

Full length article

Potentially modifiable deployment characteristics and new-onset alcohol abuse or dependence in the US National Guard



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ARTICLE INFO

Article history:

Received 16 September 2013

Received in revised form 2 July 2014

Accepted 4 July 2014

Available online 16 July 2014

Keywords:

Alcoholism

Military Populations

Military Medicine

Military environments

ABSTRACT

Background: There is a limited amount of data examining the relation between the onset of alcohol abuse/dependence and the experiences of soldiers prior to (pre), during (peri) and after (post) military deployment. Some deployment characteristics, e.g., military unit cohesion, are potentially modifiable in the context of reducing alcohol abuse/dependence peri-/post deployment. We investigated the associations between potentially modifiable deployment characteristics and peri-/post (incident) alcohol abuse/dependence among deployed Ohio Army National Guard (OHARNG) soldiers.

Methods: Using a sample of OHARNG (June, 2008 to February, 2009), eligible participants were ever been deployed and did not report alcohol abuse/dependence prior to deployment (final sample size = 963). Interviews assessed soldiers' alcohol abuse/dependence, depression, PTSD, deployment related factors (e.g., exposure to warzone stressors) and three deployment characteristics (pre-deployment preparedness, unit support during deployment, and post-deployment social support). Associations between the three deployment characteristics and incident alcohol abuse/dependence (defined as abuse or dependence at any point during or after deployment) were estimated using logistic regression.

Results: Only pre-deployment preparedness was associated with incident alcohol abuse/dependence (a non-linear inverted-u shaped relation) when controlling for demographics, deployment related factors (e.g., exposure to warzone stressors), and the presence of psychopathology that exhibited peri-/post-deployment. We present these results graphically, plotting incident alcohol abuse/dependence over the levels of pre-deployment preparedness.

Conclusions: The association between pre-deployment preparedness and alcohol abuse/dependence may be characterized as an inverted-U shaped function. Suggestions for how and whether to modify pre-deployment preparedness in an effort to reduce peri-/post-deployment alcohol abuse or dependence should await further research.

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1. Introduction

Alcohol abuse and dependence are serious health concerns in the military as indicated by its relatively high prevalence (Fear et al., 2010; Jacobson et al., 2008), potential comorbidity with psychopathology (Marshall et al., 2012), associations with negative

life consequences (e.g., loss of productivity; Fisher et al., 2000); involvement in the criminal justice system (Stahre et al., 2009), and a higher prevalence in military populations compared to civilian populations (Ames and Cunradi, 2004/2005; Hooper et al., 2008).

A common explanation for alcohol abuse and dependence in military populations is that alcohol provides relief from the psychological and physiological reactions to trauma, a supposition that falls in line with the positive association between the degree of exposure to stressful war-like situations and the prevalence of alcohol abuse and dependence, e.g., comparing military personnel

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vs. civilians (Hooper et al., 2008), deployed vs. non-deployed military personnel (Wilk et al., 2010), and combat versus non-combat deployed soldiers (Fear et al., 2010; Jacobson et al., 2008). An extensive review on trauma and alcohol abuse and dependence (Stewart, 1996) further supports this explanation, suggesting that alcohol is used to relieve a range of trauma-related symptoms including those that are physiological, behavioral, affective, and cognitive both within military populations and in the general population.

Another explanation related to but distinct from the relief of symptoms of trauma, is the historical tradition of alcohol use in the military. Alcohol has served and currently serves several functions in military life (whether tacitly endorsed or not) including: relief from stress and combat fatigue; as a stimulant to invigorate soldiers during combat; engendering social bonding; and, maintaining or increasing morale of troops (Jones and Fear, 2011).

From a health promotion perspective, these two explanatory mechanisms might serve as the basis for revealing potentially modifiable deployment characteristics that could be leveraged to reduce alcohol abuse and dependence in military populations. For example, a low-level of unit leadership and having soldiers' work in theater not matching their training, have both been associated with the risk of post-deployment alcohol abuse and dependence (Browne et al., 2008), potentially suggesting a link between stress experienced in theater (e.g., higher stress given low-levels of leadership) and alcohol use. Furthermore, a higher level of comradeship and being deployed with a parent unit (a unit with which the soldier was familiar) have been positively associated with alcohol abuse and dependence (Browne et al., 2008). This may implicate the use of alcohol in situations where social bonding is relatively high and/or well established.

The effects of potentially modifiable characteristics of deployment on improving soldiers' welfare has been studied more systematically for Post-traumatic Stress Disorder (PTSD) compared to alcohol use (Goldmann et al., 2012). In this work, the modifiable characteristics are delineated in time relative to deployment. Pre-deployment characteristics refer to the degree of preparedness prior to deployment, e.g., having the supplies needed or receiving accurate information about deployment life. Peri-deployment characteristics refer to the degree of support within a soldier's military unit during deployment, e.g., trust among comrades and quality of leadership. Post-deployment characteristics capture the perceived social environment upon returning home from deployment, e.g., feeling at home when returning from deployment and having someone available with whom to discuss deployment-related experiences. Pre-, peri-, and post-deployment characteristics are all positively associated with lower deployment-related PTSD (Goldmann et al., 2012).

Distinguishing among the pre-, peri-, and post-deployment characteristics related to alcohol abuse and dependence in the military may be useful not only because it suggests several potential pathways, but also because it prescribes more specific preventive and intervention approaches. For example, it may be possible to decrease alcohol abuse and dependence by increasing the efficacy of pre-deployment training (highly prepared soldiers more accurately appraise the level of threat across combat situations (Renshaw, 2011)). To date, however, extant research has not yet enumerated the detailed deployment characteristics and the respective associations with deployment-related alcohol abuse and dependence.

In this paper, we attempt to provide a further basis for developing intervention and prevention efforts that use the pre-, peri-, post-deployment distinction. Specifically, we test the associations between pre-, peri- and post-deployment characteristics and alcohol abuse or dependence in a sample of deployed US National Guard who did not have a history of alcohol abuse or dependence prior to deployment. Reserve and National Guard populations

have shown stronger associations with deployment experience and alcohol abuse (Jacobson et al., 2008; Santiago et al., 2010) and this population is understudied compared to active-duty personnel.

2. Methods

2.1. Study population and data collection

The source population was Ohio Army National Guard (OHARNG) soldiers who were enlisted between June 2008 and February 2009. We recruited participants for this study from November 2008–November 2009 through a 2-stage process. First, we notified all soldiers with accurate addresses on file with the OHARNG ($N=12,225$) about the study through an opt-out card; 11,212 soldiers did not return an opt-out card. Of these, we contacted the 6514 (64.6%) who had correct telephone numbers. The final number of survey participants was 2616 (1364 did not wish to participate; 2316 were never reached before the cohort was closed; 187 were retired; 31 were ineligible, e.g., hard of hearing or couldn't speak English). The participation rate was 43.2% (consented/[all correct numbers – ineligible]). The final sample was not representative of the Ohio National Guard 2008 Profile on the following characteristics (see Table 1 of Calabrese et al. (2011) for original data): age, race, marital status, and military rank. These discrepancies were most pronounced for marital status (e.g., our final sample of 2616 was 47% married (Calabrese et al., 2011) compared to 39% for the Ohio National Guard 2008 Profile).

For the current study, we included only respondents who reported ever been deployed ($N=1668$) minus those who had a history of alcohol abuse or dependence before deployment ($N=613$). Because our outcome was alcohol abuse or dependence we excluded those for whom we could not determine the timing of their alcohol abuse or dependence ($N=92$); the final sample size totaled 963. In sum, the study sample were those OHARNG soldiers who participated in the Ohio Army National Guard Mental Health Initiative (OHARNG MHI), had deployment experience, and had no history of alcohol abuse or dependence prior to this deployment.

Study participants were interviewed over the telephone in 60-min interviews (computer-assisted interviewing). We collected data concerning sociodemographics, current living situation, military history, deployment and combat experiences, current and past psychopathology, and alcohol abuse and dependence. All participants were compensated for their time and had access to an on-call clinician in case the participants became distressed at any time during or after the interview. The Institutional Review Boards of University Hospitals Case Medical Center University of Toledo and Columbia University approved the study protocol. The National Institutes of Health provided the study with a certificate of confidentiality. The study was approved by the US Department of Defense (Human Research Protection Office, Office of Research Protections and the US Army Medical Research and Materiel Command).

2.2. Measures

Our main outcome of interest was whether a soldier developed alcohol abuse or dependence at any point in time from the beginning of his/her most recent deployment to participation in the survey (Yes/No). We operationalized alcohol abuse or dependence using the Mini International Neuropsychiatric Interview and DSM-IV criteria (Sheehan et al., 1998); i.e., the soldier reported at least 1 maladaptive pattern of alcohol use that lead to clinically significant impairment or distress. The temporal context for the items used to measure alcohol abuse or dependence was soldier's

Table 1

Distribution of individuals with selected characteristics in the sample (column 2), the distribution of individuals who developed alcohol abuse or dependence during or after deployment by each selected characteristic (column 3), and the association between the selected characteristics and new-onset alcohol abuse or dependence (column 4).

Characteristic	Total sample number (%)	Number (%) who develop alcohol abuse/dependence	Odds ratio of incident alcohol abuse/dependence
Demographics			
Gender			
Male	841 (87.3)	109 (13.0)	1
Female	122 (12.7)	4 (3.3)	0.23 (0.08–0.63)
Age			
17–24	200 (20.8)	29 (14.5)	1
25–34	373 (38.8)	55 (14.8)	1.02 (0.63–1.66)
35–44	281 (29.2)	25 (8.9)	0.58 (0.33–1.01)
≥45	107 (11.1)	4 (3.7)	0.23 (0.08–0.67)
Race			
White	828 (86.1)	105 (12.7)	1
Black	85 (8.8)	4 (4.7)	0.34 (0.12–0.95)
Other	49 (5.1)	4 (8.2)	0.61 (0.22–1.74)
Income			
>\$60,000	532 (56.3)	40 (9.7)	1
≤\$60,000	413 (43.7)	72 (13.5)	0.69 (0.46–1.03)
Marital status			
Married	539 (56.2)	44 (8.2)	1
Divorced/separated/widowed	106 (11.0)	17 (16.0)	2.15 (1.18–3.93)
Never married	315 (32.8)	51 (16.2)	2.17 (1.41–3.34)
Deployment related factors			
Most recent deployment setting			
Non-conflict	528 (54.8)	39 (7.4)	1
Conflict	435 (45.2)	74 (17.0)	2.57 (1.70–3.88)
Number of deployments			
One	511 (53.1)	73 (16.7)	1
>One	452 (46.9)	40 (9.7)	0.58 (0.39–0.88)
Exposure to warzone stressors			
≤Median	499 (51.8)	33 (7.1)	1
>Median	464 (48.2)	80 (20.8)	2.94 (1.92–4.51)
Either PTSD or depression developed during or after deployment			
No	821 (85.3)	70 (8.2)	1
Yes	142 (14.7)	43 (30.1)	4.66 (3.02–7.19)
Total	963	113 (11.7)	

lifetime. We used age at first occurrence of symptoms to time-lock alcohol abuse or dependence to the most recent deployment.

Our main exposures of interest were the nature of potentially modifiable deployment characteristics, specifically, the level of preparedness before, unit support during, and general social support after deployment (preparedness, unit support, and post-deployment support, respectively). To measure these exposures, we used validated instruments from the Deployment Risk and Resilience Inventory (King et al., 2006). Each instrument was constructed from Likert-like items where 1 = strongly disagree, 3 = neutral, and 5 = strongly agree. The preparedness instrument was composed of five items; the unit support and post-deployment support instruments, from seven and six items, respectively. Examples of the items for preparedness were “I received adequate training on how to use my equipment” and “I was accurately informed of what daily life would be like during my deployment;” for unit support, “I was impressed by the quality of leadership in my unit” and “Most people in my unit were trustworthy;” for post-deployment support, “The reception I received when I returned from my deployment made me feel appreciated for my efforts” and “There are people to whom I can talk about my deployment experiences.” The internal consistency for the pre-deployment preparedness instrument was 0.69 (Cronbach’s alpha); for unit support it was 0.85; for post-deployment support, 0.62.

For the analysis, we manipulated these instruments in the following way. First, we transformed each item into dichotomous form where “somewhat agree” and “strongly agree” became equal to one and “neutral”, “somewhat disagree”, “strongly disagree” and non-response became equal to zero. Then, for each instrument we

summed the dichotomous items to construct the final measure. The range for the final pre-deployment preparedness measure was zero to five; for the unit and post-deployment support measures, it was zero to seven and zero to six, respectively. Given this construction, each final measure can be considered the number of items in the instrument for which a respondent responded “somewhat agree” or “strongly agree” and assumes that non-response was not one of these categories (the average non-response rate across items within each scale was 0.75, 0.79, and 0.94% for preparedness, unit support and post-deployment support, respectively).

A key covariate was the presence of psychopathology (posttraumatic stress disorder and/or depression) that was first developed during or after deployment. We assessed the symptoms of posttraumatic stress disorder using the PTSD Checklist (PCL-C) (Weathers et al., 1991). Those coded as exhibiting PTSD met the following criteria (according to the PCL-C and the DSM-IV 2000): the experience of a traumatic event, and as a result of the event, experienced fear, helpless or horror during or immediately after the trauma; at least 1 symptoms of re-experiencing the trauma; at least 3 symptoms of avoidance and numbing; and at least 2 symptoms of hypervigilance. He/she must also have experienced the symptoms for at least 1 month and reported either social or functional impairment because of the symptoms. We determined whether a participant met the criteria for depression using the Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001). To meet the criteria for depression, he/she had to have at least 2 or more symptoms of depression, one of which was either depressed mood or anhedonia, in the same two-week period. The time of the first presence of symptoms for PTSD and depression were assessed separately and

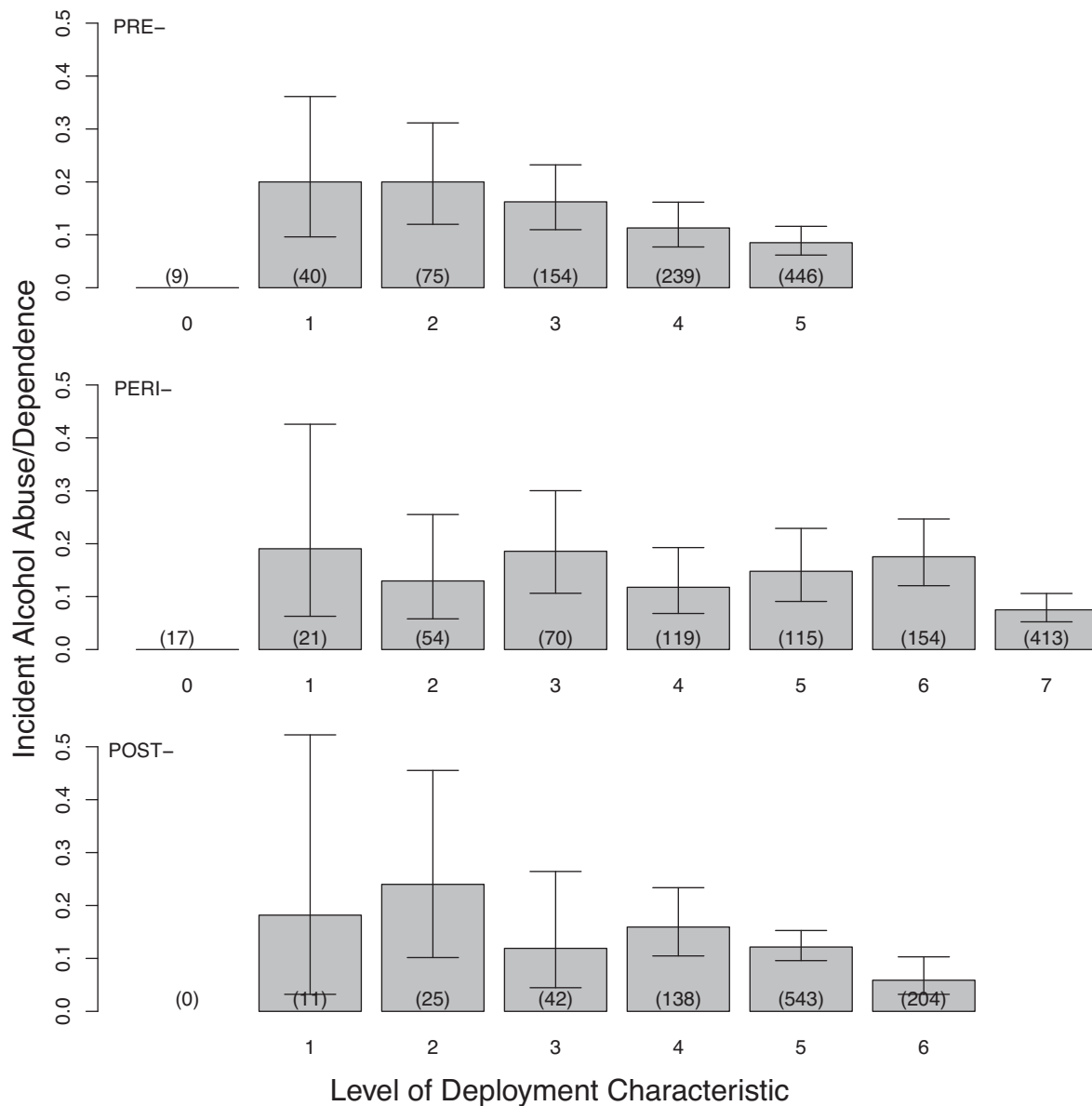


Fig. 1. Proportion of incident alcohol abuse or dependence by each level of deployment characteristic (pre-, peri-, post- separately). The *N* for each proportion is provided in parenthesis on the x-axis. The error bars represent 95% confidence intervals.

in reference to the soldier's most recent deployment. If a soldier first developed either PTSD or depression during or after deployment they were categorized as developing a psychopathology as a result of the deployment.

We computed a measure of degree of exposure to warzone stressors using the 25 items from the Deployment Risk and Resilience Inventory (DRRI; King et al., 2006) and a list of 9 additional traumatic events (Breslau et al., 1998). Participants completed a battery of 34 items about their exposure (yes/no response categories) during their most recent deployment, to a variety of combat experiences. For analysis, we constructed a simple sum score across items (range was 0 to 31; $M = 6.65$ (7.24 SD); median = 4). The magnitude of this scale was a proxy for the degree of exposure to warzone stressors.

2.3. Analysis

First, we examined the distribution of incident alcohol abuse or dependence across selected characteristics of our participants.

We used bivariate logistic regression to examine if the distribution of incident alcohol cases was associated with the sample characteristics. Second, we plotted the average incident alcohol abuse or dependence across levels of the preparedness, unit support and post-deployment support measures. Third, we ran a series of logistic regression models to determine the association between deployment characteristics (preparedness, unit support, and post-deployment support) and incident alcohol abuse or dependence. Because our final model included squared terms, we presented the predicted probabilities in graphical form to aid in interpretation.

3. Results

The distribution of incident alcohol abuse or dependence is reported in Table 1. Of our entire sample, 11.7% of soldiers first developed symptoms of alcohol abuse or dependence during or after their most recent deployment. Several key significant findings from Table 1 are as follows (Odds Ratios are provided here, see Table 1 for confidence intervals; the latter category was the

referent in all comparisons): being divorced, separated, or widowed vs. married (OR = 2.15), being single vs. married (OR = 2.17), being deployed most recently to a conflict setting vs. a non-conflict setting (OR = 2.57), having exposure to greater than four warzone stressors (the median) vs. less than or equal to the median (OR = 2.94), and those who developed psychopathology during or after deployment vs. not (OR = 2.53) were all associated with an increased odds of incident alcohol abuse or dependence that manifested during or after deployment. Furthermore, women were less likely than men to exhibit incident alcohol abuse or dependence (OR = 0.23); black was less than white (OR = 0.34); greater than or equal to 45 years old was less than 17–24 (OR = 0.23); and having participated in more than one deployment was less than having participated in only one deployment (OR = 0.58).

Fig. 1 illustrates the average incident alcohol abuse or dependence across levels of the three potentially modifiable deployment characteristics and suggests that the relation between deployment characteristics and incident alcohol abuse or dependence was not linear. In particular, for both preparedness and unit support, the respondents with the lowest level had no incident alcohol abuse or dependence. This suggested the introduction of quadratic terms in the regression models.

Table 2 presents the results of the logistic regression models (Odds Ratios and CIs are reported in Table 2). In Model 1, adjusting for other deployment conditions (and no other factors), only preparedness and post-deployment support were associated with incident alcohol abuse or dependence during or after deployment. Model 2 was used to test whether adding the squared deployment characteristics terms would significantly improve the fit of the Model 1. A likelihood ratio test indicated an improved fit from Model 1 to Model 2 (Chi-sq = 10.86, df = 3, $p < 0.05$). Models 3 and 4, using the same logic and with the same purpose as the comparison between Models 1 and 2, adjusted for the following: demographics (e.g., gender and age), whether psychopathology developed during or after deployment, whether the most recent deployment was to a conflict setting, whether the last deployment was the first and only deployment ever, and the degree of exposure to warzone stressors. A likelihood ratio test indicated an improved fit from Model 3 to Model 4 (Chi-sq = 9.19, df = 3, $p < 0.05$). Thus, as a whole, Models 1 to 4 suggest that the squared terms for deployment characteristics should be kept in the model. Next, we conducted a series of three likelihood ratio tests, each of which tested the addition of only one squared deployment characteristics measure to Model 3, to determine which of the three squared deployment characteristics terms should be kept in the final model. Only the addition of the squared term for pre-deployment preparedness was significant (Chi-sq = 6.90, df = 1, $p < 0.05$). So, the final model, Model 5, added only the squared term for pre-deployment preparedness to Model 3. In Model 5, pre-deployment preparedness was the only deployment characteristic associated with incident alcohol abuse or dependence.

Fig. 2 plots the predicted probabilities of incident alcohol abuse or dependence over pre-deployment preparedness. To do this, we used a simplified version of Model 5 that included only its statistically significant predictors and also collapsed “divorced/separated/widowed” and “never married” into one category to create a currently not-married dichotomous variable (0 = married, 1 = divorced/separated/widowed/never married). To create Fig. 2, we varied pre-deployment preparedness from zero to five while fixing the degree of exposure to warzone stressors to its average value (6.65) for each of all 16 combinations of the following dichotomous variables: gender, currently non-married, number of deployments > 1, and psychopathology during or after deployment. The purpose here was to visually depict the non-linear relation between pre-deployment preparedness and incident alcohol abuse or dependence, a relation that can be characterized for some

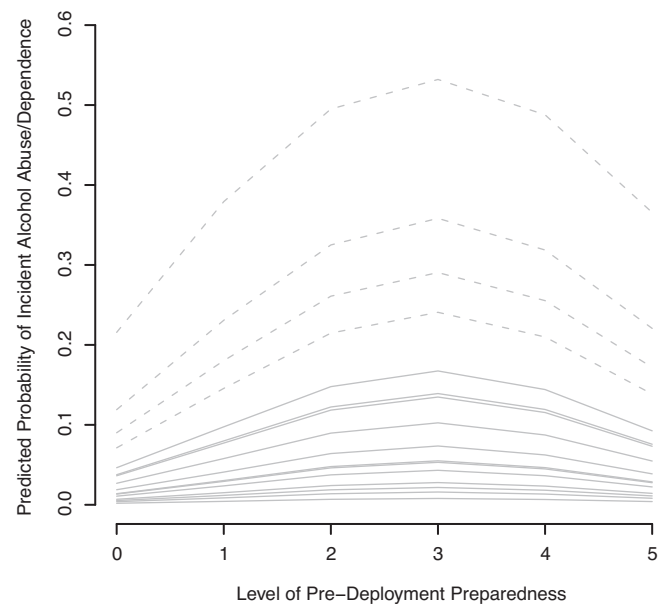


Fig. 2. The predicted probability of incident alcohol abuse or dependence over levels of pre-deployment preparedness using a simplified version of Model 5 from Table 2. (see text for details on the simplified Model 5).

combinations of predictors as strongly inverted-U shaped. The four dotted-lines in Fig. 2 represent the combinations of factors with the highest predicted probabilities and can be characterized as all male, primarily non-married, primarily with only one deployment and primarily with psychopathology during or after deployment (see Table 3 for a more precise characterization).

4. Discussion

In a sample of the US National Guard, without a history of alcohol abuse or dependence, the level of pre-deployment preparedness was associated with the likelihood of developing new-onset peri- or post-deployment alcohol abuse or dependence. Specifically, the relation between pre-deployment preparedness and peri- or post-deployment alcohol abuse or dependence was characterized by an inverted-u shaped function such that the highest degree of alcohol abuse or dependence was at moderate levels of pre-deployment preparedness. Furthermore, the inverted-U shaped function was most prominent in four specific sub-groupings of respondents, characterized as male, mostly non-married, mostly deployed only once, and mostly with PTSD/depression during or after deployment.

This work is a direct descendent of a recent paper—using precisely the same dataset, the same subpopulation ($N = 963$) and the same definitions of incident alcohol abuse/dependence and psychopathology—that investigated the association between psychopathology and incident alcohol abuse/dependence (Marshall et al., 2012). They found that depression and PTSD that developed during or after deployment was associated with incident alcohol abuse or dependence. (Importantly, depression and PTSD that developed prior to deployment was not associated with incident alcohol abuse or dependence.) The findings presented here extend these findings to suggest that when controlling for PTSD/depression that occurred during or after deployment, only pre-deployment preparedness (and not unit support or post-deployment social support) was associated with incident alcohol abuse or dependence.

This interpretation, however, is qualified by the non-linear, inverted-U shaped relation between pre-deployment preparedness and incident alcohol abuse or dependence. We explored the 9 survey participants (see Fig. 1) who reported no pre-deployment

Table 2

Adjusted association (OR, 95% CI) between incident alcohol abuse or dependence and the pre-, peri- and post-deployment characteristics.

Predictors	Model 1	Model 2	Model 3	Model 4	Model 5
Preparedness	0.83 (0.71–0.98)	1.41 (0.66–3.00)	0.97 (0.80–1.18)	2.79 (1.12–6.95)	3.02 (1.23–7.44)
Unit support	0.99 (0.88–1.11)	1.85 (1.05–3.24)	0.93 (0.82–1.07)	1.46 (0.79–2.72)	0.95 (0.83–1.09)
Post-deployt. support	0.82 (0.67–0.99)	1.57 (0.57–4.30)	0.98 (0.78–1.24)	1.16 (0.37–3.63)	0.95 (0.75–1.21)
Preparedness squared	–	0.92 (0.82–1.03)	–	0.85 (0.74–0.98)	0.84 (0.73–0.96)
Unit supp. squared	–	0.93 (0.88–0.99)	–	0.95 (0.89–1.02)	–
Post-dep. supp. squared	–	0.92 (0.81–1.04)	–	0.98 (0.85–1.12)	–
Female	–	–	0.15 (0.05–0.45)	0.14 (0.05–0.41)	0.13 (0.04–0.40)
Age 25–34	–	–	1.53 (0.84–2.79)	1.59 (0.87–2.90)	1.60 (0.88–2.92)
Age 35–44	–	–	0.95 (0.44–2.08)	0.99 (0.45–2.18)	1.01 (0.46–2.22)
Age ≥45	–	–	0.47 (0.14–1.58)	0.50 (0.15–1.70)	0.50 (0.15–1.69)
Black	–	–	0.32 (0.10–1.01)	0.32 (0.10–1.01)	0.32 (0.10–1.00)
Other	–	–	0.69 (0.22–2.19)	0.64 (0.20–2.08)	0.65 (0.20–2.10)
Income ≤\$60k	–	–	1.17 (0.71–1.93)	1.14 (0.69–1.90)	1.14 (0.69–1.89)
Divorced/sep/widow	–	–	2.68 (1.32–5.44)	2.82 (1.38–5.77)	2.82 (1.38–5.76)
Never married	–	–	2.66 (1.49–4.77)	2.78 (1.54–5.02)	2.88 (1.60–5.19)
Conflict setting last depl.	–	–	1.04 (0.59–1.85)	1.02 (0.57–1.82)	1.02 (0.57–1.84)
Num. deployments >1	–	–	0.47 (0.29–0.77)	0.45 (0.28–0.74)	0.45 (0.28–0.74)
Warzone stressors*	–	–	1.08 (1.04–1.12)	1.08 (1.04–1.12)	1.08 (1.04–1.12)
PTSD/depression	–	–	3.58 (2.15–5.98)	3.69 (2.20–6.19)	3.66 (2.19–6.12)

Note: See Table 1 for referent categories of categorical predictors.

* Warzone stressors used the continuous measure as described in text under Measures.

Table 3

Characterization of the four groups with the highest predicted probabilities of incident alcohol abuse or dependence as depicted in Fig. 2.

Order	Gender	Currently non-married	Num. deployments >1	PTSD/depression during/after deployment
1	Male	Yes	No	Yes
2	Male	Yes	Yes	Yes
3	Male	No	No	Yes
4	Male	Yes	No	No

Note: Ordering of groups is from the highest predicted probability to lowest from Fig. 2.

preparedness with respect to all of the factors that are presented in the regression models. There were no obvious distinguishing characteristics of this small sub-group of participants except that all were male. Furthermore, the average values for the deployment related factors for these 9 survey participants were as follows: most recent deployment to a conflict setting, 67%; participating in more than one deployment, 44%; exposure to warzone stressors, 10.67; and, development of psychopathology during or after deployment, 56%. Clearly, these factors were not driving the lack of any alcohol abuse or dependence in this small group when taken in context of the results of the regression modeling in Table 2, where these factors, with the exception of deployment in a conflict setting, were strongly associated with incident alcohol abuse or dependence. These data do not warrant speculation concerning what underlies the inverted-u relation. Further research should investigate this finding in more detail.

The non-linear relation between pre-deployment preparedness and incident alcohol abuse or dependence poses an interesting challenge in terms of thinking about the potential to modify deployment preparedness. One way to interpret these data is that increasing the amount of pre-deployment preparedness may increase peri-/post-deployment alcohol abuse or dependence for those with little or no preparedness (by shifting them to the right of the inverted-U relation). This interpretation, naturally, flies in the face of both logic and intuition, especially given that these data are cross-sectional. However, we present this counter-intuitive interpretation to emphasize the need for further research, either focusing on alternative or expanded measurements of pre-deployment preparedness or attempting to better characterize the rare participants who reported zero pre-deployment preparedness. It may be that our measure of pre-deployment preparedness did not capture its intended meaning for the nine respondents who reported zero preparedness; or, potentially, these respondents may not have been in need of pre-deployment preparedness. Further

research is warranted before recommendations on the potential to modify pre-deployment preparedness are provided.

Another issue raised by our findings is why was pre-deployment preparedness the only modifiable characteristic associated with alcohol abuse or dependence? Similar work on the relation between deployment characteristics – defined in the same way – and deployment-related PTSD (Goldmann et al., 2012) found that all three types of deployment characteristics (pre-, peri- and post-) reduced the odds of peri-/post-deployment related PTSD. In our regression models, we controlled for peri-/post-deployment PTSD and depression. This suggests that although all three types of deployment characteristics are implicated in peri-/post deployment related PTSD, there is an additional association between pre-deployment preparedness and incident alcohol, but not for unit support or post-deployment social support. These data do not warrant speculation on this point, but instead point to the possibility that the potential for modifiable deployment-related characteristics must be considered in tandem with specific targeted outcomes (e.g., PTSD, depression and alcohol abuse/dependence). Please note, however, that the internal consistency of the post-deployment support measure was moderate (Cronbach's alpha = 0.62), which may have affected the lack of association between post-deployment support and incident alcohol abuse or dependence.

This study has the following strengths: (1) the use of the DSM-IV to define the outcome of interest and the principle covariate, psychiatric conditions, and (2) the delineation of new-onset alcohol abuse or dependence relative to deployment. This study also suffered from several limitations. First, the use of retrospective data to assess pre- and peri- deployment characteristics may have introduced recall bias with respect to new-onset alcohol abuse or dependence, preparedness, unit support, and post-deployment support. Second, although these data were supposed to capture variables related to the most recent deployment, there was no assurance that this consideration was reflected in the participants'

reporting for those with multiple deployment histories. Third, some respondents may have been misclassified in terms of both new-onset alcohol abuse or dependence and peri-/post-deployment PTSD and depression. It is known that psychiatric conditions may be delayed post-deployment by 3–4 months (Bliese et al., 2007), a window of time that, for some respondents, may not have transpired between the end of deployment and survey administration. Such misclassification would most likely reduce the prevalence of both variables. Fourth, the current study used a relatively sensitive measure of alcohol abuse or dependence (only one of the four DSM-IV criteria had to be reported) that does not accord with the DSM-5. We decided to use the DSM-IV definition of alcohol abuse or dependence because it has established predictive validity (Schuckit et al., 2001). Finally, our sample was not representative of the Ohio National Guard, although the differences in the distribution of demographic characteristics were not of large magnitude except for marital status (see above under Study Population and Data Collection). The Millennium Cohort Study, a high-quality longitudinal study of the US Armed Forces, suffers from similar non-representativeness but has provided much useful information (Riddle et al., 2007; Ryan et al., 2007) as have several other studies using the same sample we use in this article (Calabrese et al., 2011; Goldmann et al., 2012; Marshall et al., 2012).

In sum, this study demonstrated that pre-deployment preparedness, a potentially modifiable characteristic of military deployment, was associated with incident alcohol abuse or dependence relative to deployment in members of the Ohio National Guard. Thus, pre-deployment preparedness may be a candidate for intervention/prevention efforts that aim to reduce incident alcohol abuse and dependence among deployed military personnel, at least within the Ohio National Guard, and potentially to other similar military populations. Although this work points to a potentially modifiable deployment characteristic that may be useful to military planners, further research is needed to better understand the non-linear relation between pre-deployment preparedness and incident alcohol abuse or dependence, how all types of deployment characteristics may be improved and whether these results may generalize to other military populations.

Role of funding source

This work was funded by the Ohio Army National Guard Mental Health Initiative through Department of Defense Appropriations W81XWH-07-1-0409/W81XWH-10-1-0579 (Joseph R. Calabrese and Marijo Tamburrino) and by a Merit Fellowship in Epidemiology to Dr. Orr from the Columbia University Mailman School of Public Health. Neither funding sources had any role in study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

Contributors

Author SG had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the analysis. Authors MGO, MRP, and SG designed the study and wrote the protocol. Authors IL, MBT, JRC and SG were responsible for obtaining study funding and acquiring the data. Author MGO managed the literature searches and summaries of previously published related work. Author MRP undertook the statistical analysis with significant scientific input from MGO and SG. Author MGO wrote the first draft of the manuscript and authors MRP, IL, MBT, JRC, and SG contributed to its content and critical revision of the manuscript for important intellectual content. All authors approved the final manuscript.

Conflict of interest statement

Dr. Calabrese has received federal funding from the Department of Defense, Health Resources Services Administration and National Institute of Mental Health; has received research support from Abbott, AstraZeneca, Bristol-Myers Squibb, Cephalon, Cleveland Foundation, Eli Lilly, GlaxoSmithKline, Janssen, NARSAD, Repligen, Stanley Medical Research Institute, Takeda and Wyeth; has consulted to or served on advisory boards of Abbott, AstraZeneca, Bristol-Myers Squibb, Cephalon, Dainippon Sumitomo, EPI-Q, Inc., Forest, France Foundation, GlaxoSmithKline, Janssen, Johnson and Johnson, Lundbeck, Neurosearch, OrthoMcNeil, Otsuka, Pfizer, Repligen, Schering-Plough, Servier, Solvay, Supernus, Synosia, and Wyeth; has provided CME lectures supported by Abbott, AstraZeneca, Bristol-Myers Squibb, France Foundation, GlaxoSmithKline, Janssen, Johnson and Johnson, Sanofi Aventis, Schering-Plough, Pfizer, Solvay, and Wyeth; has no speaker bureaus for the past 9 years (past speaker bureaus included Abbott, AstraZeneca, Eli Lilly, and GlaxoSmithKline); has no stock, no equity, and no patents. All other authors declare that they have no conflicts of interest.

Acknowledgements

We wish to thank soldiers of the Ohio Army National Guard who participated in this study for contributing to the research.

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