

Award Number: W81XWH-10-1-0579

TITLE: Kaptur Combat Mental Health Initiative: Risk and Resilience Factors for Combat Related Posttraumatic Psychopathology and Post Combat Adjustment

PRINCIPAL INVESTIGATOR: Joseph R. Calabrese, M.D.

CONTRACTING ORGANIZATION:
University Hospitals Case Medical Center
Cleveland, Ohio 44106

REPORT DATE: October 2012

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release;
Distribution Unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

REPORT DOCUMENTATION PAGE				<i>Form Approved</i> OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE 1 Oct 2012		2. REPORT TYPE Annual		3. DATES COVERED 28 Sep 2011 – 27 Sep 2012	
4. TITLE AND SUBTITLE Kaptur Combat Mental Health Initiative: Risk and Resilience Factors for Combat Related Posttraumatic Psychopathology and Post Combat Adjustment				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER W81XWH-10-1-0579	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Calabrese, Joseph, R., M.D. Tamburrino, Marijo, M.D. Galea, Sandro, M.D., DrPH E-Mail: joseph.calabrese@uhhospitals.org				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University Hospitals of Cleveland 11100 Euclid Ave. Cleveland, OH 44106-5000				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution Unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT The general objective of the Ohio Army National Guard Mental Health Initiative is to evaluate the relationships between resilience and risk factors, both cross-sectionally and longitudinally, before, during, and after deployment in the Ohio Army National Guard. The primary project collects long-term data on a random representative sample of up to 3,000 service members per year in the OANG, both treatment seeking and non-treatment seeking. Over the past year, six manuscripts have been published, with 3 others currently under peer review. An additional six data analyses are completed with manuscripts in preparation. The investigators have continued to focus on alcohol use disorders and suicide as areas of unmet need in the National Guard. For example, 10% of our study sample qualified for wave 1 depression, and 9% of those soldiers had suicidal ideation at the 1-year follow-up, as compared to only 2% among those with no depression at baseline ($p < 0.0001$). Additionally, among those reporting wave 1 alcohol dependence (6% of $N=1587$ without depression or prior suicidal ideation), 9% reported suicidal ideation at 1-year follow-up, compared to only 2% incident suicidal ideation among those with no baseline alcohol dependence ($p=0.0002$). These results highlight the need for further study, prevention, and intervention of alcohol use disorders in the military.					
15. SUBJECT TERMS Risk, Resilience, Combat, Posttraumatic Stress Disorder, Ohio National Guard, Mental Health, Genetics, Alcohol Use Disorders, Suicide					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON USAMRMC
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (include area code)
			UU	369	

Table of Contents

	<u>Page</u>
Introduction.....	4
Body.....	4
Key Research Accomplishments.....	14
Reportable Outcomes.....	15
Conclusion.....	18
References.....	20
Appendices.....	21

Ohio Army National Guard Mental Health Initiative

Risk and Resilience Factors for Combat-Related Posttraumatic Psychopathology and Post Combat Adjustment

Annual Report, October 2012

INTRODUCTION

Previously conducted research has demonstrated that deployment accompanied by combat experience results in increased risk of posttraumatic psychopathology and other mental health conditions. The general objective of the Ohio Army National Guard Mental Health Initiative is to create a research infrastructure capable of supporting a series of projects that evaluate the relationships between resilience and risk factors, both cross-sectionally and longitudinally, before, during, and after deployment. The primary project will collect long-term data on a random representative sample of up to 3,000 service members of the Ohio Army National Guard, both treatment seeking and non-treatment seeking. Research visits will be conducted at study entry and every 12 months for a minimum of 10 years. The Telephone Survey will be completed on all main project participants, and 500 of these participants will also have an in-depth In-Person Survey on an annual basis for the duration of the study. The Genetics Repository component collects a DNA saliva sample from consenting participants in the main project.

BODY

The Initiative is designed to study the relationships between 1) pre-existing mental illness/substance use disorders, 2) deployment to Operation Iraqi Freedom (OIF) or Operation Enduring Freedom (OEF), and 3) post-deployment related mental health and overall psychosocial adjustment and functioning. The study will evaluate several groups of the Ohio Army National Guard: those deployed to OIF (Iraq, Kuwait, or Qatar), those deployed OEF (Afghanistan), those deployed to other theaters (Bosnia, Turkey, Uzbekistan, Kosovo, on a ship, or other), those deployed domestically, and those not deployed.

Project #1 (main cohort – Telephone Survey and In-Person Survey) and Project #2 (Genetics component) are currently ongoing. An ancillary project entitled: “Neuroimaging and Genetic Investigation of Resilience and Vulnerability to PTSD” began enrolling (N=37) in September 2011.

Sites

The team of individuals and infrastructures committed to this project is extensive and has a reporting relationship to the leadership of the Ohio National Guard, The Ohio Adjutant General Deborah Ashenhurst and Assistant Adjutant General of the Army BG John Harris, through the Guard’s OHIOCARES Workgroup. The Principal Investigator (PI) of the Ohio Army National Guard Mental Health Initiative is Joseph R. Calabrese, M.D. and the Co-PI is Marijo Tamburrino, M.D. The Initiative includes a Coordinating Center based out of University Hospitals Case Medical Center (UHCMC) (Dr. Calabrese), and six operating research sites including University Hospitals Case Medical Center, the University of Toledo (Dr. Tamburrino), Columbia University Department of Epidemiology (Dr. Galea), a prestigious research survey firm, Abt SRBI, Inc. with a very

long history of military research, the Ann Arbor VAMC Department of Psychiatry at the University of Michigan (Dr Liberzon), and Michigan State University's Biomedical Research and Informatics Center - BRIC (Dr Reed).

With Dr. Calabrese as the coordinating principal investigator, the UHCMC Coordinating Center is responsible for all aspects of project coordination (scientific, administrative, and fiscal) and the conduct of in-person assessments of 300 service members in their local communities. With Dr. Tamburrino as project Co-PI, the University of Toledo provides leadership and also conducts in-person assessments of 200 service members in their local communities. The Columbia University Department of Epidemiology responsibilities include, but are not be limited to, the design of the project's field procedures, including the annual Telephone Survey and In-Person Survey, scientific manuscript preparation, NIMH grant application, etc. Dr. Galea also serves as the primary interface between the project and the survey firm, Abt SRBI, which carries out the telephone surveys. The University of Michigan Ann Arbor VA Department of Psychiatry is responsible for the design, implementation, and oversight of the Genetics Repository, including laboratory and field procedures for biological sample collection, processing, storage, association analyses, etc. The Michigan State University Biomedical Research Informatics Center will provide all aspects of informatics needs for the In-Person Survey assessments, including data entry and management privileges, enrollment privileges, survey building privileges, etc.

Project #1

The primary study (Project #1) within this Initiative is a clinical epidemiology and health services project and is designed to function as the template upon which other projects, including but not limited to those of a translational research nature, will be superimposed. The first three specific aims of the primary research project were designed to build support and stimulate additional interest in the study of the role of resilience and risk in combat-related posttraumatic psychopathology and other similar adjustment problems.

Specific Aims of Project #1:

1. To study the relationship between deployment-related experiences and the development and trajectory of DSM-IV Axis I diagnoses
2. To document the factors across the life-course that are associated with resilience to DSM-IV Axis I diagnoses and with better post-deployment functioning
3. To study the relationship between National Guard-specific pre-deployment and post-deployment factors and the risk of development of DSM-IV Axis I disorders

Project #1 will interview up to 3,000 members of the Ohio National Guard, who were selected at random from the entire population of the Guard. All individuals who participate are interviewed for 1 hour by telephone on an annual basis, and began in November 2008.

A sub-sample of 500 participants of the telephone survey group is also interviewed on an annual basis and in-person, which on average last 2-3 hours. This sub-sample allows both for validation of key domains employed in the phone interviews and for further in-depth study of trajectory of psychopathology in this sample. Study personnel recommend that participants bring a family member, friend, or significant other for support and assistance during the interview. Family support often facilitates participant retention throughout the life of the project.

Research visits are conducted at study entry and every 12 months for a minimum of 10 years for both the telephone survey and in person survey. Currently, Year 4 of data collection is proceeding with the Telephone Survey sample. The participants have variable lengths of involvement and variable combat exposures, allowing us to suitably address the specific aims.

As recommended by the Scientific Advisory Board during the 2010 annual meeting, the investigators started a Dynamic Cohort at the end of 2010.

Research Accomplishments from the Statement of Work for Project #1: Tasks #1 - #5 from the Statement of Work delineate the critical events that must be accomplished in order for the project to be successful in terms of cost, schedule, and performance. Task #1 has been completed, with Tasks #2 through #5 currently in progress.

Tasks #1 and #2 – Baseline enrollment and Annual participant follow-up of up to 3,000 Ohio National Guard Members in the Telephone Survey, and 500 for the validation In-Person Survey, in order to be able to test Specific Aims #1 -3 with associated hypotheses.

Telephone Survey Enrollment		
Project Year	Actual Enrollment	Interviews Completed
Year 1 2008-2009	2,616	2,616
Year 2 2009-2010	0	1,770
Year 3 2010-2011	578	1,973
Year 4 2011-2012	233	1,456
Total	3,427	7,815

In-Person Survey Enrollment		
Project Year	Actual Enrollment	Interviews Completed
Year 1 2008-2009	500	500
Year 2 2009-2010	0	418
Year 3 2010-2011	105	461
Year 4 2011-2012	63	405
Total	668	1,784

Telephone Survey and In-Person Survey Summary Table		
Project Year	Actual Enrollment	Interviews Completed
Year 1 2008-2009	3,116	3,116
Year 2 2009-2010	0	2,188
Year 3 2010-2011	683	2,434
Year 4 2011-2012	296	1,861
Total	4,095	9,599

Task #3 – Performance of a descriptive analysis of the data collected from the primary and sub-sample group including the prevalence of current mental illness and voluntary triage to OhioCares. At least one peer-reviewed publication per year will be derived from the study data.

We have performed several analyses of the data collected from the baseline sample, Year 2, and Year 3 sample of participants. As reported previously, for baseline analyses we examined the broad range of characteristics that are hypothesized to be associated with mental health conditions, as well as potential mediators of these associations. As further analyses were completed over the past year, we presented the results at scientific conferences and submitted manuscripts for peer-reviewed publication.

The following manuscripts have been published since the last annual report. Please see **Appendix A** for the full text reprints.

1. Marshall BD, Prescott MR, Liberzon I, Tamburrino MB, Calabrese JR, Galea S. Coincident posttraumatic stress disorder and depression predict alcohol abuse during and after deployment among Army National Guard soldiers. *Drug Alcohol Depend.* 2012 Aug 1;124(3):193-9. Epub 2012 Feb 17. PMID:22342428
 - Coincident depression and PTSD were predictive of developing peri-/post-deployment alcohol abuse, and thus may constitute an etiologic pathway through which deployment-related exposures increase the risk of alcohol-related problems.
2. Elhai JD, Contractor AA, Tamburrino M, Fine TH, Prescott MR, Shirley E, Chan PK, Slembariski R, Liberzon I, Galea S, Calabrese JR. The factor structure of major depression symptoms: A test of four competing models using the Patient Health Questionnaire-9. *Psychiatry Res.* 2012 Jun 12. [Epub ahead of print] PMID: 22698261
 - Results demonstrated greater support for the two-factor models of depression than for the one-factor model.
3. Goldmann E, Calabrese JR, Prescott MR, Tamburrino M, Liberzon I, Slembariski R, Shirley E, Fine T, Goto T, Wilson K, Ganocy S, Chan P, Serrano MB, Sizemore J, Galea S. Potentially modifiable pre-, peri-, and postdeployment characteristics associated with deployment-related posttraumatic stress disorder among ohio army national guard soldiers. *Ann Epidemiology.* 2012 Feb; 22(2):71-7. PMID 22226029
 - Results show that factors throughout the life course of deployment in particular, postdeployment support may influence the development of PTSD. These results suggest that the development of suitable postdeployment support opportunities may be centrally important in mitigating the psychological consequences of war.
4. Goodwin R, Prescott MR, Tamburrino MB, Calabrese JR, Liberzon I, Galea S. Cigarette smoking and subsequent suicidal ideation among National Guard Soldiers. *Journal of Affective Disorders.* *in press*
 - Army National Guard soldiers who smoke have a greater risk of subsequent suicidal ideation. Depression concurrent with suicidal ideation appears to

explain this relationship. If these results are replicated, screening of soldiers who smoke may be recommended as a proactive step towards mitigating the high risk of suicide in military personnel.

5. Biehn TL, Contractor A, Elhai JD, Tamburrino M, Fine TH, Prescott MR, Shirley E, Chan PK, Slembariski R, Liberzon I, Calabrese J, and Galea S. Relations Between the Underlying Dimensions of PTSD and Major Depression Using an Epidemiological Survey of Deployed Ohio National Guard Soldiers. *Journal of Affective Disorders. In press*
 - Results demonstrated that both PTSD's dysphoria and hyperarousal factors were more related to depression's somatic than non-somatic factor; however, PTSD's dysphoria was more related to somatic depression than PTSD's hyperarousal factor. Given PTSD's substantial dysphoria/distress component these results have implications for understanding the nature of PTSD's high comorbidity with depression.
6. Marshall BDL, Prescott MR, Liberzon I, Tamburrino MB, Calabrese JR, Galea S. Posttraumatic Stress Disorder and HIV Risk Behavior among Army National Guard Soldiers: The Mediating Role of Depression. *Journal of Traumatic Stress. In press*
 - Soldiers with PTSD may be at greater risk of HIV infection due to increased engagement in HIV risk behavior. New onset depression following trauma mediates this relationship. Integrated interventions to address mental health problems and reduce HIV risk behavior are in need of development and evaluation.

The following manuscripts have been submitted to peer-reviewed journals and are currently under review: See Appendix A for final drafts submitted

1. Walsh K., Koenen K., Cohen G., Ursano R., Gifford R., Fullerton C., Calabrese J., Tamburrino M., Liberzon I., Galea S. (2012) Sexual Violence and Mental Disorders Among National Guard and Reserve Soldiers. *American Journal of Public Health*, submitted on 8/13/2012.
 - Lifetime sexual violence prevalence was 4.0%, 3.9%, and 5.0% among Reserve, NG, and OHARNG men, and 36.6%, 25.5%, and 36.3% among the Reserve, NG, and OHARNG women, respectively. Among victims, 2.4-7.1% of women and 0-4.5% of men reported deployment-related sexual violence, and odds of current or lifetime PTSD ranged from 3.3 to 7.5, and odds of current or lifetime depression ranged from 1.7 to 5.0.
2. Hoggatt KJ, Prescott M, Goldmann E, Tamburrino M, Calabrese JR, Liberzon I, Galea S. (2012) Risk-taking Behavior Among National Guard Soldiers. *Annals of Emergency Medicine*, submitted 10/12/2012.
 - Drinking and driving, passing on the right, and ignoring speed limits were positively associated with a history of psychiatric disorders, deployment, deployment-related traumatic events, and combat or post-combat stressors. In contrast, high self-reported psychosocial support was negatively associated with risky driving.
3. Goodwin RD, Prescott M, Tamburrino M, Calabrese J, Liberzon I, and Galea S. Does smoking predict depression onset among military personnel? *Psychiatry Research*, submitted 9/2012.

- Persistent, active smoking is associated with increased risk of incident depression at follow up. History of smoking in the absence of current smoking at baseline was not associated with depression at follow-up.

The following manuscripts are in process:

PTSD symptom differences after war-related and civilian-related potentially traumatic events in military personnel

There is evidence that different types of potentially traumatic events can result in varying symptoms of PTSD. Given the differences between war- and civilian-related traumatic events, it is possible that war-related and civilian-related PTSD may present with different symptoms. We used latent-class analysis to compare the pattern and distribution of the 17 PTSD symptoms to find similar groups (latent classes) of individuals with war-related and civilian-related potentially traumatic events. After identifying individuals with the highest score of symptoms from the latent class analysis, we compared the odds of each PTSD symptom between those with war vs. civilian related PTSD using multivariable logistic regression adjusting for gender, age, marital status, total experience of traumatic events and the time since the traumatic event. Those with war-related potentially traumatic events were more likely to have symptoms of physiologic reactivity (OR 5.59 95%CI 1.51-20.8), diminished interest in activities (OR 3.49, 95% CI 1.24-9.80) and feeling numb (OR 3.82, 95% CI 1.18 – 12.4). Future research should examine the implications of these increased symptoms among those with war-related events including possible link to more chronic conditions or co-morbidity.

Suicidal ideation after war-related and civilian-related potentially traumatic events in military personnel.

There is recent evidence that the rate of suicide among Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) are increasing compared to the general population. While it is well known that PTSD is a risk factor for suicidal outcomes (suicidal ideation, attempted suicide and completed suicide) little is known about how the event that leads to PTSD may then be associated with suicidal ideation. Specifically, it is unclear how war-related PTSD and civilian-related PTSD are associated with suicidal ideation. We used the baseline results from the telephone sample (N=2616) of the OHARNG MHI to compare the association between PTSD and suicidality for those with war-related traumatic events and those with civilian-related traumatic. Among veterans with war-related traumatic events, having PTSD was minimally associated with suicidal ideation, adjusting for history of mental illness and other covariates (AOR 0.943, 95% CI 0.253 – 3.52). In contrast, there was an adjusted association between PTSD status and suicidal ideation among veterans with civilian traumatic events (AOR 4.47, 95% CI 2.04 – 9.82), and association persisted when the analysis was limited to assaultive events only (AOR 15.1, 95% CI 3.14 – 72.3). This highlights that suicide rates in the army may not be linked to increased rates of PTSD from returning OIF and OEF veterans. Future studies should confirm these findings that it is civilian-related PTSD that linked to suicidal thoughts as compared to war-related PTSD.

Ethics in trauma research: participant reactions to trauma questions in the Ohio National Guard

Several studies have shown that participants in trauma research generally appreciate their research engagement and do not suffer inadvertent adverse effects (Griffin, Resick, Waldrop & Mechanic, 2003). However, this has not been examined in military populations. We evaluated the effects of asking Ohio National Guard (ONG) members to recall details of their trauma exposure, and to determine factors that may put participants at risk of becoming upset by such assessments. Of 500 participants, 17.2% (n=86) reported being upset during the survey and 7.0% (n=6) of those reported still being upset at the end of the session. The following diagnostic groups were more likely to report being upset by any of the survey questions: 36.2% of those with a history of childhood physical abuse ($p<.0001$), 33.9% of those with a history of childhood physical neglect ($p=0.0004$), 37.1% of those with a history of childhood emotional abuse ($p<.0001$), and 47.5% of those with a history of childhood sexual abuse ($p<.0001$); 34% of those with suicidal ideation ($p=.001$); 37.3% of those participants who were female gendered ($p<.0001$); 24.4% of those participants who had a male-gendered interviewer ($p=.0002$); 22.5% of those who were the same gender as their interviewer ($p=.0057$); 31.8% of those who had Major Depressive Disorder ($p<.0001$), 37.5% of those who had Generalized Anxiety Disorder ($p=.013$), 50.0% of those who had Bipolar Disorder ($p=.0023$), 21.2% of those who had an alcohol use disorder ($p=.0274$), 28.6% of those who had a drug use disorder ($p=.0045$), and 61.3% of those who had Posttraumatic Stress Disorder ($p<.0001$). Most research participants were not upset as a result of the survey. Of the few participants who were upset by interview questions, those with mental health disorders were most likely to report being upset during the course of the interview, with only a small percentage still upset by the end of the interview. We did not find statistically significant differences from the following factors: high level of interpersonal conflict (found in the Conflict Tactics Scale), activity-limiting physical or emotional pain, number of deployments (stateside and overseas), marital status, employment, and socioeconomic status. Further research should be conducted to determine how a participant's emotional state at the end of an interview affects his/her continued participation in the research project. Also, it should be determined how elapsed time from the trauma to the interview affects a participant's emotional reaction to recounting the details of his/her trauma.

Spirituality

Methods: A sample of 418 Ohio Army National Guard (OHARNG) soldiers was analyzed from data obtained from an in-person, clinician-conducted survey. The survey data included demographic variables, results from a 21 item Spirituality Well-Being Survey (SWBS) assessment, Suicide Ideation (CSSRS) assessment and PTSD and MDD diagnoses. The SWBS provided both a religious and existential measure of spiritual well-being as well as an overall spiritual measure. Scores on the SWBS were treated as continuous variables in logistic regression models of suicidal ideation and as categorical variables in logistic regression models of suicidal behavior. Higher scores indicate a more positive feeling of well-being.

Results: Suicidal ideation occurred in 32/418 = 7.7% of the soldiers. The odds decreased as their scores on spiritual well-being and existential well-being increased (OR = 1.03, 95% CI 1.01-1.06 for spiritual and OR = 1.09, 95% CI 1.05-1.14 for existential). Suicidal ideation was not statistically significantly influenced by religious well-being (OR = 1.02, 95% CI 0.99-1.06). None of the spirituality scores affected suicidal behavior which presented in 37/418 = 8.9% of the soldiers.

Child abuse and depression

Applying a life course approach to depression, we wish to explore whether childhood experiences are a determinant of depression in adulthood. The main hypothesis is that individuals with negative childhood experiences (e.g. childhood physical and/or sexual abuse, neglect) are at greater risk for adult depression than individuals with positive childhood experiences (e.g. dependable social supports, experience of care and love) after adjustment for potential confounders. The primary outcome of this analysis is reporting on depression at T1 and/or T2, based on the DSM-IV criteria for Depression NOS. The primary exposures of interest are childhood experiences. We will also examine as possible confounders sex, age, race, income, employment, marital status, children at home, lifetime trauma history, current health status, branch of current and previous service, deployment history, future deployment expectations, and post-deployment supports.

Pre-, peri- and post-deployment factors and the incidence of alcohol abuse during or after deployment

We wish to determine whether pre-, peri- and post deployment support are associated with an alcohol disorder first occurring during/following deployment. The main hypothesis is that low deployment support groups will have a higher incidence of post-deployment alcohol disorder compared to higher deployment support groups, after adjustment for potential confounders. The primary outcome of this analysis is reporting an alcohol disorder during or following deployment, based on the DSM-IV criteria for alcohol dependence or abuse. The primary exposures of interest are pre-deployment preparation, unit support during deployment and post-deployment support. Other primary exposures may be major depressive disorder, PTSD, GAD, and most recent deployment location. We will also examine as possible confounders sex, age, race, income, education, marital status, and family history of drug and alcohol abuse.

Other

Please also see **Appendix B** for the Continuing Review Report with the annual update for the local IRBs, submitted in September 2012.

Task #4 – Annual oversight meetings for the Initiative.

The *Administrative Advisory Board (AAB)*, consisting of state and local leaders, administrators, and stakeholders providing guidance on non-scientific issues, is held on an annual basis. The most recent meeting was held on May 16, 2012 at Beightler Armory in Columbus, Ohio with representatives from the following:

- Leadership of OANG including TAG MG Ashenhurst and brigade commanders
- Ohio Dept of Mental Health
- Ohio Dept of Veterans Services
- Ohio Dept of Alcohol & Drug Addiction Services
- Ohio Assoc of County Behavioral Health Authorities
- Veteran's Affairs
- Columbus Veteran Center

From the data presented at the AAB, the study team's aim was to present an overview of the data and to focus on clinical topics of areas of unmet need that the Guard may wish to study in depth. The study team is moving beyond dissemination into translation by engaging the brigade commanders in meaningful problem-solving, including an in-depth discussion revolving around the issue of problem alcohol use. The Guard was strongly in support of the investigator's plan to implement an alcohol prevention and intervention

study. The Guard is hopeful that having a validated tool will improve their training process and reduce problem drinking of Guard service members.

The External Scientific Advisory Board, consisting of nationally and internationally renowned individuals with strong scientific backgrounds providing critical feedback on the scientific merit of the project, is held on an annual basis. The most recent meeting was held on April 2, 2012 (see **Appendix C** for the SAB slide presentations). The primary recommendations resulting from the recent SAB meeting were further analyses of the existing data, as well as ideas on how to shift the current study to a translational focus. The manuscripts under peer review were circulated to the SAB members for feedback.

Task # 5 – Financial Reporting is due quarterly via SF425, and has been submitted regularly and on schedule over the past year. The most recent report was submitted on October 10, 2012 for the third quarter 2012. Additionally, the most recent Quarterly Report was submitted to TATRC and USAMRAA on October 10, 2012 for the third quarter 2012.

Project #2

The Genetics Repository component (Project #2) is a study on genetic determinants of risk and resilience to the development of PTSD and other mental illnesses. This first translational project involves the creation of a repository of saliva DNA samples, which will be used to perform genetic association studies on selected candidate alleles and potentially genome-wide analyses at multiple levels. These may include cross-sectional genetic association analyses of pre-deployment traits, longitudinal analyses to investigate genetic markers and functional polymorphisms involved in vulnerability to deployment-related psychiatric disorders (i.e. in case-control association analyses), as well as building models incorporating measures of deployment-related and pre-deployment environmental factors for vulnerability (i.e. gene x environment interactions). This will also allow for integrated research utilizing neuroimaging, psychophysiological, and neuroendocrine measures to investigate the effects of genetic variants on cognitive, behavioral, and physiological function at baseline and after deployment stressors.

Research Accomplishments from the Statement of Work for Project #2:

Task #1 – In order to test the 2 hypotheses in the Genetics Protocol, the participants in the Telephone Survey of Project #1 are approached to participate in the Genetics Repository and are asked to submit a saliva sample via a kit mailed to them. Regulatory approval was granted 3/16/2010 by the DoD Office of Research Protections, with enrollment proceeding as of May 1, 2010 with the beginning of the project's 3rd quarter in Year 2, and through Year 3 and Year 4 thus far for participants who have not been approached to date.

Genetics Study Enrollment	
Project Year	Total Enrollment
Year 1 2008-2009	0
Year 2 2009-2010	275
Year 3 2010-2011	701
Year 4 2011-2012	87
Total	1,063

Task #2 – Upon receipt of saliva samples, the lab at the Ann Arbor VA will process them appropriately to provide genomic DNA preparation of the samples.

With the existing funding, a preliminary genetics analysis was completed and presented at the SAB meeting held in April 2012 (see Project #1, Task #3 above). In summary, the Ann Arbor VA genetics repository had received genetic specimens from a total of N=1063 participants, and had completed genotyping on the custom SNP array (>4000 tagging SNPs across more than 300 candidate genes and ancestry informative markers) and PCR-based genotyping of serotonin transporter 5-HTTLPR and DRD4 VNTR alleles on N=945 participants. We performed initial gene association analyses on PTSD symptom severity on N=770 subjects who endorsed lifetime trauma and for which we have complete data available; these analyses included GLM (linear regression) of both main effect of SNPs and Gene x Childhood abuse interaction, controlling for effects of childhood abuse and adult trauma exposures. Initial analyses in our dataset replicated two previously reported findings of Gene x Environment (G x E) interaction: 1.) a Gene x Childhood abuse interaction ($p < .005$) in SNPs in the FKBP5 gene and 2.) a Gene x Childhood abuse interaction with the serotonin transporter 5-HTTLPR functional “S” allele ($p < .008$). Testing for gene association with PTSD symptoms across the microarray, we considered ~3800 SNPs with call rates $> 99.8\%$ and MAF $> .05$, and performed PCA analyses on 1500 unlinked markers to control for population stratification. In soldiers of European ancestry, found several SNPs in chromosome 5 in the gene for the beta-2 adrenergic receptor gene (*ADRB2*) that showed a Gene x Child abuse interaction association with PTSD that was significant after Bonferroni correction. The beta-2 adrenergic receptor is one of the primary factors which mediate the effects of sympathetic nervous system activation. Gene association with the same *ADRB2* SNPs has previously been shown with pain sensitivity, but is a novel and exciting finding in PTSD.

When preliminary results were presented at the 2012 SAB meeting, the investigators were encouraged to seek funding to complete a GWAS on all samples.

KEY RESEARCH ACCOMPLISHMENTS

1. Completion of Year 1 (beginning November 2008) of data collection
 - Telephone Survey N=2616
 - In-Person Survey N=500
2. Completion of Year 2 data collection (beginning November 2009).
 - Telephone Survey N= 1770
 - In-Person Survey N=418 interviews completed (end date December 31, 2010 per the approved protocol window)
3. Completion of Year 3 data collection (beginning November 2010):
 - Telephone Survey N=1973 interviews completed:
 - o Year 3 follow up interviews: N=1395
 - o Dynamic Cohort baseline interviews (closed December 2011): N=578
 - In-Person Survey N=458 interviews completed
 - o Year 3 follow up interviews: N=354
 - o Dynamic Cohort baseline interviews: N=104
4. Year 4 data collection (beginning August 2012) thus far:
 - Telephone Survey N=1456 as of October 9, 2012:
 - Year 4 follow up interviews: N=1223
 - Dynamic Cohort Year 4 baseline interviews: N=233
 - In-Person Survey N=405 interviews completed as of October 16, 2012:
 - Year 4 follow up interviews: N=342
 - Dynamic Cohort Year 4 baseline interviews: N=63
5. Genetics Repository data collection (beginning May 2010) as of October 9, 2012:
 - Agreed to receive Genetics kit: N=2012 out of 2664 (76%)
 - Returned completed Genetics kit: N=1063 out of 2012 (53%)
6. Scientific Advisory Board Meeting on April 2, 2012
7. Administrative Advisory Board Meeting on May 17, 2012
8. Six manuscripts have been published over the past year, and three other manuscripts have been submitted to peer-reviewed journals over past year
9. Disseminated data through 5 professional meetings (APA, AAPO, ASER, IAC, IOPSM)

REPORTABLE OUTCOMES

Manuscripts, Abstracts, and Presentations

1. Manuscripts: For manuscripts published or accepted for publication over the past year, please see Task 3 above and **Appendix A** for reprints
2. Oral presentations:
 - a. Symposia presentation at the American Association for Public Opinion Research Conference 2012 in May 2012. Symposia topic included the impact of cell phones in a longitudinal study.
 - b. Lucas County Suicide Prevention Coalition Fall Conference at Promedica Toledo Hospital in September 2012. Data was presented on suicide in the military and risk and resilience factors.
3. Poster presentations:
 - a. Mental health disorders increase the risk of during and post-deployment alcohol abuse among Ohio Army National Guards . Cohen G. International Society for Traumatic Stress Studies 27th Annual Meeting
 - b. The Ohio Army National Guard Mental Health Initiative: Prevalence of DSM-IV Disorders. Tamburrino M. University of Toledo Research Day on April 19, 2012.
 - c. The Ohio Army National Guard Mental Health Initiative: Prevalence of DSM-IV Disorders. Tamburrino M. American Psychiatric Association 2012 Annual Conference in May 2012.
 - d. Posttraumatic stress disorder and HIV risk behavior among Army National Guard Soldiers: The mediating role of depression. Marshall B., 45th Annual Society for Epidemiologic Research Meeting in June 2012.
 - e. Posttraumatic stress disorder and HIV risk behavior among Army National Guard Soldiers: The mediating role of depression. Marshall B. XIX International AIDS Conference in June 2012.
 - f. The Ohio Army National Guard Mental Health Initiative: Prevalence of DSM-IV Disorders. Tamburrino M. 2012 Institute on Psychiatric Services Meeting in October 2012.
4. *Abstracts (see **Appendix D** for reprints):*
 - a. American Psychiatric Association 2012 Annual Conference in December 2011. The Ohio Army National Guard Mental Health Initiative: Prevalence of DSM-IV Disorders. Tamburrino M.
 - b. Society for Epidemiologic Research 2012 Annual Meeting in December 2011. Posttraumatic stress disorder and HIV risk behavior among Army National Guard Soldiers: The mediating role of depression. Marshall B.
 - c. XIX International AIDS Conference in December 2011: Posttraumatic stress disorder and HIV risk behavior among Army National Guard Soldiers: The mediating role of depression. Marshall B.
 - d. 45th Annual Society for Epidemiologic Research Meeting and the American Journal of Epidemiology: Posttraumatic stress disorder and HIV risk behavior among Army National Guard soldiers: The mediation role of depression. Marshall B.

Licenses applied for and issued:

- 1) Childhood Trauma Questionnaire
- 2) Conflict Tactics Scale
- 3) Military Acute Concussion Evaluation and Post Deployment Health Assessment Form DD2789 (MACE)

- 4) Resilience Scale
- 5) Structured Interview for DSM-IV (SCID)
- 6) Spiritual Well Being Scale
- 7) SF (Short Form) -12

Degrees obtained that were supported by this award:

- 1) Marta Prescott, PhD – Dr. Prescott was supported by the University of Michigan site budget and served as the Telephone Survey Data Analyst and Project Manager until late 2011 when she defended her dissertation, utilizing project data.

Development of Repositories:

- 1) Genetics Repository at Ann Arbor VA – saliva DNA samples

Informatics:

- 1) Michigan State University's RIX database and electronic data capture system (including the SCID and CAPS) for the In-Person Survey
- 2) Abt SRBI, Inc.'s CATI database for the Telephone Survey

Research opportunities received based on training supported by this award:

- 1) Neuroimaging and Genetic Investigation of Resilience and Vulnerability to PTSD, ancillary study started in 2011, funded by University of Toledo internal funds. Xin Wang, PhD, began on the project as a research fellow at the University of Toledo, and Israel Liberzon, MD and Anthony King, PhD mentored him at the Ann Arbor VA site during his fellowship. This ancillary project is done in conjunction between the University of Toledo and the Ann Arbor VA sites.

Funding applied for based on work supported by this award:

Submission Date	Funding Agency / Mechanism	Proposal Title	Outcome
Sep-07	FY07 DOD PTSD/ TBI	A Prospective Study of Genetic, Environmental, and Neural Predictors of Deployment-related PTSD using an Emotional fMRI Paradigm	Grant reviewed, not funded
Sep-07	CDMRP: FY07 DOD PTSD/TBI	Pilot Study for Developing Prospective, Longitudinal Genetic Association Studies of Risk and Resilience for Deployment-related PTSD	Grant reviewed, not funded
Jun-08	NIMH: R01	Prospective Study of Combat PTSD: Genetic, Development & Neuroimaging Predictors	Grant reviewed, not funded
May-09	NIMH: RC2 GO grant	Genetics of Risk for PTSD in OEF/OIF Veterans: GWAS and Targeted Re-sequencing of Genomic Risk Regions.	Grant reviewed, not funded
Aug-09	CDMRP Psychological Health and Traumatic Brain Injury (PH/TBI) Research Program: Advanced Technology/Therapeutic Development Award W81XWH-09-PH/TBIRP-AT/TDA)	Resiliency Index for Post-deployment PH & TBI in OEF/OIF soldiers: Genome-wide Association, Childhood Adversity, & Brain Structure studies	LOI submitted, not selected for full submission
Sep-09	CDMRP FY 2010 DoD PTSD / TBI	Resiliency Index for Post-deployment Psychological Health in OEF/OIF Soldiers Using Genome Wide Genetic and Predeployment Psychosocial Data	LOI accepted (25%), full application submitted 12/18/09, not funded
Sep-09	DMRDP FY10: Applied Research & Advanced Technology Award (W81XWH-09-DMRDP-ARATDA)	Longitudinal Symptoms and Military/Civilian Functional Impairments in Ohio National Guard Comorbid for PTSD and TBI	LOI submitted, not selected for full submission
Nov-10	University of Toledo Translational Research Stimulation Award	Neuroimaging and Genetic Investigation of Resilience and Vulnerability to PTSD	Internally funded
Jan-11	NIH: Social Environment (R01 RFA-DA-11-003)	Social environment and substance use: Using EMA to understand mechanisms	Grant reviewed, not funded
Oct-11	NIH: R01	Social environment and substance use: Using EMA to understand mechanisms	Grant reviewed, not funded
Dec-11	NIH: Mechanistic Pathways Linking Psychosocial Stress and Behavior (R01 - RFA-HL-12-037)	Mechanistic Pathways Linking Psychosocial Stress and Behavior	Grant reviewed, not funded

CONCLUSION

This project has provided the military with novel, long-term, prospective data on the National Guard, traditionally an understudied military population. More than 13,000 Ohio Army and Air National Guard have been deployed for both national and international duty since September 11, 2001. The magnitude of this contribution makes Ohio fifth in the nation in the size of its National Guard reserve component contribution deployed internationally and nationally. These factors make Ohio an integral location amongst the military, and for this reason, the OHARNG MHI has been well positioned to study this important population, the data from which may have a national impact considering the high utilization of the National Guard in recent wars.

The Initiative's accomplishments include the following. Operationally, the project has built a four wave unique dynamic cohort of Ohio National Guard members combining extensive exposure, phenotypic, and genotypic data. Scientifically, the investigators have re-conceptualized the standard approach to the health of reserve forces through a pre-, peri-, and post-deployment continuum. Findings have focused on guard support and risk of psychopathology, risk behavior, substance use, and mental health services.

Since project conceptualization in 2007, the Initiative has evolved from a clinical epidemiology and genetics project to a focus on translational research, bridging the link between science and practice. One of the study design's most unique components is that areas of unmet need in mental health illness have been identified in real time, allowing the Ohio National Guard leadership to intervene and help improve the lives of soldiers on an ongoing basis throughout the study. For example, in early 2010, the ONG expressed a desire to better understand how to predict the development of suicidal thoughts and suicide attempts in soldiers with PTSD. Based on this desire, analyses were conducted that elucidated the most important predictors of suicide in soldiers with PTSD compared to soldiers without PTSD. These analyses determined that there is a significant increase in suicidal thoughts in soldiers with PTSD who also have co-occurring symptoms of depression, generalized anxiety, and alcohol use disorder. As these other disorders compound PTSD, the risk for suicidal thoughts increase dramatically. With this knowledge, the ONG has implemented programs in place to better manage this likelihood, such as specific enrichments to the ONG Suicide Prevention Training Program.

Based on the success of the enrichments to the Suicide Prevention Training Program, the investigators and leadership of the Ohio National Guard have worked collaboratively in the design phase for waves 3 and 4. The Guard has proposed areas of special interest to be prioritized to potentially change operational procedures, including soldier training:

- The effectiveness and success of the ONG's Battle Buddy Program
- The role of Axis I comorbidity in suicide, not only PTSD, but depressive episodes and alcohol use

Specifically over the past year, the investigators have continued to focus on alcohol use disorders as an area of unmet need in the military. For example, 10% of our study sample qualified for wave 1 depression, and 9% of those soldiers had suicidal ideation at the 1-year follow-up, as compared to only 2% among those with no depression at baseline ($p<0.0001$). Additionally, among those reporting wave 1 alcohol dependence (6% of $N=1587$ without depression or prior suicidal ideation), 9% reported suicidal ideation at 1-year follow-up, compared to only 2% incident suicidal ideation among those with no baseline alcohol dependence ($p=0.0002$). These results highlight the need for further study, prevention, and intervention of alcohol use disorders in the military.

The current funding allows the investigators to complete Year 4 data collection through the end of 2012 and utilize the remaining funds to continue analyses of the databases, manuscript writing, and dispersal of the findings in 2013.

As of October 3, 2012, the Investigators have submitted two pre-proposals to the USAMRMC Broad Agency Announcement with requests for additional funding allowing data collection to resume beyond 2012:

1. **Trajectory as the Phenotype:** The first pre-proposal extends the epidemiologic observations to trajectories of psychopathology, risk behavior, and substance use, and combining the genetic and environmental data over the life-course and trajectories of phenotypes. This pre-proposal incorporates the existing Telephone Survey, In-Person Survey, and Genetics Repository.
2. **Alcohol Prevention & Intervention Study:** The second submission consists of an alcohol use intervention study, targeting secondary prevention in high risk drinkers in the OHARNG. The investigators have continued to focus on alcohol use disorders as an area of unmet need in the military. Among soldiers with depression at wave 1 (10%; $n=164$), 9% ($n=14$) had incident suicidal ideation at 1-year follow-up ($p<0.0001$). Among the 6% ($N=93$) who met criteria for wave 1 alcohol dependence, 9% ($n=8$) reported incident suicidal ideation at 1-year follow-up, ($p=0.0002$). Alcohol dependence [AOR(95% CI)=2.72 (1.12-6.63)] predicted incident suicidal ideation independent of depression [AOR(95% CI)= 3.49 (1.68-7.24)] (Cohen et al 2012). These results highlight the need for further study, prevention, and intervention of alcohol use disorders in the military. The investigators have begun a collaboration with alcohol experts at the University of Michigan (site PI: Fred Blow, PhD) who will guide the scientific progress of the alcohol prevention initiative.

REFERENCES

Biehn TL, Contractor A, Elhai JD, Tamburrino M, Fine TH, Prescott MR, Shirley E, Chan PK, Slembariski R, Liberzon I, Calabrese J, and Galea S. Relations Between the Underlying Dimensions of PTSD and Major Depression Using an Epidemiological Survey of Deployed Ohio National Guard Soldiers. *Journal of Affective Disorders. In press*

Calabrese JR, Prescott M, Tamburrino M, Liberzon I, Slembariski R, Goldmann E, et al. PTSD comorbidity and suicidal ideation associated with PTSD within the Ohio Army National Guard. *J Clin Psychiatry* 2011 Aug;72(8):1072-1078, PMID: 21899816

Elhai JD, Contractor AA, Tamburrino M, Fine TH, Prescott MR, Shirley E, Chan PK, Slembariski R, Liberzon I, Galea S, Calabrese JR. The factor structure of major depression symptoms: A test of four competing models using the Patient Health Questionnaire-9. *Psychiatry Res.* 2012 Jun 12. [Epub ahead of print] PMID: 22698261

[Goldmann E](#), [Calabrese JR](#), [Prescott MR](#), [Tamburrino M](#), [Liberzon I](#), [Slembariski R](#), [Shirley E](#), [Fine T](#), [Goto T](#), [Wilson K](#), [Ganocy S](#), [Chan P](#), [Serrano MB](#), [Sizemore J](#), [Galea S](#). Potentially modifiable pre-, peri-, and postdeployment characteristics associated with deployment-related posttraumatic stress disorder among ohio army national guard soldiers. *Ann Epidemiology.* 2012 Feb; 22(2):71-7. PMID 22226029

Goodwin R, Prescott MR, Tamburrino MB, Calabrese JR, Liberzon I, Galea S. Cigarette smoking and subsequent suicidal ideation among National Guard Soldiers. *Journal of Affective Disorders. in press*

Marshall BD, Prescott MR, Liberzon I, Tamburrino MB, Calabrese JR, Galea S. Coincident posttraumatic stress disorder and depression predict alcohol abuse during and after deployment among Army National Guard soldiers. *Drug Alcohol Depend.* 2012 Aug 1;124(3):193-9. Epub 2012 Feb 17. PMID:22342428

Marshall BDL, Prescott MR, Liberzon I, Tamburrino MB, Calabrese JR, Galea S. Posttraumatic Stress Disorder and HIV Risk Behavior among Army National Guard Solders: The Mediating Role of Depression. *Journal of Traumatic Stress. In press*

Marshall B. Posttraumatic stress disorder and HIV risk behavior among Army National Guard Soldiers: The mediating role of depression. Society for Epidemiologic Research 2012 Annual Meeting. 2011 December.

Marshall B. Posttraumatic stress disorder and HIV risk behavior among Army National Guard Soldiers: The mediating role of depression. XIX International AIDS Conference. 2011 December.

Tamburrino M. The Ohio Army National Guard Mental Health Initiative: Prevalence of DSM-IV Disorders. American Psychiatric Association 2012 Annual Conference in 2011 December



Coincident posttraumatic stress disorder and depression predict alcohol abuse during and after deployment among Army National Guard soldiers[☆]

Brandon D.L. Marshall^{a,f,*}, Marta R. Prescott^a, Israel Liberzon^{b,c}, Marijo B. Tamburrino^d, Joseph R. Calabrese^e, Sandro Galea^a

^a Department of Epidemiology, Columbia University Mailman School of Public Health, 722 W 168th Street, New York, NY, 10032-3727, USA

^b Department of Psychiatry, University of Michigan, Rachel Upjohn Building, 4250 Plymouth Road, Ann Arbor, MI, 48105, USA

^c Veterans Affairs Medical Center, 2215 Fuller Road, Ann Arbor, MI, 48105, USA

^d Department of Psychiatry, University of Toledo College of Medicine, Mail Stop 1193, 3120 Glendale Avenue, Toledo, OH, 43614, USA

^e University Hospitals Case Medical Center, Case Western Reserve University, 10524 Euclid Avenue, Cleveland, OH, 44106, USA

^f Department of Epidemiology, Brown University, 121 South Main Street, Providence, RI, 02912, USA

ARTICLE INFO

Article history:

Received 27 October 2011

Received in revised form

13 December 2011

Accepted 30 December 2011

Available online 17 February 2012

Keywords:

Alcoholism

Depression

PTSD

Military medicine

Psychiatry

ABSTRACT

Background: Although alcohol problems are common in military personnel, data examining the relationship between psychiatric conditions and alcohol abuse occurring *de novo* peri-/post-deployment are limited. We examined whether pre-existing or coincident depression and post-traumatic stress disorder (PTSD) predicted new onset peri-/post-deployment alcohol abuse among Ohio Army National Guard (OHARNG) soldiers.

Methods: We analyzed data from a sample of OHARNG who enlisted between June 2008 and February 2009. Participants who had ever been deployed and who did not report an alcohol abuse disorder prior to deployment were eligible. Participants completed interviews assessing alcohol abuse, depression, PTSD, and the timing of onset of these conditions. Logistic regression was used to determine the correlates of peri-/post-deployment alcohol abuse.

Results: Of 963 participants, 113 (11.7%) screened positive for peri-/post-deployment alcohol abuse, of whom 35 (34.0%) and 23 (32.9%) also reported peri-/post-deployment depression and PTSD, respectively. Soldiers with coincident depression (adjusted odds ratio [AOR] = 3.9, 95%CI: 2.0–7.2, $p < 0.01$) and PTSD (AOR = 2.7, 95%CI: 1.3–5.4, $p < 0.01$) were significantly more likely to screen positive for peri-/post-deployment alcohol abuse; in contrast, soldiers reporting pre-deployment depression or PTSD were at no greater risk for this outcome. The conditional probability of peri-/post-deployment alcohol abuse was 7.0%, 16.7%, 22.6%, and 43.8% among those with no peri-/post-deployment depression or PTSD, PTSD only, depression only, and both PTSD and depression, respectively.

Conclusions: Coincident depression and PTSD were predictive of developing peri-/post-deployment alcohol abuse, and thus may constitute an etiologic pathway through which deployment-related exposures increase the risk of alcohol-related problems.

© 2012 Elsevier Ireland Ltd. All rights reserved.

1. Introduction

Excessive drinking and alcohol abuse have long been recognized as significant public health problems in the military (Greden et al., 1975). Recent studies from the United States and the United Kingdom have demonstrated that binge drinking and other

alcohol-related problematic behaviors continue to be common among military personnel (Fear et al., 2007, 2010; Jacobson et al., 2008; Lande et al., 2008; Milliken et al., 2007). In addition to the well-characterized array of health hazards associated with excessive drinking (Eckardt et al., 1981), soldiers with alcohol problems are at increased risk for a host of adverse social and occupational consequences, including: loss of work productivity (Fisher et al., 2000), motor vehicle injury (Bell et al., 2000), criminal justice problems (Stahre et al., 2009), violence (McCarroll et al., 2009), and discharge from military service (Santiago et al., 2010). Previously identified risk factors for alcohol misuse in this population include: younger age (Bray and Hourani, 2007; Fear et al., 2007; Jacobson et al., 2008), male sex (Bray and Hourani, 2007; Jacobson et al., 2008), unmarried marital status (Fear et al.,

[☆] Disclaimer: The information or content and conclusions do not necessarily represent the official position or policy of, nor should any official endorsement be inferred by the Department of Defense or the U.S. Government.

* Corresponding author at: Department of Epidemiology, Brown University, 121 South Main Street, Room 222, Providence, RI, 02912 USA. Tel.: +1 401 863 6427; fax: +1 401 863 3713.

E-mail address: brandon_marshall@brown.edu (B.D.L. Marshall).

2007; Wilk et al., 2010), and having a family history of drug and alcohol problems (Fear et al., 2007, 2010). A growing body of literature has also examined the effect of deployment and specific combat exposures on alcohol abuse in active duty personnel and in soldiers of the Reserve and National Guards (Browne et al., 2008; Hooper et al., 2008; Jacobson et al., 2008; Wilk et al., 2010).

Fewer studies have investigated how psychopathology contributes to the risk for alcohol abuse during or following deployment. Preliminary evidence indicates that alcohol problems and psychiatric disorders are highly prevalent and appear to be comorbid in this population, particularly after return from theater (Fear et al., 2010; Hoge et al., 2004; Hotopf et al., 2006; Milliken et al., 2007; Wilk et al., 2010). For example, a recent study suggested that approximately half of soldiers who screen positive for depression or posttraumatic stress disorder (PTSD) also meet the criteria for potential alcohol misuse (Thomas et al., 2010). Furthermore, in a large cohort study of US military personnel, individuals with depression or PTSD were at an increased risk of continuing and new onset alcohol-related problems at follow-up (Jacobson et al., 2008).

While these studies have been instrumental in improving our understanding of the effects of combat on substance use and the mental health of soldiers, several important gaps in knowledge remain. First, while most studies of alcohol use in the military focus on active duty personnel, recent findings have suggested that soldiers of the Reserve and National Guard may be at an even higher risk for alcohol-related problems (Jacobson et al., 2008; Santiago et al., 2010). There is, however, very little data on alcohol abuse among reservists. Second, most previous research has failed to elucidate the timing of incident alcohol problems in relation to the onset of psychiatric disorders. It is therefore often unclear if alcohol use disorders and psychiatric conditions were prevalent at the time of deployment or if these conditions first manifested during or return from theater. The timing of these conditions in relation to deployment has important implications for screening interventions and other prevention programs. For example, if pre-existing psychiatric disorders are associated with peri-/post-deployment alcohol abuse, screening for these conditions prior to deployment may help to identify those at risk for developing substance abuse problems. In contrast, if psychiatric disorders and alcohol-related problems tend to be coincident during or following deployment (and occur even among previously low-risk persons), this would suggest shared or co-occurring deployment-related risk factors that could then be the focus of future prevention efforts. One recent study of Operation Iraqi Freedom (OIF)-deployed National Guard soldiers found that alcohol use disorders (AUDs) prior to deployment were associated with emotionality and disinhibition, whereas new onset AUDs following deployment were uniquely associated with post-deployment PTSD (Kehle et al., 2011). Although this study was limited by small sample size (only 17 participants reported new onset AUDs) and limited adjustment for potential sociodemographic and deployment-related confounders, the results provide preliminary evidence that post-deployment PTSD may be an important predictor of new onset alcohol problems among National Guard populations.

The primary objective of this analysis was to determine the prevalence of peri-/post-deployment alcohol abuse, depression, and PTSD among a sample of deployed National Guard who had never experienced an alcohol abuse disorder prior to active duty. We also sought to determine whether coincident depression and PTSD were associated with alcohol abuse first occurring during or following deployment, or whether these disorders preceded the manifestation of peri-/post-deployment alcohol abuse. Finally, we sought to determine the capacity of psychiatric disorders to act as clinical markers for peri-/post-deployment alcohol abuse in this population.

2. Methods

2.1. Study sample and data collection

Between November 2008 and November 2009, soldiers of the Ohio Army National Guard (OHARNG) were recruited to participate in the OHARNG Mental Health Initiative. This study aims to identify the risk factors and deployment-related exposures associated with psychiatric conditions experienced by OHARNG soldiers. The study population is all OHARNG who served between June 2008 and February 2009. Recruitment procedures were as follows. All soldiers with a current address ($n = 12,225$) were mailed a letter explaining the study's objectives and consenting procedures along with a pre-paid opt-out card. Addresses were obtained directly from the Ohio National Guard; thus, consent from the VA was not required to collect this information. Additional contact details were then obtained for all 11,212 (91.7%) individuals from whom an opt-out card was not received. We eliminated 1130 (10.1%) soldiers who did not have a telephone number listed with the guard and 3568 (31.8%) who had incorrect or non-active numbers, leaving 6514 (58.1%) potentially eligible participants. Of these individuals, 187 (2.9%) were not eligible (e.g., too young or retired), 1364 (20.9%) refused to participate, 31 (0.5%) were excluded for other reasons (e.g., did not speak English), and 2316 (35.6%) were not contacted before the cohort closed in November 2009. Informed consent was thus obtained and data collected from 2616 participants.

For this study, we excluded all participants who had never been deployed ($n = 939$, 35.9%) and 9 (0.3%) who refused to report deployment status, as the primary objective was to examine alcohol abuse disorders in relation to deployment. In order to compare individuals with peri-/post-deployment alcohol abuse to those with no lifetime history of alcohol abuse, we also excluded participants who reported an alcohol abuse disorder first occurring prior to their most recent deployment ($n = 613$, 23.4%). In addition we excluded 92 (3.5%) who did not answer one or more items used to assess the presence and timing of an alcohol abuse disorder. The final eligible analytic sample was $n = 963$.

Computer-assisted telephone interviewing was used to collect a wide array of information regarding sociodemographic characteristics, current living situation, military history, deployment and combat experiences, and past and present symptoms of psychopathology. Where possible, validated survey instruments (see below) were used to assess symptom timing, duration, and degree of impairment. Interviews took approximately 60 min to complete. All participants were compensated for their time and a clinician was on call to speak to participants who expressed feeling disturbed at any point during or after the survey. The study received a certificate of confidentiality from the National Institutes of Health and the study protocol was approved by the Institutional Review Boards of University Hospitals Case Medical Center, University of Toledo, and Columbia University. The study was also approved by the Human Research Protection Office (HRPO), Office of Research Protections (ORP), and the U.S. Army Medical Research and Materiel Command (USAMRMC) of the United States Department of Defense.

2.2. Measures

The main outcome for this analysis was screening positive for alcohol abuse and reporting these symptoms as first occurring during or following one's most recent deployment (yes vs. no). The Mini International Neuropsychiatric Interview (MINI) and DSM-IV criteria were used to determine the presence of alcohol abuse (i.e., reporting at least one maladaptive pattern of alcohol use leading to clinically significant impairment or distress; American Psychiatric Association, 2000; Sheehan et al., 1998). In accordance with previous studies (Kessler et al., 2005; Wells et al., 2006), alcohol abuse disorders were diagnosed without hierarchy (i.e., regardless of whether a dependence diagnosis was present), in recognition that abuse is often a stage in the progression to dependence. Participants screening positive for alcohol abuse were then asked at what age they first had the symptoms. If the age of symptom onset was at least one year after the participant's most recent deployment, she/he was categorized as having post-deployment alcohol abuse. Individuals who reported having symptoms the same year as their most recent deployment were asked to clarify if the symptoms started before, during or after deployment. Individuals who reported that symptoms started during or after their most recent deployment were also defined as having peri-/post-deployment alcohol abuse.

The primary exposures of interest were screening positive for pre-deployment or peri-/post-deployment depression and/or PTSD. The Primary Care Evaluation of Mental Health Disorders Patient Health Questionnaire-9 (PHQ-9) was used to assess for depression (Kroenke and Spitzer, 2002; Kroenke et al., 2001). To screen positive for depressive disorder, a participant had to score ≥ 2 of 9 symptoms on the PHQ-9, and these symptoms had to occur together within a 2-week period along with either depressed mood or anhedonia. Although a conservative cut-off of ≥ 5 has been used to assess for major depressive disorder, we opted to use a more sensitive measure to screen for any depression, which has been validated and used previously (Calabrese et al., 2011). If participants screened positive for depression, they were asked at what age these symptoms first began and were also asked to clarify if the symptoms occurred before, during or after their most recent deployment. The PTSD Checklist-Civilian Version (PCL-C) was used to measure PTSD symptoms (Blake et al., 1995). We used the 17-item instrument to assess PTSD-related symptoms in relation to two events: participants' self-identified "worst" event that occurred during

their most recent deployment, and an event that was unrelated to this deployment. The diagnostic criteria for PTSD parallels that of the DSM-IV; thus, participants screened positive for PTSD if he/she reported experiencing a qualifying trauma, at least one intrusion symptom, at least three symptoms of avoidance, and at least two hyperarousal symptoms. Symptoms must also have lasted for at least a month and caused significant social or functional impairment. For PTSD cases due to a traumatic event unrelated to the soldier's most recent deployment, the date of the traumatic event was used to estimate the earliest PTSD could have occurred. All persons with PTSD cases arising from a traumatic event during or after return from deployment were considered to have peri-/post-deployment PTSD. Both the PHQ-9 and PCL-C have been found to be reliable and valid instruments in both general and military personnel populations (Blanchard et al., 1996; Maguen et al., 2010; Martin et al., 2006).

Other variables assessed included the following sociodemographic characteristics, which have been shown in previous studies of military personnel to be associated with alcohol abuse (Bray and Hourani, 2007; Bray et al., 1991; Ferrier-Auerbach et al., 2009; Jacobson et al., 2008; Lande et al., 2008): sex (male vs. female), age, self-identified racial background (white, black, other), income ($\leq$ \$60,000 vs. $>$ \$60,000), education (high school graduate, some college or technical training, college/graduate degree), marital status (never married, divorced/separated/widowed, married), smoking history (ever vs. never), self-reported family history of drug or alcohol abuse (yes vs. no), and number of previous deployments (1, 2–3, $>$ 3). We also included as a covariate most recent deployment setting (conflict vs. non-conflict), based on research demonstrating a high prevalence of problem drinking among soldiers experiencing combat (Hooper et al., 2008; Lande et al., 2008; Wilk et al., 2010).

2.3. Statistical analyses

As a first step, we compared the sociodemographic characteristics of those who reported a peri-/post-deployment alcohol abuse disorder versus those with no lifetime history of alcohol abuse using Pearson's χ^2 test. We also used Pearson χ^2 test to examine the associations between peri-/post-deployment alcohol abuse and the

presence and timing of the psychiatric disorders of interest (i.e., none in lifetime, prior to deployment, peri-/post-deployment). We then constructed a multivariable logistic regression model to determine the independent associations between peri-/post-deployment alcohol abuse and depression or PTSD developed at different stages in relation to deployment. All covariates assessed in bivariable analysis were included in the final model in order to provide as complete control of confounding as possible given the data set (Hosmer and Lemeshow, 2000).

As a final step, we conducted reverse logit transformations to examine the predictive capacity of peri-/post-deployment depression and PTSD, using the relevant coefficients derived from the multivariate model. We computed the conditional probability of reporting peri-/post-deployment alcohol abuse, given the presence of no psychiatric conditions, peri-/post-deployment depression only, peri-/post-deployment PTSD only, and both peri-/post-deployment depression and PTSD. Each conditional probability was weighted by the sample prevalence of the other covariates to estimate population averages. All statistical analyses were conducted in SAS 9.1, and all p -values are two-sided.

3. Results

3.1. Sample characteristics

The characteristics of the 963 eligible participants are described in Table 1. The majority of participants were male (87.3%), less than 35 years of age (59.6%), white (86.1%) and married (56.2%). The sociodemographic characteristics of the sample were similar to the entire OHARNG, with no significant differences with respect to gender ($p=0.53$) or race ($p=0.34$); however, the sample was slightly older ($p<0.01$) and more likely to be married ($p<0.01$). A total of 113 (11.7%) participants reported an alcohol abuse disorder that first occurred during or post-deployment. As shown in Table 1,

Table 1
Sociodemographic factors associated with peri-/post-deployment alcohol abuse^a among a sample of Ohio Army National Guard who have ever been deployed.

Characteristic	Total (%) ^b (n = 963)	Peri-/post-deployment alcohol abuse ^a		p-Value
		Yes (%) (n = 113)	No (%) (n = 850)	
Sex				
Men	841 (87.3)	109 (13.0)	732 (87.0)	<0.01
Women	122 (12.7)	4 (3.3)	118 (96.7)	
Age (years)				
17–24	200 (20.8)	29 (14.5)	171 (85.5)	<0.01
25–34	373 (38.8)	55 (14.8)	318 (85.3)	
35–44	281 (29.2)	25 (8.9)	256 (91.1)	
≥ 45	107 (11.1)	4 (3.7)	103 (96.3)	
Race				
White	828 (86.1)	105 (12.7)	723 (87.3)	0.07
Black	85 (8.8)	4 (4.7)	81 (95.3)	
Other	49 (5.1)	4 (8.2)	45 (91.8)	
Income				
$>$ \$60,000	413 (43.7)	40 (9.7)	373 (90.3)	0.07
$\leq$ \$60,000	532 (56.3)	72 (13.5)	460 (86.5)	
Education				
High school graduate	223 (23.2)	28 (12.6)	195 (87.4)	0.28
Some college or technical training	484 (50.3)	62 (12.8)	422 (87.2)	
College/graduate degree	256 (26.6)	23 (9.0)	233 (91.0)	
Marital status				
Married	539 (56.2)	44 (8.2)	495 (91.8)	<0.01
Divorced/separated/widowed	106 (11.0)	17 (16.0)	89 (84.0)	
Never married	315 (32.8)	51 (16.2)	264 (83.8)	
Smoking history				
Ever	516 (55.1)	79 (15.3)	437 (84.7)	<0.01
Never	420 (44.9)	32 (7.6)	388 (92.4)	
Family history of drug/alcohol abuse				
Yes	188 (19.5)	25 (13.3)	163 (86.7)	0.46
No	775 (80.5)	88 (11.4)	687 (88.7)	
Number of deployments				
1	511 (53.1)	73 (14.3)	438 (85.7)	0.02
2–3	372 (38.6)	31 (8.3)	341 (91.7)	
$>$ 3	80 (8.3)	9 (11.3)	71 (8.8)	
Most recent deployment setting				
Conflict	435 (45.2)	74 (17.0)	361 (83.0)	<0.01
Non-conflict	528 (54.8)	39 (7.4)	489 (92.6)	

^a Defined as an alcohol abuse disorder meeting DSM-IV criteria first occurring during or following deployment. Persons reporting an alcohol disorder prior to deployment were excluded from analysis.

^b Not all columns add to 100% due to missing values.

Table 2Psychiatric conditions associated with peri-/post-deployment alcohol abuse^a among a sample of Ohio Army National who have ever been deployed.

Characteristic	Total (%) ^b (n = 963)	Peri-/post-deployment alcohol abuse ^a		p-Value
		Yes (%) (n = 113)	No (%) (n = 850)	
Depressive disorder				
None in lifetime	766 (80.1)	72 (9.4)	694 (90.6)	<0.01
First occurring prior to deployment	87 (9.1)	6 (6.9)	81 (93.1)	
First occurring during/post deployment	103 (10.8)	35 (34.0)	68 (66.0)	
Posttraumatic stress disorder (PTSD)				
None in lifetime	775 (89.0)	76 (9.8)	699 (90.2)	<0.01
First occurring prior to deployment	26 (3.0)	3 (11.5)	23 (88.5)	
First occurring during/post deployment	70 (8.0)	23 (32.9)	47 (67.1)	

^a Defined as an alcohol abuse disorder meeting DSM-IV criteria first occurring during or following deployment. Persons reporting an alcohol disorder prior to deployment were excluded from analysis.^b Not all columns add to 100% due to missing values.

individuals reporting peri-/post-deployment alcohol abuse were more likely to be men, of younger age, non-married, only deployed once, and most recently deployed to a conflict setting (all $p < 0.01$).

3.2. Effects of depression and PTSD on peri-/post-deployment alcohol abuse

We examined the prevalence of peri-/post-deployment alcohol abuse among soldiers reporting coincident depression or PTSD, among those who reported depression or PTSD prior to deployment, and among those who never experienced these conditions. As shown in Table 2, the prevalence of peri-/post-deployment alcohol abuse was low among those who never experienced depression (9.4%), and also among those who reported no lifetime history of PTSD (9.8%). Similarly, peri-/post-deployment alcohol abuse was uncommon among the small subset of participants who reported onset of depression or PTSD prior to their deployment (6.9% and 11.5%, respectively). In contrast, the prevalence of peri-/post-deployment alcohol abuse was elevated among participants who also reported peri-/post-deployment depression and PTSD:

34.0% and 32.9%, respectively. Of the 113 persons who reported peri-/post-deployment alcohol abuse, 35 (31.0%) reported coincident depression, 23 (20.4%) reported coincident PTSD, and 15 (13.3%) reported both conditions. In bivariable analyses (Table 2), coincident depression ($p < 0.01$) and PTSD ($p < 0.01$) were both significantly associated with peri-/post-deployment alcohol abuse. Among the subset of 27 participants reporting depression onset during deployment, 17 (63.0%) reported no alcohol abuse, two (7.4%) reported concurrent onset of alcohol abuse, and eight (29.6%) reported alcohol problems first occurring after deployment. Only one individual reported onset of PTSD symptoms during deployment.

The results of the multivariable model examining the independent effects of coincident depression and PTSD on peri-/post-deployment alcohol abuse are shown in Table 3. Even after extensive adjustment for potential confounding, peri-/post-deployment depression (adjusted odds ratio [AOR] = 3.9, 95%CI: 2.0–7.2) and peri-/post-deployment PTSD (AOR = 2.7, 95%CI: 1.3–5.4) were significantly associated with the outcome of interest. Experiencing depression or PTSD prior to deployment had no

Table 3Multivariate regression of factors associated with peri-/post-deployment alcohol abuse^a among a sample of Ohio Army National Guard who have ever been deployed ($n = 847^b$).

Characteristic	AOR	95% CI	p-Value
Sex (male vs. female)	7.9	2.6–23.8	<0.01
Age (ref: 17–24)	–	–	–
25–34	1.5	0.8–2.9	0.23
35–44	0.9	0.4–2.0	0.73
≥45	0.4	0.1–1.5	0.18
Race (ref: white)	–	–	–
Black	0.4	0.1–1.3	0.14
Other	0.9	0.3–2.8	0.83
Income (≤\$60,000 vs. >\$60,000)	1.4	0.8–2.4	0.22
Education (ref: high school graduate)	–	–	–
Some college	1.1	0.6–2.0	0.66
College/graduate degree	1.0	0.5–2.1	0.97
Marital status (ref: married)	–	–	–
Divorced/separated/widowed	2.6	1.2–5.6	0.01
Never married	2.6	1.4–4.8	<0.01
Family history of drug/alcohol abuse (yes vs. no)	0.9	0.5–1.7	0.79
Smoking history (ever vs. never)	1.9	1.1–3.1	0.01
Most recent deployment setting (conflict vs. con-conflict)	2.4	1.5–3.9	<0.01
Prior number of deployments (ref: 1)	–	–	–
2–3	0.4	0.2–0.7	<0.01
>3	0.7	0.3–1.8	0.44
Depressive disorder (ref: none in lifetime)	–	–	–
First occurring prior to deployment	0.7	0.3–1.8	0.44
First occurring during/post deployment	3.9	2.0–7.2	<0.01
Posttraumatic stress disorder (ref: none in lifetime)	–	–	–
First occurring prior to deployment	0.9	0.1–4.7	0.87
First occurring during/post deployment	2.7	1.3–5.4	<0.01

^a Defined as an alcohol abuse disorder meeting DSM-IV criteria first occurring during or following deployment. Persons reporting an alcohol disorder prior to deployment were excluded from analysis.^b Some participants were excluded from multivariate regression due to missing values.

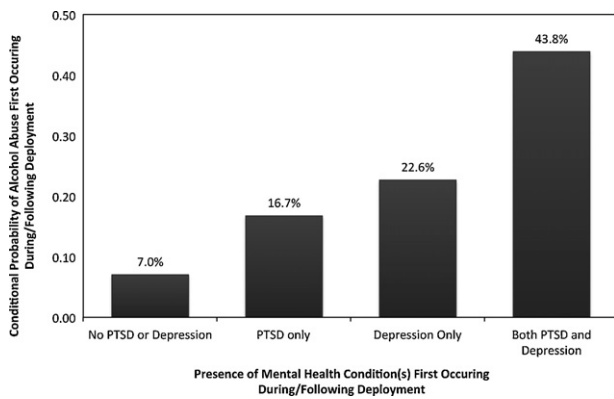


Fig. 1. Estimated conditional probabilities of peri-/post-deployment alcohol abuse among a sample of Ohio Army National Guard who have ever been deployed. Note: conditional probabilities were derived from reverse logit transformations of the coefficients presented in Table 3 and are adjusted for other variables entered in the multivariate regression model. Note: depression and PTSD are both defined as first occurring during or following deployment.

effect on the likelihood of the outcome. In the final model, male sex, never married or divorced/separated/widowed marital status, ever smoking, and being deployed to a conflict setting were also positively associated with peri-/post-deployment alcohol abuse. A lifetime history of multiple deployments (i.e., 2–3) was negatively associated with the outcome.

3.3. Predictive capacity of depression and PTSD

Reverse logit transformations of the coefficients from the multivariate model were used to estimate the conditional probability of peri-/post-deployment alcohol abuse in the study sample. As shown in Fig. 1, given the absence of coincident depression and PTSD, the conditional probability of having a peri-/post-deployment alcohol abuse disorder was 7.0% (95%CI: 2.7–16.9%). Among participants who reported peri-/post-deployment PTSD or depression, the estimated conditional probability of this outcome was 16.7% (95%CI: 5.9–39.2%) and 22.6% (95%CI: 9.2–45.7%), respectively. In the presence of both conditions, the conditional probability of peri-/post-deployment alcohol abuse rose sharply to 43.8% (95%CI: 20.6–70.1%).

4. Discussion

In a sample of OHARNG soldiers, we observed a high prevalence of peri-/post-deployment alcohol abuse among persons who reported not having an alcohol use disorder prior to their most recent deployment. Coincident psychiatric disorders were common: among persons with alcohol abuse first occurring during or following deployment, 31% and 20% also screened positive for peri-/post-deployment depression and PTSD, respectively. In a multivariable regression model, pre-existing psychiatric conditions were not associated with alcohol abuse first manifesting during or following deployment, while coincident depression and PTSD were highly predictive of peri-/post-deployment alcohol-related problems.

These findings support a growing literature indicating that deployed National Guard are at high risk for developing alcohol abuse after return from theater (Jacobson et al., 2008; Milliken et al., 2007; Santiago et al., 2010). In fact, previous studies have shown that compared to Active Component personnel, National Guard soldiers are more likely to engage in alcohol-related behavior (e.g., drinking and driving) and are less likely to enter substance abuse treatment after return from theater (Jacobson et al., 2008; Santiago et al., 2010). These findings, in addition to the results of the

present study, indicate the urgent need to evaluate the availability and uptake of alcohol treatment interventions for this population.

Consistent with previous research, new onset alcohol abuse was particularly common among males, unmarried persons, and soldiers deployed to a conflict setting (Bray and Hourani, 2007; Fear et al., 2007; Hooper et al., 2008; Jacobson et al., 2008; Santiago et al., 2010; Wilk et al., 2010). A novel finding of this study is that preexisting depression and PTSD were not found to be risk factors for the development of peri-/post-deployment alcohol-related problems. One possible explanation is that many participants with preexisting psychiatric conditions would have already developed alcohol abuse prior to deployment and thus were excluded from the analytic sample. It is also possible that persons with a lifetime history of severe depression or PTSD were identified prior to deployment and either counseled or not sent to theater; therefore, this group may represent a population with milder symptomatology compared to those who developed depression or PTSD during or following deployment. Regardless of the underlying mechanism of action, screening for these disorders upon enlistment would be unlikely to identify soldiers at high risk for deployment-related alcohol problems.

The finding that psychiatric disorders were frequently coincident with new onset alcohol abuse may indicate a common set of deployment-related risk factors for both psychiatric and alcohol use disorders. This “shared environmental risk factor” model has been proposed previously to explain the high prevalence of comorbid PTSD and substance use disorders among persons experiencing trauma (Breslau et al., 2003). However, we cannot preclude the possibility that the risk factors for alcohol abuse and PTSD are not shared, but simply co-occur in this population. Additionally, some literature suggests that underlying genetic vulnerability modifies the risk of comorbid psychiatric disorders after exposure to traumatic events, including combat (Kilpatrick et al., 2007; Koenen et al., 2003). Although recent studies have begun to elucidate how specific combat experiences increase the risk of both mental illness and alcohol abuse following deployment (Browne et al., 2008; Hoge et al., 2006; Hooper et al., 2008; Wilk et al., 2010), more research is required to determine whether these exposures constitute a common etiologic pathway that drives both substance use and psychiatric conditions in soldiers of the National Guard.

There are several other possible explanations for the observed associations between peri-/post-deployment alcohol abuse and coincident psychiatric problems. One hypothesis, discussed previously (McFarlane, 1998), is that persons with depression or PTSD self-medicate with alcohol to cope with negative affect and perceived stress. Thus, soldiers who develop depression and/or PTSD after being exposed to a deployment-related traumatic event may rely on alcohol as a way to self-medicate emotional suffering (Ferrier-Auerbach et al., 2009). This hypothesis is supported by our finding that new onset alcohol abuse was most common among persons experiencing both peri-/post-deployment depression and PTSD, given that the co-occurrence of these conditions following trauma interacts to increase distress and functional impairment (Shalev et al., 1998). However, it is also possible that heavy alcohol use following deployment increases the likelihood of developing depression or PTSD in the event that trauma has been experienced (Stewart, 1996). Evidence for this hypothesis comes from several studies demonstrating that incident substance abuse disorders following trauma are elevated only in persons who developed PTSD (Breslau et al., 2003). Although we are unable to determine the precise order of peri-/post-deployment alcohol abuse and psychiatric disorders in this study, the coincident nature of these events highlights the need for comprehensive screening and support services for individuals experiencing comorbid psychiatric and alcohol abuse disorders in this population.

There are several strengths of the study, including its rigorous sampling procedures, reliance on DSM-IV criteria to define

the primary outcome and exposures of interest, and the ability to determine the timing of new onset alcohol abuse and psychiatric disorders in relation to deployment. As for study limitations, we note that these data are cross-sectional and thus the timing of the outcome and exposures were retrospectively self-reported. Future analyses will utilize prospectively collected data to validate these findings. Second, the results may be subject to recall bias. It is possible that participants who recalled developing alcohol problems may have been more likely to also remember having psychiatric disorders during the same time period. Third, we may have misclassified persons surveyed shortly after their return from deployment, since prior research demonstrates increased rates of psychiatric symptoms 3–4 months after deployment (Bliese et al., 2007). If present, this bias would result in an underestimate of the true prevalence of new onset psychiatric and alcohol-related problems. Fourth, given the small number of women in the study, we caution that the observed results may not be generalizable to female National Guard soldiers. Furthermore, we were unable to conduct interaction analyses between sex and the mental disorder variables of interest. Finally, although consistent with the DSM-IV, we note that a diagnosis for alcohol abuse required a positive response to only one (or more) of the four criteria, and is thus a sensitive measure of an alcohol disorder. While many studies have demonstrated the predictive validity of DSM-IV alcohol abuse (Hasin and Paykin, 1999; Hasin et al., 1990; Schuckit et al., 2001), the DSM-V Substance Use Disorders Workgroup has recommended that abuse and dependence be combined into a single alcohol disorder of graded clinical severity (American Psychiatric Association, 2011). Future studies will be required to establish the validity of this new measure in military populations.

Given that heavy alcohol use is of significant concern in military personnel (Bray and Hourani, 2007), these findings have important implications for intervention and policy. Historically, uptake of treatment services for alcohol problems in the military has been low, likely due to the fact that accessing these programs is non-confidential and can be perceived as having negative career ramifications (Jacobson et al., 2008). Furthermore, unlike Active Component soldiers, National Guard soldiers do not have uninterrupted access to care, and free military medical coverage lasts only six months following their deployment (Thomas et al., 2010). The high prevalence of peri-/post-deployment alcohol abuse observed in this and other samples of National Guard soldiers suggests that policies which promote improved access to care and encourage utilization of confidential drug and alcohol treatment services merit consideration. Several interventions that utilize one-on-one interviewing and Web-based tools to improve perceptions of privacy have been shown to be efficacious and should continue to be evaluated (Fernandez et al., 2006; Jacobson et al., 2008). Furthermore, physicians treating deployed National Guard for psychiatric conditions including depression and PTSD should be aware that these conditions are highly predictive of concurrent alcohol abuse disorders. Given that persons with comorbid alcohol abuse and psychiatric disorders experience significant disability and reduced quality of life (Andrews et al., 2001), it is recommended that soldiers reporting multiple coincident conditions during or following deployment have ready access to comprehensive and confidential care.

This study demonstrated that incident alcohol abuse during and following deployment is common in soldiers of the Ohio Army National Guard. Furthermore, persons who experience peri-/post-deployment psychiatric disorders are at the greatest risk of developing alcohol-related problems. Although further research is required to elucidate whether deployment-related psychiatric conditions precede substance use disorders or share a common etiology with them, these findings point to the need for comprehensive screening and support services for National Guard with comorbid psychiatric and substance abuse conditions.

Role of funding source

This work was supported by the United States Department of Defense Congressionally Directed Medical Research Program (W81XWH-07-1-0409, the “Combat Mental Health Initiative”). Dr. Marshall is supported by a Fellowship Award from the Canadian Institutes of Health Research (CIHR). All funding bodies had no further 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 BDLM, 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 BDLM managed the literature searches and summaries of previously published related work. Author MRP undertook the statistical analysis with significant scientific input from BDLM and SG. Author BDLM 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

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 8 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.

Acknowledgement

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

References

- American Psychiatric Association, 2000. Diagnostic and Statistical Manual of Mental Disorders: DSM-IV. American Psychiatric Association, Washington, DC.
- American Psychiatric Association, Proposed Revision: R 00 Alcohol Use Disorder. <http://www.dsm5.org/ProposedRevisions/Pages/proposedrevision.aspx?rid=452> [accessed on October 26, 2011].
- Andrews, G., Henderson, S., Hall, W., 2001. Prevalence, comorbidity, disability and service utilisation. Overview of the Australian National Mental Health Survey. *Br. J. Psychiatry* 178, 145–153.
- Bell, N.S., Amoroso, P.J., Yore, M.M., Smith, G.S., Jones, B.H., 2000. Self-reported risk-taking behaviors and hospitalization for motor vehicle injury among active duty army personnel. *Am. J. Prev. Med.* 18, 85–95.
- Blake, D.D., Weathers, F.W., Nagy, L.M., Kaloupek, D.G., Gusman, F.D., Charney, D.S., Keane, T.M., 1995. The development of a clinician-administered PTSD scale. *J. Trauma Stress* 8, 75–90.

- Blanchard, E.B., Jones-Alexander, J., Buckley, T.C., Forneris, C.A., 1996. Psychometric properties of the PTSD Checklist (PCL). *Behav. Res. Ther.* 34, 669–673.
- Bliese, P.D., Wright, K.M., Adler, A.B., Thomas, J.L., Hoge, C.W., 2007. Timing of post-combat mental health assessments. *Psychol. Serv.* 4, 141–148.
- Bray, R.M., Hourani, L.L., 2007. Substance use trends among active duty military personnel: findings from the United States Department of Defense Health Related Behavior Surveys, 1980–2005. *Addiction* 102, 1092–1101.
- Bray, R.M., Marsden, M.E., Peterson, M.R., 1991. Standardized comparisons of the use of alcohol, drugs, and cigarettes among military personnel and civilians. *Am. J. Public Health* 81, 865–869.
- Breslau, N., Davis, G.C., Schultz, L.R., 2003. Posttraumatic stress disorder and the incidence of nicotine, alcohol, and other drug disorders in persons who have experienced trauma. *Arch. Gen. Psychiatry* 60, 289–294.
- Browne, T., Iversen, A., Hull, L., Workman, L., Barker, C., Horn, O., Jones, M., Murphy, D., Greenberg, N., Rona, R., Hotopf, M., Wessely, S., Fear, N.T., 2008. How do experiences in Iraq affect alcohol use among male UK armed forces personnel? *Occup. Environ. Med.* 65, 628–633.
- Calabrese, J.R., Prescott, M., Tamburrino, M., Liberzon, I., Slembariski, R., Goldmann, E., Shirley, E., Fine, T., Goto, T., Wilson, K., Ganocy, S., Chan, P., Serrano, M.B., Sizemore, J., Galea, S., 2011. PTSD comorbidity and suicidal ideation associated with PTSD within the Ohio Army National Guard. *J. Clin. Psychiatry* 72, 1072–1078.
- Eckardt, M.J., Harford, T.C., Kaelber, C.T., Parker, E.S., Rosenthal, L.S., Ryback, R.S., Salmoiraghi, G.C., Vanderveen, E., Warren, K.R., 1981. Health hazards associated with alcohol consumption. *JAMA* 246, 648–666.
- Fear, N.T., Iversen, A., Meltzer, H., Workman, L., Hull, L., Greenberg, N., Barker, C., Browne, T., Earnshaw, M., Horn, O., Jones, M., Murphy, D., Rona, R.J., Hotopf, M., Wessely, S., 2007. Patterns of drinking in the UK Armed Forces. *Addiction* 102, 1749–1759.
- Fear, N.T., Jones, M., Murphy, D., Hull, L., Iversen, A.C., Coker, B., Machell, L., Sundin, J., Woodhead, C., Jones, N., Greenberg, N., Landau, S., Dandeker, C., Rona, R.J., Hotopf, M., Wessely, S., 2010. What are the consequences of deployment to Iraq and Afghanistan on the mental health of the UK armed forces? A cohort study. *Lancet* 375, 1783–1797.
- Fernandez, W.G., Hartman, R., Olshaker, J., 2006. Brief interventions to reduce harmful alcohol use among military personnel: lessons learned from the civilian experience. *Mil. Med.* 171, 538–543.
- Ferrier-Auerbach, A.G., Kehle, S.M., Erbes, C.R., Arbisi, P.A., Thuras, P., Polusny, M.A., 2009. Predictors of alcohol use prior to deployment in National Guard Soldiers. *Addict. Behav.* 34, 625–631.
- Fisher, C.A., Hoffman, K.J., Austin-Lane, J., Kao, T.C., 2000. The relationship between heavy alcohol use and work productivity loss in active duty military personnel: a secondary analysis of the 1995 Department of Defense Worldwide Survey. *Mil. Med.* 165, 355–361.
- Greden, J.F., Frenkel, S.I., Morgan, D.W., 1975. Alcohol use in the army: patterns and associated behaviors. *Am. J. Psychiatry* 132, 11–16.
- Hasin, D., Paykin, A., 1999. DSM-IV alcohol abuse: investigation in a sample of at-risk drinkers in the community. *J. Stud. Alcohol* 60, 181–187.
- Hasin, D.S., Grant, B., Endicott, J., 1990. The natural history of alcohol abuse: implications for definitions of alcohol use disorders. *Am. J. Psychiatry* 147, 1537–1541.
- Hoge, C.W., Auchterlonie, J.L., Milliken, C.S., 2006. Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *JAMA* 295, 1023–1032.
- Hoge, C.W., Castro, C.A., Messer, S.C., McGurk, D., Cotting, D.I., Koffman, R.L., 2004. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N. Engl. J. Med.* 351, 13–22.
- Hooper, R., Rona, R.J., Jones, M., Fear, N.T., Hull, L., Wessely, S., 2008. Cigarette and alcohol use in the UK Armed Forces, and their association with combat exposures: a prospective study. *Addict. Behav.* 33, 1067–1071.
- Hosmer, D.W., Lemeshow, S., 2000. *Applied Logistic Regression*. John Wiley and Sons, Inc., Hoboken, NJ.
- Hotopf, M., Hull, L., Fear, N.T., Browne, T., Horn, O., Iversen, A., Jones, M., Murphy, D., Bland, D., Earnshaw, M., Greenberg, N., Hughes, J.H., Tate, A.R., Dandeker, C., Rona, R., Wessely, S., 2006. The health of UK military personnel who deployed to the 2003 Iraq war: a cohort study. *Lancet* 367, 1731–1741.
- Jacobson, I.G., Ryan, M.A., Hooper, T.I., Smith, T.C., Amoroso, P.J., Boyko, E.J., Gackstetter, G.D., Wells, T.S., Bell, N.S., 2008. Alcohol use and alcohol-related problems before and after military combat deployment. *JAMA* 300, 663–675.
- Kehle, S.M., Ferrier-Auerbach, A.G., Meis, L.A., Arbisi, P.A., Erbes, C.R., Polusny, M.A., 2011. Predictors of postdeployment alcohol use disorders in National Guard soldiers deployed to Operation Iraqi Freedom. *Psychol. Addict. Behav.*, doi:10.1037/a0024663, Epub ahead of print (August 8).
- Kessler, R.C., Berglund, P., Demler, O., Jin, R., Merikangas, K.R., Walters, E.E., 2005. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Arch. Gen. Psychiatry* 62, 593–602.
- Kilpatrick, D.G., Koenen, K.C., Ruggiero, K.J., Acierno, R., Galea, S., Resnick, H.S., Roitzsch, J., Boyle, J., Gelernter, J., 2007. The serotonin transporter genotype and social support and moderation of posttraumatic stress disorder and depression in hurricane-exposed adults. *Am. J. Psychiatry* 164, 1693–1699.
- Koenen, K.C., Lyons, M.J., Goldberg, J., Simpson, J., Williams, W.M., Toomey, R., Eisen, S.A., True, W.R., Cloitre, M., Wolfe, J., Tsuang, M.T., 2003. A high risk twin study of combat-related PTSD comorbidity. *Twin. Res.* 6, 218–226.
- Kroenke, K., Spitzer, R.L., 2002. The PHQ-9: a new depression diagnostic and severity measure. *Psychiatr. Ann.* 32, 509–515.
- Kroenke, K., Spitzer, R.L., Williams, J.B., 2001. The PHQ-9: validity of a brief depression severity measure. *J. Gen. Intern. Med.* 16, 606–613.
- Lande, R.G., Marin, B.A., Chang, A.S., Lande, G.R., 2008. Survey of alcohol use in the U.S. army. *J. Addict. Dis.* 27, 115–121.
- Maguen, S., Lucenko, B.A., Reger, M.A., Gahm, G.A., Litz, B.T., Seal, K.H., Knight, S.J., Marmar, C.R., 2010. The impact of reported direct and indirect killing on mental health symptoms in Iraq war veterans. *J. Trauma Stress* 23, 86–90.
- Martin, A., Rief, W., Klaiberg, A., Braehler, E., 2006. Validity of the Brief Patient Health Questionnaire Mood Scale (PHQ-9) in the general population. *Gen. Hosp. Psychiatry* 28, 71–77.
- McCarroll, J.E., Fan, Z., Bell, N.S., 2009. Alcohol use in nonmutual and mutual domestic violence in the U.S. Army: 1998–2004. *Violence Vict.* 24, 364–379.
- McFarlane, A.C., 1998. Epidemiological evidence about the relationship between PTSD and alcohol abuse: the nature of the association. *Addict. Behav.* 23, 813–825.
- Milliken, C.S., Auchterlonie, J.L., Hoge, C.W., 2007. Longitudinal assessment of mental health problems among active and reserve component soldiers returning from the Iraq war. *JAMA* 298, 2141–2148.
- Santiago, P.N., Wilk, J.E., Milliken, C.S., Castro, C.A., Engel, C.C., Hoge, C.W., 2010. Screening for alcohol misuse and alcohol-related behaviors among combat veterans. *Psychiatr. Serv.* 61, 575–581.
- Schuckit, M.A., Smith, T.L., Danko, G.P., Bucholz, K.K., Reich, T., Bierut, L., 2001. Five-year clinical course associated with DSM-IV alcohol abuse or dependence in a large group of men and women. *Am. J. Psychiatry* 158, 1084–1090.
- Shalev, A.Y., Freedman, S., Peri, T., Brandes, D., Sahar, T., Orr, S.P., Pitman, R.K., 1998. Prospective study of posttraumatic stress disorder and depression following trauma. *Am. J. Psychiatry* 155, 630–637.
- Sheehan, D.V., Lecrubier, Y., Sheehan, K.H., Amorim, P., Janavs, J., Weiller, E., Hergueta, T., Baker, R., Dunbar, G.C., 1998. The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J. Clin. Psychiatry* 59, 22–33.
- Stahre, M.A., Brewer, R.D., Fonseca, V.P., Naimi, T.S., 2009. Binge drinking among U.S. active-duty military personnel. *Am. J. Prev. Med.* 36, 208–217.
- Stewart, S.H., 1996. Alcohol abuse in individuals exposed to trauma: a critical review. *Psychol. Bull.* 120, 83–112.
- Thomas, J.L., Wilk, J.E., Riviere, L.A., McGurk, D., Castro, C.A., Hoge, C.W., 2010. Prevalence of mental health problems and functional impairment among active component and National Guard soldiers 3 and 12 months following combat in Iraq. *Arch. Gen. Psychiatry* 67, 614–623.
- Wells, J.E., Oakley Browne, M.A., Scott, K.M., McGee, M.A., Baxter, J., Kokaua, J., 2006. Te Rau Hinengaro: the New Zealand Mental Health Survey: overview of methods and findings. *Aust. N. Z. J. Psychiatry* 40, 835–844.
- Wilk, J.E., Bliese, P.D., Kim, P.Y., Thomas, J.L., McGurk, D., Hoge, C.W., 2010. Relationship of combat experiences to alcohol misuse among U.S. soldiers returning from the Iraq war. *Drug Alcohol Depend.* 108, 115–121.

Running head: Factor structure of depression

The factor structure of major depression symptoms:
A test of four competing models using the Patient Health Questionnaire-9

Jon D. Elhai^{a,b,*} & Ateka Contractor^a

Marijo Tamburrino^b & Thomas H. Fine^b

Marta R. Prescott^c

Edwin Shirley^{d,e}, Phillip K. Chan^{d,e} & Renee Slembariski^{d,e}

Israel Liberzon^{f,g}

Sandro Galea^c

Joseph R. Calabrese^d

^a Department of Psychology, University of Toledo, Toledo, Ohio, USA

^b Department of Psychiatry, University of Toledo, Toledo, Ohio, USA

^c Mailman School of Public Health, Columbia University, New York, New York, USA

^d Department of Psychiatry, Case Western Reserve University, Cleveland, Ohio, USA

^e University Hospitals Case Medical Center, Cleveland, Ohio, USA

^f Mental Health Service, VA Ann Arbor Health System, Ann Arbor, Michigan, USA

^g Department of Psychiatry, University of Michigan, Ann Arbor, Michigan, USA

Word count (starting with the introduction, excluding references and tables): 3,189.

Corresponding Author for this Submission

Jon D. Elhai, Ph.D.

Department of Psychology

University of Toledo

Mail Stop #948

2801 W. Bancroft St.

Toledo, Ohio 43606-3390

419.530.2829 (tel)

419.530.8479 (fax)

jon.elhai@gmail.com (e-mail)

Abstract

Little research has examined the underlying symptom structure of major depressive disorder symptoms based on *DSM-IV* criteria. Our aim was to analyze the symptom structure of major depression, using the Patient Health Questionnaire-9 (PHQ-9). The PHQ-9 was administered to a sample of 2,615 Army National Guard soldiers from Ohio. A one-factor model of depression and three separate two-factor models previously established in the literature were evaluated using confirmatory factor analysis. Results demonstrated greater support for the two-factor models of depression than for the one-factor model. The best fitting model was the two-factor model of somatic and non-somatic symptoms supported previously by Krause et al. (2010) and Richardson and Richards (2008). Implications for understanding the components and mechanisms of major depressive disorder are discussed.

Keywords: depression; confirmatory factor analysis; military veterans; Patient Health Questionnaire-9

1. Introduction

A substantial body of research has investigated the underlying symptom structure of depression symptoms (Shafer, 2006). However, this body of research has rarely used depression measures with items that map onto *DSM-IV* symptom criteria for major depressive disorder (MDD). Thus, little is known about the symptom structure of *DSM-IV*-based MDD. The Patient Health Questionnaire-9 (PHQ-9), on the other hand, is one of the few depression screening instruments comprising items that map onto *DSM-IV* diagnostic criteria for MDD symptoms. Although the PHQ-9 has been well-researched and used, few studies have assessed its factor structure.

The PHQ-9 is a nine-item major depression module from the Primary Care Evaluation of Mental Disorders (PRIME-MD), a standardized assessment for mood, anxiety, somatoform, alcohol-related, and eating disorders (Spitzer et al., 1994). It was originally designed for the purpose of screening in primary care, an important issue because primary care is the most frequent setting in which individuals seek treatment for mental health reasons (Wang et al., 2006). The PHQ-9 items are self-rated and map onto *DSM-IV* symptom criteria for MDD. An additional item assesses the impact of depressive symptoms on functional impairment. Psychometric evidence demonstrates adequate construct and criterion validity across diverse samples of civilian primary care and obstetrics-gynecology patients (Kroenke et al., 2010; Flynn et al., 2011). Total cut-off scores of 5, 10, 15 and 20 represent “mild,” “moderate,” “moderately severe,” and “severe” (clinically diagnosable) depression respectively; although these labels should not be confused with similar specifiers for major depression from *DSM-IV*. The PHQ-9 diagnostic scoring algorithm corresponds to *DSM-IV* MDD requirements, wherein five or more

items must be recently experienced at least “more than half the days,” with one symptom being depressed mood and/or anhedonia (Kroenke et al., 2001).

There is a paucity of research on the factor structure of *DSM-IV*-based MDD symptoms. The PHQ-9 is an instrument that queries such symptoms. It is true that the Major Depression Inventory (MDI) (Olsen et al., 2003) is another instrument of *DSM-IV*-based MDD symptoms. Despite being analyzed using item response theory which assumes unidimensionality, the MDI’s factor structure has not been investigated. Research is necessary in understanding the latent structure and mechanisms underlying MDD, and studying the PHQ-9 is one means of examining this relatively unexplored research area.

Several studies have used exploratory factor analysis (EFA) to discover relatively unique sets or “factors” of PHQ-9 items that are correlated with each other, in samples of primary care patients, outpatient substance abusers and spinal cord injury patients (Huang et al., 2006; Cameron et al., 2008; Dum et al., 2008; Kalpakjian et al., 2009; Krause et al., 2010). Other studies have used confirmatory factor analysis to test hypothesized models generated from EFA studies, using samples of spinal cord injury and primary care patients (Krause et al., 2008; Baas et al., 2011). Some EFA studies (Huang et al., 2006; Cameron et al., 2008; Dum et al., 2008; Kalpakjian et al., 2009) and CFA studies of the PHQ found support for a one-factor model (Baas et al., 2011), reflecting unidimensionality of the depression construct. Other EFA studies (Richardson and Richards, 2008; Krause et al., 2010) and a CFA study (Krause et al., 2008) found support for a two-factor PHQ model, with one factor primarily based on somatic items (e.g., sleep difficulties, appetite changes and fatigue) and the other factor primarily based on non-somatic or affective items (e.g., depressed mood, feelings of worthlessness and suicidal thoughts). Importantly, these studies typically investigated only one depression model per paper.

Lacking in the literature is a comprehensive evaluation of the various depression factor models, from a *DSM-IV*-based instrument such as the PHQ-9, tested against each other using objective statistical criteria.

We believe that using CFA is more defensible in examining the structure of MDD symptoms, and we built on this area in the present paper. EFA is exploratory and capitalizes on chance error in statistically “discovering” the best patterns of item sets based on computer-generated mathematical algorithms. Given the substantial Type I error, and lack of ability to narrowly specify hypothesized models of interest in EFA a priori, EFA findings do not often cross-validate with other samples (Fabrigar et al., 1999). Unlike EFA, CFA requires the testing of a specifically hypothesized model (or models), evaluating how well the model’s patterns of intercorrelations are represented in the observed data (Bollen, 1989; Kline, 2010).

The PHQ-9’s depression models derived from EFA and CFA have important implications for understanding the core components of depression – specifically, with implications for underlying dimensions and mechanisms of the disorder. For example, three PHQ-9 items have consistently been found represented by the somatic factor (sleep difficulties, appetite changes and fatigue); three additional items have been represented by the affective/non-somatic factor (depressed mood, feelings of worthlessness and thoughts of death) (Krause et al., 2008; Richardson and Richards, 2008; Krause et al., 2010). These preliminary studies thus suggest somatic and affective components of MDD that may have implications for the disorder’s underlying mechanisms. Additionally, the psychomotor difficulties item was less represented by the somatic and non-somatic factors (Krause et al., 2008; Krause et al., 2010), thus possibly reflecting that this symptom may not be as strong of a general depression marker.

The current study aimed to study the factor structure of *DSM-IV*-based MDD symptoms by comparing four empirically-supported models using CFA to assess which model fits best. We used the PHQ-9 to examine our research question. We used objective statistical criteria to judge and compare model fit. Our sample included a large, regional epidemiological sample of National Guard soldiers, many of whom had been deployed to a war zone which places soldiers at risk of depression soon and months after returning from combat (Grieger et al., 2006). This sampling plan broadens previous research on the PHQ-9's factor structure from the restricted samples that have included patients with spinal cord injury (Krause et al., 2008; Richardson and Richards, 2008; Kalpakjian et al., 2009; Krause et al., 2010), and primary care patients (Huang et al., 2006; Baas et al., 2011). We found no studies examining the PHQ's factor structure among a military population.

2. Method

2.1. Participants and Procedure

The present study was part of the Ohio Army National Guard Mental Health Initiative, a large-scale epidemiological study of mental health among National Guard soldiers in Ohio. We initially invited all members of the Ohio National Guard who served between July 2008 and February 2009 for participation in the telephone interview portion of the study, executed through an alert letter. 12,225 Guard members with a valid mailing address were invited to participate (345 additional individuals were excluded for having no mailing address). Among the pool of potential subjects, 1,013 (8.3%) declined to participate, 1,130 (10.1%) did not have a telephone number listed with the Guard, and 3,568 (31.8%) did not have a correct or working phone number. Among the remaining 6,514 Guard members (58.1%), the following individuals were excluded: 187 (2.8%) based on age eligibility restrictions, 1,364 (20.9%) declined to participate,

31 (0.4%) for having English language or hearing difficulties, and 2,316 (35.5%) for not being contacted before the cohort was closed to new recruitment. Of the remaining 2,616 subjects, one subject was excluded for missing six items on our primary measure (PHQ-9), leaving 2,615 participants.

Age ranged from 17 to 61 years ($M = 30.69$, $SD = 9.50$). Most participants were men ($n = 2,227$, 85.2%), with 388 women (14.8%). The vast majority of participants were either currently married ($n = 1,227$, 47.0%) or had never been married ($n = 1,133$, 43.4%). A small proportion of respondents were of Hispanic ethnicity ($n = 82$, 3.1%). Most identified their racial background as Caucasian ($n = 2,295$, 87.9%), or African American ($n = 194$, 7.4%). The majority had some college or technical school education ($n = 1,233$, 47.2%), a completed college education ($n = 466$, 17.8%) or a terminal high school or equivalent degree ($n = 598$, 22.9%). Participants were primarily employed full-time ($n = 1,560$, 59.9%), part-time ($n = 340$, 13.1%), unemployed ($n = 419$, 16.1%) or of student status ($n = 244$, 9.4%). Household income of \$20,000 or less was reported by 326 participants (12.9%), between \$20,001 and \$40,000 by 604 respondents (23.8%), between \$40,001 and \$60,000 by 568 participants (22.4%), between \$60,001 and \$80,000 by 426 (16.8%), and more than \$80,000 by 611 participants (24.1%). Service in the military ranged from 0 to 50 years ($M = 10.08$, $SD = 8.41$). Roughly one-third of the sample had never been deployed ($n = 939$, 36.0%), while most deployed participants reported being deployed once ($n = 816$, 31.3%), twice ($n = 469$, 18.0%), or three times ($n = 213$, 8.2%). 765 participants (46.0%) had been deployed to Iraq or Afghanistan between 2003-2009.

Study enrollment began in November 2008 and ended in November 2009. The National Guard Bureau, Office of Human Research Protections of the U.S. Army Medical Research and Materiel Command, along with several affiliated hospital and university institutional review

boards, approved the study, with written informed consent waived in lieu of verbal consent by telephone. We complied with the Declaration of Helsinki in ethically conducting this research.

2.2. Instrumentation

A computer-assisted telephone interview was conducted for all participants by trained professionals, to assess demographic characteristics and mental health functioning using standardized questionnaires.

Of relevance to the present study, the PHQ-9 was administered by telephone (Kroenke et al., 2001). The PHQ-9 measures depression symptoms over the previous two weeks based on *DSM-IV* major depressive episode symptom criteria. We modified the instructions in order to query depression symptoms over the course of the respondent's lifetime; support for this approach was found in Cannon et al. (2007). The PHQ-9 is a Likert-type self-report instrument with four response options ranging from "0 = *Not at all*" to "3 = *Nearly every day*." As a severity measure, scores on the PHQ-9 range from zero to 27. Internal consistency has ranged from 0.86 to 0.89 (Kroenke et al., 2001) ($\alpha = 0.86$ in the present sample). Test-retest reliability within 48 hours was $r = 0.84$. Diagnostic validity has been demonstrated in detecting an MDD diagnosis based on structured diagnostic interviews. Lastly, construct validity is reflected in the association of PHQ-9 severity scores and measures of functional status, number of disability days and difficulties based on symptoms (Kroenke et al., 2001).

2.3. Analysis

Of the 2,615 participants, 62 were missing between one to two PHQ items each, and one subject missed three items. We used multiple imputation procedures with an iterative Markov chain Monte Carlo method and the Gibbs Sampler procedure (in SPSS's Version 17 Missing Value Analysis software) to estimate missing item-level PHQ data, generated across 10 imputed

datasets. CFA analyses were conducted using Mplus 6.1 software, averaging parameter estimates across the 10 imputed datasets. Three PHQ items had kurtosis values greater than 2.0, thus deemed non-normally distributed. Therefore CFA analyses implemented maximum likelihood estimation with a mean-adjustment, using the Satorra-Bentler chi-square value which is robust to non-normality (Satorra and Bentler, 2001).

CFA analyses were implemented by specifying the four models discussed above (and displayed in Table 1), treating PHQ items as continuously-scaled. All residual error covariances were fixed to zero. In scaling the factors within a model, we fixed factor variances to 1. Goodness of fit indices are reported below, including the comparative fit index (CFI), Tucker Lewis Index (TLI), root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR). Models fitting very well (or adequately) are indicated by CFI and $TLI \geq 0.95$ (0.90-0.94), $RMSEA \leq .06$ (0.07-0.08), $SRMR \leq 0.08$ (0.90-0.10) (Hu and Bentler, 1999). All tests were two-tailed. Comparing nested models by examining differences in traditional goodness of fit indices (mentioned above) is not appropriate, and inaccurate (Fan and Sivo, 2009). Therefore, in comparing the one-factor model with a given two-factor model, we used a difference test for nested models between Satorra-Bentler chi-square values (with a correction factor because the Satorra-Bentler chi-square value is not distributed normally on a chi-square distribution) (Muthén and Muthén, 2006). We also present Bayesian Information Criterion (BIC) values for comparing the two-factor models with each other; chi-square difference testing is not possible between the two-factor models since they are not nested within one another. In comparing BIC values between models, a 10-point BIC difference represents a 150:1 likelihood and “very strong” ($p < 0.05$) support that the model with the smaller BIC value

fits best; a difference in the 6 to 9 point range indicates “strong” support (Kass and Raftery, 1995; Raftery, 1995).

3. Results

We first estimated descriptive statistics for the PHQ-9 total score. The sample ranged in score from 0 to 27, with a mean of 5.12 ($SD = 6.01$). Thus this sample, as a whole, was represented by only mild depression. Based on the diagnostic scoring algorithm described above and discussed by Kroenke et al. (2001), 282 participants (10.8%) would be classified as a “probable depression” case. Based on a more liberal screening method, using a cutoff score of 10 or higher, 564 participants (21.6%) would be classified as a “probable depression” case.

The one-factor model (Model 1) fit the data reasonably well (see Table 2), as indicated by relatively high estimates on CFI and TLI, and low estimates of RMSEA and SRMR. As demonstrated by chi-square difference testing (implementing the Satorra-Bentler correction factor) each two-factor model fit significantly better than the one-factor model (with uniformly lower chi-square values for the two-factor models); thus the PHQ-9 appeared to be multidimensional rather than unidimensional. Based on BIC values, Model 2b fit significantly better (with a smaller BIC value) than Model 2a, which in turn fit significantly better than Model 2c. Model 2b’s superior fit is evidenced by a difference in BIC values of 66 when compared to Model 2a, and a difference of 92 when compared to Model 2c.¹

Table 3 presents factor loadings for Model 2b, which was the best fitting model. All factor loadings were 0.65 or higher, except for the last loading per factor. Thus for the most part,

¹ Because CFA results sometimes do not replicate with other samples, we drew a random subsample of ~50% of participants ($n = 1304$) and re-computed the CFA analyses, comparing those results with results computed for the remaining 1311 subjects. We found nearly identical results across subsamples and when compared to the results presented above, with only very minor discrepancies in fit indices. Furthermore, as in the findings presented above, in both randomly generated subsamples all fit indices were strongest for Model 2b.

the items within a given factor hung together very well. The correlation between factors was 0.87.

4. Discussion

We empirically tested four *DSM-IV*-based depression models previously investigated using EFA or CFA in order to reveal the best fitting depression model. Our sample of Army National Guard soldiers was not a severely depressed sample; rather, they were represented as a whole by previously having only mild depression symptoms. As such, our tests of the latent structure of the PHQ-9's depression symptoms essentially modeled depression's components at the mild end of the depression continuum.

We found that using the PHQ-9, the two-factor model supported by Krause et al. (2010) using EFA from their study's second wave of data (17-month) of three longitudinal measurement waves, and by Richardson and Richards (2008), best fit the data. This model is different from the one-factor model previously supported in EFA studies because it separates the general depression factor into somatic and non-somatic factors. It differs from Krause et al.'s model found to fit best in the authors' first of three longitudinal measurement phases because the current model conceptualizes concentration and psychomotor difficulties as part of the somatic factor. The current model differs from Krause et al.'s model discovered from EFA at their study's third measurement wave (29-month follow up) because the current model conceptualizes anhedonia as part of the non-somatic factor.

Each of the two-factor models fit significantly better than the one-factor model. Thus, we find that MDD symptoms (using the PHQ-9) are best represented by somatic and non-somatic factors, rather than a single, unidimensional factor. This distinction between somatic and non-somatic factors is not only an internal distinction within a depression instrument (the PHQ-9),

but likely represents differential relations with other types of psychopathology. For example, Elhai et al. (2011) found that using the Center for Epidemiologic Studies-Depression Scale with Canadian military veterans, depression's somatic items were significantly more related than depression's affective items to particular posttraumatic stress disorder (PTSD) factors. Furthermore, in the present study, the best fitting model (2b) fit better than the other two-factor models, determined by objective statistical criteria. However, because the present study is the first to use CFA with a *DSM-IV*-based depression instrument to test competing depression models, future studies are needed to further examine these, and perhaps other, competing models.

This research is important in contributing to an understanding of the true components of MDD. Future research should further explore the somatic and affective dimensions of MDD and evaluate which of these constructs is more related to depression-related psychopathology as well as treatment outcomes. Understanding these constructs and their correlates can potentially aid clinicians in prioritizing treatment interventions aimed at reducing the more severe subtype of these MDD symptoms. For example, if one subtype of MDD symptoms (for example, somatic items) is found more related to psychopathology, then perhaps that subtype would represent a priority for clinical intervention over other depression symptoms. Furthermore, MDD is similar to, overlaps with, and is comorbid with other mood and anxiety disorders. This feature of MDD will not likely cease with *DSM-5*'s publication, since MDD's proposal for *DSM-5* is quite similar to the *DSM-IV* version, as is the case for other mood and anxiety disorders with which MDD overlaps (American Psychiatric Association. *DSM-5 Development.*, 2010), Future research should attempt to examine the latent structure of MDD in relation to the structure of other mood and anxiety disorders, such as dysthymic disorder, PTSD, and generalized anxiety disorder,

given their conceptual and empirical overlap with MDD (Watson, 2005; 2009). Although recent studies have examined the underlying factors accounting for diagnostic variables marking these disorders (Forbes et al., 2010; Forbes et al., 2011), future work should attempt to analyze this issue with these disorders at the latent construct level (e.g., Elhai et al., 2011).

Several limitations apply to the present study. First, we used the PHQ-9 which is a self-report instrument, albeit administered via telephone format in our study. We do not know the extent to which our findings with a self-report instrument would replicate using a comprehensive, structured diagnostic interview to query MDD, such as the Structured Clinical Interview for *DSM-IV*'s (SCID) depression modules, given the difference in instrument format. Second, our study sampled Army National Guard military personnel (predominantly male), rather than a broader, representative community or clinical sample of men and women. Future work should explore MDD's factor structure using more generalizable civilian and military samples. Third, our sample as a whole reported only mild depression in their lifetimes, and thus we were unable to examine depression's factor structure among a heterogeneous sample varying on current depression severity. Finally, future research should test relationships between MDD factors and specific external constructs of psychopathology.

Author Note

This project was funded by the Department of Defense Congressionally Directed Medical Research Program W81XWH-O7-1-0409, the “Combat Mental Health Initiative.”

Correspondence about this article may be addressed to Dr. Elhai through his website:
www.jon-elhai.com

Disclosures

The authors have no perceived or actual conflicts of interest related to this project. The sponsor had no role in study design, data collection, analysis, interpretation of results, report writing or manuscript submission.

References

- American Psychiatric Association. DSM-5 Development., 2010. Proposed draft revisions to DSM disorders and criteria.
- Baas, K.D., Cramer, A.O.J., Koeter, M.W.J., van de Lisdonk, E.H., van Weert, H.C., Schene, A.H., 2011. Measurement invariance with respect to ethnicity of the Patient Health Questionnaire-9 (PHQ-9). *Journal of Affective Disorders* 129, 229-235.
- Bollen, K.A., 1989. *Structural equations with latent variables*. John Wiley & Sons, John Wiley & Sons.
- Cameron, I.M., Crawford, J.R., Lawton, K., Reid, I.C., 2008. Psychometric comparison of PHQ-9 and HADS for measuring depression severity in primary care. *British Journal of General Practice* 58, 32-36.
- Cannon, D.S., Tiffany, S.T., Coon, H., Scholand, M.B., McMahon, W.M., Leppert, M.F., 2007. The PHQ-9 as a brief assessment of lifetime major depression. *Psychological Assessment* 19, 247-251.
- Dum, M., Pickren, J., Sobell, L.C., Sobell, M.B., 2008. Comparing the BDI-II and the PHQ-9 with outpatient substance abusers. *Addictive Behaviors* 33, 381-387.
- Elhai, J.D., Contractor, A.A., Palmieri, P.A., Forbes, D., Richardson, J.D., 2011. Exploring the relationship between underlying dimensions of posttraumatic stress disorder and depression in a national, trauma-exposed military sample. *Journal of Affective Disorders* 133, 477-480.
- Fabrigar, L.R., Wegener, D.T., MacCallum, R.C., Strahan, E.J., 1999. Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods* 4, 272-399.

- Fan, X., Sivo, S.A., 2009. Using Δ goodness-of-fit indexes in assessing mean structure invariance. *Structural Equation Modeling* 16, 54-67.
- Flynn, H.A., Sexton, M., Ratliff, S., Porter, K., Zivin, K., 2011. Comparative performance of the Edinburgh Postnatal Depression Scale and the Patient Health Questionnaire-9 in pregnant and postpartum women seeking psychiatric services. *Psychiatry Research* 15, 130-134.
- Forbes, D., Lockwood, E., Elhai, J.D., Creamer, M., O'Donnell, M., Bryant, R., McFarlane, A., Silove, D., 2011. An examination of the structure of posttraumatic stress disorder in relation to the anxiety and depressive disorders. *Journal of Affective Disorders* 132, 165-172.
- Forbes, D., Parslow, R., Creamer, M., O'Donnell, M., Bryant, R., McFarlane, A., Silove, D., Shalev, A., 2010. A longitudinal analysis of posttraumatic stress disorder symptoms and their relationship with fear and anxious-misery disorders: Implications for DSM-V. *Journal of Affective Disorders* 127, 147-152.
- Grieger, T.A., Cozza, S.J., Ursano, R.J., Hoge, C., Martinez, P.E., Engel, C.C., Wain, H.J., 2006. Posttraumatic stress disorder and depression in battle-injured soldiers. *American Journal of Psychiatry* 163, 1777-1783.
- Hu, L., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling* 6, 1-55.
- Huang, F.Y., Chung, H., Kroenke, K., Delucchi, K.L., Spitzer, R.L., 2006. Using the Patient Health Questionnaire-9 to measure depression among racially and ethnically diverse primary care patients. *Journal of General Internal Medicine* 21, 547-552.

- Kalpakjian, C.Z., Toussaint, L.L., Albright, K.J., Bombardier, C.H., Krause, J.K., Tate, D.G., 2009. Patient Health Questionnaire-9 in spinal cord injury: An examination of factor structure as related to gender. *The Journal of Spinal Cord Medicine* 32, 147-156.
- Kass, R.E., Raftery, A.E., 1995. Bayes factors. *Journal of the American Statistical Association* 90, 773-795.
- Kline, R.B., 2010. *Principles and practice of structural equation modeling*, 3rd edn. Guilford Press, Guilford Press.
- Krause, J.S., Bombardier, C., Carter, R.E., 2008. Assessment of depressive symptoms during inpatient rehabilitation for spinal cord injury: Is there an underlying somatic factor when using the PHQ? *Rehabilitation Psychology* 53, 513-520.
- Krause, J.S., Reed, K.S., McArdle, J.J., 2010. Factor structure and predictive validity of somatic and nonsomatic symptoms from the Patient Health Questionnaire-9: A longitudinal study after spinal cord injury. *Archives of Physical Medicine and Rehabilitation* 91, 1218-1224.
- Kroenke, K., Spitzer, R.L., Williams, J.B., Lowe, B., 2010. The Patient Health Questionnaire Somatic, Anxiety, and Depressive Symptom Scales: A systematic review. *General Hospital Psychiatry* 32, 345-359.
- Kroenke, K., Spitzer, R.L., Williams, J.B.W., 2001. The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine* 16, 606-613.
- Muthén, B.O., Muthén, L., 2006. Chi-square difference testing using the Satorra-Bentler scaled chi-square. Muthén & Muthén
- Olsen, L.R., Jensen, D.V., Noerholm, V., Martiny, K., Bech, P., 2003. The internal and external validity of the Major Depression Inventory in measuring severity of depressive states. *Psychological Medicine* 33, 351-356.

- Raftery, A.E., 1995. Bayesian model selection in social research. *Sociological Methodology* 25, 111–163.
- Richardson, E.J., Richards, J.S., 2008. Factor structure of the PHQ-9 screen for depression across time since injury among persons with spinal cord injury. *Rehabilitation Psychology* 53, 243-249.
- Satorra, A., Bentler, P.M., 2001. A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika* 66, 507-514.
- Shafer, A.B., 2006. Meta-analysis of the factor structures of four depression questionnaires: Beck, CES-D, Hamilton, and Zung. *Journal of Clinical Psychology* 62, 123-146.
- Spitzer, R.L., Williams, J.B.W., Kroenke, K., Linzer, M., Ill, d.F.V., Hahn, S.R., Brody, D., Johnson, J.G., 1994. Utility of a new procedure for diagnosing mental disorders in primary care: The PRIME-MD 1000 study. *Journal of American Medical Association* 272, 1749-1756.
- Wang, P.S., Demler, O., Olfson, M., Pincus, H.A., Wells, K.B., Kessler, R.C., 2006. Changing profiles of service sectors used for mental health care in the United States. *American Journal of Psychiatry* 163, 1187-1198.
- Watson, D., 2005. Rethinking the mood and anxiety disorders: A quantitative hierarchical model for DSM-V. *Journal of Abnormal Psychology* 114, 522-536.
- Watson, D., 2009. Differentiating the mood and anxiety disorders: A quadripartite model. *Annual Review of Clinical Psychology* 5, 221-247.

Table 1. Factor models tested, and factors on which items were mapped

PHQ 9 Items	Model 1	Model 2a	Model 2b	Model 2c
1. Anhedonia	Depression	Non-Somatic	Non-Somatic	Somatic
2. Depressed mood	Depression	Non-Somatic	Non-Somatic	Non-Somatic
3. Sleep difficulties	Depression	Somatic	Somatic	Somatic
4. Fatigue	Depression	Somatic	Somatic	Somatic
5. Appetite changes	Depression	Somatic	Somatic	Somatic
6. Feeling of worthlessness	Depression	Non-Somatic	Non-Somatic	Non-Somatic
7. Concentration difficulties	Depression	Non-Somatic	Somatic	Somatic
8. Psychomotor agitation/retardation	Depression	Non-Somatic	Somatic	Somatic
9. Thoughts of death	Depression	Non-Somatic	Non-Somatic	Non-Somatic

Note. Model 2a is based on Krause et al.'s (2010) EFA model at baseline measurement and Krause et al.'s (2008) CFA model. Model 2b is based on Krause et al.'s (2010) EFA model at 17 months post-injury, and Richardson and Richards' (2008) model at 1 year post-injury. Model 2c is based on Krause et al.'s (2010) EFA model at 29 months post-injury.

Table 2. Comparison of fit statistics for the four PHQ factor analytic models.

Model	Satorra-Bentler $\chi^2(df)$	CFI	TLI	RMSEA	SRMR	BIC	Compared to Model 1 $\chi^2_{Diff}(df)$
1	317.71(27)*	0.94	0.91	0.06	0.04	56476.07	
2a	246.62(26)*	0.95	0.93	0.06	0.04	56356.37	69.64(1)*
2b	210.35(26)*	0.96	0.94	0.05	0.03	56290.75	101.02(1)*
2c	261.63(26)*	0.95	0.93	0.06	0.04	56382.56	53.87(1)*

Note: CFI = Comparative fit index; TLI = Tucker-Lewis Index; RMSEA = Root mean square error of approximation; SRMR = standardized root mean square residual; BIC = Bayesian information criterion.

* $p < 0.001$.

Table 3. Standardized Factor Loadings for Model 2b.

Factor Loadings	β
<u>Non-somatic</u>	
1. Anhedonia	0.76
2. Depressed mood	0.79
6. Feelings of worthlessness	0.68
9. Thoughts of death	0.48
<u>Somatic</u>	
3. Sleep difficulties	0.68
4. Fatigue	0.71
5. Appetite changes	0.65
7. Concentration difficulties	0.65
8. Psychomotor agitation/retardation	0.50

Potentially Modifiable Pre-, Peri-, and Postdeployment Characteristics Associated With Deployment-Related Posttraumatic Stress Disorder Among Ohio Army National Guard Soldiers

EMILY GOLDMANN, PhD, JOSEPH R. CALABRESE, MD, MARTA R. PRESCOTT, PhD, MARIJO TAMBURRINO, MD, ISRAEL LIBERZON, MD, PhD, RENEE SLEMBARSKI, MBA, EDWIN SHIRLEY, PhD, THOMAS FINE, MA, TOYOMI GOTO, MA, KIMBERLY WILSON, MSW, STEPHEN GANOCY, PhD, PHILIP CHAN, MS, MARY BETH SERRANO, MA, JAMES SIZEMORE, MDIV, AND SANDRO GALEA, MD, DRPH

PURPOSE: To evaluate potentially modifiable deployment characteristics—predeployment preparedness, unit support during deployment, and postdeployment support—that may be associated with deployment-related posttraumatic stress disorder (PTSD).

METHODS: We recruited a sample of 2616 Ohio Army National Guard (OHARNG) soldiers and conducted structured interviews to assess traumatic event exposure and PTSD related to the soldiers' most recent deployment, consistent with DSM-IV criteria. We assessed preparedness, unit support, and postdeployment support by using multimeasure scales adapted from the Deployment Risk and Resilience Survey.

RESULTS: The prevalence of deployment-related PTSD was 9.6%. In adjusted logistic models, high levels of all three deployment characteristics (compared with low) were independently associated with lower odds of PTSD. When we evaluated the influence of combinations of deployment characteristics on the development of PTSD, we found that postdeployment support was an essential factor in the prevention of PTSD.

CONCLUSIONS: Results show that factors throughout the life course of deployment—in particular, postdeployment support—may influence the development of PTSD. These results suggest that the development of suitable postdeployment support opportunities may be centrally important in mitigating the psychological consequences of war.

Ann Epidemiol 2012;22:71–78. © 2012 Elsevier Inc. All rights reserved.

KEY WORDS: Military Personnel, Post-Traumatic Stress Disorders, War.

INTRODUCTION

The authors of several studies have documented the prevalence of psychopathology after combat. In a study of veterans from the first Gulf War (1990–1991), Kang et al. (1) reported that the prevalence of posttraumatic stress

disorder (PTSD) was 10.1% approximately 10 years after the war. Hoge et al. (2) examined soldiers upon returning from deployment and found prevalence estimates of 12.9% and 6.2% among U.S. Army soldiers in Iraq (Operation Iraqi Freedom, [OIF]) and Afghanistan (Operation Enduring Freedom [OEF]), respectively, and 12.2% among Marine Corps soldiers who served in OIF. The Millennium Cohort Study, a prospective study that assesses mental health in current and former members of the U.S. military, reported at baseline that 2.4% of respondents had the symptoms of PTSD in the past month (3).

Although there are fewer such studies, some investigators have also estimated the burden of PTSD among National Guard and Reserve soldiers, ranging from 2.0% in Gulf War veterans (4, 5) to 12.7% in OIF veterans (6). These soldiers have historically contributed only part-time to the military and have principally participated in mostly domestic incidents. However, more recently they have increasingly been deployed to war zones overseas. As of 2008, Guard and Reserve forces constituted approximately

From the Columbia University, New York, NY (E.G., M.R.P., S.G.); University of Michigan, Ann Arbor, MI (E.G., M.R.P., I.L., S.G.); Department of Psychiatry, University Hospitals Case Medical Center, Case Western Reserve University, Cleveland, OH (J.R.C., R.S., E.S., T.G., S.G., P.C., M.B.S.); Department of Psychiatry, University of Toledo College of Medicine, Toledo, OH (M.T.); University of Toledo Health Science Center, Toledo, OH (T.F., K.W.); and Ohio Army National Guard, Columbus, OH (J.S.).

Address correspondence to: Marta R. Prescott, PhD, 722 W. 168th St. Rm 520, New York, NY 10032. Tel.: 212–342–1977; Fax: 212–342–5168. E-mail: mrp2163@columbia.edu.

Funding source: Department of Defense Congressionally Directed Medical Research Program:W81XWH-O7-1-0409, the "Combat Mental Health Initiative."

Received January 21, 2011. Accepted November 15, 2011.

Selected Abbreviations and Acronyms

PTSD = posttraumatic stress disorder
OIF/OEF = Operation Iraqi Freedom/Operation Enduring Freedom
OHARNG = Ohio Army National Guard
DRRI = Deployment Risk and Resilience Inventory
DSM-IV = Diagnostic and Statistical Manual of Mental Disorders
OR = odds ratio
CI = confidence interval

11% of current combat forces in OIF and 21% in OEF (7). Understanding what factors influence PTSD development among Guard and Reserve forces may shed light on post-deployment psychopathology in this population.

Risk factors for PTSD can be divided into three groups on the basis of their temporal relationship with the traumatic event (i.e., characteristics from before, during, and after the event) (8). In studies that use data from various military populations, e.g., veterans of the Vietnam War (9), the first Gulf War (10), OIF and OEF (11, 12), as well as soldiers and peacekeepers in other combat locations (13), authors have examined the relationship between these types of variables and PTSD after deployment. They have found associations between PTSD and predeployment risk factors, such as socioeconomic status, history of early trauma, antisocial behavior during childhood, friendships and family environment in childhood, age at entry to Vietnam, and exposure to predeployment stressors (10, 14–16). Other studies report relations between PTSD and factors during deployment, such as traditional combat experience, difficult living/working environment, concerns about family at home, unit support, experience with atrocities or abusive violence, and perceived life threat (10, 13, 16–18). Postdeployment factors such as additional stressful life events, hardiness, and social support also are influential in the development of PTSD, with perceived functional social support acting as a particularly strong predictor of the disorder (13, 15, 16, 19–21).

Although some of the risk factors identified in these studies are inextricable from the experience of war, other factors may well be modifiable and can therefore point to potential interventions that may mitigate the psychological consequences of war. In this study we consider modifiable factors pre-, peri-, and post-deployment that may influence the risk of PTSD by using baseline data from a 10-year prospective study of a current Army National Guard population. We approach the study from a life-course perspective, considering both the independent and the interactive contribution of these factors (22). Although we evaluate the independent relations between each deployment factor and deployment-related PTSD, we are particularly interested in how these factors together influence risk of PTSD. We hope that through this approach we might (i) identify potential areas of intervention that can be modified

throughout the course of deployment to mitigate the consequences of deployment experience or (ii) identify one modifiable deployment characteristic whose improvement may have the greatest benefit to soldiers' postdeployment psychological well-being.

METHODS

The source population for the study was Ohio Army National Guard (OHARNG) soldiers who were serving between June 2008 and February 2009. We invited all participants through a two-stage process between November 2008 and November 2009. First, we notified all OHARNG soldiers through an opt-out card (N = 12,225). Second, among those who did not return an opt-out card (N = 10,082), we called all remaining soldiers who had a working phone number on file with the guard (n = 6514; 64.6%). Of these soldiers, 2616 male and female soldiers ultimately took part in the study (43.2% fraction who consented to a survey [2616 + 187] among all correct numbers minus the ineligible [6514–31]). This sample excluded those who did not want to participate (n = 1364), those never reached (n = 2316), retired (n = 187), or ineligible (n = 31). Additional work on the baseline population of the OHARNG MHI found that the sample was representative of the Ohio National Guard overall (data available upon request). For this work, our study population was the members of the OHARNG MHI who had ever been deployed (n = 1668, 63.8% of the parent study). Of those deployed, 41.9% of members who had ever been deployed had most recently been deployed to OIF, whereas 4.7% had been most recently deployed to OEF.

We conducted 60-minute structured telephone interviews to assess lifetime traumatic event experience (in civilian life and during most recent deployment), symptoms of PTSD, depression, and generalized anxiety disorder, social support, general health history, overall military and deployment experience, substance use and other behaviors, and demographic information.

We assessed pre-, peri-, and post-deployment domains associated with respondents' most recent deployments—specifically, predeployment military preparedness, unit support during deployment, and post-deployment support—by using validated instruments from the Deployment Risk and Resilience Inventory (DRRI). Each instrument comprised several items asking whether the participant had that particular experience; scores per item ranged from 1 (strongly disagree) to 5 (strongly agree). We summed item scores to create a total score for each domain. Scores were calculated for all participants, even if not all questions were answered; the unanswered questions were treated as having a score of 0, a neutral response. All three domains showed good internal consistency in our study population

(standardized Cronbach's coefficient alpha = 0.7, 0.8, 0.7, respectively). We created dichotomous variables for these factors (e.g., high vs. low preparedness) on the basis of their median scores. Scores greater than 21, 29, and 24 indicated high preparedness, high unit support, and high postdeployment support, respectively. We then created eight dummy variables to represent combinations of pre-, peri-, and post-deployment experiences (e.g., high preparedness, low unit support, high postdeployment support).

We assessed traumatic event experience during the most recent deployment by using a list of 20 events from the DRRI, as well as one item from an additional list of 19 other events that asks about combat experience, used by Breslau et al. (23). We used the PTSD Checklist, a 17-symptom self-report measure based on Diagnostic and Statistical Manual of Mental Disorders, Edition 4 (DSM-IV) criteria B, C, and D (24), to evaluate symptoms of re-experiencing, avoidance/numbing, and increased arousal related to a deployment traumatic event (25). If a participant experienced more than one event during deployment, we asked PTSD symptom questions based on the event reported as the "worst." Participants indicated how much each symptom bothered them from 1 (not at all) to 5 (extremely). Scores can range from 17 to 85 (26).

Additional questions were used to assess DSM-IV criteria A2 (feelings of intense fear, helplessness, or horror in response to the event), E (at least 1-month duration of symptoms), and F (clinically significant distress or disability attributable to symptoms) (25). Participants had to meet all six DSM-IV criteria to be considered a PTSD case. We conducted clinical, in-person interviews among a random sample of telephone survey participants ($n = 500$) to validate the PTSD Checklist by using the Clinician-Administered PTSD Scale (27, 28). Clinicians were blinded to responses from the telephone survey.

We used logistic regression analysis to examine the relation between the deployment-related characteristics and their combinations and symptoms of deployment-related PTSD among those who had experienced at least one deployment-related traumatic event during their most recent deployment. To address the possibility that our DRRI measures differed by the number of deployments experienced, we compared the distribution of the high DRRI measure across deployments (1, 2, or 3 or more). Regressions were adjusted for military experience (pay grade, number of deployments, location of most recent deployment in a conflict area or nonconflict area, number of deployment-related traumatic events experienced during most recent deployment) and other sociodemographic characteristics (age, gender, race, household income, educational attainment, and marital status, all self-reported). We selected potential confounders based on the definition of a confounder: there existed an association between the

TABLE 1. Characteristics of the OHARNG study participants

Characteristics	Been deployed ($n = 1668$)	
	n	%
Gender		
Male	1498	89.8
Female	170	10.2
Age, yr		
17–24	297	17.8
25–34	656	39.3
35–44	524	31.4
45+	189	11.3
Race		
White	1477	88.5
Black	114	6.8
Other	74	4.4
Income		
$\leq \$60,000$	885	53.1
$\$60,001+$	748	44.8
Education		
High school graduate/GED or less	375	22.5
Some college or technical training	824	49.4
College/graduate degree	469	28.1
Marital status		
Married	954	57.2
Divorced/separated/widowed	189	11.3
Never married	522	31.3
Rank		
Officer	256	15.3
Enlisted, cadets, and civilian employees	1411	84.6
Most recent deployment location		
Never deployed	0	0.0
Nonconflict area	872	52.3
Conflict area	793	47.5
Number of lifetime deployments		
0	0	0.0
1	817	49.0
2–3	682	40.9
4+	165	9.9
Total number of deployment-related traumatic events experienced		
0	374	22.4
1–5	588	35.3
6–11	337	20.2
12+	369	22.1

OHARNG = Ohio Army National Guard.

Note: These are the percentage breakdown of demographics and military characteristics among those with deployment experience. Some percentages do not add up to 100 because of missing values.

selected characteristics and our exposure as well as our outcomes of interest (data available upon request). We used SAS 9.2 (SAS Institute Inc., Cary, NC) for all analyses.

RESULTS

Table 1 shows descriptive characteristics of those soldiers who had been deployed (our study population $n = 1668$). The majority of participants were men (89.8%), with more participants reporting being white than another race

TABLE 2. Characteristics related to most recent deployment among those who have been deployed (n = 1668)

	Median	Range	Alpha*
Training and deployment preparation	21.0	4–25	0.7
I had all the supplies and equipment needed to get my job done	4.0		
The equipment I was given functioned the way it was supposed to	5.0		
I received adequate training on how to use my equipment	5.0		
I was accurately informed about what to expect from the enemy	4.0		
I was accurately informed of what daily life would be like during my deployment	4.0		
Unit support	29.0	7–35	0.8
I felt a sense of camaraderie between myself and other soldiers in my unit	5.0		
Most people in my unit were trustworthy	4.0		
I could go to most people in my unit for help when I had a personal problem	4.0		
My commanding officers were interested in what I thought and how I felt about things	4.0		
I was impressed by the quality of leadership in my unit	4.0		
My superiors made a real attempt to treat me as a person	4.0		
I felt like my efforts really counted to the military	4.0		
Postdeployment support	26.0	1–30	0.7
The reception I received when I returned from my deployment made me feel appreciated for my efforts	5.0		
The American people made me feel at home when I returned	5.0		
When I returned, people made me feel proud to have served my country in the Armed Forces	5.0		
People at home just don't understand what I have been through while in the Armed Forces [†]	2.0		
There are people to whom I can talk about my deployment experiences	5.0		
The people I work with respect the fact that I am a veteran	5.0		

These are the characteristics (mean, median, and Chronbach's alpha) reported from the Deployment Risk and Resilience Inventory (DRRI). Each question was asked on a scale from 1–5, with 1 being strongly disagree and 5 being strongly agree.

*Cronbach's coefficient alpha (standardized).

[†]Recoded, reverse order.

(88.5% vs 11.2%), and almost half of the sample was married (57.2%). The majority (77.6%) experienced at least one traumatic event during their most recent deployment. When compared with the parent study population, the deployed population was significantly older than the total population; more were male, married, officers, had greater income and educational attainment, and greater traumatic event experience (all $p < .01$). The majority of the sample had been deployed within 3 years of the survey (61.8%). Data from the validation analyses (not shown) yielded excellent internal consistency (0.95). In addition, we found that the specificity was extremely high (0.97) but the sensitivity was weak (0.35).

Table 2 shows the pre-, peri-, and post-deployment characteristics included in this study—training and deployment preparedness, unit support, and postdeployment support, respectively—as they relate to the participant's most recent deployment among those soldiers who have been deployed. As a domain, preparedness had the lowest median score (21.0) and unit support had the highest (29.0). Among the individual items, feeling that people at home did not understand what the participant had been through while in the Armed Forces had the lowest median score (2.0). Score ranges by domain show that participants failed to answer a greater number of questions in the postdeployment support section than in the other sections. We did not find that the frequency of those with high levels of training and deployment preparedness, unit support, or postdeployment

support differed depending on the number of deployments the soldiers experienced.

Table 3 reports the distribution of the eight deployment characteristic combinations among those who have been deployed. The largest proportion of the sample reported high levels for all three domains (25.2%). The high preparedness, high unit support, and low post-deployment support combination was reported by the smallest proportion of soldiers (3.2%). The prevalence of deployment-related PTSD (given exposure to a deployment-related traumatic event) was highest among those who reported low for all three domains (22.4%) and lowest among those

TABLE 3. Distribution of pre-, peri-, and postdeployment characteristic combinations and PTSD among those who have been deployed (n = 1668)

Combination	Preparedness	Unit support	Postdeployment support	n	%	PTSD %*
1	High	High	High	421	25.2	4.7
2	High	High	Low	53	3.2	11.9
3	High	Low	High	189	11.3	4.2
4	High	Low	Low	65	3.9	16.4
5	Low	High	High	259	15.5	6.2
6	Low	Low	High	377	22.6	7.6
7	Low	High	Low	55	3.3	20.0
8	Low	Low	Low	249	14.9	22.4
Overall						9.6

PTSD = posttraumatic stress disorder.

*Among those who experienced a traumatic event during their most recent deployment (n = 1294).

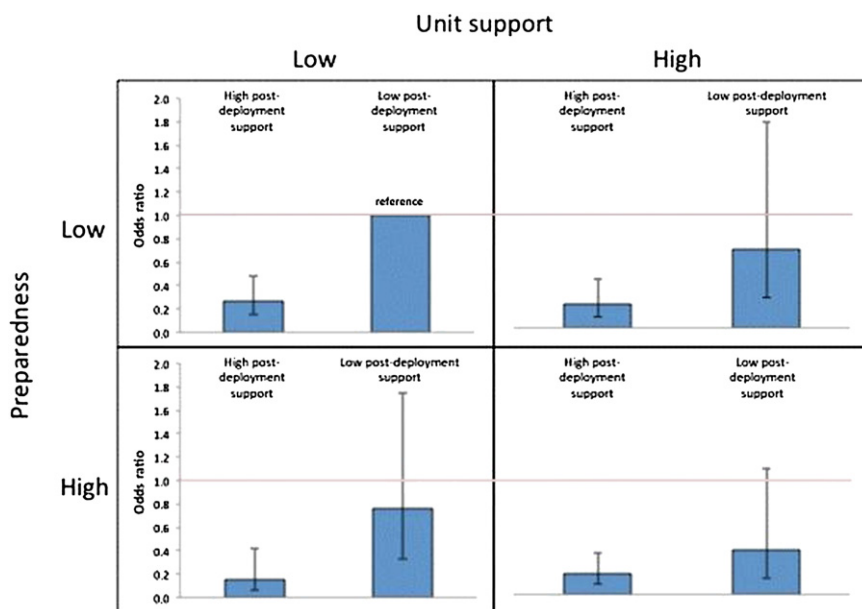


FIGURE 1. Association between pre-, peri-, and postdeployment characteristics and deployment-related PTSD. Reporting the lowest of all three deployment characteristics is the reference category for all ORs. These are the results from the multivariable regression, which are adjusted for gender, age, race, income, educational attainment, marital status, rank, most recent deployment location, total number of deployment-related traumatic events and number of deployments. Significance at $p < .05$.

who reported high preparedness, low unit support, and high post-deployment support (4.2%). Overall, the prevalence of PTSD from a deployment-related event was 9.6%.

High preparedness, high unit support, and high post-deployment support (vs low levels) were all associated with lower odds of PTSD in separate multivariable models (preparedness: odds ratio [OR], 0.6; 95% confidence interval [CI], 0.4–0.9; unit support: OR, 0.5; 95% CI, 0.3–0.8; post-deployment support: OR, 0.3; 95% CI, 0.2–0.4). Figure 1 shows results from multivariable regression analysis that modeled deployment characteristic combinations as dummy variable predictors of PTSD, adjusted for gender, age, race, income, educational attainment, marital status, rank (officer vs enlisted, cadets, and civilian employees), most recent deployment location (to nonconflict area vs conflict area), and total number of deployments-related traumatic events experienced (one vs two or more). Four of the characteristic combinations—all of those that included *high* postdeployment support—had significantly lower odds of PTSD with the low preparedness, low unit support, and low postdeployment support combination as the reference group.

Specifically, soldiers reporting (i) low preparedness, low unit support, and high post-deployment support; (ii) low preparedness, high unit support, and high post-deployment support; (iii) high preparedness, low unit support, and high post-deployment support; and (iv) high levels of all three domains had significantly lower odds of developing PTSD than those who reported low levels of all three domains (OR, 0.3; 95% CI, 0.1–0.5; OR, 0.2, 95% CI,

0.1–0.4; OR, 0.2, 95% CI, 0.1–0.4; and OR, 0.2, 95% CI, 0.1–0.4; respectively). The odds of PTSD were not significantly lower for any combination that included low postdeployment support, compared with the reference group.

DISCUSSION

Characteristics at various stages of deployment may influence the likelihood of developing PTSD from a deployment-related traumatic event in this population. We found that reporting high levels (compared with low levels) of the three pre-, peri-, and postdeployment factors—preparedness, unit support, and post-deployment support—were all independently associated with lower odds of deployment-related PTSD, consistent with findings from previous studies (13, 18, 19, 29–31). Soldiers who report high training and deployment preparedness, i.e., knowing what to expect, having adequate supplies and training, may be more psychologically prepared for the potentially traumatic events they may experience during combat and thus may be more able to appraise the level of threat related to these experiences.

In a recent study, Renshaw (30) found that soldiers who reported high preparedness more realistically appraised the threat involved in different levels of combat exposure, whereas less prepared soldiers perceived even low level combat as highly threatening. Perceived threat is thought to be an important link between combat experience and PTSD (i.e., the greater the perceived threat, the greater

the likelihood of developing PTSD from the experience) (10, 16, 17, 32). Preparedness may play a role in the development of PTSD through its relationship with perceived threat, perhaps by reducing the level of threat perceived by soldiers in situations that are actually less threatening (30).

Reporting high levels of unit support, compared with low levels, also appeared protective against the development of PTSD from a deployment-related traumatic event. This result lends support to findings that suggest a positive influence of high levels of unit support and cohesion on mental health among U.K. and U.S. soldiers in the Iraq and Afghanistan conflicts who have experienced combat (18, 29). Receiving support from one's unit during deployment may promote soldiers' resilience to PTSD by increasing self-efficacy (i.e., personal belief in one's ability to handle situations or perform well) and/or mitigating the psychological consequences of war-zone stressors through strengthened coping abilities (18, 33, 34).

Postdeployment social support seemed to confer the most protection against PTSD of the three deployment characteristics evaluated in this study. Studies of both civilians and soldiers have documented postevent social support as a strong predictor of PTSD and other psychopathology (11, 13, 19, 35–38). Receiving support from others after a traumatic event may enhance an individual's coping abilities or influence how the individual evaluates the stressful situation and subsequently reacts to it emotionally and behaviorally, which may buffer the psychological consequences of traumatic event experience (39–42).

When we examined the combined effects of different deployment characteristics, we found that only characteristic combinations that included high postdeployment support (as opposed to low post-deployment support) were significantly associated with lower odds of PTSD (compared with the low preparedness, low unit support, low postdeployment support combination). This may provide evidence of the importance of postdeployment social support in preventing the development of PTSD from deployment-related traumatic events. It also suggests that for soldiers who experience low postdeployment support, being well prepared and/or having high unit support may not provide as strong a defense against post-deployment psychological illness.

This study benefited from its population-based design, allowing us to understand relations between deployment characteristics and PTSD in the OHARNG as a whole, although not generalizable to all branches of the military. It is important to note, however, that the cross-sectional nature of our study introduces limitations to the study findings; in particular, similar to other studies of deployment characteristics, results may suffer from the subjects' recall bias (18). For example, respondents' psychological well-being may have influenced their reporting of preparedness,

unit support, and postdeployment support (18, 35, 43). To address this possible bias, prospective studies are necessary to examine preparedness, unit support and postdeployment support before and after deployment (18). We also faced challenges in our ability to accurately measure these deployment characteristics in relation to the most recent deployment among OHARNG members who have been deployed more than once (half of our sample population). It is possible that participants who have been deployed multiple times may differ in their reporting of these deployment characteristics. However, additional analysis found no significant differences between multiple deployment experience and reporting of deployment characteristics.

It is also possible that participants who have experienced multiple deployments will be unable to accurately recall deployment characteristics of their most recent deployment and will instead report aggregate feelings regarding all of their deployments. Studies that follow soldiers over time and assess deployment characteristics at multiple time points, as the soldier experiences additional deployments, would be fruitful. In addition, it has been suggested by Kanaisty and Norris (44) that social support may lead to less PTSD after a traumatic event in the period directly after the event (6–12 months) but that the inverse relation between social support and PTSD in later time points may be better explained by greater PTSD resulting in less social support. Because our study relied on cross-sectional data, we were unable to fully assess what may indeed be a reciprocal relation between social support and PTSD. Our conclusion that social support may be protective against the development of deployment-related, therefore, may be more accurate for the portion of participants who had experienced their most recent deployment in the past year. Finally, the use of a layperson assessment of PTSD prevented us from formally diagnosing respondents. We did, however, benefit from the use of a validated structured assessment of PTSD (as well as validated instruments for the three DRR1 deployment characteristics). Clinical re-appraisal data suggest that, by eliminating those unlikely to have PTSD, the telephone assessment of PTSD has a high negative predictive value and may be a useful research tool. However it is also provides a very conservative screen that may miss PTSD cases and should not be used to facilitate clinical diagnosis (45).

Preparedness, unit support, and postdeployment support are examples of modifiable characteristics of deployment experience that may influence psychological outcomes independently and in combination. For example, reducing the number of soldiers who do not deploy with the unit through which they train may reduce the consequences of psychopathology after deployment. In addition, postdeployment support can be improved through means such as increasing access to chaplain services, employment support

groups, and improving mental health support services upon completion of deployment. Although observational data such as these are limited in their ability to suggest the outcomes of interventions, this study does suggest that future efforts to evaluate interventions that aim to improve postdeployment social support in particular may fruitfully point to approaches that mitigate the mental health consequences of war.

REFERENCES

- Kang HK, Natelson BH, Mahan CM, Lee KY, Murphy FM. Post-traumatic stress disorder and chronic fatigue syndrome-like illness among Gulf War veterans: A population-based survey of 30,000 veterans. *Am J Epidemiol*. 2003;157:141–148.
- Hoge CW, Castro CA, Messer SC, McGurk D, Cotting DI, Koffman RL. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N Engl J Med*. 2004;351:13–22.
- Riddle JR, Smith TC, Smith B, Corbeil TE, Engel CC, Wells TS, et al. Millennium Cohort: the 2001–2003 baseline prevalence of mental disorders in the U.S. military. *J Clin Epidemiol*. 2007;60:192–201.
- Black DW, Carney CP, Peloso PM, Woolson RF, Schwartz DA, Voelker MD, et al. Gulf War veterans with anxiety: prevalence, comorbidity, and risk factors. *Epidemiology*. 2004;15:135–142.
- Group TIPGS. Self-reported illness and health status among Gulf War veterans. *JAMA*. 1997;277:8.
- 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;298:2141–8214.
- Waterhouse M, O'Bryant J. National Guard Personnel and Deployments: Fact Sheet. Washington, DC: CRS Report for Congress; 2008.
- Keane TM, Marshall AD, Taft CT. Posttraumatic stress disorder: Etiology, epidemiology, and treatment outcome. *Annu Rev Clin Psychol*. 2006;2:161–197.
- King DW, King LA, Foy DW, Keane TM, Fairbank JA. Posttraumatic stress disorder in a national sample of female and male Vietnam veterans: Risk factors, war-zone stressors, and resilience-recovery variables. *J Abnorm Psychol*. 1999;108:164–170.
- Vogt DS, Tanner LR. Risk and resilience factors for posttraumatic stress symptomatology in Gulf War I veterans. *J Trauma Stress*. 2007;20:27–38.
- Pietrzak RH, Johnson DC, Goldstein MB, Malley JC, Southwick SM. Psychological resilience and postdeployment social support project against traumatic stress and depressive symptoms in soldiers returning from Operations Enduring Freedom and Iraqi Freedom. *J Spec Oper Med*. 2009;9:67–73.
- Vogt DS, Proctor SP, King DW, King LA, Vasterling JJ. Validation of scales from the Deployment Risk and Resilience Inventory in a sample of Operation Iraqi Freedom veterans. *Assessment*. 2008;15:391–403.
- Fikretoglu D, Brunet A, Poundja J, Guay S, Pedlar D. Validation of the deployment risk and resilience inventory in French-Canadian veterans: Findings on the relation between deployment experiences and postdeployment health. *Can J Psychiatry*. 2006;51:755–763.
- King DW, King LA, Foy DW, Gudowski DM. Prewar factors in combat-related posttraumatic stress disorder: Structural equation modeling with a national sample of female and male Vietnam veterans. *J Consult Clin Psychol*. 1996;64:520–531.
- Schnurr PP, Lunney CA, Sengupta A. Risk factors for the development versus maintenance of posttraumatic stress disorder. *J Trauma Stress*. 2004;17:85–95.
- Green BL, Grace MC, Lindy JD, Gleser GC, Leonard A. Risk factors for PTSD and other diagnoses in a general sample of Vietnam veterans. *Am J Psychiatry*. 1990;147:729–733.
- King DW, King LA, Gudowski DM, Vreven DL. Alternative representations of war zone stressors: Relationships to posttraumatic stress disorder in male and female Vietnam veterans. *J Abnorm Psychol*. 1995;104:184–195.
- Rona RJ, Hooper R, Jones M, Iversen AC, Hull L, Murphy D, et al. The contribution of prior psychological symptoms and combat exposure to post Iraq deployment mental health in the UK military. *J Trauma Stress*. 2009;22:11–19.
- King LA, King DW, Fairbank JA, Keane TM, Adams GA. Resilience-recovery factors in post-traumatic stress disorder among female and male Vietnam veterans: Hardiness, postwar social support, and additional stressful life events. *J Pers Soc Psychol*. 1998;74(2):420–434.
- Boscarino JA. Post-traumatic stress and associated disorders among Vietnam veterans: The significance of combat exposure and social support. *J Trauma Stress*. 1995;8:317–336.
- Boscarino J. Current Excessive Drinking among Vietnam Veterans—a Comparison with Other veterans and non-veterans. *Int J Soc Psychiatry*. 1980;27:204–212.
- Kuh D, Ben-Shlomo Y, Lynch J, Hallqvist J, Power C. Life course epidemiology. *J Epidemiol Community Health*. 2003;57:778–783.
- Breslau N, Kessler RC, Chilcoat HD, Schultz LR, Davis GC, Andreski P. Trauma and posttraumatic stress disorder in the community: The 1996 Detroit Area Survey of Trauma. *Arch Gen Psychiatry*. 1998;55:626–632.
- Weathers FW, Huska JA, Keane TM. PCL-C for DSM-I-V. Boston: National Center for PTSD-Behavioral Science Division; 1991.
- American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4th ed. Washington, DC: American Psychiatric Association; 1994.
- Weathers FW, Ford J. Psychometric review of PTSD checklist (PCL-C, PCL-S, PCL-M, PCL-PR). In: Stamm BH, ed. *Measurement of Stress, Trauma, and Adaptation*. Lutherville, MD: Sidran Press; 1996.
- Blake DD, Weathers FW, Nagy LM, Kaloupek DG, Gusman FD, Charney DS, et al. The development of a Clinician-Administered PTSD Scale. *J Trauma Stress*. 1995;8:75–90.
- Weathers FW, Ruscio AM, Keane TM. Psychometric properties of nine scoring rules for the Clinician-Administered Posttraumatic Stress Disorder Scale. *Psychol Assess*. 1999;11:10.
- Brailey K, Vasterling JJ, Proctor SP, Constans JJ, Friedman MJ. PTSD symptoms, life events, and unit cohesion in U.S. soldiers: baseline findings from the neurocognition deployment health study. *J Trauma Stress*. 2007;20:495–503.
- Renshaw KD. An integrated model of risk and protective factors for post-deployment PTSD symptoms in OEF/OIF era combat veterans. *J Affect Disord*. 2011;128:321–326.
- Pietrzak RH, Johnson DC, Goldstein MB, Malley JC, Southwick SM. Psychological resilience and postdeployment social support protect against traumatic stress and depressive symptoms in soldiers returning from Operations Enduring Freedom and Iraqi Freedom. *Depress Anxiety*. 2009;26:745–751.
- King LA, King DW, Bolton EE, Knight JA, Vogt DS. Risk factors for mental, physical, and functional health in Gulf War veterans. *J Rehabil Res Dev*. 2008;45:395–407.
- Britt TW, Dickinson JM. Morale during military operations: A positive psychology approach. In: Britt WB, Castro CA, Adler AB, eds. *Military Performance: Military Life. The Psychology of Serving in Peace and Combat*. London: Praeger Security International; 2006:157–184.
- Bandura A. Self-efficacy: Toward a unifying theory of behavioral change. *Psychol Rev*. 1977;84:191–215.
- Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *J Consult Clin Psychol*. 2000;68:748–766.
- Taylor SE, Seeman TE. Psychosocial resources and the SES-health relationship. In: Adler NE, Ostrove JM, eds. *Socioeconomic Status and Health*

- in Industrialized Nations: Social Psychological, and Biological Pathways. New York: New York Academy of Sciences; 1999.
37. Galea S, Ahern J, Tracy M, Hubbard A, Cerda M, Goldmann E, et al. Longitudinal determinants of posttraumatic stress in a population-based cohort study. *Epidemiology*. 2008;19:47–54.
 38. Fontana A, Rosenheck R, Horvath T. Social support and psychopathology in the war zone. *J Nerv Ment Dis*. 1997;185:675–681.
 39. Kawachi I, Berkman LF. Social ties and mental health. *J Urban Health*. 2001;78:458–467.
 40. Thoits PA. Social support as coping assistance. *J Consulting Clin Psychol*. 1986;54:416–423.
 41. Dalgard OS, Bjork S, Tambs K. Social support, negative life events and mental health. *Br J Psychiatry*. 1995;166:29–34.
 42. Cohen S, Syme SL. Issues in the study and application of social support. In: Cohen S, Syme SL, eds. *Social Support and Health*. New York: Academic Press, Inc.; 1985.
 43. Ozer EJ, Best SR, Lipsey TL, Weiss DS. Predictors of posttraumatic stress disorder and symptoms in adults: A meta-analysis. *Psychol Bull*. 2003;129:52–73.
 44. Kanaisty K, Norris FH. Longitudinal linkages between perceived social support and posttraumatic stress symptoms: Sequential roles of social causation and social selection. *J Traumatic Stress*. 2008;21:274–281.
 45. Calabrese JR, Prescott M, Tamburrino M, Liberzon I, Slembariski R, Goldmann E, et al. PTSD comorbidity and suicidal ideation associated with PTSD within the Ohio Army National Guard. *J Clin Psychiatry*. 2011;72(8):1072–1078.

Wordcount:1,744

Tables: 2

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

Renee D Goodwin (1)

Marta Prescott (1)

Marijo Tamburrino, MD (3)

Joseph R. Calabrese, MD (4)

Israel Liberzon, MD, PhD (2)

Sandro Galea (1)

(1) Columbia University, NY, NY, (2) University of Michigan, Ann Arbor, Michigan, (3) University of Toledo Health Science Center, Toledo, Ohio, (4) Department of Psychiatry, University Hospitals Case Medical Center, Case Western Reserve University, Cleveland Ohio,

ABSTRACT

BACKGROUND: Suicide rates are alarmingly high among military personnel, and particularly Army National Guard soldiers. Smoking is also disproportionately common in the military. Previous studies have suggested that smoking is associated with an increased risk of suicide behavior in the general population. No previous study has assessed whether smoking may be related to increased risk of suicide-related outcomes in the National Guard.

OBJECTIVE: To investigate the relationship between cigarette smoking and suicidal ideation among a representative sample of national guard soldiers.

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

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

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

Military populations are at high risk for suicidal behavior and suicide rates in the military continue to rise [1]. Suicide rates in the US military have increased in recent years, and the most dramatic increase has been among Army National Guard members (22288872). Suicide rates in the Army National Guard are now higher than rates among active duty army personnel (US Army, Office of the Chief of Public Affairs, 2010).

Smoking is also disproportionately prevalent among soldiers (19608945). Cigarettes were included as part of meal rations during World War I and II and the Vietnam War [19743733]. It was not until the early 1970s that the United States (US) Department of Defense issued policies aimed at preventing and treating substance abuse; by 1975 cigarettes were no longer rationed to soldiers [16435763]. Trend data show that over the past 28 years cigarette smoking in the US military has decreased; however, the prevalence of cigarette smoking has remained higher among military personnel compared to the general population: approximately 32% of active duty military personnel are smokers compared to 21% of US adults (17567397).

Results from numerous epidemiologic studies have consistently documented a strong association between cigarette smoking and suicide-related outcomes among adults in the community [4-6; 21443823]. Only one study has examined this relationship among military personnel. Miller and colleagues (2000) found that smoking was associated with completed suicide among active

duty male army soldiers. The study did not consider key potentially mediating factors, such as depression.

Since that study, several things have changed. Active military conflicts over the past decade have led to increased military personnel; each year the US military brings in 300,000 new recruits. Since the start of Operation Iraqi Freedom and Operation Enduring Freedom, National Guard members have been called upon increasingly to serve in combat situations. As of January 2010, there were over 1.1 million active duty personnel serving in the four branches of the US military and 131,066 personnel serving in the National Guard. National Guard members are a distinct and sizable subset of the military, increasingly relied upon for active duty deployments. However, compared with active/full-time military, relatively little is known about mental health risks in this group. In addition, National Guard members are outside the support structures provided to regular military personnel and are, therefore, exposed to an especially heavy burden of chronic civilian stressors post-deployment (e.g., family conflict, job loss) without the benefit of adequate resources to cope with such stressors. Finally, as noted above, the rate of suicide among National Guard members has increased substantially in the past few years (22288872).

To our knowledge, no previous study has examined the potential impact of smoking on subsequent suicide-related outcomes in a reservist population. The current study examined the relationship between smoking and subsequent risk of

suicidal ideation in 2010 in a representative sample of Army National Guard soldiers.

Methods

Study population and survey

Data were drawn from the Ohio Army National Guard Mental Health Initiative (OHARNG MHI). The OHARNG MHI is a longitudinal cohort of Ohio Army National Guard Soldiers who are interviewed annually to assess mental health, substance use and life experiences. All soldiers were asked to participate in the study with the option to opt out. Between June 2008 and February 2009, 11,212 soldiers did not opt out of the study, and accurate contact information was available for 58.1% of participants (n=6,514). This group was further reduced to a final baseline sample of 2,616 after eligibility, language proficiency, and desire to participate were taken into account; survey response rate was 43.2%.

Participants were contacted for follow-up interviews in November of 2009, within 12 months of their original interview, and given 12 months to respond. 67.7% of the original 2,616 soldiers responded to follow-up surveys (n=1,770). This study included the 1,770 soldiers who participated in both baseline and follow-up surveys. After giving written informed consent, soldiers participated in computer-assisted telephone interviews that obtained information on mental health, substance use, military experiences, and life events history.

Our main dependent variable of interest was whether or not an individual reported having suicidal thoughts, or thoughts of being better off dead or wanting to hurt themselves, at some point between the baseline survey and the follow-up survey. Suicidal ideation was assessed via the question from the Patient Health Questionnaire-9 (PHQ-9) which asked if individuals ever thought of harming themselves or that they would be better off dead[7].

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

Other covariates included presence of suicidal behavior at baseline and depression at baseline, smoking status at follow-up and depression at follow-up, and age and gender. Depression was assessed using the Patient Health Questionnaire-9 [9]. To have had a history of depression at baseline, individuals had to have at least 2 co-occurring symptoms at some point in the past [9]. To have depression at follow-up, the individual had to have had the same number of symptoms but they must have occurred between the baseline survey and follow-up survey. A concurrent clinical reappraisal conducted with the OHARNG MHI found the PHQ to be highly specific, when compared to clinician- administered interviews [10]. The presence of the conditions (Yes vs No), gender (female vs.

male) and age were included as indicator variables (18-24 (reference), 25-34, 35-44, 45+).

Statistical analysis

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

Results

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

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

DISCUSSION

The prevalence of suicide in Army National Guard members has been increasing since 2006 and in 2010 exceeded the rate among active duty army personnel

(22288872). Suicidal ideation is a significant predictor of future suicide behavior, but is also associated with substantial impairment and distress even when it does not lead to suicide behavior [10]. To our knowledge, this is the first study to examine the relationship between smoking and subsequent suicidal ideation in a National Guard population. Our results suggest that active smoking is associated with increased suicidal ideation at follow-up among National Guard soldiers.

Comment [r1]: Add this reference

There are a number of plausible explanations for this association. One possibility is that smoking leads to increased depression that then increases the risk of suicidal ideation. There is a well-documented relationship between cigarette smoking and increased levels of inflammation [11]. A relationship between major depression and inflammation is also well-documented [12-17]. It is thought that the release of specific inflammatory markers and activation of the immune system may be related to the pathophysiology of depression potentially via the effects of cytokines on specific regions of the brain [12]. Major depression is the strongest known risk factor for suicide behavior [18], and suicide ideation is so entwined with depression that it is part of the diagnostic criteria for major depression [19]. As such, it is reasonable to postulate that inflammation may be related to suicide behavior through similar pathways. Our data support this

pathway (i.e., that depression is a mediator of the relationship). It is also conceivable that the relationship is due to other common causes that we could not evaluate in this study. While it is not possible to definitively identify the mechanism in this study and some studies have suggested that the association between smoking and suicide-related outcomes may be due to confounding[20, 21], the potential importance of smoking as a screen in evaluating suicide risk in this high risk group is clearly supported by our findings.

This study has several limitations that should be considered when interpreting our results. First, we did not have measures of suicide attempt or completion. Suicidal ideation is highly correlated with these behaviors [4, 22-24], and one study of male active-duty army soldiers found a link between smoking and suicide though this study did not adjust for depression[25]. Future studies that can take depression and other mental disorders into account while examining the relationship between smoking and other suicide-related outcomes over time in various military populations are needed. Second, although there is no reason to believe that Ohio Army National Guard members are systematically different from other reservists nationwide, it is possible that our findings may not be generalizable to other National Guard and/or active military personnel. Therefore, additional studies in these vulnerable populations should be carried out toward replicating these results. Third, our ability to test potential mechanisms of the relationship between smoking and suicidal ideation was limited. Future studies in

military samples will be needed to examine potential mechanisms of these relationships.

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

References

1. Kuehn, B.M., *Soldier Suicide Rates Continue to Rise*. JAMA: The Journal of the American Medical Association, 2009. **301**(11): p. 1111-1113.
2. *Alcohol and Public Health*. 2010 11/10/2010; Available from: <http://www.cdc.gov/alcohol/index.htm>.
3. Ames, G.M., et al., *Military culture and drinking behavior among U.S. Navy careerists*. J Stud Alcohol Drugs, 2007. **68**(3): p. 336-44.
4. Kessler, R.C., et al., *The association between smoking and subsequent suicide-related outcomes in the National Comorbidity Survey panel sample*. Mol Psychiatry, 2009. **14**(12): p. 1132-42.
5. Kessler, R.C., et al., *Smoking and suicidal behaviors in the National Comorbidity Survey: Replication*. J Nerv Ment Dis, 2007. **195**(5): p. 369-77.
6. Breslau, N., et al., *Smoking and the Risk of Suicidal Behavior: A Prospective Study of a Community Sample*. Arch Gen Psychiatry, 2005. **62**(3): p. 328-334.
7. Kroenke, K., R.L. Spitzer, and J.B. Williams, *The PHQ-9: validity of a brief depression severity measure*. Journal of general internal medicine, 2001. **16**(9): p. 606-613.
8. Calabrese, J.R., et al., *PTSD comorbidity and suicidal ideation associated with PTSD within the Ohio Army National Guard*. J Clin Psychiatry, 2011. **72**(8): p. 1072-8.
9. Kuehn, B.M., *Military Probes Epidemic of Suicide*. JAMA: The Journal of the American Medical Association, 2010. **304**(13): p. 1427-1430.
10. Olfson, M., et al., *Suicidal ideation in primary care*. Journal of General Internal Medicine, 1996. **11**(8): p. 447-453.
11. Garbin, U., et al., *Cigarette smoking blocks the protective expression of Nrf2/ARE pathway in peripheral mononuclear cells of young heavy smokers favouring inflammation*. PLoS One. **4**(12): p. e8225.
12. Pace, T. and A. Miller, *Cytokines and glucocorticoid receptor signaling. Relevance to major depression* Ann N Y Acad Sci, 2009. **1179**: p. 86-105.
13. Glover, A., et al., *Can inflammation be an independent predictor of depression?* Brain Behav Immun, 2009.
14. Miller, A., *Depression and immunity: a role for T cells?* . Brain Behav Immun, 2010. **24**(1): p. 1-8.
15. Su, S., et al., *Serotonin transporter gene, depressive symptoms, and interleukin-6*. Circ Cardiovasc Genet, 2009. **2**(6): p. 614-620.
16. Miller, A., V. Maletic, and C. Raison, *Inflammation and its discontents: the role of cytokines in the pathophysiology of major depression*. Biol Psychiatry, 2009. **65**(9): p. 732-741.
17. Halder, I., et al., *Polymorphisms in the CRP gene moderate an association between depressive symptoms and circulating levels of C-reactive protein*. Brain Behav Immun, 2010. **24**(1): p. 160-167.
18. Fawcett, J., et al., *Clinical predictors of suicide in patients with major affective disorders: A controlled prospective study*. American Journal of Psychiatry., 1987. **144**(1): p. 35-40.
19. Association, A.P., *Diagnostic and Statistical Manual of Mental Disorders IV*. 1994, Washington, DC: American Psychiatric Press.

20. Smith, G.D., A.N. Phillips, and J.D. Neaton, *Smoking as "independent" risk factor for suicide: illustration of an artifact from observational epidemiology?* Lancet, 1992. **340**(8821): p. 709-12.
21. Hemmingsson, T. and D. Kriebel, *Smoking at age 18–20 and suicide during 26 years of follow-up—how can the association be explained?* International Journal of Epidemiology, 2003. **32**(6): p. 1000-1004.
22. Beck, A.T., et al., *Suicide Ideation at Its Worst Point: A Predictor of Eventual Suicide in Psychiatric Outpatients*. Suicide and Life-Threatening Behavior, 1999. **29**(1): p. 1-9.
23. Brown, G.K., et al., *Risk factors for suicide in psychiatric outpatients: A 20-year prospective study*. Journal of Consulting and Clinical Psychology;Journal of Consulting and Clinical Psychology, 2000. **68**(3): p. 371-377.
24. Mann, J.J., et al., *Toward a clinical model of suicidal behavior in psychiatric patients*. The American Journal of Psychiatry, 1999. **156**(2): p. 181-181-9.
25. Miller, M., et al., *Cigarette Smoking and Suicide: A Prospective Study of 300, 000 Male Active-duty Army Soldiers*. American Journal of Epidemiology, 2000. **151**(11): p. 1060-1063.

Table 1. The distribution (number (%)) of selected characteristics in the total sample and the distribution (number (%)) and association (crude odds ratio, 95% CI) of suicidal thoughts in the follow-up survey and selected characteristics.

Characteristics	Total sample (number (%))	Those with suicidal ideation at follow-up (number (%))	COR (95% CI)
Smoked at baseline			
No	1228 (69.5)	40 (3.3)	1
Yes	538 (30.5)	34 (6.32)	2.01 (1.26-3.21)
Gender			
Male	1520 (86.1)	59 (3.9)	1
Female	246 (13.9)	15 (6.1)	1.6 (0.90-2.88)
Age			
18-24	552 (31.3)	26 (4.7)	1
25-34	582 (33.0)	22 (3.8)	0.80 (0.45-1.43)
35-44	438 (24.8)	17 (3.8)	0.82 (0.44-2.53)
45+	193 (10.9)	9 (4.7)	0.99 (0.46-2.15)
History of depression at baseline			
No	1391 (78.8)	33 (2.4)	1
Yes	375 (21.2)	41 (10.9)	5.1 (3.2-8.2)
History of suicidal thoughts at			

baseline			
No	1583 (89.6)	42 (2.7)	1
Yes	180 (10.2)	32 (17.8)	8.0 (4.9-13.0)
Smoked at follow-up			
No	1244 (70.4)	39 (3.1)	1
Yes	522 (29.6)	35 (6.7)	2.2 (1.4-3.6)
Depression at follow-up			
No	1549 (87.7)	24 (1.6)	1
Yes	217 (12.3)	50 (23.0)	19.2 (11.5-32.1)
Total	1766	74 (4.2)	

Table 2. The adjusted association (AOR, 95% CI) between the covariates of interest and suicidal ideation after one year of follow-up.

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

Smoked at follow-up

No	1
Yes	1.57 (0.65-3.79)

Depression at follow-up

No	1
Yes	13.2 (7.56-23.0)

-2 Log likelihood	603.0	535.5	445.2



Research report

Relations between the underlying dimensions of PTSD and major depression using an epidemiological survey of deployed Ohio National Guard soldiers

Tracey L. Biehn^a, Ateka Contractor^a, Jon D. Elhai^{a,b,*,1}, Marijo Tamburrino^b, Thomas H. Fine^b, Marta R. Prescott^c, Edwin Shirley^{d,e}, Philip K. Chan^{d,e}, Renee Slembariski^{d,e}, Israel Liberzon^{f,g}, Joseph R. Calabrese^d, Sandro Galea^c

^a Department of Psychology, University of Toledo, United States

^b Department of Psychiatry, University of Toledo, United States

^c Mailman School of Public Health, Columbia University, United States

^d Department of Psychiatry, Case Western Reserve University, United States

^e University Hospitals Case Medical Center, United States

^f Mental Health Service, VA Ann Arbor Health System, United States

^g Department of Psychiatry, University of Michigan, United States

ARTICLE INFO

Article history:

Received 16 May 2012

Accepted 12 June 2012

Keywords:

Posttraumatic stress disorder

Major depressive disorder

Factor analysis

Military veterans

Comorbidity

ABSTRACT

Background: In the present study, the authors investigated the relationship between the underlying symptom dimensions of posttraumatic stress disorder (PTSD) and dimensions of major depressive disorder (MDD).

Method: A sample of 1266 Ohio National Guard soldiers with a history of overseas deployment participated and were administered the PTSD Checklist (assessing PTSD) and Patient Health Questionnaire-9 (assessing depression).

Results: Using confirmatory factor analysis, results demonstrated that both PTSD's dysphoria and hyperarousal factors were more related to depression's somatic than non-somatic factor. Furthermore, depression's somatic factor was more related to PTSD's dysphoria than hyperarousal factor.

Limitations: Limitations of this study include the use of self-report measures and a predominately male military sample.

Conclusions: Results indicate that PTSD's dysphoria factor is related to depression specifically by way of depression's somatic construct. Given PTSD's substantial dysphoria/distress component, these results have implications for understanding the nature of PTSD's high comorbidity with depression.

© 2012 Elsevier B.V. All rights reserved.

1. Introduction

There are substantial rates of comorbidity between posttraumatic stress disorder (PTSD) and major depression. For example, the National Comorbidity Survey (NCS) found that 48–55% of individuals diagnosed with PTSD were also diagnosed with major depression in their lifetimes (Kessler et al., 1995). While the comorbidity between PTSD and depression is well established (Elhai et al., 2011a; Keane and Kaloupek, 1997), few studies have examined how the underlying dimensions of PTSD and depression

are most related to each other in order to further understand the high comorbidity rates.

Several hypotheses have been proposed to explain the significant comorbidity between PTSD and major depressive disorder. We focus on two hypotheses in particular. First, several symptoms overlap between DSM-IV major depressive disorder (MDD) and PTSD (i.e., difficulties with sleep, concentration and anhedonia). As a consequence, satisfying criteria for one of these two disorders places an individual at substantial risk of being diagnosed with the other disorder merely by virtue of these overlapping symptoms (Spitzer et al., 2007). Second, there may be a shared underlying latent association behind depression and PTSD. Watson (2005) proposed that mood and anxiety disorders are defined by a higher order negative affect factor which subsumes a broad range of negative emotional states including fear, anger, and sadness. Watson argued that this higher order

* Corresponding author at: Department of Psychology, University of Toledo, Mail Stop #948, 2801 West Bancroft Street, Toledo, OH 43606-3390, United States.

¹ Correspondence concerning this article should be addressed to Jon Elhai via his website: www.jon-elhai.com.

factor accounts for the high rates of comorbidity among mood and anxiety disorders, such as major depression and PTSD.

Recently, researchers have investigated the overlapping symptoms hypothesis of PTSD's comorbidity. Spitzer et al. (2007) suggested that removing the overlapping PTSD–depression items should result in a more pure, less comorbid PTSD diagnostic construct. However, a study by Elhai et al. (2008) found instead that removing overlapping items had negligible effects on PTSD's comorbidity rates (after removing overlapping items, comorbidity rates dropped nominally from 54.72% to 54.41% in the NCS Replication dataset). Similar results were found in a study of military veterans by Grubaugh et al. (2010) and a study of nationally representative, trauma-exposed adolescents conducted by Ford et al. (2009). Thus symptom overlap does not seem to primarily account for the PTSD–MDD comorbidity.

The shared latent mechanism hypothesis has been investigated as well, by examining PTSD's robust, empirically supported latent factor of dysphoria that is conceptually similar to the general negative affect construct (Simms et al., 2002). We discuss the dysphoria construct more extensively below in the context of factor analysis. Factor analysis is a relatively under-utilized approach to examining issues of comorbidity between mental disorders. The use of factor analysis can help to elucidate the nature of comorbidity by examining which underlying factors of a disorder are more highly correlated with factors of another similar mental disorder. This method can be used to test the construct validity of a disorder (e.g., its uniqueness as a disorder) in a more refined manner than by examining comorbidity between crudely measured, observed diagnostic variables. Furthermore, this research is particularly timely given that a new edition of the *DSM* is currently being developed.

1.1. PTSD's factor structure

There are two models of underlying PTSD symptoms that have received substantial empirical support. One model proposed by King et al. (1998) comprises the following four intercorrelated factors: re-experiencing, effortful avoidance, emotional numbing, and hyperarousal. This model is essentially identical to *DSM-IV*'s conceptualization of PTSD except that the avoidance and numbing symptom cluster (PTSD's Criterion C) is separated into distinct avoidance and numbing factors, supported by empirical research (reviewed by Asmundson et al., 2004). The other empirically supported PTSD model is the dysphoria model proposed by Simms et al. (2002), comprising the following four intercorrelated factors: re-experiencing, avoidance, dysphoria, and hyperarousal. In this model, the numbing items are combined with three hyperarousal items (difficulties with sleep, concentration difficulties, and irritability) to form a dysphoria factor which involves symptoms of emotional distress common to mood and anxiety disorders (reviewed in Watson, 2005). In this model of PTSD, the hyperarousal factor only contains anxious-arousal items (hypervigilance and exaggerated startle response) which are more characteristic of fear based disorders. Both models have been extensively studied using confirmatory factor analysis (CFA), demonstrating good fit among different trauma exposed samples and using a variety of PTSD instruments (reviewed in Elhai and Palmieri, 2011; Yufik and Simms, 2010).

One specific research question that recent empirical studies have tested is the notion that PTSD's dysphoria factor drives PTSD's association with external measures of depression and general emotional distress. Several studies have found support for this notion (Elklit et al., 2010; Forbes et al., 2010; Simms et al., 2002). However, other studies have found that in contrast to other factors of PTSD, PTSD's dysphoria is no more related to depression and distress (Marshall et al., 2010; Miller et al., 2010). Importantly, these

studies used crude, unitary measures of depression and distress rather than examining these constructs in a more refined manner to better understand the PTSD–depression relationship.

1.2. Depression's factor structure

There is less research regarding the factor structure of major depressive disorder, and the resulting factor structure often differs depending on the specific depression instrument used to assess depressive symptoms. In the present study, the Patient Health Questionnaire-9 (PHQ-9) was used to examine depression's factor structure. The PHQ-9 is a widely used self-report measure of depression and maps directly onto *DSM-IV* symptom criteria for a major depressive episode (MDE) (Kroenke et al., 2001). Although the PHQ-9 has been empirically well-researched, few studies have analyzed its factor structure using CFA. Prior studies have used exploratory factor analyses (EFA) (Cameron et al., 2008; Dum et al., 2008; Huang et al., 2006; Kalpakjian et al., 2009; Krause et al., 2010) and CFA (Baas et al., 2011; Krause et al., 2008) to assess the PHQ-9's symptom structure. Most PHQ-9 factor analytic studies either support a unidimensional depression model (Baas et al., 2011; Cameron et al., 2008; Dum et al., 2008; Kalpakjian et al., 2009) or a two-factor model of somatic and non-somatic/affective dimensions (Krause et al., 2008; 2010; Richardson and Richards, 2008).

The only study, to our knowledge, that has empirically tested several PHQ-9 depression factor models simultaneously with objective statistical criteria using CFA was a study conducted by Elhai et al. (in press). Overall, this and other studies have found the most support for a two-factor model, with one factor comprising five somatic items (sleep changes, appetite disturbances and feeling tired, difficulty concentrating and psychomotor changes) and the other factor primarily based on four non-somatic or affective items (anhedonia, depressed mood, suicidal thoughts, and feeling bad about oneself) (Elhai et al., in press; Krause et al., 2010; Richardson and Richards, 2008).

1.3. Relationship between the factor structure of depression and PTSD

Despite PTSD's high comorbidity with major depressive disorder, lacking in the literature is a more refined analysis of the PTSD–depression relationship by exploring relations between the latent factors of PTSD and MDD. In only one recent study, evidence demonstrated that PTSD's dysphoria factor was strongly related to the Center for Epidemiologic Studies–Depression Scale's (CES-D) factors of somatic problems and negative affect, indicating that the shared variance between the two comorbid disorders may be best accounted for by the dysphoria symptoms present in the PTSD diagnosis (Elhai et al., 2011b). Specifically, this study found that the PTSD dysphoria factor demonstrated a strong relationship with the CES-D's depressive affect ($r=.77$) and somatic problems ($r=.84$) factors, compared to the positive affect ($r=-.45$) and interpersonal problems ($r=.65$) factors. Although this study provides a better understanding of the relationship between the latent factors of PTSD and MDD, the CES-D is a 20-item depression instrument that does not directly map onto *DSM-IV*'s major depressive disorder criteria. Therefore, it is unknown whether those study results are generalizable to a *DSM-IV* major depression-based instrument that would be more likely used to support a MDD diagnosis.

1.4. Study aims

The purpose of the current study was to replicate and extend findings by Elhai et al. (2011b) to further examine the

relationship between the latent factors of PTSD and depression in a sample of war-exposed military veterans. At present, this is only the second known study to address the comorbidity of PTSD and depression by analysis at the latent level. The Simms et al. (2002) dysphoria model was used to model PTSD symptoms given that this model comprises a general negative affect component which is conceptually similar to depression. Krause et al.'s (2008) two-factor depression model of somatic and non-somatic factors was used to analyze the depression factor structure, given that this model has received the most empirical support (Elhai et al., *in press*). We used the PTSD Checklist (PCL) to measure PTSD symptoms, and the PHQ-9 to measure major depression symptoms.

We were interested in testing if the dysphoria and hyperarousal factors of PTSD were more related to depression's somatic vs. non-somatic factor. Four specific hypotheses were tested in particular. The first hypothesis was that PTSD's dysphoria factor would correlate most strongly with depression's somatic than non-somatic factor. The dysphoria factor comprises both somatic items and non-somatic items (e.g., difficulty concentrating, feeling emotionally numb). We hypothesized that dysphoria would correlate more strongly with the somatic factor of depression given that a previous study found that PTSD's dysphoria correlated more strongly with depression's somatic complaints factor (Elhai et al., 2011b). The second hypothesis was that the two-item PTSD hyperarousal factor (i.e., exaggerated startle response, hypervigilance) would correlate more strongly with MDD's somatic than non-somatic factor given that these items are somatic in nature. However, in Hypothesis 3, we expected that depression's somatic factor would more strongly correlate with PTSD's dysphoria factor than with the hyperarousal factor given that the dysphoria factor contains more somatic-related items (PTSD items D1–D3). Finally, as our fourth hypothesis, we expected that neither re-experiencing nor avoidance factors of PTSD would be differentially related to the somatic or non-somatic factors of depression, given the lack of conceptual similarities between these constructs.

2. Method

2.1. Participants and procedure

The present study was part of the Ohio Army National Guard Mental Health Initiative (OHARNG MHI), a longitudinal prospective study of mental health among National Guard soldiers in Ohio. All members of the Ohio National Guard who served between July 2008 and February 2009 were invited to participate in the telephone interview portion of the study. There were 12,225 Guard members with a valid mailing address who were invited to participate (345 individuals were excluded for having no mailing address). Among the pool of potential subjects, 1013 (8.3%) declined to participate, 1130 (10.1%) did not have a telephone number listed with the Guard, and 3568 (31.8%) did not have a correct or working phone number. Among the remaining 6514 Guard members (58.1%), the following individuals were excluded: 187 (2.8%) based on the age eligibility restrictions, 1364 (20.9%) declined to participate, 31 (.4%) for having English language or hearing difficulties, and 2316 (35.5%) for not being contacted before the cohort was closed to new recruitment. Of the remaining 2616 subjects, one subject was excluded for missing as many as six items on the PHQ-9, leaving 2615 participants. Finally, we only included participants who reported being deployed and further reported a deployment related trauma, leaving an effective dataset of 1266.

Study enrollment began in November 2008 and ended in November 2009. The National Guard Bureau, Office of Human

Research Protections of the U.S. Army Medical Research and Materiel Command, along with the institutional review boards of University Hospitals Case Medical Center, University of Toledo, and Columbia University, approved the study with written informed consent waived in lieu of verbal consent by telephone.

Among the 1266 remaining subjects, the average age of participants was 33 years ($SD=8.81$) and ranged from 18 to 60 years. The majority of participants were male ($n=1144$, 90.4%) and identified their racial background as primarily Caucasian ($n=1127$, 89.0%) or African-American ($n=81$, 6.4%). Only 16 participants identified themselves as Hispanic (1.3%). The majority of participants had at a minimum received a high school diploma or its equivalent ($n=1260$, 99.5%). Many had attended some college or technical training ($n=636$, 50.2%) or graduated from college ($n=243$, 19.2%). There were 873 participants working full-time (69.0%), 103 participants working part-time (8.1%), 185 unemployed (14.6%), and 80 who were of student status (6.3%). There were 333 participants (26.3%) who had a household income greater than \$80,000. Income of \$20,000 or less was reported by 84 participants (6.6%), between \$20,001 and \$40,000 by 276 respondents (21.8%), \$40,001 to \$60,000 by 311 participants (24.6%), and between \$60,001 and \$80,000 by 236 (18.6%). The average length of time participants served in the military was 12.7 years ($SD=7.81$). All participants had deployed at least once, with the average number of deployments being 2.02 ($SD=1.76$). For the majority of participants ($n=742$, 58.6%), the most recent deployment was in support of Operation Iraqi Freedom (OIF) or Operation Enduring Freedom (OEF). There were 503 (39.7%) who most recently deployed to an area of non-conflict.

The most prevalent traumatic events experienced by participants were exposure to combat ($n=999$, 78.9%), sudden and unexpected death of a loved one or close friend ($n=874$, 69.0%), witnessing someone being killed or injured ($n=968$, 55.1%), and witnessing severe human suffering ($n=598$, 47.2%). There were 240 participants (19.0%) who reported that receiving incoming hostile fire was their worst deployment related trauma. The other most frequently nominated worst deployment-related traumas included experiencing combat or exposure to a war zone ($n=87$, 6.9%), and experiencing a sudden death of a close friend or loved one ($n=69$, 5.5%).

2.2. Instrumentation

2.2.1. Computer-assisted telephone interview (CATI)

A CATI was conducted for all participants by trained professionals at the survey research firm Abt SRBI, Inc., to assess demographic characteristics and mental health functioning using standardized questionnaires.

2.2.2. PHQ-9

Participants completed the PHQ-9 (Spitzer et al., 1994). Traditionally, the PHQ-9 measures depression symptoms over the previous two weeks based on the DSM-IV major depressive episode symptom criteria, but for this study, the instructions were modified in order to query depression symptoms over the course of the respondent's lifetime, as done by Cannon et al. (2007). The PHQ-9 uses a Likert-type scale with four response options ranging from 0 = "Not at all" to 3 = "Nearly every day" to assess symptom severity. A study by Kroenke et al. (2001) examined the validity of using the PHQ-9 to detect and assess for depression, and found that internal consistency ranged from .86 to .89. Diagnostic validity was demonstrated in detecting an MDD diagnosis based on structured diagnostic interviews. Lastly, construct validity was reflected in the association of PHQ-9 severity scores and measures of functional

status, number of disability days and difficulties based on symptoms (Kroenke et al., 2001).

2.2.3. PCL-C

Participants also completed the PTSD Checklist – Civilian Version (PCL-C). The PCL-C was adapted so that participants were asked to anchor their PTSD ratings to one's self-nominated worst deployment trauma. The PCL is a self-report measure which maps onto the *DSM-IV* symptom criteria for PTSD. There are 17 symptoms assessed by the PCL, and respondents indicate how distressed they were by each symptom over the past month by rating items on a five-point Likert-type scale (1 = "not at all" to 5 = "extremely"); however, in our study we assessed lifetime symptoms since the worst trauma. The PCL has demonstrated adequate reliability ($\alpha = .94$; test-retest $r = .88$) in various trauma-exposed populations (Ruggiero et al., 2003), and total scores were found to highly correlate (r range = .8–.9) with those from structured PTSD diagnostic interviews in military veterans (Forbes et al., 2001). The psychometric properties of the PCL are reviewed in articles by McDonald and Calhoun (2010) and Wilkins et al. (2011).

2.3. Analysis

There were nominal amounts of missing items from the PCL and PHQ measures. There were 1243 complete cases (98.2%) for the PCL and 1240 complete cases from the PHQ (97.9%). Missing data were estimated with multiple imputation procedures using an iterative Markov chain Monte Carlo method with the Gibbs Sampler procedure (in SPSS's Version 17 Missing Value Analysis software) to estimate missing item-level PCL and PHQ data, generated across 10 imputed datasets.

The data were screened for univariate and multivariate non-normality. There were several PCL and PHQ items with skewness and kurtosis values greater than 2.0, which indicated a non-normal univariate distribution. Further, Mardia's multivariate skewness and kurtosis tests indicated a non-normal multivariate distribution (p 's < .001).

All CFA analyses were conducted using the Mplus 6.1 software, averaging parameter estimates across the 10 imputed datasets. Error covariances were fixed to zero, and factor variances were fixed to 1 to scale the factors within a model. All tests were two-tailed, with alpha set at .05. Goodness of fit indices are reported below, including the comparative fit index (CFI), Tucker Lewis Index (TLI), root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR). Models fitting very well (or adequately) are indicated by CFI and TLI $\geq .95$ (.90–.94), RMSEA $\leq .06$ (.07–.08), SRMR $\leq .08$ (.09–.10) (Hu and Bentler, 1999).

CFA analyses for the PCL were conducted using maximum likelihood estimation with a mean-adjusted chi-square (MLM) (the Satorra-Bentler chi-square value), which is robust to non-normality (Satorra and Bentler, 2001). In the first CFA, we examined PTSD's dysphoria model, with PCL items 1–5 specified to load onto the re-experiencing factor, PCL items 6 and 7 on the avoidance factor, PCL items 8–15 on the dysphoria factor, and PCL items 16 and 17 on the hyperarousal factor. The PCL items were treated as continuously scaled items. Next, Krause's depression model was examined using the PHQ items. PHQ items 1, 2, 6, and 9 were specified to load onto the non-somatic factor, and PHQ items 3, 4, 5, 7, and 8 on the somatic factor. The PHQ items were also treated as continuously scaled items, using MLM estimation. A CFA was then conducted to examine the combined PTSD dysphoria and depression model, with all factors allowed to correlate.

Wald's chi-square test of parameter constraints was used, which tests the null hypothesis that the difference between two correlations would be zero; we used an alpha level of .01 to control for Type I error. These analyses were conducted to determine if specific PTSD dysphoria model factors were more highly correlated with either the non-somatic or somatic factors of the depression model. Specifically, we tested whether the PTSD's dysphoria factor was more related to depression's somatic than non-somatic factor (Hypothesis 1). Likewise, we next tested whether the PTSD's hyperarousal factor was more related to depression's somatic than non-somatic factor (Hypothesis 2). Additionally, we tested whether depression's somatic factor would be more related to PTSD's dysphoria than hyperarousal factor (Hypothesis 3). Furthermore, we tested whether PTSD's re-experiencing and avoidance factors (separately) were differentially related to depression's somatic vs. non-somatic factors (Hypothesis 4).

3. Results

The average PHQ total score among participants was 5.85 ($SD = 6.18$), and the average PCL score was 29.86 ($SD = 14.60$). A PCL cutoff score of 50 in military veterans best discriminates between those with and without PTSD (McDonald and Calhoun, 2010). Kroenke et al. (2001) reported that PHQ-9 scores greater than 10 result in a sensitivity of 88% and specificity of 88% for detecting major depressive disorder.

CFA results from the PTSD dysphoria model indicate that the model fit well, $S-B \chi^2(113, N = 1266) = 569.53, p < .001, CFI = .95, TLI = .93, RMSEA = .06, SRMR = .03$. Similar well-fitting results were obtained from Krause's 2-factor depression model, $\chi^2(26) = 131.93, p < .001, CFI = .95, TLI = .94, RMSEA = .06, SRMR = .04$. The 6-factor combined model also fit the data well, $\chi^2(284, N = 1266) = 1115.407, p < .001, CFI = .93, TLI = .93, RMSEA = .05, SRMR = .04$.

Wald's tests of parameter constraints were conducted in order to test our hypotheses regarding the differential relationship between the somatic and non-somatic factors of depression with the four PTSD factors. Results indicated that PTSD's dysphoria factor was more strongly correlated with depression's somatic factor ($r = .69$) than with the non-somatic factor ($r = .59$), $\chi^2(1) = 3.323, p < .048$, as expected (Hypothesis 1). PTSD's hyperarousal factor was also more correlated with depression's somatic factor ($r = .51$) than with the non-somatic factor ($r = .34$), $\chi^2(1) = 21.731, p < .001$ (Hypothesis 2) (Table 1).

Next, to assess Hypothesis 3, we assessed whether depression's somatic factor was more related to PTSD's dysphoria than hyperarousal factor. Results indicated that the depression somatic factor was more strongly correlated with PTSD's dysphoria ($r = .69$) than with hyperarousal ($r = .51$), $\chi^2(1) = 64.482, p < .001$ (see Table 2).

Table 1

Correlations between somatic vs. non-somatic factors with PTSD factors.

Correlation between factors	r Value	Wald chi-square
Re-experiencing and somatic	$r = .544$	$\chi^2(1) = 3.306, p = .069$
Re-experiencing and non-somatic	$r = .459$	
Avoidance and somatic	$r = .537$	$\chi^2(1) = 6.502, p = .011$
Avoidance and non-somatic	$r = .425$	
Dysphoria and somatic	$r = .689$	$\chi^2(1) = 3.323, p = .048$
Dysphoria and non-somatic	$r = .592$	
Hyperarousal and somatic	$r = .505$	$\chi^2(1) = 21.731, p < .001$
Hyperarousal and non-somatic	$r = .337$	

Table 2

Correlations for the Somatic factor with Dysphoria and Avoidance.

Correlation between factors	r Value	Wald Chi-Square
Somatic and dysphoria	$r=.689$	$\chi^2(1)=64.482, p<.001$
Somatic and avoidance	$r=.537$	
Somatic and dysphoria	$r=.689$	$\chi^2(1)=53.330, p<.001$
Somatic and hyperarousal	$r=.505$	

Table 3

Correlations among PTSD and depression factors.

Factor	1	2	3	4	5	6
Re-experiencing	–					
Avoidance	.898	–				
Dysphoria	.846	.837	–			
Hyperarousal	.772	.717	.740	–		
Somatic	.544	.537	.689	.505	–	
Non-Somatic	.459	.425	.592	.337	.862	–

Unexpectedly, in contrast to Hypothesis 4, the PTSD's avoidance factor was more strongly correlated with depression's somatic factor ($r=.54$) than to the non-somatic factor ($r=.425$), $\chi^2(1)=6.502$, $p<.011$.

4. Discussion

The purpose of this study was to clarify the nature of the comorbid relationship between depression and PTSD by examining the relationships between one disorder's latent factors with those of the other disorder's latent factors. It was hypothesized that PTSD's dysphoria factor would be more related to depression's somatic than non-somatic factor (Hypothesis 1), and that PTSD's hyperarousal factor would correlate more strongly with depression's somatic than non-somatic factor (Hypothesis 2). Further, it was hypothesized that depression's somatic factor would be more related to PTSD's dysphoria than hyperarousal factor (Hypothesis 3), and that PTSD's re-experiencing and avoidance would not be differentially related to depression's somatic or non-somatic factors (Hypothesis 4). Results confirmed that despite PTSD's dysphoria factor evidencing a large relationship with non-somatic aspects of major depressive disorder ($r=.59$), dysphoria was significantly more related to somatic depression ($r=.69$). As hypothesized, PTSD's hyperarousal factor was also more strongly correlated with depression's somatic than non-somatic factor. However, hyperarousal was not as strongly correlated with the somatic factor as dysphoria was (Table 3).

Previous research has found mixed support for the notion that PTSD's dysphoria is especially related to depression and general emotional distress. While some studies (Elklit et al., 2010; Forbes et al., 2010; Simms et al., 2002) have found that PTSD's dysphoria is uniquely related to emotional distress, other studies have failed to replicate that finding (Marshall et al., 2010; Miller et al., 2010). The present study clarifies these findings by more precisely analyzing depression not as a crude single variable but rather by analyzing its underlying factors. Thus perhaps mixed findings for dysphoria's external relationships resulted because depression and/or general emotional distress were analyzed as global external variables.

Rather based on our findings, analyzing depression based on its subcomponents, we find that PTSD's dysphoria is related to depression specifically by way of depression's somatic construct. Our findings corroborate those of a recent factor analytic study

which examined the combined symptom structure of PTSD and depression symptoms. In that paper, Elhai et al. (2011b) also found that PTSD's dysphoria factor was more related to somatic symptoms of depression. It is possible that the shared somatic components to both PTSD and depression could account for the comorbidity between depression and PTSD. Perhaps PTSD is so highly comorbid with major depressive disorder because of the shared somatic component between these disorders.

Although PTSD's dysphoria factor shares two symptoms with the PHQ-9's somatic factor (sleep and concentration difficulties), which could account for its substantial relationship, the dysphoria factor has several other symptoms that are not shared by the somatic factor. Furthermore, it should be noted that research demonstrates that symptom overlap between PTSD and major depressive disorder is not solely responsible for the high rates of comorbidity between these two disorders (Elhai et al., 2008; Ford et al., 2009; Grubaugh et al., 2010).

The hypothesis that the somatic and non-somatic factors of depression would not be differentially related to either PTSD's re-experiencing or avoidance factors was not supported. Specifically, results indicated that depression's somatic factor was significantly more correlated with avoidance than the non-somatic factor was. It may be that individuals who use avoidance as a coping mechanism exhibit more somatic signs of distress (Morina et al., 2010). Avoidance in fact is considered a maladaptive emotion regulation strategy that leads to an increase in PTSD symptoms—especially physiological (somatic) manifestations of fear (Foa and Kozak, 1986).

Limitations of this study include using self-report instruments (in particular, by telephone) to assess PTSD and depression severity. Thus the limitations that are inherent in using self-report measures apply to this study, including potential problems with response validity, social desirability, memory recall, etc. Additionally, most respondents were men, and thus women were underrepresented. Furthermore, we assessed lifetime symptoms of depression and PTSD and thus we cannot generalize these findings to current assessment of PTSD and depression. Also, the relatively low mean scores on the PHQ-9 and PCL indicate relatively modest MDD and PTSD severity among respondents. Thus, the results of this study may not generalize to a sample of patients with more severe depression and PTSD. Finally, the results may not generalize to civilian trauma-exposed samples. Future studies should test these research questions using structured diagnostic interviews. Future studies should also attempt to use a more diverse sample exposed to a wider range of traumatic events.

Role of funding source

This project was funded by the Department of Defense Congressionally Directed Medical Research Program W81XWH-07-1-0409, the "Combat Mental Health Initiative." The sponsor had no role in study design, data collection, analysis, interpretation of results, report writing or manuscript submission.

Conflict of interest

No conflict declared.

References

- Asmundson, G.J.G., Stapleton, J.A., Taylor, S., 2004. Are avoidance and numbing distinct PTSD symptom clusters. *Journal of Traumatic Stress* 17, 467–475.
- Baas, K.D., Cramer, A.O.J., Koeter, M.W.J., Van de Lisdonk, E.H., Van Weert, H.C., Schene, A.H., 2011. Measurement invariance with respect to ethnicity of the Patient Health Questionnaire-9 (PHQ-9). *Journal of Affective Disorders* 129, 229–235.
- Cameron, I.M., Crawford, J.R., Lawton, K., Reid, I.C., 2008. Psychometric comparison of PHQ-9 and HADS for measuring depression severity in primary care. *British Journal of General Practice* 58, 32–36.

- Cannon, D.S., Tiffany, S.T., Coon, H., Scholand, M.B., McMahon, W.M., Leppert, M.F., 2007. The PHQ-9 as a brief assessment of lifetime major depression. *Psychological Assessment* 19, 247–251.
- Dum, M., Pickren, J., Sobell, L.C., Sobell, M.B., 2008. Comparing the BDI-II and the PHQ-9 with outpatient substance abusers. *Addictive Behaviors* 33, 381–387.
- Elhai, J.D., Contractor, A., Tamburrino, M., Fine, T.H., Prescott, M.R., Shirley, E., Chan, P.K., Slembariski, R., Liberzon, I., Galea, S., Calabrese, J.R. The factor structure of major depression symptoms: A test of four competing models using the Patient Health Questionnaire-9. *Psychiatry Research*, in press.
- Elhai, J.D., Carvalho, L.d.F., Miguel, F.K., Palmieri, P.A., Primi, R., Christopher Frueh, B., 2011a. Testing whether posttraumatic stress disorder and major depressive disorder are similar or unique constructs. *Journal of Anxiety Disorders* 25, 404–410.
- Elhai, J.D., Contractor, A.A., Palmieri, P.A., Forbes, D., Richardson, J.D., 2011b. Exploring the relationship between underlying dimensions of posttraumatic stress disorder and depression in a national, trauma-exposed military sample. *Journal of Affective Disorders* 133, 477–480.
- Elhai, J.D., Grubaugh, A.L., Kashdan, T.B., Frueh, B.C., 2008. Empirical examination of a proposed refinement to DSM-IV posttraumatic stress disorder symptom criteria using the National Comorbidity Survey Replication data. *Journal of Clinical Psychiatry* 69, 597–602.
- Elhai, J.D., Palmieri, P.A., 2011. The factor structure of posttraumatic stress disorder: a literature update, critique of methodology, and agenda for future research. *Journal of Anxiety Disorders* 25, 849–854.
- Elklit, A., Armour, C., Shevlin, M., 2010. Testing alternative factor models of PTSD and the robustness of the dysphoria factor. *Journal of Anxiety Disorders* 24, 147–154.
- Foa, E.B., Kozak, M.J., 1986. Emotional processing of fear. *Psychological Bulletin* 99, 20–35.
- Forbes, D., Creamer, M., Biddle, D., 2001. The validity of the PTSD checklist as a measure of symptomatic change in combat-related PTSD. *Behaviour Research and Therapy* 39, 977–986.
- Forbes, D., Parslow, R., Creamer, M., O'Donnell, M., Bryant, R., McFarlane, A., Silove, D., Shalev, A., 2010. A longitudinal analysis of posttraumatic stress disorder symptoms and their relationship with fear and anxious-misery disorders: implications for DSM-V. *Journal of Affective Disorders* 127, 147–152.
- Ford, J.D., Elhai, J.D., Ruggiero, K.J., Frueh, B.C., 2009. Refining the posttraumatic stress disorder diagnosis: evaluation of symptom criteria with the national survey of adolescents. *Journal of Clinical Psychiatry* 70, 748–755.
- Grubaugh, A.L., Long, M.E., Elhai, J.D., Frueh, B.C., Magruder, K.M., 2010. An examination of the construct validity of posttraumatic stress disorder with veterans using a revised criterion set. *Behaviour Research and Therapy* 48, 909–914.
- Hu, L., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling* 6, 1–55.
- Huang, F.Y., Chung, H., Kroenke, K., Delucchi, K.L., Spitzer, R.L., 2006. Using the Patient Health Questionnaire-9 to measure depression among racially and ethnically diverse primary care patients. *Journal of General Internal Medicine* 21, 547–552.
- Kalpakjian, C.Z., Toussaint, L.L., Albright, K.J., Bombardier, C.H., Krause, J.K., Tate, 2009. Patient Health Questionnaire-9 in spinal cord injury: an examination of factor structure as related to gender. *Journal of Spinal Cord Medicine* 32, 147–156.
- Keane, T.M., Kaloupek, D.G., 1997. Comorbid psychiatric disorders in PTSD: implications for research. *Annals of the New York Academy of Sciences* 821, 24–34.
- Kessler, R.C., Sonnega, A., Bromet, E., Hughes, M., Nelson, C.B., 1995. Posttraumatic stress disorder in the national comorbidity survey. *Archives of General Psychiatry* 52, 1048–1060.
- King, D.W., Leskin, G.A., King, L.A., Weathers, F.W., 1998. Confirmatory factor analysis of the clinician-administered PTSD scale. *Psychological Assessment* 10, 90–96.
- Krause, J.S., Bombardier, C., Carter, R.E., 2008. Assessment of depressive symptoms during inpatient rehabilitation for spinal cord injury: is there an underlying somatic factor when using the PHQ? *Rehabilitation Psychology* 53, 513–520.
- Krause, J.S., Reed, K.S., McArdle, J.J., 2010. Factor structure and predictive validity of somatic and nonsomatic symptoms from the Patient Health Questionnaire-9: a longitudinal study after spinal cord injury. *Archives of Physical Medicine and Rehabilitation* 91, 1218–1224.
- Kroenke, K., Spitzer, R.L., Williams, J.B.W., 2001. The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine* 16, 606–613.
- Marshall, G.N., Schell, T.L., Miles, J.N.V., 2010. All PTSD symptoms are highly associated with general distress: ramifications for the dysphoria symptom cluster. *Journal of Abnormal Psychology* 119, 126–135.
- McDonald, S.D., Calhoun, P.S., 2010. The diagnostic accuracy of the PTSD checklist: a critical review. *Clinical Psychology Review* 30, 976–987.
- Miller, M.W., Wolf, E.J., Harrington, K.M., Brown, T.A., Kaloupek, D.G., Keane, T.M., 2010. An evaluation of competing models for the structure of PTSD symptoms using external measures of comorbidity. *Journal of Traumatic Stress* 23, 631–638.
- Morina, N., Ford, J.D., Risch, A.K., Morina, B., Stangier, U., 2010. Somatic distress among Kosovar civilian war survivors: relationship to trauma exposure and the mediating role of experiential avoidance. *Social Psychiatry & Psychiatric Epidemiology* 45, 1167–1177.
- Richardson, E.J., Richards, J.S., 2008. Factor structure of the PHQ-9 screen for depression across time since injury among persons with spinal cord injury. *Rehabilitation Psychology* 53, 243–249.
- Ruggiero, K.J., Del Ben, K., Scotti, J.R., Rabalais, A.E., 2003. Psychometric properties of the PTSD Checklist-Civilian Version. *Journal of Traumatic Stress* 16, 495–502.
- Satorra, A., Bentler, P.M., 2001. A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika* 66, 507–514.
- Simms, L.J., Watson, D., Doebbeling, B.N., 2002. Confirmatory factor analyses of posttraumatic stress symptoms in deployed and nondeployed veterans of the Gulf War. *Journal of Abnormal Psychology* 111, 637–647.
- Spitzer, R.L., First, M.B., Wakefield, J.C., 2007. Saving PTSD from itself in DSM-V. *Journal of Anxiety Disorders*, 21.
- Spitzer, R.L., Williams, J.B.W., Kroenke, K., Linzer, M., Verloin deGruy III, F., Hahn, S.R., Brody, D., Johnson, J.G., 1994. Utility of a new procedure for diagnosing mental disorders in primary care. *Journal of the American Medical Association* 272, 1749–1756.
- Watson, D., 2005. Rethinking the mood and anxiety disorders. *Journal of Abnormal Psychology* 114, 522–536.
- Wilkins, K.C., Lang, A.J., Norman, S.B., 2011. Synthesis of the psychometric properties of the PTSD checklist (PCL) military, civilian, and specific versions. *Depression and Anxiety* 28, 596–606.
- Yufik, T., Simms, L.J., 2010. A meta-analytic investigation of the structure of posttraumatic stress disorder symptoms. *Journal of Abnormal Psychology* 119, 764–776.



Posttraumatic stress disorder, depression, and HIV risk behavior among Army National Guard Soldiers.

Journal:	<i>Journal of Traumatic Stress</i>
Manuscript ID:	JOTS-12-0074.R2
Wiley - Manuscript type:	Research Article
Date Submitted by the Author:	n/a
Complete List of Authors:	Marshall, Brandon; Brown University, Department of Epidemiology Prescott, Marta; Columbia, Mailman School of Public Health, Epidemiology Liberzon, Israel; University of Michigan, Department of Psychiatry; Veterans Affairs Medical Center, Tamburrino, Marijo; Univeristy of Toledo, Psychiatry; Calabrese, Joseph; Case Western Reserve University, University Hospitals Case Medical Center Galea, Sandro; Columbia University School of Public Health, Epidemiology;
Keyword - Topics:	Depression, Epidemiology, HIV/AIDS, PTSD phenomenology
Keywords - Trauma Exposure:	War/armed conflict in military role
Keyword - Statistical Categories:	Epidemiology, Logistic Regression
Keyword - Intervention:	
Keyword - Special Populations:	Military (active duty/veteran)

SCHOLARONE™
Manuscripts

POSTTRAUMATIC STRESS DISORDER, DEPRESSION, AND HIV
RISK BEHAVIOR AMONG ARMY NATIONAL GUARD SOLDIERS

Brandon D.L. Marshall,^{1,2} Marta R. Prescott,¹ Israel Liberzon,^{3,4}
Marijo B. Tamburrino,⁵ Joseph R. Calabrese,⁶ and Sandro Galea¹

1. Department of Epidemiology, Columbia University Mailman School of Public Health, 722 W 168th Street, New York, NY, 10032-3727
2. Department of Epidemiology, Brown University, 121 South Main Street, Box G-S-121-2, Providence, RI, 02912.
3. Department of Psychiatry, University of Michigan, Rachel Upjohn Building, 4250 Plymouth Road, Ann Arbor, MI, 48105
4. Veterans Affairs Medical Center, 2215 Fuller Road, Ann Arbor, MI, 48105, USA
5. Department of Psychiatry, University of Toledo College of Medicine, Mail Stop 1193, 3120 Glendale Avenue, Toledo, OH, 43614
6. Case Western Reserve University, University Hospitals Case Medical Center, 10524 Euclid Avenue, Cleveland, OH, 44106

Word Count: 5,365 (incl. references, tables, and figures)

Revised: September 4th, 2012

Author Note: The research was supported by the U.S. Department of Defense Congressionally Directed Medical Research Program (W81XWH-O7-1-0409, the “Combat Mental Health Initiative”) and a Fellowship Award from the Canadian Institutes of Health Research. Correspondence concerning this article should be addressed to: Brandon DL Marshall, Assistant Professor, Department of Epidemiology, Brown University, 121 South Main Street, Box G-S-121-2, Providence, RI, 02912. Tel: 401-863-6472. Fax: 401-863-3713. Email: brandon_marshall@brown.edu.

ABSTRACT

We examined the relationship between posttraumatic stress disorder (PTSD), major depressive disorder (MDD), and HIV risk behavior among Ohio Army National Guards (OHARNG). We analyzed data collected from a sample of OHARNG enlisted between June 2008 and February 2009. Participants completed interviews assessing HIV risk activities defined by the Behavioral Risk Factor Surveillance System and were screened for PTSD and MDD based on DSM-IV criteria. Logistic regression was used to examine the independent and combined effects of PTSD and MDD on past-year HIV risk behavior. Of 2,259 participants, 142 (6.3%) reported at least one HIV risk behavior. In adjusted models, relative to soldiers with neither disorder, screening positive for MDD only was associated with HIV risk behavior (adjusted odds ratio [*AOR*] = 2.33, 95% CI [1.15, 4.71]), while PTSD was not significant (*AOR* = 1.60, 95% CI [0.80, 3.20]). Participants with both PTSD and depression were most likely to report HIV risk behavior (*AOR* = 2.75, 95% CI [1.06, 7.11]). Soldiers with PTSD and MDD may be at greater risk of HIV infection due to increased engagement in HIV risk behavior. Integrated interventions to address mental health problems and reduce HIV risk behavior are in need of development and evaluation.

INTRODUCTION

Posttraumatic stress disorder (PTSD) has long been recognized as a debilitating condition that adversely affects physical and psychological health (Breslau, Davis, Peterson, & Schultz, 1997; Davidson, Hughes, Blazer, & George, 1991; Zatzick et al., 1997). The development of PTSD is associated with a variety of health behaviors (e.g., smoking, alcohol and substance use, physical inactivity, poor utilization of preventive health services) that increase the risk of morbidity and mortality (Breslau, Davis, & Schultz, 2003; Buckley, Mozley, Bedard, Dewulf, & Greif, 2004; Schnurr & Spiro, 1999). A growing body of literature has also shown that persons who develop PTSD following exposure to trauma are more likely to participate in HIV risk behaviors (Brief et al., 2004). For example, a lifetime occurrence of PTSD has been associated with recent engagement in receptive anal intercourse and sex work among women prisoners (Hutton et al., 2001). A study of women who had experienced intimate partner violence (IPV) demonstrated that IPV-related PTSD was significantly associated with a composite measure of sexual risk behavior, and was particularly elevated among women with avoidance and numbing symptoms (Cavanaugh, Hansen, & Sullivan, 2010). Similar results have been reported among women seeking emergency care in New York City (El-Bassel, Gilbert, Vinocur, Chang, & Wu, 2011). Although fewer studies have examined the relationship between PTSD and HIV risk among men, some evidence indicates that PTSD increases the risk of unprotected anal intercourse in men who have sex with men (Reisner, Mimiaga, Safren, & Mayer, 2009).

Depression is also widely reported as a risk factor for sexual- and drug-related HIV risk behavior in the general and at-risk populations (Alegría et al., 1994; Lehrer, Shrier, Gortmaker, & Buka, 2006; Perdue, Hagan, Thiede, & Valleroy, 2003; Williams & Latkin, 2005). Despite the high prevalence of mental health comorbidities in many populations affected by HIV, research

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

has typically focused on the independent effects of PTSD and depression in people living with or at risk for the disease (Boarts, Sledjeski, Bogart, & Delahanty, 2006). Several authors have examined the influence of comorbid conditions on adherence to HIV therapy, with two studies suggesting that depression plays a more important role in poor adherence than PTSD (Sledjeski, Delahanty, & Bogart, 2005; Vranceanu et al., 2008). While some evidence suggests that HIV risk behaviors are particularly common among persons experiencing co-occurring depression and PTSD (Holmes, Foa, & Sammel, 2005; Plotzker, Metzger, & Holmes, 2007), these studies have focused on persons with childhood abuse histories. Therefore, more research is required to determine the unique and combined contributions of PTSD and depression on risk behavior in other populations at risk for HIV.

The objective of this study was to examine whether depression and PTSD were associated with increased engagement in HIV risk behavior among a sample of Ohio Army National Guards (OHARNG). We also sought to determine whether soldiers with both disorders were more likely to report HIV risk behavior compared to participants reporting one or neither conditions. Although studies of active U.S. army personnel and armed forces in other countries have investigated HIV prevalence and risk factors for HIV infection including PTSD (Anastario et al., 2011; Levin et al., 1995; Tavaréz, Chun, & Anastario, 2011), to our knowledge no studies have examined the relationships between depression, PTSD, and HIV risk behavior in soldiers of the U.S. National Guard. Given the high prevalence of trauma exposure and subsequent PTSD among National Guard soldiers (Calabrese et al., 2011; Kehle et al., 2011), elucidating the relationships between mental health problems and HIV risk behavior has important implications for the development of effective HIV prevention services for military personnel.

METHODS

Study Sample and Data Collection

Between November 2008 and November 2009, OHARNG soldiers were recruited to participate in the OHARNG Mental Health Initiative. This study aims to identify the risk and resilience factors associated with psychiatric conditions experienced by soldiers of the OHARNG. For the present study, all enlisted soldiers between June 2008 and February 2009 with a current address (12,225) were mailed a letter explaining the study’s objectives and consenting procedures along with a pre-paid opt-out card. We excluded 1,013 (8.3%) who returned an opt-out card, 1,130 (9.2%) who did not have a telephone number listed with the guard, and 3,568 (29.2%) who had an incorrect telephone number. We then contacted 4,198 of the 6,514 (53.2%) participants remaining. Of those contacted, 1,364 (20.9%) refused to participate, and 218 (3.3%) were excluded for other reasons (i.e., were deceased, did not speak English, had hearing problems, or were retired). Thus, the eligible sample was 2,616.

Computer-assisted telephone interviewing (CATI) was used to collect a wide array of information regarding sociodemographic characteristics, risk behaviors, military history, deployment and combat experiences, and past and present psychopathological symptoms. Interviews took approximately 60 minutes to complete and all participants were compensated for their time.

The study received a certificate of confidentiality from the National Institutes of Health, and the study protocol was approved by the Institutional Review Boards of University Hospitals Case Medical Center, University of Toledo, and Columbia University. The study was also approved by the Human Research Protection Office (HRPO), Office of Research Protections

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

(ORP), and the U.S. Army Medical Research & Materiel Command (USAMRMC) of the U.S. Department of Defense.

Measures

The dependent variable for this analysis was self-reported participation in HIV risk behavior(s) in the past year (yes vs. no). To define this variable, we used a standardized set of core questions from the Behavioral Risk Factor Surveillance System (BRFSS), a U.S. Centers for Disease Control and Prevention (CDC)-supported general population survey that includes measures of HIV/STD risk behaviors (Centers for Disease Control and Prevention, 2011). Core items included in the HIV/AIDS section of the BRFSS were developed by a 1997 CDC working group and were chosen after extensive cognitive laboratory testing and field piloting (Rietmeijer, Lansky, Anderson, & Fichtner, 2001). To assess HIV risk behaviors, participants were asked whether they had engaged in any of the following in the past year: 1) used intravenous drugs, 2) been treated for a sexually transmitted or venereal disease, 3) given or received money or drugs in exchange for sex, and 4) had anal sex without a condom. To be consistent with BRFSS methodology and with previously published studies using this measure (Bensley, Van Eenwyk, & Simmons, 2000; Link, Battaglia, Frankel, Osborn, & Mokdad, 2006; Wen, Balluz, & Town, 2012), participants were informed that they did not have to identify which risk(s) they had practiced in the past year. All participants provided a “yes” or “no” answer to the question (no non-responses or refusals were recorded).

The primary independent variables of interest were screening positive for PTSD and major depressive disorder (MDD), each based on DSM-IV criteria. Specifically, a positive screen for PTSD was assessed using the PTSD Checklist – Civilian Version (PCL-C), modified to include questions that assessed DSM-IV diagnostic criteria A2, E, and F (Blake et al., 1995).

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

Thus, participants screening positive for PTSD must have met all DSM-IV criteria related to a specific traumatic event: been exposed to a criterion A stressor (e.g., a traumatic event involving actual or threatened death or serious injury); had at least one intrusion symptom (e.g., recurrent distressing recollections or dreams of the event); had at least three symptoms of avoidance (e.g., avoiding activities, places, or people associated with the trauma); and had at least two hyperarousal symptoms (e.g., difficulty falling asleep, hyper-vigilance). Symptoms must also have lasted for at least a month and caused significant social or functional impairment. The PCL-C has been found to be a reliable and valid instrument in both general and military personnel populations (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; Maguen et al., 2010). We assessed MDD using the Primary Care Evaluation of Mental Health Disorders Patient Health Questionnaire – 9 (PHQ-9) (Kroenke & Spitzer, 2002; Kroenke, Spitzer, & Williams, 2001). To screen positive for MDD, a participant had to score ≥ 5 of 9 symptoms on the PHQ-9, and these symptoms had to occur together within a 2-week period along with either depressed mood or anhedonia. The PCL-C and PHQ-9 were found to have excellent ($\alpha = 0.93$) and acceptable ($\alpha = 0.66$) internal consistency, respectively.

The following covariates were also included as possible confounds: gender (female vs. male); age; marital status (never married, divorced/separated/widowed, married); race (white, black, other); annual income ($\leq \$60,000$ vs. $> \$60,000$); education (high school graduate, some college, college/graduate degree); insurance status (non-insured vs. insured); history of alcohol abuse, based on DSM-IV criteria, with onset prior to the PTSD-related traumatic event (yes vs. no); and deployment history (deployed vs. never deployed). Although men who have sex with men including those in the active and reserve forces are disproportionately affected by HIV

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

(Levin et al., 1995), the survey did not assess same sex behavior and therefore we were unable to include this variable as a possible confounder.

In addition to the PCL-C and PHQ-9, we also asked participants to report the year during which the criterion A traumatic event was experienced and the age of onset of PTSD and depressive symptoms. In order to examine the effect of PTSD and new onset MDD after experiencing a qualifying trauma, we used this timing data to exclude participants who reported having depressive symptoms prior to the date of experiencing the criterion A stressor ($n = 39$). We also excluded participants for whom the timing of onset of the trauma and depression could not be differentiated ($n = 44$), or who were missing the timing of the trauma or onset of PTSD and MDD symptoms ($n = 22$). We further excluded 141 participants who had never experienced a qualifying traumatic event, and 111 participants who had non-responses to any of the model covariates of interest (none were missing or refused to respond to the questions assessing HIV risk behavior). Therefore, the final sample was $N = 2,259$.

Clinical Interview

In addition to the CATI interviews and as part of the larger study, in-person clinical assessments were conducted on a random sub-sample of 500 participants. Masters or doctoral level clinicians fully consented the participants and conducted the clinical interviews. After consent was obtained, clinicians conducted the interviews in a location chosen by the participant. HIV risk behaviors were assessed using the same set of BRFSS questions listed in the telephone survey; however, in addition to the global measure of HIV risk (i.e., reporting one or more risk activities), participants completing the clinical interview were also asked to identify the specific set of behavior(s) in which they had engaged. In order to examine the level of agreement between HIV risk behaviors reported during the CATI and those during the in-person interviews,

we computed the kappa coefficient for responses from all participants who completed both types of assessments.

The Structured Clinical Interview for DSM-IV Disorders (SCID) was used to conduct detailed psychopathology assessments in the clinical subsample (First, Spitzer, Gibbon, & Williams, 2002). In the clinical reappraisal, the CATI assessments were found to be reliable and of high specificity (Calabrese et al., 2011). Clinical interviews typically lasted two hours and participants were compensated per hour for their time.

Statistical Analyses

As a first step, we compared the characteristics of persons reporting past year HIV risk behavior with those reporting no risk behavior using chi-square tests or Fisher’s exact test in the case of expected cell counts ≤ 5 in more than 20% of the cells. In order to determine the independent and combined effects of PTSD and MDD, we then constructed an indicator variable consisting of four mutually exclusive categories: neither PTSD nor MDD, MDD only, PTSD only, and both PTSD and MDD. This variable was then included in a multivariable logistic regression model, adjusting for all other covariates hypothesized *a priori* as possible confounders. All statistical analyses were conducted in SAS 9.2, and all *p*-values are two-sided.

RESULTS

Sample Characteristics

Of 2,259 participants, the majority were male (86.0%), white (88.1%) and less than 35 years of age (64.7%). The lifetime prevalence of PTSD in the sample was 7.9% (*n* = 178), and 145 persons (6.4%) screened positive for MDD. Past year HIV risk behavior was reported by 142 (6.3%, 95% CI [5.3%, 7.3%]) participants. As shown in Table 1, the sub-sample of

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

participants with PTSD were more likely to report past year HIV risk behavior ($\chi^2 = 9.97$, $p = 0.002$), as were those post-traumatic event MDD ($\chi^2 = 7.78$, $p = 0.005$). Participants reporting HIV risk behavior were also more likely to be female, younger, single or of divorced/separated/widowed marital status, non-white, have lower annual income, and report a history of alcohol abuse (see Table 1).

Multivariate Analysis

The results of the multivariate logistic regression analysis are shown in Table 2. After adjustment for selected characteristics, screening positive for MDD (in the absence of PTSD) was found to be positively and independently associated with HIV risk behavior (adjusted odds ratio [AOR] = 2.3, 95% CI [1.2, 4.7]), compared to participants with neither condition. PTSD (in the absence of MDD) was not statistically significant (AOR = 1.6, 95% CI [0.8, 3.2]). Finally, participants screening positive for both PTSD and MDD were most likely to report HIV risk behavior (AOR = 2.7, 95% CI [1.1, 7.1]).

Clinical Sample Characteristics

Among the subsample of 500 participants who completed the in-person clinical assessment, HIV risk behavior data was assessed and collected from 310. Of these participants, 24 (8.1%, 95% CI [5.1%, 11.1%]) reported engaging in at least one HIV risk behavior. In total, 16 (5.2%) reported unprotected anal intercourse, 9 (2.9%) reported being treated for a sexually transmitted disease, 4 (1.3%) had used intravenous drugs, and none reported exchanging sex for money or drugs in the past year. Of participants who completed both the CATI and in-person interviews, the level of agreement for reported HIV risk behavior was fair ($\kappa = 0.58$, 95% CI [0.41, 0.75]).

DISCUSSION

In this study of Ohio Army National Guard, we observed a high prevalence of self-reported participation in HIV risk behavior. Screening positive for either PTSD or depression was found to be correlated with this outcome. Finally, soldiers reporting both PTSD and MDD after experiencing a traumatic event were most likely to report past-year HIV risk behavior.

The prevalence of HIV risk behavior observed in this study (6.4%) is higher than that found in a nationally representative sample of US adults conducted in 2005, in which 4.0% reported past year engagement in at least one of the HIV risk behaviors included in the BRFSS (Ohl & Perencevich, 2011). Interestingly, our results are comparable to the prevalence of BRFSS HIV risk behaviors found in other populations with adverse life experiences and exposure to trauma, including survivors of childhood abuse (7.6%), intimate partner violence (7.4%), and childhood cancer (8.3%) (Bensley et al., 2000; Breiding, Black, & Ryan, 2008; Phillips-Salimi, Lommel, & Andrykowski, 2012). Given that over 90% of the OHARNG cohort has experienced at least one traumatic event (Calabrese et al., 2011), the comparable prevalence reported here to those observed in these studies is not entirely unexpected. However, it is also likely that the young and predominantly unmarried sociodemographic profile of the cohort resulted in an HIV risk behavior prevalence greater than that observed in general population studies.

Our findings are also broadly consistent with an existing body of literature that has routinely demonstrated PTSD and depression to be positively associated with engagement in HIV risk behavior in non-military populations (Alegría et al., 1994; Cavanaugh et al., 2010; Hutton et al., 2001; Perdue et al., 2003). Although there is a paucity of research examining the relationship between mental health problems and HIV risk in military personnel, an analysis of data from the 1992 National Survey of Veterans showed that persons with co-morbid PTSD and

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

1
2
3 substance abuse disorders were at a greatly elevated risk of HIV infection (Hoff, Beam-Goulet,
4 & Rosenheck, 1997). One recent study of soldiers in the Dominican Republic also found that
5 PTSD was associated with sexual risk behavior (Tavarez et al., 2011). While these
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

substance abuse disorders were at a greatly elevated risk of HIV infection (Hoff, Beam-Goulet, & Rosenheck, 1997). One recent study of soldiers in the Dominican Republic also found that PTSD was associated with sexual risk behavior (Tavarez et al., 2011). While these aforementioned studies have demonstrated that PTSD is more strongly correlated with HIV risk behavior than depression (in contrast to our findings), neither examined the effect of co-morbid mental health problems on HIV risk in a military population. Although further research is required, our results suggest that PTSD in the presence of other psychiatric conditions (e.g., depression) may have a greater influence on HIV risk behavior than PTSD on its own.

Although the cross-sectional nature of our work and these studies limit inference with respect to the causal relationship between PTSD, depression, and HIV risk, these findings suggest that interventions which aim to address psychiatric disorders among military personnel may have an ancillary benefit of reducing high-risk sex and drug-related behaviors. Irrespective of an underlying causal mechanism, our results indicate that soldiers suffering from both PTSD and depression should be the focus of future HIV prevention efforts. Although military-focused HIV prevention interventions have been implemented and are effective at reducing risk behavior in some settings (Bing et al., 2008; Ross et al., 2006; Russak, Ortiz, Galvan, & Bing, 2005), to our knowledge no studies have evaluated the efficacy of HIV prevention programs specifically for military personnel with mental illness. Given the significant burden of mental health problems in this population (Kehle et al., 2011; Milliken, Auchterlonie, & Hoge, 2007; Thomas et al., 2010), interventions that integrate psychiatric and HIV prevention services warrant development and evaluation.

A number of important study limitations must be noted. First, as the study instruments for the OHARNG Mental Health Initiative were not designed specifically to measure HIV risk, we

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

were unable to conduct a thorough examination of behavioral risks for HIV acquisition in this population. For example, additional information regarding the context in which these behaviors take place (e.g., monogamous relationships or with casual partners of unknown serostatus) would have allowed for a deeper understanding of the true risks for HIV transmission experienced by soldiers of the OHARNG. Second, the cross-sectional nature of our analysis precludes a causal interpretation of the observed associations. Third, we were not able to examine more antecedent components of the hypothesized etiologic pathway, including the potentially direct relationship between exposure to trauma and HIV risk behavior in the absence of PTSD. Fourth, a small number of participants were unable to recall the precise timing of these conditions and were excluded. Fifth, our measure of HIV risk was self-reported, and thus may be susceptible to under-reporting, particularly given the stigmatized nature of the assessed behaviors. While the higher prevalence of HIV risk behavior observed among participants completing the in-person clinical assessment does suggest some under-reporting in the larger CATI sample, the relatively small difference of these values (i.e., 8.1% vs. 6.4%) indicates that the magnitude of potential bias from under-reporting is minimal. However, we cannot exclude the possibility that HIV risk was under-reported in both the CATI and clinical interviews. Sixth, the observed relationships between depression, PTSD, and HIV risk may be due to residual or unmeasured confounding. Finally, while our results are strictly generalizable to soldiers willing to participate in the research, we note that the characteristics of our sample are similar to those of the OHARNG (Calabrese et al., 2011), and are thus likely representative of the larger population.

In summary, this study demonstrated that mental health problems, notably PTSD and depression, were prevalent and associated with increased engagement in HIV risk behaviors among a sample of Ohio Army National Guard. These findings suggest that mental health

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

problems including depression and PTSD play a role in augmenting vulnerability to HIV in this population. Given the expanding role of National Guard in combat operations and the commensurate increase in exposure to traumatic events, effective interventions are required to support soldiers at risk for HIV and prevent future infections.

ACKNOWLEDGEMENTS

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

REFERENCES

Alegria, M., Vera, M., Freeman, D. H., Robles, R., Santos, M. C., & Rivera, C. L. (1994). HIV infection, risk behaviors, and depressive symptoms among Puerto Rican sex workers. *American Journal of Public Health, 84*(12), 2000-2002. doi: 10.2105/AJPH.84.12.2000.

Anastario, M., Manzanero, R., Blanco, R., Reyes, E., Jaramillo, R., Black, L., ...Chun, H. (2011). HIV infection, sexual risk behaviour and condom use in the Belize defense force. *International Journal of STD & AIDS, 22*(2), 73-79. doi: 10.1258/ijsa.2010.010274.

Bensley, L. S., Van Eenwyk, J., & Simmons, K. W. (2000). Self-reported childhood sexual and physical abuse and adult HIV-risk behaviors and heavy drinking. *American Journal of Preventive Medicine, 18*(2), 151-158. doi: 10.1016/S0749-3797(99)00084-7.

Bing, E. G., Cheng, K. G., Ortiz, D. J., Ovalle-Bahamon, R. E., Ernesto, F., Weiss, R. E., & Boyer, C. B. (2008). Evaluation of a prevention intervention to reduce HIV Risk among Angolan soldiers. *AIDS and Behavior, 12*(3), 384-395. doi: 10.1007/s10461-008-9368-2.

Blake, D. D., Weathers, F. W., Nagy, L. M., Kaloupek, D. G., Gusman, F. D., Charney, D. S., & Keane, T. M. (1995). The development of a clinician-administered PTSD scale. *Journal of Traumatic Stress, 8*(1), 75-90. doi: 10.1002/jts.2490080106.

Blanchard, E. B., Jones-Alexander, J., Buckley, T. C., & Forneris, C. A. (1996). Psychometric properties of the PTSD Checklist (PCL). *Behaviour Research and Therapy, 34*(8), 669-673. doi: 10.1016/0005-7967(96)00033-2.

Boarts, J. M., Sledjeski, E. M., Bogart, L. M., & Delahanty, D. L. (2006). The differential impact of PTSD and depression on HIV disease markers and adherence to HAART in people living with HIV. *AIDS and Behavior, 10*(3), 253-261. doi: 10.1007/s10461-006-9069-7.

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

- Breiding, M. J., Black, M. C., & Ryan, G. W. (2008). Chronic disease and health risk behaviors associated with intimate partner violence-18 U.S. states/territories, 2005. *Annals of Epidemiology*, 18(7), 538-544. doi: 10.1016/j.annepidem.2008.02.005.
- Breslau, N., Davis, G. C., Peterson, E. L., & Schultz, L. (1997). Psychiatric sequelae of posttraumatic stress disorder in women. *Archives of General Psychiatry*, 54(1), 81-87. doi: 10.1001/archpsyc.1997.01830130087016.
- Breslau, N., Davis, G. C., & Schultz, L. R. (2003). Posttraumatic stress disorder and the incidence of nicotine, alcohol, and other drug disorders in persons who have experienced trauma. *Archives of General Psychiatry*, 60(3), 289-294. doi: 10.1001/archpsyc.60.3.289.
- Brief, D. J., Bollinger, A. R., Vielhauer, M. J., Berger-Greenstein, J. A., Morgan, E. E., Brady, S. M., ...Keane, T. M. (2004). Understanding the interface of HIV, trauma, post-traumatic stress disorder, and substance use and its implications for health outcomes. *AIDS Care*, 16(Suppl 1), S97-S120. doi: 10.1080/09540120412301315259.
- Buckley, T. C., Mozley, S. L., Bedard, M. A., Dewulf, A. C., & Greif, J. (2004). Preventive health behaviors, health-risk behaviors, physical morbidity, and health-related role functioning impairment in veterans with post-traumatic stress disorder. *Military Medicine*, 169(7), 536-540.
- Calabrese, J. R., Prescott, M., Tamburrino, M., Liberzon, I., Slembariski, R., Goldmann, E., ...Galea, S. (2011). PTSD comorbidity and suicidal ideation associated with PTSD within the Ohio Army National Guard. *The Journal of Clinical Psychiatry*, 72(8), 1072-1078. doi: 10.4088/JCP.11m06956.

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

- Cavanaugh, C. E., Hansen, N. B., & Sullivan, T. P. (2010). HIV sexual risk behavior among low-income women experiencing intimate partner violence: The role of posttraumatic stress disorder. *AIDS and Behavior, 14*(2), 318-327. doi: 10.1007/s10461-009-9623-1.
- Centers for Disease Control and Prevention. (2011, January 27). *2011 Behavioral Risk Factor Surveillance System Questionnaire*. Retrieved October 19, 2011, from: <http://www.cdc.gov/brfss/questionnaires/pdf-ques/2011brfss.pdf>.
- Davidson, J. R., Hughes, D., Blazer, D. G., & George, L. K. (1991). Post-traumatic stress disorder in the community: an epidemiological study. *Psychological Medicine, 21*(3), 713-721. doi: 10.1017/S0033291700022352.
- El-Bassel, N., Gilbert, L., Vinocur, D., Chang, M., & Wu, E. (2011). Posttraumatic stress disorder and HIV risk among poor, inner-city women receiving care in an emergency department. *American Journal of Public Health, 101*(1), 120-127. doi: 10.2105/AJPH.2009.181842.
- First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (2002). *Structured Clinical Interview for the DSM-IV-TR Axis I Disorders, Research Version, Non-Patient Edition. (SCID-I/NP)*. New York: Biometrics Research, New York State Psychiatric Institute.
- Hoff, R. A., Beam-Goulet, J., & Rosenheck, R. A. (1997). Mental disorder as a risk factor for human immunodeficiency virus infection in a sample of veterans. *The Journal of Nervous and Mental Disease, 185*(9), 556-560. doi: 10.1097/00005053-199709000-00004.
- Holmes, W. C., Foa, E. B., & Sammel, M. D. (2005). Men's pathways to risky sexual behavior: role of co-occurring childhood sexual abuse, posttraumatic stress disorder, and depression histories. *Journal of Urban Health, 82*(1 Suppl 1), i89-i99. doi: 10.1093/jurban/jti028.

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

- Hutton, H. E., Treisman, G. J., Hunt, W. R., Fishman, M., Kendig, N., Swetz, A., & Lyketsos, C. G. (2001). HIV risk behaviors and their relationship to posttraumatic stress disorder among women prisoners. *Psychiatric Services*, 52(4), 508-513. doi: 10.1176/appi.ps.52.4.508.
- Kehle, S. M., Reddy, M. K., Ferrier-Auerbach, A. G., Erbes, C. R., Arbisi, P. A., & Polusny, M. A. (2011). Psychiatric diagnoses, comorbidity, and functioning in National Guard troops deployed to Iraq. *Journal of Psychiatric Research*, 45(1), 126-132. doi: 10.1016/j.jpsychires.2010.05.013.
- Kroenke, K., & Spitzer, R. L. (2002). The PHQ-9: A new depression diagnostic and severity measure. *Psychiatric Annals*, 32(9), 509-515.
- Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *Journal of General Internal Medicine*, 16(9), 606-613. doi: 10.1046/j.1525-1497.2001.016009606.x.
- Lehrer, J. A., Shrier, L. A., Gortmaker, S., & Buka, S. (2006). Depressive symptoms as a longitudinal predictor of sexual risk behaviors among US middle and high school students. *Pediatrics*, 118(1), 189-200. doi: 10.1542/peds.2005-1320.
- Levin, L. I., Peterman, T. A., Renzullo, P. O., Lasley-Bibbs, V., Shu, X. O., Brundage, J. F., & McNeil, J. G. (1995). HIV-1 seroconversion and risk behaviors among young men in the US army. The Seroconversion Risk Factor Study Group. *American Journal of Public Health*, 85(11), 1500-1506. doi: 10.2105/AJPH.85.11.1500.
- Link, M. W., Battaglia, M. P., Frankel, M. R., Osborn, L., & Mokdad, A. H. (2006). Address-based versus random-digit-dial surveys: comparison of key health and risk indicators. *American Journal of Epidemiology*, 164(10), 1019-1025. doi: 10.1093/aje/kwj310.

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

Maguen, S., Lucenko, B. A., Reger, M. A., Gahm, G. A., Litz, B. T., Seal, K. H., ...Marmar, C. R. (2010). The impact of reported direct and indirect killing on mental health symptoms in Iraq war veterans. *Journal of Traumatic Stress*, 23(1), 86-90. doi: 10.1002/jts.20434.

Milliken, C. S., Auchterlonie, J. L., & Hoge, C. W. (2007). Longitudinal assessment of mental health problems among active and reserve component soldiers returning from the Iraq war. *Journal of the American Medical Association*, 298(18), 2141-2148. doi: 10.1001/jama.298.18.2141.

Ohl, M. E., & Perencevich, E. (2011). Frequency of human immunodeficiency virus (HIV) testing in urban vs. rural areas of the United States: Results from a nationally-representative sample. *BMC Public Health*, 11, 681. doi: 10.1186/1471-2458-11-681.

Perdue, T., Hagan, H., Thiede, H., & Valleroy, L. (2003). Depression and HIV risk behavior among Seattle-area injection drug users and young men who have sex with men. *AIDS Education and Prevention*, 15(1), 81-92. doi: 10.1521/aeap.15.1.81.23842.

Phillips-Salimi, C. R., Lommel, K., & Andrykowski, M. A. (2012). Physical and mental health status and health behaviors of childhood cancer survivors: findings from the 2009 BRFSS survey. *Pediatric Blood & Cancer*, 58(6), 964-970. doi: 10.1002/pbc.23359.

Plotzker, R. E., Metzger, D. S., & Holmes, W. C. (2007). Childhood sexual and physical abuse histories, PTSD, depression, and HIV risk outcomes in women injection drug users: a potential mediating pathway. *The American Journal on Addictions*, 16(6), 431-438. doi: 10.1080/10550490701643161.

Reisner, S. L., Mimiaga, M. J., Safren, S. A., & Mayer, K. H. (2009). Stressful or traumatic life events, post-traumatic stress disorder (PTSD) symptoms, and HIV sexual risk taking

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

among men who have sex with men. *AIDS Care*, 21(12), 1481-1489. doi: 10.1080/09540120902893258.

Rietmeijer, C. A., Lansky, A., Anderson, J. E., & Fichtner, R. R. (2001). Developing standards in behavioral surveillance for HIV/STD prevention. *AIDS Education and Prevention*, 13(3), 268-278. doi: 10.1521/aeap.13.3.268.19740.

Ross, M. W., Essien, E. J., Ekong, E., James, T. M., Amos, C., Ogungbade, G. O., & Williams, M. L. (2006). The impact of a situationally focused individual human immunodeficiency virus/sexually transmitted disease risk-reduction intervention on risk behavior in a 1-year cohort of Nigerian military personnel. *Military Medicine*, 171(10), 970-975.

Russak, S. M., Ortiz, D. J., Galvan, F. H., & Bing, E. G. (2005). Protecting our militaries: a systematic literature review of military human immunodeficiency virus/acquired immunodeficiency syndrome prevention programs worldwide. *Military Medicine*, 170(10), 886-897.

Schnurr, P. P., & Spiro, A. (1999). Combat exposure, posttraumatic stress disorder symptoms, and health behaviors as predictors of self-reported physical health in older veterans. *The Journal of Nervous and Mental Disease*, 187(6), 353-359. doi: 10.1097/00005053-199906000-00004.

Sledjeski, E. M., Delahanty, D. L., & Bogart, L. M. (2005). Incidence and impact of posttraumatic stress disorder and comorbid depression on adherence to HAART and CD4+ counts in people living with HIV. *AIDS Patient Care & STDS*, 19(11), 728-736. doi: 10.1089/apc.2005.19.728.

Tavarez, M. I., Chun, H., & Anastario, M. P. (2011). Correlates of sexual risk behavior in sexually active male military personnel stationed along border-crossing zones in the

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

Dominican Republic. *American Journal of Men's Health*, 5(1), 65-77. doi: 10.1177/1557988310362097.

Thomas, J. L., Wilk, J. E., Riviere, L. A., McGurk, D., Castro, C. A., & Hoge, C. W. (2010). Prevalence of mental health problems and functional impairment among active component and National Guard soldiers 3 and 12 months following combat in Iraq. *Archives of General Psychiatry*, 67(6), 614-623. doi: 10.1001/archgenpsychiatry.2010.54.

Vranceanu, A. M., Safren, S. A., Lu, M., Coady, W. M., Skolnik, P. R., Rogers, W. H., & Wilson, I. B. (2008). The relationship of post-traumatic stress disorder and depression to antiretroviral medication adherence in persons with HIV. *AIDS Patient Care & STDS*, 22(4), 313-321. doi: 10.1089/apc.2007.0069.

Wen, X. J., Balluz, L., & Town, M. (2012). Prevalence of HIV risk behaviors between binge drinkers and non-binge drinkers aged 18- to 64-years in US, 2008. *Journal of Community Health*, 37(1), 72-79. doi: 10.1007/s10900-011-9418-y.

Williams, C. T., & Latkin, C. A. (2005). The role of depressive symptoms in predicting sex with multiple and high-risk partners. *Journal of Acquired Immune Deficiency Syndromes*, 38(1), 69-73. doi: 10.1097/00126334-200501010-00013.

Zatzick, D. F., Marmar, C. R., Weiss, D. S., Browner, W. S., Metzler, T. J., Golding, J. M., ...Wells, K. B. (1997). Posttraumatic stress disorder and functioning and quality of life outcomes in a nationally representative sample of male Vietnam veterans. *American Journal of Psychiatry*, 154(12), 1690-1695.

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

Table 1. Factors Associated with Reporting Past Year HIV Risk Behavior[¶] among a Sample of Ohio Army National Guard (N = 2,259)

Characteristic	HIV risk		No HIV risk		χ^2
	behavior [¶]		behavior [¶]		
	(n = 142)		(n = 2,117)		
	<i>n</i>	%	<i>n</i>	%	
PTSD [†]					
No	121	85.2	1960	92.6	9.97**
Yes	21	14.8	157	7.4	
MDD [†]					
No	125	88.0	1989	94.0	7.78**
Yes	17	12.0	128	6.0	
Sex					
Men	114	80.3	1828	86.3	4.06*
Women	28	19.7	289	13.7	
Age (years)					
17-24	69	48.6	638	30.1	28.13***
25-34	47	33.1	707	33.4	
35-44	22	15.5	548	25.9	
≥ 45	4	2.8	224	10.6	
Marital status					
Married	38	26.8	1086	51.3	33.98***
Divorced/separated/widowed	15	10.5	197	9.3	

Table 1. Factors Associated with Reporting Past Year HIV Risk Behavior[¶] among a Sample of Ohio Army National Guard (N = 2,259)

Characteristic	HIV risk behavior [¶] (<i>n</i> = 142)		No HIV risk behavior [¶] (<i>n</i> = 2,117)		χ^2
	<i>n</i>	%	<i>n</i>	%	
Never married	89	62.7	834	39.4	
Race					
White	117	82.4	1874	88.5	5.72
Black	17	12.0	145	6.9	
Other	8	5.6	98	4.6	
Income					
> \$60,000	42	29.6	907	42.8	9.61**
≤ \$60,000	100	70.4	1210	57.2	
Education					
High school graduate	41	28.9	561	26.5	2.24
Some college	72	50.7	1001	47.3	
College/graduate degree	29	20.4	555	26.2	
History of alcohol abuse [§]					
No	134	94.4	2074	98.0	7.83**
Yes	8	5.6	43	2.0	
Insurance Status					
Insured	123	86.6	1895	89.5	1.17

Table 1. Factors Associated with Reporting Past Year HIV Risk Behavior[¶] among a Sample of Ohio Army National Guard ($N = 2,259$)

Characteristic	HIV risk		No HIV risk		χ^2
	behavior [¶]		behavior [¶]		
	(n = 142)		(n = 2,117)		
	<i>n</i>	%	<i>n</i>	%	
Non-insured	19	13.4	222	10.5	
Deployment History					
Never deployed	54	38.0	677	32.0	2.23
Deployed	88	62.0	1440	68.0	

Note. MDD = Major depressive disorder; PTSD = posttraumatic stress disorder.

¶ Defined as an affirmative response to at least one of the following: (in the past year, have you) used intravenous drugs; been treated for a sexually transmitted or venereal disease; given or received money or drugs in the exchange for sex; or had anal sex without a condom.

† Restricted to cases occurring after a PTSD-related traumatic event (individuals with depressive symptoms preceding PTSD-related trauma were excluded).

§ Only consider as “yes” those with onset prior to PTSD-related traumatic event.

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

Table 2. Multivariate Logistic Regression of Factors Associated with Reporting Past Year HIV Risk Behavior[¶] among a Sample of Ohio Army National Guard

Characteristic	<i>B</i>	<i>SE</i>	<i>AOR</i>	95% CI	Wald χ^2
PTSD and MDD [†] (ref: Neither)					
PTSD only	0.47	0.35	1.60	[0.80, 3.20]	1.75
MDD [†] only	0.85	0.36	2.33	[1.15, 4.71]	5.54*
PTSD and MDD [†]	1.01	0.49	2.75	[1.06, 7.11]	4.32*
Sex (ref: Men)					
Women	0.09	0.24	1.10	[0.69, 1.74]	0.69
Age (ref: 17-24)					
25-34	-0.38	0.24	0.69	[0.43, 1.11]	2.40
35-44	-0.72	0.36	0.48	[0.25, 0.93]	4.68*
≥ 45	-1.52	0.57	0.22	[0.07, 0.67]	7.04***
Marital status (ref: Married)					
Divorced/separated/widowed	0.77	0.33	2.16	[1.13, 4.10]	5.49*
Never married	0.79	0.25	2.20	[1.35, 3.57]	10.09***
Race (ref: White)					
Black	0.60	0.29	1.82	[1.04, 3.18]	4.33*
Other	0.18	0.39	1.20	[0.56, 2.56]	0.21
Income (ref: ≤ \$60,000)					
> \$60,000	-0.03	0.21	0.97	[0.64, 1.47]	0.02

PTSD, DEPRESSION, AND HIV RISK AMONG NATIONAL GUARDS

Table 2. Multivariate Logistic Regression of Factors Associated with Reporting Past Year HIV Risk Behavior[¶] among a Sample of Ohio Army National Guard

Characteristic	<i>B</i>	<i>SE</i>	<i>AOR</i>	95% CI	Wald χ^2
Education (ref: High school)					
Some college	0.06	0.21	1.06	[0.70, 1.61]	0.07
College/graduate degree	0.16	0.28	1.17	[0.68, 2.02]	0.31
History of alcohol abuse [§] (ref: No)					
Yes	0.84	0.51	2.31	[0.86, 6.22]	2.73
Insurance Status (ref: Insured)					
Non-insured	-0.14	0.27	0.87	[0.51, 1.47]	0.28
Deployment History (ref: Never)					
Been deployed	0.10	0.21	1.11	[0.73, 1.67]	0.63

Note. *N* = 2,259. *AOR* = Adjusted odds ratio; CI = confidence interval; MDD = major depressive disorder; PTSD = posttraumatic stress disorder.

[¶] Defined as an affirmative response to at least one of the following: (in the past year, have you) used intravenous drugs; been treated for a sexually transmitted or venereal disease; given or received money or drugs in the exchange for sex; or had anal sex without a condom.

[†] Restricted to cases occurring after a PTSD-related traumatic event (individuals with depressive symptoms preceding PTSD-related trauma were excluded).

[§] Only consider as “yes” those with onset prior to PTSD-related traumatic event.

* *p* < 0.05. *** *p* < 0.001.

Sexual Violence and Mental Disorders Among National Guard and Reserve Soldiers

Abstract

Objectives: We examined the prevalence of sexual violence and its mental health consequences among three representative samples of male and female soldiers.

Methods: Structured telephone interviews assessing lifetime and deployment-related rape or sexual assault and current and lifetime posttraumatic stress disorder (PTSD) and depression were conducted with 1,030 Reservists (23% female), 973 National Guard (NG; 15% female), and 2,616 Ohio Army National Guard (OHARNG; 15% female) soldiers.

Results: Lifetime sexual violence prevalence was 4.0%, 3.9%, and 5.0% among Reserve, NG, and OHARNG men, and 36.6%, 25.5%, and 36.3% among the Reserve, NG, and OHARNG women, respectively. Among victims, 2.4-7.1% of women and 0-4.5% of men reported deployment-related sexual violence, and odds of current or lifetime PTSD ranged from 3.3 to 7.5, and odds of current or lifetime depression ranged from 1.7 to 5.0.

Conclusions: Female reservists reported markedly higher sexual violence prevalence and male soldiers reported similar prevalence relative to the general population. The majority of sexual violence reported is not deployment-related. Findings emphasize a need to screen for lifetime sexual violence experiences and associated mental disorders in military samples.

INTRODUCTION

Sexual violence, encompassing both rape (i.e., penetration due to force, threat of force, or drug or alcohol incapacitation) and the broader experience of sexual assault (i.e., unwanted sexual contact occurring due to use of force, threat of force, or manipulation), is a highly prevalent experience with 1 in 5 U.S. women and 1 in 71 U.S. men reporting a rape during their lifetimes¹. Relative to other forms of violent crime, sexual violence is associated with the highest losses in quality-adjusted life years², and significant costs to society in the form of police and victim advocate services, medical and mental health treatment, loss of productivity/wages, and loss of quality of life³. Sexual violence also contributes to substantial burden of psychopathology; posttraumatic stress disorder (PTSD) and depression are the most commonly reported and impairing mental health consequences^{4,5,6,7}.

Sexual violence is an underreported experience that is understudied among U.S. soldiers; thus, examining the prevalence and correlates of sexual violence in non-patient, non-VA military samples is critical. Best available estimates suggest that 19% to 42% of U.S. service members returning from Iraq and Afghanistan report mental health problems^{8,9,10}. However, we know little about the sexual violence experiences of these soldiers or how they contribute to mental health problems. Prior studies have focused primarily on patients seeking services through the Veteran's Administration and assessed sexual violence occurring only during military engagement^{11,12,13,14}. Only three studies have assessed sexual violence prior to military engagement using non-patient active duty samples^{15,16,17}. Among a representative sample of Air Force women, 28% reported lifetime sexual violence¹⁵. In two studies that used non-representative samples of active duty soldiers, 38% of female Navy recruits reported adolescent or adult sexual violence (since age 14)¹⁶, and 6% of Army men and 50% of Army women

reported ever experiencing sexual violence¹⁷. All three studies found that the majority of incidents involved assaults by civilians when the victims were civilians, suggesting that we may be overlooking important risk factors for mental disorders among soldiers when sexual violence is assessed only in the context of military service. To date, there have been no epidemiological studies examining sexual violence among non-patient military samples of men and women, which has hindered our understanding of the scope and burden of sexual violence among military personnel.

The present study substantively advances the literature by documenting the prevalence of sexual violence (both lifetime and in the context of the most recent deployment) and associated mental health consequences among three representative samples of non-treatment seeking male and female reservists.

METHOD

Sample

Samples 1 and 2. Soldiers serving in the Reserves and National Guard as of June 2009 were drawn using a stratified random sample from the Defense Manpower Data Center. In June 2009, we obtained contact information for 10,000 Reserve and 10,000 National Guard soldiers, a sampling frame representative of the national U.S. Reserve and Guard population. A random sample of 9,751 soldiers was invited to participate in the study; 1097 returned an opt-out letter and did not wish to be contacted. After excluding individuals without a correct or working telephone number (2,866 or 29.4% of the possible 9,751), 6,885 working numbers (71%) were called. Of these working numbers, 324 (3%) were not eligible (e.g. no longer enrolled or retired), 1,097 (11% of working numbers) did not wish to participate, 1% (61) were disqualified because they did not speak English or had hearing problems and 35% (3,386) were not contacted before

the cohort closed. A total of 2,003 Reserve and National Guard service personnel were interviewed at baseline (between January and July 2010), with an overall cooperation rate (defined as the number of those who consented divided by the number of working numbers successfully contacted) of 68.2% and an overall response rate of 34.1%.

Sample 3. All soldiers serving in the Ohio Army National Guard (OHARNG) as of June 2008 (N=10,778) as well as those who enlisted between July 2008 and February 2009 (N=1,792) were invited to participate via a letter describing the study with an option to opt-out and a phone call to obtain each soldier's consent to participate in a telephone interview. Approximately 345 individuals were excluded due to lack of a current address; thus 12,225 letters were sent. Approximately 8% (1,013 soldiers) returned opt-out cards; the remaining 11, 212 soldiers were contacted to provide consent for the telephone interviews. Approximately 10% of individuals (n = 1,130) did not have a telephone number listed with the Guard, and 32% (n = 3,568) did not have correct or working telephone numbers; a total of 6,514 working numbers were called. A total of 2,616 male and female soldiers were interviewed at baseline, with an overall cooperation rate of 67.5% and a response rate of 43.2%.

Measures

Sexual violence. As part of a larger screening that assessed twenty-one different traumatic events, participants were asked, "In your lifetime, have you ever 1) been raped? 2) experienced another kind of sexual assault or unwanted sexual contact as a result of force, threat of harm, or manipulation?" Participants who responded affirmatively to either question were considered lifetime sexual violence victims. A follow-up yes/no question was asked regarding whether that experience was related to the respondent's most recent deployment.

PTSD. For participants who reported any traumatic event, and for those who noted that they responded to the event with fear, helplessness, or horror, the PTSD Checklist-Civilian¹⁸ (PCL-C) version was administered. The PCL-C consists of seventeen items corresponding to the Diagnostic and Statistical Manual of Mental Disorders – 4th Edition (DSM-IV) criteria for PTSD. Participants responded to each item on a Likert-type scale ranging from *1 = Not at All* to *5 = Extremely*. Participants also rated the degree to which their symptoms interfere with occupational or social pursuits on a scale from *1 = Not at All* to *4 = Extremely*. To meet criteria for PTSD, respondents must have endorsed: 1) a criterion A traumatic event; 2) a response to this event that involved helplessness or terror; 3) at least one reexperiencing symptom of moderate severity; 4) at least three avoidance/numbing symptoms of moderate severity; 5) at least two hyperarousal symptoms of moderate severity; 6) a symptom duration of at least one month; and 7) impairment in social or occupational functioning or extreme distress due to these symptoms. The PCL-C has good reliability, validity, and psychometrics among this population^{19,20,21}.

Depression. Participants completed the Patient Health Questionnaire²² (PHQ-9) to assess any of nine symptoms of Major Depression as defined by the DSM-IV for a period of two weeks or more. If participants responded affirmatively to any depression items, they were asked to rate the severity of that symptom on a scale from *1 = several days* to *3 = nearly every day*. To be considered depressed, participants had to endorse two or more depression symptoms plus anhedonia or depressed mood at least more than half the days over the course of a two week period. Finally, participants were asked whether the two weeks of depressive symptoms had occurred in the previous thirty days. Clinical validation work with this population suggests that this broader definition of depression (versus Major Depression specifically) assessed on the PHQ-9 corresponds most closely to depression as assessed in clinical interviews^{20,21}.

Covariates. Previous studies have documented associations between military sexual violence and older age, enlisted rank, and number of traumatic events experienced¹⁴; thus, we examined associations between lifetime sexual violence and each covariate and included significant covariates in multivariate analyses.

Procedures

As part of a larger investigation of military experiences, health/mental health status, and service utilization, participants completed a 60-minute telephone survey. All interviews were conducted by trained interviewers, who obtained informed consent from each participant at the start of the interview and offered \$25 compensation. Institutional Review Board approval was obtained for both surveys.

Statistical Analyses

First, we present descriptive information and differences between the OHARNG, Reserve, and NG samples on demographic characteristics and potential covariates. Second, we present prevalence estimates for lifetime and deployment-related sexual violence by sample (Reserves, NG, and OHARNG) and by sex/gender (female, male). Third, we present chi-square analyses to examine bivariate differences in prevalence of PTSD and depression among sexual violence victims and non-victims. Fourth, to adjust for significant covariates, we report odds ratios from logistic regression analyses predicting PTSD and depression from sexual violence while adjusting for covariates that were significant in bivariate analyses.

RESULTS

Demographic Characteristics and Covariate Analyses

Demographic characteristics of participants are presented in Table 1. The Reserve sample contained a greater proportion of women and soldiers 45 or older when compared to the OHARNG and NG samples. No sex differences emerged between the OHARNG and NG samples, but NG soldiers were more likely to be 45 or older compared to OHARNG soldiers. Reserve soldiers were more likely to be ethnic minority when compared to OHARNG and NG soldiers, and NG soldiers were more likely to be ethnic minority when compared to OHARNG soldiers. Reserve soldiers were more likely than NG soldiers and NG soldiers were more likely than OHARNG soldiers to have completed some college or a graduate degree. OHARNG soldiers were less likely to have ever been married compared to NG and RNG soldiers. Reserve soldiers reported less social support compared to NG and OHARNG soldiers. Reserve soldiers were more likely than NG and OHARNG soldiers, and NG soldiers were more likely than OHARNG soldiers to be officers (versus enlisted). NG soldiers were more likely than Reserve and OHARNG soldiers, and Reserves were more likely than OHARNG soldiers to have ever been deployed. Reserve and NG soldiers reported more “other” traumatic events than OHARNG soldiers, but Reserve and NG soldiers did not differ in the number of traumatic events reported.

Sexual violence victims and non-victims did not differ on age in the Reserve or NG samples; however, female sexual violence victims were likely to be older in the OHARNG sample, $\chi^2(1, n=385) = 5.6, p < .05$. Victims and non-victims did not differ in rank; however, across samples, victims reported experiencing a greater number of other traumatic events when compared to non-victims.

Sexual violence prevalence estimates for male and female soldiers

As shown in Figure 1, lifetime sexual violence prevalence ranged from 25.5% for NG women to 36.3% and 36.6% for the OHARNG and Reserve women, respectively. Among men, estimates ranged from 3.9% in the NG sample to 4.0% and 5.0% in the Reserve and OHARNG samples, respectively. Among those reporting any lifetime sexual violence, the prevalence of sexual violence during the most recent deployment ranged from 2.4% for NG women to 5.8% for Reserve women to 7.1% for OHARNG women. For men, estimates were 0.0% for NG and Reserve samples and 4.5% in the OHARNG sample.

Current PTSD and depression prevalence among sexual violence victims and non-victims

Reserve sample. As shown in Table 2, sexual violence victims were more likely to report past-year PTSD relative to non-victims, but no differences emerged for past-year depression. Those reporting sexual violence during a recent deployment did not report past-year PTSD or depression.

NG sample. No significant differences emerged for current PTSD or depression, nor did those with sexual violence during a recent deployment report past-year PTSD or depression.

OHARNG sample. Sexual violence victims were significantly more likely to report past-year PTSD and depression. Among women reporting sexual violence during a recent deployment ($n = 10$), 50.0% ($n = 5$) and 30.0% ($n = 3$) met criteria for past-year PTSD and depression, respectively. Among men reporting sexual violence during a recent deployment ($n = 5$), 60% ($n = 3$) and 40% ($n = 2$) met criteria for past-year PTSD and depression, respectively.

Lifetime PTSD and depression prevalence among sexual violence victims and non-victims

Reserve sample. As shown in Table 3, sexual violence victims were more likely than non-victims to report lifetime PTSD and lifetime depression. Although 60% ($n = 3$) of women reporting sexual violence during a recent deployment reported lifetime PTSD, sexual violence during a recent deployment was not associated with lifetime depression among women, nor was it associated with lifetime PTSD or depression among men.

NG sample. Although sexual violence victims were not more likely than non-victims to report lifetime PTSD or depression, 50% ($n = 1$) of women who reported sexual violence during a recent deployment met criteria for lifetime PTSD and depression.

OHARNG sample. Sexual violence victims were more likely to report lifetime PTSD and depression. Among women reporting sexual violence during the most recent deployment ($n = 10$), 50% met criteria for lifetime PTSD and 40% met criteria for lifetime depression. Among men reporting sexual violence during the most recent deployment ($n = 5$), 60% and 40% met criteria for lifetime PTSD and depression, respectively.

Covariate adjusted odds of meeting criteria for current or lifetime PTSD and depression

As presented in Table 4, unadjusted odds of meeting criteria for past-year and lifetime PTSD and depression ranged from 2.1 to 6.8 across samples. After controlling for number of traumas experienced and age in the OHARNG sample, adjusted odds ranged from 1.3 to 5.5.

COMMENT

This study is the first to document pervasive exposure to sexual violence over the lifecourse in an epidemiological sample of female and male soldiers. Approximately 1/3 of women and 4-5% of men in each sample reported lifetime sexual violence despite our use of

restrictive definitions (e.g., rape) that require individuals to label their experiences as such. Whereas prior studies have predominantly focused on VA patients' experience of sexual violence in the context of military service, the present study highlights the importance of measuring sexual violence over the lifecourse, even among non-treatment seeking samples, to best understand the impact sexual violence have on soldiers' mental health.

General population prevalence estimates suggest that 18-22% of women and 1.4-4.0% of men report sexual violence^{1,5}. Thus, while female soldiers report substantially higher estimates of lifetime sexual violence compared to the general population, male soldiers report estimates that are consistent with those found in the general population. Differences between community-residing women and female soldiers could suggest that those who are drawn to military service may represent a subsample of women with more severe early life adversity including sexual violence. Indeed, the majority of sexual violence reported in the present study appears to have occurred prior to military engagement.

Sexual violence victims in the Reserves and OHARNG were between two and eight times more likely to meet past-year or lifetime PTSD criteria and between two and five times more likely to meet criteria for lifetime depression compared with non-victims. These odds ratios highlight the pervasive and detrimental impact of sexual violence on mental health functioning.

Results from the present study should be considered in the context of study limitations. Data regarding sexual violence exposure and both lifetime and current symptoms of PTSD and depression were self-report and thus may be susceptible to biases or inaccuracies in recall. Further, measures used in the present study allowed us to assess various types of traumatic events, but we were unable to assess the number of times each of these events occurred or the ages at which respondents experienced each event. Similarly, lifetime and deployment-related

sexual violence questions were not necessarily mutually exclusive; thus, individuals who responded affirmatively to questions about deployment-related sexual violence also may have experienced sexual violence prior to military engagement. Future studies should collect additional information about the nature and timeline of traumatic events experienced. Data for the present study were cross-sectional, thus, we do not have measures of pre-military functioning, and definitive statements about these findings cannot be made without additional longitudinal research. Although cooperation rates were consistent with those of other recent epidemiologic samples (for review see²³), efforts should be made to improve participation.

Despite these limitations, the present study has important implications for the assessment of sexual violence and associated mental disorders among military personnel. Specifically, if practitioners focus only on sexual violence occurring during military service, they may be missing an important contingent of soldiers with lifetime sexual violence experiences that may be contributing to current mental health problems. Further, although sexual violence estimates in the present study were reported at or above estimates found in prior studies with female soldiers, sexual violence is substantially underreported to formal agencies in civilian samples²⁴. Recent reviews have highlighted significant barriers to reporting sexual violence occurring within the context of military service among male soldiers including stigma, fear of negative consequences, and shame¹¹, and the Department of Defense has documented heightened barriers to reporting sexual violence among military samples including perceived lack of available forensic and medical care, lack of confidentiality, and perceived deficiencies in command leadership²⁵. Future research can fruitfully explore ways to improve sexual violence and mental health symptom reporting among military samples.

REFERENCES

1. Black MC, Basile KC, Breiding MJ, et al. The National Intimate Partner and Sexual Violence Survey (NISVIS): 2010 Summary Report. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention.
2. Dolan P, Loomes G, Peasgood T, Tsuchiya A. Estimating the intangible victim costs of violent crime. *Br J Criminol* 2005;45:958-976.
3. Post LA, Mezey NJ, Maxwell C, Wibert WN. The rape tax: Tangible and intangible costs of sexual violence. *J Interpers Violence* 2002;17:773-782.
4. Darves-Bornoz J-M, Alonso J, de Girolamo G, et al. Main traumatic events in Europe: PTSD in the European study of the epidemiology of mental disorders survey. *J Traumatic Stress* 2008;21:455-462.
5. Elliott DM, Mok DS, Briere J. Adult sexual assault: Prevalence, symptomatology, and sex differences in the general population. *J Traumatic Stress* 2004; 17: 203-211.
6. Hapke Um Schumann A, Rumf H-J, John U, Meyer C. Posttraumatic stress disorder: The role of trauma, pre-existing psychiatric disorders, and gender. *European Archives of Psychiatry and Clinical Neuroscience* 2006; 256:299-306.
7. Kaminer D, Grimsund A, Myer L, Stein DJ, Williams DR. Risk for posttraumatic stress disorder associated with different forms of interpersonal violence in South Africa. *Social Science and Medicine* 2008;67:1589-95.
8. Hoge CW, Auchterlonie JL, Miliken CS. Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *JAMA* 2006; 295:1023-32.
9. 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;298:2141-8.
10. Seal KH, Metzler TJ, Gima KS, Bertenthal D, Maguen S, Marmar CR. Trends and risk factors for mental health diagnoses among Iraq and Afghanistan veterans using Department of Veterans Affairs health care, 2002-2008. *Am J Public Health* 2009;99:1651-1658.
11. Hoyt T, Rielage JK, Williams LF. Military sexual trauma in men: A review of reported rates. *Journal of Trauma & Dissociation* 2011;12:244-260.
12. Kimerling R, Street AE, Pavao J, et al. Military-related sexual trauma among Veteran's Health Administration patients returning from Afghanistan and Iraq. *Am J Public Health* 2010; 100:1409-12.

13. Street AE, Stafford JA, Mahan CM, Hendricks AM. Sexual harassment and assault experienced by reservists during military service: prevalence and health correlates. *Journal of Rehabilitation Research and Development* 2008;45:409-19.
14. Suris A, Lind L. Military sexual trauma: A review of prevalence and associated health consequences in veterans. *Trauma, Violence, & Abuse* 2008; 9: 250-69.
15. Bostock DJ, Daley JG. Lifetime and current sexual assault and harassment victimization rates of active-duty United States Air Force women. *Violence Against Women* 2007;13:927-44.
16. Stander VA, Merrill LL, Thomsen CJ, Crouch JL, Milner JS. Premilitary adult sexual assault victimization and perpetration in a Navy recruit sample. *J Interpersonal Violence* 2008; 23:1636-53.
17. Martin L, Rosen LN, Durand DB, Knudson KH, Stretch RH. Psychological and physical health effects of sexual assaults and nonsexual traumas among male and female United States Army soldiers. *Behavioral Medicine* 2000;26,23-33.
18. Weathers F, Ford J. Psychometric review of PTSD Checklist (PCL-C,PCL-S, PCL-M, PCL-PR). In: Stamm BH, ed. *Measurement of Stress, Trauma, and Adaptation*. Lutherville: Sidran Press, 1996.
19. Blanchard EB, Jones-Alexander J, Buckley TC, Forneris CA. Psychometric properties of the PTSD Checklist. *Behavior Research and Therapy* 1996;34:669-73.
20. Calabrese JR, Prescott M, Tamburrino M, Liberzon I, Slembariski R, Goldmann E. et al. PTSD comorbidity and suicidal ideation associated with PTSD within the Ohio Army National Guard. *J Clin Psychiatry* 2011;72:1072-78.
21. Marshall BDL, Prescott MR, Liberzon I, Tamburrino MB, Calabrese JR, Galea S. Coincident posttraumatic stress disorder and depression predict alcohol abuse during and after deployment among army national guard soldiers. *Drug and Alcohol Dependence* 2012;
22. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: Validity of a brief depression severity measure. *J Gen Intern Med* 2001;16:606-13.
23. Galea S, Tracy M. Participation rates in epidemiologic studies. *Annals of Epi* 2007; 17: 643-653.
24. Tjaden P, Thoennes N. *Extent, Nature, and Consequences of Rape Victimization: Findings From the National Violence Against Women Survey*. Washington, DC: National Institute of Justice, 2006.
25. Department of Defense (DoD). Task Force report on care for victims of sexual assault. April 2004.

TITLE: Correlates of risky driving behavior among National Guard soldiers

AUTHORS:

Katherine J. Hoggatt, Ph.D. 1,2

Marta R. Prescott, Ph.D. 3

Emily Goldmann, Ph.D. 3

Marijo Tamburrino, MD. 4

Joseph R. Calabrese, MD. 5

Israel Liberzon, MD. 6,7

Sandro Galea, MD, DrPH. 3

1 VA Greater Los Angeles Health Services Research and Development (HSR&D) Center of Excellence for the Study of Healthcare Provider Behavior, Sepulveda, CA, USA

2 Department of Epidemiology, UCLA School of Public Health, Los Angeles, CA, USA

3 Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY, USA

4 Department of Psychiatry, University of Toledo, Toledo, OH, USA

5 Department of Psychiatry, Case Western Reserve University, Cleveland, OH, USA

6 VA Ann Arbor, Ann Arbor, MI, USA

7 Department of Psychiatry, University of Michigan, Ann Arbor, MI, USA

Address correspondence to: Katherine J. Hoggatt

VA Greater Los Angeles, HSR&D Center of Excellence for the Study of Healthcare Provider Behavior, 16111 Plummer St., Sepulveda, CA 91343, USA

Telephone: 734-239-5107

Fax: 818-895-5838

Email: khoggatt@ucla.edu

Abstract word count: 254

Word count: 3273 words in text, 4 tables, 0 figures

Financial disclosures:

Katherine J. Hoggatt has no financial disclosures.

Marta R. Prescott has no financial disclosures.

Emily Goldmann has no financial disclosures.

Marijo Tamburrino has no financial disclosures.

Joseph R. 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 & Johnson, Sanofi Aventis, Schering-Plough, Pfizer, Solvay, and Wyeth; and has not been on a speakers bureau for the past 8 years. Past speaker bureaus included Abbott, AstraZeneca, Eli Lilly, and GlaxoSmithKline. He has no related stock, equity, or patents.

Israel Liberzon has no financial disclosures.

Sandro Galea has no financial disclosures.

Abstract

Introduction: Previous studies have reported that risky driving is associated with deployment and combat exposure in military populations, but little research has focused on risky driving as a possible consequence of deployment among reserve forces who have been increasingly deployed to active international conflicts..

Objective: The goal of this analysis was to assess the pre-, peri-, and post-deployment predictors of risky driving among men and women in the Ohio Army National Guard (OHARNG).

Methods: The study group comprised 2616 eligible OHARNG soldiers enlisted as of June 2008 or who enlisted between June 2008 and February 2009 who were at least 18 years old or were emancipated minors and capable of giving informed consent. The outcomes of interest were risky driving behaviors: drinking and driving in the past 30 days, passing cars on the right often in the past year, and disregarding speed limits late at night or early in the morning often in the past year. The association between risky driving and mental health factors, deployment factors, and psychosocial stressors and supports were estimated using multiple-variable logistic regression models.

Results: Drinking and driving, passing on the right, and ignoring speed limits were positively associated with a history of psychiatric disorders, deployment, deployment-related traumatic events, and combat or post-combat stressors. In contrast, high self-reported psychosocial support was negatively associated with risky driving.

Conclusions: Soldiers with a history of psychiatric disorder, alcohol abuse or dependence, or low post-deployment support may benefit from post-deployment education or counseling with tailored messages to decrease the tendency for risky driving.

Key words: Driving, Mental Health, Military Medicine, Veterans of War

INTRODUCTION:

Risky driving, other risky behaviors (e.g., unprotected sex or risky recreation), and a predisposition for risk-taking are associated with deployment and combat exposure in military populations.¹⁻⁶ Moreover, it has been reported that deployment and conflict-zone exposure were associated with increased mortality from motor vehicle accidents in Vietnam War and Gulf era Veterans,⁷⁻⁹ an association researchers have hypothesized may be due to increased risky behavior after deployment.^{9,10}

Several hypotheses have been proposed to explain increased risky driving after deployment. Soldiers may exhibit increased risk-taking, including risky driving, as a result of general disinhibition as a response to stressors, thrill-seeking to recreate the type of “rush” felt in high-stress combat environments, or an expression of feelings of post-combat invincibility.^{3,11} Alternatively, persistent risky driving may reflect a habituation to practices that are learned and normative in deployment settings.² Finally, risky driving may be a correlate or an expression of underlying psychiatric conditions, including PTSD, or stress.^{12,13}

Members of the reserve forces, particularly members of the Army National Guard (ARNG), are playing a larger role in active military operations, including combat.¹⁴ It has been reported that reservists may be at greater risk of deployment-related stress and adverse mental health effects of war than their active duty counterparts,¹⁵ yet relatively little research has focused on risky driving as a possible consequence of deployment in Guard troops. The goal of this analysis therefore was to assess the pre-, peri-, and post-deployment predictors of risky driving among members of the Ohio Army National Guard (OHARNG). In particular, we explored the association between risky driving and deployment-related factors, psychiatric conditions, and psychosocial support or stressors.

METHODS:

The Ohio Army National Guard Mental Health Initiative (OHARNG MHI) is a cohort of OHARNG soldiers who are monitored annually for mental health and exposure to military and non-military stressors. All soldiers enlisted as of June 2008 (N=10,778) and those who enlisted between June 2008 and February 2009 (N=1,792) received alert-letters directly from the OHARNG; of these, 345 individuals were excluded

due to the lack of a current address and 1,013 returned opt-out cards leaving 11,212 soldiers eligible to be sampled for our study. Study personnel received contact information for these eligible soldiers, and of these we excluded 10% (1,130) with no listed telephone number or address. Of the remaining 10,082 soldiers, 35% (3,568) were excluded due to non-functioning or incorrect numbers. Of the 6514 possible participants with working numbers, 3% (187) were retired and therefore ineligible, and 36% (2347) were not enrolled before the baseline cohort closed in November 2009 or were disqualified for other reasons ($n = 31$) (e.g., did not speak English, had hearing problems, or were deceased). Only 20.9% (1,364) declined to participate, making the overall participation rate 43.2% (total completed and those who consented but were retired divided by all of the working numbers minus those disqualified for other reasons). This final study group comprised 2616 eligible OHARNG soldiers of any ethnicity who were at least 18 years old or were emancipated minors and capable of giving informed consent.

Potential participants were contacted to obtain informed consent for telephone interviews; if the service member was deployed at the time of contact, a call was scheduled for a future date. Enrollment began in November 2008 and the consent procedure continued through November 2009. This study was approved by the Institutional Review Boards of University Hospitals Case Medical Center, University of Toledo, and Columbia University and also by the Human Research Protection Office (HRPO), Office of Research Protections (ORP), and the U.S. Army Medical Research & Materiel Command (USAMRMC) of the United States Department of Defense. The study received a certificate of confidentiality from the National Institutes of Health, and all participants identities and responses were kept confidential.

Variable Definitions:

The telephone questionnaire included items on demographics, deployment and military experiences, and past and present symptoms of psychopathologies including posttraumatic stress disorder (PTSD), major depressive disorder, generalized anxiety disorder (GAD), alcohol use disorders, psychosocial support and stressors, and risky driving.

The main predictors of interest included the mental health measures, self-perceived social support, and

events experienced during deployment. PTSD was assessed using the PTSD Checklist—Civilian Version.¹⁶⁻¹⁸ Participants were asked to recall PTSD symptoms relative to the “worst” traumatic event experienced outside of deployment and the “worst” traumatic event experienced during their most recent deployment. To meet the definition of PTSD, participants had to meet criteria A1, A2, and B-F for either of the “worst” traumatic event experiences. Additional questions assessed if symptoms occurred ever in their lifetime, in the past year, or past in the month to determine the recency of symptoms. Participants were characterized as having PTSD if they met all criteria from the worst traumatic event experienced outside of their most recent deployment or during their most recent deployment. Lifetime major depressive disorder (MDD) was assessed using the Patient Health Questionnaire-9 (PHQ-9).^{19,20} The traditional and validated scoring for MDD was used; patients who scored ≥ 5 out of 9 symptoms on the PHQ-9, had symptoms occurring in the same 2-week period with one symptom being either depressed mood or anhedonia were defined as having MDD.).^{19,20} GAD was assessed using the GAD-7; a probable case of GAD was classified as a score ≥ 10 with a symptom duration of at least 6 months, symptoms co-occurring within the same time period, and reported functional impairment.²¹ Alcohol abuse and dependence were defined using the MINI International Neuropsychiatric Interview and DSM-IV criteria.^{16,22} As with PTSD timing of symptoms, for each psychopathology, additional questions for MDD, GAD, and alcohol abuse and dependence assessed if the two-week period of symptoms occurred ever in their lifetime, within the past year, and/or within the past month.

A sub-sample (N=500) of all study participants was re-interviewed by a clinician to assess the psychometric properties of the self-reported scales. The lifetime history of PTSD had high reliability of the items (Cronbach’s alpha of 0.93) and excellent specificity (SP of 0.92). The reliability between the items and specificity for MDD (0.77 and 0.97), GAD (0.81 and 0.98), and alcohol abuse (0.73 and 0.80) and dependence (0.81 and 0.81) were similarly high.

Social support and traumatic events experienced during participants’ most recent deployment were assessed using segments of the Deployment Risk and Resilience Inventory (DRRI),^{23,24} and the frequency of traumatic events over the lifetime was assessed using a the Life Events Checklist from the

Clinician-Administered PTSD Scale²⁵ with the inclusion of other traumatic event experiences (e.g., car accident, divorce) used in other population-based studies.²⁶ Binary variables were created for high and low social support or stress related to participants' most recent deployment using a median cutpoint calculated using the entire sample for each pre-deployment (preparedness), peri-deployment (unit support, combat experiences, post-combat experiences, perceived threat, general harassment, sexual harassment), post-deployment (post-deployment support), and overall (psychosocial support) variable. Military experiences were categorized to describe if the soldiers experienced conflict or combat during the most recent deployment (never deployed, deployed to non-conflict zone, deployed to conflict zone) and deployment-related trauma (total number of both DRRI and general traumas that occurred during their most recent deployment: 0, 1-5, 6-11, ≥ 12).

The main outcomes of interest were risky driving behaviors assessed using six questions: "How often do you use seat belts when you drive or ride in a car?"; "In the past 30 days, how many times have you driven when you've had perhaps too much to drink?"; "In the past year, have you ever become impatient with a slow driver in the fast lane and passed them on the right?"; "In the past year have you crossed an intersection knowing that the traffic lights have already changed from yellow to red?"; "In the past year have you disregarded speed limits late at night or early in the morning?"; and "In the past year have you underestimated the speed of an oncoming vehicle when attempting to pass a vehicle in your own lane?".

Use of seat belts was dichotomized to "seldom/never" vs. "always/nearly always/sometimes". Drinking and driving was indicated for one or more times in the past 30 days among those who reported ever drinking in the alcohol section; if they never drank they were categorized as driving after drinking. The remaining four driving items were indicated for "nearly all the time/frequently/quite often" vs. "occasionally/hardly ever/never in the past year". In addition, due to the limited number of persons reporting they passed through an intersection on a red light or underestimated the speed of an oncoming car, these outcomes were not included in our regression modeling.

Statistical Analyses:

Descriptive statistics were calculated for the study group, and the association between the predictors and the risky driving outcomes was quantified using point and interval estimates of the odds ratio derived from single- and multiple-variable logistic regression models. The main predictors of interest were mental health factors, deployment factors, psychosocial stressors and supports; demographic characteristics (age, race, education, income, and marital status) were included in all models. In addition, the models with mental health factors as predictors included deployment history as a covariate, while the models with deployment and psychosocial factors as predictors included an indicator variable for a lifetime history of PTSD, MDD, or GAD. Because of the low number of subjects reporting underestimating the speed of an oncoming car, this outcome was not included in the regression modeling. To assess whether there was effect measure modification (heterogeneity) by gender, multiple logistic regression models were fit with interaction terms for gender and each of the main predictors variables, and p-values for the product-term coefficients were calculated. As has been noted, such tests for heterogeneity often have low power to detect departures from additivity or multiplicativity, and therefore p-values up to 0.20 were reported.^{27,28}

RESULTS:

Overall, 309 (12%) subjects reported drinking and driving in the past 30 days, 672 (26%) reported passing cars on the right often in the past year, and 665 (25%) reported disregarding speed limits late at night or early in the morning often in the past year (Table 1). For the latter two behaviors, 29% of male and 25% of female OHARNG soldiers reported “never” passing on the right in the past year and 34% of male and 35% of female OHARNG soldiers reported “never” disregarding speed limits late at night or early in the morning in the past year. Only 3% of subjects reported crossing an intersection on a red light and 1% reported underestimating the speed of an oncoming car when attempting to pass a vehicle in the same lane. A lifetime history of psychiatric disorder (PTSD, MDD, GAD, and alcohol abuse or dependence) was positively related to all three risky behaviors (Table 2). Current-year alcohol abuse or dependence was likewise related to all risky behaviors and had a strong association with drinking and driving 1 or more times in the past 30 days ($OR=11.13$, 95% $CI=(8.31, 14.91)$). We also fit models for the outcome of drinking and driving 3 or more times in the past 30 days, which yielded point estimates similar to, though slightly greater in magnitude, than those for the outcome of drinking and driving 1 or more

times in the past 30 days. There was some indication that the association between current year alcohol abuse or dependence and drinking and driving differed for men and women (p-value for test for interaction=0.11) with women having the stronger association (Women: OR=23.24, 95% CI=(8.90, 60.70); Men: OR=10.36, 95% CI=(7.64, 14.05)). Similarly, there was some indication that the association between lifetime history of PTSD and drinking and driving was stronger for women (OR=3.09, 95% CI=(1.32, 7.24)) than for men (OR=1.44, 95% CI=(0.95, 2.21); p-value for test for interaction=0.12).

Being deployed to a conflict area was associated with risky driving as compared to those who were never deployed, and there was a positive association between increasing numbers of deployment-related traumatic events and the odds of risky driving (Table 3); due to the limited number of women who reported being deployed, we were not able to assess differences in these associations by gender. Other deployment-related stressors were generally positively associated with risky driving (Table 4).

Among subjects with a deployment history (N=1,626), high scores for overall psychosocial support were associated with decreased report of all types of risky behavior (Table 4). High scores for pre-deployment preparedness and post-deployment support were associated with decreased risky driving behavior, whereas high scores for general and sexual harassment were positively associated with drinking and driving.

DISCUSSION:

In this study, three risky driving behaviors—drinking and driving, passing on the right, and ignoring speed limits—were positively associated with a history of psychiatric disorders (PTSD, depressive disorder, and GAD), deployment (particularly to a combat area), deployment-related traumatic events, and combat or post-combat stressors among a representative sample of guard soldiers. In contrast, high self-reported psychosocial support was negatively associated with risky driving.

Among OHARNG soldiers in this study, 12% reported drinking and driving in the past 30 days and one-quarter of subjects reported passing cars on the right or disregarding speed limits often in the past year.

The prevalence of drinking and driving in OHARNG soldiers was higher than in recent reports for the US civilian population (2.8% for men and 0.8% for women),²⁹ however differences in the demographic composition of military and civilian populations make direct comparisons difficult. Although comparable recent national prevalence estimates could not be found for the other driving behaviors studied, a survey conducted in 1994-1995 reported that 45% of women and 36% of men reported “always” observing the speed limit, in comparison with 35% of female and 34% of male OHARNG soldiers who reported “never disregarding speed limits late at night or early in the morning”.³⁰

This work builds on previous research linking deployment-related traumatic events to risk-taking. An increase in the propensity for risk-taking and risky behavior (e.g., increased alcohol use and increased aggression toward other people) following specific violent combat experiences has been reported in US Army soldiers returning from Operation Iraqi Freedom (OIF),³ in US Marine Corps and US Navy active duty soldiers,⁶ and in regular armed forces personnel from the United Kingdom.² Previous research has also noted a co-occurrence of risky behaviors, as in a study of individuals in basic training for the Air Force in 1999-2000 in which the propensity to drive after drinking was associated with engaging in bad driving behaviors, getting into serious verbal arguments, and taking legal risks.³¹

In this study, deployment and combat-related traumatic exposures and combat or post-combat stressors were related to risky driving, similar to a study of active duty US Marine Corps and Navy personnel in which there were associations between combat deployment and risky behavior, with 25% of respondents reporting post-deployment risky recreation, in addition to drug use and self-harm.⁶ It has been suggested that deployment may lead to some types of risky driving due to a persistence of learned driving behaviors that are normative in deployment settings but potentially dangerous in civilian settings (e.g., passing on the right, disregarding speed limits).² Understanding the links with deployment may be useful in developing strategies to mitigate the harmful consequences of risky driving. Interventions aimed at adjusting driving behavior can be tailored to appeal to a post-deployment military audience, which has been done in the U.K.⁴

Consistent with our findings, a previous study of post-deployment soldiers, including reservists, reported that drinking and driving was associated with high levels of reported stress.¹³ Increased substance use, including alcohol, has been reported in soldiers post-deployment, particularly those who have experienced combat,³² and increased alcohol consumption in deployed individuals may have resulted in increased drinking and driving in this study.

A history of PTSD, MDD, or GAD was positively associated with all types of risky driving in our analysis. Most studies of risky behavior in military population have not included similarly detailed assessments of mental health disorders, however a previous study of soldiers in the U.K. reported that symptoms of common mental disorder were associated with risky driving, and a survey of US Marine Corps and Navy soldiers found that while lifetime reports of depression, anxiety, or PTSD were associated with a range of risky behaviors, it was current psychiatric conditions that was more consistently associated with risk taking.⁶ In addition, a recent study of male Veterans in treatment for PTSD found that severity of PTSD symptoms was associated with the occurrence and frequency of aggressive driving and had a weak association with driving after substance abuse.¹² The associations between psychosocial stressors and supports were less consistent across types of risky driving. We found that high psychosocial support was associated with less risk-taking for all risky driving behaviors measured, even after controlling for lifetime history of psychiatric disorder. These findings on the role of psychosocial support were generally consistent with the previous U.K. study that reported indicators of *low* psychosocial support—low morale or comradeship in theater or problems at home while on deployment—were associated with increased risky driving.² The negative psychosocial stressors, however, were associated with different types of risk-taking behavior. Combat and post-combat stressors were related to the risky driving behaviors while general and sexual harassment were related to some, but not all, types of risky driving. Strategies to increase psychosocial support in ARNG soldiers are likely to have many positive effects, and our results suggest those may include less risk-taking behavior.

Interpretation of these results is subject to certain limitations. Because the predictors (psychiatric history, deployment experiences, and psychosocial variables) and outcomes (risky driving) were self-reported, the

measurement errors for these variables may be correlated, which could lead to the observation of spurious associations between exposure and outcome; however, the nature of the outcome—risky driving—may be less subject to this type of information bias than other self-reported outcomes related to functioning. Although we did not have a standardized instrument to assess risky driving, we did use standardized instruments to assess the key predictors, such as psychiatric disorder and psychosocial support and stress; this may have improved the measures of the predictor variables beyond global self-reports of functioning. Although the analysis included detailed measures on past psychological history, most-recent deployment, psychosocial supports and stressors, and recent risk taking behavior, this analysis focused on current and historical exposure information using limited longitudinal data, and thus it was not possible to explore in detail the causal pathways that might link a predisposing psychological vulnerability, deployment-related exposures, psychosocial resiliency factors, and current risk-taking behavior. In particular, because there were no pre-deployment measures of risk-taking propensity, the possibility that some of the relations between deployment and risk-taking reflect confounding by these pre-deployment factors cannot be ruled out. Future work with longitudinal data would be useful in exploring whether psychosocial support can “buffer” the effects of deployment-related exposures, particularly among those with underlying vulnerabilities. It is possible that those who chose to not participate in the study may have differed in their relation between deployment experiences and driving behavior as compared to those who participated. An important strength of this study is that its sampling frame was representative of OHARNG soldiers, about 15% of whom were female. Although there were limited numbers of deployed women and thus a limited ability to examine whether the relations between deployment-related factors and risky behavior differed by gender, subsequent work using longitudinal assessments may have a larger sample of women in whom to examine the gender-specific correlates of risk-taking behavior.

CONCLUSION:

Increased risky driving behavior was associated with deployment and a history of psychiatric disorder, including alcohol abuse or dependence, in a representative sample of OHARNG soldiers. Soldiers with a history of psychiatric disorder, alcohol abuse or dependence, or low post-deployment support, may

benefit from post-deployment education or counseling with tailored messages to decrease the tendency for risky driving.

ACKNOWLEDGMENTS:

This research was supported by Department of Defense Congressionally Directed Medical Research Program: W81XWH-O7-1-0409/W81XWH-10-1-0579, the “Combat Mental Health Initiative” and the Department of Veterans Affairs, Veterans Health Administration, Health Services Research and Development Service. Dr. Hoggatt was funded through a VA HSR&D QUERI Career Development Award (CDA 11-261) at the VA Greater Los Angeles and received additional support from the VA Office of Academic Affiliations. The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs.

REFERENCES:

1. Bell NS, Amoroso PJ, Yore MM, Smith GS, Jones BH. Self-reported risk-taking behaviors and hospitalization for motor vehicle injury among active duty army personnel. *Am J Prev Med.* Apr 2000;18(3 Suppl):85-95.
2. Fear NT, Iversen AC, Chatterjee A, et al. Risky driving among regular armed forces personnel from the United Kingdom. *Am J Prev Med.* Sep 2008;35(3):230-236.
3. Killgore WD, Cotting DI, Thomas JL, et al. Post-combat invincibility: violent combat experiences are associated with increased risk-taking propensity following deployment. *J Psychiatr Res.* Oct 2008;42(13):1112-1121.
4. King's Centre for Military Health Research. *King's Centre for Military Health Research: A fifteen year report* 2010.
5. Lincoln AE, Hooper TI, Kang HK, Debakey SF, Cowan DN, Gackstetter GD. Motor vehicle fatalities among Gulf War era veterans: characteristics, mechanisms, and circumstances. *Traffic Inj Prev.* Mar 2006;7(1):31-37.
6. Thomsen CJ, Stander VA, McWhorter SK, Rabenhorst MM, Milner JS. Effects of combat deployment on risky and self-destructive behavior among active duty military personnel. *J Psychiatr Res.* Oct 2011;45(10):1321-1331.
7. Postservice mortality among Vietnam veterans. The Centers for Disease Control Vietnam Experience Study. *Jama.* Feb 13 1987;257(6):790-795.
8. Kang HK, Bullman TA, Macfarlane GJ, Gray GC. Mortality among US and UK veterans of the Persian Gulf War: a review. *Occup Environ Med.* Dec 2002;59(12):794-799.
9. Knapik JJ, Marin RE, Grier TL, Jones BH. A systematic review of post-deployment injury-related mortality among military personnel deployed to conflict zones. *BMC Public Health.* 2009;9:231.
10. Bell NS, Amoroso PJ, Wegman DH, Senior L. Proposed explanations for excess injury among veterans of the Persian Gulf War and a call for greater attention from policymakers and researchers. *Inj Prev.* Mar 2001;7(1):4-9.
11. Hooper TI, Debakey SF, Bellis KS, et al. Understanding the effect of deployment on the risk of fatal motor vehicle crashes: a nested case-control study of fatalities in Gulf War era veterans, 1991-1995. *Accid Anal Prev.* May 2006;38(3):518-525.
12. Kuhn E, Drescher K, Ruzek J, Rosen C. Aggressive and unsafe driving in male veterans receiving residential treatment for PTSD. *J Trauma Stress.* Jun 2010;23(3):399-402.
13. Gutierrez CA, Blume AW, Schmalting KB, Stoeve CJ, Fonseca C, Russell ML. Predictors of aversive alcohol consequences in a military sample. *Mil Med.* Sep 2006;171(9):870-874.
14. Vogt DS, Samper RE, King DW, King LA, Martin JA. Deployment stressors and posttraumatic stress symptomatology: comparing active duty and National Guard/Reserve personnel from Gulf War I. *J Trauma Stress.* Feb 2008;21(1):66-74.
15. Thomas JL, Wilk JE, Riviere LA, McGurk D, Castro CA, Hoge CW. Prevalence of mental health problems and functional impairment among active component and National Guard soldiers 3 and 12 months following combat in Iraq. *Arch Gen Psychiatry.* Jun 2010;67(6):614-623.
16. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders: DSM-IV.* Washington, DC: American Psychiatric Association; 2000.
17. Blanchard EB, Jones-Alexander J, Buckley TC, Forneris CA. Psychometric properties of the PTSD Checklist (PCL). *Behav Res Ther.* Aug 1996;34(8):669-673.
18. Lang AJ, Laffaye C, Satz LE, Dresselhaus TR, Stein MB. Sensitivity and specificity of the PTSD checklist in detecting PTSD in female veterans in primary care. *J Trauma Stress.* Jun 2003;16(3):257-264.
19. Kroenke K, Spitzer RL. The PHQ-9: a new depression diagnostic and severity measure. *Psychiatr Ann.* 2002;32:509-515.
20. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* Sep 2001;16(9):606-613.
21. Spitzer RL, Kroenke K, Williams JB, Lowe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med.* May 22 2006;166(10):1092-1097.
22. Sheehan DV, Lecrubier Y, Sheehan KH, et al. The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J Clin Psychiatry.* 1998;59 Suppl 20:22-33;quiz 34-57.

23. King et al. Deployment Risk and Resilience Inventory (DRRI). Ft. Detrick: US ARMY Medical Research and Materiel Command; 2003.
24. Vogt DS, Pless AP, King LA, King DW. Deployment stressors, gender, and mental health outcomes among Gulf War I veterans. *J Trauma Stress*. Apr 2005;18(2):115-127.
25. Weathers FW, Keane TM, Davidson JR. Clinician-administered PTSD scale: a review of the first ten years of research. *Depress Anxiety*. 2001;13(3):132-156.
26. Breslau N, Kessler RC, Chilcoat HD, Schultz LR, Davis GC, Andreski P. Trauma and posttraumatic stress disorder in the community: the 1996 Detroit Area Survey of Trauma. *Arch Gen Psychiatry*. Jul 1998;55(7):626-632.
27. Greenland S. Tests for interaction in epidemiologic studies: a review and a study of power. *Stat Med*. Apr-Jun 1983;2(2):243-251.
28. Greenland S. Modeling and variable selection in epidemiologic analysis. *Am J Public Health*. Mar 1989;79(3):340-349.
29. Vital signs: alcohol-impaired driving among adults--United States, 2010. *MMWR Morb Mortal Wkly Rep*. Oct 7 2011;60(39):1351-1356.
30. Shinar D, Schechtman E, Compton R. Self-reports of safe driving behaviors in relationship to sex, age, education and income in the US adult driving population. *Accid Anal Prev*. Jan 2001;33(1):111-116.
31. Vander Weg MW, DeBon M, Sherrill-Mittleman D, Klesges RC, Relyea GE. Binge drinking, drinking and driving, and riding with a driver who had been drinking heavily among Air National Guard and Air Force Reserve Personnel. *Mil Med*. Feb 2006;171(2):177-183.
32. Wilk JE, Bliese PD, Kim PY, Thomas JL, McGurk D, Hoge CW. Relationship of combat experiences to alcohol misuse among U.S. soldiers returning from the Iraq war. *Drug Alcohol Depend*. Apr 1 2010;108(1-2):115-121.

Table 1: Characteristics of Ohio National Guard study participants (N, %)

	<u>N (%)</u>
Gender	
Female	388 (15)
Male	2228 (85)
Age (years)	
17-24	878 (34)
25-34	848 (32)
35-44	634 (24)
≥ 45	250 (10)
Race	
White	2295 (88)
Black	195 (67)
Other	123 (5)
Income	
> \$60,000	1498 (59)
≤ \$60,000	1038 (41)
Education	
High school graduate/GED or less	727 (28)
Some college	1234 (47)
College/graduate degree	655 (25)
Marital status	
Divorced/separated/widowed	252 (10)
Never married	1134 (43)
Currently married	1227 (47)
Alcohol abuse or dependence, lifetime	1243 (48)
Alcohol abuse or dependence, past year	322 (12)
Lifetime PTSD	249 (10)
Lifetime major depressive disorder	270 (10)
Lifetime GAD	75 (3)
Lifetime any psychiatric disorder	666 (25)
Most recent deployment setting	
Never deployed	939 (36)
Non-conflict	879 (34)
Conflict	786 (30)
Number of deployment-related traumatic events	
0	374 (22)
1-5	588 (35)
6-11	337 (20)
≥ 12	369 (22)
Overall	
High psychosocial support	1267 (48)
Pre-deployment	
High preparedness	728 (44)
Peri-deployment	
High unit support	788 (47)
High combat stressors	760 (46)
High post-combat stressors	781 (47)
High perceived threat	828 (50)
High general harassment	594 (36)

High sexual harassment	380 (23)
Post-deployment	
High postdeployment support	1105 (66)
Risky driving	
Use seatbelts rarely	303 (12)
Drink and drive 1 or more times past 30 days	309 (12)
Drink and drive 3 or more times past 30 days	76 (3)
Passed on the right	673 (26)
Ran red light	86 (3)
Disregard speed limits	665 (25)
Underestimate speed oncoming car	25 (1)

a. The percentages may not add to 100% due to missing values

Table 2: Adjusted odds ratios (95% confidence intervals) for risky behavior and select mental health characteristics

	<u>Use seatbelt rarely (n=303)</u>	<u>Drinking and driving 1 or more times past 30 days (n=309)</u>	<u>Drinking and driving 3 or more times past 30 days (n=76)</u>	<u>Passing on the right (n=672)</u>	<u>Run red light (n=86)</u>	<u>Disregarding speed limits (n=665)</u>
Lifetime history of alcohol abuse or dependence	2.58 (1.94, 3.44)	9.48 (6.49, 13.83)	17.25 (6.20, 48.00)	15.91 (5.72, 44.26)	2.37 (1.94, 2.90)	3.43 (2.00, 5.86)
Current year history of alcohol abuse or dependence	2.41 (1.76, 3.31)	10.97 (8.13, 14.79)	13.73 (8.03, 23.45)	13.10 (7.62, 22.55)	2.08 (1.60, 2.69)	2.07 (1.20, 3.58)
Lifetime history of PTSD, MDD, or GAD	1.73 (1.26, 2.36)	1.37 (1.00, 1.88)	1.83 (1.04, 3.20)	1.88 (1.49, 2.38)	2.02 (1.22, 3.35)	1.75 (1.38, 2.22)
Lifetime history of PTSD	1.60 (1.08, 2.37)	1.66 (1.14, 2.42)	2.31 (1.22, 4.37)	1.87 (1.40, 2.50)	2.07 (1.15, 3.74)	1.76 (1.32, 2.36)
Lifetime history of MDD	1.82 (1.27, 2.62)	1.33 (0.91, 1.95)	2.39 (1.29, 4.43)	1.97 (1.49, 2.61)	2.41 (1.37, 4.24)	2.05 (1.56, 2.70)
Lifetime history of GAD	3.64 (2.10, 6.30)	2.31 (1.27, 4.18)	3.33 (1.34, 8.28)	1.89 (1.14, 3.13)	4.20 (1.90, 9.24)	1.69 (1.02, 2.80)

a. Results adjusted for gender, age, race, income, education, marital status, and deployment; alcohol results also adjusted for lifetime history of

PTSD, MDD, or GAD

Table 3: Adjusted odds ratios (95% confidence intervals) for risky behavior and select deployment variables

	Use seatbelt rarely	<u>Drinking and driving 1 or more times past 30 days</u>	<u>Drinking and driving 3 or more times past 30 days</u>	Passing on the right	Run red light	Disregarding speed limits
Deployment combat category (new reference category)						
Never deployed	1.12 (0.80, 1.58)	0.60 (0.42, 0.86)	0.69 (0.34, 1.42)	0.77 (0.60, 1.00)	0.63 (0.33, 1.21)	0.88 (0.68, 1.13)
Deployed to non- conflict area	1.0	1.0	1.0	1.0	1.0	1.0
Deployed to conflict area	1.05 (0.76, 1.46)	1.38 (1.03, 1.85)	1.91 (1.06, 3.44)	1.46 (1.17, 1.83)	1.47 (0.87, 2.48)	1.27 (1.01, 1.59)
Number of deployment-related traumatic events						
0	1.0	1.0	1.0	1.0	1.0	1.0
1-5	0.78 (0.48, 1.27)	1.58 (0.99, 2.53)	4.50 (1.02, 19.91)	1.18 (0.84, 1.66)	1.77 (0.64, 4.90)	1.30 (0.92, 1.82)
6-11	1.03 (0.62, 1.74)	2.01 (1.22, 3.32)	6.87 (1.54, 30.76)	1.52 (1.05, 2.20)	2.26 (0.78, 6.52)	1.71 (1.18, 2.46)
12+	1.33 (0.82, 2.16)	2.22 (1.36, 3.61)	8.64 (1.98, 37.70)	2.64 (1.85, 3.76)	4.84 (1.81, 12.92)	1.99 (1.39, 2.85)

a. Results adjusted for gender, age, race, income, education, marital status, and lifetime history of PTSD, MDD, or GAD

Table 4: Adjusted odds ratios (95% confidence intervals) for risky behavior and psychosocial support and stress factors related to the most-recent deployment (n=1626)

	<u>Use seatbelt rarely</u>	<u>Drinking and driving 1 or more times past 30 days</u>	<u>Drinking and driving 3 or more times past 30 days</u>	<u>Passing on the right</u>	<u>Run red light</u>	<u>Disregarding speed limits</u>
Overall						
High psychosocial support	0.74 (0.56, 0.97)	0.80 (0.61, 1.03)	0.83 (0.50, 1.37)	0.76 (0.63, 0.92)	0.64 (0.39, 1.05)	0.77 (0.63, 0.93)
Pre-deployment						
High preparedness	0.64 (0.46, 0.91)	0.91 (0.67, 1.23)	0.83 (0.47, 1.49)	0.73 (0.58, 0.92)	0.68 (0.40, 1.18)	0.71 (0.56, 0.89)
Peri-deployment						
High unit support	0.59 (0.42, 0.83)	0.84 (0.62, 1.14)	0.69 (0.38, 1.25)	0.93 (0.74, 1.17)	0.98 (0.58, 1.66)	0.89 (0.70, 1.11)
High combat stressors	1.36 (0.98, 1.90)	1.49 (1.11, 2.01)	2.10 (1.15, 3.82)	1.57 (1.24, 1.97)	1.99 (1.15, 3.42)	1.37 (1.09, 1.72)
High post-combat stressors	1.08 (0.77, 1.50)	1.68 (1.24, 2.28)	2.42 (1.30, 4.50)	1.82 (1.45, 2.30)	2.03 (1.17, 3.51)	1.29 (1.03, 1.62)
High perceived threat	1.16 (0.83, 1.62)	1.58 (1.17, 2.15)	2.32 (1.24, 4.33)	1.26 (1.00, 1.58)	1.38 (0.81, 2.36)	1.14 (0.90, 1.43)
High general harassment	1.83 (1.30, 2.56)	1.37 (1.01, 1.86)	2.21 (1.23, 3.97)	1.08 (0.85, 1.36)	1.17 (0.68, 2.00)	1.15 (0.91, 1.46)
High sexual harassment	1.09 (0.74, 1.61)	1.68 (1.20, 2.36)	1.84 (1.00, 3.40)	1.12 (0.85, 1.47)	1.86 (1.06, 3.29)	1.68 (1.28, 2.20)
Post-deployment						
High postdeployment support	0.58 (0.41, 0.81)	1.02 (0.74, 1.40)	0.67 (0.37, 1.19)	0.82 (0.65, 1.04)	0.76 (0.44, 1.30)	0.77 (0.61, 0.98)

a. Results adjusted for gender, age, race, income, education, marital status, and lifetime history of PTSD, MDD, or GAD

Wordcount: 1,484

Tables: 1

Does smoking predict depression onset among military personnel?

Renee D Goodwin (1)

Marta Prescott (1)

Marijo Tamburrino, MD (3)

Joseph R. Calabrese, MD (4)

Israel Liberzon, MD, PhD (2)

Sandro Galea (1)

(1) Columbia University, NY, NY, (2) University of Michigan, Ann Arbor, Michigan, (3) University of Toledo Health Science Center, Toledo, Ohio, (4) Department of Psychiatry, University Hospitals Case Medical Center, Case Western Reserve University, Cleveland Ohio,

BACKGROUND: Recent studies suggest a disproportionately high level of depression in military populations. The reason for this is not known. Smoking is also exceedingly common among soldiers. Several studies have documented a relationship between smoking and increased depression among general population samples. The potential impact of smoking on depression in the military has not been examined.

OBJECTIVES: To investigate the relationship between smoking and depression in a representative sample of Ohio Army National Guard soldiers.

METHOD: A representative sample of Ohio Army National Guard participants were followed prospectively and information was gathered on smoking and depression at baseline and follow-up one year later.

RESULTS: Persistent, active smoking is associated with increased risk of incident depression at follow up. History of smoking in the absence of current smoking at baseline was not associated with depression at follow-up.

CONCLUSIONS: Our results suggest smoking may increase vulnerability to depression onset among military personnel. If replicated, these findings suggest that another benefit to smoking cessation may be decreasing an individual's vulnerability to depression.

Major depression is increasingly recognized as a serious health problem among military personnel in the US(1). The National Guard is a subgroup of the US military among whom rates of depression are even higher than among active military personnel(2). Smoking is also disproportionately common among military service personnel(3). Cigarette smoking has a long history of being tolerated and even encouraged in American military culture(4, 5). Trend data show that over the past 28 years cigarette smoking in the US military has decreased. However, the prevalence of cigarette smoking remains higher among military personnel compared to the general population; 31% of active duty military personnel compared to 21% of US adults are current smokers(6).

Recently several general population studies have documented a link between smoking and increased risk of depression(7-11). Previous studies have not examined this relationship in a military population. Against this background, this study assessed the relationship between depression and smoking in a representative sample of national guard members.

METHOD

Study population and survey

Data were drawn from the Ohio Army National Guard Health Initiative (OHARNG MHI). The OHARNG MHI is a longitudinal cohort of Ohio Army National Guard Soldiers who are interviewed annually to assess mental health, substance use

and life experiences. All soldiers were asked to participate in the study with the option to opt out. Between June 2008 and February 2009, 11,212 soldiers did not opt out of the study, and accurate contact information was available for 58.1% of participants (n=6,514). This group was further reduced to a final baseline sample of 2,616 after eligibility, language proficiency, and desire to participate were taken into account; the overall survey response rate was 43.2%. Participants were contacted for follow-up interviews in November of 2009, within 12 months of their original interview, and given 12 months to respond. 67.7% of the original 2,616 soldiers responded to follow-up surveys (n=1,770). This study included the 1,770 soldiers who participated in both baseline and follow-up surveys. After giving written, informed consent, soldiers participated in computer-assisted telephone interviews that obtained information on mental health, substance use, military experiences, and life events history.

Measures

Our main independent variable of interest was whether or not an individual reported smoking at baseline. Our main dependent variable of interest was depression status at time 2. The Patient Health Questionnaire-9 was used to evaluate depression(12). Incident depression at time 2 was defined as having two symptoms at follow-up and they must have occurred between the baseline survey and follow-up survey among participants with no history of depression at baseline (individuals had to have had at least 2 co-occurring symptoms at some point in the past to be considered to have a history of depression at baseline

(12)). A concurrent clinical reappraisal was conducted with the OHARNG MHI and found the PHQ to be highly specific, compared to clinician- administered interviews (13).

Other covariates included smoking status at follow-up, age and gender. Age was included as an indicator variable (18-24 (reference), 25-34, 35-44, 45+).

Statistical analysis

For the study sample, we eliminated those who did not answer the smoking series of questions (N=4) and included only those who were at risk for incident depression at follow-up (N=1391). To be considered at risk, we excluded those who ever had a history of depression as reported in the baseline survey (375). Within this sample, we first examined the distribution of incident depression among those who were and were not smoking. We also examined the distribution of incident depression among the multiple categories of smoking (never, history but not currently, on and off again, incident smoker, chronic smoker). We used unadjusted logistic regression to estimate the crude association between smoking status and incident depression. We then used adjusted logistic regression to estimate the crude association between smoking status and incident depression adjusting for age and gender.

RESULTS

The distribution (number (%)) and the association (crude odds ratio, 95% CI) of depression at follow-up according to the baseline and follow-up characteristics is listed in Table 1. 28.5% of the sample reported smoking at baseline; the majority of the sample was male (86.1%) and below the age of 35 (64.3%). In bivariable cross-sectional associations, smoking status at baseline was associated with depression at baseline (crude odds ratio COR=1.6, 95% confidence interval CI: 1.0-2.4). History of smoking (but not current), sporadic/inconsistent smoking and incident smoking at baseline were not associated with increased risk of depression at follow-up, but chronic smoking was associated with significantly increased risk of incident depression at follow-up (COR=1.9, 95% CI: 1.2-3.2). This association remained statistically significant after adjusting for demographic differences.

DISCUSSION

In the first study of the relationship between smoking and depression over time among military personnel, we found that persistent smoking is associated with incident depression among National Guard soldiers. This finding is consistent with results from several longitudinal studies showing that smoking is associated with increased risk of depression (7-9, 14) in general population samples.

There are four main explanations for the observations noted here. First, while the military has traditionally experienced higher rates of smoking than the general population, recently there have been targeted efforts to improve smoking

cessation in the military (15). Therefore, it is conceivable that depression could result from increased exposure to stigma among remaining smokers though this seems less likely in the military than among some other population subgroups. Second, there is a near-perpetual state of withdrawal among chronic smokers, beginning after the effects of the last cigarette wear off. Since soldiers are frequently unable to smoke at will while fulfilling their duties, it is possible that they are more vulnerable to depression via increased exposure to withdrawal symptoms than the civilian population. Third, it is possible that smoking influences the brain through depletion of serotonin due to frequent nicotine use, leading to increased vulnerability to depression via neurobiological pathways(16). Fourth, the relationship between smoking and depression among National Guard members could result from uncontrolled confounding. For example, anxiety disorders, substance use disorders (i.e. alcohol and illicit substances) and exposure to traumatic events are all associated with increased smoking and depression(17-19). It is possible that exposure to one of these factors results in the observed association.

Limitations of this study should be considered. First, while we were able to examine levels of smoking at two time points, we did not have any measure of nicotine dependence. Future studies that can differentiate between dependent and non-dependent smoking, including an examination of withdrawal symptoms in the relationship between smoking and depression will lead to a better understanding of the relationship between smoking and depression in the

military. Second, due to fairly small cell sizes we were not able to adjust for a number of potential confounders (e.g., exposure to traumatic experiences, substance use disorders, other mental disorders). Yet, numerous previous studies have examined potential confounders and the relationship has remained significant.

The current study provides evidence that smoking is associated with incident depression, and provides the first evidence of a relationship between smoking and depression among National Guard members. As smoking continues to be highly prevalent among military personnel, these data suggest the burden of mental health – as well as physical health – consequences of smoking. As such, the importance of making smoking cessation programs available to soldiers cannot be overestimated.

Blank Page

Table 1. Distribution (N(%)) of smoking characteristics among those at risk for incident depression (never had depression at baseline) and the distribution (N(%)) of incidence of depression at follow-up; and the estimated association (crude odds ratio (COR), 95% CI) and adjusted association (AOR), 95% CI) between smoking status and incident depression.

Smoking status	Total	Incident occurrence of depression	Crude Odds Ratio (95% CI)	Adjusted* Odds Ratio (95% CI)
Smoked at baseline				
No	995 (71.5)		1	1
Yes	396 (28.5)	37 (9.3)	1.6 (1.0, 2.4)	1.7 (1.1, 2.5)
Categories of smoking				
Never smoked	586 (42.2)	31 (5.3)	1	1
History of smoking but not currently	366 (26.3)	24 (6.6)	1.3 (0.7, 2.2)	1.2 (0.7, 2.1)
On and off smoker	71 (5.1)	7 (9.9)	2.0 (0.8, 4.6)	2.2 (0.9, 5.2)
Incident smoker	19 (1.4)	2 (10.5)	2.1 (0.5, 9.5)	2.7 (0.6, 12.4)
Chronic smoker	349 (25.1)	34 (9.7)	1.9 (1.2, 3.2)	2.0 (1.2, 3.4)
Total				

*Models were adjusted for age and gender

1. Tanielian T JLe. Invisible wounds of war. Psychological and cognitive injuries, their consequences and services to assist recovery. The RAND Corporation. 2008.
2. Thomas JL, Wilk JE, Riviere LA, McGurk D, Castro CA, Hoge CW. Prevalence of Mental Health Problems and Functional Impairment Among Active Component and National Guard Soldiers 3 and 12 Months Following Combat in Iraq. *Arch Gen Psychiatry*. 2010;67:614-23.
3. Schei E, S gaard AJ. The impact of military service on young men's smoking behavior. *Preventive Medicine: An International Journal Devoted to Practice and Theory*; *Preventive Medicine: An International Journal Devoted to Practice and Theory*. 1994;23:242-8.
4. ConwayTL. Tobacco use and the United States military: a longstanding problem. *Tobacco Control*. 1998;7:219-21.
5. Smith EA, Malone RE. "Everywhere the Soldier Will Be": Wartime Tobacco Promotion in the US Military. *American Journal of Public Health*. 2009;99:1595-602.
6. Required Warnings for Cigarette Packages and Advertisements. *Federal Register*.76.
7. Boden JM, Fergusson DM, Horwood LJ. Cigarette smoking and depression: tests of causal linkages using a longitudinal birth cohort. *The British Journal of Psychiatry*. 2010;196:440-6.
8. dos Santos VA, Migott AM, Bau CHD, Chatkin JM. Tobacco smoking and depression: results of a cross-sectional study. *The British Journal of Psychiatry*. 2010;197:413-4.
9. Kang E, Lee J. A Longitudinal Study on the Causal Association Between Smoking and Depression. *J Prev Med Public Health*. 2010;43:193-204.
10. Breslau N, Kilbey MM, Andreski P. Nicotine Dependence, Major Depression, and Anxiety in Young Adults. *Arch Gen Psychiatry*. 1991;48:1069-74.
11. Fergusson DM, Goodwin RD, Horwood LJ. Major depression and cigarette smoking: results of a 21-year longitudinal study. *Psychological Medicine*. 2003;33:1357-67.
12. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *Journal of General Internal Medicine*. 2001;16:606-13.
13. Calabrese JR, Prescott M, Tamburrino M, Liberzon I, Slembariski R, Goldmann E, Shirley E, Fine T, Goto T, Wilson K, Ganocy S, Chan P, Serrano MB, Sizemore J, Galea S. PTSD comorbidity and suicidal ideation associated with PTSD within the Ohio Army National Guard. *J Clin Psychiatry*. 2011;72:1072-8.
14. Covey LS, Glassman AH, Stetner F. Cigarette Smoking and Major Depression. *Journal of Addictive Diseases*. 1998;17:35-46.
15. Military CoSCi, Populations V, Medicine Io. Combating Tobacco Use in Military and Veteran Populations. Bondurant S, Wedge R, editors: The National Academies Press; 2009.
16. Malone KM, Waternaux C, Haas GL, Cooper TB. Cigarette smoking, suicidal behavior, and serotonin function in major psychiatric disorders. *The American Journal of Psychiatry*. 2003;160:773-9.
17. Feldner MT, Babson KA, Zvolensky MJ. Smoking, traumatic event exposure, and post-traumatic stress: A critical review of the empirical literature. *Clinical Psychology Review*. 2007;27:14-45.

18. Kalman D, Morissette SB, George TP. Co-Morbidity of Smoking in Patients with Psychiatric and Substance Use Disorders. *American Journal on Addictions*. 2005;14:106-23.
19. Vlahov D, Galea S, Resnick H, Ahern J, Boscarino JA, Bucuvalas M, Gold J, Kilpatrick D. Increased Use of Cigarettes, Alcohol, and Marijuana among Manhattan, New York, Residents after the September 11th Terrorist Attacks. *American Journal of Epidemiology*. 2002;155:988-96.

CONTINUING REVIEW ABSTRACT & STATUS REPORT

TITLE: Ohio Army National Guard Mental Health Initiative (OHARNG MHI): Risk and Resilience Factors for Combat-Related Posttraumatic Psychopathology and Post Combat Adjustment

IRB#: 03-06-46

ABSTRACT

SUMMARY OF PURPOSE, AIMS, & OBJECTIVES:

Since 2005 a team of investigators have been working with Congresswoman Marcy Kaptur and the Department of Defense on operationalizing the Ohio Army National Guard Mental Health Initiative (ONARNG MHI). The general objective of this effort is to evaluate the relationships between risk and resilience factors, both cross-sectionally and longitudinally, before, during, and after deployment.

The primary research project for this initiative was garnered through a 2006 Department of Defense congressional special interest award and is entitled "Risk and Resilience Factors for Combat-Related Posttraumatic Psychopathology and Post Combat Adjustment". The protocol and study documents were reviewed by the U.S. Army Medical Research and Materiel Command (USAMRMC), Office of Research Protections (ORP), Human Research Protection Office (HRPO) and found to comply with applicable DOD, U.S. Army, and USAMRMC human subjects protection requirements on October 1, 2008.

The Coordinating Principal Investigator for the project is Joseph R. Calabrese, MD, and the Co-Principal Investigator, Marijo Tamburrino, MD (University of Toledo). Field Procedures are directed by Sandro Galea, MD, Dr.PH, Professor of Epidemiology and Chairman, Mailman School of Public Health, Columbia University. Responsible for the development of future Translational Research projects will be Israel Liberzon, MD, PhD, Professor of Psychiatry & Neuroscience, Ann Arbor VA. The Coordinating Center is based out of University Hospitals Case Medical Center at Case Western Reserve University. The survey firm, Abt SRBI, Inc., carries out telephone interviews and investigators at University Hospitals Case Medical Center and the University of Toledo carry out in-person research assessments. The data is stored at Abt SRBI, Inc. for the Telephone Survey and psychosocial data associated with the Genetics Study. The In-Person Survey data is stored at Michigan State University's Biomedical Research Informatics Core headed by Philip Reed, PhD. DNA saliva samples are stored at the Ann Arbor VA.

This initiative is overseen by the Ohio National Guard, the Office of Congresswoman Marcy Kaptur, the Department of Defense's Military Operational Medicine Research Program (MOMRP) and the Telemedicine & Advanced Technologies Research Center (TATRC) (last annual Product Line Review Meeting on April 27, 2010), the Initiative's External Scientific Advisory Board (last annual meeting May 24, 2011) and External Administrative Advisory Board (last annual meeting May 25, 2011).

The primary study within this initiative is a clinical epidemiology and health services project and is designed to function as the template, upon which other projects, including but not limited to those of a translational research nature, will be added. Accordingly, this project has obtained permission to re-contact previously studied, well-characterized research subjects and their family members for future research that specifically targets the

improvement of the scientific understanding of combat-related posttraumatic psychopathology and similar adjustment problems.

METHODOLOGY:

This project is designed to interview a representative sample of up to 3,000 members of the Ohio National Guard on an annual basis for 10 years, which started in November 2008. These Guard members participate in the primary sample and complete an interview over the telephone. Group assignment to the telephone interview is made randomly from the entire population of the Ohio National Guard (~12,000) on an ongoing basis with the dynamic cohort sampling each year of new members of the Ohio National Guard. Research visits are conducted at baseline and also every 12 months for 10 years through the end of 2018. In addition, 500 participants, randomly selected from the telephone sample, complete annual in-person interviews as a part of a validation sub-sample. We have obtained a random representative sample of National Guard members that will have variable lengths of involvement and combat exposures, allowing us to adequately address the proposed aims.

The Telephone Survey requires 60 minutes on average (depending on the individual history of the service member) and constitutes the primary dataset, whereas the In-Person Survey requires 2-3 hours (depending on individual history). The In-Person Survey is used to validate key domains employed in the telephone survey, gather more in-depth information and across different domains, and to further study of the longitudinal trajectory of PTSD. The Genetics Repository began in May 2010 and all cohort participants from the main study are being approached to provide informed consent, complete a self-report survey, and provide a saliva sample from which DNA will be extracted.

STATUS REPORT

Summary

Over the past year, the OHARNG MIH has been collecting data for Year 4 of the main project. Year 4 began on November 17, 2011 for the Telephone Survey and December 12, 2012 for the In-Person Survey. As per the recently approved protocol and update to the IRB, data collection for Year 5 will be put on hold due to grant funding expiration. The remaining funds in 2013 will be devoted to data analysis, manuscript writing, and data presentations. The investigators are pursuing additional sources of funding in order to continue data collection.

Telephone Survey (interviewed by Abt SRBI, Inc):

Year 3 Interviews:

At the time of the last continuing review (October 25, 2011), there were 1,273 active participants from the original N=2,616. Year 3 interview administration closed on July 31, 2012. A summary of enrollment activity since the last CR is as follows (data reported as of August 31, 2012):

- 1,395 participants out of the 2,616 have completed the Year 3 Telephone Survey, 122 since the last CR report (from October 25, 2011). The cooperation rate for the Telephone Survey was 88.3%. The participants who declined did not withdraw from the study but were not able to complete the Year 3 survey at the time they were contacted. They are being re-contacted in Year 4.

Dynamic Cohort Year 3 Telephone Survey Interviews:

At the time of the last continuing review (October 25, 2011) there were 573 active participants in the Dynamic Cohort Baseline. A summary of enrollment activity since the last CR is as follows: (Data reported on August 31, 2012).

- As of October 25, 2011, N=578 DC-B interviews have been completed thus far. The cooperation rate for the DC-B survey is 65.8%.

Year 4 Interviews:

Year 4 in the Telephone Survey began November 17, 2011 with 11 pilot interviews. The Y4 Telephone Survey was deemed to be an average of 41 minutes for participants who have not been deployed in the past year, and 58 for participants deployed within the past year (since their last interview). Since the average duration is within 1 hour which is the maximum stated in the protocol and verbal consent script, cuts to the survey content did not need to be made.

A summary of enrollment activity since the last CR is as follows: (Data reported on September 11, 2012)

- 1, 094 out of 2,616 Year 4 interviews have been completed thus far. The cooperation rate for Year 4 Telephone Survey is 84.2%. The participants who declined to participate did not withdraw from the study but were not able to complete the Year 4 survey at the time they were contacted

Dynamic-Cohort Year 4 Telephone Survey Interviews:

On November 8, 2011 the Ohio National Guard provided a de-identified list of new enlistees to the investigators since the last sampling in September 2010. On January 3, 2012, the Guard mailed out the project alert letter to the 1,493 potential participants. After the 3 week opt-out period, February 1, 2012 the Guard finished processing the opt-out cards received back from the service members (N=118 or 7%) and removed those persons from the master list. The Guard then sent an encrypted and password-protected CD-rom to Abt. SRBI, Inc. with the identified list (N=1375) of potential participants to be called to enroll into the study.

Abt SRBI, Inc. conducted the pilot period of the Telephone Dynamic Cohort Year 4 Survey on February 9, 2012. 11 pilot interviews were completed, with an overall average of 48 minutes. Since the average duration is within 1 hour which is the maximum stated in the protocol and verbal consent script, cuts to the survey content did not need to be made.

- As of September 11, 2012 N=198 Dynamic Cohort Year 4 interviews have been completed thus far. The cooperation rate for the Year 4 DC-B is 53.1%.

Telephone Survey Withdrawals:

Since the beginning of the main telephone survey, a total of 51 participants have withdrawn from the study. 9 participants were withdrawn from the study due to death (not study-related) and 42 participants have withdrawn voluntarily.

Telephone Survey Cumulative Enrollment and Interview Summary:

	Telephone Survey Enrollment			
Project Year	Actual Enrollment	Projected Enrollment	Total Enrollment	Interviews Completed
Year 1 2008-2009	2,616	0	2,616	2,616
Year 2 2009-2010	0	0	0	1,770
Year 3 2010-2011	578	0	578	1,973
Year 4 2011-2012	185	0	185	1,260
Year 5 2012-2013*	0	0	0	
Year 6 2013-2014**		450	450	
Year 7 2014-2015		450	450	
Year 8 2015-2016		450	450	
Year 9 2016-2017		450	450	
Year 10 2018-2019		450	450	
Total	3,379	2,250	5,629	7,619

*Year 5 data collection hiatus - see protocol

**Assumptions - 15% will be lost to attrition (deployment, lost to follow-up, declined,etc) of 3,000 interviews being completed

Genetics Study (approached by Abt SRBI, Inc. interviewer at the end of the Telephone Survey):

Recruitment began on May 3, 2010. Since that time (data reported as of September 4, 2012):

1. N=2,578 participants (N= 338 since the last CR) have been approached on the Telephone Survey (Year 2, Year 3, Dynamic Cohort Baseline, Year 4 Dynamic Cohort).
2. N=1,952 participants (N= 220 since the last CR) have agreed to receive the Genetics Kit via mail (79% positive response)
3. N=1,059 participants (N= 131 since the last CR) completed kits (consent form, self report survey, and saliva DNA sample) have been returned (54% return rate).

In-Person Survey (interviewed by UHCMC and UT clinician interviewers):

Year 3 Interviews:

At the time of the last continuing review (October 25, 2011), there were 317 active participants from the original N=500. A summary of enrollment activity since the last CR is as follows (data reported as of December 6, 2011):

1. Year 3 Interviews Completed: N=356. UHCMC site N=208; UT site N=148
2. Year 3 Declined participants (will be contacted again in Year 4): N=12
3. Year 3 Delayed participants (will be contacted again in Year 4): N=2
4. Year 3 Lost to follow-up participants (were sent IRB approved non-contact letter and we will attempt to find them again in Year 4): N=64
5. Deployed participants (will be contacted for Year 4 upon their return): N=44

Year 3 Dynamic Cohort Interviews:

At the time of the last continuing review (October 25, 2011), there were N=91 Year 3 Dynamic Cohort Interviews. A summary of enrollment activity since the last CR is as follows (data reported as of October 17, 2011):

1. Dynamic Cohort Interviews Completed: N= 105, UHCMC site N=67; UT site N=38;
Total enrollment: Year 3 Interviews N=356 + DC-B Interviews N=105 = **461**
2. Screen Failures N=107 for the following reasons:

- a. Deployment
- b. Unable to contact
- c. Live out of state
- d. Not interested in participating.

Year 4 Interviews

Year 4 pilot interviews began on December 12, 2011 and ended on January 31, 2012. A total of N=20 interviews were completed. As the average time to complete the Clinician Rated Survey was 2 hours, and the Self Report Survey was less than one hour, the overall durations of 2-3 hours was achieved. No major cuts besides administrative updates; i.e. skip patterns, page numbers, etc. needed to be done. A summary of enrollment activity as of September 14, 2012:

- 1. Year 4 Interviews Completed: N=300 out of 500. UHCMC site N=173; UT site N=127
- 2. Year 4 Declined participants : N=7
- 3. Year 4 Delayed participants: N=0
- 4. Year 4 Lost to follow-up participants: N=40
- 5. Year 4 Deployed participants: N=103

Dynamic Cohort Baseline

Year 4 Dynamic Cohort pilot interviews began on February 27, 2012. As the average time to complete the Clinician Rated Survey was 2 hours, and the Self Report Survey was less than one hour, the overall durations of 2-3 hours was achieved. No major cuts besides administrative updates; i.e. skip patterns, page numbers, etc. needed to be done. A summary of enrollment activity since the last CR is as follows:

- 1. Dynamic Cohort Interviews Completed: N= 62, UHCMC site N=50; UT site N=12;
- 2. Screen Failures N=28 for the following reasons:
 - e. Decline: N= 10
 - a. Incorrect Contact Information: N= 2
 - b. Never Responded: N=12
 - c. No contact information: N=1
 - d. Out of Area: N =3

In-Person Survey Cumulative Enrollment and Interview Summary:

	In-Person Survey Enrollment			
Project Year	Actual Enrollment	Projected Enrollment	Total Enrollment	Interviews Completed
Year 1 2008-2009	500	0	500	500
Year 2 2009-2010	0	0	0	418
Year 3 2010-2011	105	0	105	461
Year 4 2011-2012	61	0	61	346
Year 5 2012-2013*	0	0	0	0
Year 6 2013-2014**		75	75	0
Year 7 2014-2015		75	75	0
Year 8 2015-2016		75	75	0
Year 9 2016-2017		75	75	0
Year 10 2018-2019		75	75	0
Total	666	375	1,041	1,725

*Year 5 data collection hiatus - see protocol

**Assumptions - 15% will be lost to attrition (deployment, lost to follow-up, declined,etc) of 500 interviews being completed

In-Person Survey Withdrawals:

Since the beginning of the In-Person Survey, a total of 59 participants have withdrawn from the study for the following reasons:

1. N=4 participant is deceased
2. N=31 participants requested to be withdraw consent
3. N=24 was withdrawn from the study for non-compliance

Adult Relative Registry (approached by the In-Person team):

Recruitment into the Registry remains closed. When an ancillary family study is funded the investigators will inform the IRB and will re-open recruitment if needed.

Total Summary Enrollment Table:

Telephone Survey and In-Person Survey Summary Table				
Project Year	Actual Enrollment	Projected Enrollment	Total Enrollment	Interviews Completed
Year 1 2008-2009	3,116	0	3,116	3,116
Year 2 2009-2010	0	0	0	2,188
Year 3 2010-2011	683	0	683	2,434
Year 4 2011-2012	246	0	246	1,606
Year 5 2012-2013*		0	0	
Year 6 2013-2014**		525	525	
Year 7 2014-2015		525	525	
Year 8 2015-2016		525	525	
Year 9 2016-2017		525	525	
Year 10 2018-2019		525	525	
Total	4,045	2,625	6,670	9,344

EVENT REPORTING: ADVERSE EVENTS, UNANTICIPATED EVENTS, AND PROTOCOL DEVIATIONS

Serious Adverse Events

There has been 6 Serious Adverse Event since the last CR report from Abt. SRBI, Inc., University Hospitals Case Medical Center, and The University of Toledo for the Telephone Survey and the In-Person Survey. Please see attached SAE reports with a synopsis and letter from the DSMB stating that the event was unrelated and unexpected.

1. 3 Telephone Survey Participants - study ID unknown - (external- Abt. SRBI): serious, not study related, unexpected
2. In-Person Survey Participant #0792 (internal – UHCMC): serious, not study related, unexpected
3. In-Person Survey Participant #0493 (internal – UHCMC): serious, not study related, unexpected
4. In-Person Survey Participant #0047 (internal – UHCMC): serious, not study related, unexpected

Unanticipated Problems

There have been 0 unanticipated problems over the past year since the last CR report.

Protocol Deviations

Over the past year since the last CR, there have been 5 protocol deviations reported to the IRB and DSMB:

1. December 2011: Telephone Survey participants were approached twice to participant in the genetics repository. On December 7, 2011, it was discovered that 5 telephone survey participants were asked twice if they wanted to participate in the genetics study component, first in survey year 2 and second in survey year 3. 3 of the 5 participants were sent a second genetics kit, however, none of them have been returned. 3 of the 5 affected participants who received 2 genetics kits will be called to explain the error and clear up any confusion. They will be asked to only send back one of these kits. If a second kit is sent in, it will be properly discarded and considered a "dead kit"
2. December 2011: Telephone Survey - 121 Year 4 alert letters mistakenly sent to group 4 (supposed to be sent July 2012). When sending out the first group of year 4 telephone survey alert letters on October 18, 2011, 121 Guard members in the project's quarterly group 4, who were sent a Year 3 survey alert letter in July 2011, were also sent this Year 4 alert letter. A one year time span is typically given between participants follow up interviews and alert letters. 47 of the 121 affected participants had already completed their Year 3 interview and are not due for their Year 4 interview until fall 2012 (thus the correct schedule of sending their Year 4 alert letter in July 2012). As 74 of the 121 have not yet completed their Year 3 interview, this may have caused some confusion since they received 2 alert letters for different surveys years within 4 months. The 121 Telephone Survey participants who received the erroneous alert letter will be sent an additional letter explaining the mistake and when they should be expecting their Year 4 telephone survey alert letter.
3. January 2012: It was discovered on 01-03-2012; upon entry of study data that participant 0253 did not have a scan of their self report survey. Quality assurance measures in place did not detect the missing scanned file as there was no way to

ascertain that the file was actually missing without performing entry. The physical file was not found. The file does not contain any identifying information; it does contain the study participant identification number and date of the interview on the front cover. The coordinating center for the project has created online copies of the survey prior to the launch of surveys for each survey year. The new online surveys will feature a checklist to confirm what physical files are present in the survey with an upload link directly below the checklist items. The new process highlights when any scanned items are missing, so the event is much less likely to occur.

4. January 2012: On 1/13/2012 the data management team conducted quality assurance of #0304's Year 4 In-Person Survey conducted on 1/9/2012. It was discovered that the incorrect version of the Self-Report Survey (SRS) was administered: Dynamic Cohort Baseline (only conducted with new participants as lifetime information is asked) instead of Year 4. This participant is assigned to the University of Toledo (UT) site. Upon discovery, the UHCMC Coordinating Center contacted the UT staff to determine what happened. The Data Management team double-checked all completed interviews for Year 4 to ensure that the correct version of the SRS was completed, and this instance was the only deviation. For #0304, the incorrect SRS he completed originally will be destroyed.
5. February 2012: On January 26, 2012 the UHCMC Coordinating Center discovered that the Genetics consent forms were outdated in the kits on site at UHCMC. When the CR was approved, the study team failed to destroy the old stamped version of the genetics consents in the kits at UHCMC and UT with the In-Person Survey interviewers. SRBI had been sent the updated Genetics stamped consent forms once available and promptly switched out the consent forms in their kits. Upon discovery of this fact, the Coordinating Center asked SRBI if any Genetics consents had been received that were signed on expired forms. SRBI found the following during their investigation:
 - 12 Telephone Survey participants were mailed kits with the outdated consent form after the CR was approved and before the expiration date, during the switchover process.
 - 5 Telephone Survey participants were sent genetics kits between August 2011 and October 2011 with the correct informed consents (expiration date 12/20/2011). However, these 5 participants signed and dated the genetics consent and returned their completed kit after the the expiration date.
 - 4 In-Person Survey participants requested a new Genetics kit at the time of their In-Person interview between December 2011-January 2012. The kits that were given erroneously included those with expired informed consents (stamp of 12/20/2011). Upon investigation, SRBI informed the Coordinating Center on 1/26/2012 that two of these expired consents had been received. One of these participants who signed an expired sent had previously sent back a genetics kit in July 2010. The in-person interviewer was unaware of this and reminded the participant in January 2012 to complete the genetics kit. The participant completed another one and it was received by Abt. SRBI. The second saliva sample will be discarded, and the original study data collected in July 2010 will be kept.

The following minor deviations occurred over the past year since the last CR and per IRB event reporting policy are kept in the investigator's file: See Appendix A for the detailed memo to file reports of the below minor deviations.

1. January 2012 – Participant #3183 audio file mistakenly deleted from audio tape
2. January 2012 – Participant #0006's informed consent had 1 page with a different version date (content did not change)
3. February 2012 – Participants #0279, 0038, 0165, 0080, and 0046 were erroneously sent a RedCap link to complete their SRS during testing of the system.
4. April 2012 – Participant #4000 misdated the informed consents
5. May 2012 – Participant #0406 missing initial for permission to audio tape
6. June 2012 – Participant #0550 missing audio consent signature but verbal consent process utilized instead.
7. September 2012 – Participant #0922 – optional audio consent form was not administered (interview was not audio-taped).

SUBJECT COMPLAINTS:

Since the last CR, there have been no subject complaints filed with the Telephone Survey at Abt. SRBI Inc.

Since the last CR, there has been one complaint for the In-Person Survey at the UHCMC site. Participant #0223 was contacted beginning on 1/25/2012 to complete the in-person survey. After 4 attempts through email and telephone, the Project Coordinator contacted the secondary contact listed in the electronic data capture system on 2/7/2012. Per the IRB approved protocol, all participants are asked to give secondary contacts information in case we are unable to reach the participant due to deployment or new phone number. The secondary contact told the coordinator that the participant was in Hawaii and not deployed at the time. On 2/14/2012, participant #0223 was reached and was unhappy to hear we contacted her ex-husband, who was the secondary contact she had previously given. Also, the coordinator was calling her by the wrong last name, but had been unaware of this change. As of the last contact with the participant on 10/11/2011, it was noted her last name was correct. As a result of these events, the participant was upset with the study staff and withdrew from the in-person and telephone surveys.

RECRUITMENT/RETENTION PROBLEMS

As reported in the last CR, after obtaining IRB approval for the Dynamic Cohort in August 2010, the investigators worked with the Ohio National Guard to do the second dynamic cohort sample to replenish the cohort due to losing participants due to attrition, being deployed, etc.

Challenges noted by the Telephone Survey:

With the Dynamic Cohort sampling, N=503 of the original 1,493 records had phone numbers when we received the file. N=990 of the original 1,493 didn't have phone numbers when the sample was provided to us, but through locating efforts we were able to find phone numbers for an additional 545 records, bringing us to 1,048 people that we were able to call. By September 11th, 2012, 198 respondents have completed the baseline interview for the Dynamic Cohort out of the 1,048 cases dialed (19%).

Since the study has been ongoing since 2008, we have lost track of approximately 27% of the participants, defined as not having a correct phone number and mailing address. During the summer 2012 the investigators approached the Ohio National Guard to see if they would be willing to update the sample lists (without disclosing who had enrolled into the study) with

current contact information from the Guard's central database so that the investigators could make an effort to get back into contact with these participants. Of the original telephone survey cohort N=2616, 500 out of 1150 participants with missing contact information were matches with new telephone numbers. Of the Dynamic Cohort Year 4 participants, 135 out of 415 participants with missing contact information were matches with new telephone numbers.

Challenges noted by the In-Person Survey:

As stated in the protocol, Abt SRBI, Inc. has randomly approached the DC-B participants during their baseline interview in Year 3 and Year 4 about the In-Person Survey and sent positive responses to the Coordinating Center so that the In-Person Survey could be replenished up to 500 completed interviews per project year. To date in Year 4, the in-person survey has been able to replenish 61 participants out of 105 sent to us from Abt. SRBI. The number of dynamic cohort participants sampled into the in-person survey this year is lower than last year (please see reasons above in the Telephone Survey) but the In-Person enrollment is higher at 60% currently. In comparison, at this time last year there were N=264 participants who agreed to be contacted for the in-person survey, and we ultimately enrolled N=105 (40%) in Year 3.

During the May 2011 Administrative Advisory Board Meeting with the Ohio National Guard in Columbus OH Beightler Armory, the investigators were notified that the Ohio 37th Brigade was slated to be deployed beginning the summer of 2011, with the majority of units departing in September and October 2011 for 1 year. As a result, we are aware of N=105 Year 4 follow up interview participants who have been deployed to date. As a comparison, only 28 participants were deployed at this time last year. Some participants explicitly told the interviewers of their upcoming deployment during their Year 3 interview, while others deployed status came from calling secondary contacts listed as per the IRB approved protocol. The study investigators are aware of N=30 participants who will be returning in autumn 2012 and at that point we will begin contacting them to complete their Year 4 interview. The remaining participants return date is unknown, however, we have sent an IRB approved "returning from deployment" letter to all known deployed participants asking them to contact us upon their return. Unfortunately, it can be difficult to reach participants after their deployment due to non-working cell phones, new addresses, family time, medical needs, vacation, etc. Therefore, even with the dynamic cohort replenishment, we may not reach 500 completed interviews due to the high number of deployed participants.

STUDY FINDINGS

Please find attached a **Progress Report**, detailing the Year 3 completed interviews demographic information and abstracts of recently analyzed results (not yet published).

Six manuscripts have been published or accepted for publication since the last continuing review:

1. Marshall BD, Prescott MR, Liberzon I, Tamburrino MB, Calabrese JR, Galea S. Coincident posttraumatic stress disorder and depression predict alcohol abuse during and after deployment among Army National Guard soldiers. *Drug Alcohol Depend.* 2012 Aug 1;124(3):193-9. Epub 2012 Feb 17. PMID:22342428
2. Elhai JD, Contractor AA, Tamburrino M, Fine TH, Prescott MR, Shirley E, Chan PK, Slembariski R, Liberzon I, Galea S, Calabrese JR. The factor structure of major depression symptoms: A test of four competing models using the Patient Health

Questionnaire-9. *Psychiatry Res.* 2012 Jun 12. [Epub ahead of print] PMID: 22698261

3. Goldmann E, Calabrese JR, Prescott MR, Tamburrino M, Liberzon I, Slembariski R, Shirley E, Fine T, Goto T, Wilson K, Ganocy S, Chan P, Serrano MB, Sizemore J, Galea S. Potentially modifiable pre-, peri-, and postdeployment characteristics associated with deployment-related posttraumatic stress disorder among ohio army national guard soldiers. *Ann Epidemiology.* 2012 Feb; 22(2):71-7. PMID 22226029
4. Goodwin R, Prescott MR, Tamburrino MB, Calabrese JR, Liberzon I, Galea S. Cigarette smoking and subsequent suicidal ideation among National Guard Soldiers. *Journal of Affective Disorders.* *in press*
5. Biehn TL, Contractor A, Elhai JD, Tamburrino M, Fine TH, Prescott MR, Shirley E, Chan PK, Slembariski R, Liberzon I, Calabrese J, and Galea S. Relations Between the Underlying Dimensions of PTSD and Major Depression Using an Epidemiological Survey of Deployed Ohio National Guard Soldiers. *Journal of Affective Disorders.* *In press*
6. Marshall B, Prescott M., Liberzon I, Tamburrino M., Calabrese J., Galea S. Posttraumatic Stress Disorder and HIV Risk Behavior among Army National Guard Solders: The Mediating Role of Depression. *Journal of Traumatic Stress.* *In press*

RISK/BENEFIT RATIO

The risk/benefit ratio remains unchanged for this mild-risk, non-interventional study. There have not been any relevant publications or data that the investigators are aware of that would affect the risk/benefit ratio of the study.

DATA SAFETY & MONITORING BOARD

Since the last CR, the independent DSMB met on December 15, 2011, March 19, 2012, and July 16, 2012, and the next meeting is slated for October 2012. Please see attached letters allowing the study to continue that were submitted to the IRB on File during the year. The DSMB members did not have any recommendations for the study team or reservations about the study proceeding as planned. If any SAEs should occur over the next year, the DSMB Chair, Dr Seagraves, will review in real time. During the 2013 data collection hiatus, the DSMB will meet in January to review the last quarter 2012 events, and then again in July 2013 to review data analyses and any other events that may have come to the investigators attention (i.e. SAE reports, U/D reports).

TRIAL REPORTS FROM MULTI-CENTER SITES

n/a

CONFLICT OF INTEREST

n/a: There has not been a change in investigator conflict of interest over the past year.

ADDENDA APPROVED OVER THE PAST YEAR:

The following addendum submissions were submitted and approved by the IRB during the past year covered by this review. Please note that only major submissions including an "Amendment" document, numbered sequentially, and are noted below as applicable. The submissions included the following documents:

1. November 2011 (Amendment 11):
 - a. The Year 4 telephone survey was updated after the pilot period. Changes included; survey structure, skip patterns, typos, etc. The Year 4 Telephone Survey pilot was conducted from November 9, 2011 until November 17, 2011 to ensure that the duration is maintained per protocol at an average of 1 hour.
 - b. Protocol addendum to add language into the Data Security section. Data will be stored for up to 3 years at Michigan State University after the completion of the study. All identifiable information will then be properly disposed of and at that time MSU will notify UH.
 - c. In-Person Survey non-compliance Withdrawal Letter was submitted to send to participants whose participation status is "Lost to Follow Up" two consecutive years.
 - d. Telephone Survey Dynamic Cohort Baseline Alert letter was updated for year 4 to remove University of Michigan since participants only have contact with Abt. SRBI Inc, UHCMC, and the University of Toledo.
2. January 2012 (Amendment 12a):
 - a. The Year 4 in-person surveys (Self-Report Survey and Clinician Rated Survey) were updated after the pilot period. Changes included; survey structure, skip patterns, typos, etc. The Year 4 In-Person Survey pilot was conducted from December 12, 2011 until January 20, 2012 to ensure that the duration is maintained per protocol at an average of 2-3 hours. From the N=46 interviews completed during the pilot, the average completion time for

- the SRS was 52 minutes, and for the CRS it was 81 minutes, for a total duration of 133 minutes, or 2.2 hours.
- b. In-Person consent for and telephone consent script updated the Initiative name to be in line with the protocol.
 - c. Dynamic Cohort Telephone Survey for Year 4 were updated. Changes included survey structure, skip patterns, typos, etc.
3. March 2012 (Amendment 12b):
 - a. The Telephone Survey and In-Person Survey Dynamic Cohort Year 4 surveys were updated after the pilot period. Changes included administrative updates such as, survey structure, skip patterns, typos, etc.
 - b. Updated the Protocol to add language defining deployed and delayed participants.
 - c. Genetics protocol was updated to include text that newly stamped informed consents after the approval of the continuing review will be sent to genetics participants who have not yet returned their kit. This was in response to protocol deviation #4 above. Text was also added that those participating in Neuroimaging study will also be reminded to send in their genetics kit.
 4. June 2012: Genetics protocol updated to include the University of Toledo reminding Neuroimaging study participants to send in their genetics kits.
 5. July 2012 #1: Year 4 Telephone Survey added 2 new questions asking participants how many children they have and in what age range. Also, if their children would be interested in an add-on study about children in a military family.
 6. July 2012 #2:
 - a. Text was added to the protocol outlining the details of the Year 5 data collection hiatus – see full explanation below in “Plan for Upcoming Year”
 - b. Hiatus explanatory letter was submitted to send to all participants informing them that no interviews will be done in Year 5.
 7. July 2012 #3: Genetics expired consent form letter was submitted to send to all participants who have an expired consent after the approval of the continuing review. This is intended to prevent protocol deviation #4 above from occurring again.
 8. August 2012 #1 & #2: The in-person survey audio consent form (#1) and audio consent script (#2 – pending approval with the IRB) were updated to add language that will allow the audio files to be shared with any researchers interested in analyzing the de-identified data.
 9. August 2012 #3: The Autumn 2012 Newsletter is pending approval by the IRB after being submitted on August 28, 2012.
 10. Pending with this Continuing Review: Please see page 25 for additional text in the protocol describing the data security measures that will be employed in Autumn 2012 and throughout 2013 during the data collection hiatus (see hiatus explanation below in “Plan for Upcoming Year). The subcontract with Michigan State University has provided the infrastructure for the data repository thus far, and therefore an alternate plan for the data's security is needed.

PLAN FOR UPCOMING YEAR:

Please see attached most recent quarterly report to TATRC/USAMRMC (submitted July 12 2012) which also details upcoming plans for the project. The no cost extension request referenced was approved by the Department of Defense on August 13, 2012.

Project Year 5 (2013) - Hiatus in Data Collection

During Project Year 5 (November 2012 through 2013), data collection will be put on hold for the Telephone and In-Person Surveys. Year 4 interviews will be completed through

December 2012 as previously planned. In 2013, the investigators will focus on additional data analyses, publications, and dispersal of the study results (task 3 of the scope of work) with the remaining funds. Data collection will resume when additional grant funding is obtained, which the investigators are actively pursuing. In regards to the participants, the goal during the hiatus is to lose as few subjects as possible so that the longitudinal epidemiological nature of the project is not compromised. Please see page 14 in the protocol for the previously IRB approved plan that the investigators are implementing in Autumn 2012.



OHIO NATIONAL GUARD STUDY

DATE: January 26, 2012

TO: Regulatory File for "Risk and Resilience Factors for Combat-Related Posttraumatic Psychopathology and Post Combat Adjustment"

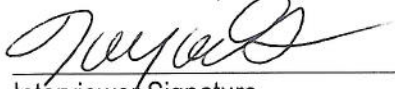
CC: UHCMC IRB for protocol # 03-06-46 & UT IRB for protocol # 105483

FROM: Toyomi Goto

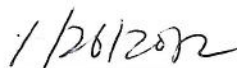
RE: **Protocol Deviation: In-Person Survey Missing audio file**

Please note that audio file for participant # 3183 of the above named protocol has been mistakenly deleted on January 26, 2012, the date on which participant was interviewed. The participant agreed to be audio taped, but when the interviewer tried to review the folder in the device after the interview, she accidentally pressed "erase" button. There is no audio file for #3183 W4 interview, but the data was captured on paper.

To prevent this from occurring in the future, audio file will not be reviewed until it is uploaded or saved in secured place.



Interviewer Signature



Date



Nicole D'Arcangelo
Interviewer
Phone:
Fax: 216.844.2875
Email: Nicole.Darcangelo@UHhospitals.org

University Hospitals of Cleveland
Mood Disorder Program
Department of Psychiatry
10524 Euclid Avenue, 12th Floor
Cleveland, Ohio 44106

January 12, 2012

To: All Regulatory Files

From: Nicole D'Arcangelo, MSW, LSW

Subject: Ohio Army National Guard Mental Health Initiative:
Minor Protocol Deviation

On January 9, 2012, it was discovered that a minor protocol deviation had occurred on December 14, 2011, the date on which the participant was interviewed. Participant 0006 had been given the In-Person Survey Consent Form, which had been signed by the participant and myself, Nicole A. D'Arcangelo. It was later discovered that pages one through eleven of the In-Person Survey Consent Form had an IRB Expiration Date of December 20, 2011, while pages eleven and twelve had an IRB Expiration Date of November 6, 2012.

To prevent this from occurring in the future, all pages of the In-Person Survey Consent Forms will be reviewed prior to obtaining the participant's signature. This will provide the opportunity to ensure all pages are consistently dated.

A handwritten signature in cursive script that reads 'Nicole A. D'Arcangelo MSW, LSW'.

Nicole A. D'Arcangelo MSW, LSW
January 12, 2012



DATE: February 16, 2012

TO: Regulatory File for "Risk and Resilience Factors for Combat-Related Posttraumatic Psychopathology and Post Combat Adjustment"

CC: UHCMC IRB for protocol #03-06-46

FROM: Renee Slembariski, Coordinating Center Administrator

RE: Minor protocol deviation: erroneous email sent to in-person participants

During testing of the Year 4 Self-Report survey in RedCap, participants 0279, 0038, 0165, 0080 and 0046 were accidentally sent an email instructing them to take the self-report survey electronically. These participants had their Year 4 interview scheduled within the next week, and so were flagged by the system as not having their self report completed yet and thus a reminder email was sent as per the reminder schedule. While the production environment had Year 4 events scheduled, a live email being sent was not anticipated by the data team during testing.

When this error occurred, the 5 affected participants were contacted and asked to disregard the email invitation to take the survey. They had been previously instructed to complete their self report survey on paper, and asked to still do so before their scheduled interview as per the IRB approved protocol. Subsequently, the electronic survey was disabled so no study data was entered accidentally by these participants.

To avoid this in the future, a testing email list was created - bric.test@bric.msu.edu - so if an event is triggered during testing, the survey invitation will be rerouted to this testing email address.

Renee Slembariski 2/16/2012



Nicole D'Arcangelo
Interviewer
Phone: 216.386.6541
Fax: 216.644.2875
Email: Nicole.Darcangelo@UHhospitals.org

University Hospitals of Cleveland
Mood Disorder Program
Department of Psychiatry
10524 Euclid Avenue, 12th Floor
Cleveland, Ohio 44106

April 12, 2012

To: All Regulatory Files

From: Nicole D'Arcangelo, MSW, LSW

Subject: Ohio Army National Guard Mental Health Initiative Minor Protocol Deviation

On March 7, 2012, participant 4000 was interviewed for the Ohio National Guard study. In addition to this interviewer, Thomas Fine, MA, LPCC, interviewer at University of Toledo, was also present for purposes of inter-rater reliability. While reviewing the In-Person Survey Consent Form, the participant expressed understanding of the consent process. He signed the Consent Form, along with the date and the time. It was later discovered by this interviewer that the participant had dated the Consent Form as June 7, 2012. The participant signed the Consent to Audio Record as well, giving permission to record his interview. The Consent to Audio Record was also incorrectly dated as June 7, 2012.

Upon meeting with the participant, he was alert and oriented to person, place, and time. He was appropriately dressed for the weather with no hygiene concerns. His speech was of normal rate, rhythm, and volume. His thoughts appeared logical and he answered questions appropriately. Please see Thomas Fine's observations of this participant's mental status, which are included for your reference.

Attempts have been made by telephone to contact the participant, verify his knowledge of the date he was interviewed, obtain his verbal consent to retain his data, and obtain his verbal consent to maintain his audio recording. This interviewer will continue attempts to reach the participant. Data will remain quarantined until verbal consent is obtained. This interviewer will be more diligent in ensuring all Consent Forms are correctly dated to prevent this type of deviation from occurring in the future.

Sincerely,

Nicole A. D'Arcangelo MSW, LSW
Research Assistant IV and Interviewer
Ohio National Guard Study



Nicole D'Arcangelo
Interviewer
Phone: 216.286.6541
Fax: 216.844.2875
Email: Nicole.Darcangelo@UHhospitals.org

University Hospitals of Cleveland
Mood Disorder Program
Department of Psychiatry
10524 Euclid Avenue, 12th Floor
Cleveland, Ohio 44106

April 30, 2012

To: All Regulatory Files

From: Nicole A. D'Arcangelo, MSW, LSW

Subject: Ohio Army National Guard Mental Health Initiative Minor Protocol Deviation

Regarding: Follow-up to Memo Dated April 12, 2012

Participant 4000 was contacted via telephone on April 30, 2012, at 12:04pm, in regard to the misdating of the Consent Form and the Consent to Audio Record. The participant recalled meeting with this interviewer, acknowledged he was aware of the date he was interviewed (March 7, 2012), and apologized for incorrectly dating these consents. He provided verbal consent to retain his data, as well as the audio recording of his interview.


Signature

04/30/2012
Date

Nicole A. D'Arcangelo MSW, LSW
Research Assistant IV and Interviewer
Ohio National Guard Study

From: [Fine, Thomas](#)
To: [DArcangelo, Nicole](#)
Subject: RE: 4000
Date: Monday, March 26, 2012 10:36:54 AM

My observations of subject 4000 before and during the interview:

Participant was alert, oriented to time , place and person. He was well groomed, acted appropriately, affect was appropriate to content, mood was euthymic, and speech was normal. There was no evidence of any perceptual disorders; thought content and thought process were intact. His memory was intact.

Thomas H. Fine, MA, LPCC

From: DArcangelo, Nicole [mailto:Nicole.DArcangelo@UHhospitals.org]
Sent: Monday, March 26, 2012 10:26 AM
To: Fine, Thomas
Subject: 4000

Tom,

It has come to my attention that participant 4000, whom we met with on March 7, 2012, incorrectly dated the In-Person Survey Consent Form. Please comment on your observations of this participant's mental status at the time we met with him.

Thank You,

Nicole A. D'Arcangelo, MSW, LSW
Research Assistant IV and Interviewer
Ohio National Guard Study
University Hospitals Case Medical Center
10524 Euclid Ave., 12th Floor
Cleveland, OH 44106
Phone: (216)286-6541
Fax: (216)844-2875
Email: Nicole.DArcangelo@UHhospitals.org
www.SRBI.com/ONGStudy

Visit us at www.UHhospitals.org.

The enclosed information is **STRICTLY CONFIDENTIAL** and is intended for the use of the addressee only. University Hospitals and its affiliates disclaim any responsibility for unauthorized disclosure of this information to anyone other than the addressee.

Federal and Ohio law protect patient medical information, including psychiatric_disorders, (H.I.V) test results, A.I.Ds-related conditions, alcohol, and/or drug_dependence or abuse disclosed in this email. Federal regulation (42 CFR Part 2) and Ohio Revised Code section 5122.31 and



OHIO NATIONAL GUARD STUDY

FOR THE RECORD

BY: Deana Couch
Research Associate

DATE: June 1, 2012

RE: Participant 0406

Even though the participant did sign and date the Audio Consent on May 9, 2012, the participant did not initial the permission to audio tape under the Voluntary Participation. I then spoke with the participant on May 29, 2012 and got verbal permission for initials for the Voluntary Participation on the Audio Consent. The Audio Consent Form could not be sent to the participant for his initials due to he was leaving to move out of state and did not have a forwarding address.



OHIO NATIONAL GUARD STUDY

FOR THE RECORD

BY: Tom Fine
Associate Professor

DATE: June 18, 2012

RE: Participant 0550

Even though the participant printed his name and dated the Audio Consent on May 24, 2012, the participant did not sign the form where indicated. I then emailed the participant on June 12, 2012. The participant returned an email on June 17, 2012 with consent. The Audio Consent Form could not be sent to the participant for his signature due to his leaving the area for deployment to Afghanistan.

Witker, Rebecca

From: Fine, Thomas
Sent: Sunday, June 17, 2012 9:23 AM
To: Witker, Rebecca
Subject: Fwd: Consent form for ONG Study. (UNCLASSIFIED)

Please print and attach to the audio consent form. Also please upload to rix. Thanks,
Tom

Sent from my iPad

Begin forwarded message:

From: "Carlson, Mark A Mr CIV USA IMCOM" <mark.a.carlson@us.army.mil>
Date: June 16, 2012 9:29:44 PM EDT
To: "Fine, Thomas" <Thomas.Fine@utoledo.edu>
Subject: Re: Consent form for ONG Study. (UNCLASSIFIED)

Classification: UNCLASSIFIED

On 06/12/12, "Fine, Thomas" <Thomas.Fine@utoledo.edu> wrote:

Hello,

I do consent to the audio recording. thank you

Hi Mark,

I hope things are going well. There was a minor glitch in one of the consent forms we did for the ONG study. On the audio consent you printed your name but the signature line was blank. If you send me an email response stating that you do consent to the audio recording that should suffice.

Thanks,

Tom

Thomas H. Fine, MA, LPCC

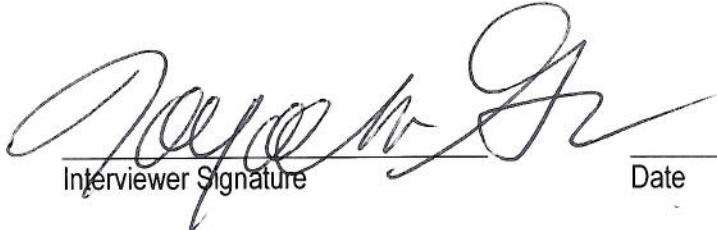
Associate Professor



OHIO NATIONAL GUARD STUDY

DATE: September 18, 2012
TO: Regulatory File for "Risk and Resilience Factors for Combat-Related Posttraumatic Psychopathology and Post Combat Adjustment"
CC: UHCMC IRB for protocol # 03-06-46
FROM: Toyomi Goto
RE: **Minor Protocol deviation: In-person Survey Missing Audio recording consent form**

Please note that the Audio consent form for participant #0922 of the above named protocol has not been signed, and consequently, the interview was not recorded. The interviewer did not have the form at the day of the interview. The consent for in-person interview was obtained and the full interview was conducted without recording.

 9/18/2012
Interviewer Signature Date

Memo

**To: Renee Slembariski, UHCMC
Abigail Williams, UHCMC**

Cc: Marta Prescott, Columbia University

Fr: Mark Morgan, Daniel Loew, Christine Cowles

Date: September 17, 2012

**Re: Ohio National Guard Study (4182) Telephone and In-Person Surveys
Interim Report: Progress and Withdrawals**

MAIN TELEPHONE SURVEY**Year 2:**

By September 11th, 2012, 1,770 respondents from the first year's 2,616 completed the second year phone interview. The second year of the phone interview closed on July 31st, 2011.

As part of their second year phone interview, by September 11th, 2012, 397 people from the original in-person cohort had been informed that they would be contacted again for the second year in-person interview. 378 of the 397 agreed to be contacted, 1 declined participation, and 18 had already completed the second year in-person interview by the time of the second year phone interview. It was not determined if the one person who declined participation had done so permanently or just for the second year, as we had not added the follow-up question that asks this at the time of this respondent's interview.

Year 3:

By September 11th, 2012, 1,395 respondents from the first year's 2,616 completed the third year phone interview. 122 of these 1,395 respondents completed the third year interview between October 14th of 2011 and July 31st of 2012, when the third year of the phone interview closed.

As part of their third year phone interview, by September 11th, 2012, 327 people from the original in-person cohort had been informed that they would be contacted again for the third year in-person interview. 323 of the 327 agreed to be contacted and 4 declined participation. It was not determined if two of the four people who declined participation had done so permanently or just for the third

year, as we had not added the follow-up question that asks this at the time of these respondents' interviews. For the remaining two, they only withdrew from the current year of the in-person interview, not for the entire study.

Year 4:

By September 11th, 2012, 1,094 respondents from the first year's 2,616 completed the fourth year phone interview.

Starting in the fourth year of the phone interview, respondents were no longer reminded about their participation in the in-person interview. However, it bears mentioning that 281 of the in-person cohort did complete the fourth year telephone interview by September 11th, 2012.

Withdrawals for main telephone survey:

No participants from the main survey were withdrawn by the PI. 4 participants disenrolled from the study due to death since July 14th, 2011 (when this was reported in last year's update). 14 participants withdrew from the study voluntarily.

Since the beginning of the main telephone survey, 42 participants have withdrawn from the main survey voluntarily and 9 disenrolled from the study due to death.

1st Dynamic Cohort – baseline interview

1,266 of the original 2,343 records had phone numbers when we received the file. 1,077 of the original 2,343 didn't have phone numbers when the sample was provided to us, but through locating efforts we were able to find phone numbers for an additional 736 records, bringing us to 2,002 people that we were able to call.

By September 11th, 2012, 578 respondents have completed the baseline interview for the Dynamic Cohort out of the 2,002 cases dialed. 5 of these 578 respondents completed the third year interview between October 14th of 2011 and November 17th of 2011, when the phone interview for the 1st Dynamic Cohort closed.

As part of their baseline interview for the Dynamic Cohort, by November 17th of 2012, 311 people had been informed that they would be contacted for the baseline in-person interview of the Dynamic Cohort. 271 of the 311 agreed to be contacted for the in-person Dynamic Cohort and 40 declined participation in the in-person Dynamic Cohort.

No participants from the Dynamic Cohort baseline survey were withdrawn by the PI. One person withdrew from the study voluntarily since the beginning of the Dynamic Cohort survey on November 17, 2010.

We have no retention or recruitment problems to report for the baseline Dynamic Cohort. As mentioned above, there was only one participant who withdrew from the study, which is highly positive.

2nd Dynamic Cohort – baseline interview

503 of the original 1,493 records had phone numbers when we received the file. 990 of the original 1,493 didn't have phone numbers when the sample was provided to us, but through locating efforts we were able to find phone numbers for an additional 545 records, bringing us to 1,048 people that we were able to call. By September 11th, 2012, 198 respondents have completed the baseline interview for the Dynamic Cohort out of the 1,048 cases dialed.

As part of their baseline interview for the 2nd Dynamic Cohort, by September 11th of 2012, 142 people had been informed that they would be contacted for the baseline in-person interview of the Dynamic Cohort. 115 of the 142 people agreed to be contacted for the 2nd in-person Dynamic Cohort and 27 declined participation in the in-person Dynamic Cohort.

No participants from the Dynamic Cohort baseline survey were withdrawn by the PI. No people withdrew from the study voluntarily since the beginning of the 2nd Dynamic Cohort survey on February 9th, 2012.

We have no retention or recruitment problems to report for the baseline Dynamic Cohort. As mentioned above, there were no participants who withdrew from the study, which is highly positive.

Progress Report

Demographics for final wave 3 completed August 2012

Gender	
Male	1146 (84.95%)
Female	203 (15.05%)
Age	
18-24	250 (18.56%)
25-34	534 (39.64%)
35-44	346 (25.69%)
45+	217 (16.11%)
Race	
White	1192 (88.43%)
Black	94 (6.97%)
Other	62 (4.6%)

Recent Data analyses

Mental Health Service Use Among National Guard forces (Goodwin, R)

- We wish to determine factors associated with seeking mental health care among our study population. The primary outcome is any use of mental health services. The primary exposure of interest is mental health need, or presence of mental health disorders. We will examine sociodemographic and military characteristics as potential confounders. We will also report on descriptive data regarding types of services used.

Post-deployment Trauma and Intimate Partner Violence (Cerdá, M.)

- The primary outcome of this analysis is reporting on intimate partner violence at T1, T2 and/or T3, based on the Conflict Tactics Scale. The primary exposures of interest are post-deployment stressors and traumatic events and post-deployment social support reported at T1. The primary mediators are alcohol abuse, depression and posttraumatic stress disorder (PTSD) at T2. We will also examine as possible confounders T1 reports of sex, age, race, education, self-reported family history of drug or alcohol abuse, pre-deployment traumatic events and life stressors, pre-deployment PTSD and depression, marital status, children at home, deployment history, military status, military pay grade, combat exposures, post-battle experiences, and sexual harassment/coercion during deployment. The main hypothesis is that individuals with higher exposure to stressors and traumatic events and less social support upon return from deployment are

at higher risk of perpetrating intimate partner violence than individuals with lower exposure to such stressors and traumatic events and more social support. Further, we hypothesize that intimate partner violence is a consequence of post-deployment psychopathology, including PTSD, depression and alcohol abuse.

Trajectories of Alcohol Abuse (Cerdá, M.)

- The primary outcome of this analysis is reporting on alcohol abuse at T1, T2 and/or T3, based on the Mini International Neuropsychiatric Interview, and following DSM-IV criteria. The primary exposures of interest include peri-deployment exposures reported at T1: combat exposures, post-battle experiences, and sexual harassment/coercion during deployment. Exposures also include post-deployment stressors and traumatic events, reported at T1-3. The primary mediator is posttraumatic stress disorder (PTSD) reported at T1-3. We will also examine as possible confounders T1 reports of sex, age, race, education, self-reported family history of drug or alcohol abuse, pre-deployment traumatic events and life stressors, pre-deployment PTSD and depression, marital status, children at home, deployment history, military status, and military pay grade. The main hypothesis is that individuals with higher exposure to peri- and post-deployment stressors and traumatic events are at higher risk of meeting criteria for alcohol abuse than individuals with lower exposure to such stressors and traumatic events. Further, we hypothesize that PTSD mediates the association between peri-deployment traumatic events and stressors and alcohol abuse, but does not mediate the association between post-deployment traumatic events and stressors and alcohol abuse.

Sexual Violence and Mental Disorders Among National Guard Soldiers (Walsh, K; manuscript currently under review)

- **Objectives:** We examined the prevalence of sexual violence and its mental health consequences among three representative samples of male and female soldiers.

Methods: Structured telephone interviews assessing lifetime and deployment-related rape or sexual assault and current and lifetime posttraumatic stress disorder (PTSD) and depression were conducted with 1,030 Reservists (23% female), 973 National Guard (NG; 15% female), and 2,616 Ohio Army National Guard (OHARNG; 15% female) soldiers.

Results: Lifetime sexual violence prevalence was 4.0%, 3.9%, and 5.0% among Reserve, NG, and OHARNG men, and 36.6%, 25.5%, and 36.3% among the Reserve, NG, and OHARNG women, respectively. Among victims, 2.4-7.1% of women and 0-4.5% of men reported deployment-related sexual violence, and

odds of current or lifetime PTSD ranged from 3.3 to 7.5, and odds of current or lifetime depression ranged from 1.7 to 5.0.

Conclusions: Female reservists reported markedly higher sexual violence prevalence and male soldiers reported similar prevalence relative to the general population. The majority of sexual violence reported is not deployment-related. Findings emphasize a need to screen for lifetime sexual violence experiences and associated mental disorders in military samples.



Ohio Army National Guard Mental Health Initiative

Annual External Scientific Advisory Board Meeting

Monday April 2, 2012





Agenda

8:00 – 9:00 a.m.	Welcome & Administrative Update
9:00 – noon	Results Presentation
Noon – 1:00 p.m.	Lunch
1:00 – 2:00 p.m.	Translational Research Update
2:00 – 3:00 p.m.	Feedback from SAB
3:00 – 3:15 p.m.	Closing
3:15 p.m.	Departures



Project History: From Clinical Epidemiology and Genetics to Focused Translational Research

- 2005: Originally conceptualized as a clinically oriented epidemiologic project intended to generate pre-, peri-, and post-deployment predictors of resilience.
- OHIOCARES Sub-committee meetings
- Direct meetings with TAG have had an increasingly refined translational focus.
- Translational Focus #1: Guard leadership expresses an interest in using Axis I comorbidity to refine suicide prevention soldier training.



Project History: Translation (continued)

- Translational Focus #2: Guard leadership express an explicit interest being involved in the design of all subsequent waves to change operational procedures, including soldier training on:
 - Role of Axis I comorbidity in suicide, not only PTSD, but depressive episodes, alcohol use, etc.
 - Changes to the Battle Buddy Program



Theme to 2012 Scientific Advisory Board:

- Provide us with concrete feedback on the development of an increasingly focused vision of translational research for the OHARNG Project.
- Assistance in the conceptualization of a vision which has the potential of extending the project's translational focus from Ohio to Millennium Cohort.



OHARNG MHI

Administrative Update



Study Sites

- **Joe Calabrese, MD**

- Coordinating Principal Investigator
- University Hospitals Case Medical Center – Coordinating Center
- Renee Slembariski, MBA (Coordinating Center Administrator) & Abby Williams, BS (Project Coordinator)
- Data Management and Statistical Analysis Unit
 - Stephen Ganocy, PhD (Director)
 - Philip Chan, MS (Assoc Director)



Study Sites

- **Marijo Tamburrino, MD**

- Co-Principal Investigator
- University of Toledo

- **Sandro Galea, MD, DrPH**

- Co-Investigator
- Director of Field Procedures
- Columbia University
- Greg Cohen, MSW – Data Analyst



Study Sites

- **Israel Liberzon, MD, PhD**

- Co-Investigator
- Director of Translational Research
- University of Michigan, Ann Arbor VA
- Anthony King, PhD – Director of Genetics Repository

- **Philip Reed, PhD**

- Director, Biomedical Research & Informatics Center
- Michigan State University
- Informatics Support for In-Person Survey



Study Sites

- **Abt SRBI, Inc.**

- Survey Research Firm conducting the Telephone Survey
- Mark Morgan, Senior VP
- Computer Assisted Telephone Interview (CATI) system to administer annual follow-ups
- Interviewers at several locations: New York City NY, West Long Branch NJ, Fort Myers FL, and Huntington WV



Leadership Interface with the Ohio Army National Guard (OHARNG)

- The Adjutant General, Major General Deborah Ashenhurst
- Brigadier General John Harris; Asst Adjutant General of the Army
- COL Julie Blike; Director Family Readiness and Warrior Support Program
- Jeremy Kaufman, PsyD; Director of Psychological Health
- CPT Sephan Frazier; Resilience, Risk Reduction, and Suicide Prevention (R3SP)Coordinator



Study Timeline

- January 2005-initial submission to Congress.
- December 2005-initial allocation
- 2006+2007-survey development, MOMRP approval, & contract execution May 2007.
- 2007 & 2008 OHRP & local IRB totaling 6 approvals
- November 2008-interviews began.
- DNA repository approved March 2010 and began recruitment May 2010.

OHARNG MHI - Organizational Oversight

Funding Mechanism & Sponsor Oversight

Congresswoman Kaptur
-Defense Appropriations Committee

CDMRP

Department of
Defense

Scientific Oversight

USAMRMC
- annual & final reports
(based on project grant year)

MOMRP
- initial scientific review

TATRC
- quarterly reports
(based on calendar)

COL Castro

PLR
- annual oversight
meeting (by invite)

Human Protections

DoD ORP

Submit significant
amendments and
events

Submit local IRB initial &
continuing review approvals

Columbia & MSU IRBs
-exempt due to role

Ann Arbor VA IRB
-Genetics &
Neuroimaging

UHCMC IRB
- Coordinating Center,
all projects reviewed
-SRBI defers to UHCMC

UT IRB
-In-Person Survey,
Genetics &
Neuroimaging

Fiscal Oversight

USAMRAA
- quarterly fiscal
reporting SF425

UHCMC
-Prime Contract
Coordinating
Center

Subawards to sites:
SRBI, UT, Columbia,
MSU, VERAM

Acronyms

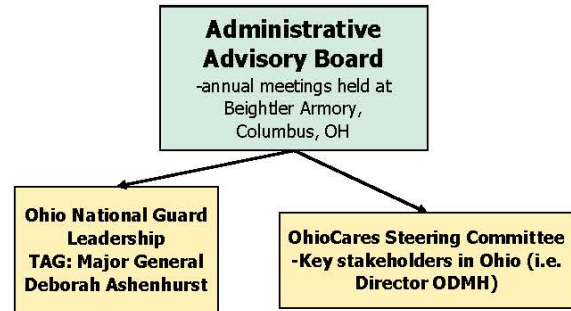
ARNG MHI - Ohio Army National Guard Mental Health Initiative
CDMRP - Congressionally Directed Medical Research Programs
USAMRMC - US Army Medical Research and Materiel Command
MOMRP - Military Operational Medicine Research Program
TATRC - Telemedicine & Advanced Technology Research Center
PLR - Product Line Review
MILCO - Millenium Cohort Study
ORP - Office of Research Protections

Acronyms

USAMRAA - US Army Medical Research Acquisition Activity
UHCMC - University Hospitals Case Medical Center
UT - University of Toledo
MSU - Michigan State University
VERAM - Ann Arbor VA / University of Michigan
SRBI - Abt. SRBI, Inc.

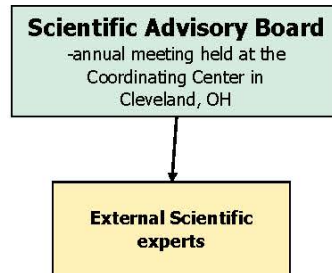
External & Internal Project Oversight

External

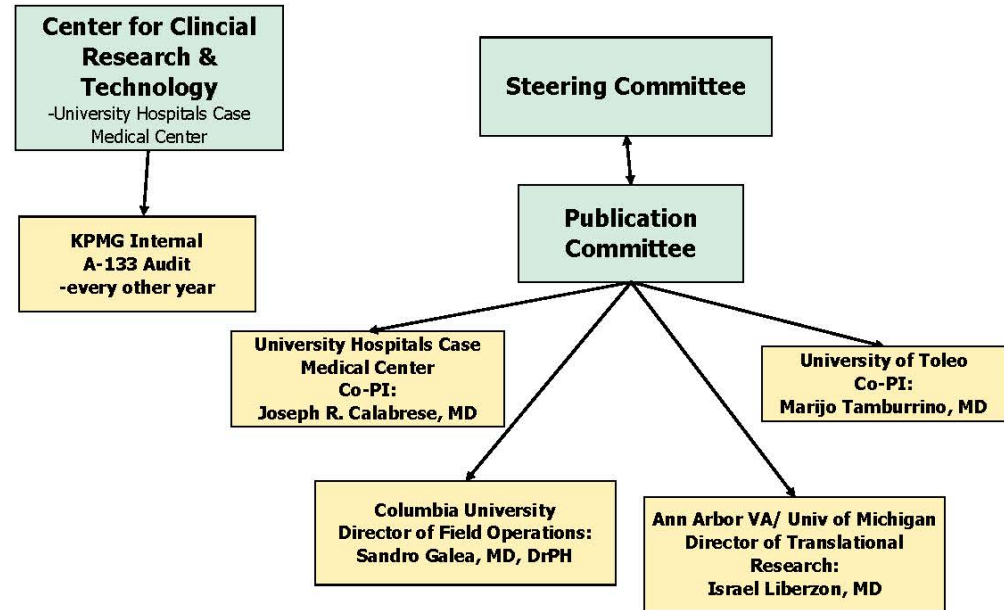


Acronyms

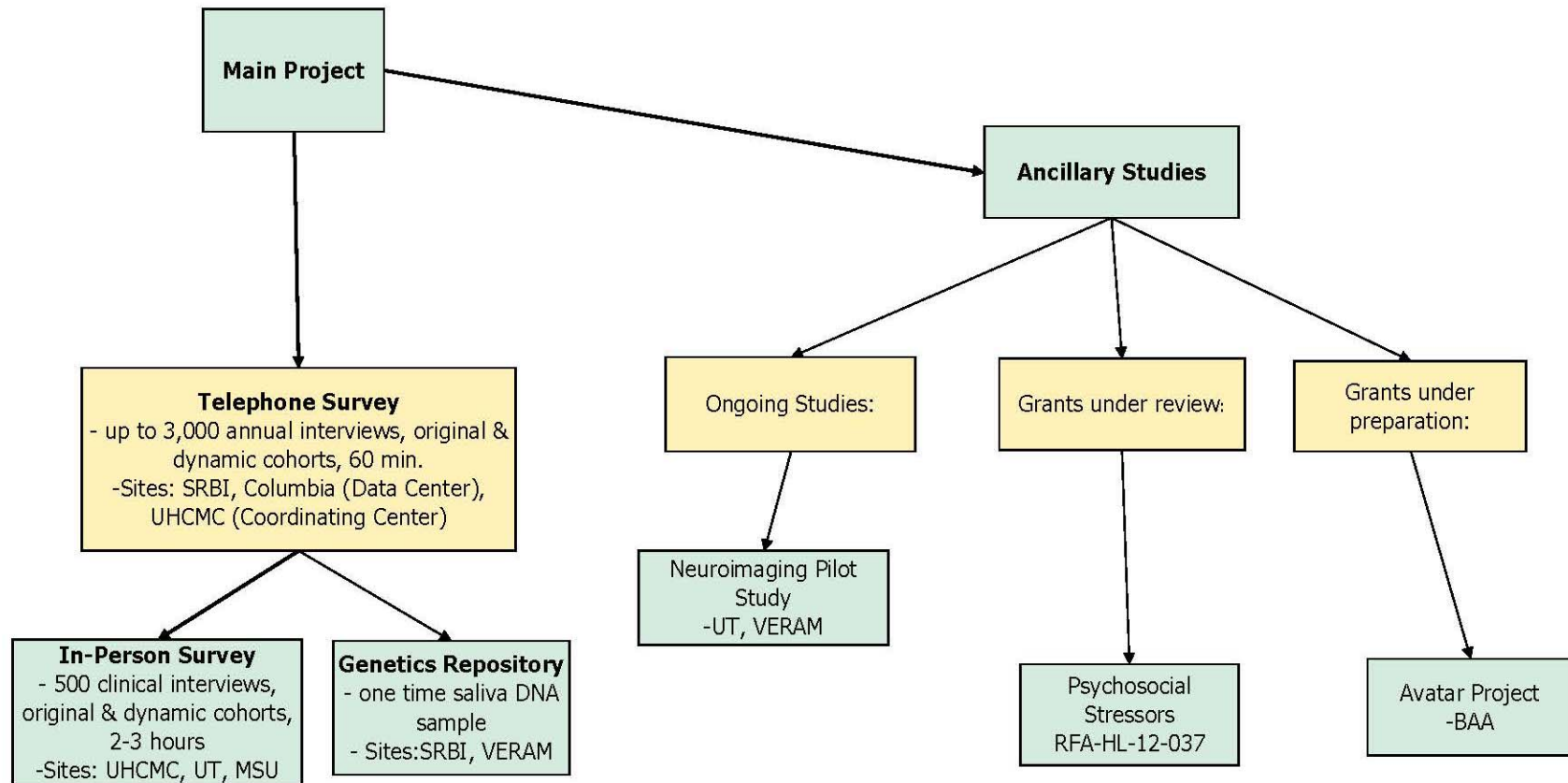
TAG - The Adjutant General
ODMH - Ohio Department of Mental Health



Internal



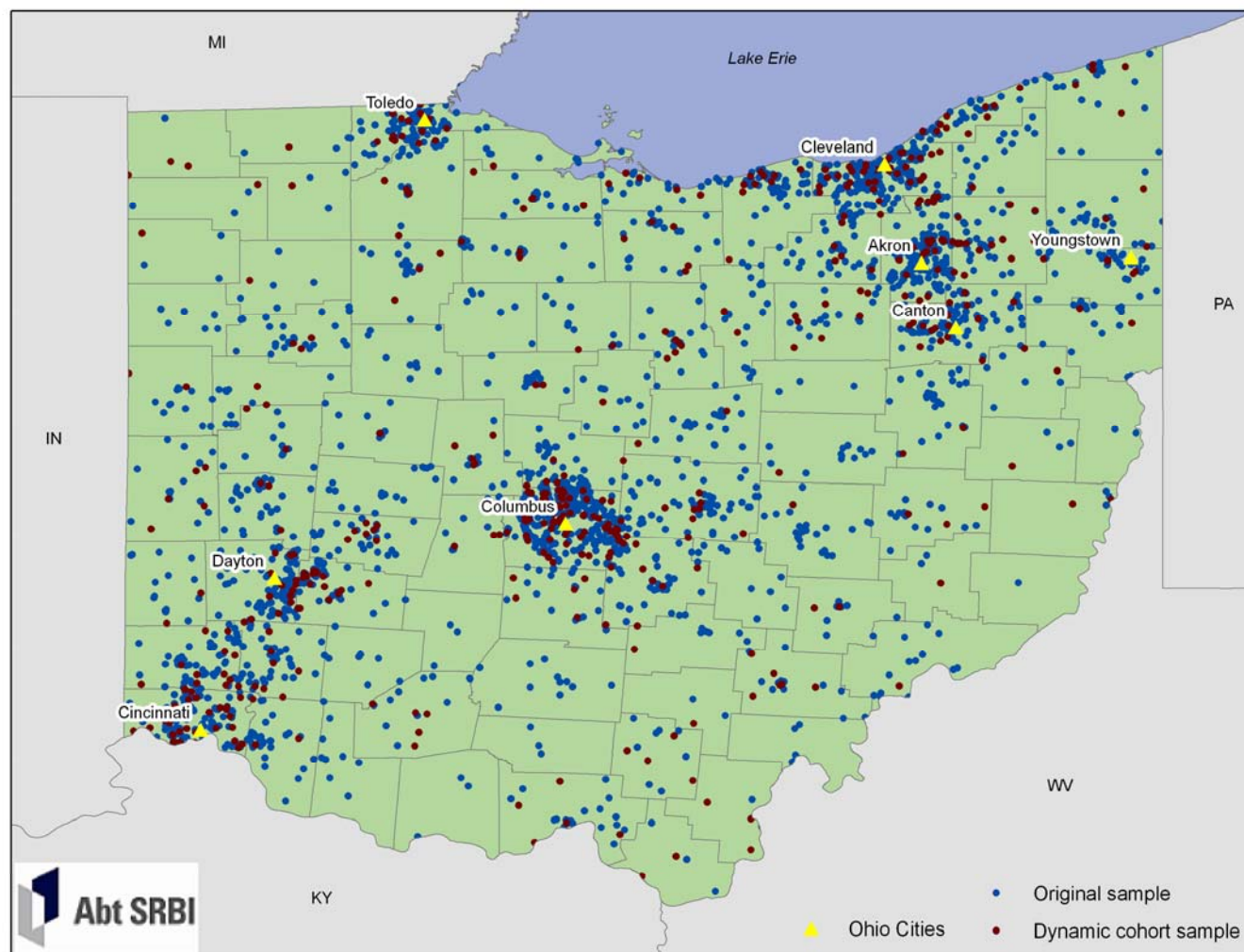
OHARNG MHI Surveys & Sites



Telephone Survey N=3,300

Original cohort
N=2616

Dynamic Cohort
N=684



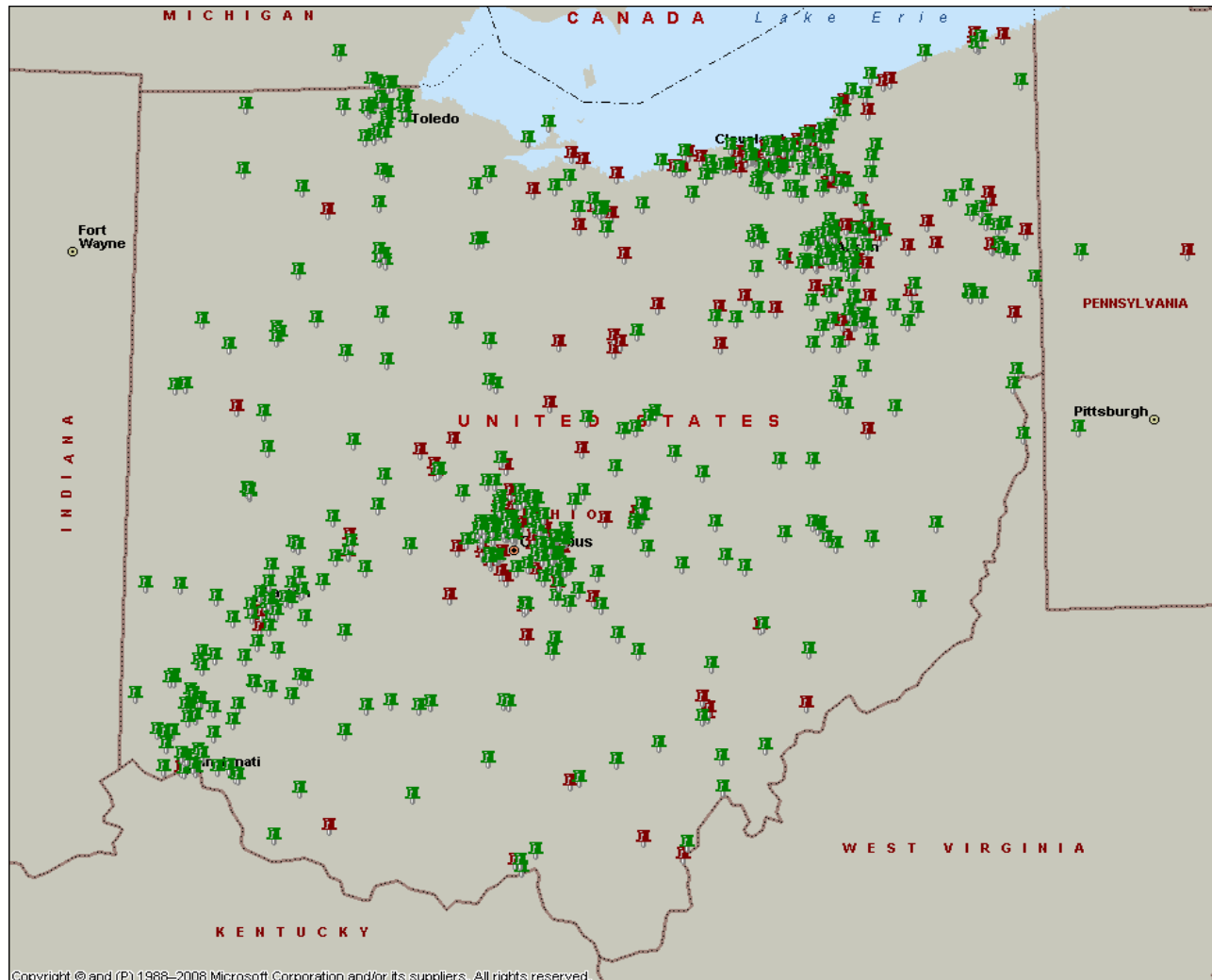
In-Person Survey N=615

GREEN
PINS:

Original
cohort
N=500

RED
PINS:

Dynamic
Cohort
N=115



Copyright © and (P) 1988–2008 Microsoft Corporation and/or its suppliers. All rights reserved.



In-Person Interviewers

- **University Hospital**

Ed Shirley, Ph.D.

Toyomi Goto, MA

Nicole D'Arcangelo, MSW

- **University of Toledo**

Thomas H. Fine, MA, LPCC

Deana J. Couch, MRC, CRC, PC-CR



In-Person Interviews

Average Duration = 2-3 hours

- Informed Consent
- Current military status and deployments
- TBI Screen
- Assess Major DSM-IV Mental Disorders - SCID
- Review and assess both civilian and military trauma exposure and Assess PTSD - CAPS
- Collect data on mental health treatments received and medications taken
- Collect data on legal issues (baseline and every other year)
- Screen for suicidal thoughts and/or behaviors
- Reasons for and Barriers to seeking treatment
- Counseling/conclusion



Advantages to clinical interviews

- Mental health clinician assessing diagnostic criteria
- Helpful to have interviewing gold standards when we later link with genetics study
- Perceived helpfulness of clinical interview by service members



Changes Based on Feedback from 2011 Advisory Board Meetings:

- Telephone Survey
 - Expanded battle buddy section
 - Additional physical health and treatment-seeking/stigma
 - Added DSM-5 symptoms to PTSD section
 - Additional questions on alcohol cravings and military use behaviors
 - Drug dependence questions focusing on pain killers
- In-Person Survey
 - Added questions on sleep, ADHD, life stressors, and reasons for living



Wave 4 Translational Focus

- OHARNG helped develop Year 4 questions to assess levels of stigma and military alcohol use behaviors
- OHARNG committed to using study data to develop strategies to improve early symptom detection, increase resilience and encourage treatment-seeking behaviors.



Genetics Predictors of Resilience

- Participants are approached to give DNA saliva samples for association studies.
- Targeting ~2,000 de-identified DNA samples.
- Currently over 1,800 (76% of N=2427 approached thus far) have committed to provide samples
- 1,003 have already sent their samples into the DNA Repository (54% of N=1849 who agreed to be sent a Genetics kit)



Active Ancillary Project

- Neuroimaging and Genetic Investigation of Resilience and Vulnerability to PTSD
 - Pilot Study, awarded by internal funds at the University of Toledo and Ann Arbor VA
 - Received initial approvals during the latter half of 2011 (VA IRB approval letter pending)
 - Recruitment began February 2012 with the first scan visit on 3/18/2012
 - N=3 consented out of 39 (7.5%)



OHARNG MHI Products:

Manuscripts Accepted for Publication

1. PTSD Comorbidity and Suicidal Ideation Associated With PTSD within the Ohio Army National Guard (Calabrese et al, 2011)
2. Pre-, peri-, and post-deployment characteristics and the risk of posttraumatic stress disorder among Ohio National Guard soldiers (Goldmann et al, 2012)
3. Posttraumatic stress disorder and depression predict coincident alcohol abuse during and after deployment among recently deployed Army National Guard soldiers (Marshall et al, pending)



OHARNG MHI Products: Manuscripts Under Peer Review (1)

4. The factor structure of major depression symptoms: A test of four competing models using the Patient Health Questionnaire-9 (Elhai et al)
5. Posttraumatic Stress Disorder and HIV Risk Behavior among Army National Guard Soldiers: The Mediating Role of Depression (Marshall et al)
6. Relations Between the Underlying Dimensions of PTSD and Major Depression Using an Epidemiological Survey of Deployed Ohio National Guard Soldiers (Elhai et al)



OHARNG MHI Products: Manuscripts Under Peer Review (2)

7. Cigarette smoking and subsequent risk of suicidal ideation among National Guard Soldiers (Goodwin et al)
8. Does smoking predict depression onset among military personnel? (Goodwin et al)



Manuscript topics in process (1)

- Psychopathology and context
 - 9. Ohio National Guard Mental Health Initiative: Baseline Methods/Validation (Prescott et al)
 - 10. Prevalence of lifetime Axis I disorders in a representative sample of Army National Guard soldiers (Tamburrino et al)
 - 11. PTSD symptom differences after war-related and civilian-related potentially traumatic events in military personnel (Prescott et al)
 - 12. War and civilian PTSD and suicidal ideation (Prescott et al)
 - 13. War and civilian PTSD and criterion A2 (Prescott et al)
 - 14. Lifetime sexual trauma exposure among National Guard soldiers and the impact of sexual trauma exposure on PTSD, depression, and alcohol use problems (Walsh et al)



Manuscript topics in process (2)

- **Alcohol**

- 15. Alcohol abuse and dependence in the Ohio National Guard (Marshall et al)
- 16. Alcohol Dependence and incident suicidal ideation (Cohen et al)
- 17. Pre/peri/post supports and their associations with alcohol abuse (Orr et al)
- 18. Pathways to post-deployment alcohol abuse (Orr et al)

- **Other**

- 19. Childhood experiences are a determinant of depression in adulthood (Rudenstine et al)
- 20. Ethics in trauma research: participant reactions to trauma questions in the Ohio National Guard (Fine et al)
- 21. Spirituality and Resilience (Ganocy et al)
- 22. Risky driving behaviors (Hoggatt et al)



Presentations 2011 (1)

1. All Ohio Institute on Community Psychiatry
March 2011 Meeting (Tamburrino)
 - Baseline Results and Validation Methods of a 10 year Longitudinal Study of the Ohio Army National Guard
2. American Psychiatric Association Annual
Conference, May 2011 (Tamburrino)
 - Baseline Results and Validation Methods of a 10 year Longitudinal Study of the Ohio Army National Guard
3. Society for Epidemiological Research, June 2011
(Hoggatt)
 - Risky Driving Behavior among Ohio Army National Guard Soldiers



Presentations 2011 (2)

4. OhioCares Subcommittee, August 2011 (Calabrese)
 - OHARNG MHI: Suicide Data
5. Air Force Research Laboratory Resilience Workshop, September 2011 (Tamburrino)
 - Participant in Resilience/Suicide Risk
6. International Society of Traumatic Stress Studies, November 2011 (Marshall)
 - Mental health disorders increase the risk of during and post-deployment alcohol abuse among Ohio Army National Guards



Project Funding

<u>Current Budget</u>	<u>Expended Funds</u>	<u>%</u>
\$12,308,000	\$9,210,372.75	75%
<i>As of 2/29/2012</i>		

<u>Congressional Allocations</u>		<u>Awarded</u>
FY-2006	\$4.5m	\$4.215m
FY-2007	\$2.6m	\$2.216m
FY-2008	\$2.8m	\$2.378m
FY-2009	\$2.4m	\$2.101m
FY-2010	\$1.6m	\$1.398m
FY-2011	\$3.0m	suspended



Project Future

- Project is funded through the first quarter of 2013.
- Met with BG Harris (aTAG, OHARNG) and COL Castro (Director, MOMRP) in Washington 31-Oct-2011
- Collaboration Meeting with MILCO on 13-Feb-2012
 - 2 separate pre-proposals: MILCO clinical/genetics sub-study & Ohio Study
- Meeting with Guard scheduled May 2012 to plan translational focus for Ohio Study pre-proposal to MOMRP

Ohio Army National Guard Mental Health Initiative

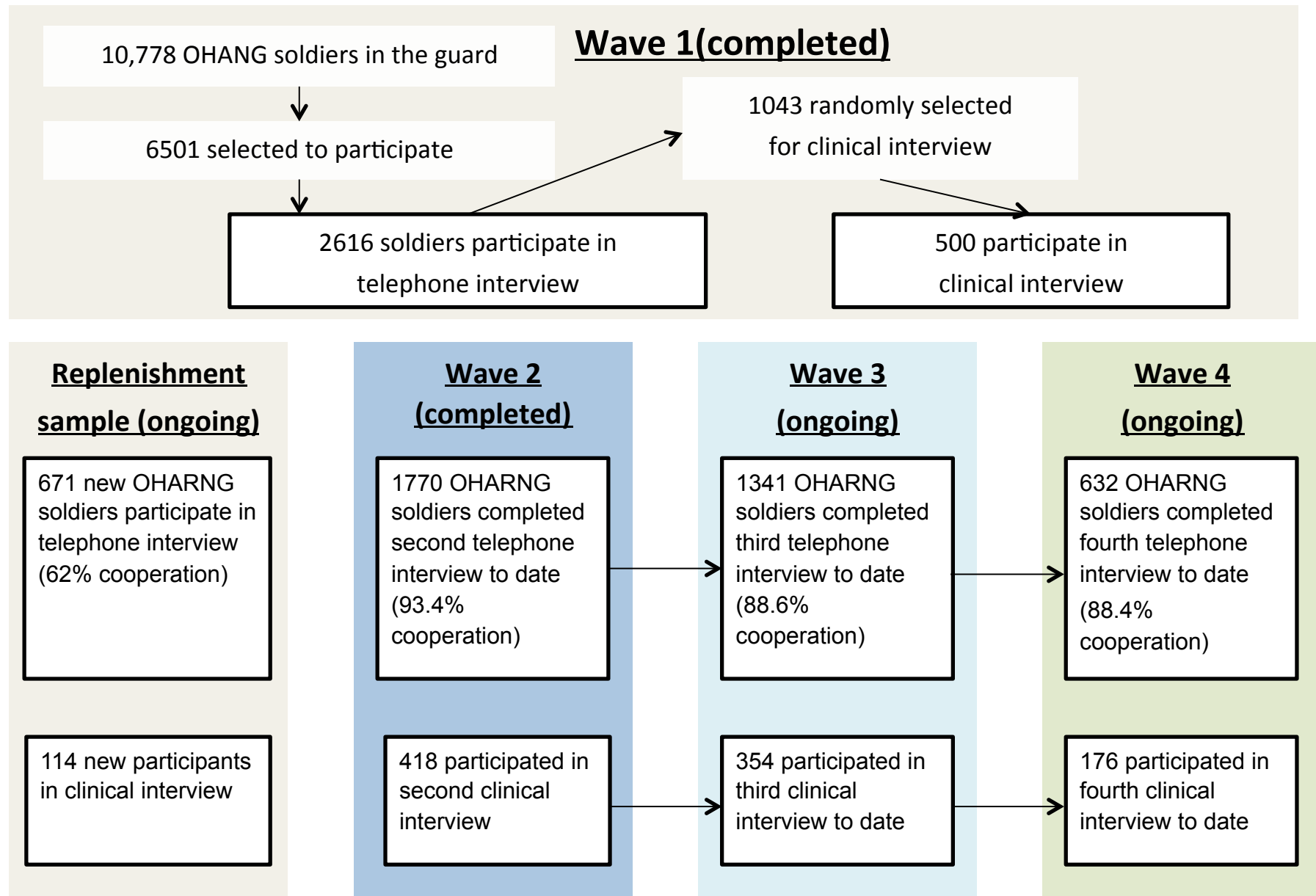


Outline

- ONG sample after 3 waves
 - attrition
 - prevalence and incidence of psychiatric disorder
 - trajectories of PTSD
- Analyses
 - 1 mental health service utilization
 - 2 deployment and risky driving behavior
 - 3 PTSD and HIV risk behavior
 - 4 sexual trauma and psychiatric comorbidity
 - 5 differences between war and civilian-related PTSD
 - 6 alcohol dependence and incident suicidal ideation
 - 7 tobacco use and risk of depression and suicidal ideation

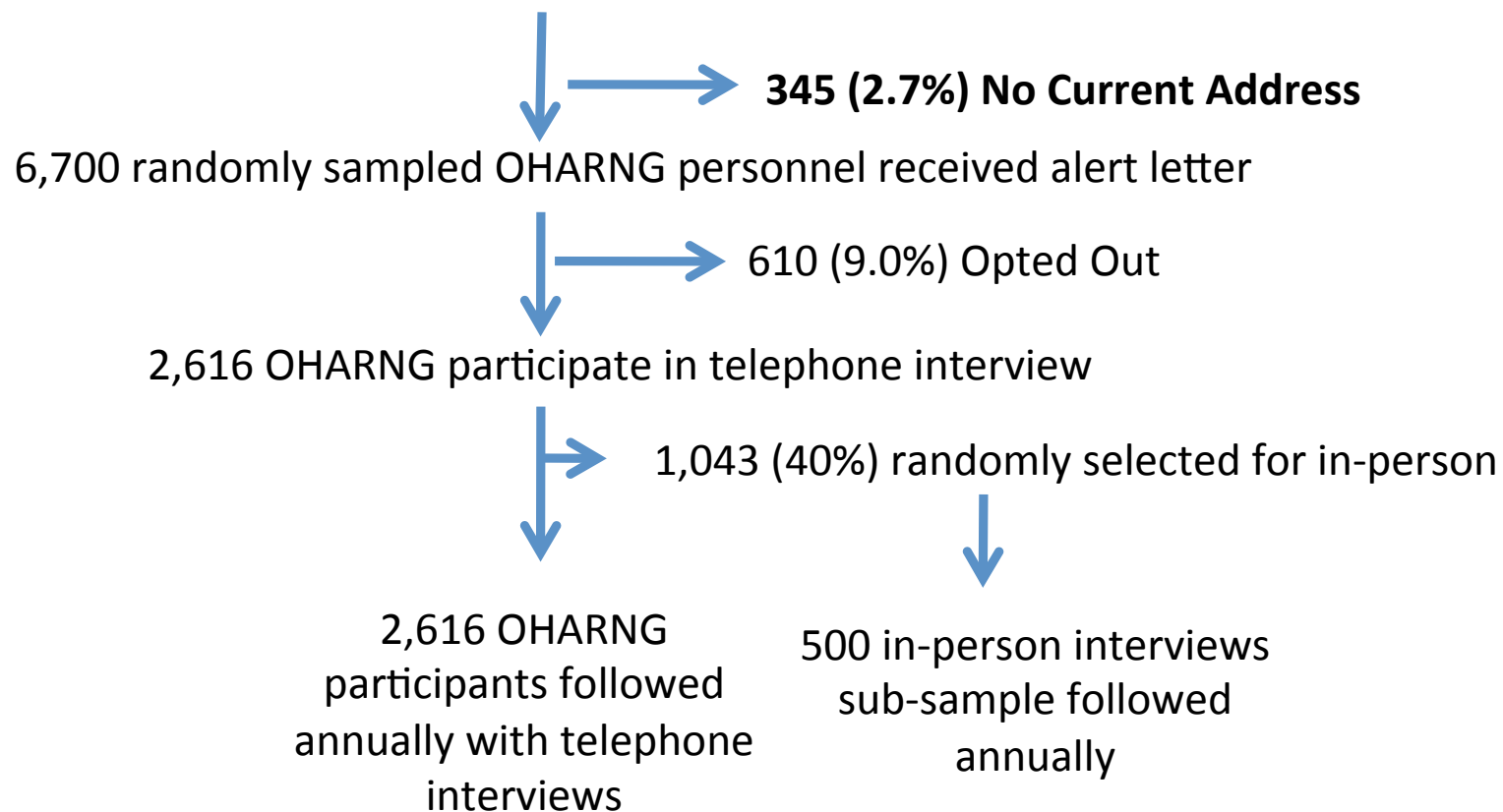
The ONG sample after 3 waves

Participation flow chart



Wave 1 (current and lifetime questions)

10,778 Men and Women in the Ohio Army National Guard (OHARNG)



Initial opt-out rate <10%, telephone cooperation rates 68%, and in-person cooperation rates 98%

Wave 2: W1 questions plus hypomania, suicide, and drug use

Telephone Interviews

2,616 OHARNG Baseline
Telephone Interviews



Genetics Repository
begins 5/3/2010



1,770 (67.6%) OHARNG Wave 2
Telephone Interviews

276 participants return
saliva sample

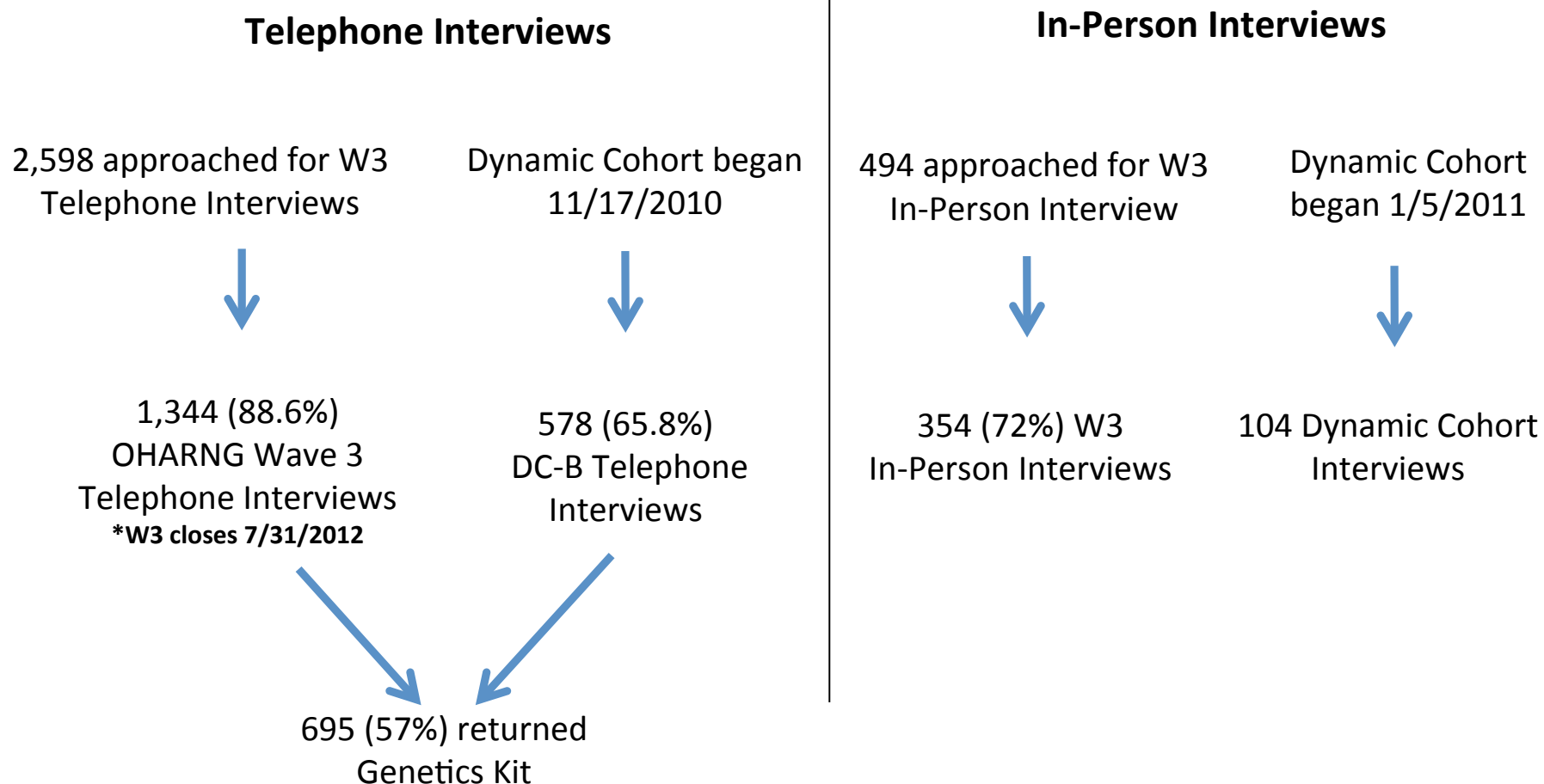
In-Person Interviews

500 OHARNG
Baseline In-Person Interviews



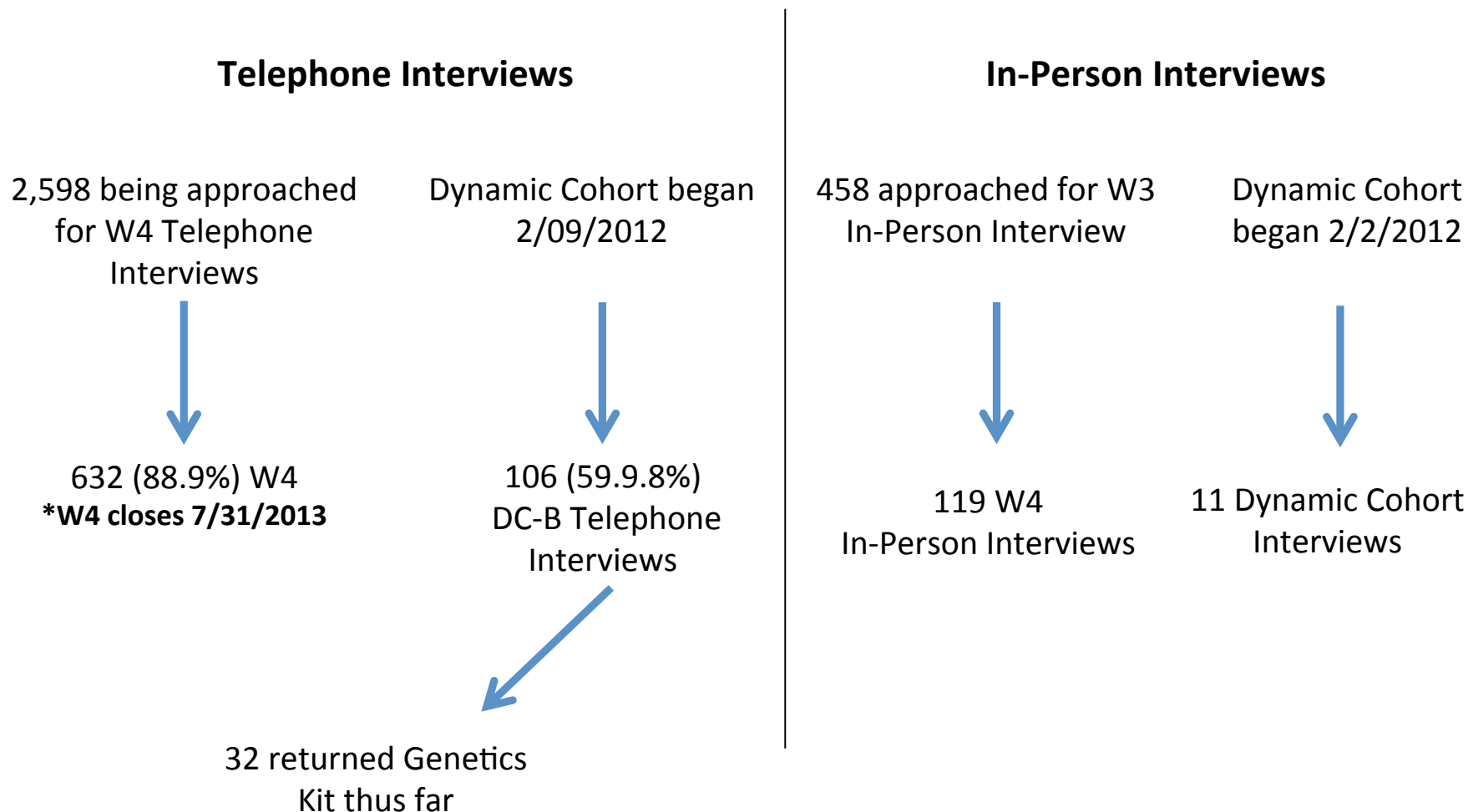
418 (83.6%) OHARNG Wave 2
In-Person Interviews

Wave 3: New questions - drug dependence, legal problems, & self-medication

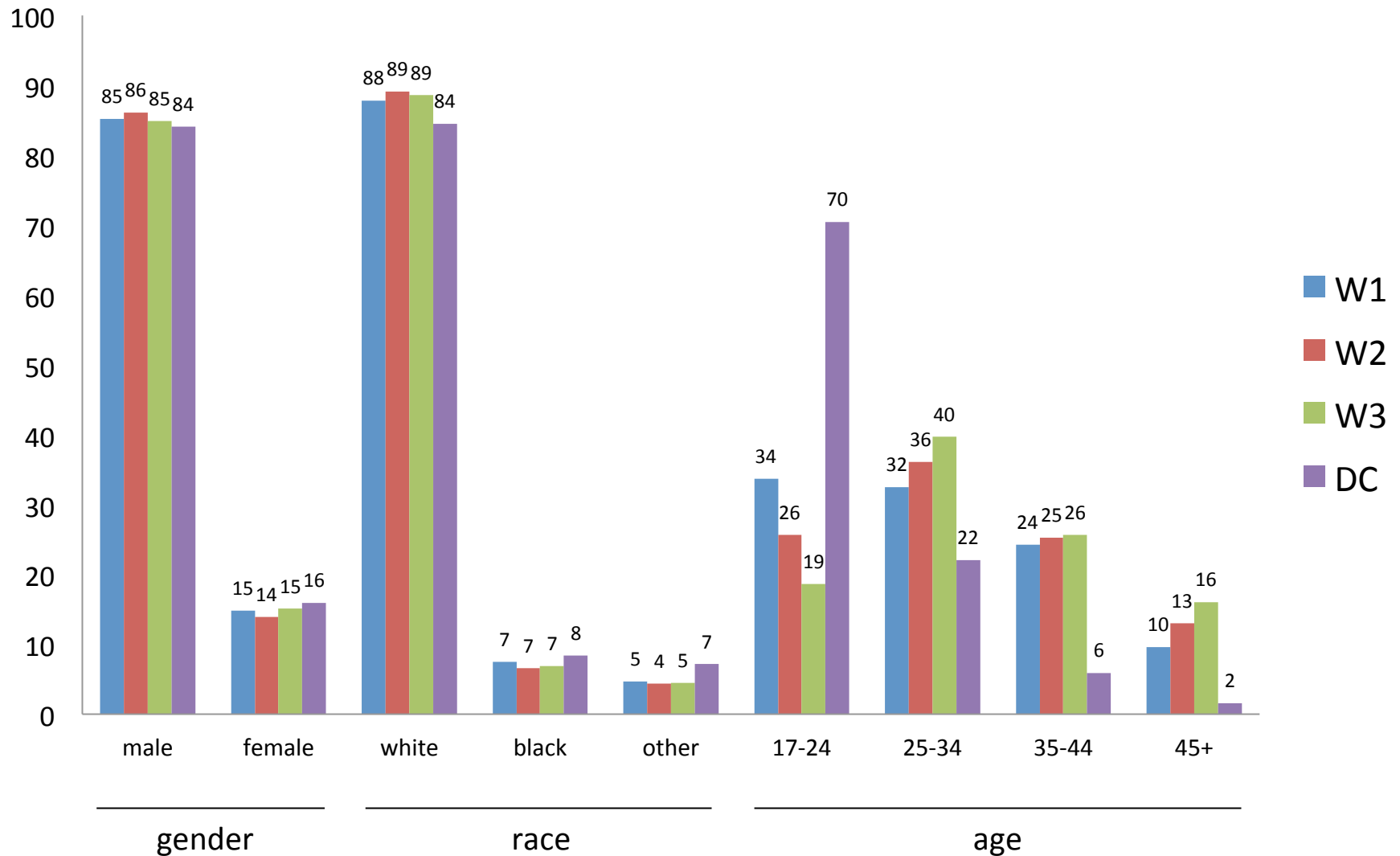


Wave 4: Translational Focus

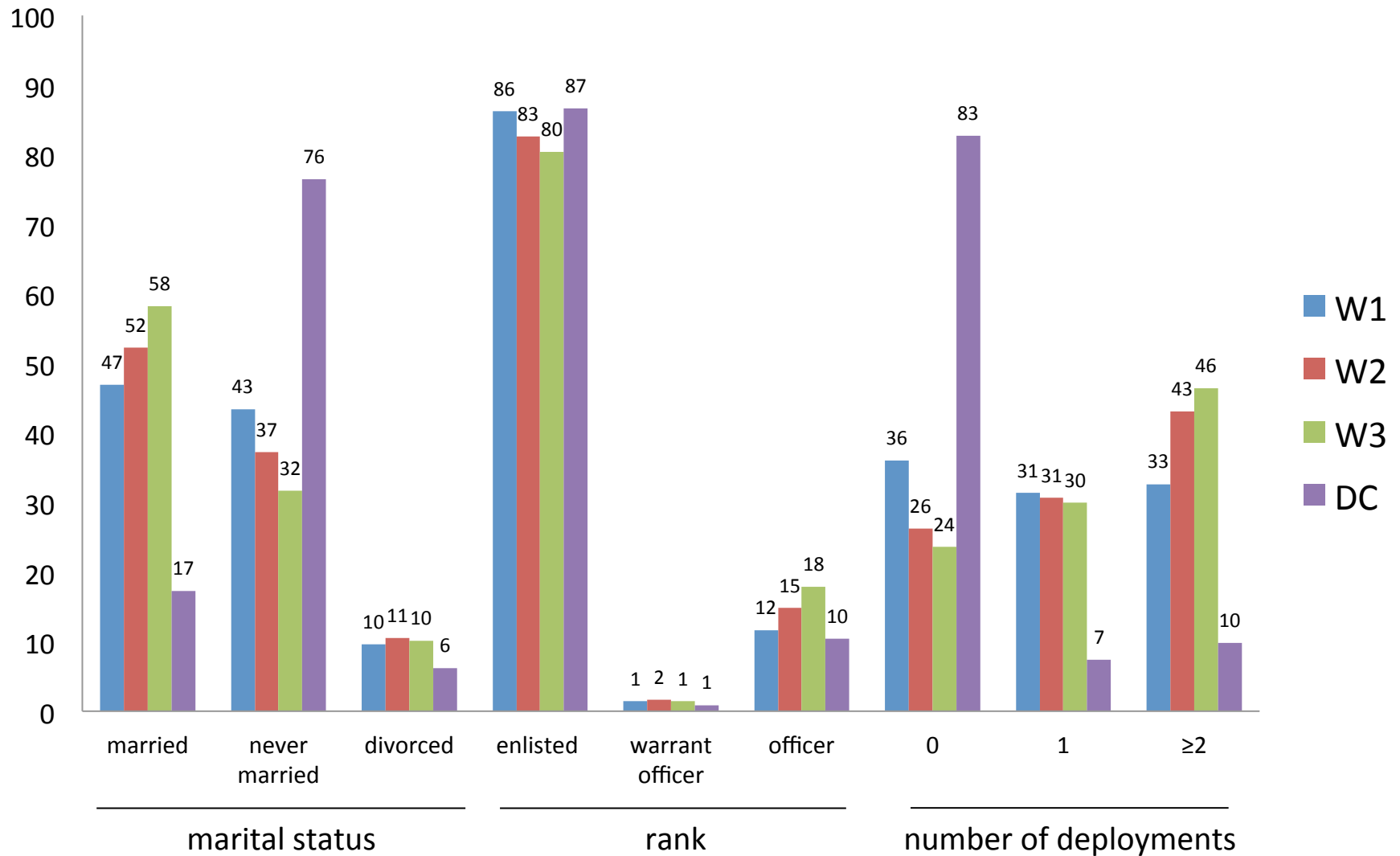
- military alcohol use, ONG Battle Buddy program, stigma and healthcare utilization



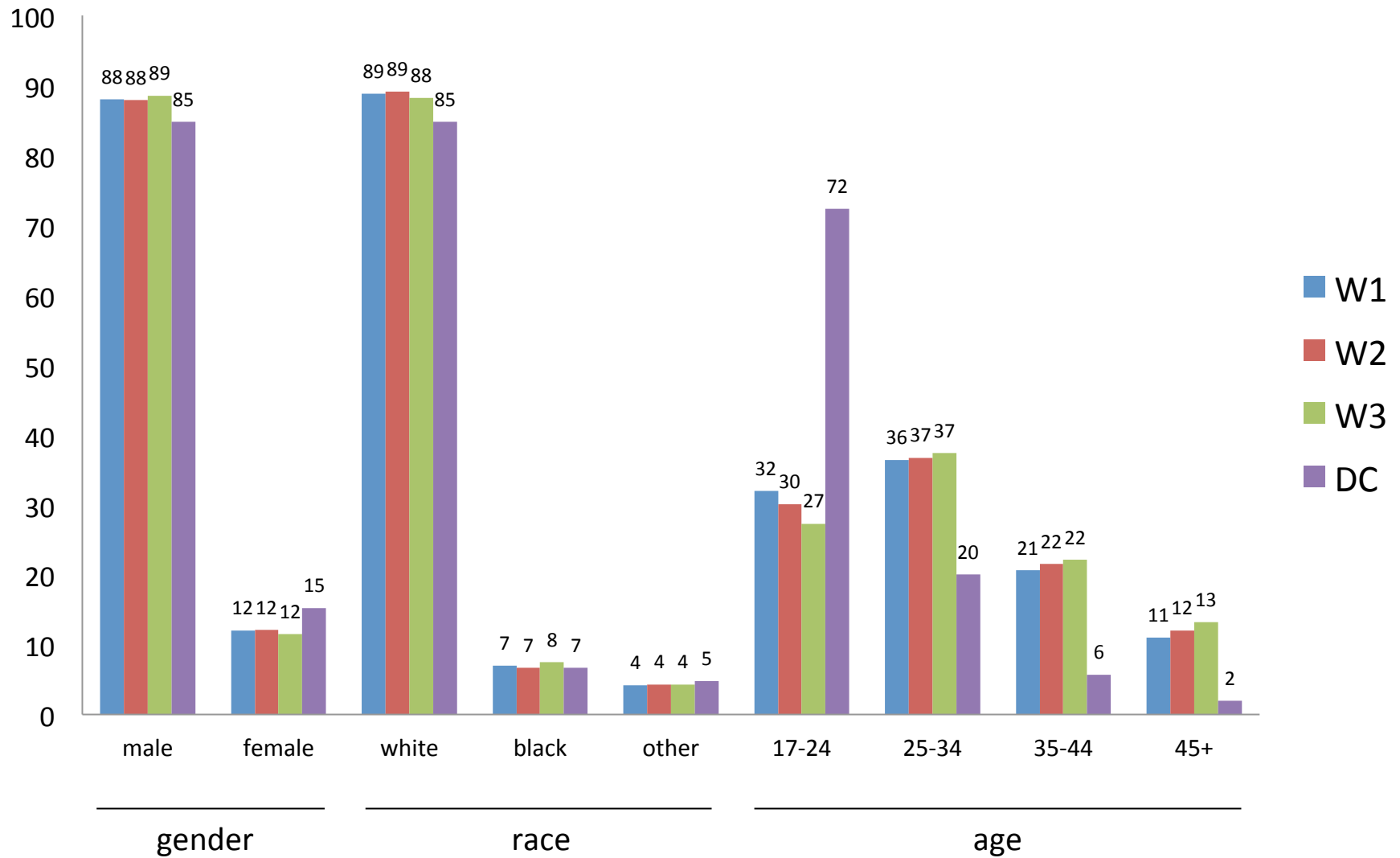
Telephone sample demographics (1)



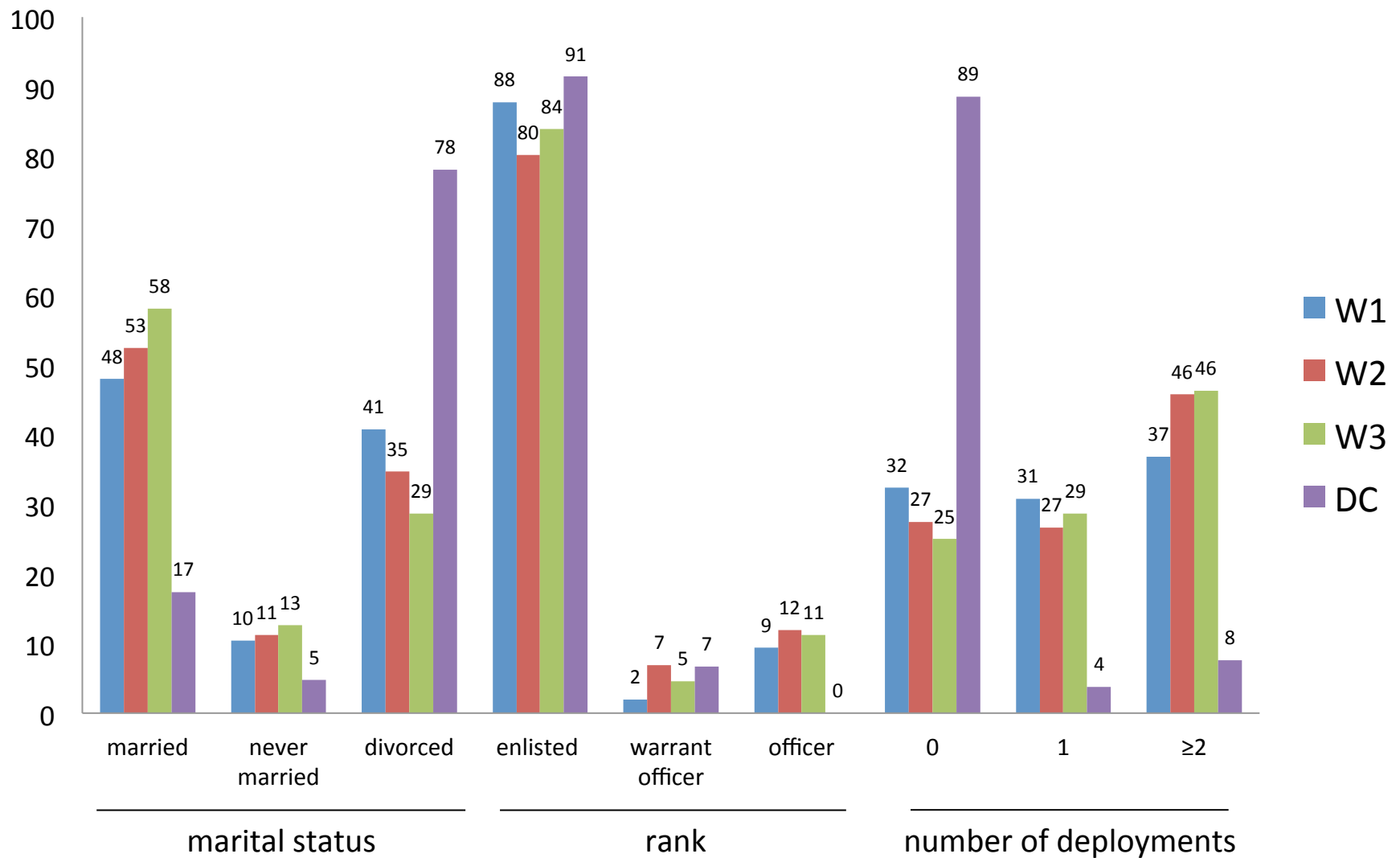
Telephone sample demographics (2)



Clinical sub-sample demographics (1)

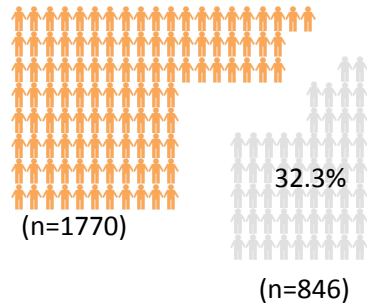


Clinical sub-sample demographics (2)



Attrition in the ONG sample to date

Attrition between waves 1 & 2

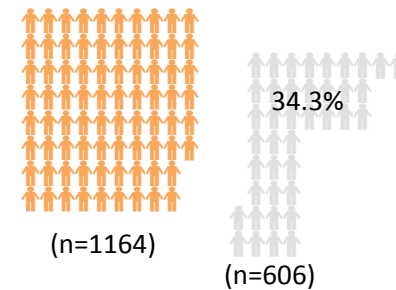


Attrition between waves 1 & 2 –
was associated with:

- age
- race
- education
- marital status
- military rank



Attrition between waves 2 & 3_(to date)



Attrition to date between waves 2 & 3
was associated with:

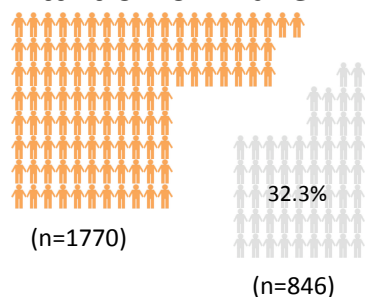
- age
- education
- marital status
- psychopathology

 = active participant

 = participant lost to follow-up

Main sample attrition between waves 1 & 2

Attrition of Wave 1



Wave 2



Main sample attrition between waves 1 & 2 disproportionately affected:

- 17-24 year old soldiers (lost n=324 or 36.9%)
- African American soldiers (lost n=79 or 40.5%)
- soldiers with < high school education (lost n= 289 or 39.8%)
- soldiers who were never married (lost n=417 or 36.8%)
- enlisted soldiers (n=760 or 33.4%)

 = active participant

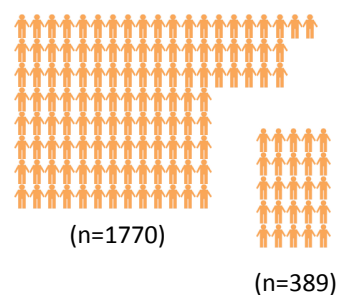
 = participant lost to follow-up

Even accounting for attrition, the DC sample will selectively augment and replenish the primary sample

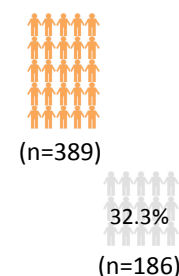
Dynamic cohort will replenish the main sample with selective oversampling of:

- 17-24 year old soldiers (w1dc n=405; projected* w2dc n=355)
- African American soldiers (w1dc n=48; projected w2dc n=28)
- soldiers with < HS education (w1dc n=187; projected w2dc n=112)
- never married soldiers (w1dc n=442; projected w2dc n=230)
- enlisted soldiers (w1dc n=511; projected w2dc n=340)

Wave 2



Attrition of DC*



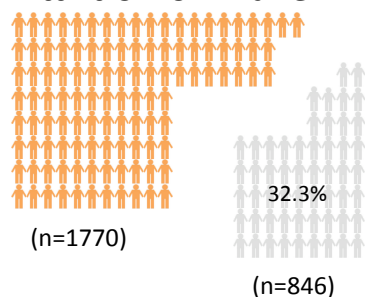
 = active participant

 = participant lost to follow-up

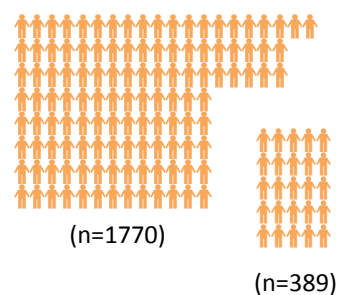
*projections based on observed main sample attrition between waves 1 and 2

Dynamic cohort sample will allow us to maintain the composition of the original sample

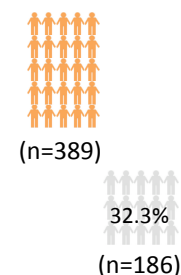
Attrition of Wave 1



Wave 2



Attrition of DC*

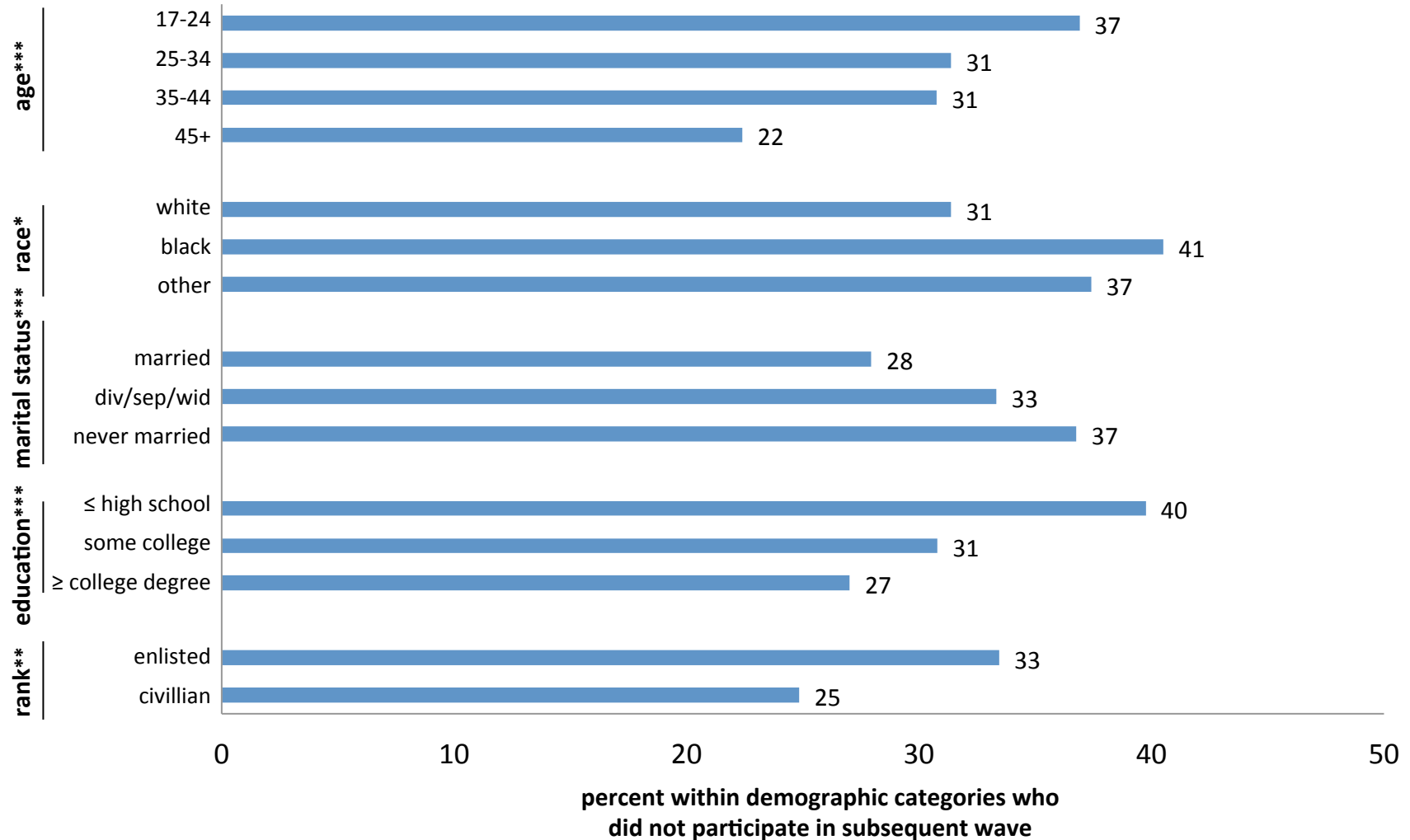


 = active participant

 = participant lost to follow-up

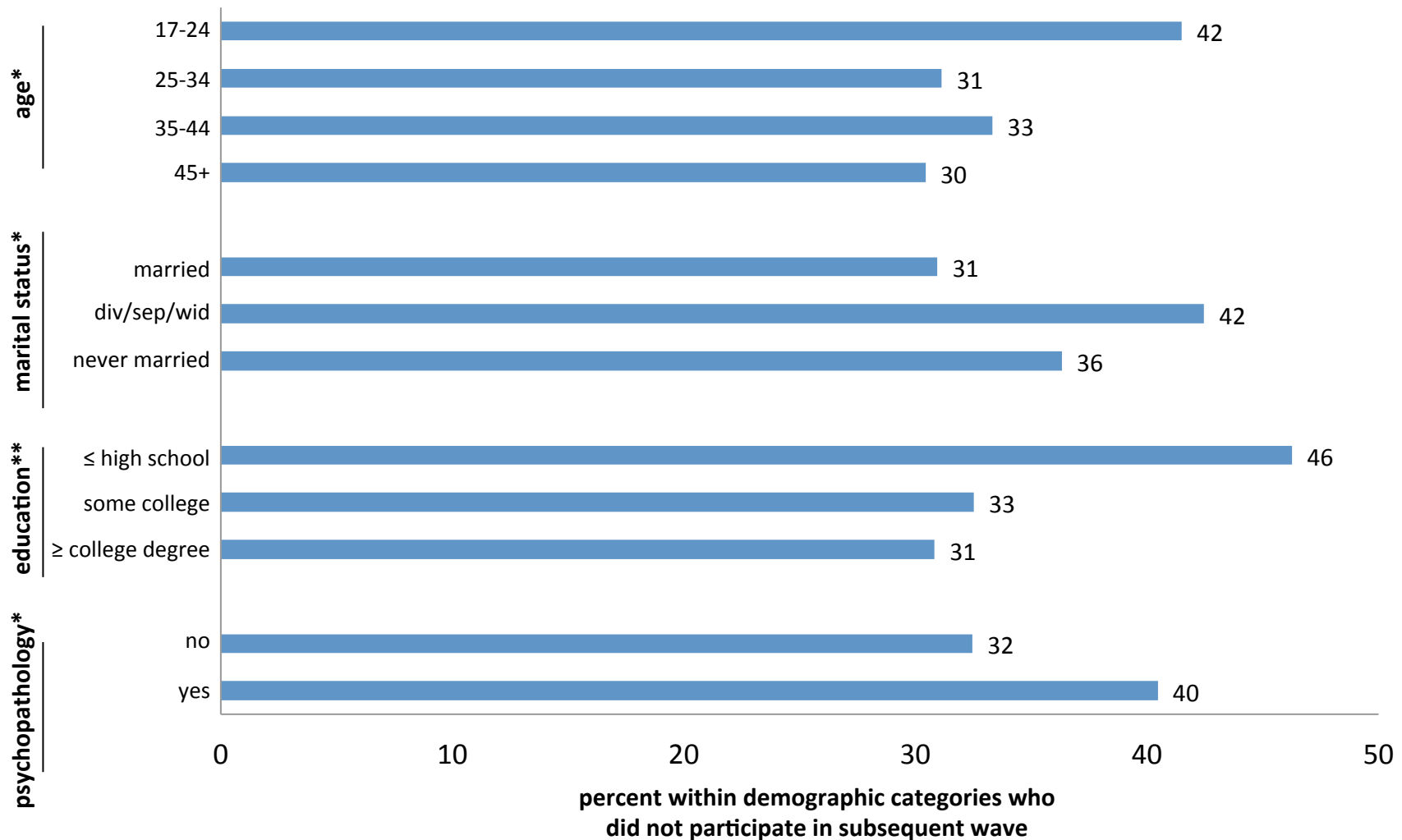
*projections based on observed main sample attrition between waves 1 and 2

Factors associated with main sample attrition between waves 1 and 2



n=2616; ***p<0.001, **p<0.01, *p<0.05

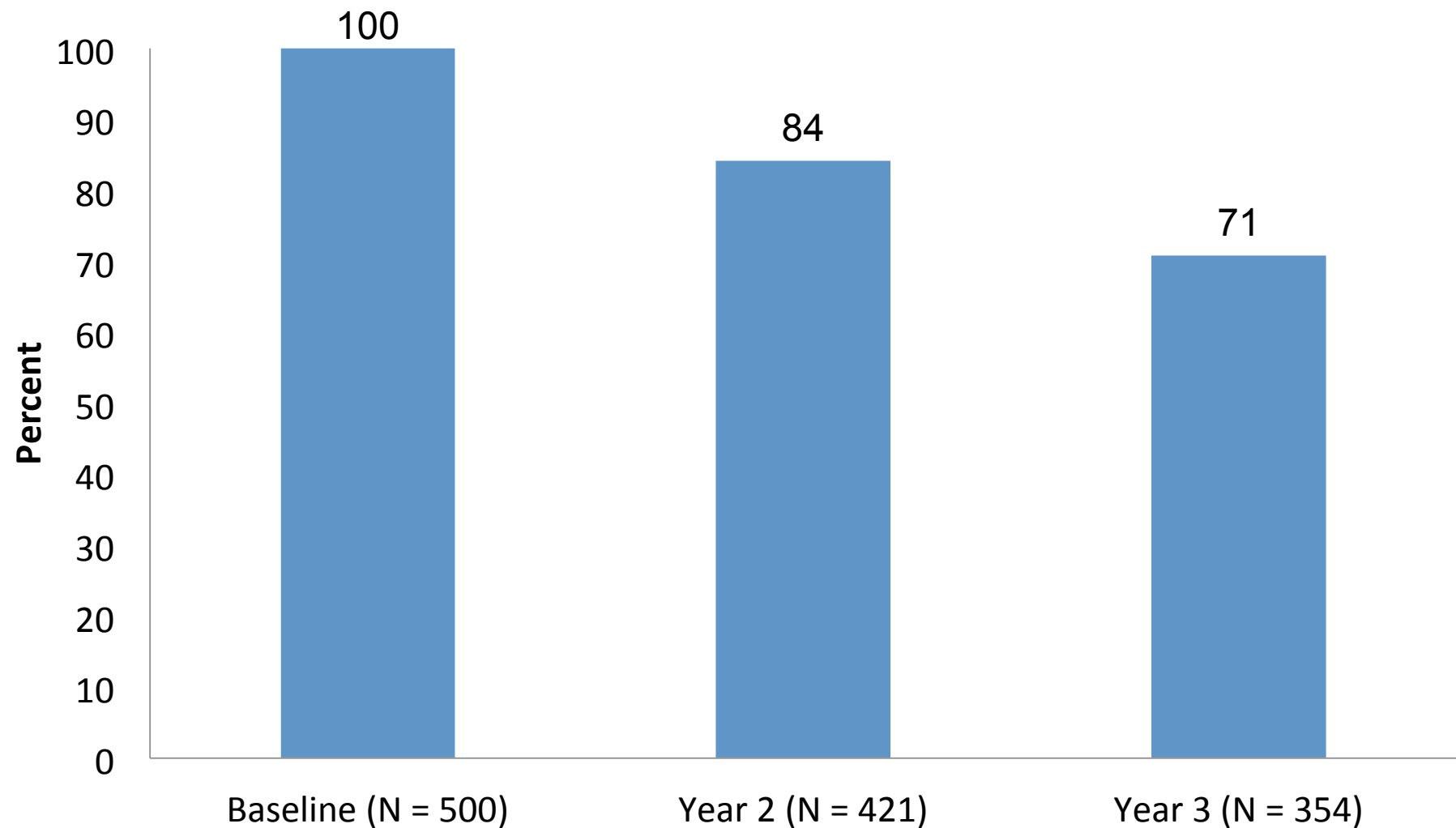
Factors associated with main sample attrition between waves 2 and 3



n=1770 participants who participated in wave 2; *p<0.01, **p<0.0001;

psychopathology included PTSD, depression, GAD, or an alcohol use disorder (AUD; including abuse or dependence)

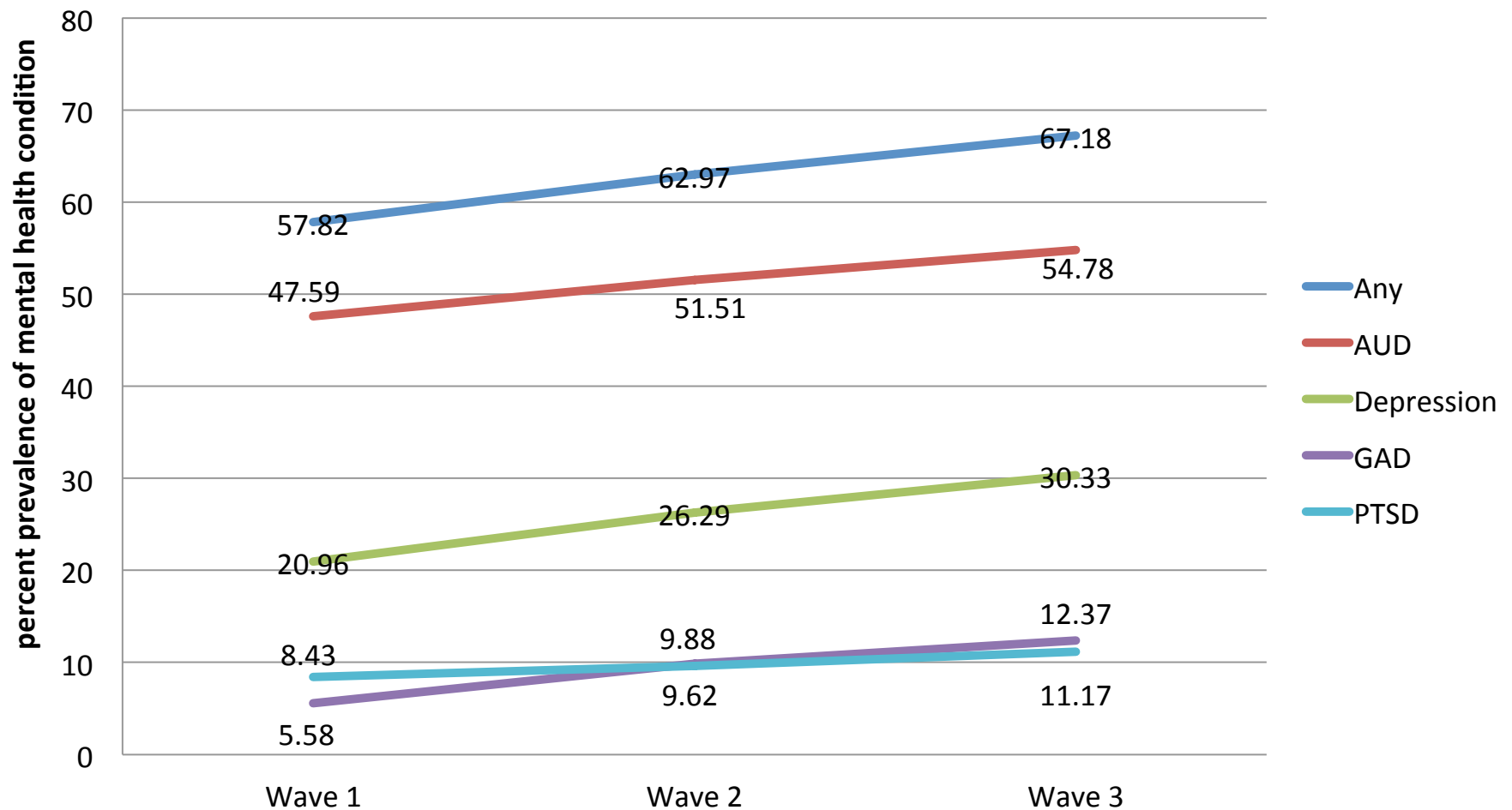
Clinical subsample retention



Prevalence and incidence of psychiatric disorder

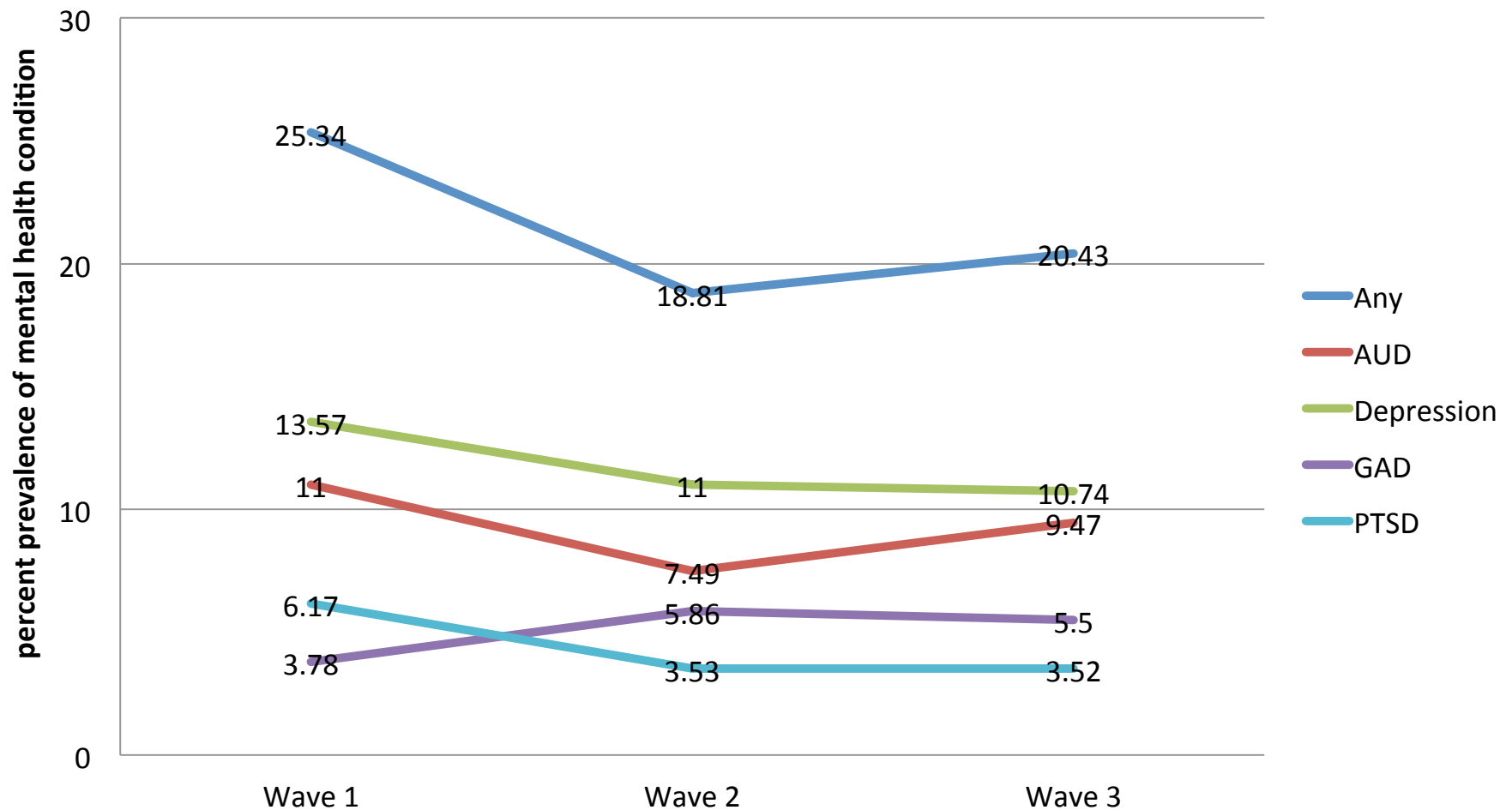
Telephone sample

Lifetime prevalence of PTSD, depression, GAD, and AUD over the three years



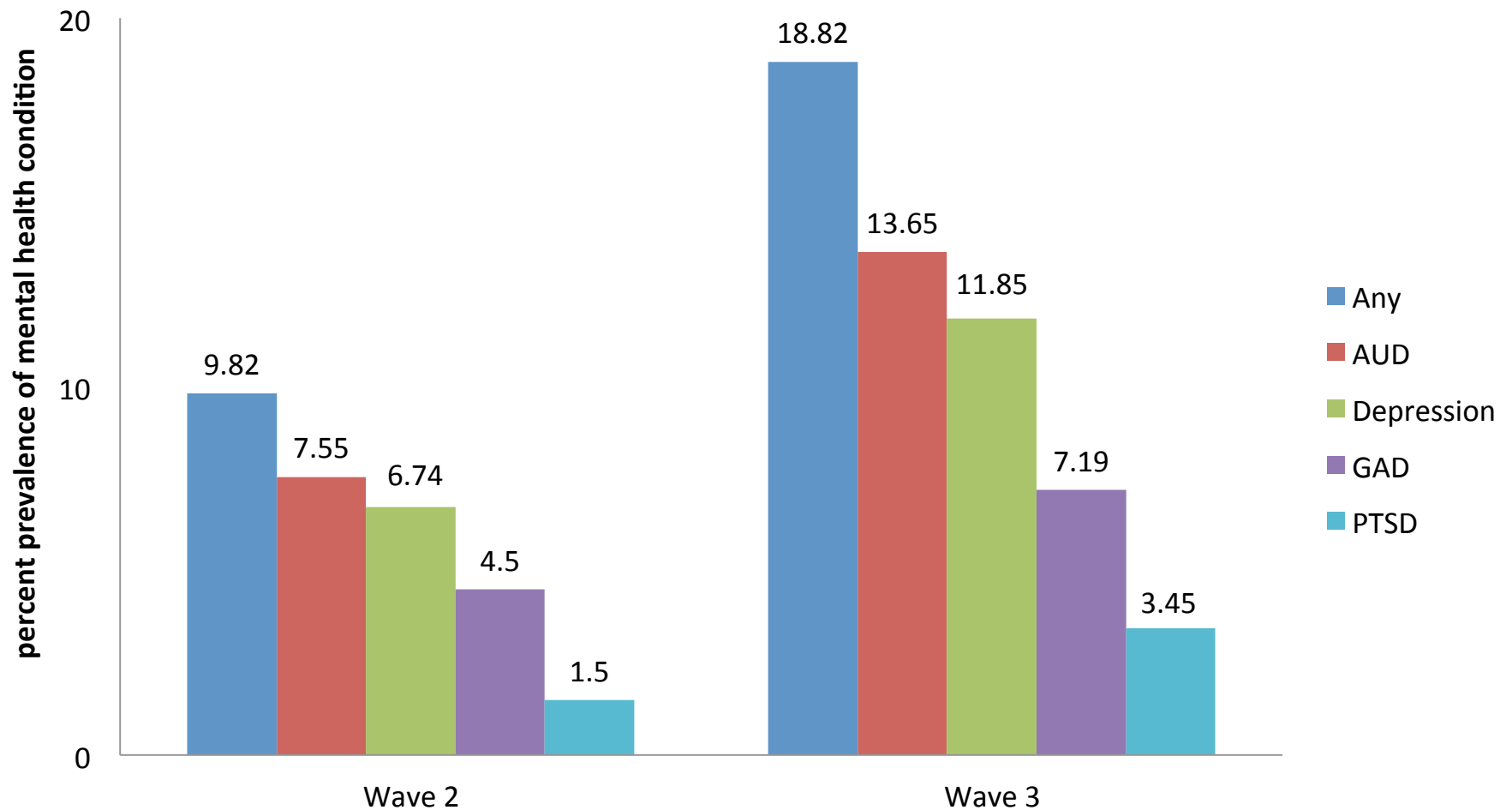
*n=1164 participants who were present for all three waves of the study

Prevalence of past-year PTSD, depression, GAD, and AUD over the three years



*n=1164 participants who were present for all three waves of the study

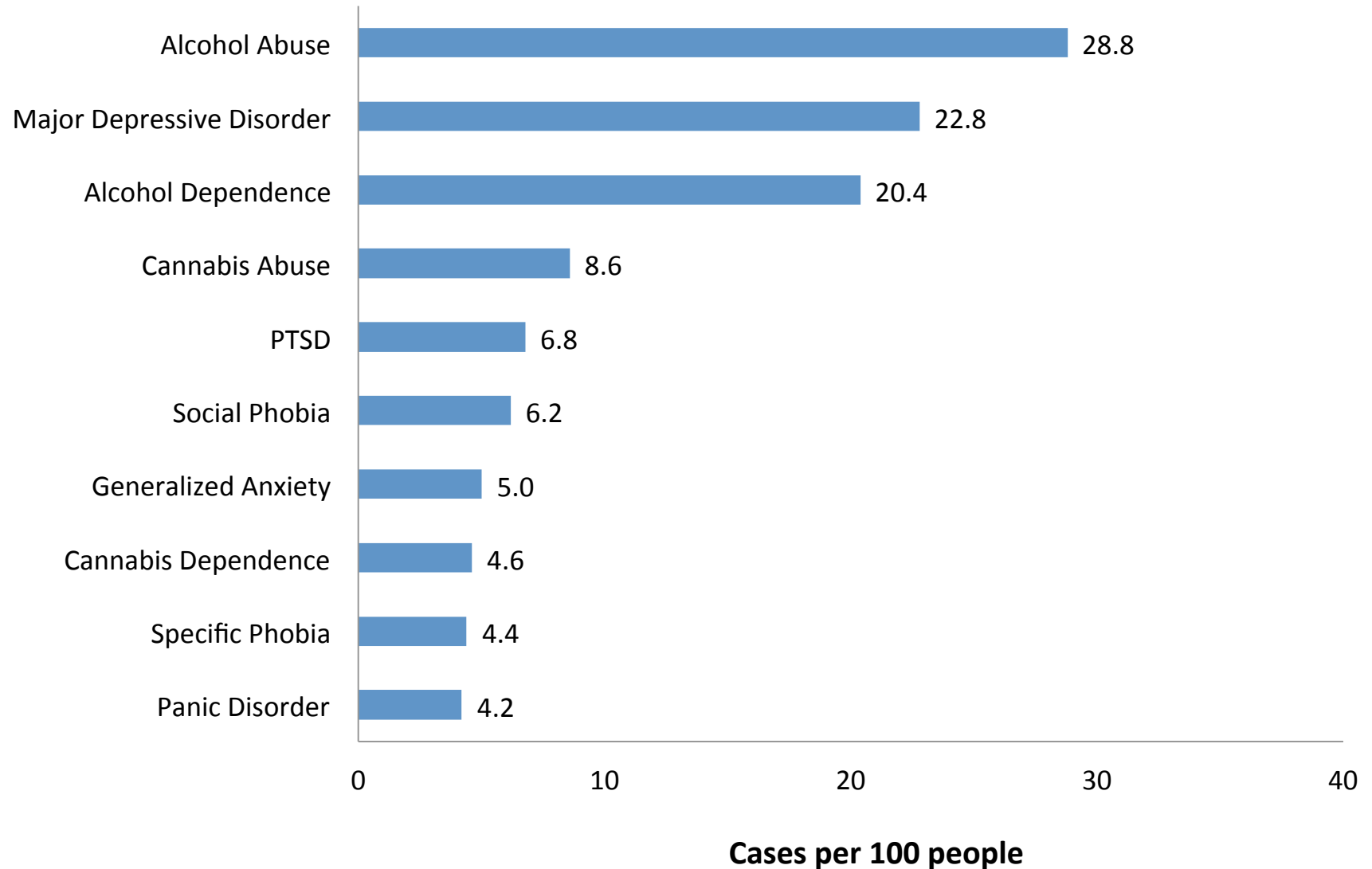
Cumulative incidence of mental health disorders over two years



*n=491 participants who did not have a mental health disorder at baseline and were present for all three waves of the study

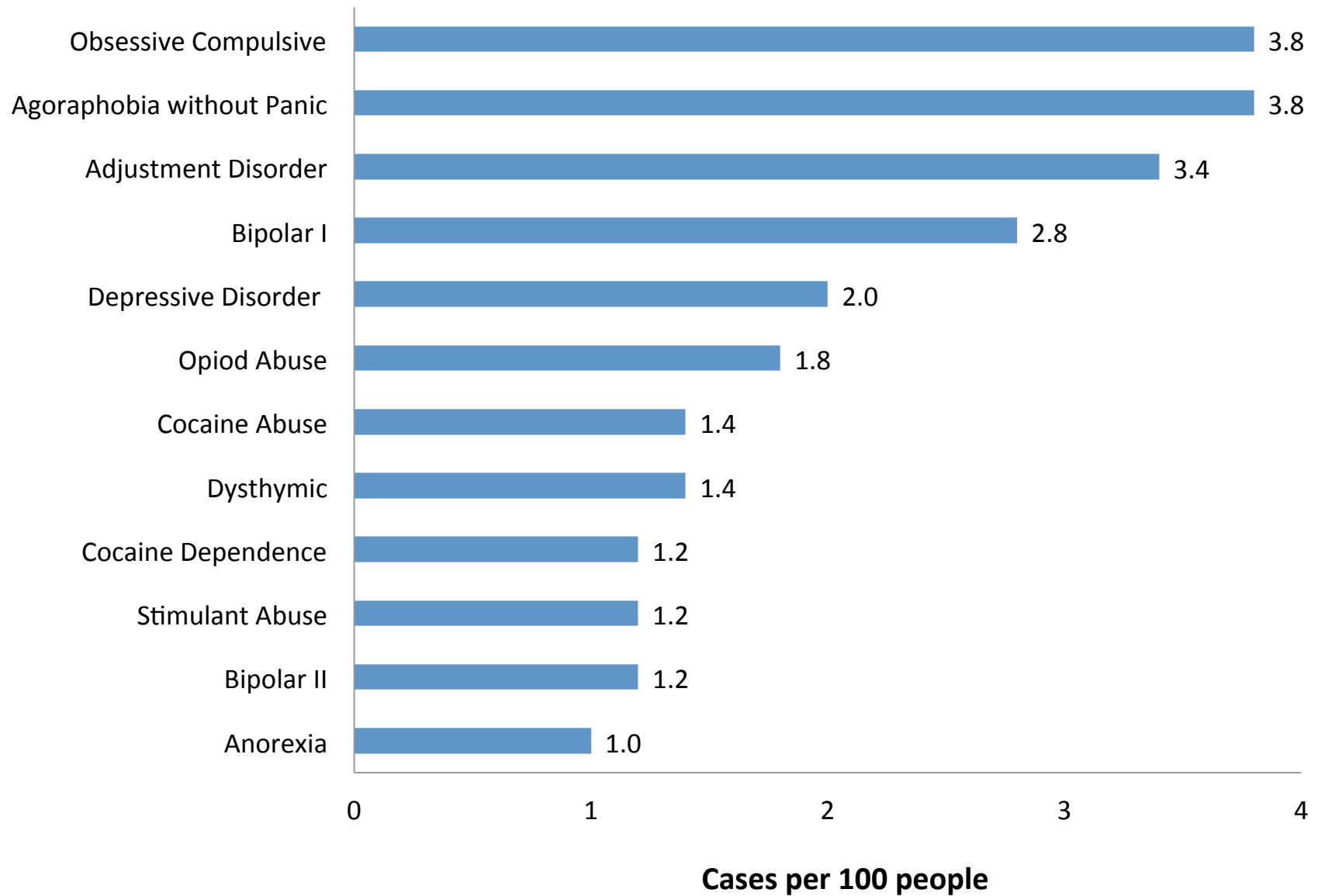
Clinical sub-sample

Baseline lifetime prevalence per 100 people (1)



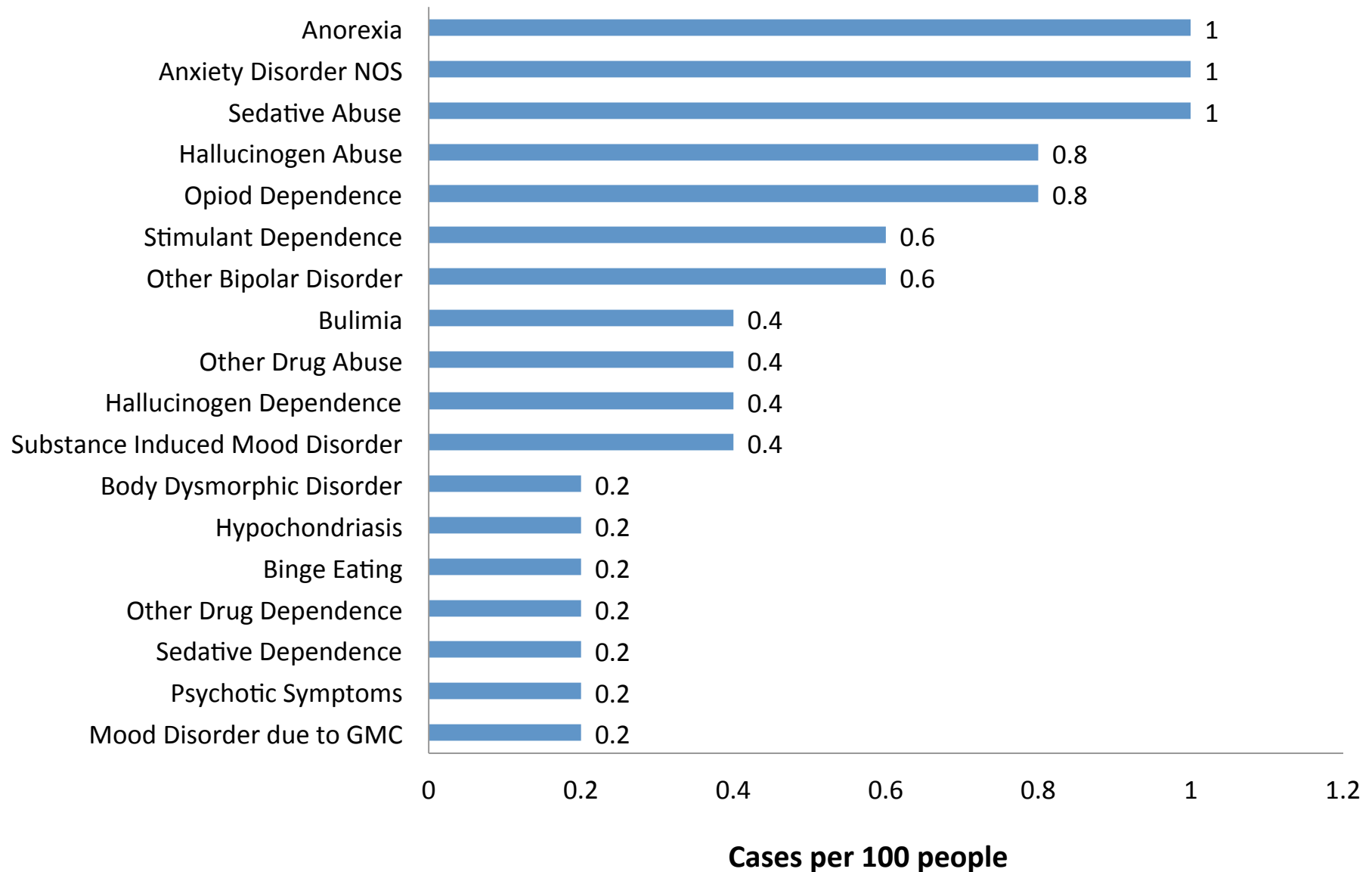
N = 500, Clinical Subsample

Baseline lifetime prevalence per 100 people (2)



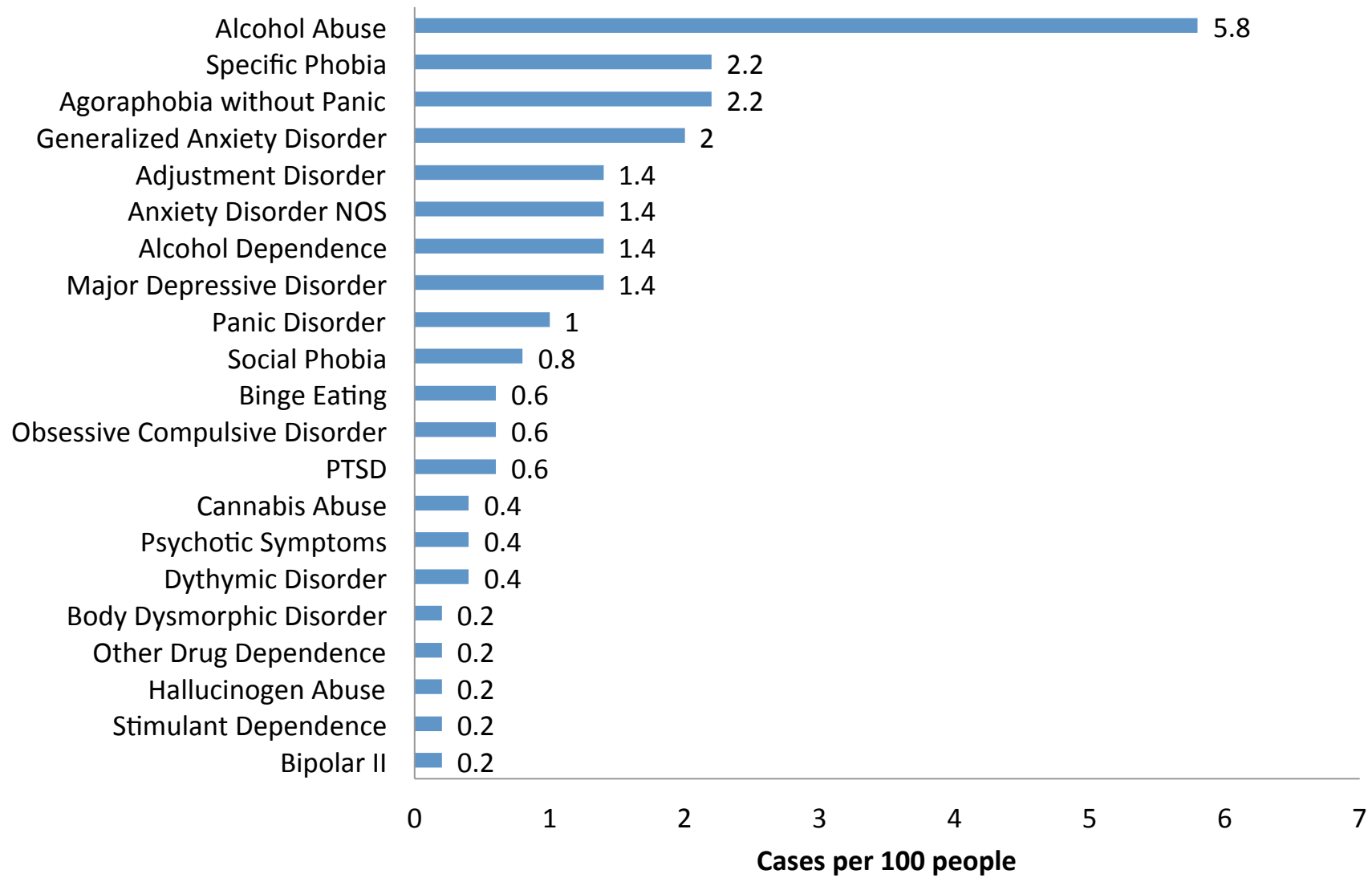
N = 500, Clinical Subsample

Baseline lifetime prevalence per 100 people (3)



N = 500, Clinical Subsample

Wave 2 incidence rate per 100 people



N = 421, Clinical Subsample

Trajectories of PTSD

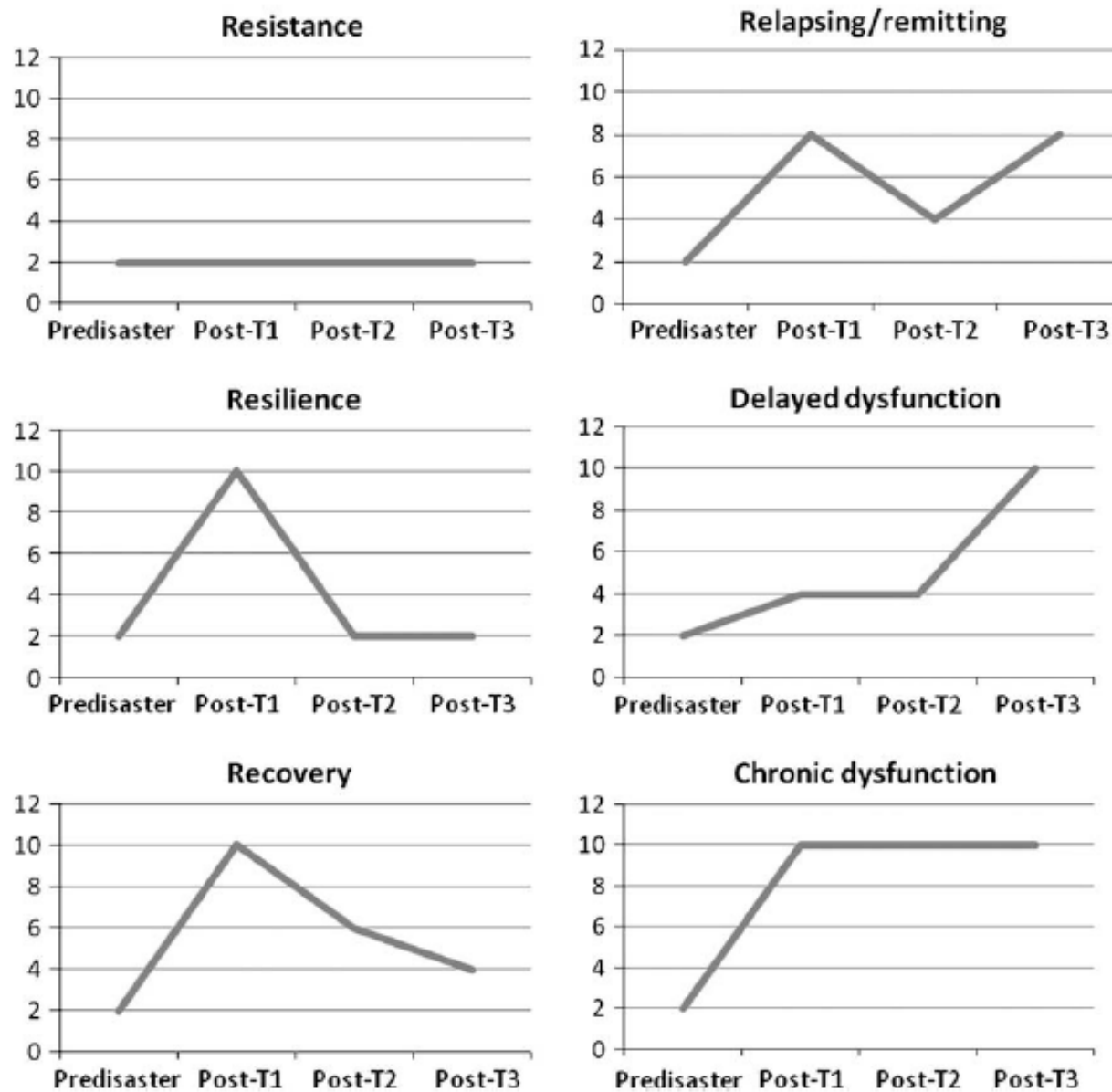
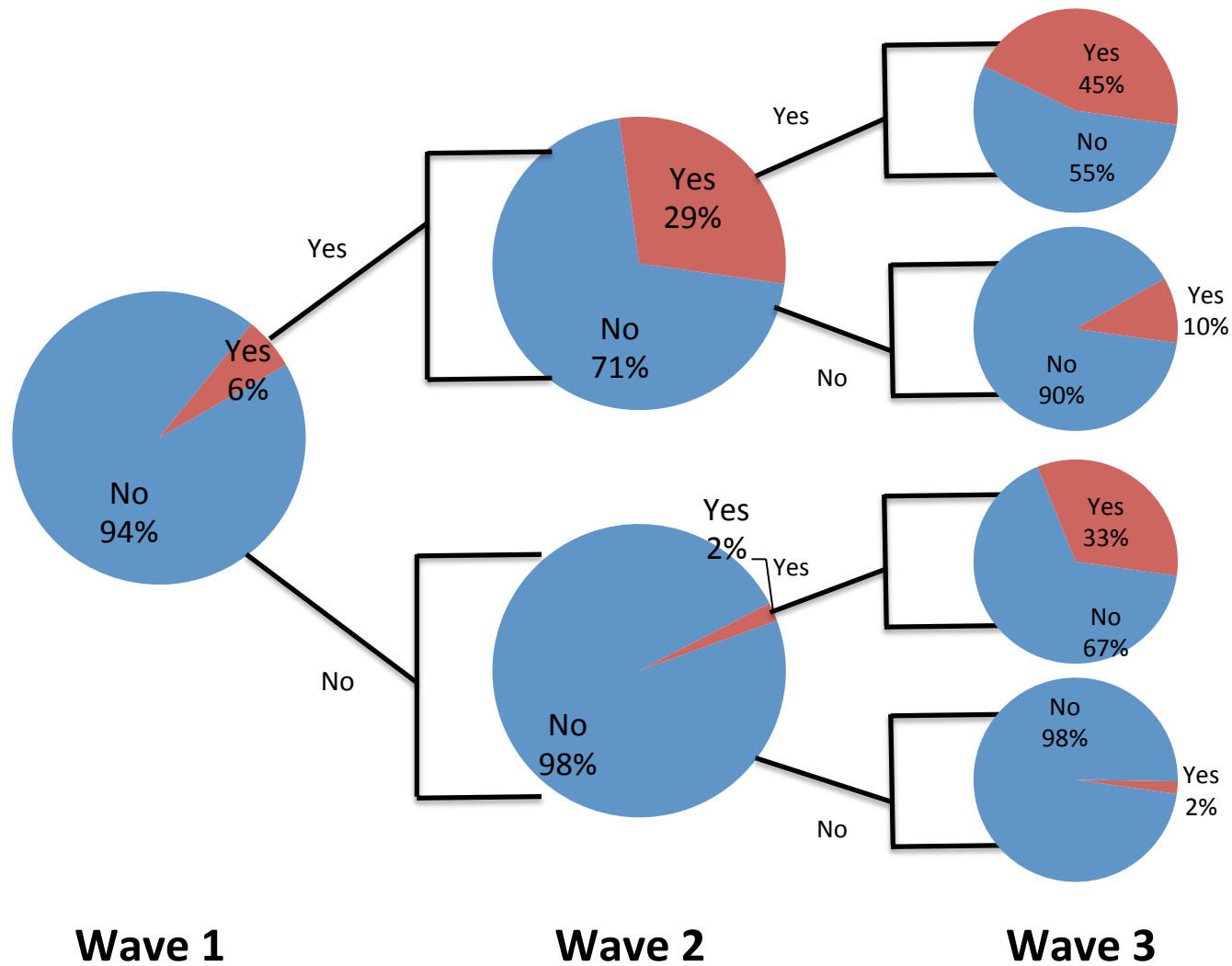


Fig. 1. Hypothesized trajectories of the course of stress responses.

Trajectories of PTSD over 3 years (1)

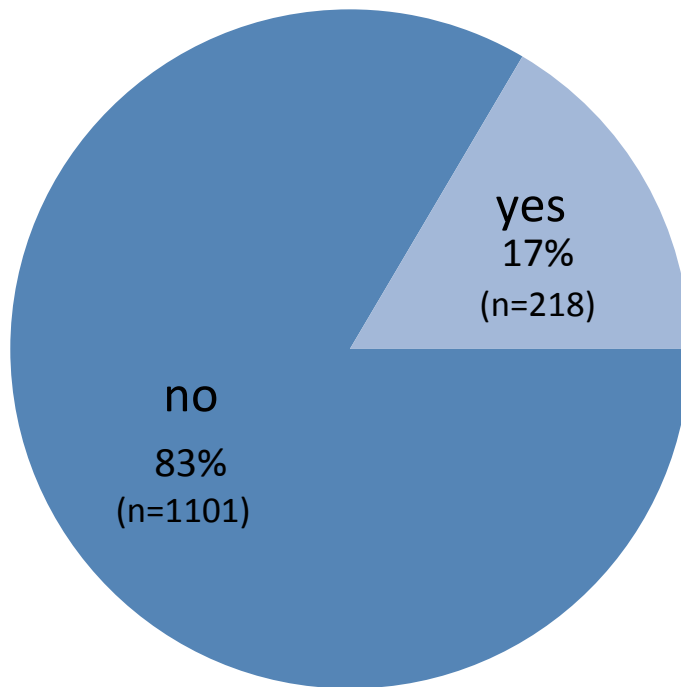


*n=1103 who reported having had at least 1 lifetime traumatic event at wave 1

Mental health service utilization

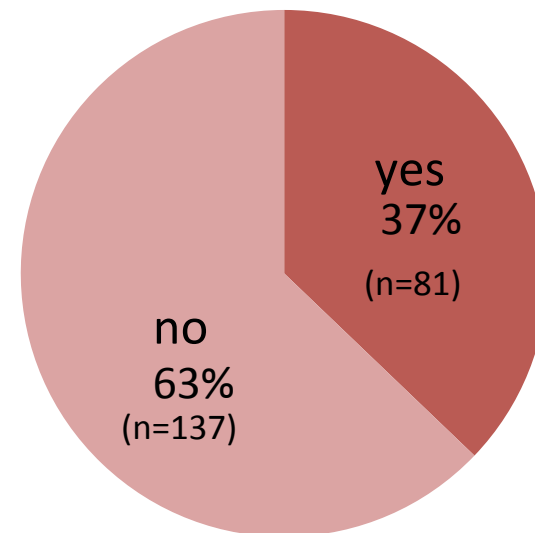
Mental health need and 1-year prevalence of service utilization among the ONG

mental health service
need at wave 2



(N=1319)

mental health service use
among those with need
between waves 2 & 3

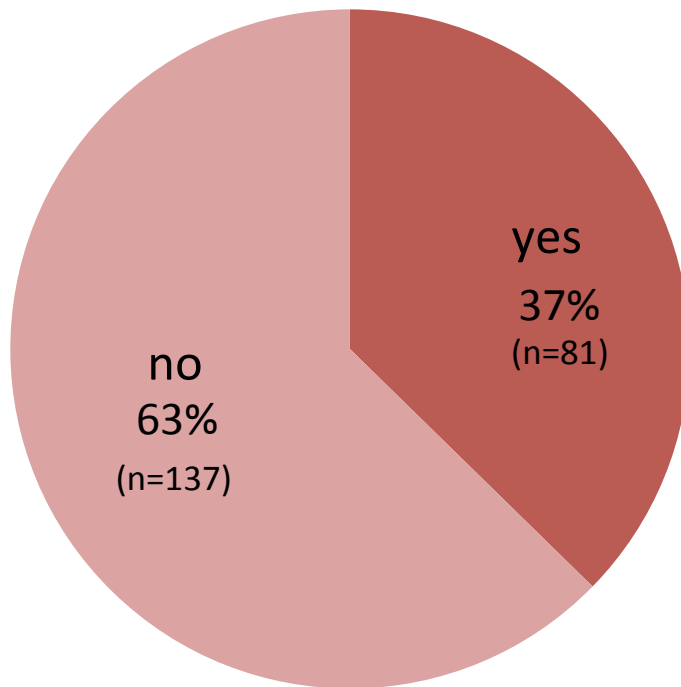


(N=218)

*mental health need was defined as ≥ 1 mental health disorder, including PTSD, depression, GAD, or an alcohol use disorder (AUD; including abuse or dependence), or past month suicidal ideation

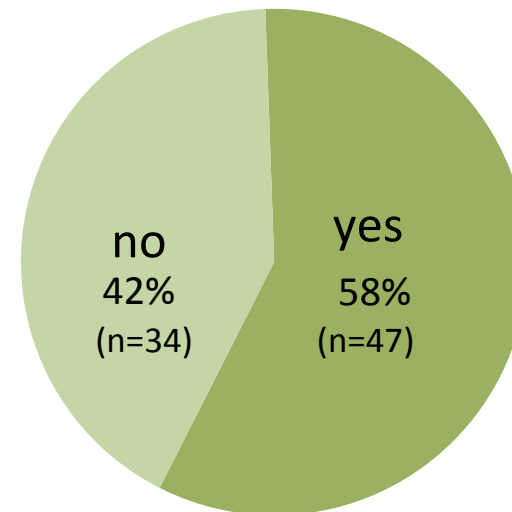
1-year prevalence of tricare or VA mental health service utilization among the ONG

any use of mental health services
between waves 2 & 3



(N=218)

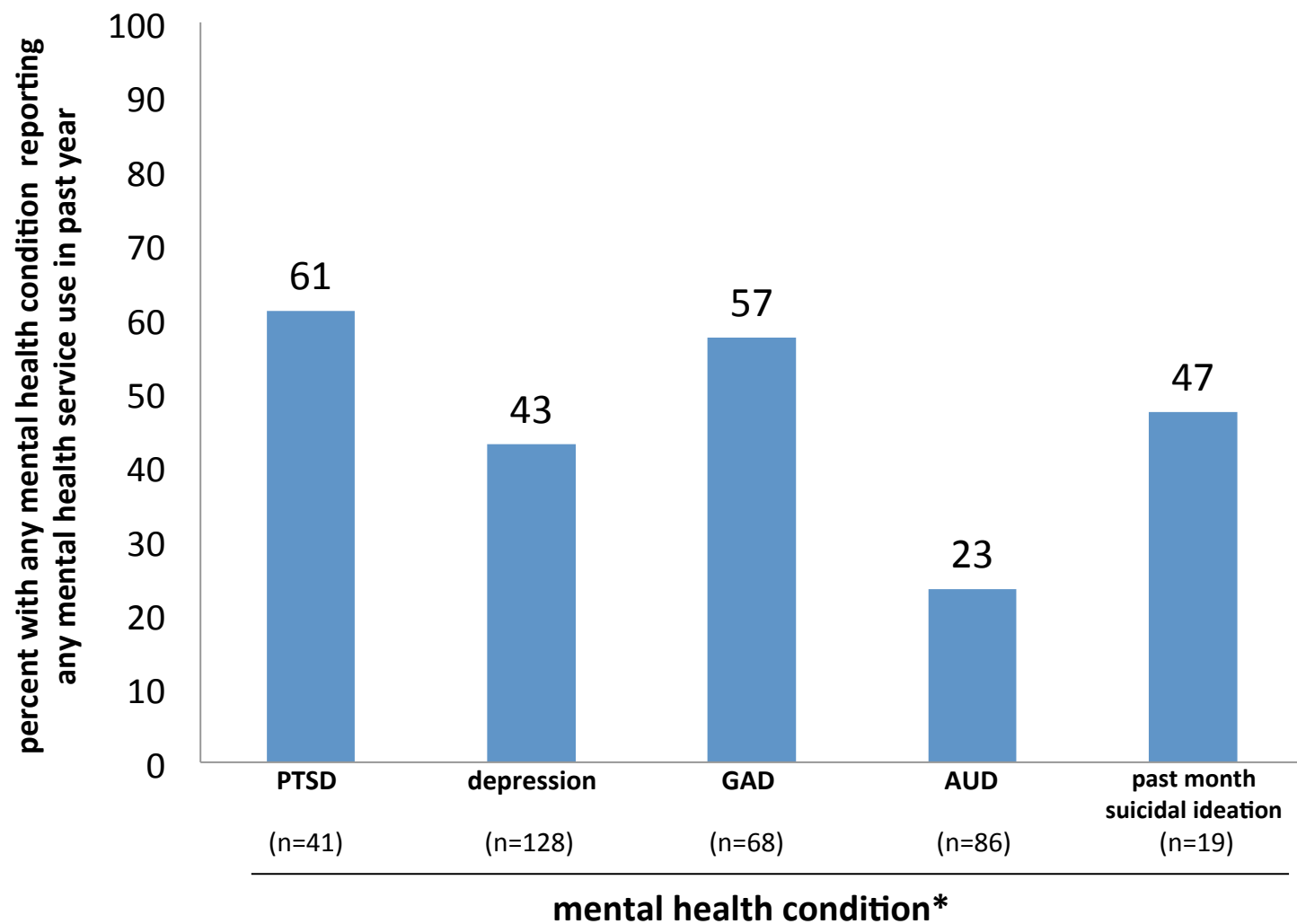
military/VA mental health service use
among those with need
between waves 2 & 3



(N=81)

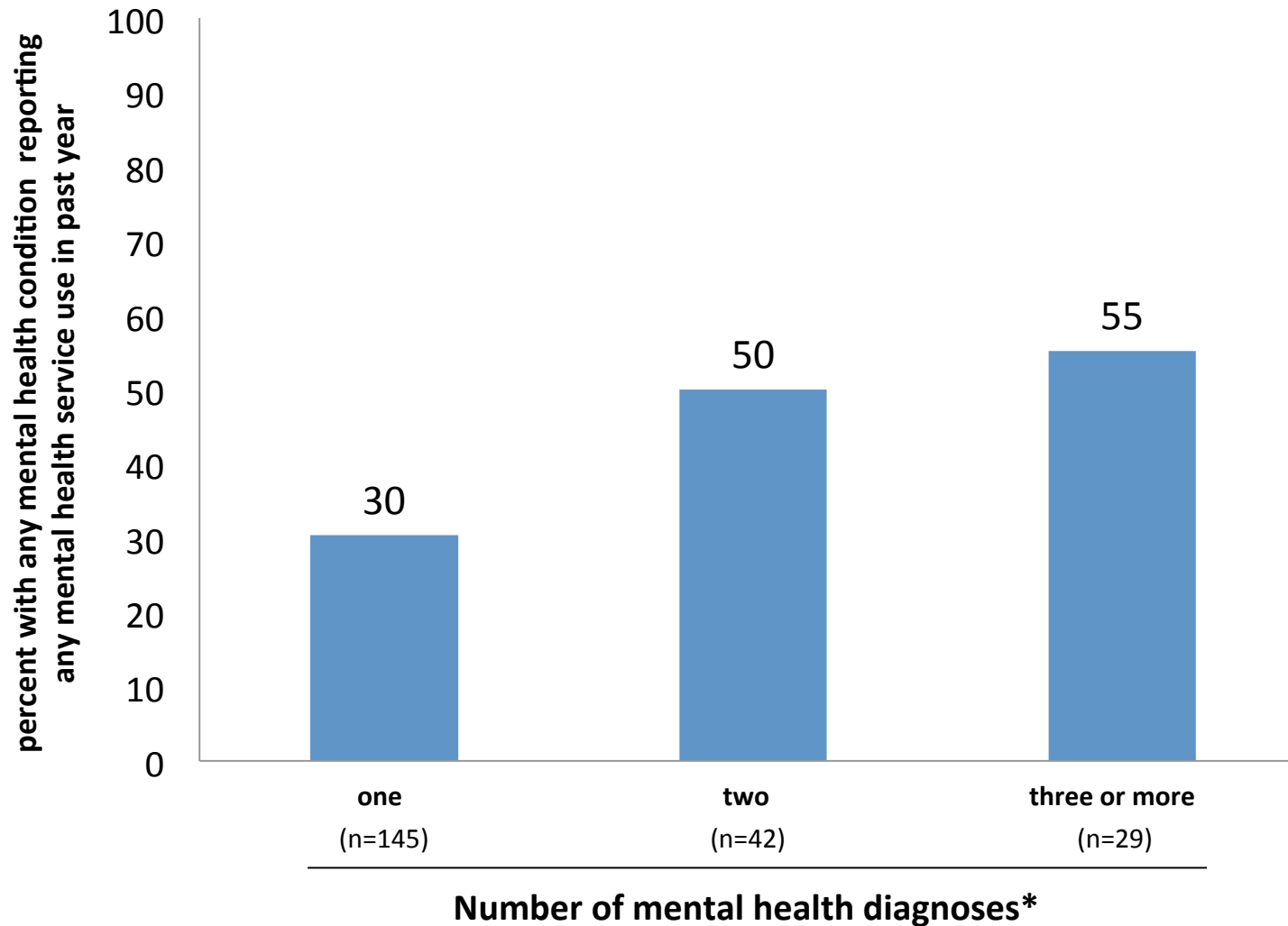
*mental health need was defined as ≥ 1 mental health disorder, including PTSD, depression, GAD, or an alcohol use disorder (AUD; including abuse or dependence), or past month suicidal ideation

Utilization of mental health services by psychiatric disorder



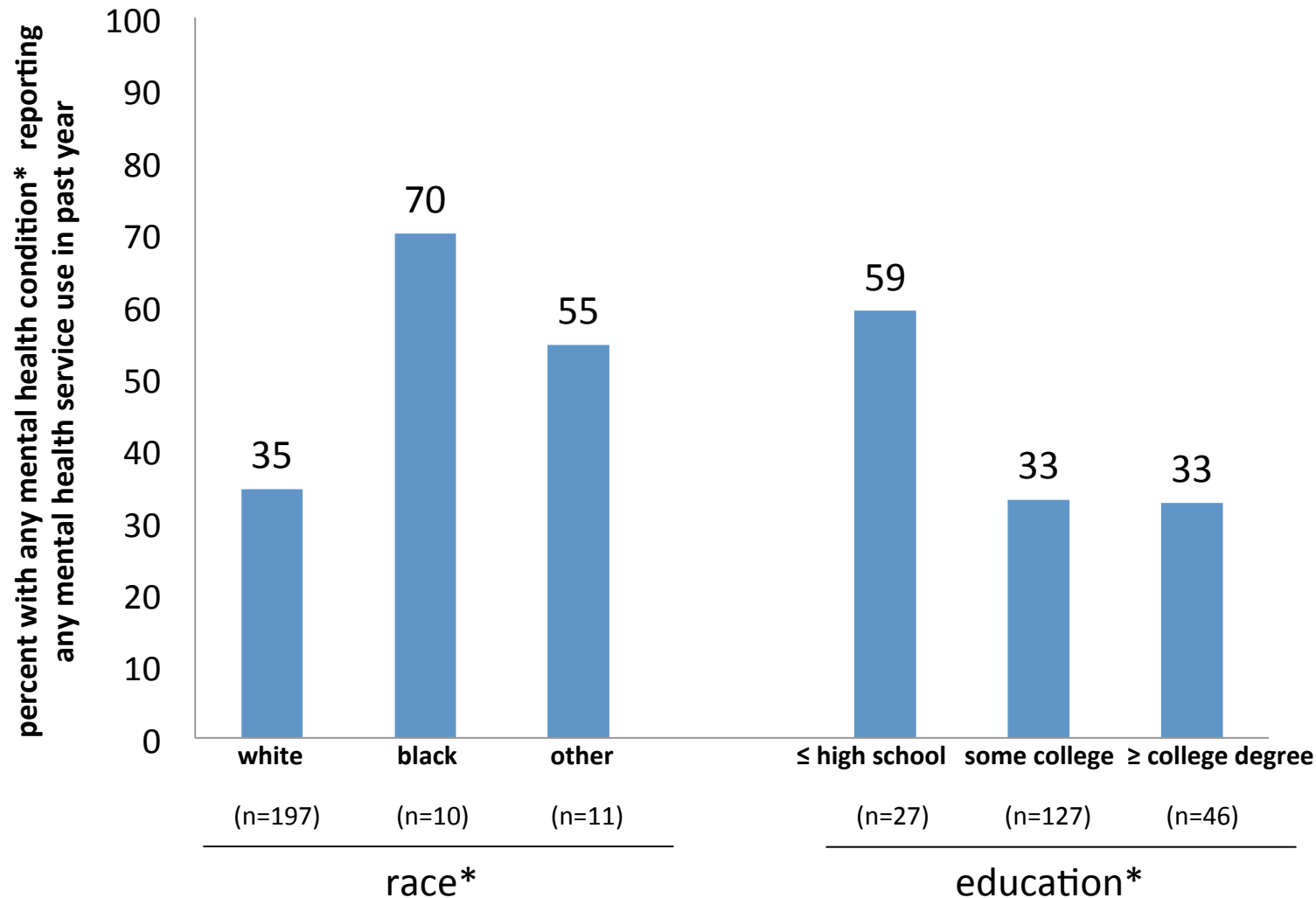
*n=218

Greater psychiatric burden was associated with higher utilization of mental health services



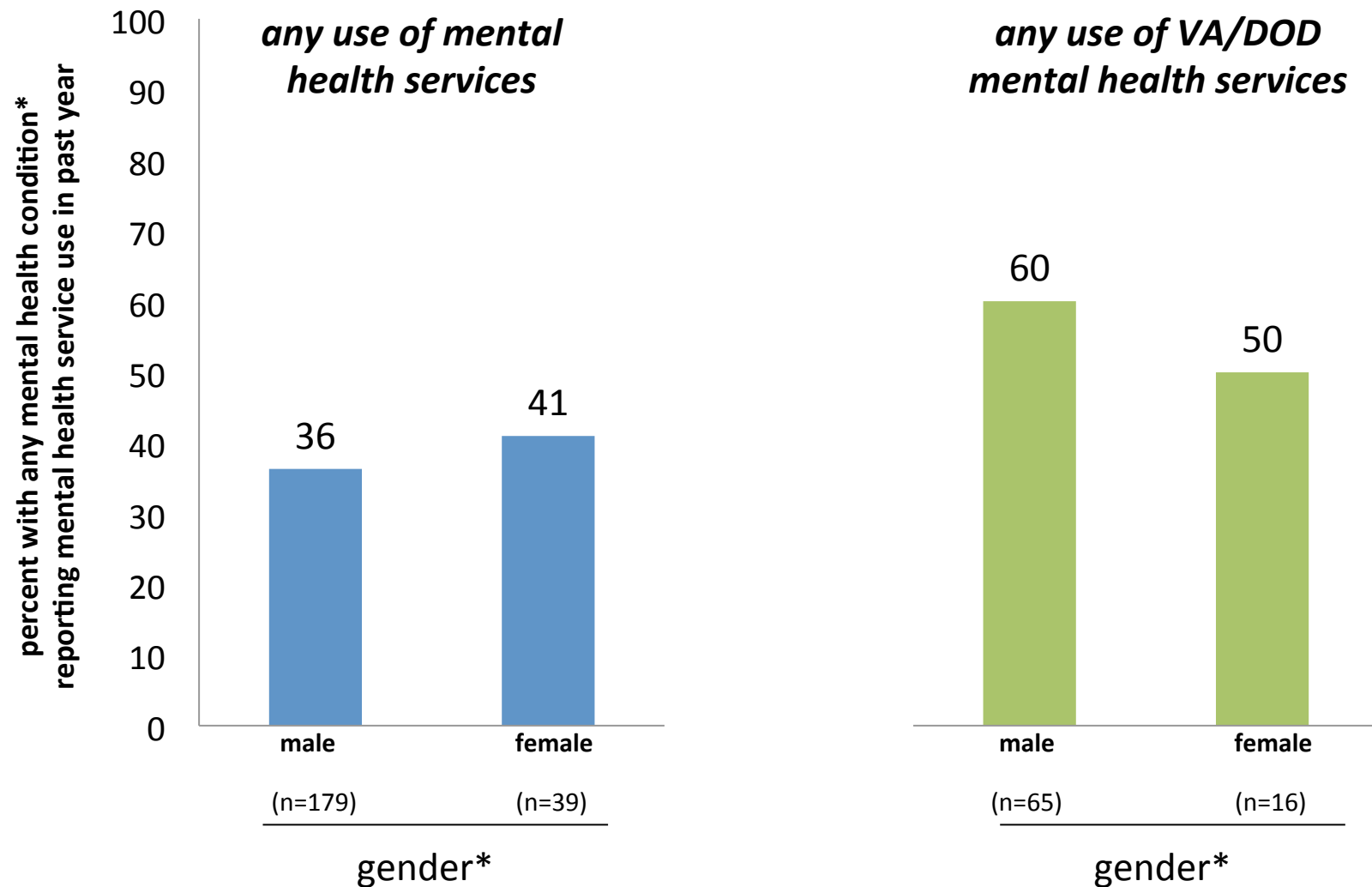
*n=218; $p < 0.01$; mental health diagnoses included PTSD, depression, GAD, or an alcohol use disorder (AUD; including abuse or dependence)

Race and education were associated with any use of mental health services



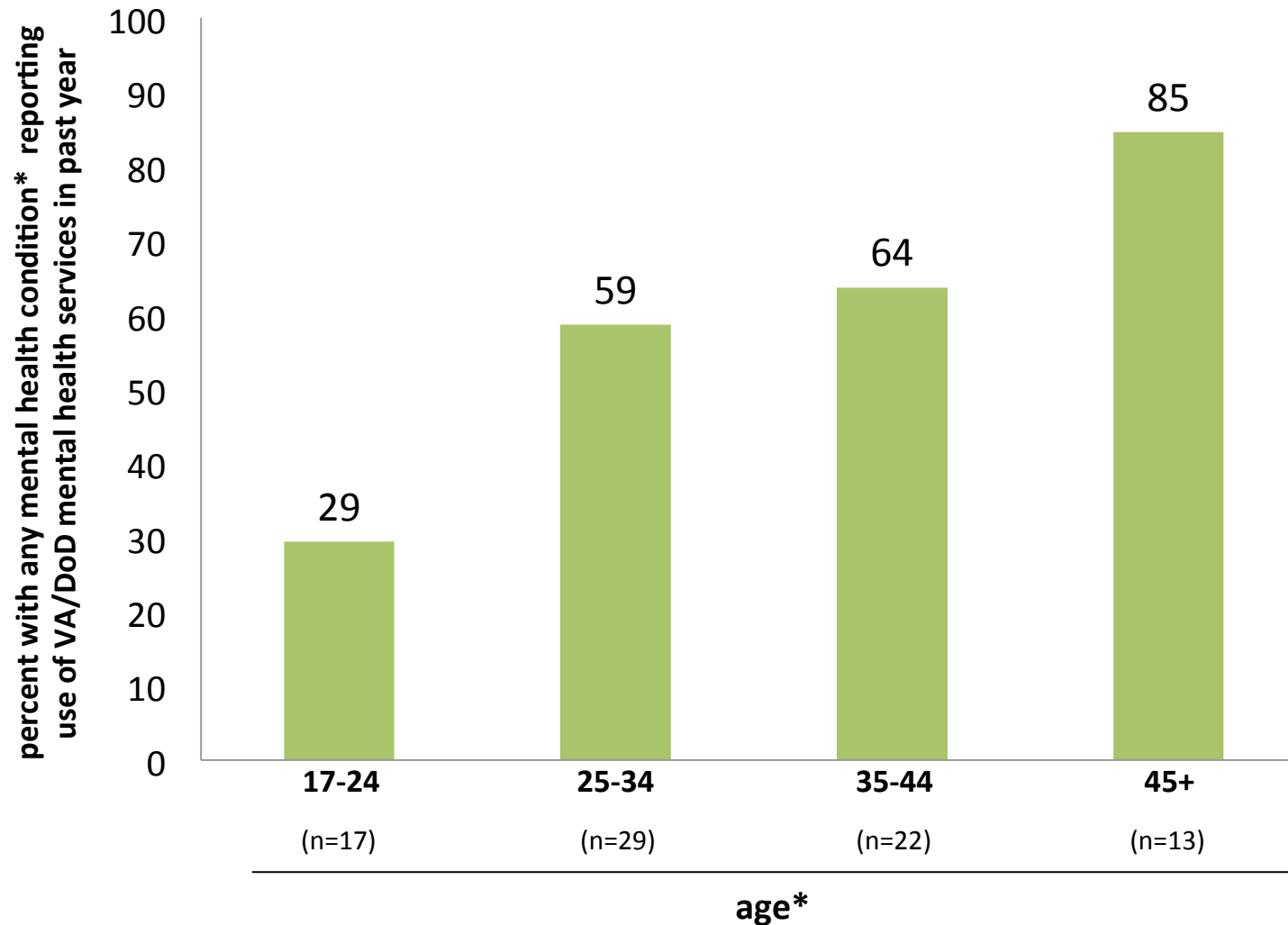
*p<0.05; n=215; mental health conditions included PTSD, depression, GAD, an alcohol use disorder (AUD; including abuse or dependence), or past month suicidal ideation

Gender was not associated with use of any mental health services or use of VA/DoD services



*neither comparison was statistically significant; n=215; mental health conditions included PTSD, depression, GAD, an alcohol use disorder (AUD; including abuse or dependence), or past month suicidal ideation

Age was associated with use of VA/DoD services



*n=81; $p < 0.05$; mental health conditions included PTSD, depression, GAD, an alcohol use disorder (AUD; including abuse or dependence), or past month suicidal ideation

Conclusions

- the majority of ONG soldiers who have mental health care need do not report accessing services
- greater psychiatric burden was associated with higher utilization of mental health services
- alcohol use disorder by far most common reported psychopathology
- those with AUD also least likely to use mental health services
- a little over half of those who access care report utilizing VA or DoD services
- the youngest group of veterans were least likely to use VA/DoD services

Risk-taking behaviors in the Ohio Army National Guard

Deployment and risky driving behavior

Study aim

To investigate the impact of pre-, peri-, and post-deployment factors and psychopathology on risk-taking behaviors in a representative sample of Ohio Army National Guard soldiers.

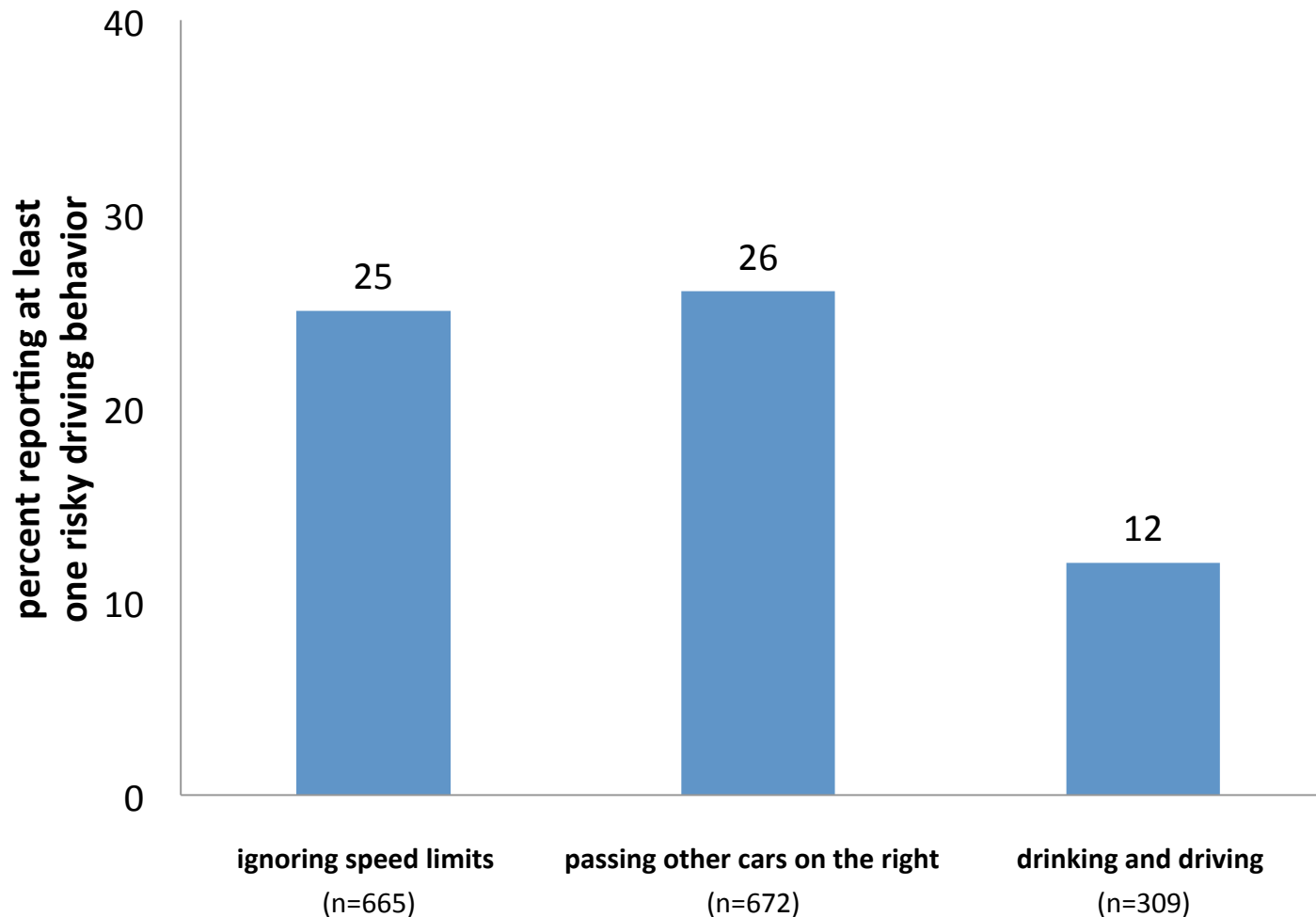
Why examine risk-taking behavior in soldiers?

- deployment-related traumatic events are linked to a propensity for risk-taking (Killgore et al., 2008)
- deployment may lead to some types of risky driving due to a persistence of learned driving behaviors that are normative in deployment settings but potentially dangerous in civilian settings (Fear et al., 2008)
- few studies have examined risky behavior in this population

Risk-taking behaviors of interest

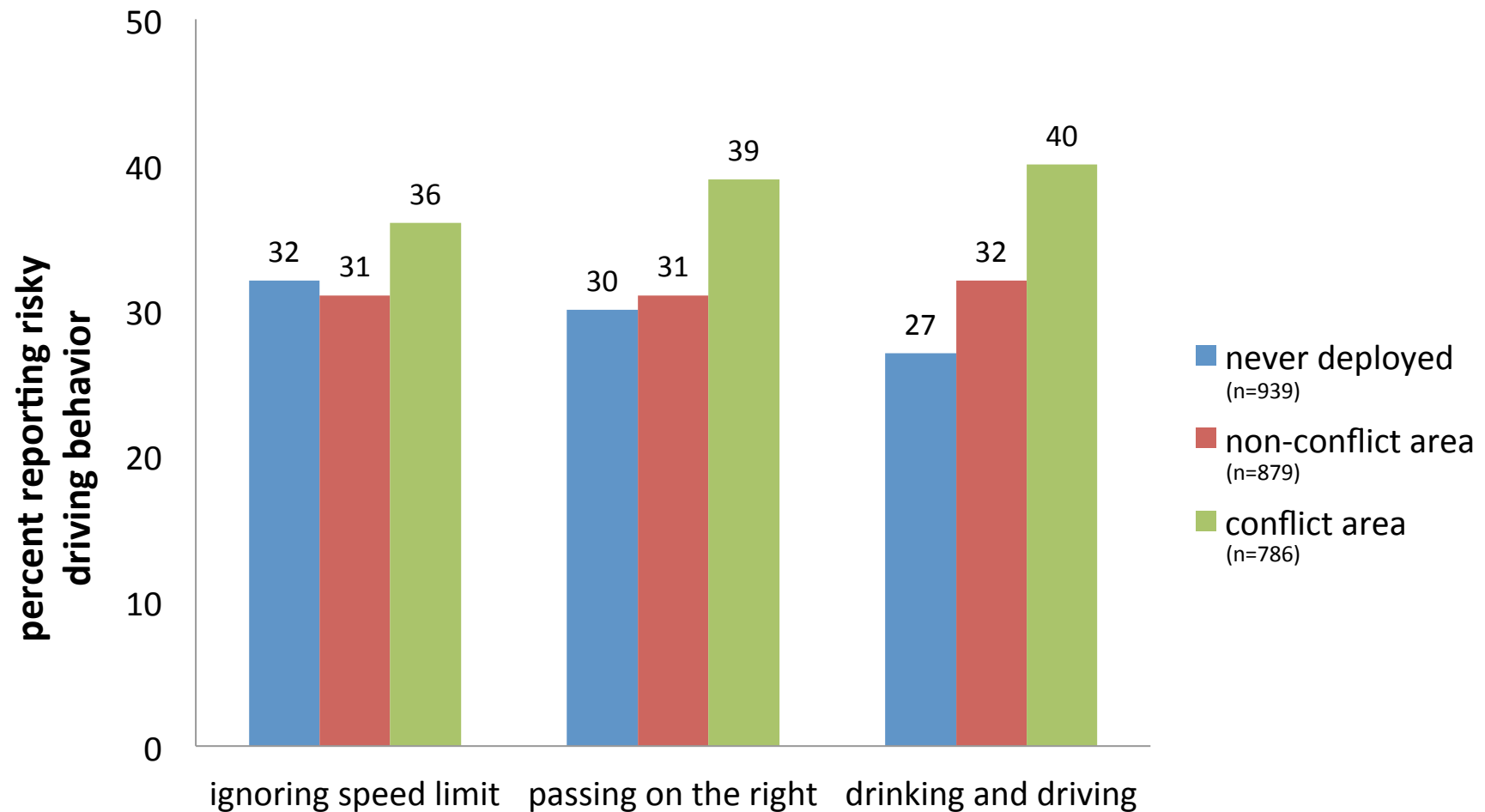
- driving behavior (within past 30 days)
 - drinking and driving
 - passing on the right
 - ignoring speed limits

Among all participants, approximately one quarter reported at least one risky driving behavior



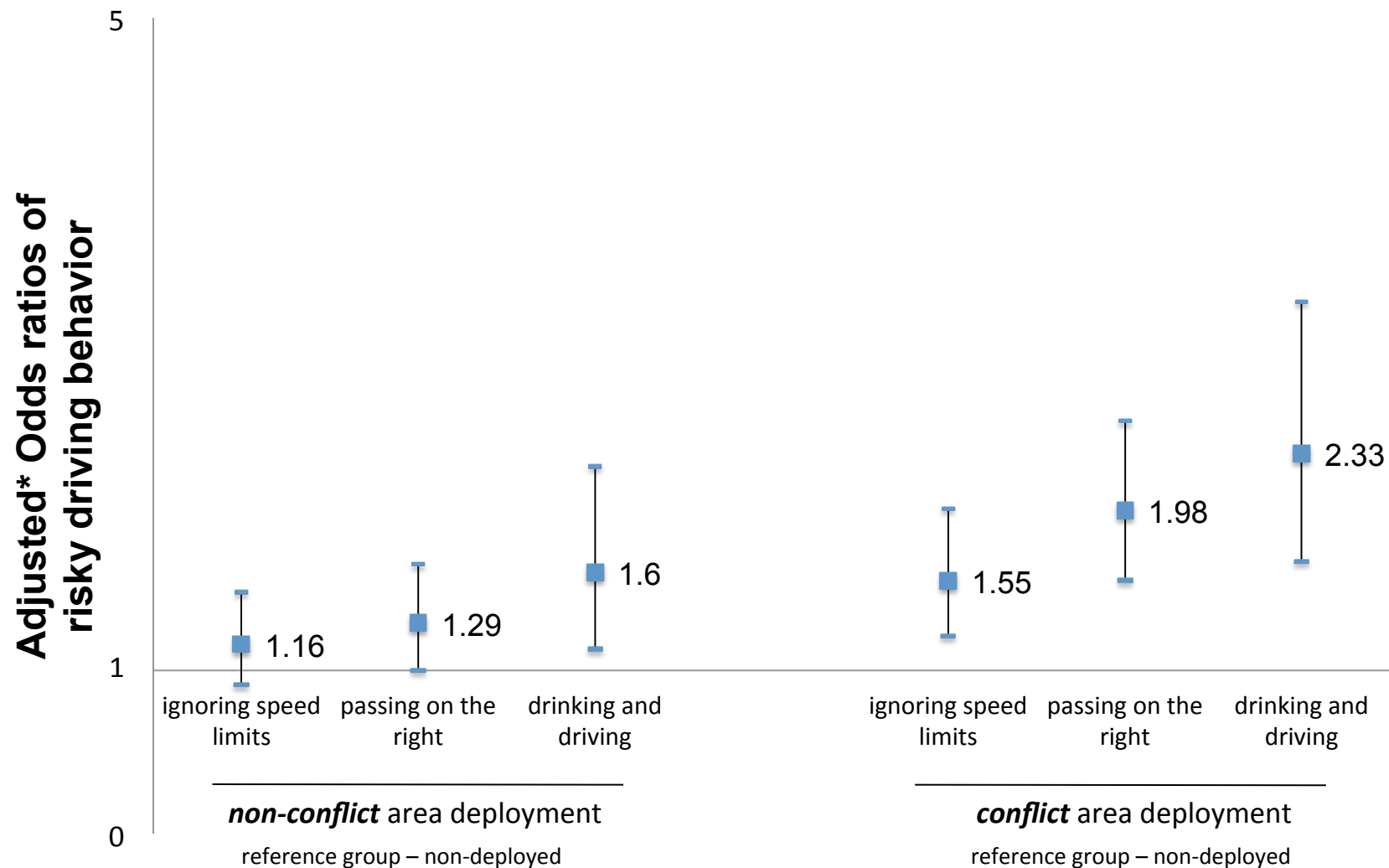
n=2616; in national sample, approximately 2% reported drinking and driving within past 30 days (Bergen et al., 2012)

Conflict area deployment was associated with risky driving behavior*



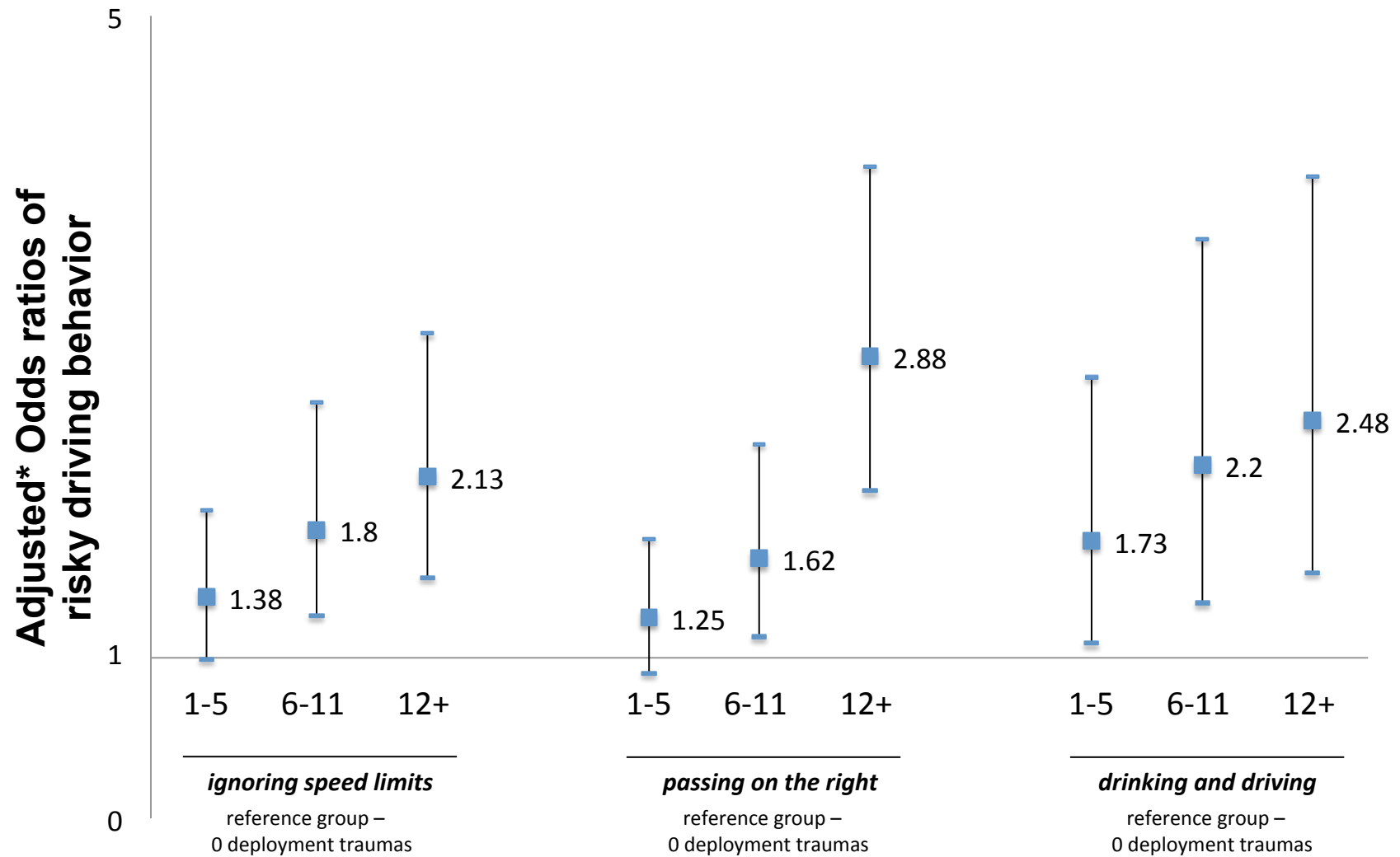
*n=2616; all comparisons significant at $p < 0.01$

Being deployed to a conflict area was associated with all types of risky driving behavior



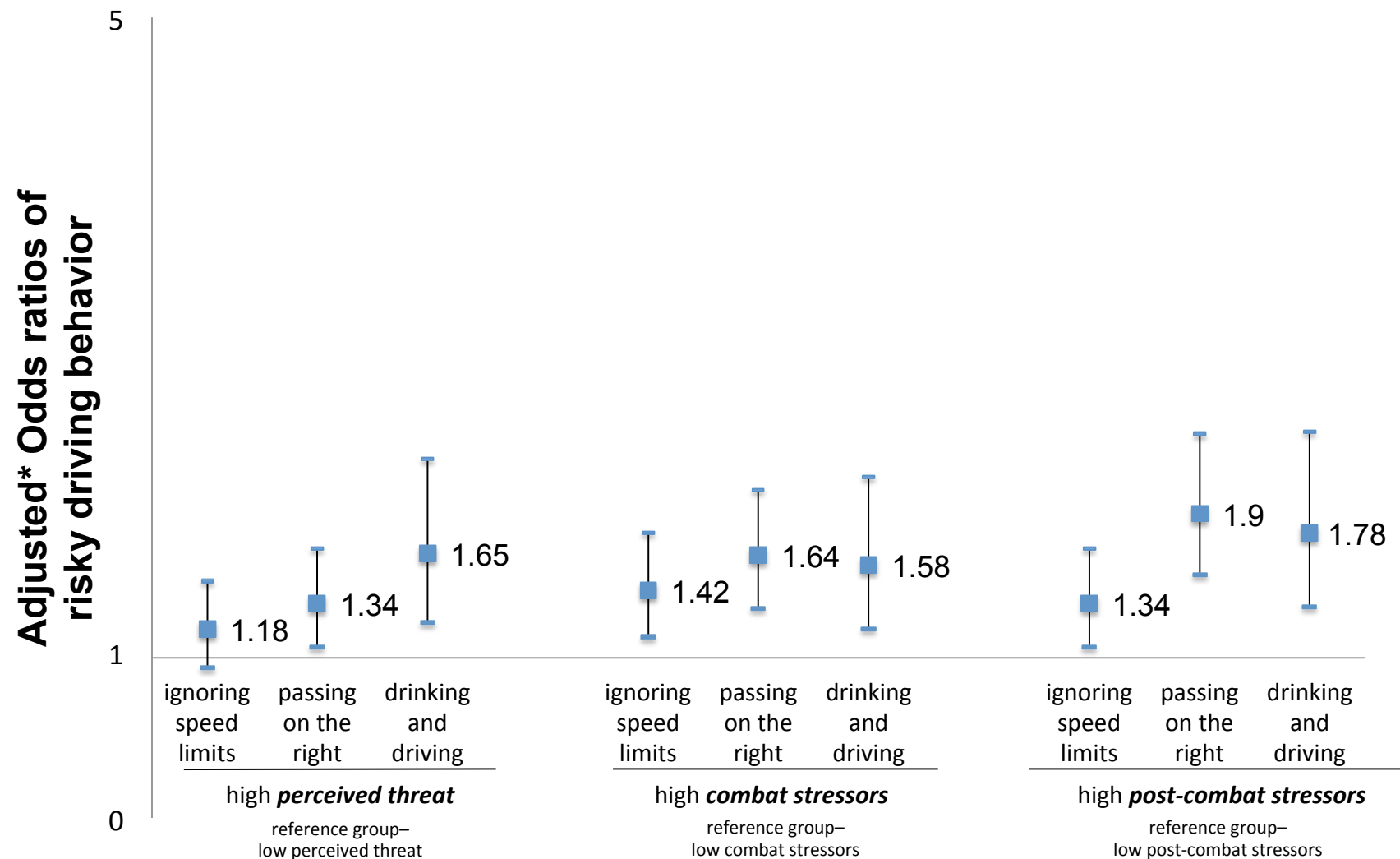
*n=2616; results adjusted for gender, age, race, income, education, marital status and deployment

Dose-response between number of deployment traumas and risky driving



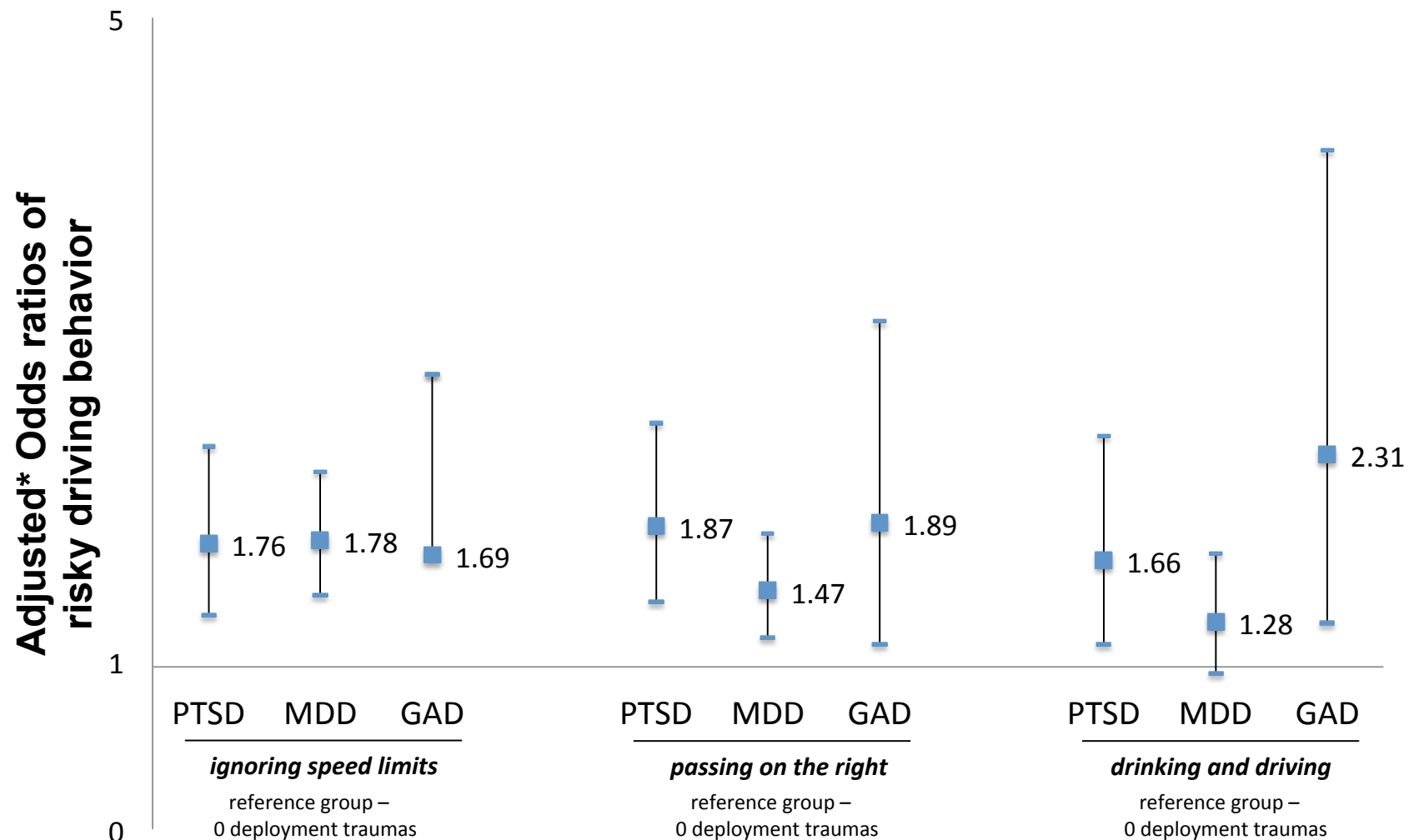
*n=2616; results adjusted for gender, age, race, income, education, marital status and deployment

Several peri-deployment stressors were associated with increased odds of risky driving behavior



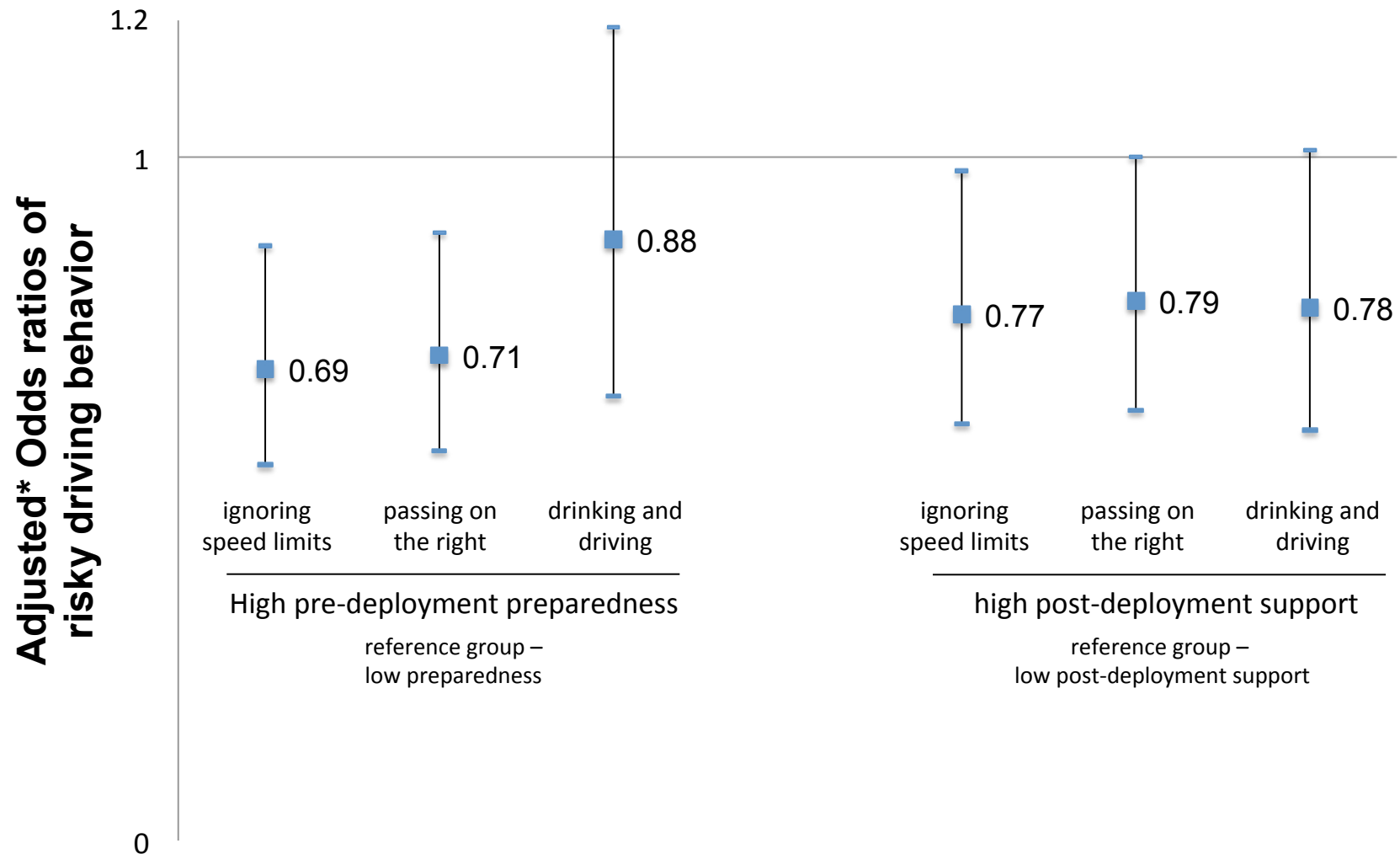
*n=2616; results adjusted for gender, age, race, income, education, marital status and deployment

Psychopathology* was associated with risky driving, adjusting for deployment



*n=2616; results adjusted for gender, age, race, income, education, marital status and deployment; mental health disorders include posttraumatic stress disorder (PTSD), major depressive disorder (MDD), and generalized anxiety disorder (GAD)

Pre-deployment preparedness and post-deployment support were associated with *lower* odds of risky driving



*n=2616; results adjusted for gender, age, race, income, education, marital status and deployment

Conclusions

- deployment, particularly to conflict zones, is associated with risky driving behavior
- quantity of deployment trauma is associated with risky driving behavior in a dose-response fashion
- exposure to high levels of combat trauma is associated with risky driving behavior
- pre-deployment preparedness and post-deployment social support were associated with a reduction in odds of risky driving behavior

PTSD and HIV risk behavior

Study aim

To determine whether PTSD and depression were associated with increased engagement in HIV risk behavior, and examine the direct and indirect effects of PTSD on HIV risk behavior.

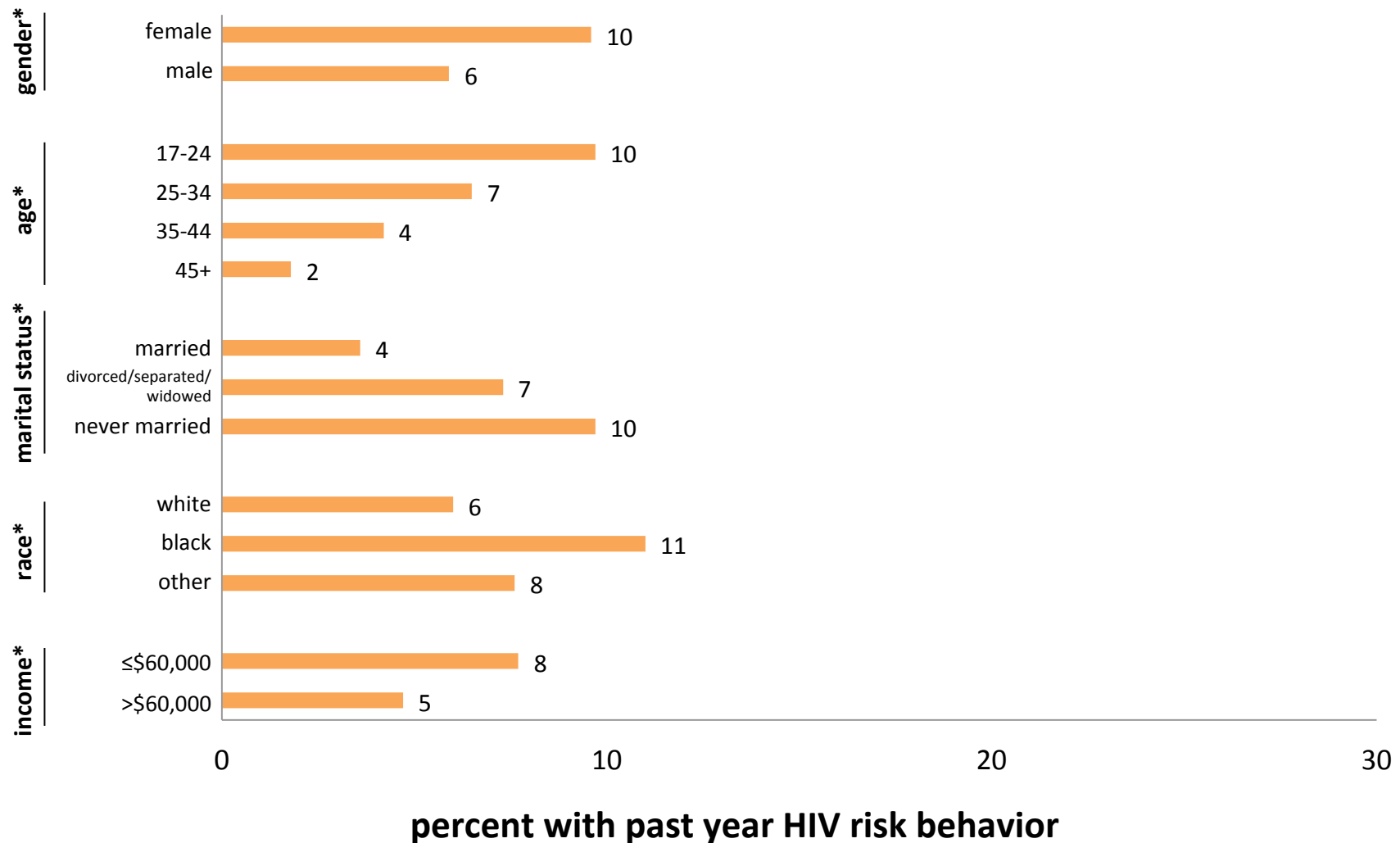
Which HIV risk behaviors did we examine?

- intravenous drug use (past year)
- treatment for a sexually transmitted or venereal disease (past year)
- giving or receiving money or drugs for sex (past year)
- anal sex without a condom (past year)

Why examine the relationship between PTSD and HIV risk behavior in soldiers?

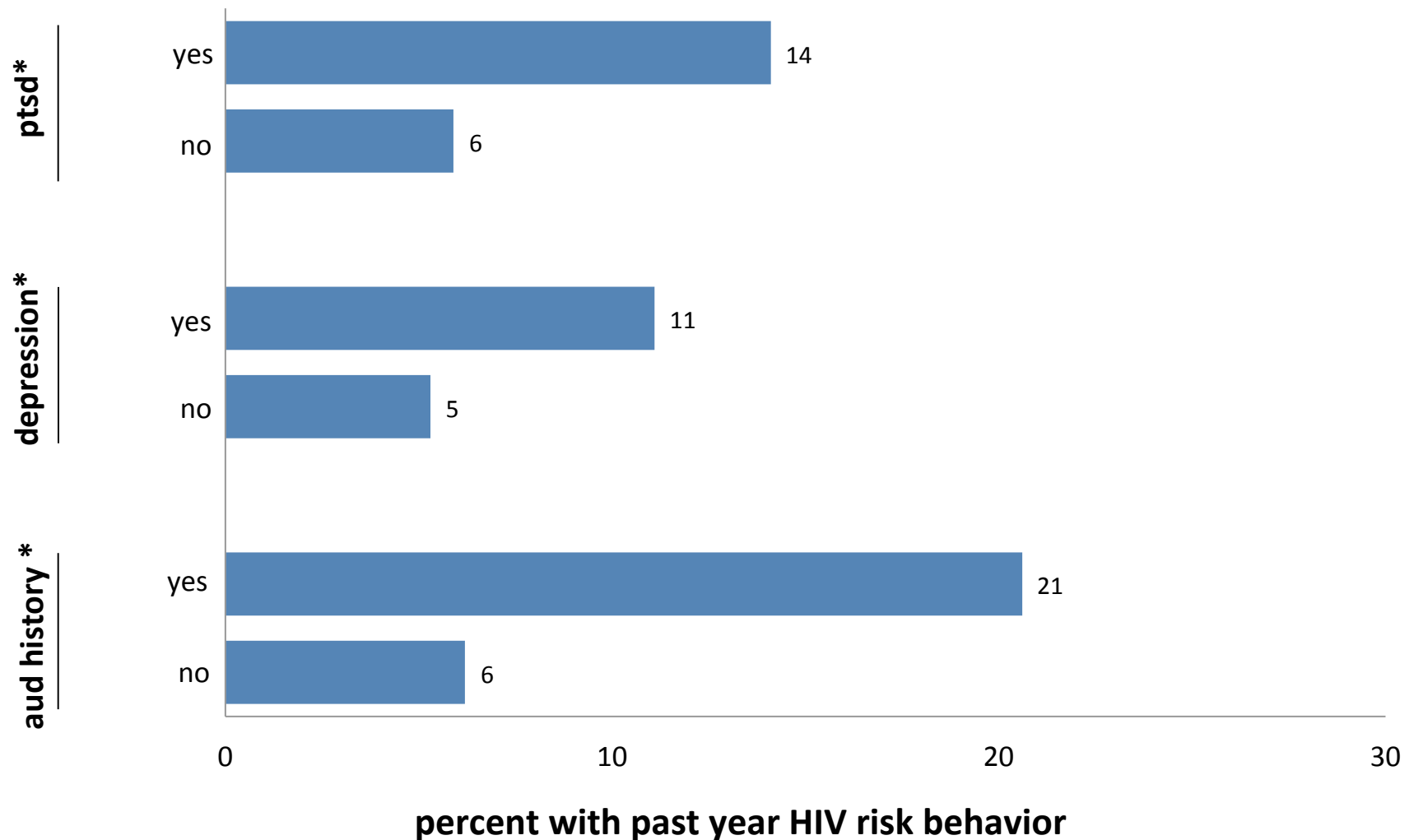
- PTSD is associated with a variety of health behaviors that increase risk of morbidity and mortality (Breslau, Davis and Schulz, 2003, Schnurr & Spiro, 1999)
- growing body of literature documenting an association between PTSD and HIV-risk behavior (Brief et al., 2004)
- some have argued that drug-related HIV risk behavior is the result of efforts to self-medicate (Chilcoat & Breslau, 1998)
- HIV risk behaviors are particularly common among those with co-occurring PTSD and depression

Past year HIV risk behavior was associated with gender, age, marital status, race, and income



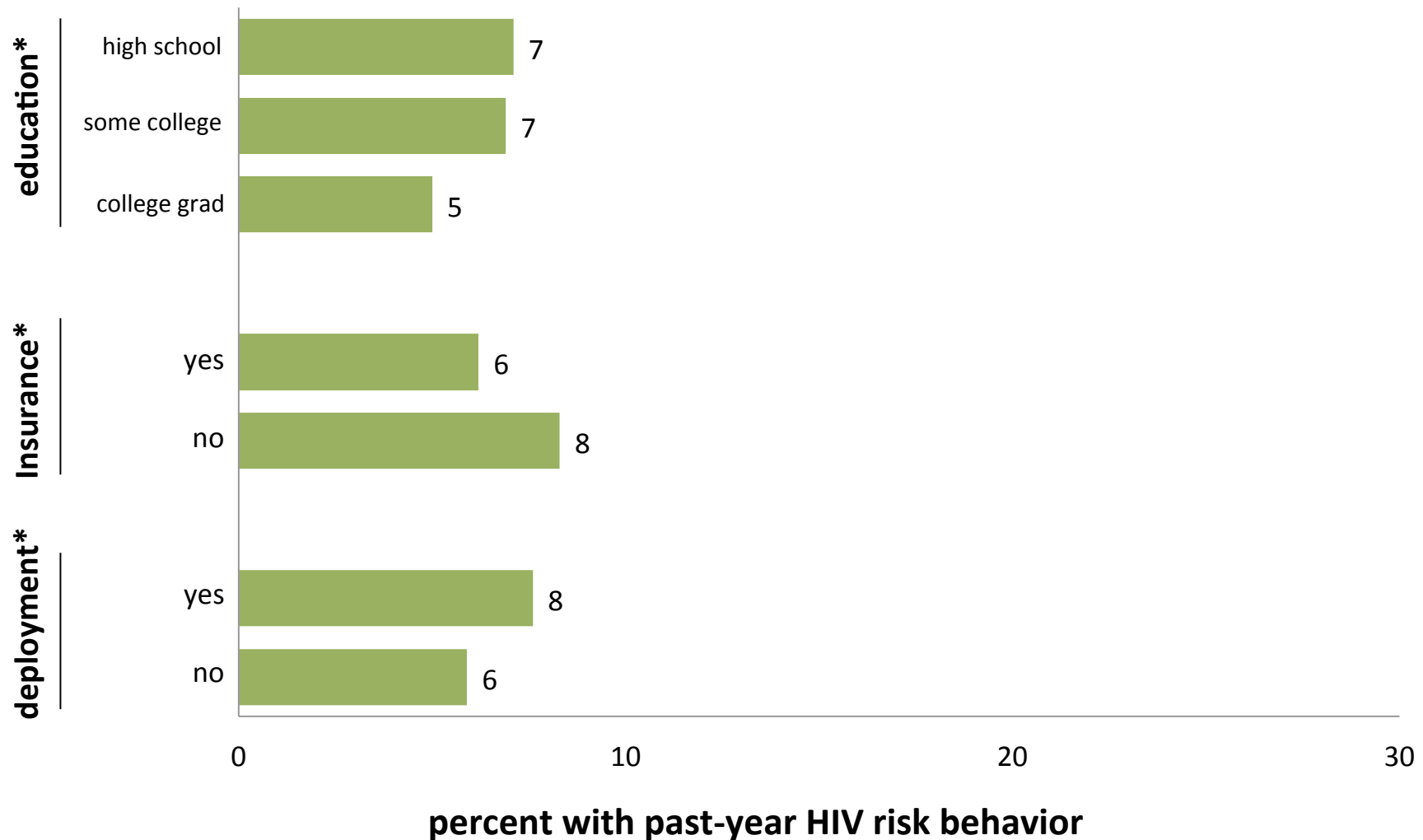
*n=2282; all comparisons significant at $p < 0.01$; div/sep/wid = divorced/separated/widowed

Past year HIV risk behavior was associated with PTSD, depression, and history of alcohol use disorder (AUD)



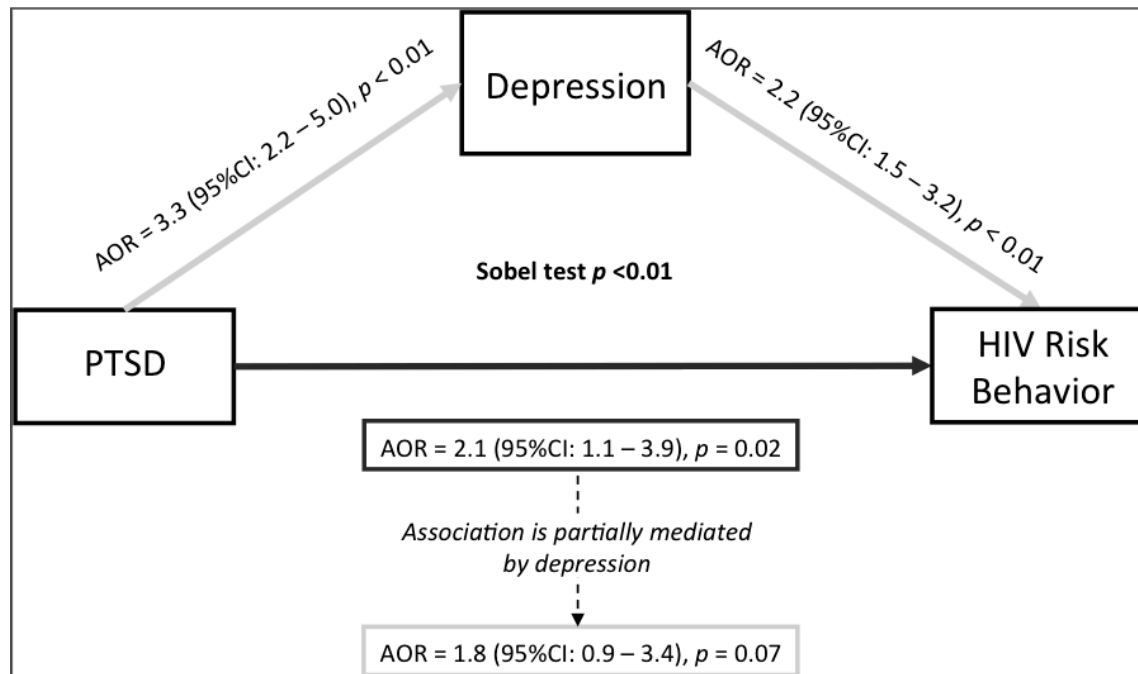
*n=2282; all comparisons significant at $p < 0.01$; aud = alcohol use disorder, including abuse and dependence

Past year HIV risk behavior was not associated with education, insurance status or deployment history



*n=2282; all comparisons non-significant

Depression partially mediates the association between PTSD and HIV risk behavior



Conclusions

- soldiers with PTSD may be at greater risk of HIV infection due to increased engagement in HIV risk behavior
- new-onset depression following trauma mediates this relationship
- integrated interventions to address mental health problems and reduce HIV risk behavior are needed

Sexual trauma and psychiatric comorbidity

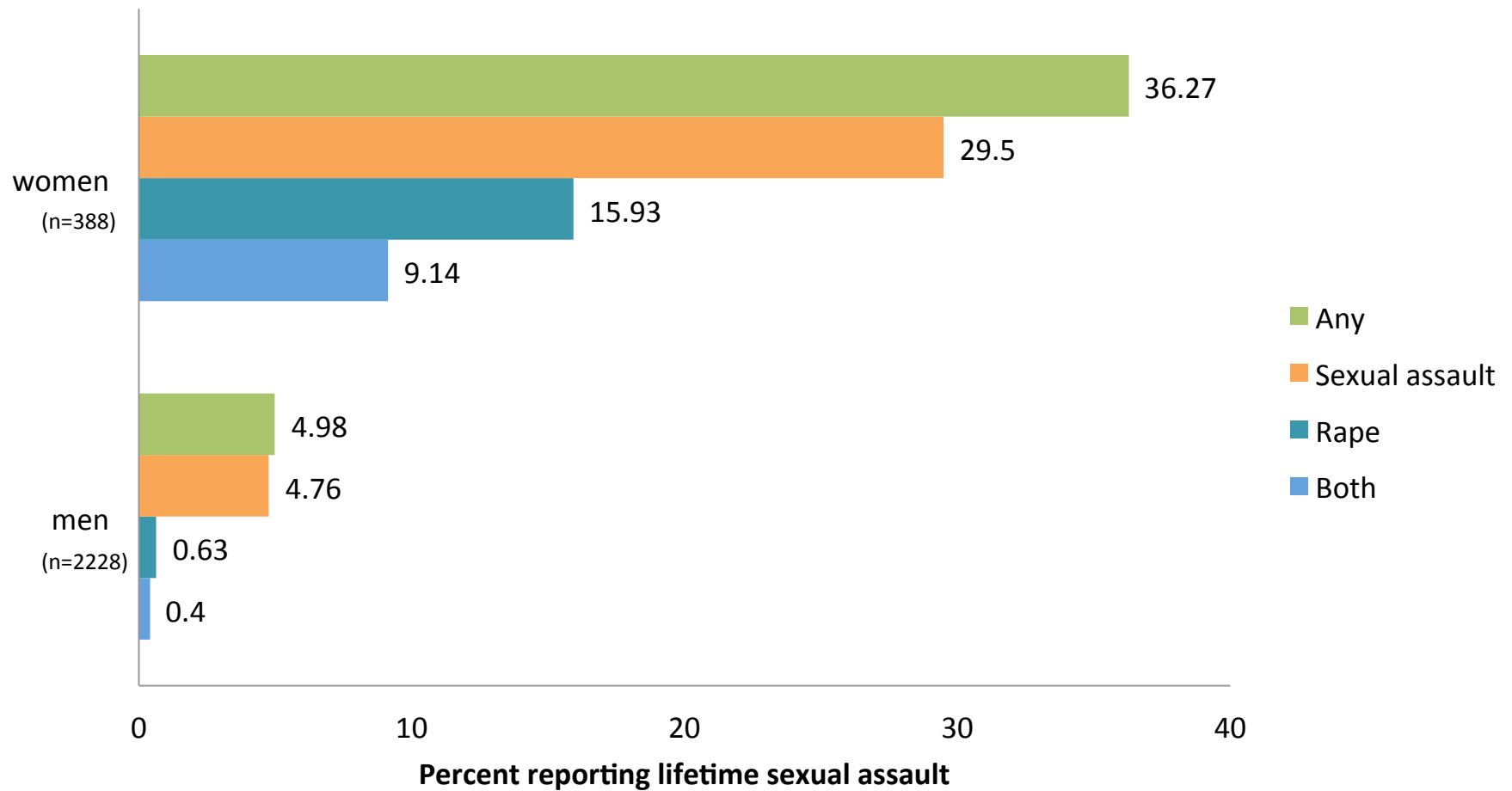
Study aim

To establish prevalence estimates for lifetime sexual trauma exposure among ONG soldiers and examine the prevalence of PTSD, MDD, and comorbid PTSD and MDD among soldiers reporting lifetime sexual trauma

Sexual trauma variables

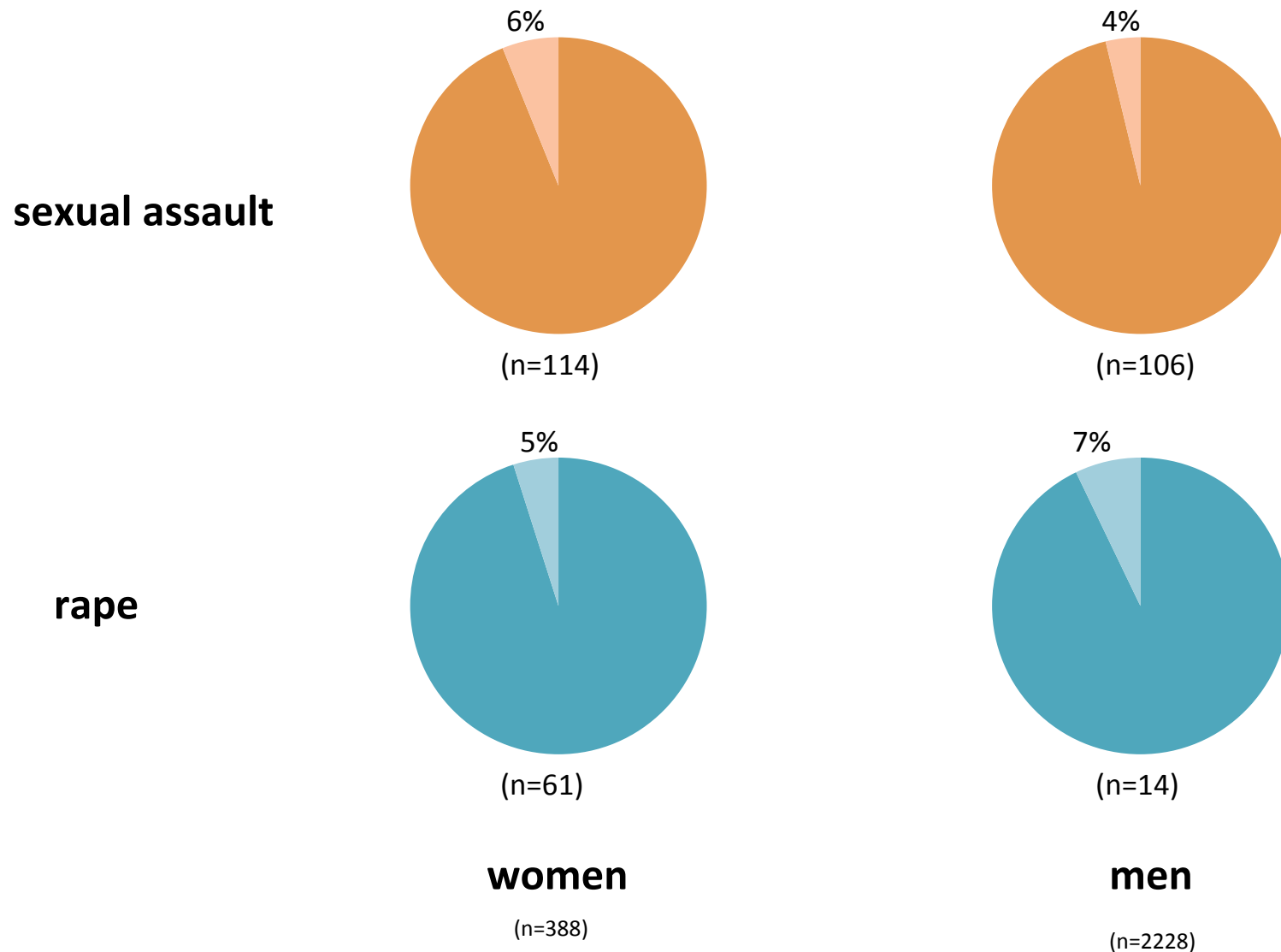
- rape – “In your lifetime, have you ever been raped?”
- sexual assault – “In your lifetime, have you ever experienced another kind of sexual assault or unwanted sexual contact as a result of force, threat of harm, or manipulation?”
- any sexual trauma – either rape or sexual assault

Gender distribution of lifetime sexual assault



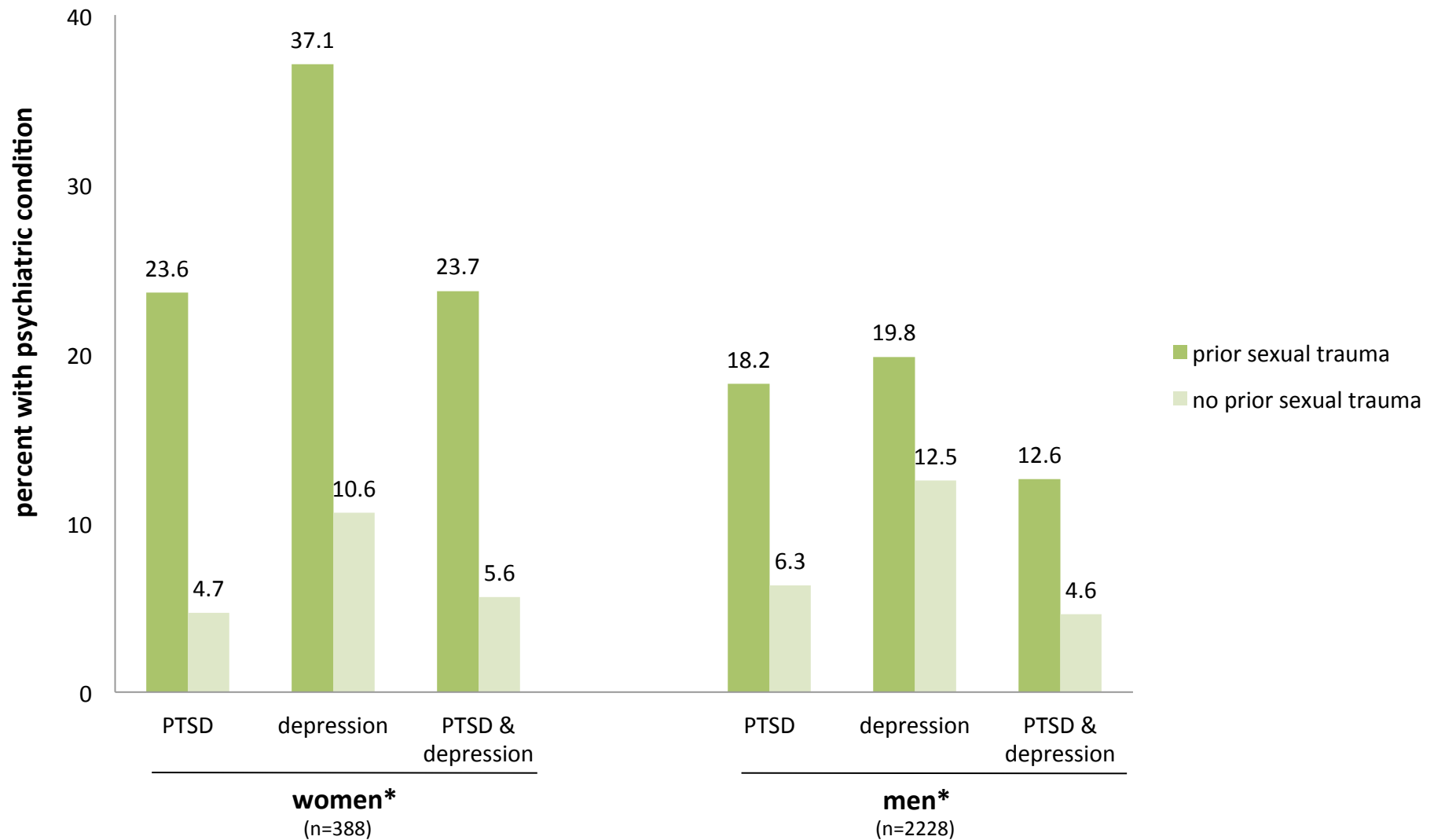
n=2616

Of sexual traumas reported, only a small percent occurred during most recent deployment



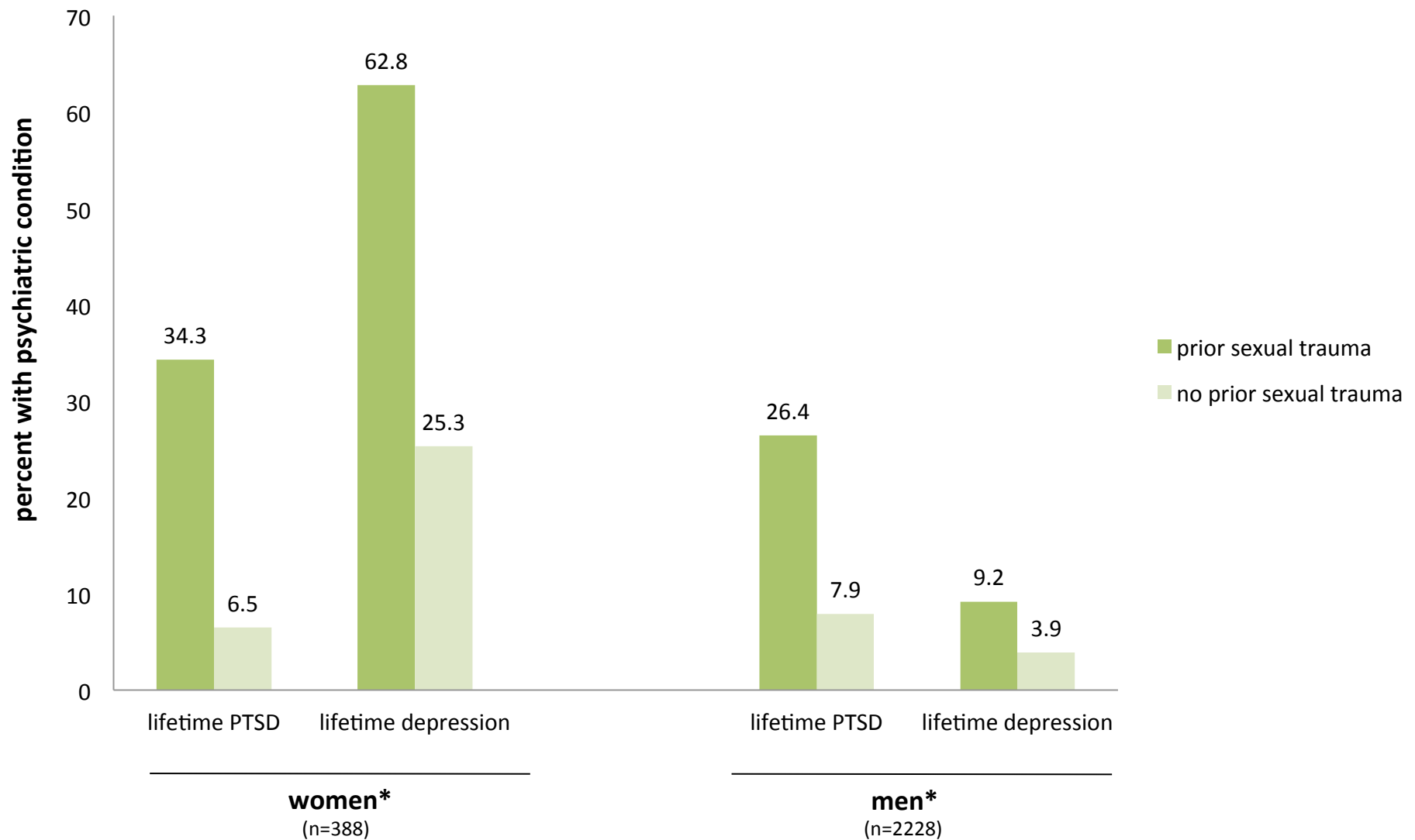
n=2616

Past year PTSD, depression and both by sexual trauma exposure



n=2616; *all comparisons significant at $p < 0.001$

Lifetime PTSD and depression by sexual trauma exposure



n=2616; *all comparisons significant at $p < 0.001$

Conclusions

- most reported sexual trauma did not occur in the context of deployment
- presence of any sexual trauma was strongly associated with PTSD and depression
- presence of sexual trauma is an important risk factor for PTSD and depression among National Guard soldiers

Differences between war- and civilian-related PTSD

Heterogeneity of PTSD

- Etiologic
- Clinical

Diagnostic differences

- Criterion A2

Co-morbidity differences

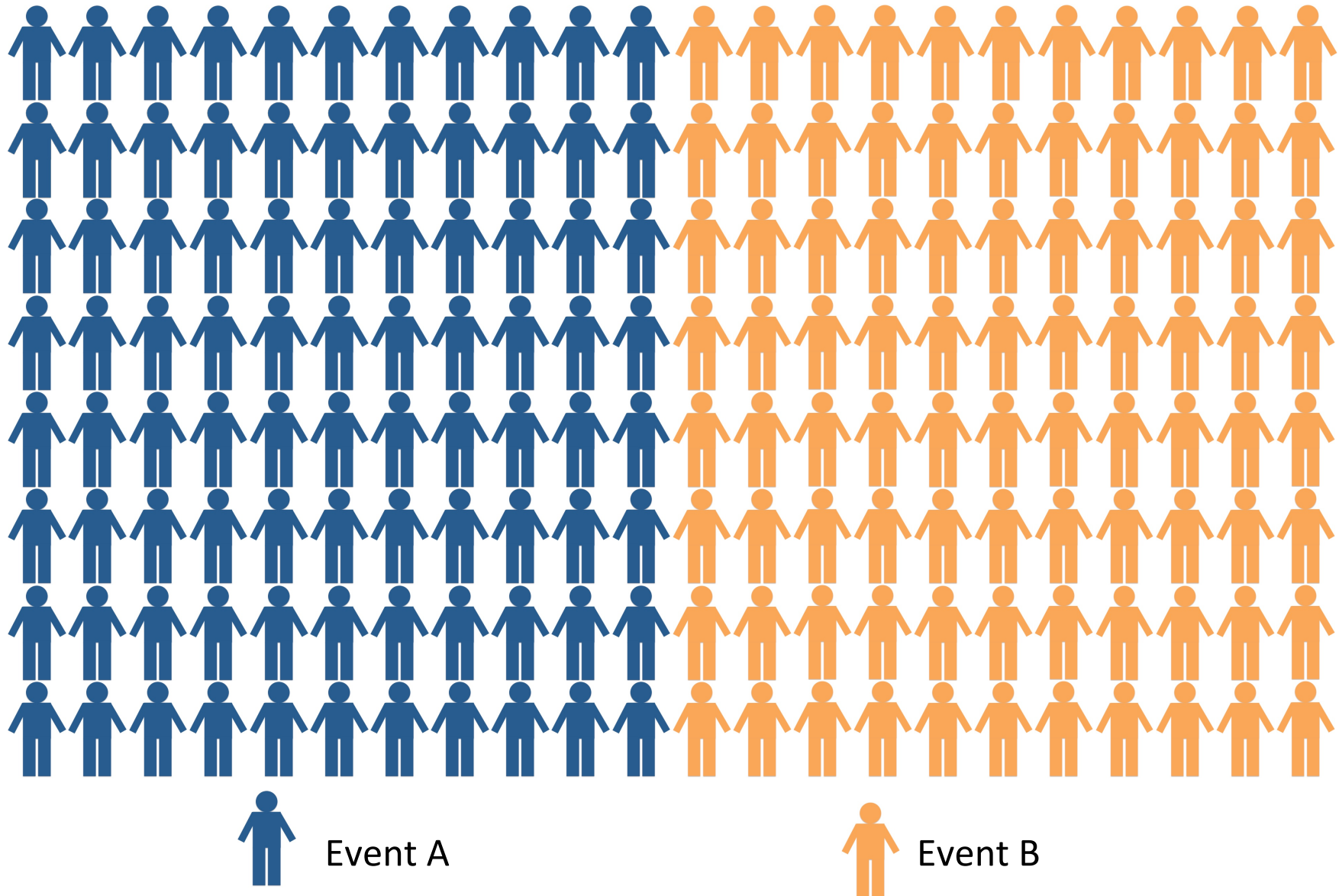
- Suicidal ideation

How can we compare PTSD symptoms after different traumatic events?

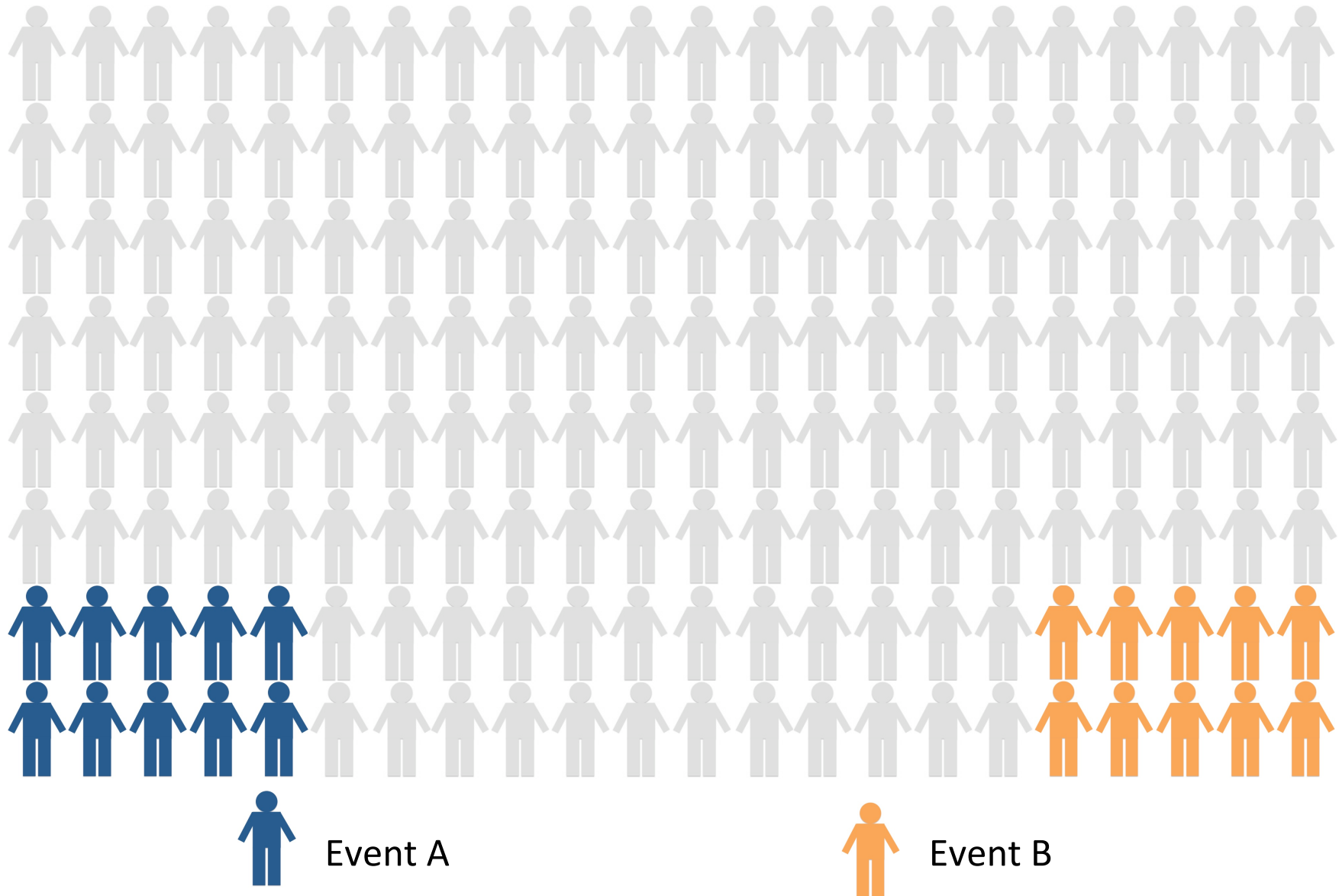
Heterogeneity of PTSD

- Etiologic
- Clinical

Etiologic heterogeneity



Clinical heterogeneity



Could differences in traumatic event experiences affect the way we diagnose PTSD?



Criterion A2

- Fear, helplessness, horror
- Added to DSM-IV in the role of gatekeeper
- Not all events are likely to produce “fear, helplessness, and/or horror”

After certain events, do individuals who do not report criterion A2 develop the remaining PTSD symptom criteria (B-F)?

Could differences in traumatic event experiences
affect other mental health outcomes?



Study sample (N=898)

War-related event group (N= 250)

- Experienced one of 3 categories of potentially traumatic events* from deployment to a combat zone and never experienced these events outside of this deployment

Civilian event group (N= 648)

- Experienced one of 3 categories of potentially traumatic events* and have never been deployed or never deployed to a combat zone

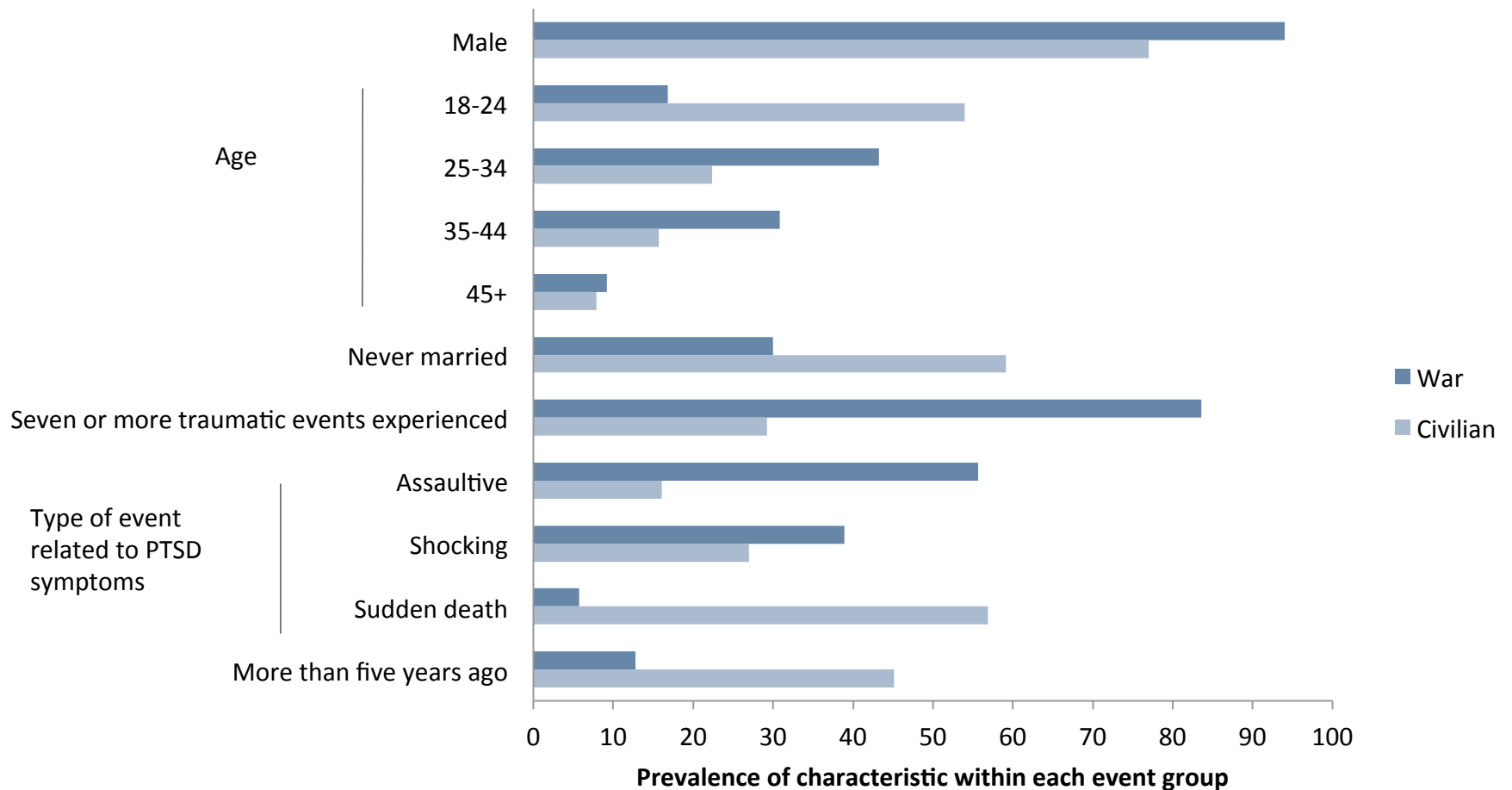


*Potentially traumatic events include assaultive, shocking events, sudden death of loved ones

Heterogeneity of PTSD

- Etiologic
- Clinical

Characteristics among those with war-related and civilian-related events



All displayed characteristics were significantly different.

Soldiers with war-events had lower odds of reporting certain symptoms than those with civilian events

Symptoms of PTSD	Adjusted OR* (95%CI)
Criterion A2 Fear, hopelessness or horror	0.46 (0.29 ,0.73)
Criterion B symptoms	0.56 (0.36, 0.87)
Intrusive memories (B1)	0.53 (0.34,0.84)
Nightmares (B2)	0.95 (0.56,1.6)
Flashbacks (B3)	0.78 (0.44,1.39)
Psychological reactivity (B4)	0.62 (0.39,0.98)
Physiological reactivity (B5)	1.38 (0.78,2.43)

*Adjusted for gender, age, marital status, total number of events ever experienced, history of depression before the event, history of PTSD before the event, category of event used to assess PTSD, and if the event occurred more than 5 years ago.

Soldiers with war-events had lower odds of reporting certain symptoms than those with civilian events

Symptoms of PTSD	Adjusted OR* (95%CI)
Criterion A2 Fear, hopelessness or horror	0.46 (0.29 ,0.73)
Criterion B symptoms	0.56 (0.36, 0.87)
Intrusive memories (B1)	0.53 (0.34,0.84)
Nightmares (B2)	0.95 (0.56,1.6)
Flashbacks (B3)	0.78 (0.44,1.39)
Psychological reactivity (B4)	0.62 (0.39,0.98)
Physiological reactivity (B5)	1.38 (0.78,2.43)

*Adjusted for gender, age, marital status, total number of events ever experienced, history of depression before the event, history of PTSD before the event, category of event used to assess PTSD, and if the event occurred more than 5 years ago.

Similar reporting for symptoms of avoidance and numbness

Symptoms of PTSD	Adjusted OR (95%CI)
Criterion C	0.78 (0.45, 1.34)
Avoid thinking about event (C1)	0.70 (0.44,1.12)
Avoid activities (C2)	0.64 (0.38,1.09)
Trouble remembering (C3)	0.72 (0.35,1.45)
Diminished interest (C4)	0.89 (0.47,1.69)
Detached from people (C5)	0.79 (0.45,1.38)
Feeling emotionally numb/restricted affect (C6)	0.79 (0.43,1.45)
Foreshortened future (C7)	0.88 (0.45,1.73)

*Adjusted for gender, age, marital status, total number of events ever experienced, history of depression before the event, history of PTSD before the event, category of event used to assess PTSD, and if the event occurred more than 5 years ago.

Similar reporting of symptoms of hyperarousal, duration, impairment and PTSD

Symptoms of PTSD	Adjusted OR (95%CI)
Criterion D	1.62 (0.998, 2.64)
Insomnia (D1)	1.23 (0.73, 2.07)
Irritability (D2)	1.14 (0.67,1.94)
Concentration problems (D3)	1.23 (0.71, 2.14)
Hyper-vigilance (D4)	0.87 (0.55, 1.38)
Exaggerated startle (D5)	1.29 (0.75, 2.21)
Criterion E symptoms for 1 month	1.05 (0.64, 1.73)
Criterion F social or functional impairment	0.83 (0.516, 1.33)
DSM-IV PTSD	1.30 (0.61, 2.80)

*Adjusted for gender, age, marital status, total number of events ever experienced, history of depression before the event, history of PTSD before the event, category of event used to assess PTSD, and if the event occurred more than 5 years ago.

Discussion and conclusion

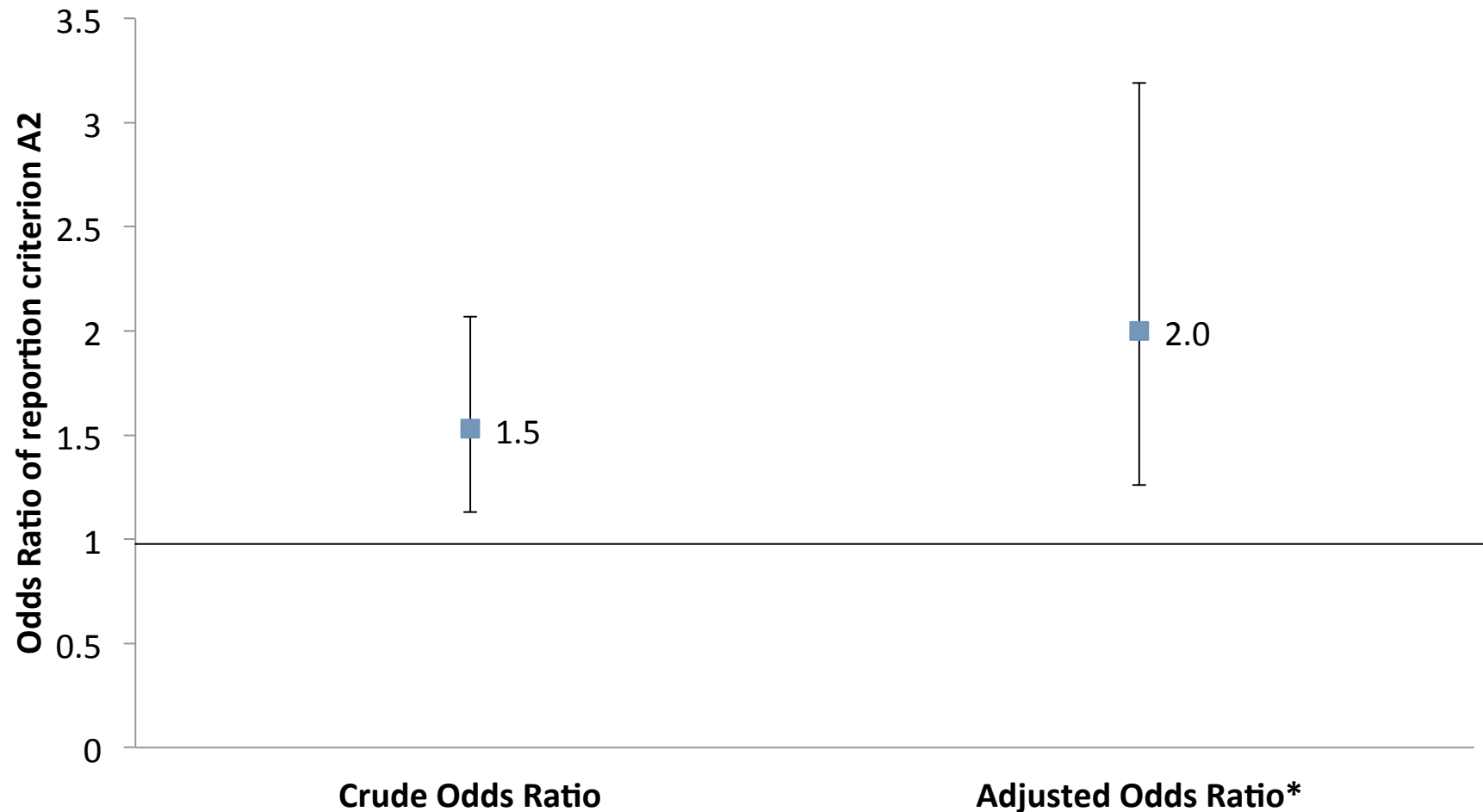
clinical heterogeneity

- soldiers with war-related events had lower odds of reporting certain symptoms compared to soldiers with civilian events
 - criterion A2
 - criterion B



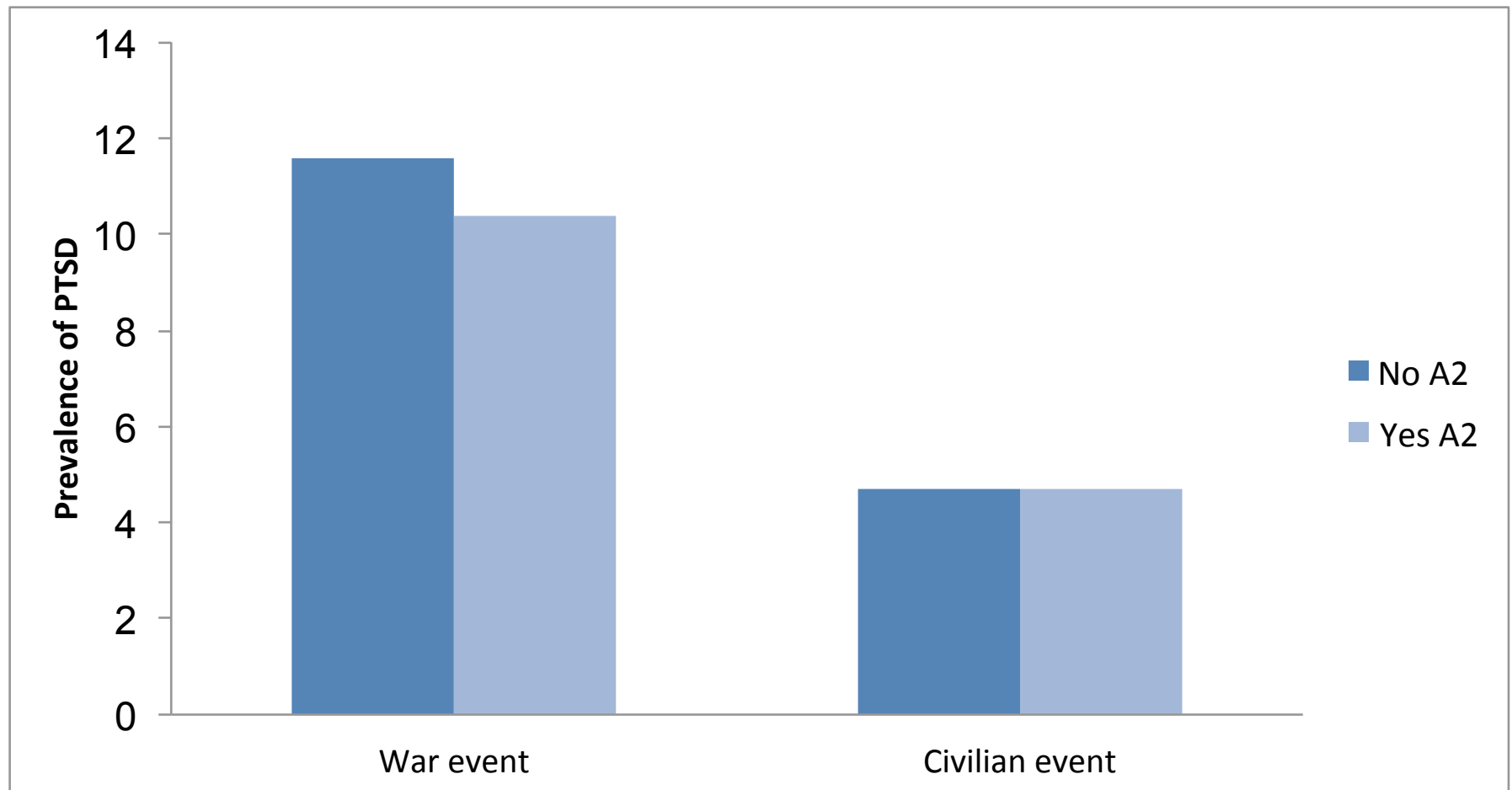


Those with civilian events were more likely to report criterion A2

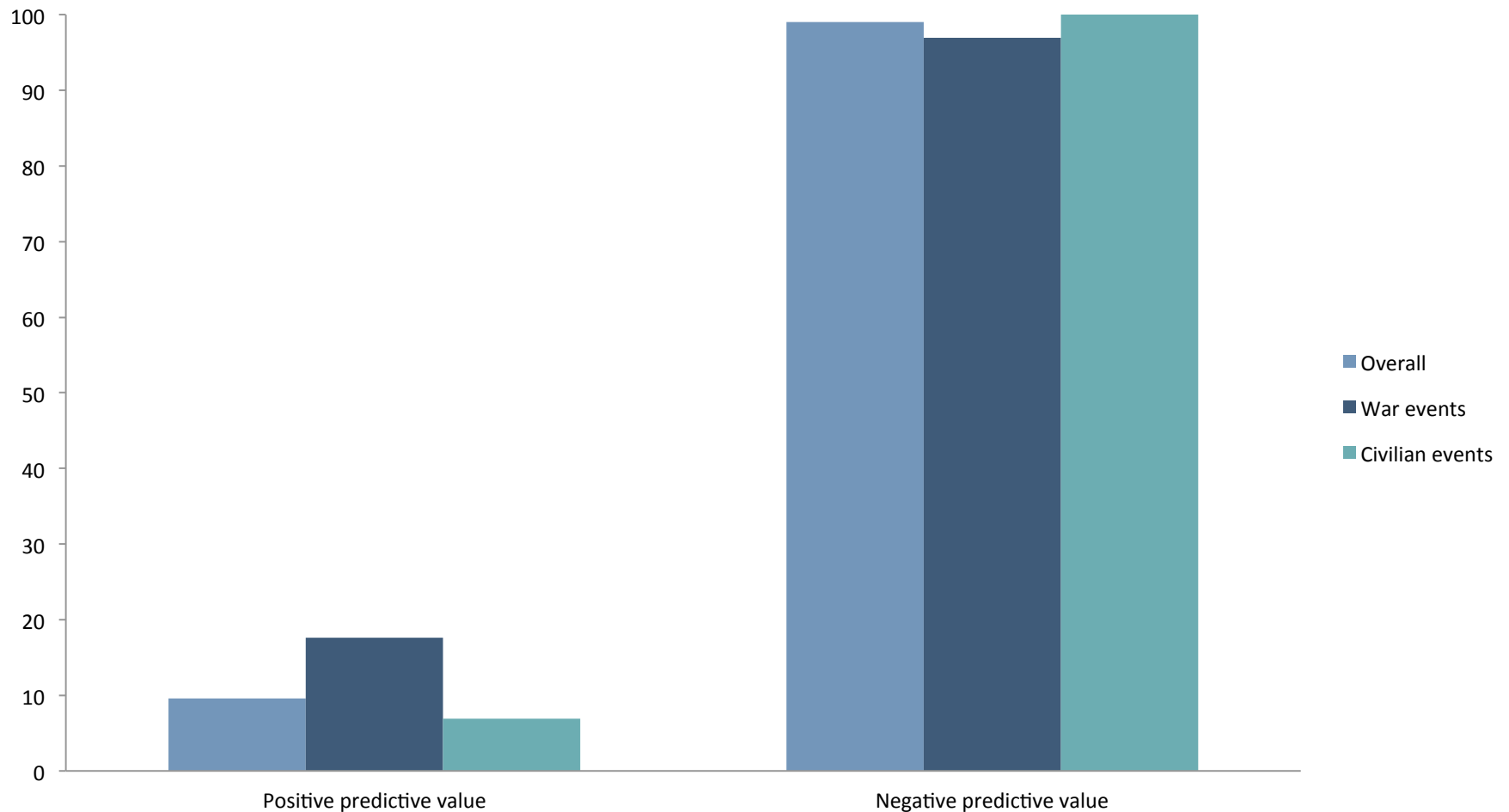


*Model is adjusted for sex, age, marital status, number of events ever experienced, history of PTSD before the event, history of alcohol abuse before the event, the category of index event (assaultive (reference), shocking event, or the sudden death of a loved one), and if the event occurred more than five years ago.

Prevalence of PTSD changes little depending on requirement of A2



Those who do *not* report criterion A2 are likely to *not* have the remaining PTSD symptom criteria

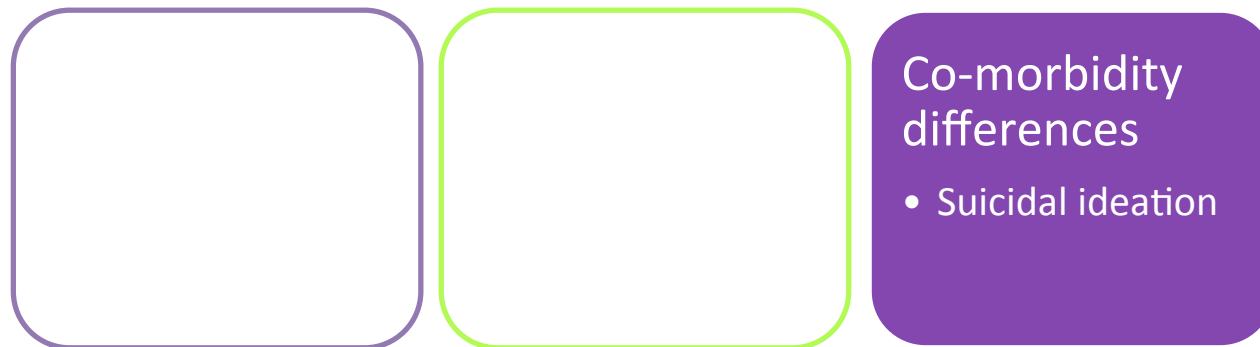


Discussion and conclusion

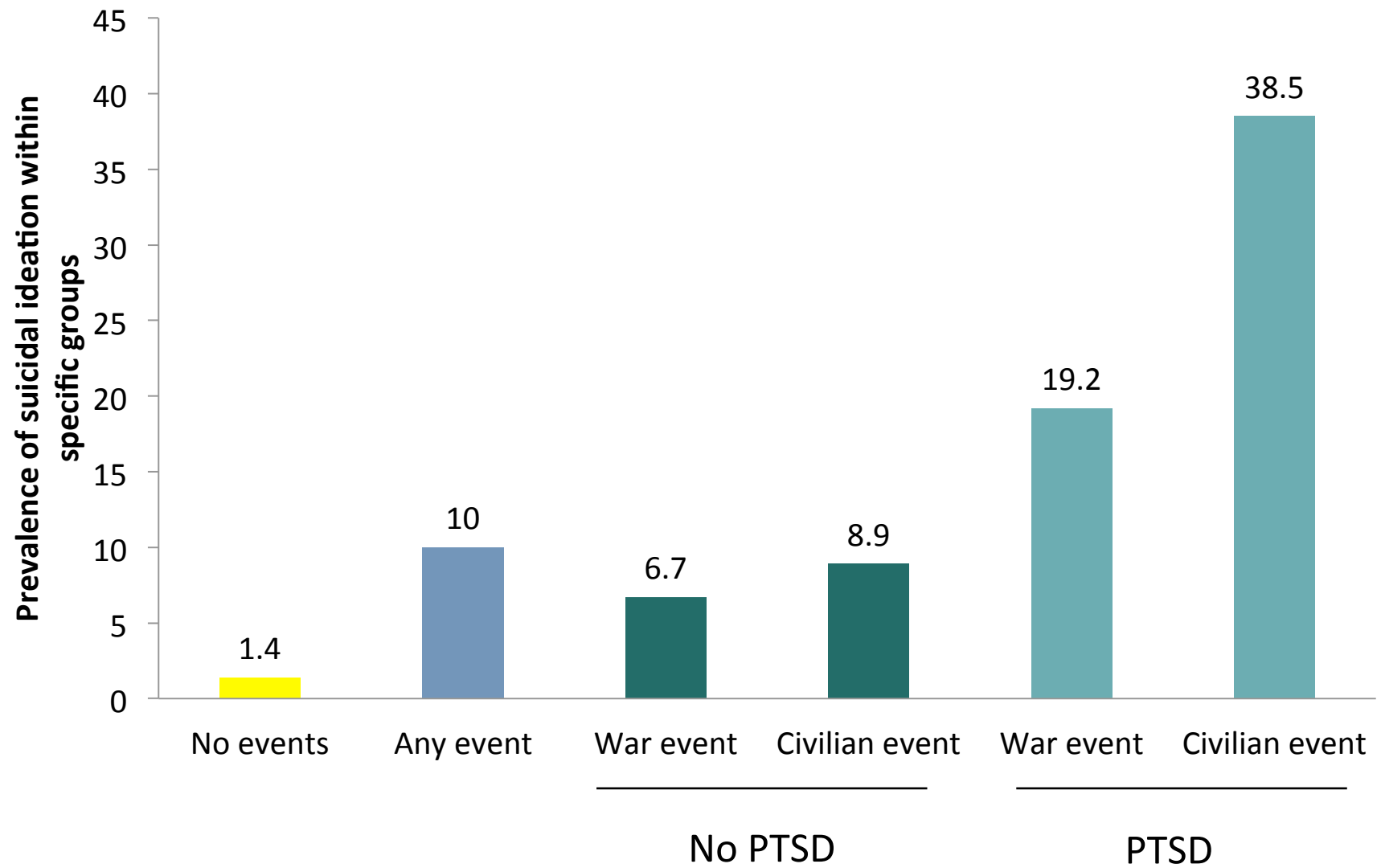
Reporting of criterion A2 for war-related events

- Does not affect prevalence of PTSD
- Low positive predictive value (9%) and high negative predictive value (99%)

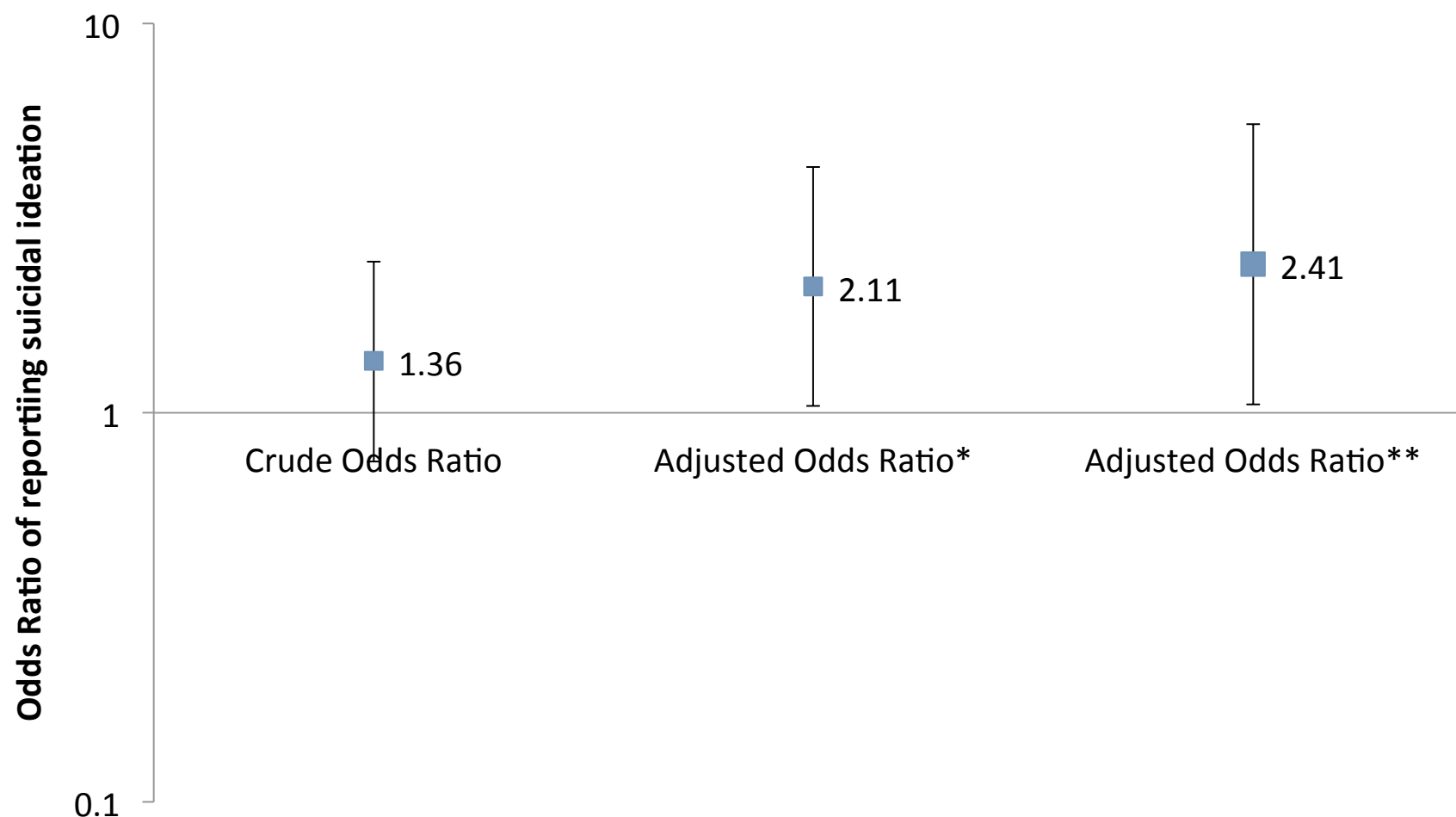




Any event matters



Among those without PTSD, soldiers with civilian events are more likely to report suicidal ideation than those with war events.



*Model is adjusted for sex, age, number of events ever experienced, history of PTSD before the event, history of alcohol abuse before the event, the category of index event (assaultive (reference), shocking event, or the sudden death of a loved one), and if the event occurred more than five years ago. ** model also adjusted for marital status

Conclusions

- presence of etiologic and clinical heterogeneity
- experience of any event is associated with suicidal ideation compared to those who do not experience an event
- soldiers who experience civilian-related events are more likely to report suicidal ideation than are soldiers with war-related events
 - Healthy warrior effect, more severe events
 - Unit support and preparedness
 - Mental health services
- criterion A2 did not affect the prevalence of PTSD



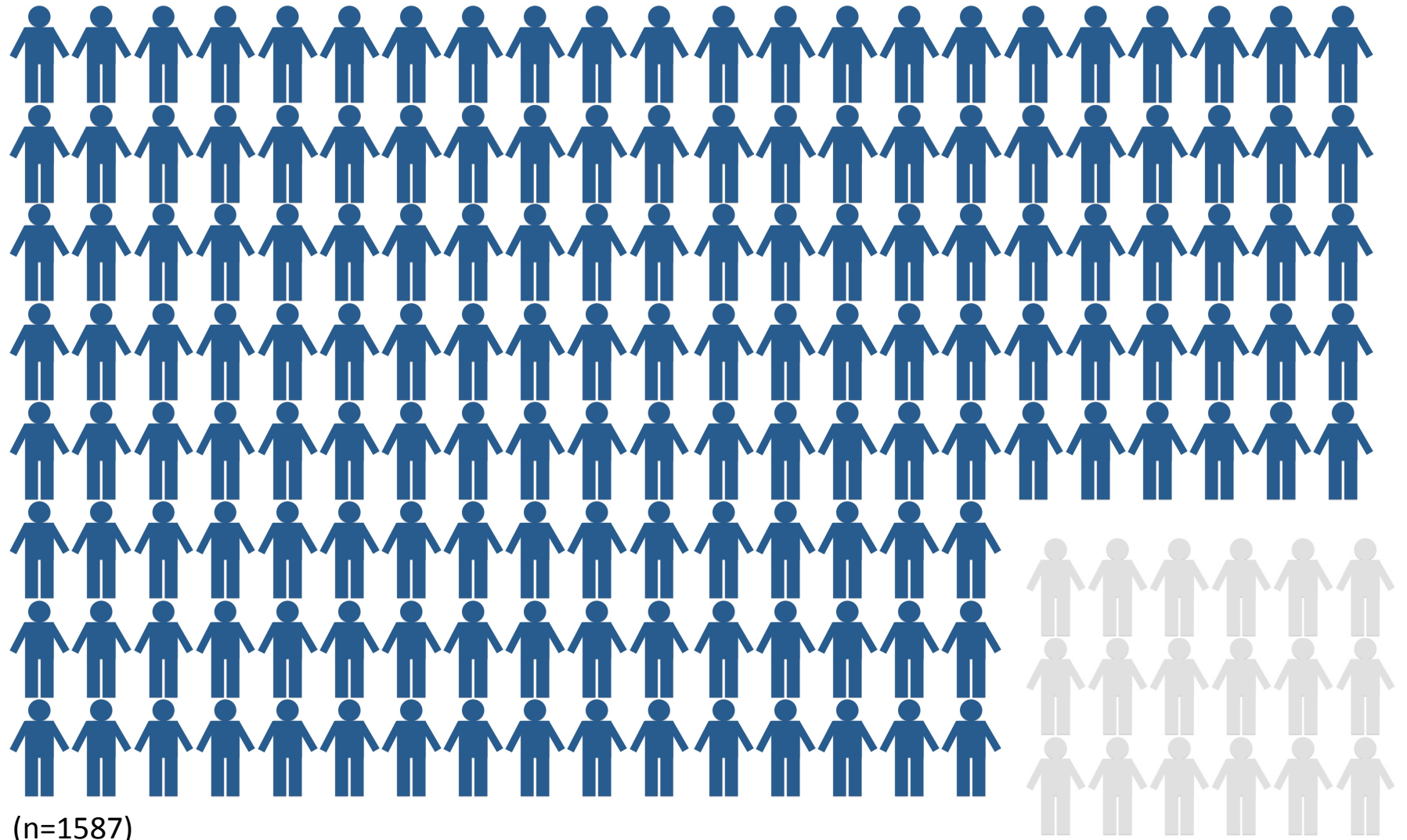
Addictive behaviors, depression and suicidal ideation in the ONG

Alcohol dependence and incident suicidal ideation

Study aim

To investigate the longitudinal relationship between alcohol dependence and incident suicidal ideation in a representative sample of Ohio Army National Guard soldiers.

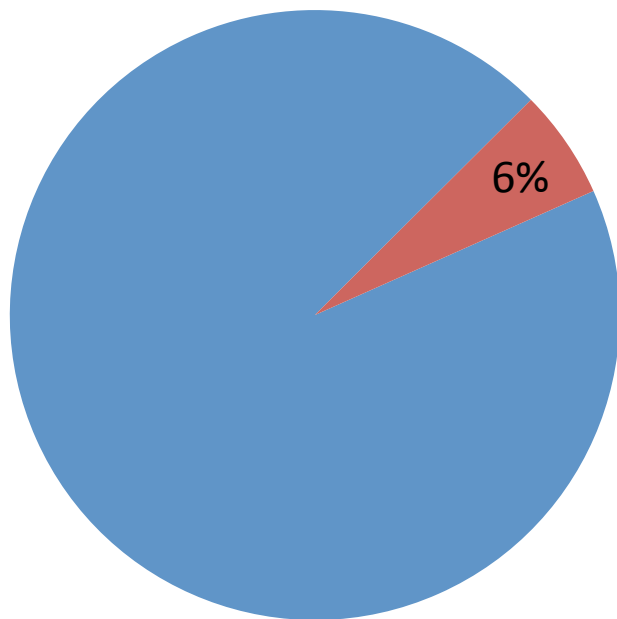
We removed the 10.4% with a lifetime history of suicidal ideation at wave 1 to examine *incidence*



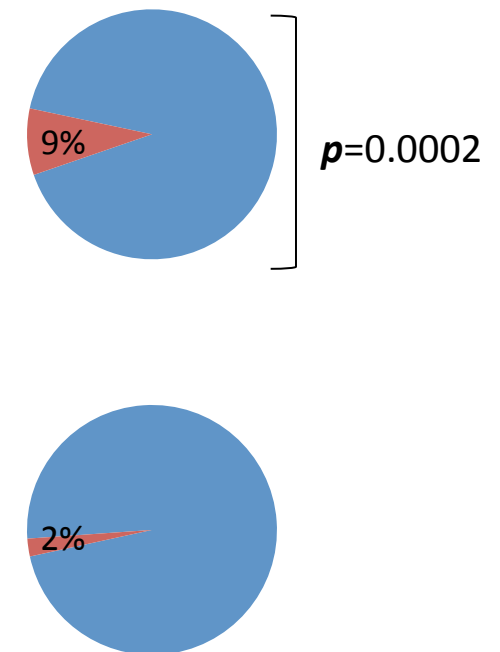
(Wave 1 lifetime suicidal ideation, phq-9: n=183)

Baseline alcohol dependence is significantly associated with incident suicidal ideation at follow-up

Baseline Alcohol dependence



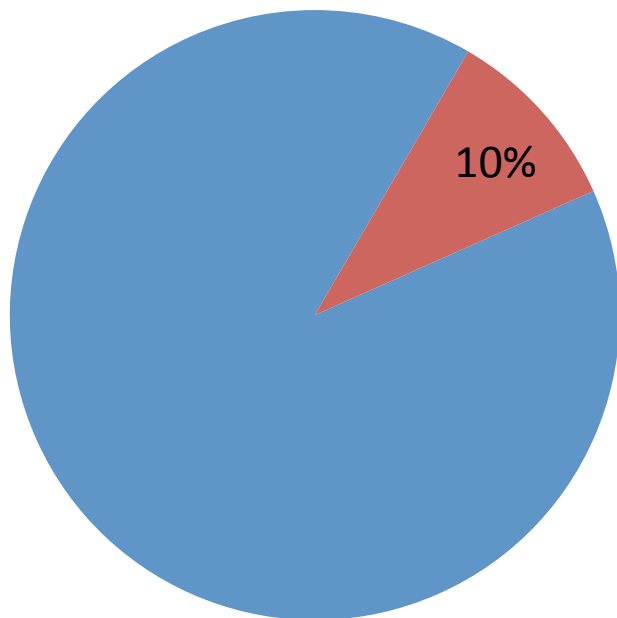
Follow-up incident suicidal ideation



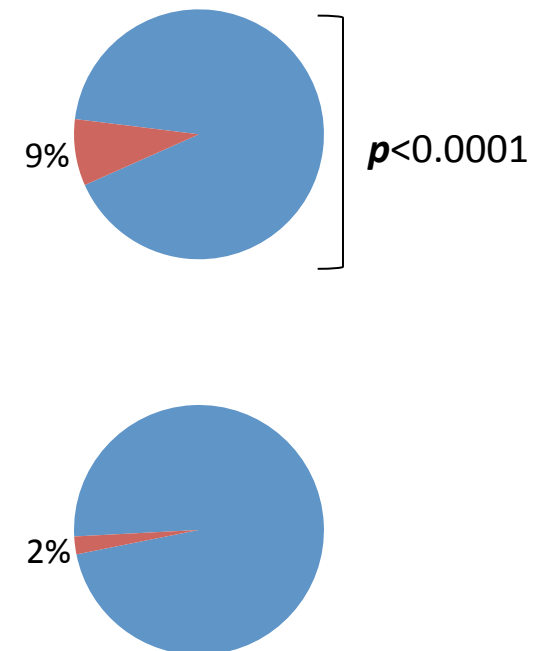
n=1587; percent alcohol dependence and suicidal ideation reported for participants meeting criteria

Depression within a year of baseline was associated with incident suicidal ideation at follow-up

Wave 1 depression



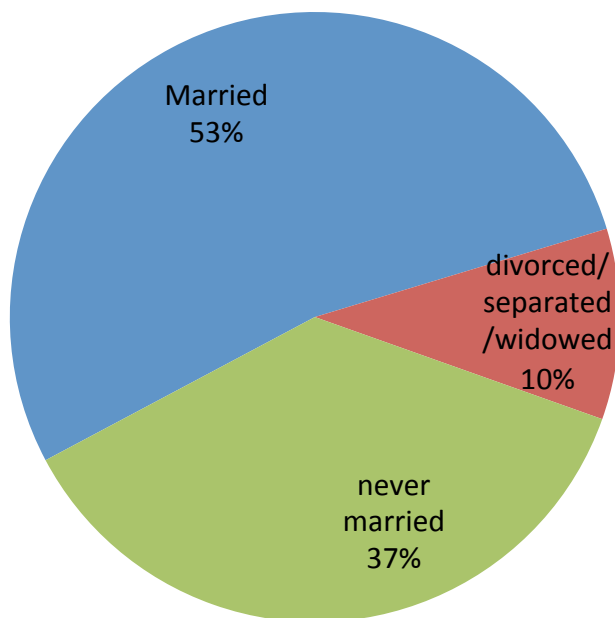
Wave 2 incident suicidal ideation



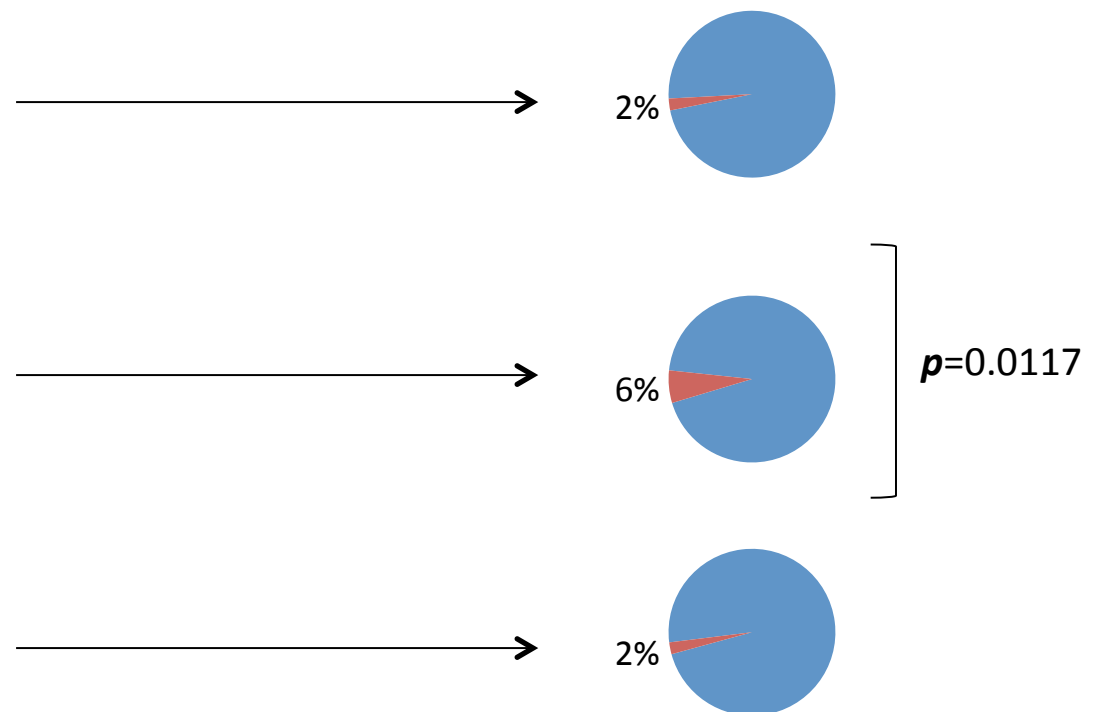
n=1587; percent depression and suicidal ideation reported for participants meeting criteria

At follow-up, those who were married were less likely to report incident suicidal ideation in the past year

Wave 2 marital status



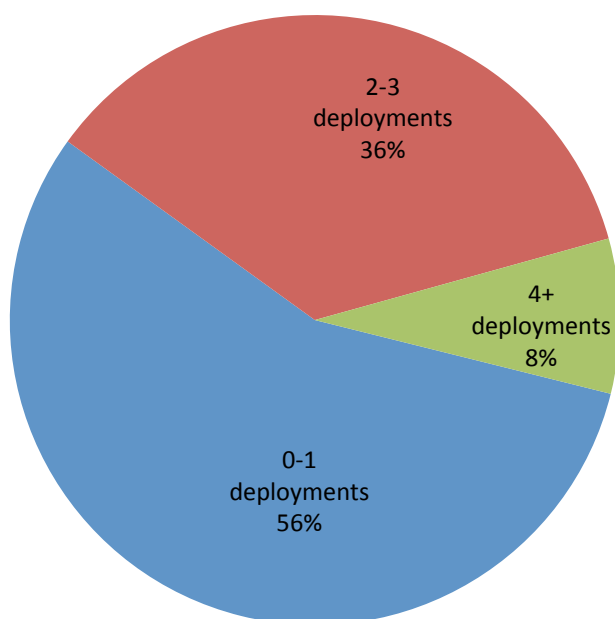
Wave 2 incident suicidal ideation



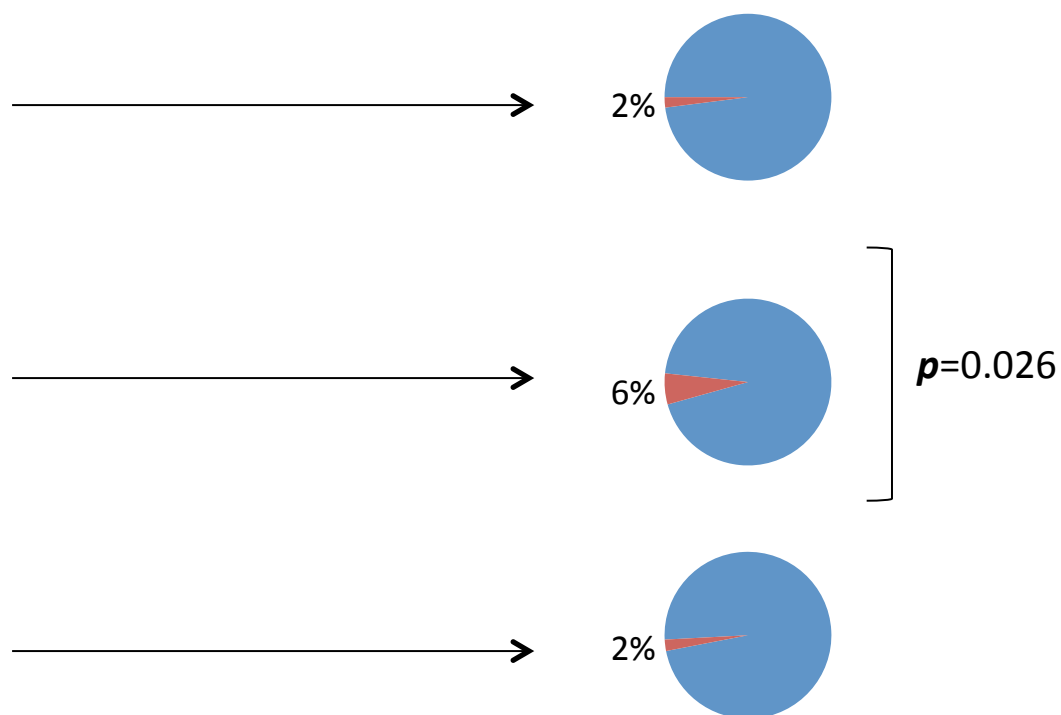
n=1587; percent suicidal ideation reported for participants meeting criteria

And, number of lifetime deployments at wave 2 were associated with incident suicidal ideation

Wave 2 Number of lifetime deployments

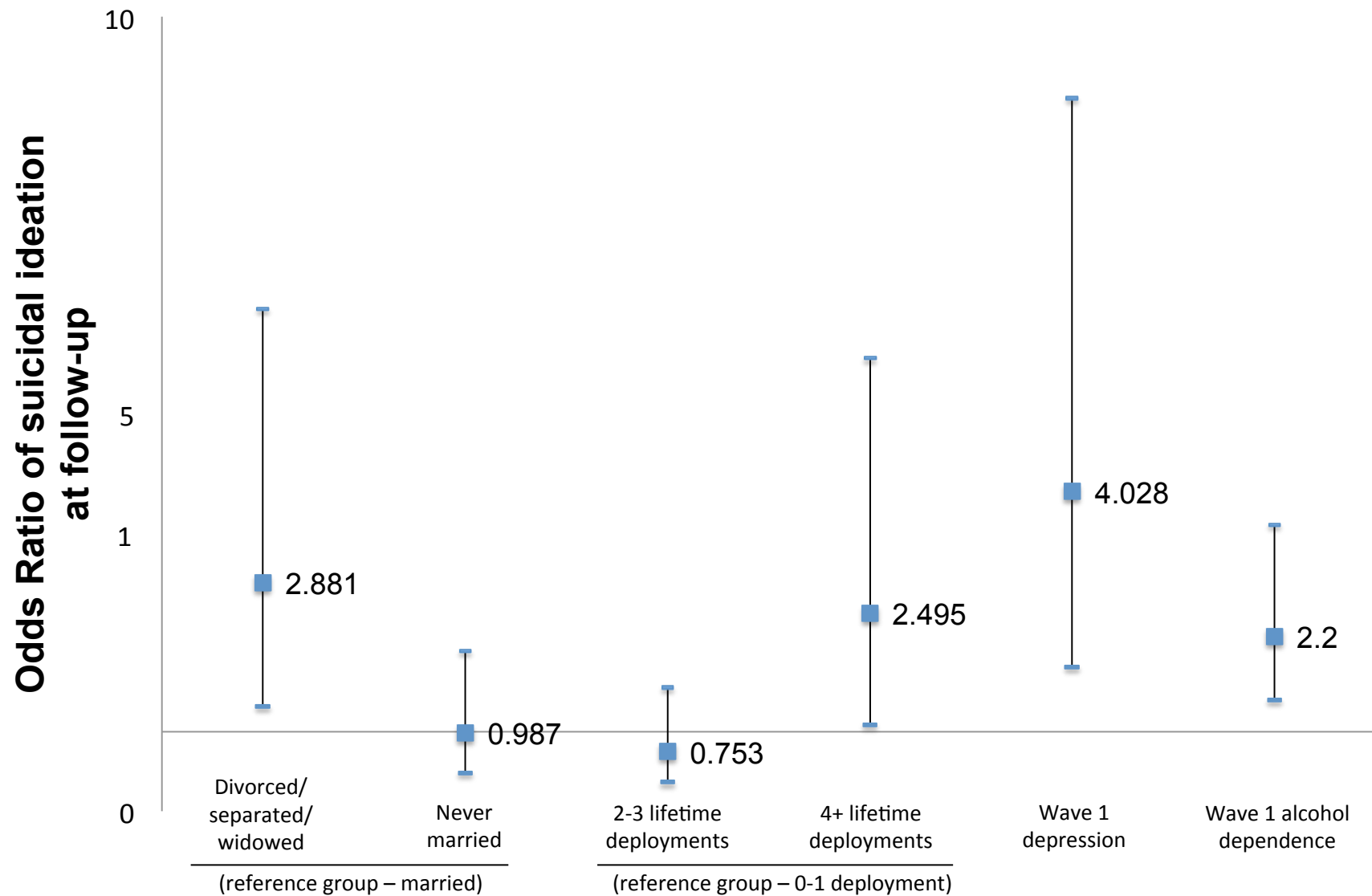


Wave 2 incident suicidal ideation

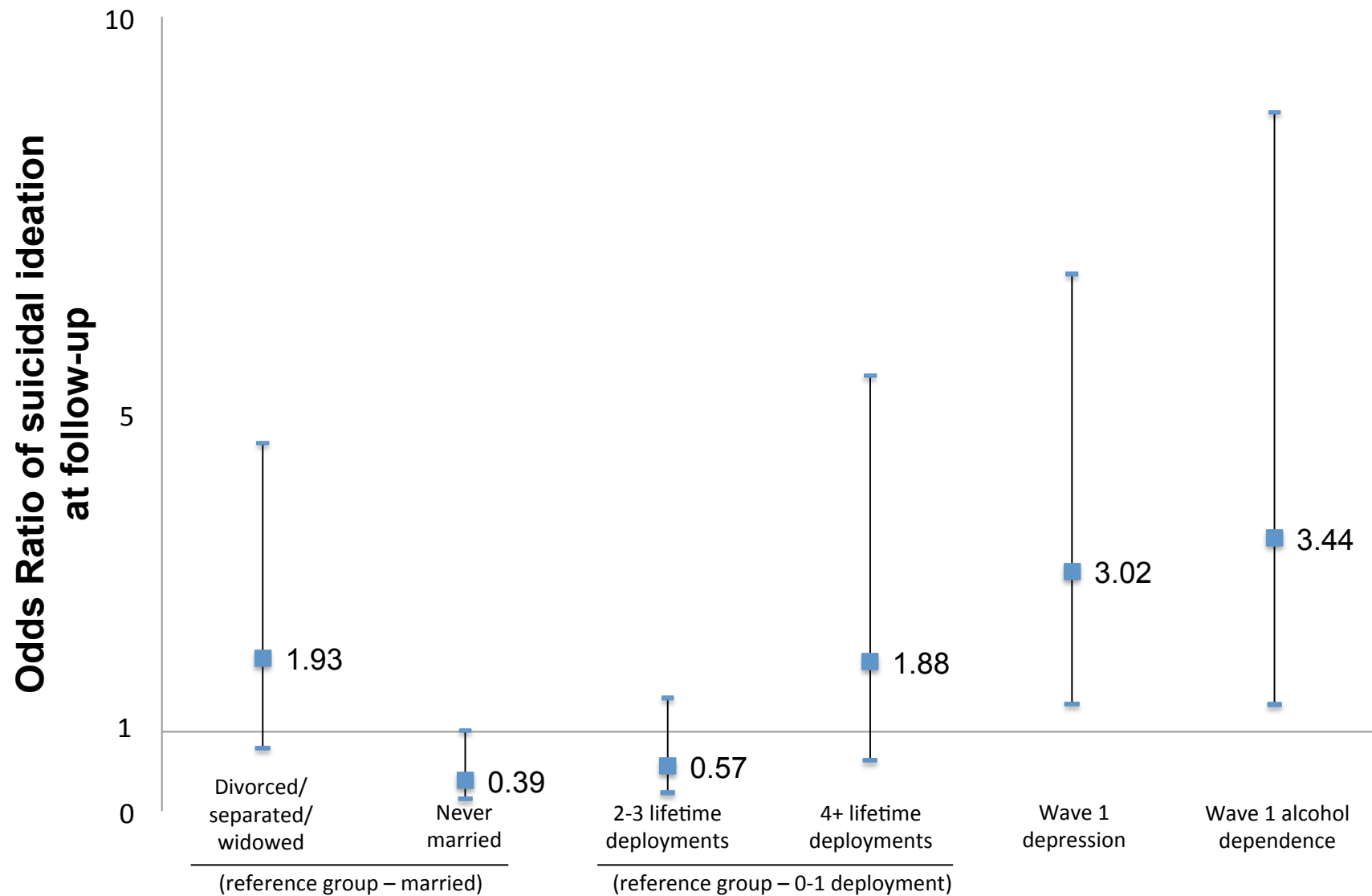


n=1587; percent suicidal ideation reported for participants meeting criteria

Crude odds of incident suicidal ideation at wave 2



*Adjusted** odds of incident suicidal ideation at wave 2



*model adjusted for gender, age, race, education, rank, and quantity of prior traumatic events

Conclusions

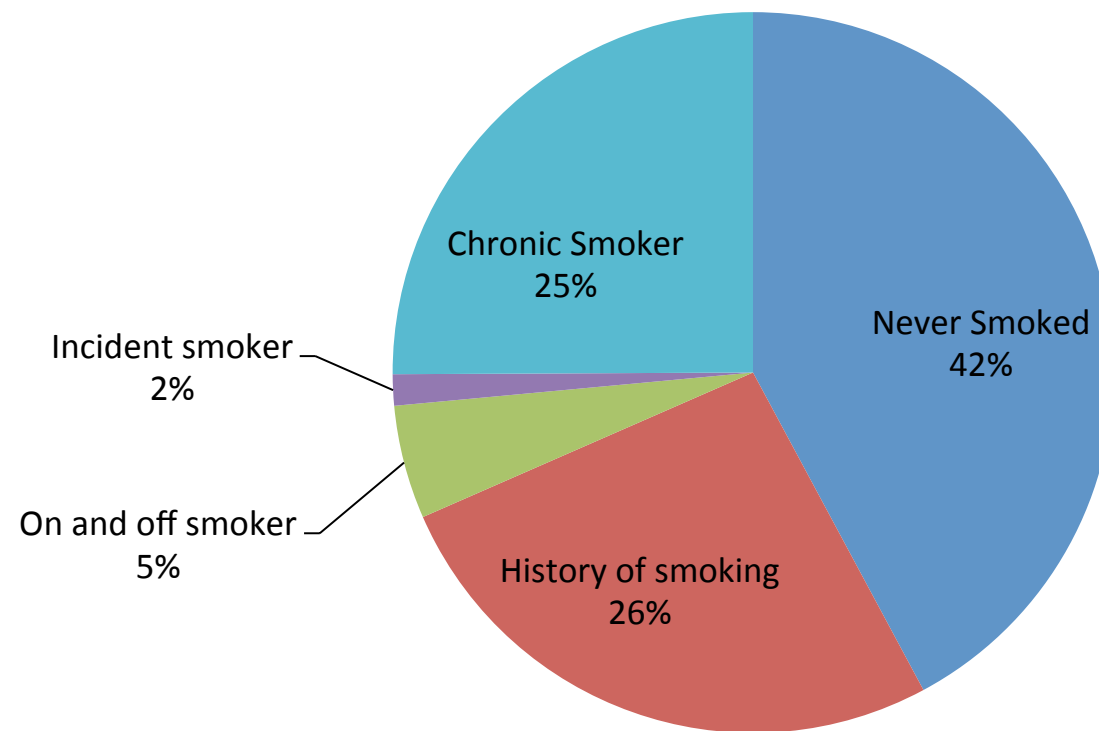
- alcohol dependence is independently and longitudinally associated with incident suicidal ideation
- depression is independently and longitudinally associated with incident suicidal ideation
- the effects of lifetime deployment upon incident suicidal ideation may be explained by alcohol dependence and depression

Tobacco use and risk of depression and suicidal ideation

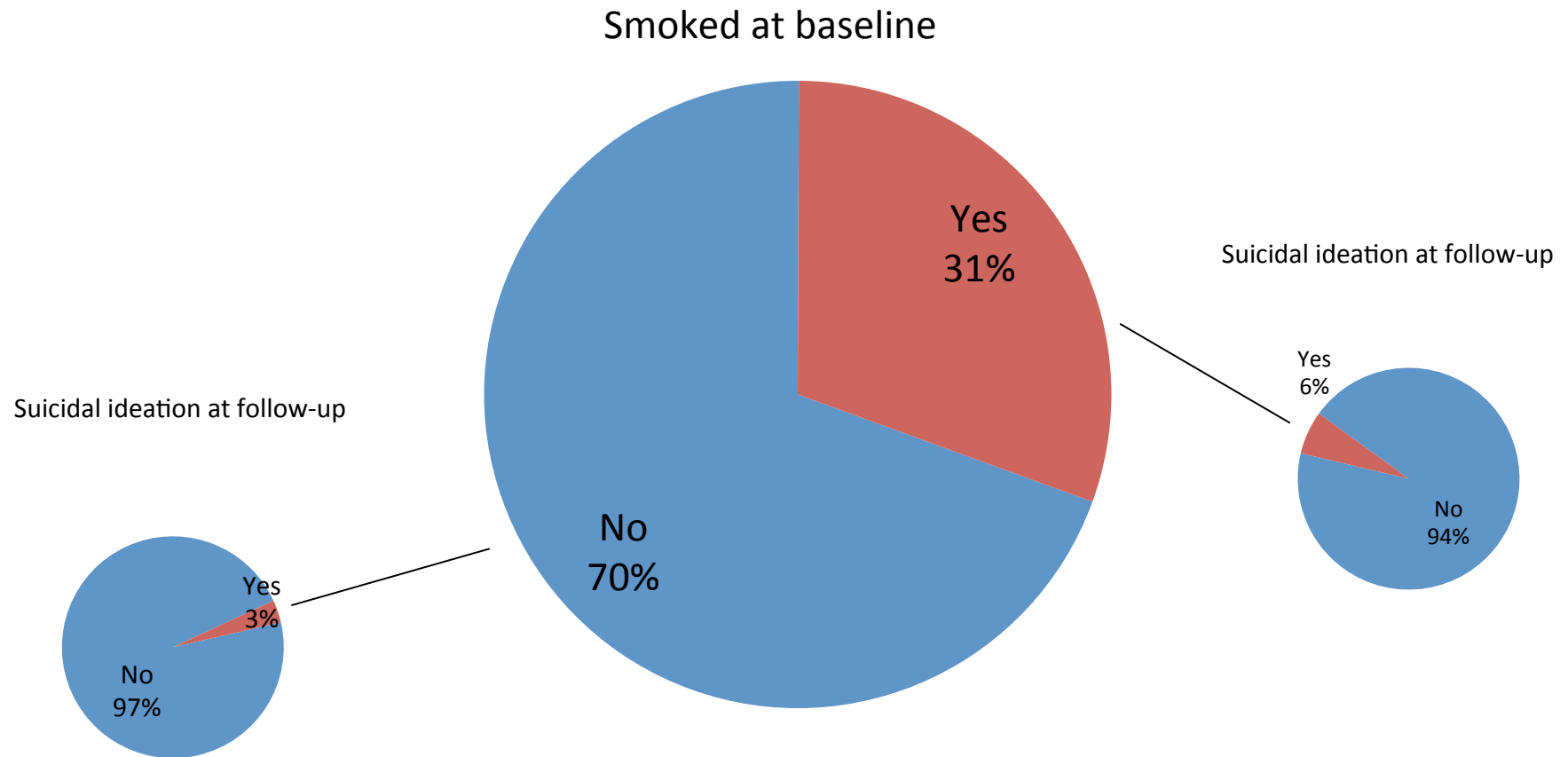
Study aim

To investigate the relationship between smoking, depression and suicidal ideation in a representative sample of Ohio Army National Guard soldiers.

History of smoking at baseline



Smoking at baseline and suicidal ideation at one year follow-up



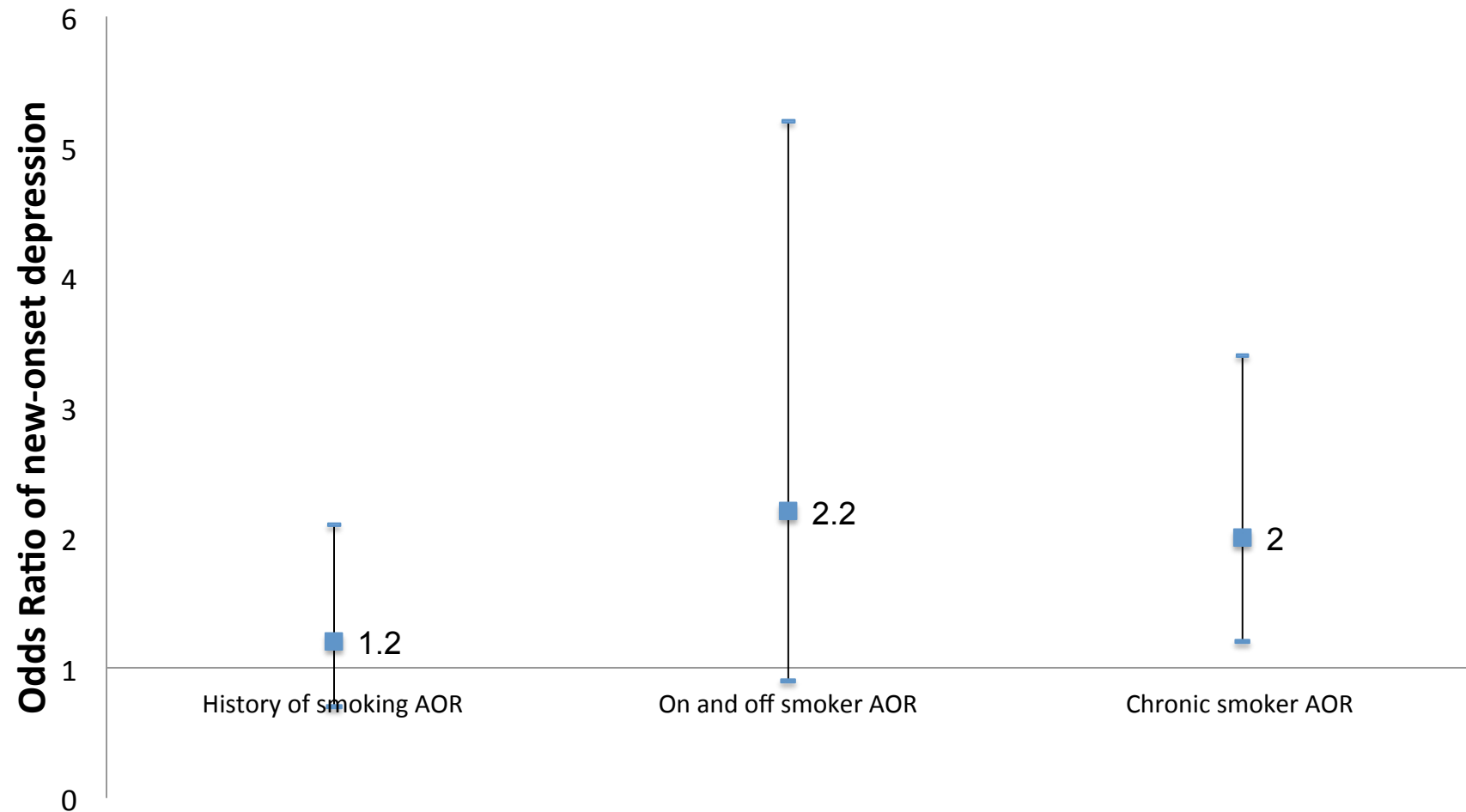
Longitudinal sample at wave 2; n=1766.

Smoking at baseline is associated with new-onset depression one year later



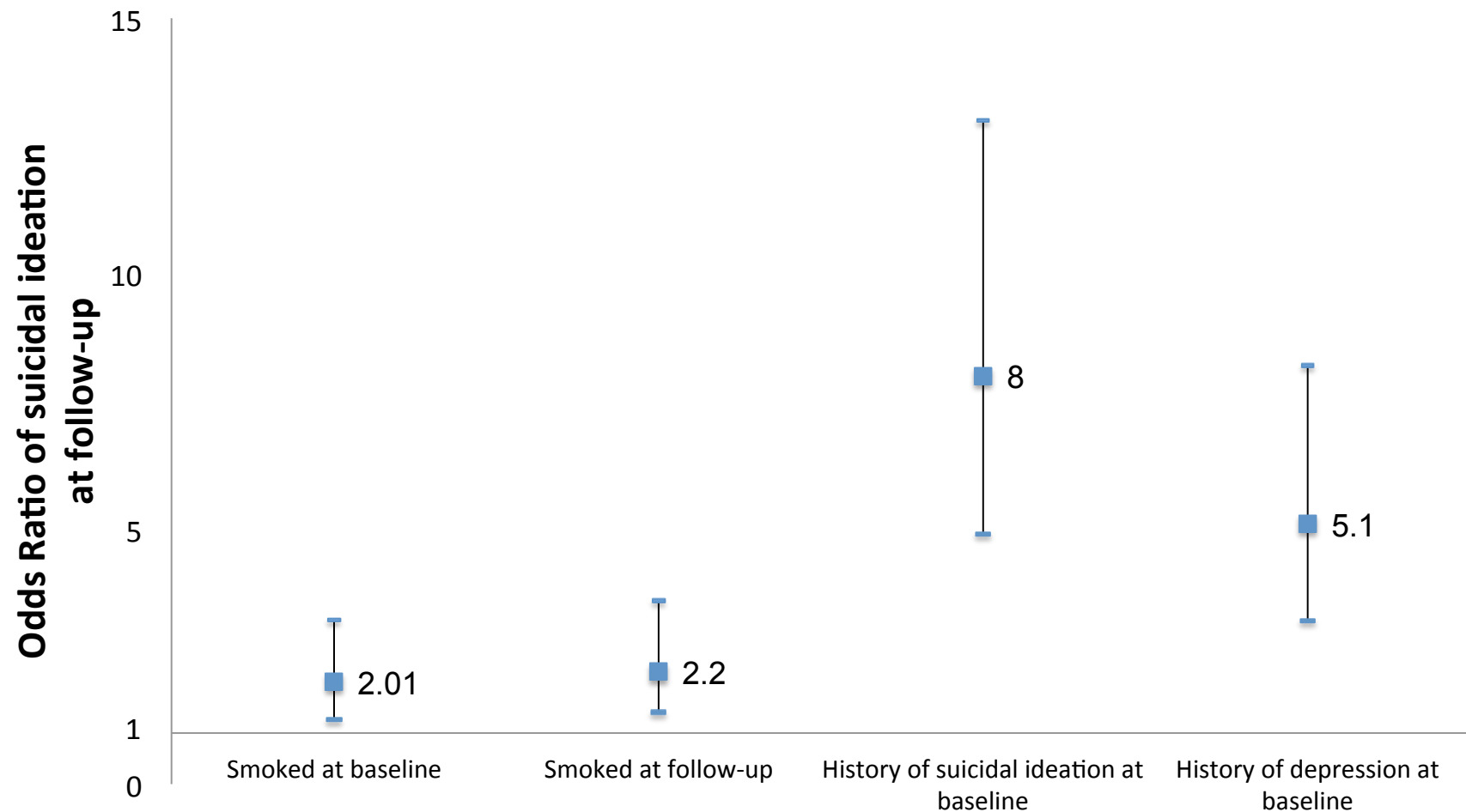
*Model is adjusted for age and gender

Chronic smokers are more likely to develop incident depression



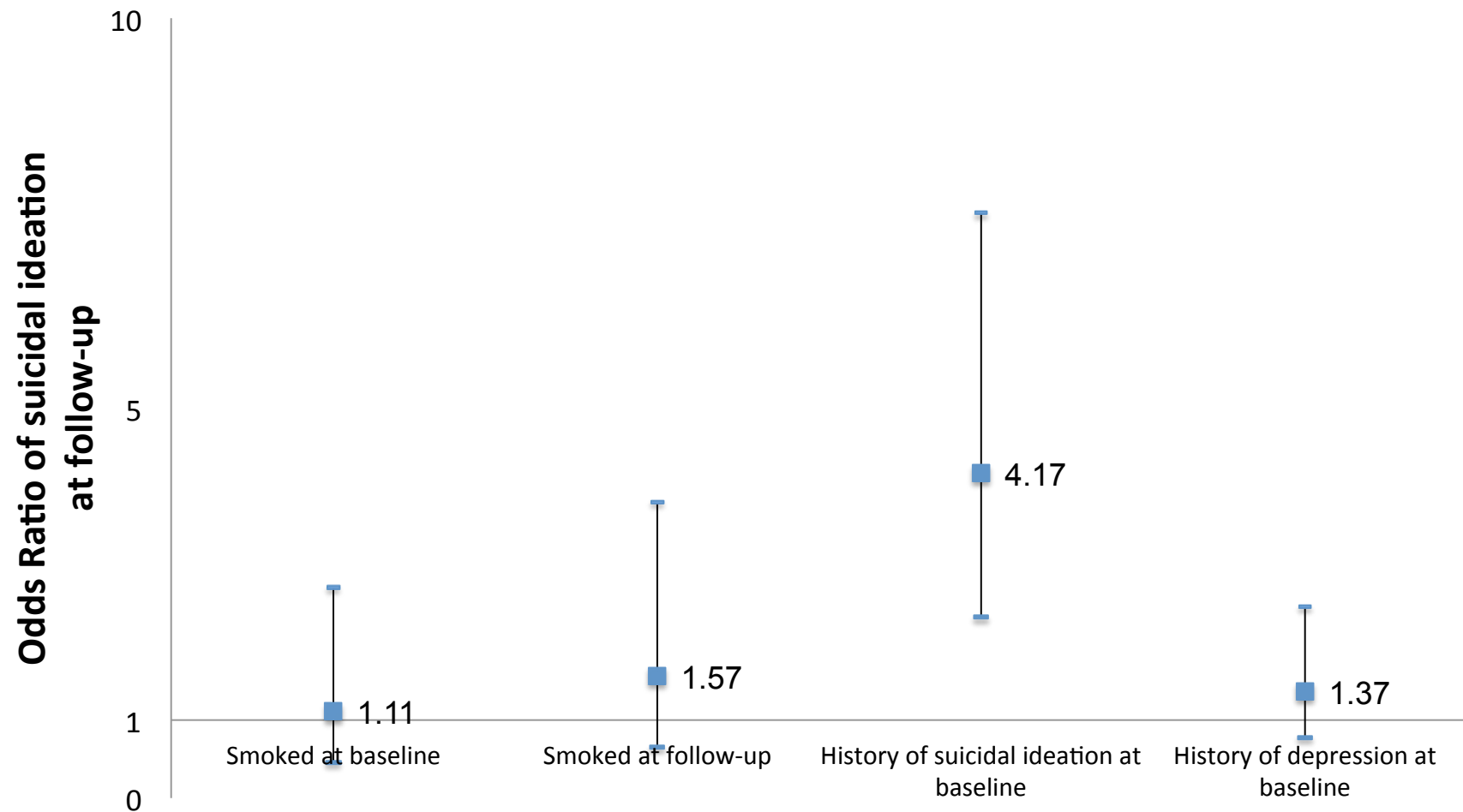
*Model is adjusted for age and gender

Crude odds of suicidal ideation at one year follow-up



*Model adjusted for age, and gender in addition to above covariates; Depression at follow-up was associated with a crude odds ratio (OR) of 19.2 (11.5, 32.1)

Adjusted* odds of suicidal ideation at one year follow-up



*Model adjusted for age, and gender in addition to above covariates; Depression at follow-up was associated with an AOR of 13.2 (7.56, 23).

Conclusions

- baseline smoking, particularly chronic smoking, is longitudinally associated with increased odds of incident depression at 1 year follow-up
- baseline smoking is longitudinally associated with suicidal ideation at 1 year follow-up
- the relationship between smoking and suicidal ideation is explained by concurrent depression at follow-up

Key Findings

Key Findings (1)

1 mental health services utilization

- the majority of ONG soldiers who have mental health care need do not report accessing services
- ONG soldiers with alcohol use disorders were least likely to use services
- a little over half of those who access care report utilizing VA or DoD services
- the youngest group of veterans was least likely to use VA or DoD services

2 deployment and risky driving behavior

- deployment, particularly to conflict zones, is associated with risky driving behavior
- quantity of deployment trauma is associated with risky driving behavior in a dose-response fashion
- pre-deployment preparedness and post-deployment social support were associated with a reduction in odds of risky driving behavior

Key Findings (2)

3 PTSD and HIV risk behavior

- soldiers with PTSD may be at greater risk of HIV infection due to increased engagement in HIV risk behavior
- new-onset depression following trauma mediates this relationship
- integrated interventions to address mental health problems and reduce HIV risk behavior are needed

4 sexual trauma and psychopathology

- most reported sexual trauma did not occur in the context of deployment
- presence of any sexual trauma was strongly associated with PTSD and depression
- presence of sexual trauma is an important risk factor for PTSD and depression among National Guard soldiers

Key Findings (3)

5 differences between war- and civilian-related PTSD

- presence of etiologic and clinical heterogeneity
- soldiers who experience civilian-related events are more likely to report suicidal ideation than are soldiers with war-related events
- criterion A2 did not affect the prevalence of PTSD
- there is a consistent positive association between PTSD and suicidal ideation

Key Findings (4)

6 alcohol dependence and incident suicidal ideation

- alcohol dependence is independently and longitudinally associated with incident suicidal ideation
- depression is independently and longitudinally associated with incident suicidal ideation
- the effects of lifetime deployment upon incident suicidal ideation may be explained by alcohol dependence and depression

7 tobacco use and risk of depression and suicidal ideation

- baseline smoking, particularly chronic smoking, is longitudinally associated with increased odds of incident depression at 1 year follow-up
- baseline smoking is longitudinally associated with suicidal ideation at 1 year follow-up
- the relationship between smoking and suicidal ideation is explained by concurrent depression at follow-up

PTSD Genetics Repository and Gene Association Studies with ONG

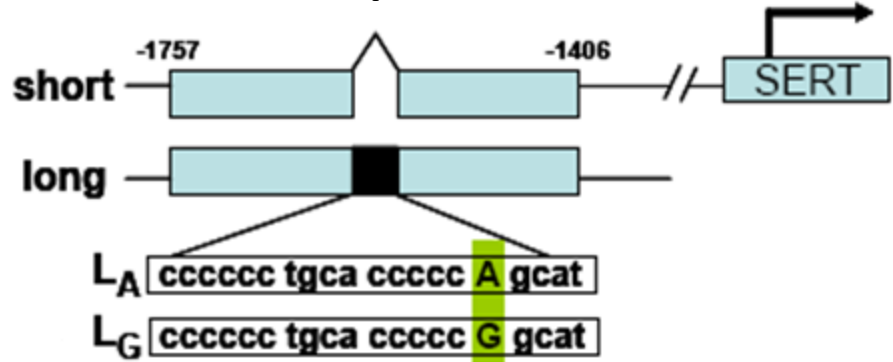
Genetics of PTSD Risk and Resilience

<i>Table 1</i>	PTSD trauma	Alleles	Total (n)	PTSD (n)	control (n)	traum contr	finding
Gelernter et al 1999	combat	DRD2	134	52	82	no	<i>Negative</i>
Segman, 2002	mixed	SLC6A3 (DAT)	206	102	104	yes	<i>Positive</i>
Lee et al, 2005	civilian mixed	5-HTTLPR	297	100	197	no	<i>positive</i>
Kilpatrick et al., 2007	civilian disaster	5-HTTLPR	589	19	570	yes	<i>interaction w/ level of exposure & support</i>
Koenen et al., 2009	civilian disaster	5-HTTLPR	589	19	570	yes	<i>interaction w/ level of exposure & support</i>
Amstadter et al., 2009	civilian disaster	RSG2	589	19	570	yes	<i>interaction w/ level of exposure & support</i>
Binder , Ressler et al., 2008	civilian mixed	FKBP5	762			85% trauma	<i>quant trait (PTSD score) interaction w</i>
Xie et al., 2009	civilian mixed	5-HTTLPR	1252	229	1023	yes	<i>Case-control, G x E</i>
Ressler et al., 2011	civilian mixed	ADCYAP1R1	763			yes	<i>PACAP -Women only association w/PTSD</i>

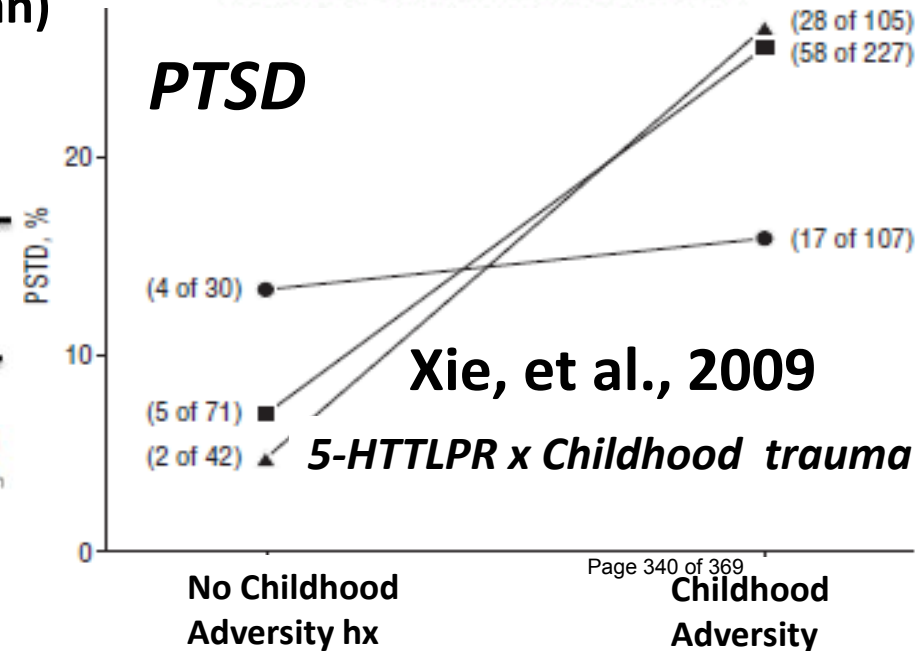
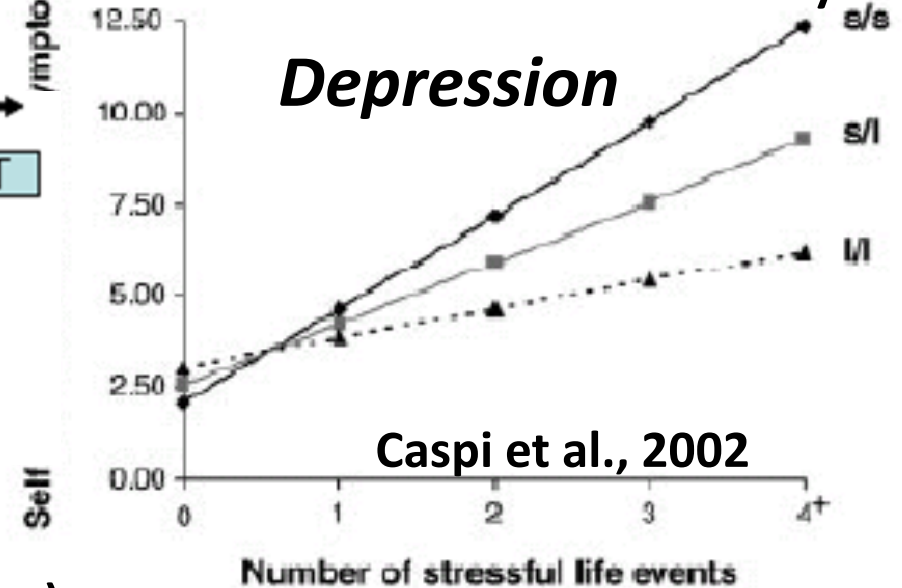
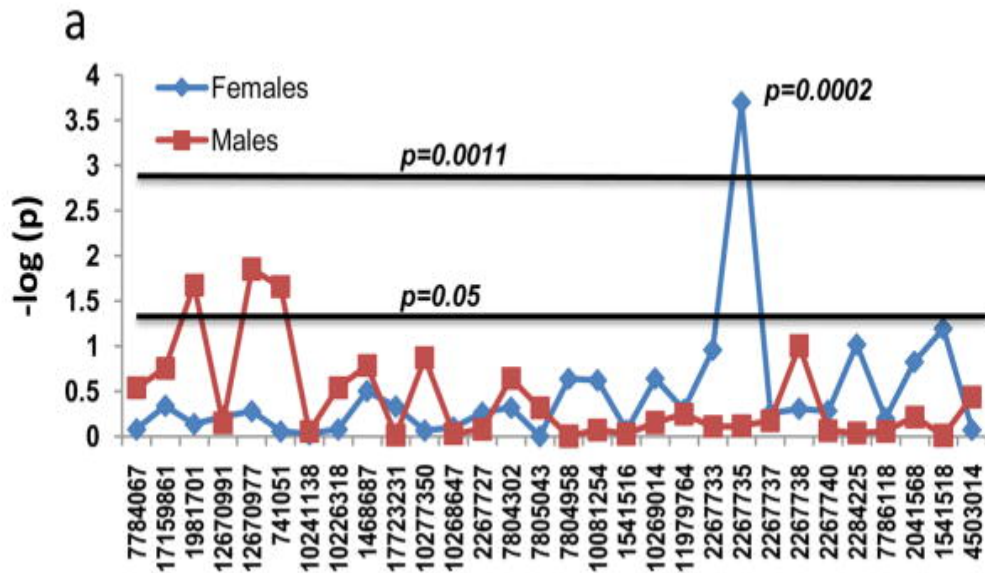
Candidate Gene Association Studies: Case-Control & Quantitative Trait

Gene x Environment interactions in psychiatric genetics: the role of childhood adversity

Serotonin Transporter Promoter



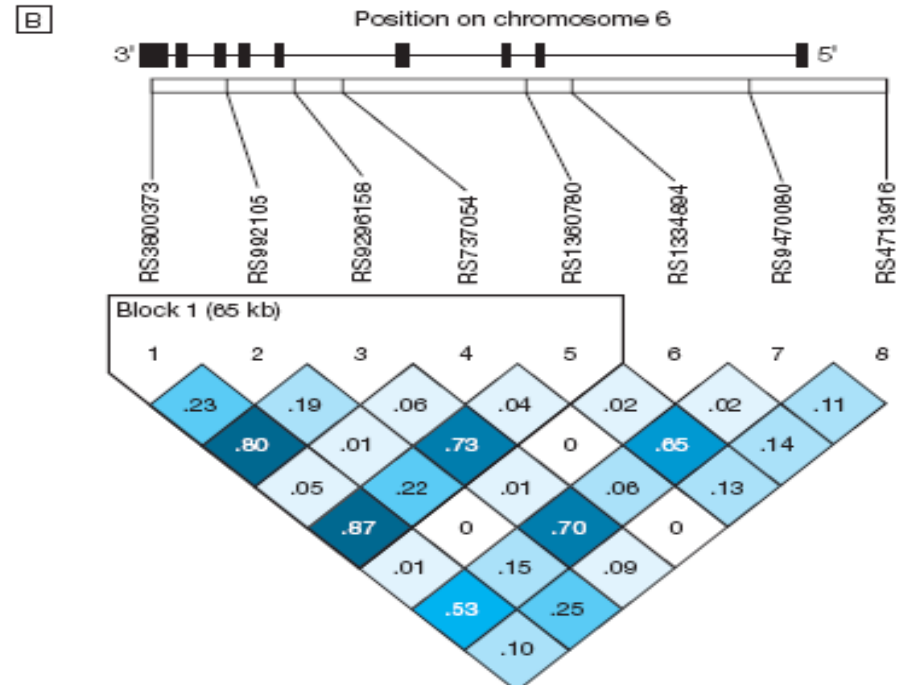
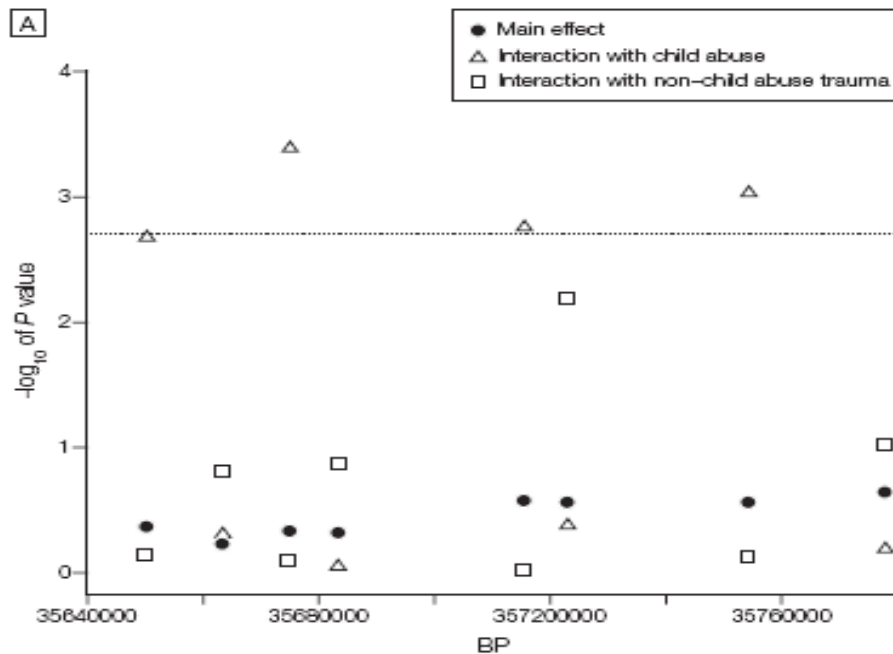
“PACAP” (*ADCYAP1R1* gene) associates w/ PTSD only in women (African American)



FKBP5: interaction with Child Abuse predicting adult PTSD

Binder, Ressler (2008)

Urban, African American sample N=1200



FKBP5 is glucocorticoid receptor chaperone, SNPs also associated with HPA axis function, depression following stress and trauma

Genetics of PTSD risk and resilience: data from our translational core

Serotonin Transporter x Childhood Trauma in PTSD

Data from our translational core

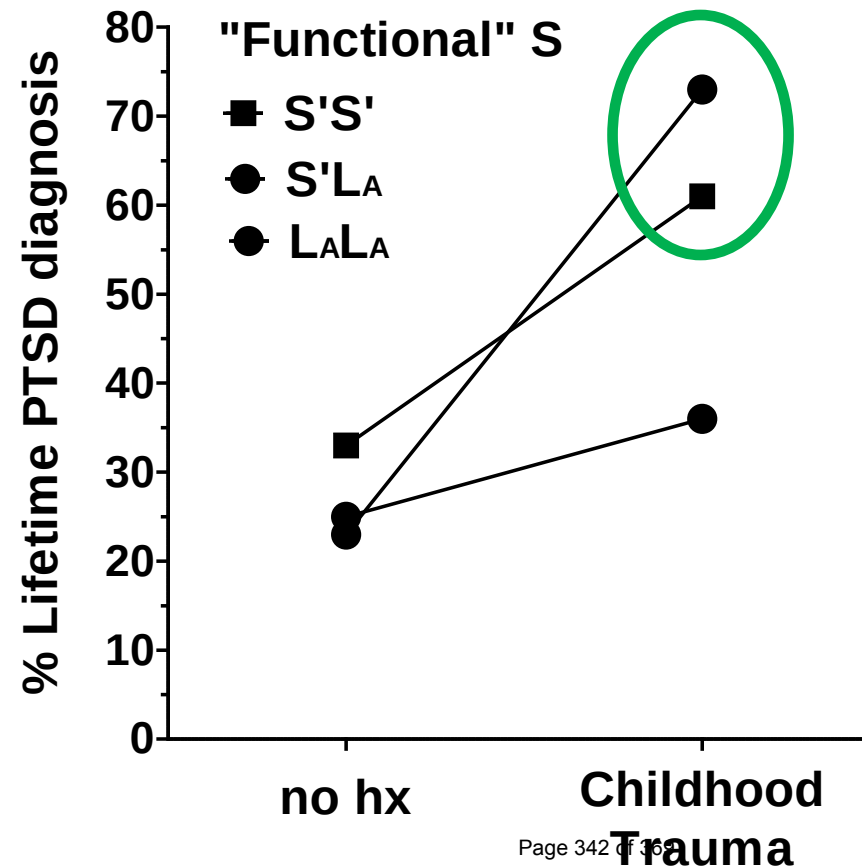
Civilian cohort 415 trauma-exposed Detroit women:

Greater risk for adult PTSD in women exposed to childhood and adult traumas: *only in those who carry function S-allele of the Serotonin Transporter gene*

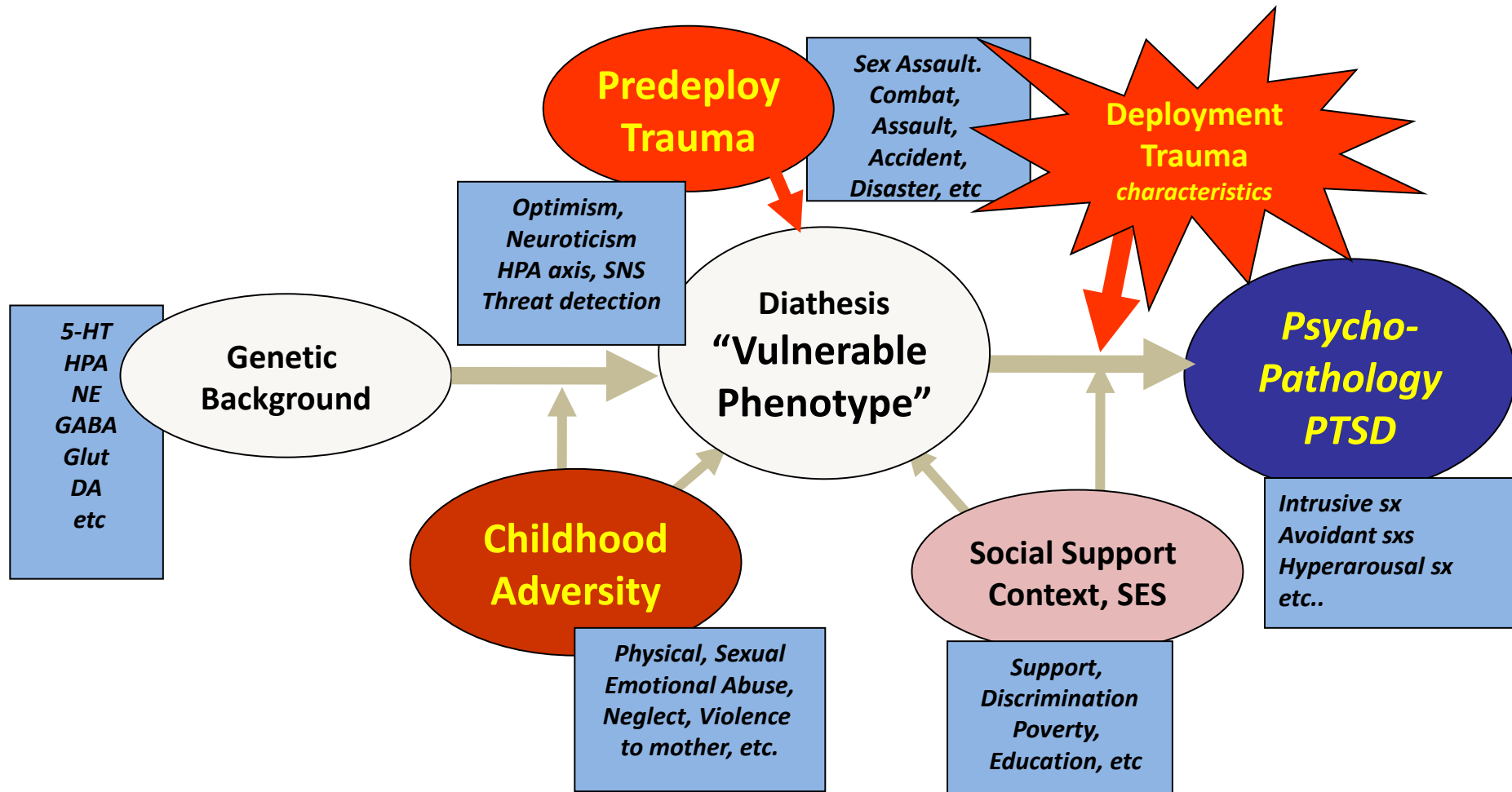
Step 1: R2=0.02	Sig.	OR	95% C.I.	
LA / LA vs S'-carrier	.051	1.79	.997	3.200
age	.363	1.01	.985	1.041
FBI crime rate	.594	1.03	.994	1.006

Step 2 R2=0.18	Sig.	OR	95% C.I.	
LA / LA vs S'-carrier	.022	2.08	1.110	3.900
Childhood Trauma	.000	4.85	2.914	8.067

Step 3: R2=0.21	Sig.	OR		
LA / LA vs S'-carrier	.877	1.07	.476	2.385
Childhood Trauma	.342	1.67	.581	4.779
SERT x CAE	.025	3.96	1.185	13.256

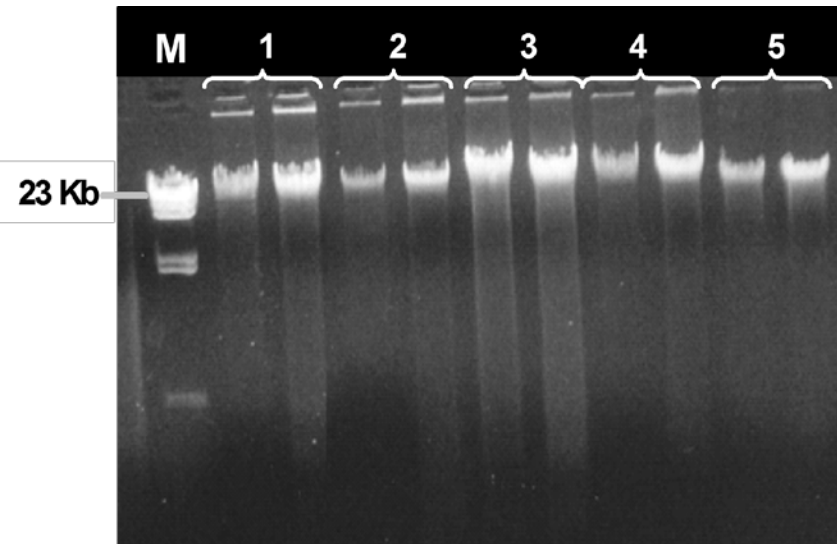


PTSD Risk and resilience: gene x environment interactions



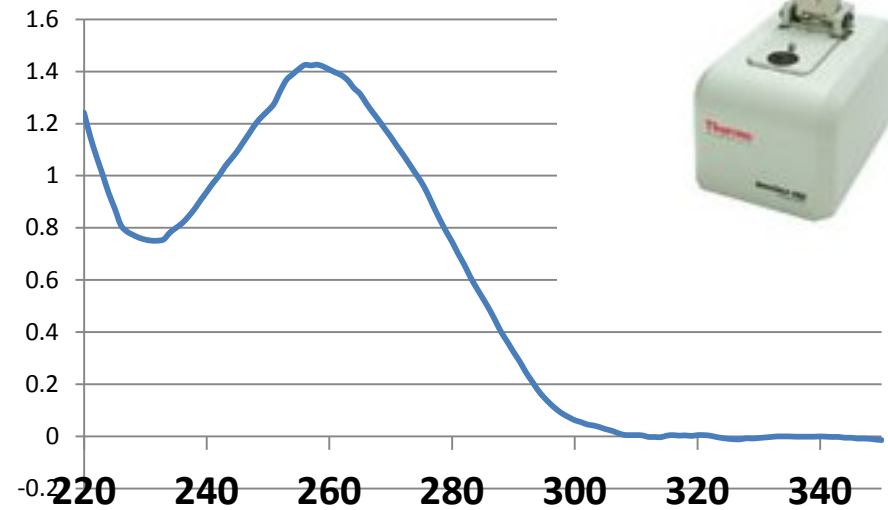
Biological repository: genomic DNA Purification from saliva

Gel electrophoresis - high quality genomic DNA from saliva



- Fragment sizes > 23 Kb, low degradation
- >800 samples to date – yield 10 - 150 ug (mean 35 ug)

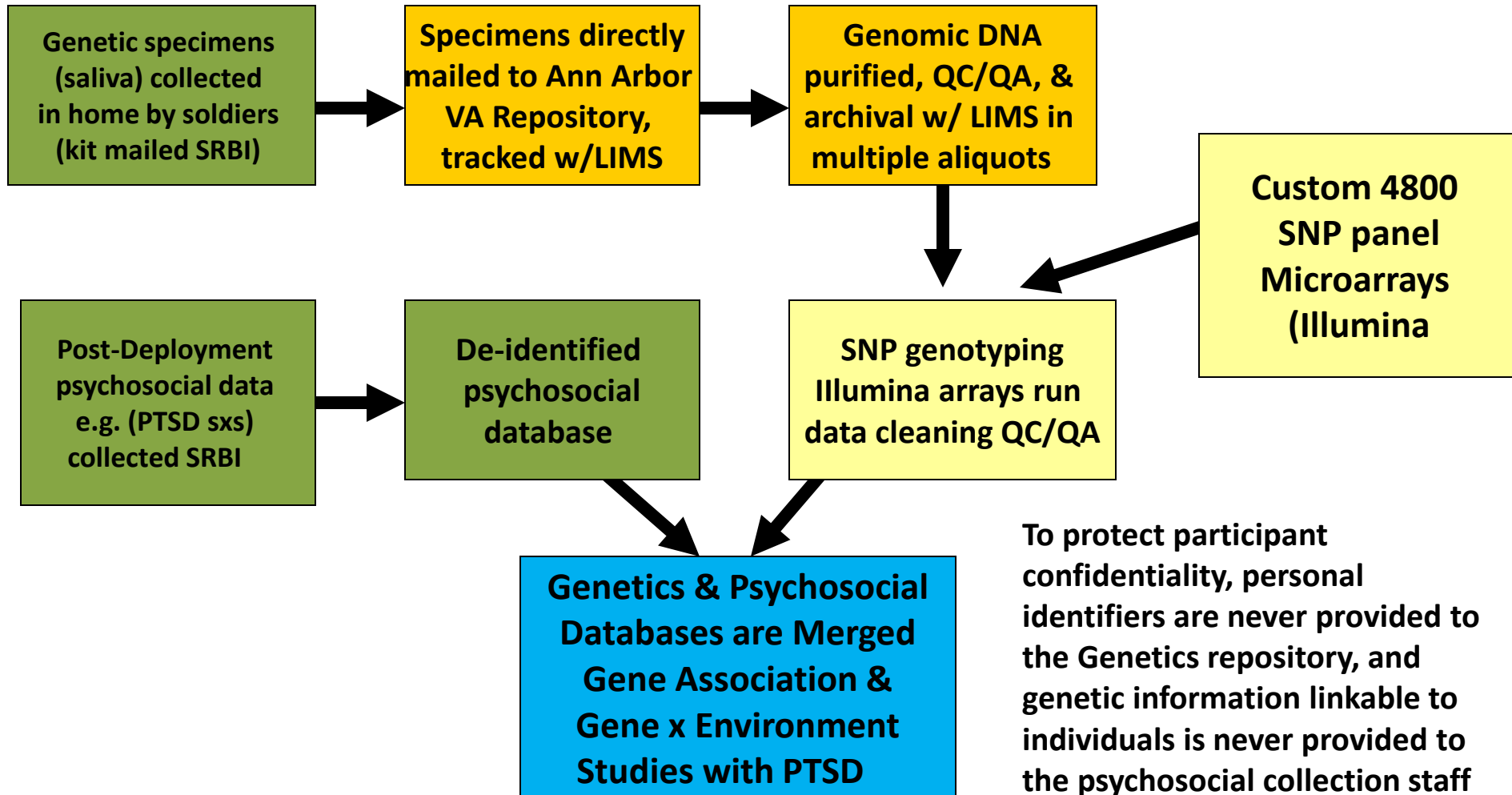
UV spectroscopy (nanodrop) DNA – UV Absorbance



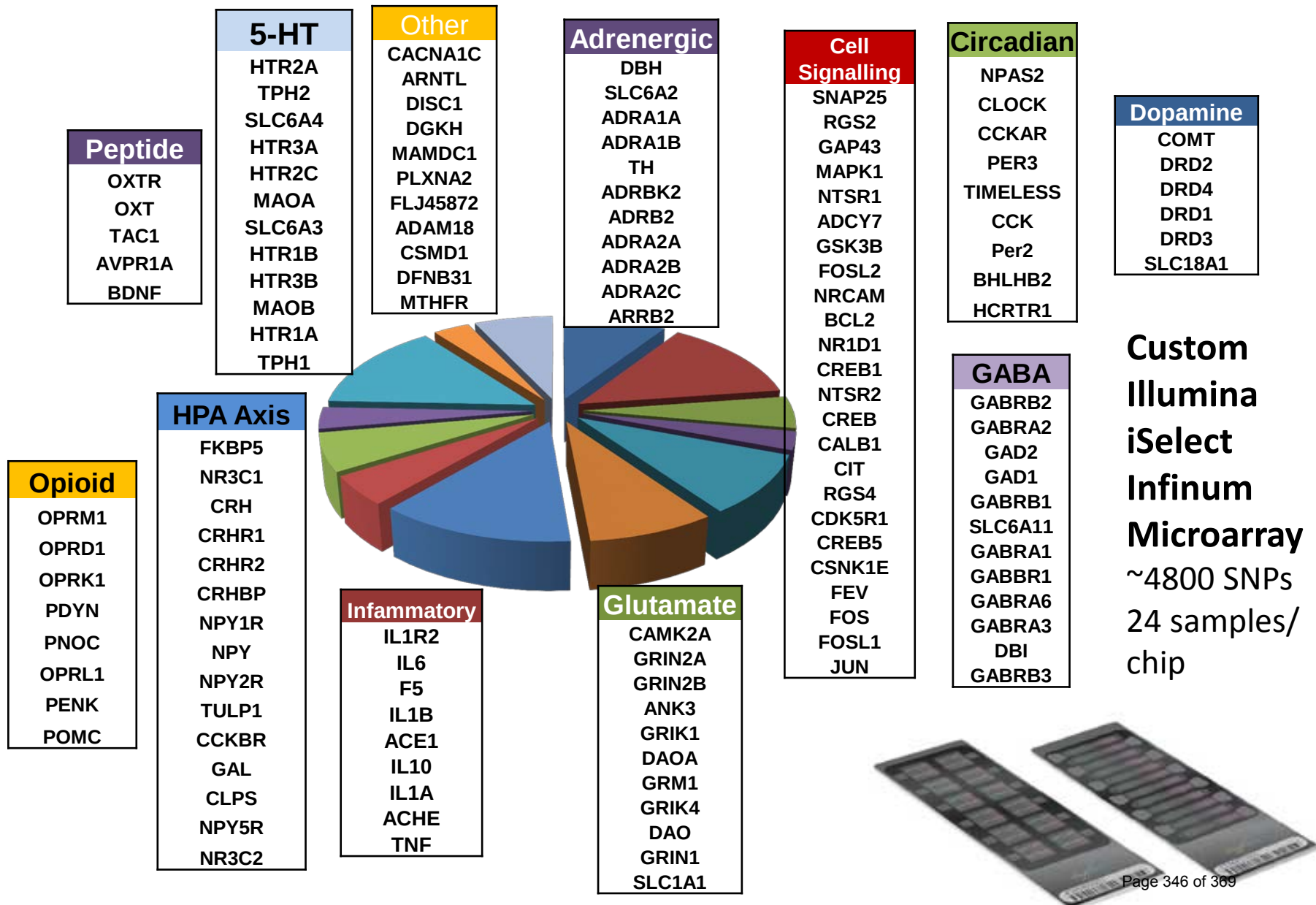
High Yield – high quality DNA

Concent (ug / ul)	OD 260	OD 280	OD260 / OD 280
74.9 ± 13.7	1.41 ± .82	0.77 ± .15	1.82 ± .05

Biological repository: specimen and data work flows



Genetic analyses – candidate gene

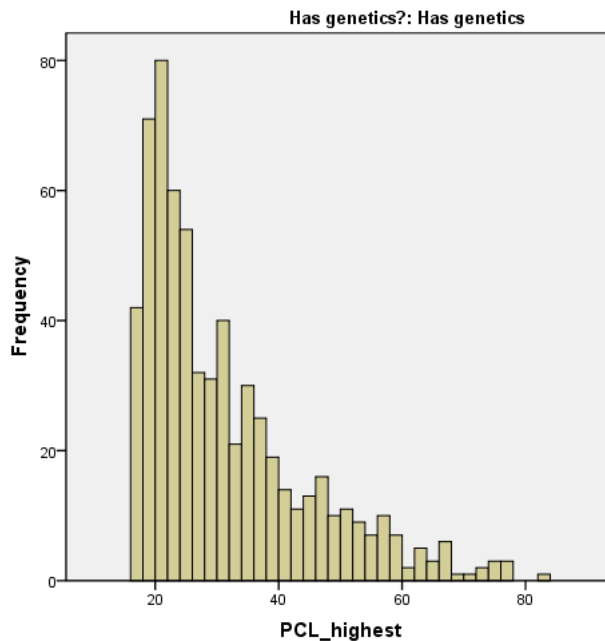


Currently available Sample of ONG soldiers for preliminary analyses:

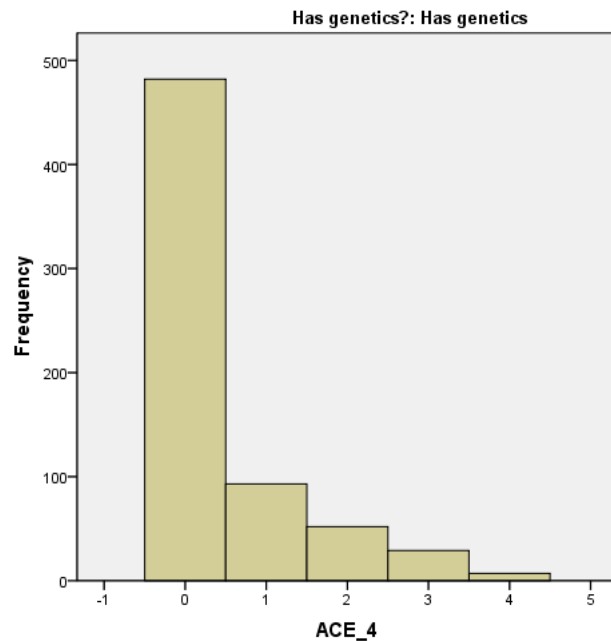
- N=944 genomic DNA specimen received
- N=937 passed QC (DNA quality, call rate >99%,)
- (HWE – SNPs inclusion)
- W1 and/or W2 survey data from N=719
- Ancestry European N=663 (92%)
African or mixed N= 38 (3%)
- Male N=607 (85%) Female N=109 (15%)
- PTSD measures available (phenotype)
 - W1 PCL non-deploy N=649
 - W1 PCL Deployment N=302
 - W2 PCL non-deploy N=617
 - W2 PCL Deployment N=333

Distributions of Phenotype (PTSD symptoms - PCL), Adverse Childhood Events types, & total lifetime traumas in the genetics sub-sample

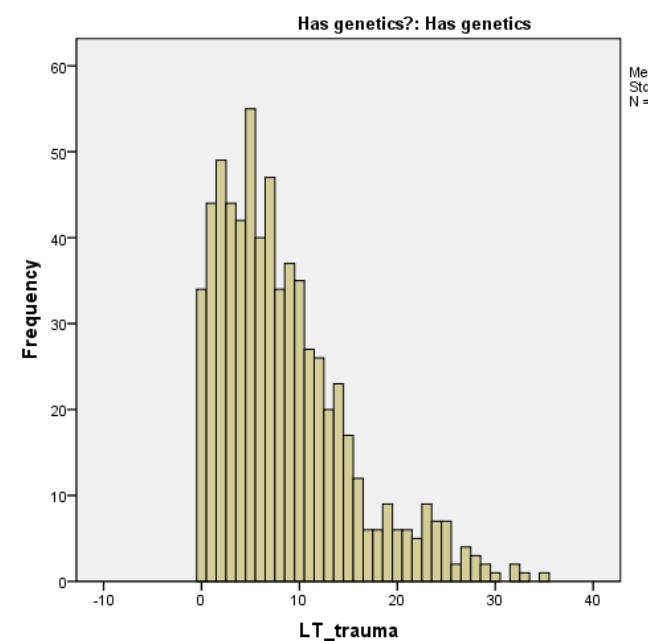
PCL score (highest)



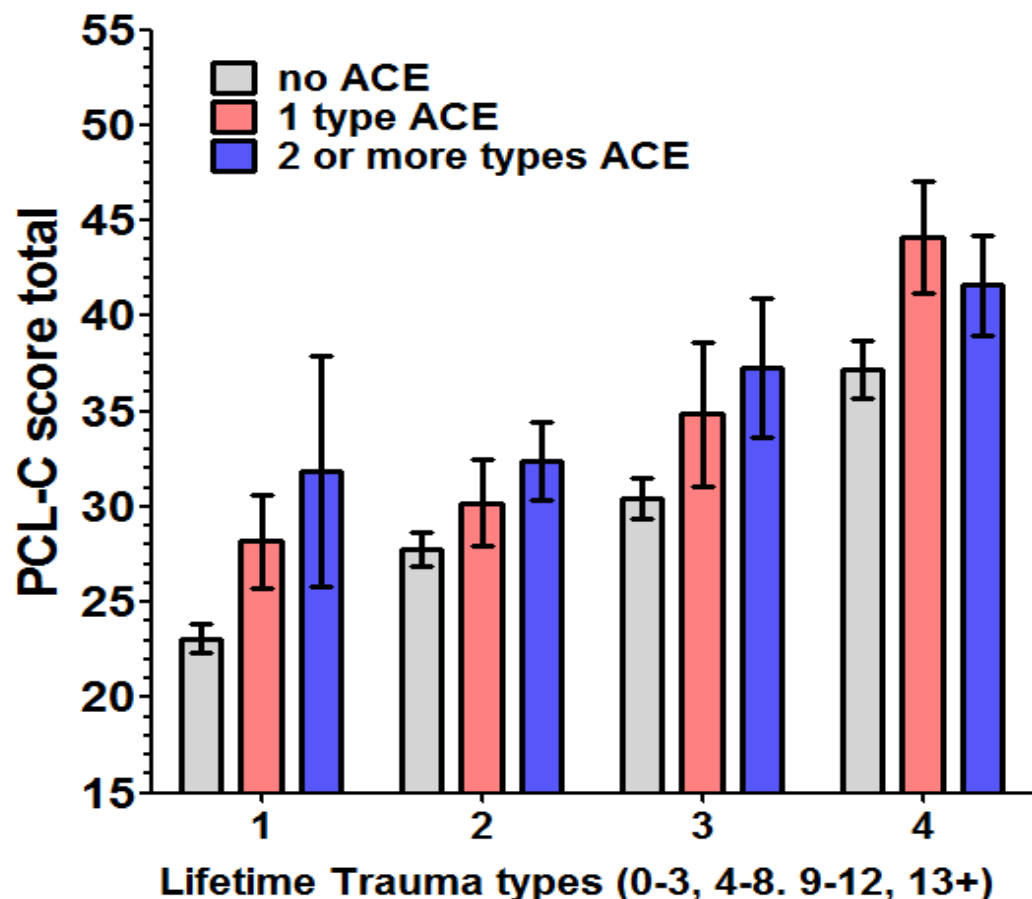
Types of ACE



Lifetime traumas



Contribution of Adverse Childhood Events (4 types), and total reported types of lifetime trauma and PTSD symptoms (highest PCL)



ANOVA

ACE $p < .001$, $\eta^2 = .04$

LT trauma $p < .001$, $\eta^2 = .09$

ACExLTtrauma Interaction ns

Correlation ACE and LT
trauma $r = 0.12$, $p < .001$

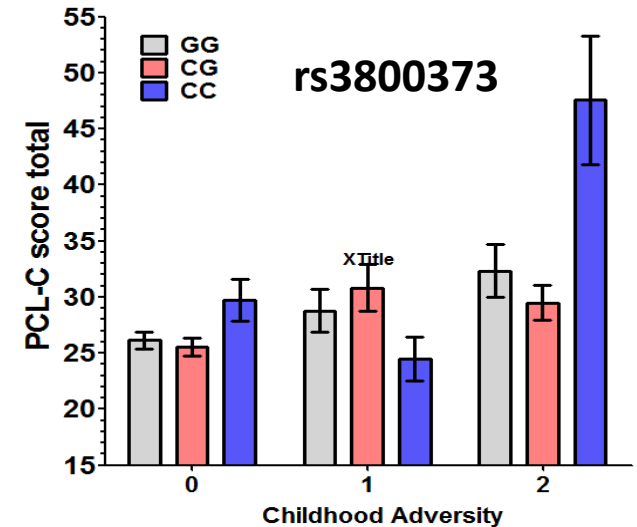
Models for gene Association and Gene x Environment interactions

- Main Effects of SNPs on PTSD symptoms
 - $Y = b_0 + b_1 \text{ SNP} + b_2 \text{ gender}$
- ME Gene, ME Adverse Childhood Event, Gene x CAE interaction
 - $Y = b_0 + b_1 \text{ SNP} + b_2 \text{ CAE} + b_3 \text{ SNP} \times \text{ACE} + b_4 \text{ gender}$
- ME Gene, ME Adverse Childhood Event, Gene x CAE interaction, Lifetime Trauma load, Gene x LT trauma load interaction
 - $Y = b_0 + b_1 \text{ SNP} + b_2 \text{ CAE} + b_3 \text{ SNP} \times \text{ACE} + b_4 \text{ LT trauma} + b_5 \text{ SNP} \times \text{LT trauma} + b_6 \text{ gender}$

Replications of G x E interactions in PTSD in ONG: *FKBP5* SNPs

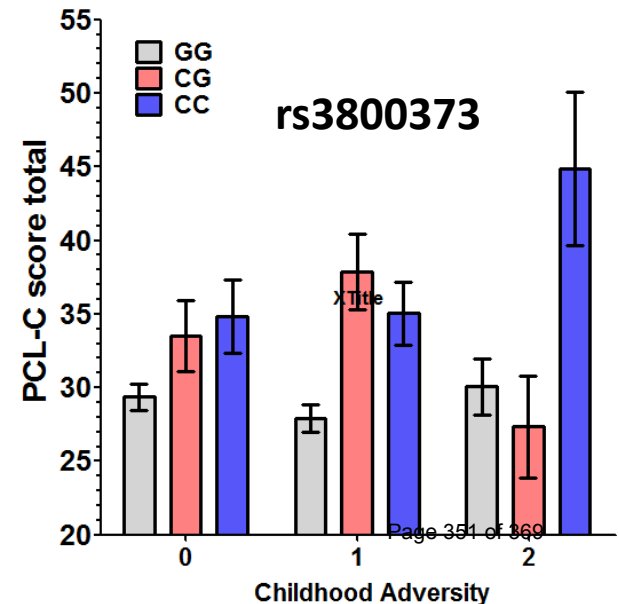
Total sample N=592

ACE p value	gene	SNP name	risk	SNP p value	SNP x ACE p
0.001	FKBP5	rs1360780	A	0.253	0.004
0.001	FKBP5	rs3800373	C	0.401	0.007
0.001	FKBP5	rs9296158	A	0.581	0.002
0.001	FKBP5	rs9470080	A	0.284	0.007



European ancestry only N=551

ACE p value	gene	SNP name	risk	SNP p value	SNP x ACE p
0.001	FKBP5	rs1360780	A	0.562	0.071
0.001	FKBP5	rs3800373	C	0.692	0.021
0.001	FKBP5	rs9296158	A	0.827	0.017
0.001	FKBP5	rs9470080	A	0.459	0.051



Replications of G x E interactions in PTSD in our ONG Cohort Sample

- **FKBP5** - replicated G x E ($p < .005$ in total sample, $p < .05$ in $N=549$ European ancestry. $N=38$ African or mixed ancestry, larger N will allow stratified analyses
- **RGS2** - ns main effect or G x E
- **ADCYAP1R1** - ns main effect or G x E in sample currently $N=109$ females, larger N for stratified analyses
- **5-HTTLPR** - genotyping (PCR-based) ongoing

Main Effects of SNPs for PTSD

Significant after Bonferroni correction ($P < 1.1 \times E-05$):

DISC1

Highest PCL total score (n=551 European Ancestry)

CHR	SNP		A1	TEST	NMISS	BETA	P
1	rs821647	DISC1	G	ADD	589	-3.52	1.55E-05
1	rs3753396	CPH	G	ADD	589	3.033	9.39E-04
6	rs2067997	FKBP5	G	ADD	589	3.427	8.21E-04
16	rs12922100	MAPK3	A	ADD	589	6.277	8.62E-04

Highest PCL Hyperarousal score (n=551 European Ancestry)

CHR	SNP	BP	A1	TEST	NMISS	BETA	P
1	rs821647	DISC1	G	ADD	589	-1.269	4.40E-06
5	rs2290638	HOMER	C	ADD	589	0.9633	9.39E-04
6	rs1051952	FKBP5	C	ADD	589	0.8764	6.89E-04
6	rs2067997	FKBP5	G	ADD	589	1.258	2.95E-04

SNP x ACE Interactions

(controlling for main effect ACE)

Significant after Bonferroni correction ($P < 1.1 \times E-05$)

none

Highest PCL total score (n=551 European Ancestry)

CHR	SNP	Gene Symbol	A1	TEST	BETA	P
5	rs2400707	NR3C1	A	SNP x ACE	-3.328	1.5E-04
5	rs1042714	ADRB2	C	SNP x ACE	-3.236	2.0E-04
5	rs11168068	ADRB2	G	SNP x ACE	-3.272	2.2E-04
5	rs11168070	ADRB2	C	SNP x ACE	-3.24	2.2E-04
5	rs1432622	ADRB2	A	SNP x ACE	-3.272	2.1E-04
5	rs1432623	ADRB2	G	SNP x ACE	-3.272	1.8E-04
5	rs2053044	ADRB2	A	SNP x ACE	-3.295	2.1E-04
6	rs2143404	FKBP5	A	SNP x ACE	-4.131	4.2E-04
6	rs13192954	FKBP5	G	SNP x ACE	-8.54	9.1E-04
6	rs4870266	OPRM1	A	SNP x ACE	4.71	7.2E-04
8	rs7820517	SLC18A1	A	SNP x ACE	4.081	2.2E-04
8	rs2576573	PENK	A	SNP x ACE	-2.688	3.5E-04
8	rs2609998	PENK	A	SNP x ACE	-2.681	3.6E-04

SNP x ACE Interactions

(controlling for main effects of ACE & LT trauma)

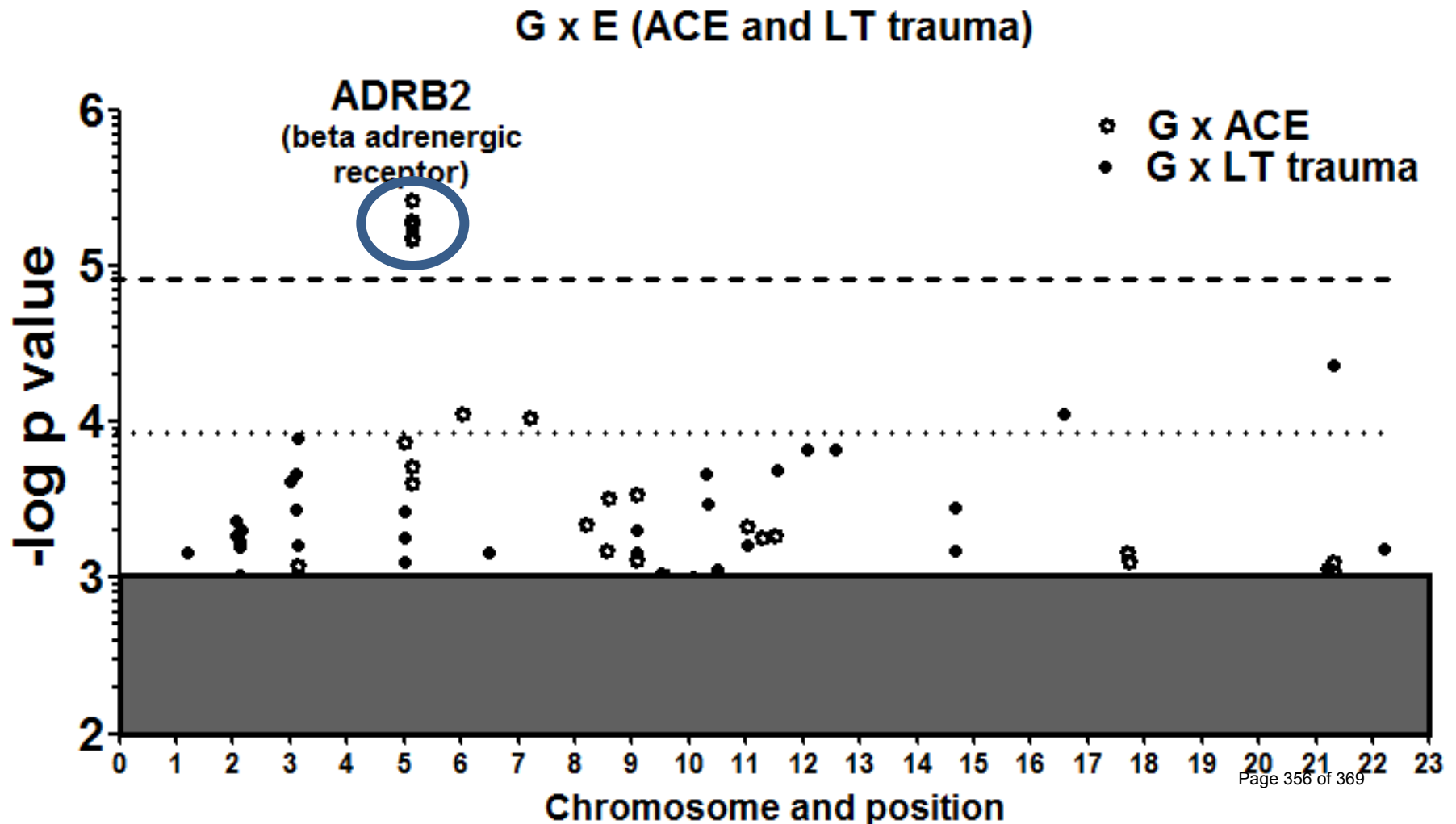
Significant after Bonferroni correction ($P < 1.1 \times 10^{-5}$):

ADRB2: beta adrenergic receptor

Highest PCL total score (n=551 European Ancestry)

CHR	SNP	Gene Symbol	A1	TEST	BETA	P
5	rs1432622	ADRB2	A	SNP x ACE	-3.659	5.41E-06
5	rs1432623	ADRB2	G	SNP x ACE	-3.659	5.41E-06
5	rs11168068	ADRB2	G	SNP x ACE	-3.659	5.41E-06
5	rs2400707	ADRB2	A	SNP x ACE	-3.715	3.82E-06
5	rs2053044	ADRB2	A	SNP x ACE	-3.665	5.20E-06
5	rs11168070	ADRB2	C	SNP x ACE	-3.627	6.74E-06
5	rs1042714	ADRB2	C	SNP x ACE	-3.626	6.66E-06

G x E interaction with Childhood Adversity including LT trauma load - significant w/ Bonferoni ($p < 10^{-5}$)



Three Major Haplotypes of the β_2 Adrenergic Receptor Define Psychological Profile, Blood Pressure, and the Risk for Development of a Common Musculoskeletal Pain Disorder

Luda Diatchenko,^{1*} Amy D. Anderson,² Gary D. Slade,³ Roger B. Fillingim,⁴ Svetlana A. Shabalina,⁵ Tomas J. Higgins,¹ Swetha Sama,¹ Inna Belfer,^{6,7} David Goldman,⁶ Mitchell B. Max,⁷ Bruce S. Weir,² and William Maixner¹

¹University of North Carolina, Center for Neurosensory Disorders, North Carolina

²University of Washington, Department of Biostatistics, Seattle

³University of Adelaide, Australian Research Centre for Population Oral Health, Adelaide

⁴University of Florida College of Dentistry, Gainesville

⁵Computational Biology Branch, NCBI, NIH, Bethesda, Maryland

⁶Laboratory of Neurogenetics, NIAAA, NIH, Rockville, Maryland

⁷Pain & Neurosensory Mechanisms Branch, NIDCR, NIH, Bethesda, Maryland

Adrenergic receptor β_2 (ADRB2) is a primary target for epinephrine. It plays a critical role in mediating physiological and psychological responses to environmental stressors. Three func-

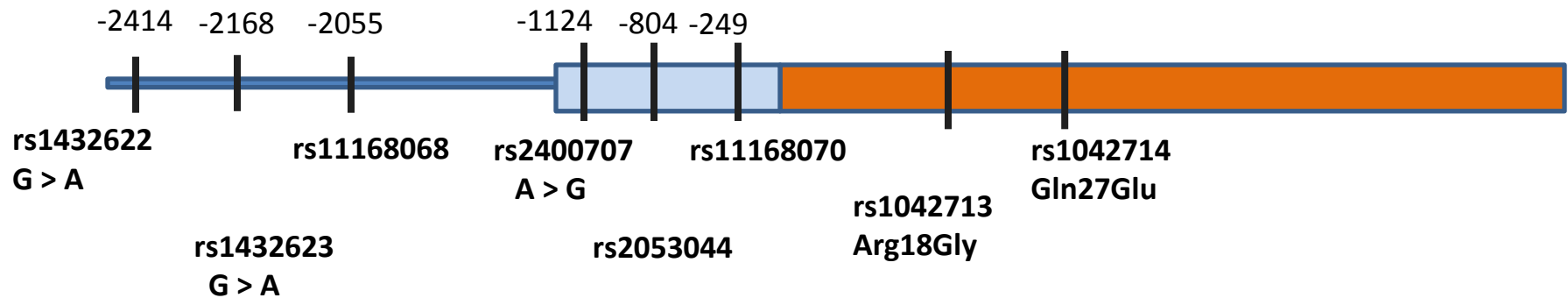
etiological pathways that imply the need for tailored treatment options. © 2006 Wiley-Liss, Inc.

KEY WORDS: adrenergic receptor β_2 ; haplo-

Beta 2 Adrenergic Receptor SNPs showing G x E interaction

mRNA transcript

ADRB2



SNP	P value
rs1432622	5.41×10^{-6}
rs1432623	5.41×10^{-6}
rs11168068	5.41×10^{-6}
rs2400707	3.82×10^{-6}
rs2053044	5.2×10^{-6}
rs12654778	0.000247
rs11168070	6.74×10^{-6}
rs1042713	0.000193
rs1042714	6.6×10^{-6}

- **Beta 2 Adrenergic Receptor central player in sympathetic nervous system**
- May be important in Brain-Immune system cross-signalling (Elenkov, 2008)
- Haplotypes of these SNPs predict depressed mood, pain sensitivity, and chronic pain (Diatchenko, 2006, 2008)

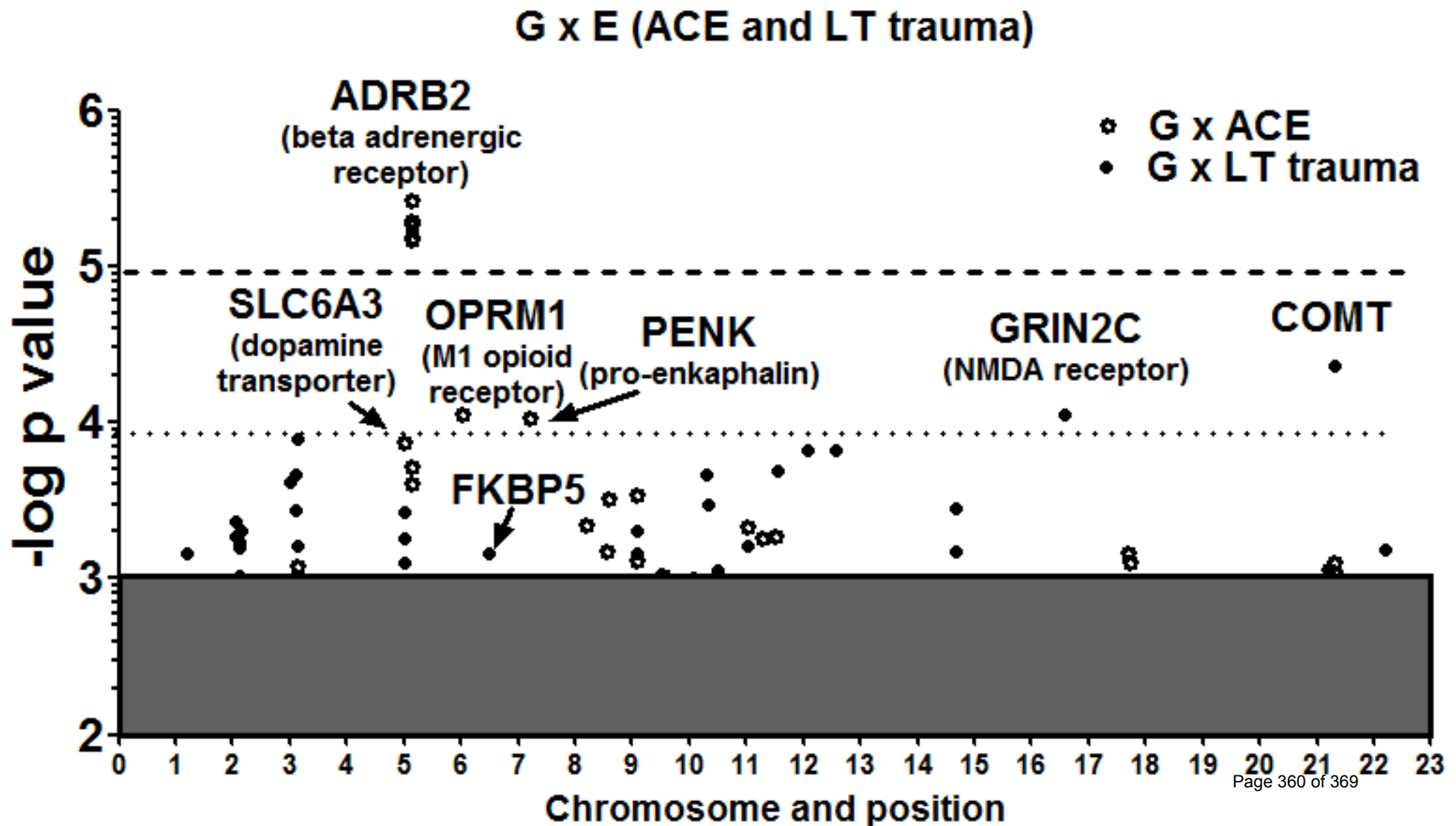
SNP x ACE Interactions

(controlling for main effects of ACE & LT trauma)

Highest PCL total score (n=551 European Ancestry)

CHR	SNP	Gene Symbol	A1	TEST	BETA	P
3	rs6440168	SLC9A9	A	SNP x ACE	2.558	5.91 E-04
5	rs12654778	ADRB2	A	SNP x ACE	2.85	2.47 E-04
5	rs1042713	ADRB2	A	SNP x ACE	2.901	1.93 E-04
6	rs4870266	OPRM1	A	SNP x ACE	4.852	1.34 E-04
8	rs2576573	PENK	A	SNP x ACE	-2.698	8.95 E-05
8	rs2609998	PENK	A	SNP x ACE	-2.691	9.41 E-05
8	rs7820517	SLC18A1	A	SNP x ACE	3.441	6.72 E-04
9	rs2808707	NTRK2	A	SNP x ACE	-2.722	4.59 E-04
11	rs2049048	BDNF	A	SNP x ACE	-3.972	4.7 E-04
11	rs3891484	HTR3B	G	SNP x ACE	3.48	5.44 E-04
21	rs2832484	GRIK1	G	SNP x ACE	2.817	6.81 E-04
21	rs2243436	GRIK1	A	SNP x ACE	2.766	7.89 E-04
21	rs2832489	GRIK1	G	SNP x ACE	2.766	7.89 E-04
21	rs420121	GRIK1	A	SNP x ACE	-2.986	9.19 E-04
22	rs11089599	SYN3	A	SNP x ACE	2.974	8.80 E-04

SNPs showing G x E interaction with Childhood Adversity – P values $< 10^{-4}$



SNP x LT trauma Interactions

(controlling for main effects of ACE &LT trauma)

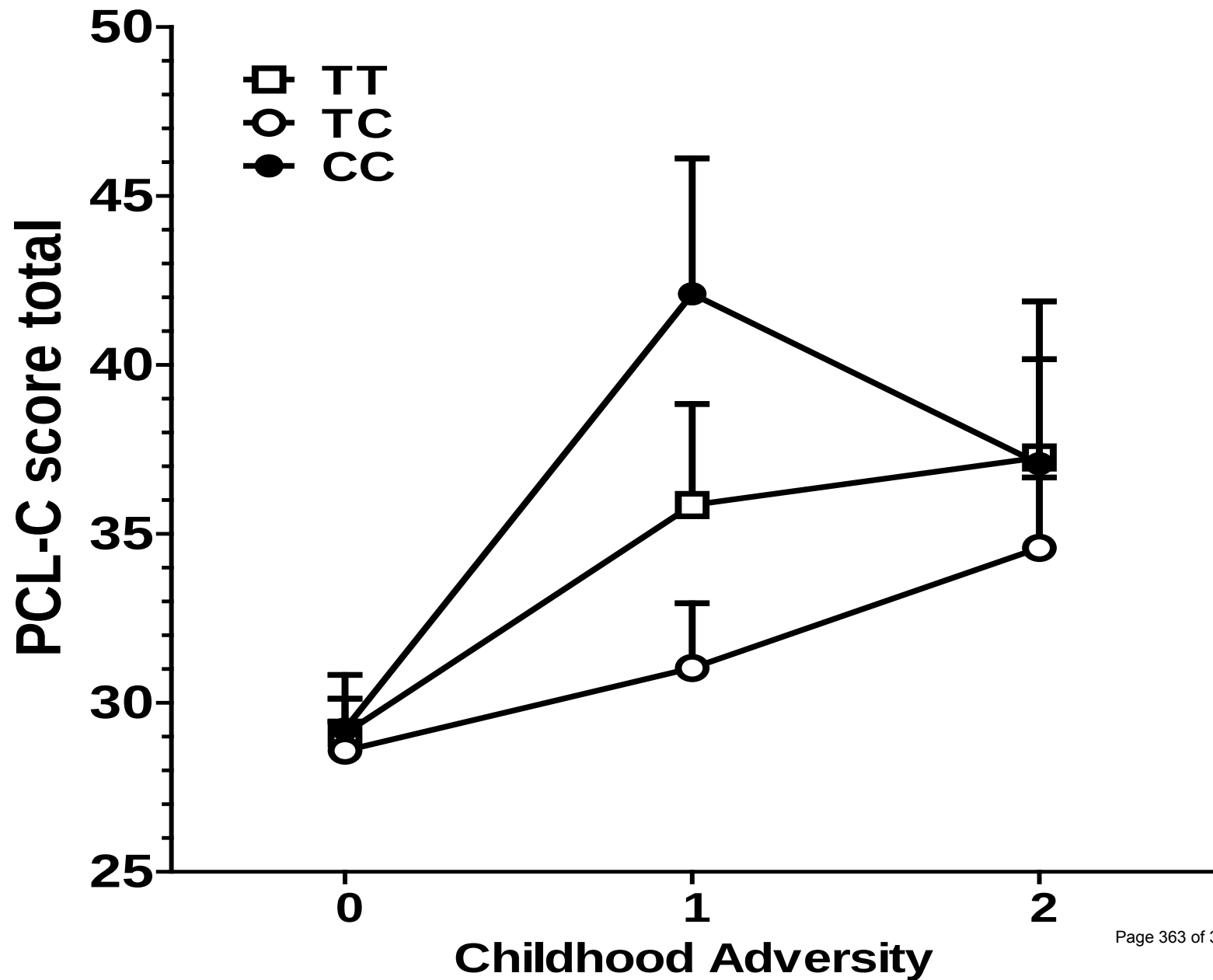
Highest PCL total score (n=551 European Ancestry)

CHR	SNP	Gene Symbol	A1	TEST	BETA	P
1	rs3811014	NGFB	G	SNP X LT trauma	0.5065	6.90 E-04
2	rs1143634	IL1B	A	SNP X LT trauma	-0.4494	5.02 E-04
2	rs1143637	IL1B	A	SNP X LT trauma	-0.4437	5.91 E-04
2	rs1143639	IL1B	A	SNP X LT trauma	-0.442	6.311 E-04
3	rs935519	SLC9A9	A	SNP X LT trauma	-0.5256	1.31 E-04
3	rs4358295	GAP43	A	SNP X LT trauma	-0.5189	2.22 E-04
3	rs9878482	SLC6A11	G	SNP X LT trauma	0.5419	2.43 E-04
3	rs9873087	SLC9A9	G	SNP X LT trauma	-0.3987	6.22 E-04
5	rs2652511	SLC6A3	A	SNP X LT trauma	0.3853	3.8 E-04
5	rs2550946	SLC6A3	A	SNP X LT trauma	0.3722	5.51 E-04
6	rs10947564	FKBP5	G	SNP X LT trauma	-0.459	7.95 E-04
7	rs1554606	IL6	A	SNP X LT trauma	0.3708	6.87 E-04
9	rs2283123	DBH	A	SNP X LT trauma	0.7322	6.91 E-04
11	rs1491851	BDNF	A	SNP X LT trauma	-0.3721	2.18 E-04
11	rs2140887	BDNF	A	SNP X LT trauma	-0.349	6.19 E-04
11	rs2212449	NCAM1	A	SNP X LT trauma	-0.3991	3.36 E-04
12	rs3759347	GNB3	A	SNP X LT trauma	0.4388	2.01 E-04
17	rs3744215	GRIN2C	A	SNP X LT trauma	-0.4918	8.91 E-05
17	rs7219247	GRIN2C	A	SNP X LT trauma	-0.4918	8.91 E-05
22	rs4646316	COMT	A	SNP X LT trauma	0.5231	4.32 E-05

Summary of Preliminary Genetics Analyses in the ONG sub-sample

- These are highly preliminary gene association and G x E analyses with data presently available sub-sample (N=551 European ancestry)
- FKBP5 G x E (childhood adversity) finding of Binder & Ressler (2008) was replicated in this (small) sample
- Array-wide significant association ($p < 1.1E-05$, SNP x childhood adversity interaction) with central gene in Sympathetic Nervous System (*ADRB2*)
- Potentially interesting ($p < 1E-04$) G x E in dopamine (*SLCA9*, *COMT*), Opioid (*OPRM1*, *PENK*), and Glutamate (*GRIN2C*, *GRIK1*), other (*BDNF*, *NCAM1*) systems

ADRB2 rs11168068



The Ohio Army National Guard Mental Health Initiative: Prevalence of DSM-IV Disorders

Objective:

To explore the lifetime and current prevalence of DSM-IV Axis I disorders among a subsample of the Ohio Army National Guard (OHARNG).

Method:

1052 (40.2%) of 2616 OHARNG soldiers who completed a telephone survey were randomly invited to participate in the in-depth clinical cohort assessments using the Clinician-Administered PTSD Scale and the Structured Clinical Interview for DSM-IV-TR. Of those invited, 11.9% (n=125) declined. Of the remaining 952, 21 (2.3%) did not attend their scheduled interview, and the goal of 500 was met before the remaining 406 (43.7%) were contacted. Interviews occurred in neutral settings such as private library rooms, between November 2008 and December 2009.

Results:

The prevalence of at least one DSM-IV disorder was 66.4% (332); substance use disorders were the most prevalent (52.2%), followed by mood disorders (30.0%) and anxiety disorders (22.0%). The prevalence of at least one current disorder was 25.0% (n=83); alcohol abuse (28.2%), MDD (22.4%) and alcohol dependence (20.4%) were the most common. Deployed soldiers had a higher lifetime prevalence of alcohol use disorders (53.0% vs. 39.5%, $p=0.0049$) and PTSD (6.8% vs. 2.5%, $p=0.0447$) compared to those never deployed. Women were more likely than men to have any mood disorder history (43.3% vs. 28.2%, $p=0.0163$).

Conclusions:

Alcohol abuse and MDD were the two most common lifetime disorders, similar to the general population. However, the prevalence of alcohol abuse in the OHARNG was twice the rate in the general population. The fourth most common disorder in this study was drug use, compared to specific or social phobia in the general population. Women were more likely to have mood disorder history, as expected from other general and military study populations. However, we did not find the expected lower prevalence of substance abuse in women. Clinicians should ask patients about military service, and carefully screen for substance abuse.

Funding Source: Department of Defense Congressionally Directed Medical Research Program: W8XHW-07-1-0409, the "Ohio Army National Guard Mental Health Initiative."

Conference: Society for Epidemiologic Research 2012 Annual Meeting

Abstract Title: Posttraumatic stress disorder and HIV risk behavior among Army National Guard Soldiers: The mediating role of depression

Name of Presenter: Brandon DL Marshall

Authors: Brandon DL Marshall, Marta R Prescott, Israel Liberzon, Marijo B Tamburrino, Joseph R Calabrese, and Sandro Galea

Topic Areas: Psychiatric; Behavioral

Submitted By: Brandon DL Marshall, PhD
Columbia University Mailman School of Public Health
722 W 168th Street
New York, NY, 10032-3727
Tel: 212-305-2433
Fax: 212-305-1460
E-mail: bdm2125@columbia.edu

Abstract:

Posttraumatic stress disorder and HIV risk behavior among Army National Guard Soldiers: The mediating role of depression. *BDL Marshall, MR Prescott, I Liberzon, MB Tamburrino, JR Calabrese, and S Galea (Columbia University, New York, NY, 10032)

The objective of this study was to examine the relationship between posttraumatic stress disorder (PTSD) and engagement in HIV risk behavior among a sample of Ohio Army National Guard (OHARNG) soldiers, and to determine whether new onset depression after exposure to a traumatic event mediated this association. We analyzed data collected from a representative sample of OHARNG enlisted between June 2008 and February 2009. Participants completed interviews assessing engagement in activities defined by the Behavioral Risk Factor Surveillance System (BRFSS) as HIV risk factors (e.g., intravenous drug use, unprotected anal intercourse, sex work, or treatment for an STD) and were screened for PTSD and depression based on DSM-IV criteria. Logistic regression was used to estimate the direct and indirect effects of PTSD on HIV risk behavior. Of 2,282 participants, 147 (6.4%) reported at least one HIV risk behavior. PTSD was independently

associated with HIV risk behavior (adjusted odds ratio [AOR] = 2.1, 95%CI: 1.1 – 3.9), as was depression (AOR = 2.2, 95%CI: 1.5 – 3.2). After depression was included as a mediator, the association between PTSD and HIV risk decreased in magnitude (AOR = 1.8, 95%CI: 0.9 – 3.4), suggesting partial mediation (Sobel test $p < 0.01$). Soldiers with PTSD may be at greater risk of HIV infection due to increased engagement in HIV risk behavior. New onset depression following exposure to trauma appears to mediate this relationship. Integrated interventions to address mental health problems and reduce engagement in HIV risk behavior are in need of development and evaluation.

Word count: 1,857 (max. 1,935 including title, author, and spaces)

Conference: XIX International AIDS Conference

Abstract Title: Posttraumatic stress disorder and HIV risk behavior among Army National Guard Soldiers: The mediating role of depression

Name of Presenter: Brandon DL Marshall

Authors: Brandon DL Marshall, Marta R Prescott, Israel Liberzon, Marijo B Tamburrino, Joseph R Calabrese, and Sandro Galea

Track: Epidemiology and Prevention Science

Track Category: Epidemiology of risk factors for acquisition of HIV (C4)

Submitted By: Brandon DL Marshall, PhD
Columbia University Mailman School of Public Health
722 W 168th Street
New York, NY, 10032-3727
Tel: 212-305-2433
Fax: 212-305-1460
E-mail: bdm2125@columbia.edu

Abstract:

Background: Persons with posttraumatic stress disorder (PTSD) and other mental health conditions are more likely to practice HIV risk behaviors, and military personnel represent one population at increased risk for trauma exposure and subsequent development of PTSD. We examined the relationship between PTSD and engagement in HIV risk behavior among a sample of Ohio ARNG soldiers, and determined whether new onset depression after exposure to a traumatic event mediated this association.

Methods: We analyzed data collected from a representative sample of OHARNG enlisted between June 2008 and February 2009. Participants completed interviews assessing engagement in activities defined by the Behavioral Risk Factor Surveillance System (BRFSS) as HIV risk factors (e.g., intravenous drug use, unprotected anal intercourse, sex work, or treatment for an STD) and were screened for PTSD and depression based on DSM-IV

criteria. Logistic regression was used to estimate the direct and indirect effects of PTSD on HIV risk behavior.

Results: Of 2,282 participants, the majority were male (86.3%), Caucasian (88.3%), and less than 35 years of age (64.8%). In total, 147 (6.4%) reported at least one HIV risk behavior. PTSD was independently associated with HIV risk behavior (adjusted odds ratio [AOR] = 2.1, 95%CI: 1.1 – 3.9), as was depression (AOR = 2.2, 95%CI: 1.5 – 3.2). After depression was included as a mediator, the association between PTSD and HIV risk decreased in magnitude (AOR = 1.8, 95%CI: 0.9 – 3.4), suggesting partial mediation (Sobel test $p < 0.01$).

Conclusions: Soldiers with PTSD may be at greater risk of HIV infection due to increased engagement in HIV risk behavior. New onset depression following exposure to trauma appears to mediate this relationship. Integrated interventions to address mental health problems and reduce engagement in HIV risk behavior are in need of development and evaluation.

Word count: 291 (max. 300)

POSTTRAUMATIC STRESS DISORDER AND HIV RISK BEHAVIOR AMONG ARMY NATIONAL GUARD SOLDIERS: THE MEDIATING ROLE OF DEPRESSION.

*B D L Marshall, M R Prescott, I Liberzon,
M B Tamburrino, J R Calabrese, and S Galea (Columbia University,
New York, NY 10032)

The objective of this study was to examine the relationship between posttraumatic stress disorder (PTSD) and engagement in HIV risk behavior among a sample of Ohio Army National Guard (OHARNG) soldiers, and to determine whether new onset depression after exposure to a traumatic event mediated this association. We analyzed data collected from a representative sample of OHARNG enlisted between June 2008 and February 2009. Participants completed interviews assessing engagement in activities defined by the Behavioral Risk Factor Surveillance System (BRFSS) as HIV risk factors (e.g., intravenous drug use, unprotected anal intercourse, sex work, or treatment for an STD) and were screened for PTSD and depression based on DSM-IV criteria. Logistic regression was used to estimate the direct and indirect effects of PTSD on HIV risk behavior. Of 2,282 participants, 147 (6.4%) reported at least one HIV risk behavior. PTSD was independently associated with HIV risk behavior (adjusted odds ratio [AOR] = 2.1, 95% CI: 1.1 – 3.9), as was depression (AOR = 2.2, 95% CI: 1.5 – 3.2). After depression was included as a mediator, the association between PTSD and HIV risk decreased in magnitude (AOR = 1.8, 95% CI: 0.9 – 3.4), suggesting partial mediation (Sobel test $P < 0.01$). Soldiers with PTSD may be at greater risk of HIV infection due to increased engagement in HIV risk behavior. New onset depression following exposure to trauma appears to mediate this relationship. Integrated interventions to address mental health problems and reduce engagement in HIV risk behavior are in need of development and evaluation.