system may be related to the pathophysiology of depression potentially via the effects of cytokines on specific regions of the brain (Pace and Miller, 2009). Major depression is the strongest known risk factor for suicide behavior (Fawcett et al., 1987), and suicide ideation is so entwined with depression that it is part of the diagnostic criteria for major depression (American Psychiatric Association, 1994). As such, it is reasonable to postulate that inflammation may be related to suicide behavior through similar pathways. Our data support this pathway (i.e., that depression is a mediator of the relationship). It is also conceivable that the relationship is due to other common causes that we could not evaluate in this study. While it is not possible to definitively identify the mechanism in this study and some studies have suggested that the association between smoking and suicide-related outcomes may be due to confounding (Hemmingsson and Kriebel, 2003; Smith et al., 1992), the potential importance of smoking

as a screen in evaluating suicide risk in this high risk group is clearly supported by our findings.

This study has several limitations that should be considered when interpreting our results. First, we did not have measures of suicide attempt or completion. Suicidal ideation is highly correlated with these behaviors (Beck et al., 1999; Brown et al., 2000; Kessler et al., 2009; Mann et al., 1999), and one study of male active-duty army soldiers found a link between smoking and suicide though this study did not adjust for depression (Miller et al., 2000). Future studies that can take depression and other mental disorders into account while examining the relationship between smoking and other suicide-related outcomes over time in various military populations are needed. Second, although there is no reason to believe that Ohio Army National Guard members are systematically different from other reservists nationwide, it is possible that our findings may not be generalizable to other National Guard and/or active military personnel. Therefore, additional studies in these vulnerable populations should be carried out toward replicating these results. Third, our ability to test potential mechanisms of the relationship between smoking and suicidal ideation was limited. Future studies in military samples will be needed to examine potential mechanisms of these relationships.

If these findings are replicated, future screening efforts that include an assessment of active smoking behavior may suggest National Guard members at greater risk of suicidal ideation, and potential suicidality.

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**Table 1**

Distribution of selected characteristics in the total sample and association of suicidal thoughts in the follow-up survey.

Characteristics	Total sample (number (%))	Those with suicidal ideation at follow-up (number (%))	COR (95% CI)
Smoked at baseline			
No	1228 (69.5)	40 (3.3)	1
Yes	538 (30.5)	34 (6.32)	2.01 (1.26–3.21)
Gender			
Male	1520 (86.1)	59 (3.9)	1
Female	246 (13.9)	15 (6.1)	1.6 (0.90–2.88)
Age			
18–24	552 (31.3)	26 (4.7)	1
25–34	582 (33.0)	22 (3.8)	0.80 (0.45–1.43)
35–44	438 (24.8)	17 (3.8)	0.82 (0.44–2.53)
45+	193 (10.9)	9 (4.7)	0.99 (0.46–2.15)
History of depression at baseline			
No	1391 (78.8)	33 (2.4)	1
Yes	375 (21.2)	41 (10.9)	5.1 (3.2–8.2)
History of suicidal thoughts at baseline			
No	1583 (89.6)	42 (2.7)	1
Yes	180 (10.2)	32 (17.8)	8.0 (4.9–13.0)
Smoked at follow-up			
No	1244 (70.4)	39 (3.1)	1
Yes	522 (29.6)	35 (6.7)	2.2 (1.4–3.6)
Depression at follow-up			
No	1549 (87.7)	24 (1.6)	1
Yes	217 (12.3)	50 (23.0)	19.2 (11.5–32.1)
<b>Total</b>	<b>1766</b>	<b>74 (4.2)</b>	

**Table 2**

Adjusted association between the covariates of interest and suicidal ideation after one year of follow-up.

	AOR (95% CI)	Total Effect AOR (95% CI)	Direct Effect AOR (95% CI)
Smoked at baseline			
No	1	1	1
Yes	2.01 (1.25–3.22)	1.69 (1.03–2.77)	1.11 (0.46–2.70)
Gender			
Male	1	1	1
Female	1.58 (0.88–2.87)	1.32 (0.71–2.45)	1.17 (0.60–2.29)
Age			
18–24	1	1	1
25–34	0.84 (0.47–1.51)	0.80 (0.43–1.46)	0.67 (0.34–1.30)
35–44	0.95 (0.50–1.79)	0.95 (0.49–1.85)	0.89 (0.44–1.81)
45+	1.16 (0.53–2.54)	1.04 (0.46–2.36)	1.07 (0.45–2.53)
History of depression			
No		1	1
Yes		2.74 (1.58–4.73)	1.37 (0.77–2.45)
History of suicidal thoughts			
No		1	1
Yes		4.64 (2.65–8.12)	4.17 (2.32–7.50)
Smoked at follow-up			
No			1
Yes			1.57 (0.65–3.79)
Depression at follow-up			
No			1
Yes			13.2 (7.56–23.0)
<b>–2 Log likelihood</b>	<b>603.0</b>	<b>535.5</b>	<b>445.2</b>