Risk of Suicide Among Veterans with Traumatic Brain Injury Experiencing Homelessness

B. Palladino, A. E. Montgomery, M. Sommers, J. D. Fargo

Introduction

Suicide is the tenth leading cause of death in the United States; during 2013 more than 41,000 individuals died as a result of self-inflicted injury, a rate of 13 suicide deaths per 100,000 individuals[1]. The rate of suicide among the 22 million veterans in 2013 was almost three times the rate in the general population[2]. Several investigations have demonstrated an association between suicide and traumatic brain injury (TBI)[3]. TBI—a type of acquired brain injury that occurs as a result of a blow, jolt, or bump to the head or a penetrating injury that disrupts brain function[4]—has been diagnosed among more than 333,000 service members since 2000[5]. Repeated traumatic brain injury (rTBI) can result in damage to the cerebral axons and lead to symptoms such as impaired judgment and impulse control, memory loss, confusion, aggression, and depression[6].

A study assessing TBI among veterans engaged with homeless services programs provided by United States Department of Veterans Affairs (VA) found that 47% had a probable TBI which is almost 4 times the rate of TBI among the general population[7]. While research has addressed the relationship between TBI and suicide, as well as TBI and homelessness among veterans generally, no research has examined suicide risk in veterans with TBI who are also experiencing homelessness. Given the fact that veterans comprise 11% of the adult homeless population in the United States[8], and have high rates of suicidal ideation and suicide attempts[9], as well as TBI, this is not a trivial gap in current understanding. This study aimed to understand the associations between suicide risk and physical, psychological, social and military characteristics among veterans with TBI who are experiencing homelessness.

Materials & Methods

Sample

The study sample included 103 veterans who presented for homeless outreach services between December 2010 and September 2011 at either a VA medical center or a drop-in center for veterans experiencing homelessness and who screened positive for TBI on two instruments, described below. An additional 19 veterans were determined ineligible for the study because they did not screen positive for TBI on both instruments; 84.4% of all participants were retained in the sample.

Measures

Demographic information. Basic demographic information included race, education, marital status, military branch and rank, and experience of deployment and combat.

TBI-4 Questionnaire. This 4-question brief screen assessed history of TBI among veterans accessing VA homeless services. A positive response to any of the following items indicated TBI: (1) Have you ever been hospitalized or treated in an emergency room following a head or neck injury? (2) Have you ever been knocked out or unconscious following an accident or injury? (3) Have you ever injured your head or neck in a car accident or from some other moving vehicle accident? 4) Have you ever injured your head or neck in a fight or fall?

Ohio State University TBI Identification Method (OSU TBI-ID). The OSU TBI-ID is a structured interview designed to elicit self-report of a TBI occurring over a person's lifetime with a focus on (1) injuries caused by a blow to the head or high-velocity forces; (2) altered consciousness; (3) treatment received;

and (4) sequelae. Information is obtained on the number of injuries, severity of injuries, initial and persistent sequelae and age at time of injury. The present study assessed the following variables from this instrument: mean number of TBIs, veterans' TBI experience—whether the veteran experienced loss of consciousness (LOC), being dazed/confused without LOC and amnesia without LOC—and TBI-related symptoms such as headache, dizziness, ringing in ears, fatigue and sleep problems, blurred vision, temper and irritability, inability to manage stress, issues with memory and problem-solving and seizures. Scores from this instrument have a reliability between 0.84–0.93.

MINI International Neuropsychiatric Interview (MINI). The MINI is a psychiatric interview that assesses a number of psychiatric disorders including mania/hypomania, major depressive episode, panic disorder, agoraphobia, anxiety disorder, post-traumatic stress disorder (PTSD), alcohol/substance abuse and dependence and psychotic disorders. The MINI has a reliability of 0.76–0.93, a sensitivity between 0.46–0.94 and a specificity between 0.72–0.97, depending on the subscale.

The MINI also assesses suicide risk with a subset of 15 questions from which a total risk score can be computed: 1–8 indicates low risk, 9–16 moderate risk, and 17 or greater high risk. Suicide-related items include: feelings of hopelessness, thoughts of being better off dead, thoughts of hurting oneself, thoughts/plans about suicide or history of a suicide attempt. We dichotomised risk for suicide as no/low/moderate versus high risk. There were no substantial differences in demographic and mental health characteristics between those with no, low or moderate risk for suicide.

Procedure

To participate in the study, veterans had to be at least 18 years of age and seeking homeless services through the local VA medical center. A psychology technician employed by VA administered each of the measures described above; veterans who were not found to screen positive for TBI, on both the TBI-4 and the OSU TBI-ID, were excluded. This study was approved by the Institutional Review Boards of the University of Pennsylvania and the Corporal Michael J. Crescenz VA Medical Center.

Data Analysis

To compare the associations between suicide risk and physical, psychological, social and military factors, we conducted a binary logistic regression analysis with suicide risk as the outcome and a set of 29 predictor variables. We retained, in the models, predictor variables for which $p < 0.20$ in univariable logistic regression models. Although age, marital status, race, LOC and total number of TBIs were not significant in the univariable models, they were retained as control variables due to their theoretical importance.

Results

Demographic characteristics are presented in Table 1. All participants were male, between 29 and 79 years old (M = 53.73, SD = 7.07) and approximately half had been married at some point in their lifetime (52.4%, n = 55). Most participants identified as non-white (82.5%, n = 85). Depression was reported in 17.5% (n = 18) of the sample, anxiety in 9.7% (n = 10), bipolar disorder in 2.9% (n = 3), psychotic disorder in 7.8% (n = 8), and PTSD in 21.4% (n = 22). Alcohol abuse was reported in 32.0% (n = 33) of the sample and substance abuse, other than alcohol, was reported in 50.5% (n = 52). Approximately one-third (n = 39) had been deployed at least once and 14.6% (n = 15) had combat experience. Approximately two-thirds (63.1%, n = 65) of the sample had 3 or more TBIs, with 82.5% (n = 85) reporting accompanying LOC. Veterans who reported high risk of suicide also reported significantly more frequently that they experienced the following TBI-related symptoms: blurred vision, seizures and difficulty with memory/problem-solving and managing stress.

Results of the multivariate model are presented in Table 2. Factors associated with high risk for suicide included being previously married (OR = 8.87, p = 0.044), PTSD (OR = 8.33, p = 0.04), difficulty with memory/problem-solving (OR = 8.42, p = 0.047) and seizures (OR = 17.26, p = 0.03).

Table 1. Characteristics of Study Sample

	No/Low/Moderate Risk (n = 92)		High Risk (n = 11)		Total (N = 103)	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
Number of TBIs	3.1	1.6	3.4	1.5	3.2	1.6
Age*	54.3	6.8	48.9	8.0	53.7	7.1
	n	%	*n*	%	*n*	%
Race*						
White	16	17.4	2	18.2	18	17.5
Non-white	76	82.6	9	81.8	85	82.5
Educational Level						
No high school diploma	7	7.6	3	27.3	10	9.7
High school diploma/GED	46	50.0	3	27.3	49	47.6
Some college	24	26.1	2	18.2	26	25.2
Associates/Bachelor degree	15	16.3	3	27.3	18	17.5
Marital Status						
Never married	45	48.9	3	27.3	48	46.6
Ever married	47	51.1	8	72.7	55	53.4
Branch of Military*						
Army	53	57.6	6	54.5	59	57.3
Non-Army	39	42.4	5	45.5	44	42.7
Rank						
E1–E2	26	28.3	2	18.2	28	27.2
E3–E4	50	54.3	8	72.7	58	56.3
E5–E6	16	17.4	1	9.1	17	16.5
Combat Experience	13	14.1	2	18.2	15	14.6
Deployment	35	38.0	4	36.4	39	37.9
TBI Experience						
Loss of consciousness (LOC)	76	82.6	9	81.8	85	82.5
Dazed/confused without LOC	67	72.8	8	72.7	75	72.8
Amnesia without LOC	26	28.3	4	36.4	30	29.1
TBI-Related Symptoms						
Headache	69	75.0	8	72.7	77	74.8
Dizziness	56	60.9	9	81.8	65	63.1
Ringing in ears	39	42.4	8	72.7	47	45.6
Fatigue/sleep problems	40	43.5	8	72.7	48	46.6
Blurred vision*	42	45.7	9	81.8	51	49.5
Temper/irritability	29	31.5	5	45.5	34	33.0
Managing stress*	25	27.2	7	63.6	32	31.1
Memory/problem-solving*	34	37.0	9	81.8	43	41.7
Seizures*	4	4.3	4	36.4	8	7.8
Mental/Behavioral Health Conditions						
Major Depressive Disorder	15	15.3	3	27.3	18	17.5
Psychotic Disorder	6	6.5	2	18.2	8	7.8
Anxiety Disorder	8	8.7	2	18.2	10	9.7
Bipolar I or II	3	3.3	0	0.0	3	2.9
PTSD*	15	16.3	7	63.6	22	21.4
Alcohol Abuse/Dependence	29	31.5	4	36.4	33	32.0
Substance Abuse/ Dependence	44	47.8	8	72.7	52	50.5

Notes. *$p < 0.05$

Table 2. Physical, Psychological, Social, and Military Factors Predicting Suicide Risk Among Veterans with TBI Experiencing Homelessness

	OR	95% Confidence Intervals
Intercept	5.28	
Age	0.89	0.76–1.04
Loss of consciousness	0.14	0.01–2.07
Total number of TBIs	1.02	0.52–2.01
Previously married*	8.87	1.06–73.85
Race	0.51	0.03–8.65
PTSD*	8.02	1.10–58.53
Memory/problem-solving*	8.42	1.02–69.28
Seizures*	17.26	1.30–228.81

Notes. *$p < 0.05$. *OR* = odds ratio

Discussion

The present study is the first to assess the relationship between factors related to suicide risk among a sample of veterans experiencing both homelessness and TBI. The findings presented are particularly important given the high rates of TBI, suicide and homelessness among the veteran population. This study indicated that, although veterans reporting low-to-moderate risk of suicide are demographically similar to those experiencing high risk—and have suffered approximately the same number of TBIs—their reporting of post-TBI symptoms are significantly different. Veterans expressing high risk of suicide more frequently experienced blurred vision, difficulty managing stress, struggles with memory and problem-solving and seizures following a TBI; the presence of these symptoms may be an indication of a more severe TBI or rTBI which has been associated with increased risk of suicide. In addition, these veterans also more frequently reported symptoms consistent with PTSD which overlap to a large degree with symptoms of TBI.

This study found that veterans with PTSD had 8 times the odds of being at high risk for suicide, compared with those who did not have PTSD. Several other studies have identified a similar relationship between PTSD and suicide among veterans. Veterans experiencing homelessness who have PTSD may be at greater risk for suicide than non-homeless veterans for a number of reasons: they may have limited access to appropriate mental health resources given a lack of sustainable income or health insurance; they are faced daily with stressful situations that can trigger or exacerbate PTSD symptoms, such as lack of food and shelter or unsafe conditions; or they may be struggling with alcohol and substance abuse which may worsen PTSD symptoms[10].

The interpretation of study findings must be tempered by a number of study limitations. First, the sample was quite small, fairly homogeneous, and likely represented the setting from which it was drawn, limiting the ability to generalise to the larger population of veterans experiencing homelessness. Second, due to limitations of data collection instruments used for this study, the present analyses could not control for a number of variables including severity of the TBI and PTSD, whether these were the result of injuries incurred during combat and if symptoms reported by veterans were due to TBI, PTSD or some other condition. Third, the identification of marriage status as a predictor of suicide risk should be tempered by the fact that approximately half the sample was married, potentially biasing the results. Future studies should consider using administrative data, at the population level, supplemented with additional primary data related to the circumstances surrounding veterans' TBIs and experience of combat.

Acknowledgments

This study was funded by the U.S. Department of Veterans Affairs, National Center on Homelessness Among Veterans.

Corresponding author: Ann Elizabeth Montgomery
Email: ann.montgomery2@va.gov
Authors: B Palladino[1], A. E. Montgomery[2], M. Sommers[3], J. D. Fargo[4]
Author Affiliations:
1 University of Pennsylvania School of Nursing - Center for Health Equity Research, Philadelphia, Pennsylvania, USA
2 U.S. Department of Veterans Affairs - National Center on Homelessness Among Veterans, Philadelphia, Pennsylvania, USA
3 University of Pennsylvania School of Nursing - Center for Health Equity Research, Philadelphia, Pennsylvania, USA
4 Utah State University - Department of Psychology, Logan, Utah, USA

References

1. Centers for Disease Control & Prevention (CDC). Fast stats: Suicide and self-inflicted injury, 2013. Atlanta, GA, CDC, 2015. Available at http://www.cdc.gov/nchs/fastats/suicide.htm; accessed October 9, 2015.
2. Zoroya G. VA study: 22 vets commit suicide every day. USA Today, 2013. Available at http://www.usatoday.com/story/news/nation/2013/02/01/Veterans-suicide/1883329/; accessed October 9, 2015.
3. Teasdale TW, Engberg AW. Suicide after traumatic brain injury: a population study. J Neurology, Neurosurgery Psych 2001; 71: 436–440.
4. CDC. Web-based Injury Statistics Query and Reporting System (WISQARS). Atlanta, GA, CDC, National Center for Injury Prevention and Control, 2010. Available at www.cdc.gov/injury/wisqars/index.html; accessed October 9, 2015.
5. Department of Defense (DOD). Worldwide numbers for TBI. Washington, DC, DOD, 2015. Available at http://dvbic.dcoe.mil/dod-worldwide-numbers-tbi; accessed October 9, 2015.
6. Baugh CM, Stamm JM, Riley DO, et al. Chronic traumatic encephalopathy: Neurodegeneration following repetitive concussive and subconcussive brain trauma. Brain Imaging Beh 2012; 6(2): 244–254.
7. Russell LM, Devore MD, Barnes SM, et al. Challenges associated with screening for traumatic brain injury among US veterans seeking homeless services. Am J Pub Health 2013; 103(S2): S211–S213.
8. U.S. Department of Housing and Urban Development (HUD). The 2014 Annual Homeless Assessment Report to Congress. Part 1, Point-in-Time Estimates of Homelessness. Washington, DC, HUD, 2014. Available at https://www.hudexchange.info/resources/documents/2014-AHAR-Part1.pdf; accessed October 9, 2015.
9. Goldstein G, Luther JF, Haas GL. Medical, psychiatric, and demographic factors associated with suicidal behavior in homeless veterans. Psych Res 2012; 199(1): 37–43.
10. National Institute of Mental Health. Post-traumatic stress disorder. U.S. Department of Health and Human Services, 2013. Available at http://www.nimh.nih.gov/health/publications/post-traumatic-stress-disorder-easy-to-read/index.shtml; accessed November 30, 2015.

High G Flight: Physiological Effects and Countermeasures

P. Leggat

High G flight is a significant challenge facing crew in high performance military aircraft, spacecraft, and in some other settings, such as acrobatic and tourism-based fighter jet aircraft in the civilian sector. It may also be experienced in high G simulators and commercial fighter jet tourist experiences. G is defined as "a dimensionless ratio which expresses the applied acceleration that an object undergoes as a multiple of the normal acceleration due to Earth's gravity" (p19).[1] This first edition of *High G Flight: Physiological Effects and Countermeasures* is a textbook encapsulating a definitive review of aerospace medical research in the high G environment, which is supported by an impressive 60 pages of references.

The 1st edition of *High G Flight: Physiological Effects and Countermeasures* is presented as a 16 x 24 x 2 cm hardcover textbook, which is widely available online for purchase. The book contains a table of Contents, List of Figures, a Foreword by Lieutenant General (Dr) Thomas W Travis, a Preface, Acknowledgements, a List of Abbreviations, four main parts, 12 Chapters, References and a comprehensive Index. There is no glossary, which would be useful for non-medical readers, nor a list of equations, of which there are many in this textbook.

The primary target audience of *High G Flight: Physiological Effects and Countermeasures* is not clearly defined in the textbook, but it could be targeted at the author's colleagues working in aerospace medicine, aerospace physiologists, and researchers in this field. It would also be a useful reference for those undertaking postgraduate studies in high G flight or undertaking advanced studies in aerospace medicine. As it may be of interest to a wider group, such as flight crew, these readers without broader aerospace medical training may be challenged by some of the medical terminology, such that a glossary may be useful to consider in future editions, as previously mentioned. The textbook will also be of passing interest to the growing band of travel medicine practitioners and aerospace physicians, who are providing advice to tourists exposed to high G flight, including various jet fighter experience programs, such as "edge of space" adventures[2], and simulator training and sub-orbital flights into space planned by a number of commercial operators.

High G Flight: Physiological Effects and Countermeasures is divided up into four (4) parts, which provide a logical flow of discussion. Commencing with the origin and causes of G-related flight conditions in part "1. Mechanisms of G", the textbook then covers physiological effects of those conditions and tolerance and adaptation mechanisms in pilots in part "2. Physiology of G" and part "3. Tolerance and Adaption" and concludes with a discussion of existing countermeasures against G effects in part "4. Countermeasures". Chapters include "1. The Physics of Gravity"; 2. High G Flight"; "3. The Cardiovascular System at +1 Gz"; "4. The Cardiovascular System at High Gz"; "5. Respiratory Effects of G"; "6. Musculoskeletal Effects of G"; "7. Miscellaneous Clinical Effects of G"; "8. Tolerance to High G"; "9. Cardiovascular Adaption to Acceleration"; "10. The Anti-G Straining Manoeuvre"; "11. The G Suit"; and "12. Positive Pressure Breathing for G Protection". The textbook is well supported with 32 figures, which effectively help to convey complex concepts. There are also numerous equations, which some may find challenging. There have been other book reviews, which have also been complimentary about the present work.[3,4] One of these reviews mentions a number of instances of misprints and missing information,[4] some of which were seen, but are difficult to confirm and do not disrupt the flow. These errors will need to be rectified in future editions.

Single author textbooks are becoming more uncommon, but they have the advantage of being highly consistent in style. The author, David G. Newman, MB, MB *Monash*, DipAvMed *RCP(UK)*, MBA *Deakin*, PhD *Newcastle*, FRAeS, FAsMA, FACAsM, FAICD, FAIM, has impeccable credentials in both aerospace medicine and high G flight experience. As well as being a consultant in aviation medicine, David Newman is currently Associate Professor and Head of the Aviation Medicine Unit in the School of Public Health and Preventive Medicine, Monash University, Melbourne, Australia. He has also served with the Royal Australian Airforce (RAAF) for 13