Longitudinal Assessment of Mental Disorders, Smoking, and Hazardous Drinking Among a Population-Based Cohort of US Service Member

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Objectives: Combat exposure is known to increase the risk for mental disorders; however, less is known about the temporal relationship between mental disorders and alcohol misuse or smoking. To better understand these interrelationships, this study investigated mental disorders in association with hazardous drinking and cigarette smoking.

Methods: Using data from a large population-based military cohort, standardized instruments were used to screen for posttraumatic stress disorder, depression, panic, and other anxiety syndromes. Self-reported use of cigarettes and hazardous drinking was also assessed. Subjects were classified as having "new-onset," "persistent," or "resolved" mental disorders and health risk behaviors on the basis of screening results from baseline to follow-up (n = 50,028). Multivariable logistic regression models were used to investigate temporal patterns between the development of mental disorders and the uptake of smoking or hazardous drinking.

Results: The strongest associations of new-onset mental disorders were among those who newly reported smoking or hazardous drinking (odds ratio [OR], 1.82; 95% confidence interval [CI], 1.28-2.59 and OR, 2.49; 95% CI, 2.15-2.89, respectively), even after adjustment for combat deployment experience. In addition, persistent smokers and hazardous drinkers had elevated odds for developing a mental disorder at follow-up.

Conclusions: This study demonstrates a positive association between the onset of mental disorders with the uptake of smoking and hazardous drinking and the likelihood that multiple temporal sequence patterns exist to explain the relationship between mental disorders and hazardous drinking and smoking. Clinical approaches to mitigate deployment-related mental disorders should include alcohol and tobacco-related assessments and interventions.

Key Words: alcohol drinking, cohort studies, mental disorders, military personnel, smoking

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Increased reporting of mental disorders including major depression and posttraumatic stress disorder (PTSD), and health risk behaviors such as cigarette smoking and hazardous drinking, has been documented after combat-related deployment in support of the recent operations in Iraq and Afghanistan (Hoge et al., 2004; 2006; Milliken et al., 2007; Jacobson et al., 2008; Smith et al., 2008a; 2008b; 2008c; Wells et al., 2010). Health risk behaviors may develop as coping mechanisms for mental disorders, or these behaviors may exist in people with no mental disorders, which may then contribute to the development of mental disorders. Previous studies report positive associations between PTSD and incident nicotine and alcohol disorders (Breslau et al., 2003), smoking and onset of psychiatric disorders (Breslau et al., 2004a), psychiatric disorders and stages of smoking (Breslau et al., 2004b), and smoking and hazardous drinking (Miller and Gold, 1998; Romberger and Grant, 2004). Risk factors include genetics, familial characteristics, environmental factors, and the effect of chronic drug exposure (such as nicotine and alcohol) (Seth et al., 2002; Janhunen and Ahtee, 2007; Vengeliene et al., 2008). Still, there is much to be learned from the temporal sequence of these comorbidities, and they remain important with

regard to the development of mental disorders in relation to cigarette smoking and hazardous drinking among US service members.

To examine temporal sequence, the collection of baseline data is critical. In addition, among populations of service members, controlling for military exposures like combat experience, which may confound the relationship between the development of mental disorders and health risk behaviors, is also essential. The Millennium Cohort Study, designed to evaluate military experiences and health outcomes over time, collects predeployment baseline data and follows participants over time, collecting follow-up data approximately every 3 years (Ryan et al., 2007; Smith, 2009). The objective of this study was to prospectively investigate the interrelationships of mental disorders (on the basis of positive screens for PTSD, depression, panic syndrome, and other anxiety syndrome) in conjunction with cigarette smoking and hazardous drinking while adjusting for deployment in support of operations in Iraq and Afghanistan.

METHODS

Population and Data Sources

The Millennium Cohort Study began collecting baseline data in July 2001 from a large population of US military members from all services and components (Ryan et al., 2007; Smith, 2009). A random sample of 256,400 service members on rosters as of October 1, 2000, was invited to participate in the study, and 77,047 provided informed voluntary consent and enrolled from July 2001 to June 2003. Of the 77,047 participants who completed a baseline survey, 55,021 (71%) also completed a follow-up from July 2004 to February 2006. Baseline and follow-up survey data were used to assess the temporal sequence of mental disorders, cigarette smoking, and hazardous drinking over a 3-year follow-up period. This study was approved by the institutional review board at the Naval Health Research Center (NHRC.2000.0007).

Assessment of Mental Disorders

The PTSD Checklist–Civilian Version and the PRIME-MD Patient Health Questionnaire (PHQ) are standardized instruments imbedded in the Millennium Cohort questionnaire. On the basis of self-reported responses, participants screened positive for PTSD if they reported a moderate or higher level of at least 1 intrusion symptom, 3 avoidance symptoms, and 2 hyperarousal symptoms during the 30 days before survey completion (*Diagnostic and Statistical Manual of Mental Disorders*, 4th Edition, Text Revision criteria) (Weathers et al., 1993). This approach has been shown to have high sensitivity (Brewin, 2005) and high internal consistency, as measured using the Cronbach α (0.94) (Smith et al., 2007d).

Using the standardized methods, panic syndrome, other anxiety syndrome, and depression were assessed using the PHQ instrument (Spitzer et al., 1999). Participants were identified as having panic syndrome if they positively responded to certain psychosocial questions, including suddenly feeling fear or panic, having the feeling of fear or panic more than 1 time, having attacks out of the blue, being bothered or worried about having another attack, and having 4 or more symptoms of an anxiety attack. Other anxiety syndrome is measured using 6 items from the PHQ (Spitzer et al., 1994; 1999; 2000). This syndrome assesses generalized anxiety excluding anxiety related to having a panic attack, while including anxiety related to being publicly embarrassed, being contaminated, being away from home or close relatives, gaining weight, having multiple physical complaints, or having a serious illness, and the anxiety and worry do not occur exclusively in relation to PTSD. Participants were defined as screening positive for depression using the PHQ-9 if they responded "more than half of the days" or "nearly every day" to at least 5 of the 9 depressive symptoms and 1 of the 5 items endorsed was depressed mood or anhedonia (Spitzer et al., 1999). An aggregated mental disorder variable was created, indicating a positive screen for 1 or more of the following: PTSD, depression, panic syndrome, and other anxiety syndrome.

Assessment of Health Risk Behaviors

Alcohol use was assessed in the following two ways: (1) the *Diagnostic and Statistical Manual of Mental Disorders*, 4th Edition, Text Revision–defined (American Psychiatric Association, 2000) maladaptive drinking was assessed using the PHQ (Spitzer et al., 1994; 1999; 2000), with at least 1 affirmative response indicating "problem drinking"; and (2) quantity/frequency of drinking was estimated by summing the number of standard drinks consumed on each day of the week before completing the questionnaire. Consumption of more than 14 drinks per week (men) and more than 7 drinks per week (women) indicated "heavy drinking," based on the research that indicates drinking beyond this level may increase the risk for alcohol-related problems (Criqui, 1998; Goldberg et al., 2001; Dawson et al., 2005; US Department of Health and Human Services and US Department of Agriculture, 2005). Therefore, screening positive for either problem drinking or heavy drinking was classified as hazardous drinking.

Self-reported cigarette smoking was assessed at baseline and follow-up. Although any degree of smoking is hazardous (US Department of Health and Human Services, 2010), current smokers were identified if they answered that they had smoked at least 100 cigarettes in their lifetime and had smoked in the last year or had not successfully quit smoking.

Assessment of Health Risk Behaviors and Mental Disorder Metrics

Participants were classified both at baseline and at follow-up as to whether they screened positive for a mental disorder, smoking, or hazardous drinking. Participants were then classified as having a "new-onset" mental disorder or "newly reported" smoking or hazardous drinking if they screened negative at baseline but positive at follow-up. Participants were identified as having a "resolved" mental disorder or hazardous drinking if they screened positive at baseline but negative at follow-up. Finally, participants who screened positive for a mental disorder, smoking, or hazardous drinking at baseline

and follow-up were classified as "persistent." Participants screening negative for mental disorders and/or health risk behaviors at both baseline and follow-up were classified as "none" or "never" and served as the reference group for all models. For smoking status, participants were additionally classified as (1) past smoker if they reported successfully quitting after smoking at least 100 cigarettes in their lifetime; (2) quit smoker if they screened positive at baseline but not at follow-up; and (3) relapsed smoker if they were a past smoker at baseline but reported smoking at follow-up.

Deployment and Covariate Data

Using military electronic deployment data, individuals with a complete deployment in support of the operations in Iraq and Afghanistan before follow-up were classified as having a 2001 to 2006 deployment. Participants who deployed and reported witnessing death, trauma, injuries, prisoners of war, or refugees were considered to have combat-associated experiences. An additional covariate, 1990 to 2000 deployment, was created to adjust for deployments occurring before submission of the baseline questionnaire. In addition, military personnel files are accessed for demographic and occupational information, including sex, birth year (pre-1960, 1960–1969, 1970–1979, 1980 and later), race/ethnicity (non-Hispanic white, non-Hispanic black, and other), education (high school or less, some college, and bachelor's degree or higher), marital status (married or not married), service branch (Army, Navy, Air Force, and Marine Corps), service component (active duty or Reserve/Guard), military pay grade (Enlisted or Officer), and occupation (combat specialist, health care specialist, service and supply handler or functional support/administration, and other).

Questionnaire data were used to adjust for a history of potential alcohol dependence reported ever in someone's lifetime with at least 1 positive response to the CAGE (*c*ut back, *a*nnoyed, *g*uilty, and *e*ye opener) questionnaire (Dhalla and Kopec, 2007). In addition, participants who self-reported having ever been diagnosed by a health care professional with PTSD, depression, manic-depressive disorder, or schizophrenia or psychosis at baseline were indicated as having a prior mental disorder diagnosis. Those who submitted a questionnaire during deployment or missing demographic, military, deployment, mental disorder screening, or key behavioral data were removed from the analyses.

Statistical Analyses

Descriptive analyses compared characteristics by baseline, follow-up, and new-onset mental disorder status, before full analyses. Multivariable logistic regression models were built to calculate the adjusted odds of new-onset mental disorders associated with the categories of smoking and hazardous drinking. Similarly, multivariable models were used to examine the association of newly reported smoking and hazardous drinking with resolved, new-onset, or persistent mental disorders. Hierarchical models were used to investigate these outcomes in the context of (1) demographic and military characteristics; (2) demographic, military characteristics, and deployment-related variables; and (3) demographic, military characteristics, deployment-related variables, and prior mental disorder diagnosis and alcohol/CAGE questionnaire at baseline. In addition, 4 models were designed to calculate adjusted odds of new-onset and newly reported outcomes independent of other comorbidities and behaviors among those who did not report smoking, a history of potential alcohol dependence (CAGE), or prior mental disorder diagnosis at baseline. Data management and statistical analyses were performed using SAS software, version 9.2 (SAS Institute, Inc, Cary, NC).

RESULTS

Composed of Millennium Cohort participants, 3 study populations (ie, baseline, follow-up, and new-onset) were created for the descriptive analyses. Of the 77,047 Millennium Cohort participants who completed a baseline questionnaire between 2001 and 2003, 1085 completed the questionnaire while deployed and another 2404 were missing baseline demographic, military, deployment, mental disorder, or behavioral data, leaving 73,558 for baseline analyses. Of participants who completed a baseline questionnaire, 55,021 completed a follow-up questionnaire between 2004 and 2006. Of these participants, 3657 completed a questionnaire while deployed and another 1336 were missing baseline demographic, military, deployment data, or follow-up mental disorder or behavioral data, leaving 50,028 for follow-up analyses. Of the 50,028 participants who were included in the follow-up analyses, 739 were missing mental disorder or behavioral data at baseline and another 2865 screened positive for a baseline mental disorder. These 3604 individuals were excluded from the new-onset mental disorders analyses, leaving 46,424 follow-up responders with a negative screen for a baseline mental disorder and eligible for new-onset mental disorder analyses. All multivariable models were based from new-onset populations, in which the number of participants changed slightly based on the number of participants who screened positive for the outcome at baseline.

Baseline demographic and military characteristics of included participants are shown in Table 1. Across the 3 groups (baseline, follow-up, and new-onset), participants who screened positive for a baseline, follow-up, or new-onset mental disorder were proportionately more likely to be female, younger, less educated, not married, Army or Marine Corps members, enlisted, deployed in support of the operations in Iraq and Afghanistan with combat experiences, and deployed to the 1990 to 1991 Gulf War. Those who reported a mental disorder were also more likely to report a prior mental disorder diagnosis and screen positive for a history of potential alcohol dependence at baseline.

At baseline and follow-up, 6.7% of participants screened positive for at least 1 mental disorder. Of participants who screened negative for all mental disorders at baseline, 1999 (4.3%) screened positive for at least 1 disorder at follow-up. Participants who smoked increased from 17.2% at baseline to 22.9% at follow-up (data not shown). Of those who reported not smoking at baseline, 4380 (10.5%) reported smoking at follow-up. Conversely, self-reported hazardous drinking decreased between baseline and follow-up from 16.4% to 12.8% (data not shown). Of those participants who did not report

TABLE 1. Baseline Demographic and Military Characteristics of Millennium Cohort Members by Mental Disorder Screening Status

	Baseline Survey Responders		Follow-Up Survey Responders		Follow-Up Responders Without Baseline Mental Disorder*	
Characteristic	**All Responders, n = 73,558**	**Baseline Mental Disorder†, n = 4,901 (%)**	**All Responders, n = 50,028**	**Follow-Up Mental Disorder‡, n = 3,337 (%)**	**All Responders, n = 46,424**	**New-Onset Mental Disorder§, n = 1,999 (%)**
Sex						
Male	53,674	3,107 (5.8)	36,405	2,097 (5.8)	34,045	1,268 (3.7)
Female	19,884	1,794 (9.0)	13,623	1,240 (9.1)	12,379	731 (5.9)
Birth year						
Pre-1960	15,867	842 (5.3)	12,604	689 (5.5)	11,746	397 (3.4)
1960-1969	26,980	1,525 (5.5)	20,315	1,212 (6.0)	19,052	747 (3.9)
1970-1979	25,426	2,025 (8.0)	15,087	1,186 (7.9)	13,859	708 (5.1)
1980 and later	4,285	509 (11.9)	2,022	250 (12.4)	1,767	147 (8.3)
Race/ethnicity						
Non-Hispanic white	51,251	3,302 (6.4)	35,706	2,317 (6.5)	33,157	1,389 (4.2)
Non-Hispanic black	10,105	797 (7.9)	6,043	474 (7.8)	5,554	272 (4.9)
Other	12,202	802 (6.6)	8,279	546 (6.6)	7,713	338 (4.4)
Education						
High school or less	35,729	3,315 (9.3)	21,468	2,074 (9.7)	19,303	1,214 (6.3)
Some college	18,840	1,018 (5.4)	13,489	743 (5.5)	12,617	435 (3.4)
Bachelor's degree or higher	18,989	568 (3.0)	15,071	520 (3.5)	14,504	350 (2.4)
Marital status						
Not married	27,005	2,275 (8.4)	16,673	1,406 (8.4)	15,214	831 (5.5)
Married	46,553	2,626 (5.6)	33,355	1,931 (5.8)	31,210	1,168 (3.7)
Service branch						
Army	34,849	2,817 (8.1)	23,169	2,000 (8.6)	21,135	1,205 (5.7)
Air Force	21,497	901 (4.2)	15,478	625 (4.0)	14,735	385 (2.6)
Navy/Coast Guard	13,453	871 (6.5)	9,320	561 (6.0)	8,645	324 (3.7)
Marine Corps	3,759	312 (8.3)	2,061	151 (7.3)	1,909	85 (4.5)
Service component						
Reserve/National Guard	31,754	1,944 (6.1)	22,141	1,457 (6.6)	20,565	891 (4.3)
Active duty	41,804	2,957 (7.1)	27,887	1,880 (6.7)	25,859	1,108 (4.3)
Military pay grade						
Enlisted	56,469	4,466 (7.9)	36,404	2,918 (8.0)	33,249	1,713 (5.2)
Officer	17,089	435 (2.5)	13,624	419 (3.1)	13,175	286 (2.2)
Occupational category						
Combat specialist	14,699	806 (5.5)	10,039	541 (5.4)	9,476	335 (3.5)
Health care specialist	7,745	477 (6.2)	5,755	341 (5.9)	5,392	196 (3.6)
Service supply/functional support	21,207	1,582 (7.5)	14,514	1057 (7.3)	13,345	629 (4.7)
Other occupation	29,907	2,036 (6.8)	19,720	1,398 (7.1)	18,211	839 (4.6)
2001-2006 deployment‖						
No deployment	70,580	4,747 (6.7)	37,034	2,462 (6.6)	34,243	1401 (4.1)
Deployed without combat	1,528	48 (3.1)	6,923	263 (3.8)	6,573	184 (2.8)
Deployed with combat	1,450	106 (7.3)	6,071	612 (10.1)	5,608	414 (7.4)

(*Continues*)

TABLE 1. Baseline Demographic and Military Characteristics of Millennium Cohort Members by Mental Disorder Screening Status (*Continued*)

Characteristic	Baseline Survey Responders		Follow-Up Survey Responders		Follow-Up Responders Without Baseline Mental Disorder*	
	All Responders, n = 73,558	Baseline Mental Disorder†, n = 4,901 (%)	All Responders, n = 50,028	Follow-Up Mental Disorder‡, n = 3,337 (%)	All Responders, n = 46,424	New-Onset Mental Disorder§, n = 1,999 (%)
1990-2000 deployment						
None	46,053	3,134 (6.8)	31,088	2,091 (6.7)	28,859	1,286 (4.5)
1990-1991 Gulf War	5,436	493 (9.1)	3,989	381 (9.6)	3,594	198 (5.5)
1998-2000 Southwest Asia, Bosnia, or Kosovo	18,653	1,086 (5.8)	12,464	732 (5.9)	11,643	436 (3.7)
Deployed to both operations	3,416	188 (5.5)	2,487	133 (5.3)	2,328	79 (3.4)
Prior mental disorder diagnosis¶						
No	67,773	3,038 (4.5)	46,094	2,333 (5.1)	43,683	1,627 (3.7)
Yes	5,785	1,863 (32.2)	3,934	1,004 (25.5)	2,741	372 (13.6)
Alcohol/CAGE#						
No	59,888	3,270 (5.5)	40,966	2,399 (5.9)	38,439	1,503 (3.9)
Yes	13,670	1,631 (11.9)	9,062	938 (10.4)	7,985	496 (6.2)

*Participants who screened negative for the following at baseline: major depression, other anxiety syndrome, and panic syndrome based on the PHQ, and PTSD symptoms based on PCL-C and DSM-IV-TR criteria.

†Participants who screened positive for 1 or more of the following at baseline: major depression, other anxiety syndrome, and panic syndrome based on the PHQ, and PTSD symptoms based on PCL-C and DSM-IV-TR criteria.

‡Participants who screened positive for 1 or more of the following at follow-up: major depression, other anxiety syndrome, and panic syndrome based on the PHQ, and PTSD symptoms based on PCL-C and DSM-IV-TR criteria.

§Participants who screened positive for 1 or more of the following at follow-up but not at baseline: major depression, other anxiety syndrome, and panic syndrome based on the PHQ, and PTSD symptoms based on PCL-C and DSM-IV-TR criteria.

||Deployment in support of the wars in Iraq and Afghanistan before follow-up. Combat experiences included reporting exposure to witnessing death, abuse, maimed soldiers or civilians, prisoners of war, or refugees.

¶At baseline, reported being told by a doctor or other health professional of having 1 or more of the following conditions: depression, schizophrenia or psychosis, manic-depressive disorder, or PTSD.

#At baseline, participant self-reported ever feeling at least 1 of the following: (1) need to cut back on drinking, (2) annoyed at anyone who suggested to cut back on drinking, (3) guilty about drinking, and (4) a need for an "eye-opener" or early morning drink.

CAGE, *c*ut back, *a*nnoyed, *g*uilty, and *e*ye opener; DSM-IV-TR, *Diagnostic and Statistical Manual of Mental Disorders*, 4th Edition, Text Revision; PCL-C, PTSD Checklist-Civilian Version; PHQ, PRIME-MD Patient Health Questionnaire; PTSD, posttraumatic stress disorder.

TABLE 2. Frequencies of Smoking and Hazardous Drinking by Deployment and Mental Disorder Status of Millennium Cohort Members*

	Hazardous drinking†			Smoking		
	Baseline, n = 73,558 (%‡)	Follow-up, n = 50,028 (%)	Newly reported§, n = 41,814 (%)	Baseline, n = 73,558 (%)	Follow-up, n = 50,028 (%)	Newly reported§, n = 41,759 (%)
1990-2000 deployment						
None	16.7	12.5	6.8	16.8	21.4	10.3
1991 Gulf War	14.4	11.2	6.2	15.3	20.4	9.7
1998-2000 Southwest Asia, Bosnia, or Kosovo	16.7	12.2	7.0	18.7	23.9	11.4
Deployed to both operations	13.1	10.7	6.2	17.7	21.1	9.4
2001-2006 deployment‖						
Not deployed	16.4	11.9	6.5	17.0	20.5	9.7
Deployed without combat exposure	13.9	11.5	6.4	20.6	23.7	11.2
Deployed with combat exposure	16.7	15.2	9.3	22.5	28.5	15.0
Baseline mental disorders¶						
No	15.3	12.3	6.6	16.3	21.9	10.1
Yes	31.4	22.1	11.3	29.4	36.8	18.4
Follow-up mental disorders#						
No		11.6	6.2		21.2	9.9
Yes		26.9	15.9		37.0	19.9
New-onset mental disorders**						
No		11.6	6.2		21.2	9.7
Yes		26.9	16.9		37.0	19.2
Alcohol/CAGE††						
No	9.5	8.3	5.6	15.6	20.1	9.4
Yes	46.2	31.4	15.7	24.2	30.4	15.8

*Data cannot be calculated for the blank cells because participants cannot screen positive for a follow-up or new-onset mental disorder at baseline.

†Reported hazardous drinking, defined as either heavy drinking (more than 7 or 14 alcoholic drinks per week before completing the questionnaire for women and men, respectively) or problem drinking (reported 1 or more PHQ alcohol-related problems).

‡For each deployment or mental disorder category, the percentage of participants who reported certain behaviors.

§Reported hazardous drinking on the follow-up questionnaire but not on the baseline questionnaire.

‖Deployment in support of the wars in Iraq and Afghanistan before completing the baseline or follow-up questionnaire.

¶Participants who screened positive for 1 or more of the following at baseline: major depression, other anxiety syndrome, panic syndrome, and PTSD.

#Participants who screened positive for 1 or more of the following at follow-up: major depression, other anxiety syndrome, panic syndrome, and PTSD.

**Participants who screened positive for 1 or more of the following at follow-up but not at baseline: major depression, other anxiety syndrome, panic syndrome, and PTSD.

††At baseline, participant self-reported ever feeling at least 1 of the following: (1) need to cut back on drinking, (2) annoyed at anyone who suggested to cut back on drinking, (3) guilty about drinking, and (4) a need for an "eye-opener" or early morning drink.

baseline hazardous drinking, 2841 (6.8%) newly reported hazardous drinking at follow-up.

Table 2 presents the frequency of smoking and hazardous drinking by deployment and mental disorder status, where the percentage of participants who reported certain behaviors is shown for each deployment or mental disorder category. Table 2 suggests that baseline, follow-up, and newly reported hazardous drinking and smoking had higher percentages of reporting among participants who deployed in support of the operations in Iraq and Afghanistan with combat experiences, screened positive for a history of potential alcohol dependence at baseline, or screened positive for at least 1 mental disorder at baseline, follow-up, or new-onset.

Among those individuals without mental disorders at baseline (n = 46,424), multivariable logistic regression revealed a statistically significant association of smoking and hazardous drinking with new-onset mental disorders (Table 3). The unadjusted and adjusted models showed similar trends of statistical significance, whereas, in general, the magnitude of the associations decreased with increasing adjustment. All smokers, except those who quit between baseline and follow-up, and all hazardous drinkers were at greater odds for new-onset mental disorders than never smokers and never hazardous drinkers, respectively. Participants with resolved, newly reported, or persistent hazardous drinking were also at increased odds for new-onset mental disorders. In the fully adjusted models (model 4 structure), the strongest associations of new-onset mental disorders were among those who newly reported smoking or hazardous drinking (odds ratio [OR], 1.82; 95% confidence interval [CI], 1.28-2.59 and OR, 2.49; 95% CI, 2.15-2.89, respectively).

Of the 49,289 participants who met criteria for both baseline and follow-up analyses, 7530 were smokers at baseline and excluded from the newly reported smoking analyses, leaving 41,759 participants (Table 3). The sample was then stratified by previous smoking status; 1 model for never smokers

TABLE 3. Unadjusted and Adjusted Odds of New Onset Mental Disorders and Maladaptive Behaviors of the Millennium Cohort Members

Outcome	Main Exposures Assessed Baseline and Follow-Up Data	Model 1: Unadjusted OR (95% CI)	Model 2: Adjusted for Demographics and Military Data OR (95% CI)*	Model 3: Adjusted for Demographics, Military, and Deployment Data OR (95% CI)†	Model 4: Fully Adjusted OR (95% CI)‡
New-onset mental disorder at follow-up (n = 46,424)	Smoking				
	Never	1.00	1.00	1.00	1.00
	Past	1.24 (1.10-1.41)	1.25 (1.10-1.42)	1.26 (1.11-1.44)	1.22 (1.07-1.39)
	Quit	1.33 (0.95-1.86)	1.20 (0.85-1.68)	1.21 (0.86-1.70)	1.16 (0.82-1.63)
	Relapsed	1.93 (1.66-2.23)	1.65 (1.42-1.92)	1.63 (1.40-1.89)	1.53 (1.31-1.78)
	Newly reported	2.53 (1.80-3.55)	1.90 (1.34-2.69)	1.83 (1.29-2.59)	1.82 (1.28-2.59)
	Persistent	1.96 (1.73-2.21)	1.62 (1.42-1.84)	1.60 (1.41-1.82)	1.51 (1.33-1.72)
	Hazardous drinking				
	Never	1.00	1.00	1.00	1.00
	Resolved	1.43 (1.22-1.67)	1.36 (1.16-1.60)	1.37 (1.16-1.60)	1.24 (1.05-1.46)
	Newly reported	2.71 (2.35-3.12)	2.59 (2.24-2.99)	2.56 (2.21-2.96)	2.49 (2.15-2.89)
	Persistent	2.40 (2.09-2.76)	2.35 (2.04-2.70)	2.33 (2.02-2.69)	2.08 (1.78-2.44)
Newly reported smoking at follow-up among nonsmokers at baseline (n = 29,250)	Mental disorder				
	None	1.00	1.00	1.00	1.00
	Resolved	1.35 (0.79-2.31)	0.98 (0.57-1.68)	1.00 (0.58-1.72)	0.91 (0.52-1.59)
	New-onset	3.10 (2.22-4.35)	2.31 (1.64-3.26)	2.15 (1.52-3.05)	2.07 (1.46-2.95)
	Persistent	4.05 (2.73-6.01)	3.24 (2.16-4.86)	3.29 (2.19-4.96)	2.84 (1.84-4.39)
Smoking relapse at follow-up among past smokers at baseline (n = 12,509)	Mental disorder				
	None	1.00	1.00	1.00	1.00
	Resolved	1.69 (1.39-2.05)	1.47 (1.19-1.80)	1.47 (1.19-1.81)	1.38 (1.12-1.70)
	New-onset	1.76 (1.49-2.09)	1.48 (1.24-1.77)	1.45 (1.21-1.74)	1.40 (1.17-1.68)
	Persistent	1.78 (1.44-2.20)	1.44 (1.15-1.80)	1.46 (1.17-1.83)	1.35 (1.07-1.70)
Newly reported hazardous drinking at follow-up (n = 41,814)	Mental disorder				
	None	1.00	1.00	1.00	1.00
	Resolved	1.54 (1.25-1.89)	1.42 (1.15-1.75)	1.42 (1.15-1.75)	1.31 (1.06-1.63)
	New-onset	3.10 (2.70-3.57)	2.84 (2.46-3.28)	2.79 (2.42-3.23)	2.72 (2.34-3.15)
	Persistent	2.51 (2.07-3.05)	2.30 (1.88-2.80)	2.29 (1.88-2.79)	2.12 (1.72-2.62)

*Models adjusted for sex, birth year, race/ethnicity, education, marital status, service branch, service component, military pay grade, and occupation.

†Models adjusted for sex, birth year, race/ethnicity, education, marital status, service branch, service component, military pay grade, occupation, 1990 to 2000 deployment experience, and 2001 to 2006 deployment experience.

‡Models adjusted for sex, birth year, race/ethnicity, education, marital status, service branch, service component, military pay grade, occupation, 1990 to 2000 deployment experience, 2001 to 2006 deployment experience, alcohol/CAGE, and prior mental health diagnosis.

Abbreviations: CI, confidence interval; OR, odds ratio.

(n = 29,250) and another for past smokers (n = 12,509). In both models, newly reported or relapse of smoking had a statistically significant positive association with new-onset or persistent mental disorder symptoms that remained even after adjustment for baseline demographic, military, mental disorder diagnosis, and behavioral data. Although those with resolved, new-onset, or persistent mental disorders had similar odds of relapse of smoking, never smokers with persistent mental disorders had the greatest likelihood for newly reported smoking at follow-up. Those with resolved mental disorders were not at increased odds for newly reported smoking compared with those who screened negative for mental disorders.

For the analysis of newly reported hazardous drinking, 7475 participants who reported hazardous drinking at baseline were excluded, leaving 41,814 (Table 3). Although the magnitude of the association decreased with adjustment, participants who had resolved, new-onset, or persistent mental disorders were at significantly increased odds for newly reported hazardous drinking. Those with new-onset mental disorders had the greatest odds for newly reported hazardous drinking (OR, 2.72; 95% CI, 2.34-3.15), followed by those with persistent and resolved mental disorders, respectively.

To separately examine those who did not screen positive for smoking, hazardous drinking, or mental disorders at baseline, additional multivariable models were built (Table 4). Of the 49,289 participants meeting criteria for baseline and follow-up analyses, 34,081 screened negative for hazardous drinking, smoking, and all the mental disorders at baseline. After adjustment for demographic, military, deployment, alcohol/CAGE, and baseline mental disorder diagnoses, individuals who screened positive for new-onset mental disorders at follow-up were also more likely to newly report smoking (OR, 1.51; 95% CI, 1.28-1.78) and hazardous drinking (OR, 2.64; 95% CI, 2.22-3.14) at follow-up. Newly reported smoking was stratified by previous smoking status; therefore, 2 models (never smokers and past smokers) were performed. In both models, those who newly reported smoking or relapsed to smoking were at increased odds for new-onset mental disorders, and newly reported hazardous drinking, with the magnitude of the associations being greater for newly reported smoking than for smoking relapse. Newly reported hazardous drinking was also associated with new-onset mental disorders (OR, 2.59; 95% CI, 2.18-3.08) and newly reported smoking (OR, 2.52; 95% CI, 2.24-2.84) (Table 4).

DISCUSSION

Complex relationships between occupational exposures, stressors, and family/social support structures can affect long-term health of service members. Another important component of the health of service members includes the temporal progression of mental disorders and maladaptive behaviors. Previous studies have explored the relationships between mental disorders, smoking, and alcohol drinking and have reported positive associations between PTSD and incident nicotine and alcohol disorders (Breslau et al., 2003), smoking and onset of psychiatric disorders (Breslau et al., 2004a), and psychiatric disorders and stages of smoking (Breslau et al., 2004b). Similar relationships are known to exist between smoking and hazardous drinking (Miller and Gold, 1998; Romberger and Grant, 2004). These studies reported on existing mental disorders and their association with new-onset smoking or hazardous drinking, or conversely on current smoking and/or hazardous drinking and their association with new-onset mental disorders and suggested factors including genetics, familial characteristics, environmental factors, and the emerging understanding of pharmacodynamic interactions, including the effect of chronic drug exposure (such as nicotine and alcohol) toward persisting brain changes (plasticity) (Seth et al., 2002; Janhunen and Ahtee, 2007; Vengeliene et al., 2008). This study uses prospective data to highlight the temporal relationships between mental disorders and maladaptive behaviors, independent of other conditions and behaviors, and provides evidence that there are numerous, bidirectional temporal sequences that exist to explain condition and behavior comorbidities.

A novel finding was that the adjusted odds for newly reported smoking were greatest among those who persistently screened positive for a mental disorder, whereas the adjusted odds for smoking relapse were similar across resolved, new-onset, and persistent mental disorders. To observe increased odds of newly reported smoking among those with persistent mental disorders is plausible. These individuals may turn to smoking as a perceived way to decrease long-term stress (Vlahov et al., 2004; Kouvonen et al., 2005; Smith et al., 2008a) or to stimulate the brain reward system (Wise, 1998; Rice and Cragg, 2004) to counteract the emotional numbing that often accompanies mental disorders. Observing approximately equal odds of smoking relapse among those with resolved, new-onset, and persistent mental disorders is less intuitive. Independent nicotine relapse variables may play a stronger role in smoking relapse than does mental health status.

Although the prevalence of hazardous drinking actually decreased from baseline to follow-up, it is noteworthy that newly reported hazardous drinking was most common and strongly associated with new-onset mental disorders. However, because of the nature of this association, it is impossible to investigate in these data whether 1 was a by-product of the other, and this should be considered for follow-up focused research. Risk factors for hazardous drinking include traumatic or stressful experiences (Windle et al., 2005; Cerda et al., 2008), which additionally are risk factors common to mental disorders (Horowitz, 1986; Bruce et al., 2001; Binder and Nemeroff, 2010). Similarly, previous investigations of this Millennium Cohort found that combat experiences increase the risk for heavy weekly drinking, binge drinking, and alcohol-related problems, and increase the risk for new-onset mental disorders (Jacobson et al., 2008; Smith, et al., 2008b; Wells et al., 2010). Therefore, because this study consistently observed these as co-occurring, postdeployment screening should target emergent newly reported smoking or hazardous drinking, or smoking relapse, to reduce progression from hazardous drinking to an alcohol use disorder, and, possibly, early identification of new-onset mental disorders.

This study has limitations that should be noted. Although baseline assessments of mental disorders were measured before deployment, it is possible that individuals may have experienced a disorder before baseline, which we could not measure. We also could not measure every potential confounder that could be associated with mental disorders, smoking, or

TABLE 4. Adjusted Odds of Newly Reported Mental Disorder and Maladaptive Behaviors Among Participants Who Screened Negative at Baseline

Outcome	Main Exposures	OR (95% CI)*
New-onset mental disorder (n = 34,081)	Newly reported smoking	
	No	1.00
	Yes	1.51 (1.28-1.78)
	Newly reported hazardous drinking	
	No	1.00
	Yes	2.64 (2.22-3.14)
Newly reported smoking among non-smokers (n = 25,179)	New-onset mental disorder	
	No	1.00
	Yes	2.04 (1.37-3.03)
	Newly reported hazardous drinking	
	No	1.00
	Yes	3.54 (2.63-4.77)
Smoking relapse among past smokers (n = 9,622)	New-onset mental disorder	
	No	1.00
	Yes	1.35 (1.09-1.67)
	Newly reported hazardous drinking	
	No	1.00
	Yes	2.02 (1.72-2.37)
Newly reported hazardous drinking (n = 34,081)	New-onset mental disorder	
	No	1.00
	Yes	2.59 (2.18-3.08)
	Newly reported smoking	
	No	1.00
	Yes	2.52 (2.24-2.84)

*Models adjusted for sex, birth year, race/ethnicity, education, marital status, service branch, service component, military pay grade, occupation, 1990 to 2000 deployment experience, 2001 to 2006 deployment experience, alcohol/CAGE, and prior mental health diagnosis. New-onset smoking model also adjusted for prior smoking status.

CI, confidence interval; OR, odds ratio.

hazardous drinking, such as illicit drug use or social support structures. Underreporting of mental disorder symptoms, including mental disorder diagnosed by the provider, smoking, or drinking, may have occurred because of the perceived stigma associated with these conditions. It is also possible that underscreening for hazardous drinking may have occurred because the questionnaire includes only 2 of 10 questions of Alcohol Use Disorders Identification Test (Saunders et al., 1993). The degree to which underreporting or underscreening may have biased study findings depends on the extent to which these conditions were differential with respect to exposed and unexposed groups, which is assumed to be minimal. Also, among participants who screened positive for a mental disorder, smoking, and hazardous drinking simultaneously, it was not possible to detect which symptom occurred first. Finally, although the Millennium Cohort was selected using weighted random sampling from all personnel on rosters in October 2000, the Cohort may not be representative of the entire military or those who deploy; however, many published efforts have highlighted a representative population of military personnel who report reliably with minimal health-related tendency for enrollment and showed little nonresponse bias at the first follow-up (LeardMann et al., 2007; Ryan et al., 2007; Smith et al., 2007d; Smith et al., 2007a; 2007b; 2007c; 2007e; Wells et al., 2008; Littman et al., 2010).

This is the first longitudinal study to examine the relationship between mental disorders and health risk behaviors in a large military population that includes all branches of service, and both active duty and Reserve/National Guard. In addition, although deployment itself is a broad measure of exposure, we also assessed combat experiences, which, in previous studies, have been shown to be predictive of mental disorders and health risk behaviors (Jacobson et al., 2008; Smith, et al., 2008a; 2008b). This study also leveraged the ability to adjust for demographic, military, previous mental disorder diagnoses, and behavioral characteristics at baseline, which were measured predeployment among those who deployed. This study was also unique in its ability to examine multiple scenarios and combinations of mental disorders in conjunction with smoking and hazardous drinking, especially with a temporal assessment for new-onset conditions. As additional longitudinal data points become available, these complex relations may be further elucidated.

CONCLUSIONS

Although much is known about mental disorder comorbidities and associated health risk behaviors, there is little known about the temporal sequence of these outcomes in the context of military deployment. In this study, findings support the association of health risk behaviors and mental disorders at baseline while highlighting increased new-onset mental disorders in conjunction with newly reported health risk behaviors in a population without reported mental disorder diagnoses or behaviors at baseline. Investigating the temporal progression of symptoms or illnesses and health risk behaviors contributes to understanding the possible health impact of military service and especially combat deployments. Findings highlight the need for mental health screening at substance abuse treatment facilities and vice versa, including attention to smoking. Clinical approaches to mitigate mental disorders should focus on early identification and treatment, which may limit maladaptive behaviors and additional mental disorder morbidity.

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REFERENCES

American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 4th ed., Text Revision. Washington, DC: American Psychiatric Association; 2000.

Binder EB, Nemeroff CB. The CRF system, stress, depression and anxiety-insights from human genetic studies. *Mol Psychiatry* 2010;15(6): 574–588.

Breslau N, Davis GC, Schultz LR. Posttraumatic stress disorder and the incidence of nicotine, alcohol, and other drug disorders in persons who have experienced trauma. *Arch Gen Psychiatry* 2003;60(3):289–294.

Breslau N, Novak SP, Kessler RC. Daily smoking and the subsequent onset of psychiatric disorders. *Psychol Med* 2004a;34(2):323–333.

Breslau N, Novak SP, Kessler RC. Psychiatric disorders and stages of smoking. *Biol Psychiatry* 2004b;55(1):69–76.

Brewin CR. Systematic review of screening instruments for adults at risk of PTSD. *J Trauma Stress* 2005;18(1):53–62.

Bruce SE, Weisberg RB, Dolan RT, et al. Trauma and posttraumatic stress disorder in primary care patients. *Prim Care Companion J Clin Psychiatry* 2001;3(5):211–217.

Cerda M, Vlahov D, Tracy M, et al. Alcohol use trajectories among adults in an urban area after a disaster: evidence from a population-based cohort study. *Addiction* 2008;103(8):1296–1307.

Criqui MH. Do known cardiovascular risk factors mediate the effect of alcohol on cardiovascular disease? *Novartis Found Symp* 1998;216:159–167; discussion 167–172.

Dawson DA, Grant BF, Li TK. Quantifying the risks associated with exceeding recommended drinking limits. *Alcohol Clin Exp Res* 2005;29(5):902–908.

Dhalla S, Kopec JA. The CAGE questionnaire for alcohol misuse: a review of reliability and validity studies. *Clin Invest Med* 2007;30(1):33–41.

Goldberg IJ, Mosca L, Piano MR, et al. AHA Science Advisory: wine and your heart: a science advisory for healthcare professionals from the Nutrition Committee, Council on Epidemiology and Prevention, and Council on Cardiovascular Nursing of the American Heart Association. *Circulation* 2001;103(3):472–475.

Hoge CW, Auchterlonie JL, Milliken CS. Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *JAMA* 2006;295(9):1023–1032.

Hoge CW, Castro CA, Messer SC, et al. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N Engl J Med* 2004;351(1):13–22.

Horowitz MJ. Stress-response syndromes: a review of posttraumatic and adjustment disorders. *Hosp Commun Psychiatr* 1986;37(3):241–249.

Jacobson IG, Ryan MA, Hooper TI, et al. Alcohol use and alcohol-related problems before and after military combat deployment. *JAMA* 2008;300(6):663–675.

Janhunen S, Ahtee L. Differential nicotinic regulation of the nigrostriatal and mesolimbic dopaminergic pathways: implications for drug development. *Neurosci Biobehav Rev* 2007;31(3):287–314.

Kouvonen A, Kivimaki M, Virtanen M, et al. Work stress, smoking status, and smoking intensity: an observational study of 46,190 employees. *J Epidemiol Community Health* 2005;59(1):63–69.

LeardMann CA, Smith B, Smith TC, et al.; for the Millennium Cohort Study Team. Smallpox vaccination: comparison of self-reported and electronic vaccine records in the Millennium Cohort Study. *Hum Vaccin* 2007;3(6):245–251.

Littman AJ, Boyko EJ, Jacobson IG, et al. Assessing nonresponse bias at follow-up in a large prospective cohort of relatively young and mobile military service members. *BMC Med Res Methodol* 2010;10:99.

Miller NS, Gold MS. Comorbid cigarette and alcohol addiction: epidemiology and treatment. *J Addict Dis* 1998;17(1):55–66.

Milliken CS, Auchterlonie JL, Hoge CW. Longitudinal assessment of mental health problems among active and reserve component soldiers returning from the Iraq war. *JAMA* 2007;298(18):2141–2148.

Rice ME, Cragg SJ. Nicotine amplifies reward-related dopamine signals in striatum. *Nat Neurosci* 2004;7(6):583–584.

Romberger DJ, Grant K. Alcohol consumption and smoking status: the role of smoking cessation. *Biomed Pharmacother* 2004;58(2):77–83.

Ryan MA, Smith TC, Smith B, et al. Millennium Cohort: enrollment begins a 21-year contribution to understanding the impact of military service. *J Clin Epidemiol* 2007;60(2):181–191.

Saunders JB, Aasland OG, Babor TF, et al. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption–II. *Addiction* 1993;88(6):791–804.

Seth P, Cheeta S, Tucci S, et al. Nicotinic–serotonergic interactions in brain and behaviour. *Pharmacol Biochem Behav* 2002;71(4):795–805.

Smith TC, Jacobson IG, Smith B, et al.; for the Millennium Cohort Study Team. The occupational role of women in military service: validation of occupation and prevalence of exposures in the Millennium Cohort Study. *Int J Environ Health Res* 2007a;17(4):271–284.

Smith B, Leard CA, Smith TC, et al.; for the Millennium Cohort Study Team. Anthrax vaccination in the Millennium Cohort; validation and measures of health. *Am J Prev Med* 2007b;32(4):347–353.

Smith B, Smith TC, Gray GC, et al.; for the Millennium Cohort Study Team. When epidemiology meets the Internet: Web-based surveys in the Millennium Cohort Study. *Am J Epidemiol* 2007c;166(11):1345–1354.

Smith TC, Smith B, Jacobson IG, et al.; for the Millennium Cohort Study Team. Reliability of standard health assessment instruments in a large, population-based cohort study. *Ann Epidemiol* 2007d;17(7):525–532.

Smith B, Wingard DL, Ryan MA, et al. U.S. military deployment during 2001–2006: comparison of subjective and objective data sources in a large prospective health study. *Ann Epidemiol* 2007e;17(12):976–982.

Smith B, Ryan MA, Wingard DL, et al. Cigarette smoking and military deployment: a prospective evaluation. *Am J Prev Med* 2008a;35(6): 539–546.

Smith TC, Ryan MA, Wingard DL, et al. New-onset and persistent symptoms of post-traumatic stress disorder self reported after deployment and combat exposures: prospective population based US military cohort study. *BMJ* 2008b;336(7640):366–371.

Smith TC, Wingard DL, Ryan MA, et al. Prior assault and posttraumatic stress disorder after combat deployment. *Epidemiology* 2008c;19(3):505–512.

Smith TC. The US Department of Defense Millennium Cohort Study: career span and beyond longitudinal follow-up. *J Occup Environ Med* 2009;51(10):1193–1201.

Spitzer RL, Kroenke K, Williams JB. Validation and utility of a self-report version of PRIME-MD: the PHQ Primary Care Study. Primary care evaluation of mental disorders. Patient health questionnaire. *JAMA* 1999;282(18):1737–1744.

Spitzer RL, Williams JB, Kroenke K, et al. Validity and utility of the PRIME-MD Patient Health Questionnaire in assessment of 3000 obstetric-gynecologic patients: the PRIME-MD Patient Health Questionnaire Obstetrics-Gynecology Study. *Am J Obstet Gynecol* 2000;183(3): 759–769.

Spitzer RL, Williams JB, Kroenke K, et al. Utility of a new procedure for diagnosing mental disorders in primary care. The PRIME-MD 1000 study. *JAMA* 1994;272(22):1749–1756.

US Department of Health and Human Services. *How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2010.

US Department of Health and Human Services and US Department of Agriculture. *Dietary Guidelines for Americans, 2005*. 6th ed. Washington, DC: US Government Printing Office; 2005.

Vengeliene V, Bilbao A, Molander A, et al. Neuropharmacology of alcohol addiction. *Br J Pharmacol* 2008;154(2):299–315.

Vlahov D, Galea S, Ahern J, et al. Consumption of cigarettes, alcohol, and marijuana among New York City residents six months after the September 11 terrorist attacks. *Am J Drug Alcohol Abuse* 2004;30(2):385–407.

Weathers FW, Litz BT, Herman DS, et al. *The PTSD Checklist (PCL): reliability, validity, and diagnostic utility*. Paper presented at: the Annual

Meeting of International Society for Traumatic Stress Studies; 1993; San Antonio, TX.

Wells TS, Jacobson IG, Smith TC, et al. Prior health care utilization as a potential determinant of enrollment in a 21-year prospective study, the Millennium Cohort Study. *Eur J Epidemiol* 2008;23(2):79–87.

Wells TS, LeardMann CA, Fortuna SO, et al. A prospective study of depression following combat deployment in support of the wars in Iraq and Afghanistan. *Am J Public Health* 2010;100(1):90–99.

Windle M, Mun EY, Windle RC. Adolescent-to-young adulthood heavy drinking trajectories and their prospective predictors. *J Stud Alcohol* 2005;66(3):313–322.

Wise RA. Drug-activation of brain reward pathways. *Drug Alcohol Depend* 1998;51(1/2):13–22.

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14. ABSTRACT

Combat exposure is known to increase the risk for mental disorders. However, little is known about the temporal relationship between mental disorders and alcohol or smoking. A positive screen for a mental disorder at baseline or follow-up was associated with increased risk for newly reported hazardous drinking and relapse of smoking among past smokers. Among service members who screened negative for a mental disorder and did not report hazardous drinking or smoking at baseline, those who screened positive for a new-onset mental disorder at follow-up were also 1.51 times (95% confidence interval [CI], 1.28–1.78) and 2.64 times (95% CI, 2.20–3.14) more likely to report new smoking and new hazardous drinking, respectively. Differentiating by recent deployment status and including all services as well as active duty and Reserve/National Guard members, this study demonstrates that multiple temporal sequence patterns exist to explain the relationship between mental disorders and hazardous drinking and smoking, and these patterns are not easily distinguished by demographic or behavioral characteristics. Clinical approaches to mitigate deployment-related mental disorders should include alcohol and tobacco-related assessment and intervention.

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