Cigarette Smoking and Suicide: A Prospective Study of 300,000 Male Active-duty Army Soldiers

Matthew Miller,[1] David Hemenway,[1] Nicole S. Bell,[2,3] Michelle M. Yore,[4] and Paul J. Amoroso[4]

The authors examined the relation between cigarette smoking and suicide by conducting a cohort study of 300,000 male US Army personnel followed prospectively from January 1987 through December 1996 for 961,657 person-years. They found that the risk of suicide increased significantly with the number of cigarettes smoked daily (p for trend < 0.001). In multivariable-adjusted analyses, smokers of more than 20 cigarettes a day, compared with never smokers, were more than twice as likely to commit suicide. For male active-duty army personnel, the dose-related association between smoking and suicide was not entirely explained by the greater tendency of smokers to be White, drink heavily, have less education, and exercise less often. *Am J Epidemiol* 2000;151:1060–3.

cohort studies; military personnel; prospective studies; smoking; suicide; tobacco

In the United States, suicide is the third leading cause of death among adult men aged 18–44 years (1) and in the military (2), where it accounts for 13 percent of all fatalities. Several risk factors for suicide are more common in smokers than in nonsmokers, including depression, alcohol consumption, social isolation, cancer, and White race (3–6). Four possible explanations (7, 8) for the smoking-suicide connection are as follows: 1) depression (a risk factor for suicide) leads to smoking as a form of self-medication (9); 2) smoking leads to depression by altering brain chemistry (10); 3) smoking leads to lung cancer (11–13), which increases the risk of suicide; and 4) smoking and suicide are not causally related (14); rather, some persons are predisposed to both. Of the prospective studies that have examined the relation between smoking and suicide (7, 14–25), several included too few suicides to effectively control for characteristics common to both smokers and suicides (14, 19, 25) or made no attempt to do so (7, 18, 22–24).

This paper presents data on 300,000 men followed prospectively during 961,657 person-years. This prospective study explored the smoking-suicide connection among young, adult men while taking into account a number of potential confounders, including age, race, alcohol intake, marital status, education, military rank, and physical activity.

MATERIALS AND METHODS

Data were extracted from the Total Army Injury and Health Outcomes Database (26). The study cohort comprised all male active-duty US Army personnel who took the Health Risk Appraisal (HRA) questionnaire between January 1, 1987, and December 31, 1996 ($n = 314,402$). Ninety-nine percent of the questionnaires were completed between 1990 and December 31, 1996. Questionnaires were administered to soldiers during routine personnel processing and routine physical examinations (77 percent of the surveys) as well as during walk-in and occupational health clinic visits, as a result of unit commander requests, or prior to physical fitness screening. Each soldier was followed up from the date he first took the questionnaire until the date of 1) his death, 2) his leaving the army, or 3) the end of the study period (December 31, 1996). When soldiers leave the US Army, they are lost to follow-up; for our study, 961,657 person-years were available for analysis (mean, 37 months; range, 0–120 months).

Soldiers who took the questionnaire in a typical year (1992) resembled those who did not in race (60 vs. 65 percent White), age (mean, 28 years (both groups)), rank (15 percent officers and 85 percent enlisted men (both groups)), college education (23 vs. 19 percent),

and marital status (40 vs. 41 percent unmarried). Similarly, the 113 suicides who took the questionnaire resembled those suicides who never took the HRA in race (65 vs. 72 percent White), age (29 vs. 28 years), marital status (49 vs. 47 percent married), and rank (5 percent officers (both groups)).

Information on suicides was collected from all deaths of active-duty army personnel between January 1, 1987, and December 31, 1996. Data on soldiers who left the army prior to their death were not available for analysis.

Men were characterized, according to their smoking status, as never smokers, current smokers, or former smokers. Current smokers were further divided into those who smoked 1–10, 11–20, or 21 or more cigarettes per day. Smoking status did not depend on whether the HRA was taken at routine or nonroutine venues (29 vs. 31 percent of current smokers, respectively).

Our analyses used suicide incidence rates, with person-years of follow-up as the denominator. Person-time was calculated by subtracting the date on which the HRA was first taken from the date of death, the date a soldier left the army, or the end of the study period (December 31, 1996). Relative risk was defined as the suicide incidence rate for men who reported a given history of smoking divided by the corresponding rate for men categorized as never smokers. Relative risks were adjusted for age by using 5-year age groups. Proportional hazards models were used to obtain multivariable hazard ratios, reported as relative risks. Multivariable relative risks were adjusted for age (in 5-year categories), race, alcohol intake, marital status, education, and military rank. Physical activity did not affect our multivariable findings; results presented here do not include this factor. Results of the Mantel-Haenszel test for

linear trend across levels of smoking were reported by using two-tailed p values. Six of the 113 suicides were eliminated from multivariable analysis because data on one or more independent variables were missing.

RESULTS

During the follow-up period, there were 113 suicides in our cohort. We also found that smokers were more likely than nonsmokers to be White, drink heavily, be married, be less educated, be of enlisted rank, and exercise less often. Except for marital status, these tendencies were more extreme in heavy smokers than in light smokers (table 1).

The suicide rate increased with an increasing number of cigarettes smoked daily (p for trend < 0.001). Multivariable-adjusted analyses showed that compared with never smokers, the relative risks of suicide were 1.2 (95 percent confidence interval (CI): 0.6, 2.3) for smokers of 10 or fewer cigarettes a day, 1.8 (95 percent CI: 1.1, 3.0) for smokers of 11–20 cigarettes a day, and 2.3 (95 percent CI: 1.2, 4.6) for smokers of more than 20 cigarettes a day. The relative risk of suicide for former smokers was 1.3 (95 percent CI: 0.7, 2.3) (table 2).

Educational level was strongly and inversely correlated with being a current smoker (table 1). Compared with men who attended college, those who did not were more likely to commit suicide (data not shown).

For each age stratum in our cohort, the suicide rate was lower than that for the corresponding stratum in the US male population but similar to that for men in the army as a whole (12/100,000 person-years; data not shown). The suicide rate was lower for African Americans than for Whites (relative risk = 0.6), but this difference did not reach statistical significance.

TABLE 1. Population characteristics, by smoking status, of male US Army personnel followed to examine the relation between smoking and suicide, 1987–1996

Smoking status	No. of men	% of cohort	Characteristic (%)					
			Race: White	Alcohol intake*	Marital status: married	College education	Military rank: enlisted	Aerobic physical exercise†
Never smoker	173,572	55	55	2	55	29	80	7
Current smoker (cigarettes/day)								
1–10	37,526	12	51	4	53	10	96	10
11–20	41,798	13	74	6	60	10	96	11
≥21	14,175	5	86	10	66	12	95	14
Former smoker	47,331	15	65	2	69	29	82	7
Entire cohort	314,402	100	60	3	58	23	85	8

* ≥3 drinks/day.
† Less often than once/week.

TABLE 2. Age-adjusted and multivariable-adjusted relative risks of suicide, by smoking status, for male US Army personnel, 1987–1996

Smoking status	No. of men	No. of cases (n = 113)	Crude incidence†	Age-adjusted RR‡,§ (95% CI‡)	Multivariable-adjusted RR§,¶ (95% CI)
Never smoker	173,572	43	8	1.0	1.0
Current smoker (cigarettes/day)					
1–10	37,526	14	13	1.6 (0.9, 3.0)	1.2 (0.6, 2.3)
11–20	41,798	26	20	2.5 (1.5, 4.1)**	1.8 (1.1, 3.0)*
≥21	14,175	12	27	3.6 (1.9, 6.9)**	2.3 (1.2, 4.6)*
Former smoker	47,331	18	12	1.4 (0.8, 2.6)	1.3 (0.7, 2.3)

* $p < 0.05$; ** $p < 0.001$.
† Per 100,000 person-years; overall, 12.
‡ RR, relative risk; CI, confidence interval.
§ Test for trend among current smokers compared with never smokers, $p < 0.0001$.
¶ Adjusted for age, race (White, African American, other), alcohol intake (none, 1–14 drinks/week, 15–21 drinks/week, ≥22 drinks/week), marital status (married vs. divorced, widowed, or never married), military rank, and education (college vs. less than college).

DISCUSSION

Smokers were disproportionately represented among the suicides in our cohort. As in the general population, smokers in our cohort were more likely to have established risk factors for depression (3–5), such as being White, drinking heavily, not attending college, and not exercising (table 1). Unlike smokers in the general population, however, those in our cohort were more likely to be married. After controlling for these factors, we found a strong, positive, and dose-related association between smoking and completed suicide. Compared with never smokers, smokers of more than 20 cigarettes a day had a relative risk of suicide of 2.3 (95 percent CI: 1.2, 4.6).

The suicide rate in our cohort was lower than the corresponding rate in the general US population of men aged 18–50 years (1). The lower military suicide rate may, in part, be attributable to mental health screening at entry, a fully employed and generally healthier military population, and requirements for regular health screening and easy access to health care (27).

The multivariable-adjusted suicide rate was lower for African Americans than for Whites to an extent consistent with US mortality data (relative risk = 0.6; data not shown) (28), but this difference did not reach statistical significance. There were too few African American suicides (n = 19) to enable us to evaluate, by race, the differential effect of various factors on suicide.

Since men were lost to follow-up once they left the army, the suicide rate for our cohort might be biased upward or downward, depending on whether those who left are less or more likely to kill themselves. However, the smoking-suicide association is unlikely to be biased since we have no reason to suspect that it is different for soldiers leaving compared with those

remaining in the army. The smoking-suicide connection is unlikely to be explained by the development of cancer, because 91 percent of the suicides in our cohort were men less than age 40 years (and 50 percent were less than age 25 years), a group too young to develop a significant burden of smoking-related malignant disease (1).

Three other large prospective studies of smoking and suicide have controlled for alcohol intake; two continued to find a smoking-suicide association (15, 29), one did not (21). All three cohorts were older than ours. Our cohort may have been too young for alcohol to have exerted an independent effect, since most alcoholics who commit suicide have abused alcohol for over 20 years (30).

A limitation of our study is that we lacked information about some risk factors for suicide, including mental illness. Other limitations were possible misclassification of suicide and smoking status. Fortunately, we have no reason to expect bias in reporting suicide to correlate with smoking status.

Our cohort consisted primarily of young men, which limits the generalizability of our results. On the other hand, studying a somewhat homogeneous population effectively controls for some potential confounders (e.g., employment, access to health care), improving the validity of our findings.

This paper confirms observations from other studies linking smoking to suicide and extends these findings to a population of young adult men. Although the association we found does not imply causation, our findings indicate that the smoking-suicide connection is not explained by the greater tendency of smokers to be White, drink heavily, have less education, be of enlisted rank, and exercise less often.

ACKNOWLEDGMENTS

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