

Disparate Prevalence Estimates of PTSD Among Service Members Who Served in Iraq and Afghanistan: Possible Explanations

Rajeev Ramchand
RAND Corporation, Arlington VA

Terry L. Schell
RAND Corporation, Santa Monica, CA

Benjamin R. Karney
Department of Psychology, University of California, Los Angeles, Los Angeles, CA

Karen Chan Osilla
RAND Corporation, Santa Monica, CA

Rachel M. Burns
RAND Corporation, Pittsburgh, PA

Leah Barnes Caldarone
RAND Corporation, Santa Monica, CA

The authors reviewed 29 studies that provide prevalence estimates of posttraumatic stress disorder (PTSD) among service members previously deployed to Operations Enduring and Iraqi Freedom and their non-U.S. military counterparts. Studies vary widely, particularly in their representativeness and the way PTSD is defined. Among previously deployed personnel not seeking treatment, most prevalence estimates range from 5 to 20%. Prevalence estimates are generally higher among those seeking treatment: As many as 50% of veterans seeking treatment screen positive for PTSD, though much fewer receive a PTSD diagnosis. Combat exposure is the only correlate consistently associated with PTSD. When evaluating PTSD prevalence estimates among this population, researchers and policymakers should carefully consider the method used to define PTSD and the population the study sample represents.

Considerable controversy surrounds estimates of the prevalence of posttraumatic stress disorder (PTSD) among service members deployed to warzones. Among Vietnam veterans, the most frequently cited estimate of prevalence of 30.9% (Kulka, 1990) is still met with criticism (Dohrenwend et al., 2007; Wessely & Jones, 2004). Similar concerns have been raised about PTSD prevalence estimates among U.S. service members serving in Afghanistan (as part of Operation Enduring Freedom [OEF]) and Iraq (as part of Operation Iraqi Freedom [OIF]), as well as among non-U.S. forces serving in corresponding military operations in Iraq and Afghanistan (e.g., Hoge, 2008; Larson, Booth-Kewley, & Highfill-McRoy, 2006). Policymakers use these estimates to guide the allo-

cation of resources made available to returning service members; deriving sound prevalence estimates is thus a matter of practical policy importance.

The objective of the current investigation is to review research to date that has presented prevalence estimates of PTSD among service members who have returned from military service in Iraq and Afghanistan

METHOD

We used the PILOTS (Published International Literature on Traumatic Stress) database to search for any study that provided a

The authors are thankful to Terri Tanielian, Lisa Jaycox, Kevin Feeney, Emily Bever, and Alison Raab Labonte, who provided helpful suggestions on earlier versions of this manuscript. This work was funded by the Iraq Afghanistan Deployment Impact Fund, which is administered by the California Community Foundation.

Correspondence concerning this article should be addressed to: Rajeev Ramchand, RAND Corporation, 1200 South Hayes Street, Arlington VA 22202-5050. E-mail: rajeev.ramchand@rand.org. Additional Supporting Information may be found in the online version of this article.

© 2010 International Society for Traumatic Stress Studies. Published online in Wiley InterScience (www.interscience.wiley.com) DOI: 10.1002/jts.20486

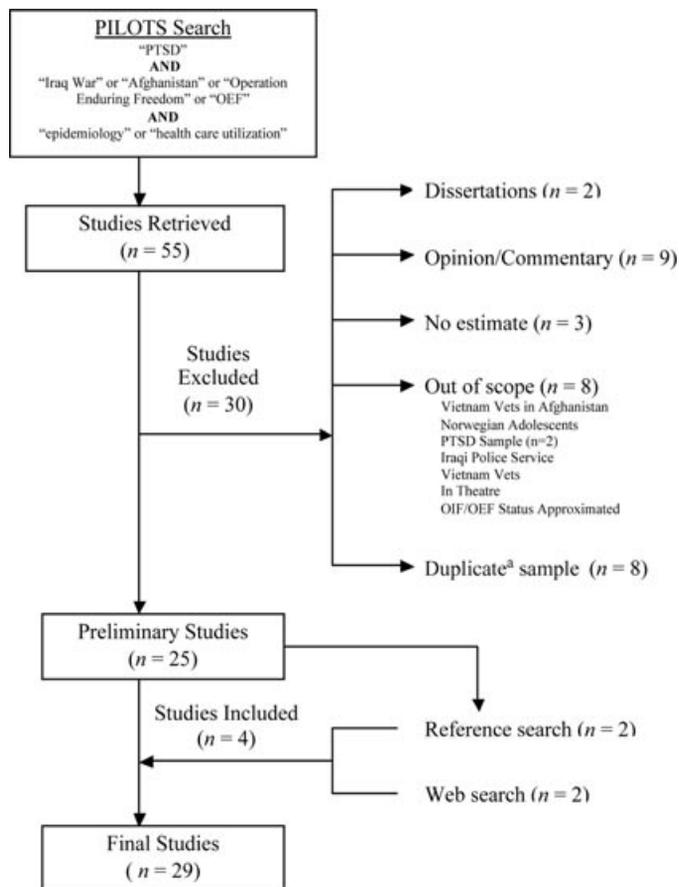


Figure 1. Literature Search Strategy (Current as of April 8, 2009).

^aPrevalence estimates from same sample or a subsample were presented in another, earlier published paper using the same case definition.

prevalence estimate of PTSD among service members or their non-U.S. counterparts who deployed in support of OIF or OEF since 2002. Figure 1 describes the logic of the literature search. This search, completed on April 8, 2009, identified 55 studies, of which 25 were included in our analysis. Searching reference lists of these 25 publications yielded two additional studies, and a search in GoogleTM Scholar using the keywords: Military, War, Veterans, Combat, Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), Afghanistan, Iraq, Prevalence, PTSD (Stress disorders, Post-Traumatic), Mental Disorders, and Mental Health located another two studies. We are aware of possible data overlap in only two studies, both of which used postdeployment screening data for returning OIF service members (Martin, 2007; Milliken et al., 2007), but were included because there are at least 6 months of data that do not overlap.

The aim of the current study is not to produce a definitive estimate of PTSD prevalence, but to describe variability in the preva-

lence estimates presented across studies, and to identify possible sources of this variability. Toward this end, we examined the characteristics of each study sample, how each study defined PTSD, and correlates of PTSD across eight domains: combat exposure, injury, component (active or reserve/National Guard), gender, race, deployment location (Iraq or Afghanistan), age, and rank. Prevalence estimates are reported as they were originally presented. For all but the two studies that provided this information (Engelhard et al., 2007; Schell & Marshall, 2008), we calculated 95% confidence intervals using the sample sizes that were presented and the normal approximation to the binomial distribution.

RESULTS

The 29 studies comprised two groups: those examining nontreatment-seeking samples ($n = 19$; Table 1), and those examining treatment-seeking samples ($n = 10$; Table 2).

Nontreatment-Seeking Samples

Studies with convenience-based samples ($n = 10$) generally surveyed select military units postdeployment. All but one of these studies (Hoge et al., 2008) reported response rates $\geq 75\%$. Studies with population-based samples ($n = 5$) were drawn from populations of U.S. service members, some of whom deployed (Smith et al., 2008); service members from the active component, some of whom deployed (Abt Associates Inc., 2006); previously deployed U.S. military personnel (Schell & Marshall, 2008; Schneiderman, Braver, & Kang, 2008); and previously deployed UK military personnel (Hotopf et al., 2006). These studies in aggregate have less than 50% of those eligible responding, with the exception of a survey of previously deployed UK service members that yielded a 62.3% response rate (Hotopf et al., 2006). Four studies used administrative data: two defined their study sample based on available data so response rates were not applicable (Larson, Highfill-McRoy, & Booth-Kewley, 2008; Milliken et al., 2007). The other two studies used data from the Post-Deployment Health Assessment, which deployed service members complete before leaving the country of their deployment or within 2-weeks of returning home. Approximately 20% of those returning from deployment did not have Post-Deployment Health Assessments (Hoge, Auchterlonie, & Milliken, 2006; Martin, 2007).

All but one study (Larson et al., 2008) used self-reports on questionnaires to define PTSD. Eleven used the 17-item PTSD Checklist (PCL), an instrument that asks about symptoms over the past month (Weathers, Litz, Herman, Huska, & Keane, 1993) with possible scores ranging from 17 to 85. Four different methods were used to define PTSD cases with the PCL: (1) Meeting the diagnostic criteria according to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)* (American Psychiatric Association, 1994) of at least one intrusion symptom, three avoidance symptoms, and two hyperarousal symptoms at the moderate

Table 1. Prevalence of Posttraumatic Stress Disorder Among Service Members Deployed to Iraq and/or Afghanistan. Studies of Population-Based Samples

Reference	Sample	Time since deployment	Year	<i>N</i>	Response rate	Case definition ^a	%	95% CI ^b
Hoge et al., 2004	Army unit (Iraq)	3–4 Months	2003	881	98% ^c	PCL–DSM	18.0	15.7–20.4
						PCL–DSM-50	12.9	10.9–15.0
	Army unit (Afghanistan)	3–4 Months	2003	811		PCL–DSM	11.5	10.1–12.8
						PCL–DSM-50	6.2	5.2–7.2
	Marine unit (Iraq)	3–4 Months	2003	1,956		PCL–DSM	19.9	17.3–22.4
						PCL–DSM-50	12.2	10.1–14.3
Hoge et al., 2006	Army+Marine (Iraq)	PDHA (2 weeks)	2003–2004	222,620	82%	PC-PTSD-2	9.8	9.7–9.9
						PC-PTSD-3	4.8	4.7–4.9
	Army+Marine (Afghanistan)	PDHA (2 weeks)	2003–2004	16,318		PC-PTSD-2	4.7	4.4–5.0
						PC-PTSD-3	2.1	2.0–2.4
Vasterling et al., 2006	Army units (Iraq)	4–7 Months	2005	1,028	94%	PCL–DSM-50	11.6	9.3–13.9
Abt Associates Inc., 2006	All services–active component	6–12 Months	2003–2004	1,382	49%	PCL–DSM	7.3	6.5–9.2
Hotopf et al., 2006	UK armed forces personnel	≥1 Year	2003	4,613	59%	PCL ≥ 50	4.0	3.8–4.9
Hoge et al., 2007	Army units (Iraq)	1 Year	2001–2005	2,815	98%	PCL–DSM-50	16.6	15.4–17.9
Kolkow et al., 2007	Military health care providers (Iraq/Afghanistan)	Wide range (0 months to >2 years)	2004	102	36%	PCL–DSM-50	9.0	3.7–14.3
Martin, 2007	All services (Iraq)	PDHA (2 weeks)	2005	222,183	77%	PC-PTSD-2	10.5	10.4–10.6
Milliken et al., 2007	Active duty Army (Iraq)	PDHA (2 weeks)	2005–2006	56,350		PC-PTSD-2	11.8	11.5–12.0
						PC-PTSD-3	6.2	6.0–6.4
		PDHRA (3–6 Months)	2005–2006	56,350		PC-PTSD-2	16.7	16.4–17.0
						PC-PTSD-3	9.1	8.8–9.3
	Army Reservists (Iraq)	PDHA (2 weeks)	2005–2006	31,885		PC-PTSD-2	12.7	12.4–13.1
					PC-PTSD-3	6.6	6.4–6.9	
		PDHRA (3–6 months)	2005–2006	31,885		PC-PTSD-2	24.5	24.1–24.9
						PC-PTSD-3	14.3	14.0–14.7
Lapierre, Schwegler, & Labaue, 2007	Army (Afghanistan)	5–8 Weeks	2005	1,810	48%	SPTSS	30.0	28.1–31.9
	Army (Iraq)	5–8 Weeks	2005	2,266		SPTSS	31.0	29.3–32.7
Stecker, Fortney, Hamilton, & Ajzen, 2007	Army National Guard Unit (Iraq)		2006	20		MINI	60.0	43.0–77.0

(Continued)

Table 1. Continued

Reference	Sample	Time since deployment	Year	<i>N</i>	Response rate	Case definition ^a	%	95% CI ^b
Engelhard et al., 2007	SFIR 3	5 Months	2005–2006	170	80% completed questionnaires/	PSS	21.0	15.0–28.0
				148			SCID	12.0
	SFIR 4	5 Months	2005–2006	140	71% received	PSS	4.0	2.0–9.0
				129			SCID	3.0
	SFIR 5	5 Months	2005–2006	72		PSS	6.0	2.0–14.0
				62		SCID	3.0	0.0–11.0
Bliese et al., 2007	Army unit (Iraq)	7 Days	2004	503		PCL \geq 50	1.4	0.4–2.4
			2004	503		PCL \geq 44	3.0	1.5–4.4
		120 Days	2004	499		PCL \geq 50	4.8	3.0–6.6
			2004	499		PCL \geq 44	8.4	6.1–10.8
Smith et al., 2008	All services- without PTSD prior to deployment who experienced combat exposure (Iraq/Afghanistan)	Wide range (0 months to >2 years)	2001–2006	5382	36% (Across entire sample)	PCL- <i>DSM</i> ^d	7.6	6.9–8.3
				5299			PCL- <i>DSM</i> -50 ^d	8.7
	All services- without PTSD prior to deployment who did not experience combat exposure (Iraq/Afghanistan)	Wide range (0 months to >2 years)	2001–2006	6357		PCL- <i>DSM</i> ^d	1.4	1.1–1.7
				6095		PCL- <i>DSM</i> -50 ^d	2.1	1.7–2.5
Smith, Ryan, Wingard et al., 2008 (Contin- ued)	All services–with PTSD prior to deployment who experienced combat exposure (Iraq/Afghanistan)	Wide range (0 months to >2 years)	2001–2006	64	36% (Across Entire Sample)	PCL- <i>DSM</i> ^d	43.5	35.7–51.3
				134			PCL- <i>DSM</i> -50 ^d	47.9
	All services–with PTSD prior to deployment who did not experience combat exposure (Iraq/Afghanistan)	Wide range (0 months to >2 years)	2001–2006	108		PCL- <i>DSM</i> ^d	26.2	16.9–36.2
				186		PCL- <i>DSM</i> -50 ^d	22.4	16.0–28.8

(Continued)

Table 1. Continued

Reference	Sample	Time since deployment	Year	<i>N</i>	Response rate	Case definition ^a	%	95% CI ^b
Schneiderman et al., 2008	All services living in a select geographic area (Iraq/Afghanistan)	≤6 months	2005	2235	34%	PCL ≥ 50	11	9.9–12.4
Schell & Marshall, 2008	All services	Wide range (0-Months to >2 years)	2007–2008	1,965	44%	PCL- <i>DSM</i>	13.8	11.1–16.5
Ouimette et al., 2008	Army National Guard unit (Iraq)	Mean = 14.9 Months	–	31		CAPS	41.9	27.4–56.5
Hoge et al., 2008	Army unit (Iraq)	3–4 Months	2006	2517	59%	PCL- <i>DSM</i> -50	13.9	12.6–15.2
Larson et al., 2008	Marines–active component (Iraq/Afghanistan)	Wide range (0 months to >2 years)	2001–2005	41,561		ICD-9-CM	1.6	1.5–1.8

Note. – indicates information not provided. PTSD = Posttraumatic stress disorder; PDHA = Post-Deployment Health Assessment; PDHRA = Post-Deployment Health Re-Assessment; SCID = Structured Clinical Interview for DSM Disorders; MINI = Mini International Neuropsychiatric Interview.

^aPCL-*DSM* = Reporting at least one intrusion symptom, three avoidance symptoms, and two hyperarousal symptoms on PTSD checklist; PCL ≥ 50 (44) = total score of at least 50 (44) on the PTSD checklist; PCL-*DSM*-50 = PCL-*DSM* + a total score of at least 50 on the PTSD checklist; PC-PTSD-2(3) = reporting two/three or more of four items on the Primary-Care PTSD Screen; SPTSS = an average total score of 4 or more on the Screen for Posttraumatic Stress Symptoms; PSS = total score of 14 on the PTSD symptom scale. ^bCI = Confidence Interval; when not given, approximated using the normal approximation to the binomial distribution. ^c% response rate includes an additional cohort of Army soldiers assessed prior to deployment to Iraq. ^dPTSD could also be defined as self-reported diagnosis in the previous 3 years.

level (PCL-*DSM*; $n = 6$); *DSM-IV* diagnostic criteria accompanied by a total score ≥ 50 (PCL-*DSM*-50; $n = 4$); a total score ≥ 50 (PCL ≥ 50; $n = 3$); and a total score ≥ 44 (PCL ≥ 44; $n = 1$).

Substantial variability across estimates may stem from these different case definitions. Three studies that used more than one threshold on the PCL reveal the effect of different thresholds on prevalence estimates. For example, Hoge et al. (2004) found that prevalence estimates using PCL-*DSM* were roughly twice as high as those using PCL-*DSM*-50; estimates using PCL ≥ 44 were roughly twice as high as those using PCL ≥ 50 (Bliese, Wright, Adler, Thomas, & Hoge, 2007).

Three studies relied on the Primary Care PTSD-Screen (PC-PTSD), a four-question scale that ranges from 0 to 4 (Prins et al., 2004) included in the Post-Deployment Health Assessment and Post-Deployment Health Re-Assessment that deployed service members are supposed to complete within 6 months of returning home. These studies provided screening estimates for total scores ≥ 2 (the threshold favoring sensitivity), and two of the three studies provided estimates for total scores ≥ 3 (the threshold favoring specificity; Prins et al., 2004). Estimates using the threshold of 2 were twice as high as those using a threshold score of 3. The remaining four studies each used other screening tools, and none of these was used more than once.

The 19 studies of nontreatment-seeking personnel produced 50 separate estimates of PTSD. Studies that presented more than one estimate produced estimates using multiple definitions of PTSD, for select subgroups, or at more than one time. Twenty-seven estimates ranged from between 5 and 20%. Estimates <5% came from studies in which samples were non-U.S. military (Engelhard et al., 2007; Hotopf et al., 2006; Hoge, Auchterlonie, & Milliken, 2006), soldiers were interviewed shortly (~7 days) after returning from deployment (Bliese et al., 2007), PTSD was defined as having been diagnosed at military treatment facilities or government-reimbursed private clinics (Larson et al., 2008), and among service members without PTSD symptoms prior to deployment who did not report combat exposure during their deployment (Smith et al., 2008). Studies that produced PTSD prevalence estimates >20% were based on convenience samples with a small number of respondents, yielding imprecise estimates (Ouimette et al., 2008; Stecker, Fortney, Hamilton, & Ajzen, 2007) or estimated among those with PTSD symptoms prior to deployment (Smith et al., 2008). Three other studies produced estimates >20%. One study (Lapierre, Schwegler, & Labauve, 2007) used the Screen for Posttraumatic Stress Symptoms (SPTSS) and presented prevalence estimates of 30% and 31% (for those deployed to Afghanistan and Iraq, respectively) among soldiers attending a reintegration program. Close to

Table 2. Prevalence of Posttraumatic Stress Disorder Among Service Members Deployed to Iraq and/or Afghanistan: Studies of Treatment-Seeking Samples

Reference	Sample	Time since deployment	Year	<i>N</i>	Response rate	Case definition ^a	%	95% CI
Helmer et al., 2007	VA-regional	Wide range (0 months to >2 years)	2004–2006	56		Chart review	45.0	33.8–55.5
Seal et al., 2007	VA-national (Iraq/Afghanistan)	Wide range (0-Months to >2 years)	2001–2005	103,788		ICD-9-CM	13.0	12.5–12.9
Grieger et al., 2006	Army-wounded (Iraq/Afghanistan)	1 Month	2003–2004	613		PCL- <i>DSM-50</i>	4.2	2.7–5.8
		4 Months	2003–2004	395	72.3%	PCL- <i>DSM-50</i>	12.2	9.1–15.2
		7 Months	2003–2004	301	61.1%	PCL- <i>DSM-50</i>	12.0	8.5–15.4
Erbes, Westermeyer, Engdahl, & Johnsen, 2007	VA-regional (Iraq/Afghanistan)	Wide range (0 months to >2 years)	2005–2007	120	55.0%	PCL ≥ 50	12.0	6.4–17.6
Gaylord et al., 2008	USAISR-burn victims (Iraq/Afghanistan)	N/A	2005–2006	76		PCL ≥ 44	32.0	22.5–40.7
Seal et al., 2008	VA-regional	Wide range (0 months to >2 years)	2001–2006	338		PC-PTSD-2 ^b	50.0	46.2–54.9
Sayer et al., 2008	VA polytrauma rehabilitation centers	Wide range (0-months to >2 years)	2001–2006	188		Chart review	35.0	28.7–40.4
Rundell, 2006	Medical evacuations for psychiatric reasons (Iraq/Afghanistan)	Wide range (0 months to >2 years)	2001–2004	1264		Psychiatric evaluations	4.4	3.3–5.5
McGhee, Maani, Garza, Gaylord, & Black, 2008	USAISR-burn victims (Iraq/Afghanistan)	Wide range (0 months to >2 years)	2002–2007	147		PCL ≥ 44	30.6	24.1–37.1
Jakupcak, Luterek, Hunt, Conybeare, & McFall, 2008	VA regional (Iraq and Afghanistan)	Wide range (0 months to >2 years)	2004–2005	108		PCL- <i>DSM-50</i>	37.8	30.2–45.8

^aICD-9-CM = The International Classification of Diseases, 9th Revision, Clinical Modification. Diagnostic code of PTSD from medical records; See Table 1 for other definitions. ^bIn 2005, the threshold was changed from PC-PTSD-2 to PC-PTSD-3.

25% of reservists reported more than 2 symptoms on the Post-Deployment Health Re-Assessment (Milliken et al., 2007); 21% of a cohort of Dutch infantry troops also screened positive for PTSD (Engelhard et al., 2007) on the PTSD Symptom Scale (Foa, Riggs, Dancu, & Rothbaum, 1993).

Three studies examined how deployment may increase the risk of PTSD. One found higher prevalence within U.S. military units

postdeployment than within a unit of Army soldiers assessed prior to being deployed (Hoge et al., 2004). A similar difference was not observed among UK service members that did and did not deploy, although there was some indication of such a difference among reservists (Hotopf et al., 2006). The only longitudinal evidence assessing the same service members pre- and postdeployment found that 2–8% developed PTSD symptoms (range varied by PTSD

case definition and level of combat exposure when deployed; Smith et al., 2008).

Combat exposure predicted PTSD across studies. Among six separate cohorts of service members, combat exposure was associated with PTSD and remained significantly associated after adjustment each of the five times it was tested in multivariable models. Suffering a physical injury was associated with PTSD in bivariate analyses six out of six times it was tested, but lost statistical significance after adjustment in one of three multivariate models (Schell & Marshall, 2008). Those deployed to Iraq were more likely to report PTSD symptoms than those deployed to Afghanistan, likely due to more frequent combat exposures in Iraq during the periods when these studies were conducted. This difference was seen primarily in bivariate analyses, and remained statistically significant in one study with multiple controls, but that did not control for combat exposure (Schneiderman et al., 2008).

Posttraumatic stress disorder estimates were not consistently associated with any of the other correlates we examined. Though the effect of gender was tested in six separate models, women were more likely than men to meet PTSD criteria in only one bivariate analysis. In one multivariate analysis, being female was significant and positively associated with PTSD after adjustment for combat exposure, rank, age, and other covariates (Schell & Marshall, 2008). Reserve status was associated with PTSD in five of six bivariate analyses, but did not retain statistical significance in the two multivariate models. Associations between age and PTSD were not statistically significant in both bivariate and adjusted models in two samples, and age lost statistical significance after adjustment in three samples. Enlisted military personnel were more likely than officers to meet PTSD study criteria in three multivariate models, including two that also controlled for combat exposure (Schell & Marshall, 2008; Smith et al., 2008). In contrast, officers were more likely to report PTSD symptoms in two bivariate analyses.

A table of correlates of PTSD is available as an online supplement to this report.

Treatment-Seeking Samples

The 10 studies of previously deployed personnel seeking treatment included studies of patients visiting Veterans Affairs (VA) medical facilities ($n = 6$), patients evacuated from theatre ($n = 2$), and burn victims receiving specialty care. In the only study that provided a response rate, the study team contacted 46% of OIF and OEF veterans who enrolled at a VA Medical Center, 92% of whom agreed to participate, and 55% returned completed surveys (Erbes, Westermeyer, Engdahl, & Johnsen, 2007). The remaining studies either did not provide response rates ($n = 4$), or defined their study sample based on available administrative data, so response rates were not applicable ($n = 4$). In a sample of patients evacuated from theatre after being physically injured, one study collected assessments at three time points over a 7-month period postevacuation (Grieger et al., 2006). That study did not present

the proportion of those eligible who participated in the first assessment, though 72% of the eligible original cohort responded at the second assessment, and 61% responded at the third.

Among the studies of treatment-seeking populations, four measured PTSD through clinical observations as recorded in charts or via the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM; National Center for Health Statistics and the Centers for Medicare & Medicaid Services, 2008) codes, whereas the remaining six surveyed those seeking treatment with the PC-PTSD using a threshold score of 3 ($n = 1$) or the PCL ($n = 5$), using one of three different case definitions: PCL-*DSM-50*, $PCL \geq 50$, and $PCL \geq 44$.

These 10 studies produced 12 unique estimates of PTSD prevalence. Two studies estimated prevalence of PTSD as <5%: 4% of those medically evacuated for psychiatric reasons received a diagnosis of PTSD upon evacuation, and 4% of service members met PCL-*DSM-50* criteria 1 month after being medically evacuated. Prevalence among this latter cohort increased to 12% 3 and 6 months later. Two studies presented estimates between 5 and 20% (Grieger et al., 2006; Seal, Bertenthal, Miner, Sen, & Marmar, 2007). The remaining seven studies presented estimates >20%: among those seeking care at VA facilities, as many as 50% screened positive to three questions on the PC-PTSD (Seal et al., 2008), though PTSD diagnoses among deployed soldiers across the VA nationwide between 2001–2005 were estimated to be 13% (Seal et al., 2007). More recent estimates indicate that 23% of OIF and OEF veterans seen by VA services receive a PTSD diagnosis (U.S. Department of Veterans Affairs Veterans Health Administration Office of Public Health and Environmental Hazards, 2008).

Only two studies of treatment-seekers examined correlates of PTSD across the domains that were the focus of the present analyses. Across the VA, OIF and OEF veterans who were women, Black, and younger were more likely to receive PTSD diagnoses in bivariate analyses (Seal et al., 2007). Among those medically evacuated, severity of physical symptoms was correlated with PTSD at each of three assessments in multivariate models (Grieger et al., 2006). In contrast, combat exposure and young age were only associated with PTSD in adjusted models at 1-month postevacuation (Grieger et al., 2006).

DISCUSSION

To guide sound policies to care for service members returning with PTSD, these analyses described the range of PTSD prevalence estimates obtained for service members serving in Iraq and Afghanistan and examined why these estimates have varied widely. Although prevalence was presented most often as a point estimate, this estimate is associated with sampling error, particularly in small samples. This is why estimates of this uncertainty (e.g., confidence intervals) are standard practice for statistical reporting in scientific journals. Only a minority of the studies described here provided

estimates of uncertainty. Some of the highest estimates of PTSD prevalence are the least precise.

All U.S. military personnel are asked to complete the Post-Deployment Health Assessment upon returning from deployment and thus studies using this data are most representative. To date, these studies have estimated the prevalence of PTSD to be between 5 to 10% among those deployed to Iraq (Hoge et al., 2004; Martin, 2007; Milliken et al., 2007). However, because the conditions under which service members are screened may impact their decision to report symptoms, Post-Deployment Health Assessment estimates may systematically underestimate prevalence (Bliese et al., 2007; McLay et al., 2008). In the one study to analyze data from the Post-Deployment Health Re-Assessment, the proportion of reservists meeting screening criteria doubled at the time of the reassessment from 6.6 to 14.3% (using a threshold of ≥ 3) or from 12.7% to 24.5% (using a threshold of ≥ 2 ; Milliken et al., 2007).

Although population-based studies are designed to generalize to the population from which the sample is selected, the generalizability of the five population-based studies examined here should be carefully considered. For example, the study by Smith et al. (2008) is by design not representative of the military or deployed population; the study by Abt Associates (2006) excludes reservists, who make up at least 25% of those deployed (Waterhouse, O'Bryant, & Library of Congress, 2007). Nonresponse bias should also be acknowledged, as between 40–60% of those eligible for these studies do not respond. It is unclear the degree to which nonresponders may be more or less likely to have PTSD, and thus whether the estimates in these studies under- or overestimate true prevalence. Convenience samples tend to report higher response rates, but the population they represent is unknown. Different military units have different experiences when deployed: for example, among two units deployed to Iraq in 2003, 28% of Marines reported being responsible for the death of a noncombatant compared to 14% of Army soldiers (Hoge et al., 2004). These differences may result in very different PTSD estimates across units.

The methods used to define PTSD ranged widely across studies. Because only a small share of individuals with PTSD seek care for their symptoms (Hoge, 2008; Hoge et al., 2004; Schell & Marshall, 2008), studies that used ICD-9-CM (National Center for Health Statistics and the Centers for Medicare & Medicaid Services, 2008) codes, chart reviews, or other methods to identify a clinical diagnosis will underestimate the actual prevalence of PTSD, particularly if the denominator is all deployed service members (e.g., Larson et al., 2008). However, such studies are useful when the denominator is those physically injured or seeking treatment more broadly, particularly for determining the allocation of resources across health care facilities serving this population (e.g., the VA).

The validity of the PC-PTSD should also be considered. Scores > 2 on the PC-PTSD will overestimate the actual presence of PTSD, but may underestimate prevalence at thresholds of 3 (Bliese

et al., 2008; Prins et al., 2004). Both thresholds have been defined as efficient for this population (Bliese et al., 2008), though the VA currently uses a threshold of 3 for mandatory screenings in primary care.

Four separate methods of scoring the PCL have been used in the literature which contributes to the variability in prevalence estimates. There have been no studies validating the use of the most widely used standard in this literature (PCL-*DSM-50*). This criterion is a more restrictive case criterion than has been suggested by any of the commonly cited validity studies (Bliese et al., 2008; Brewin, 2005). In studies that present both estimates using the PCL-*DSM* and PCL-*DSM-50*, the more restrictive criterion reduced the prevalence estimate by as much as 50% (Hoge et al., 2004).

Determining the optimal cut point for estimating PTSD prevalence among persons previously deployed to Iraq and Afghanistan is critically important. The only study to validate the diagnostic properties of the PCL in a diverse sample of OEF and OIF veterans (Bliese et al., 2008) recommends cutpoints between 30 to 34 to provide optimal diagnostic efficiency for clinical screening. From this study, one can compute that a cutpoint of 40 provided the most accurate estimate of the validated PTSD prevalence from structured clinical interviews, suggesting that case definitions that rely on total scores ≥ 44 or 50 may be underestimating PTSD prevalence in this population.

In every study the association was tested, combat exposure during deployments was significantly associated with meeting probable PTSD diagnoses. Associations between other factors and PTSD were often attenuated after controlling for combat exposure. Thus, differences in PTSD estimates across samples varying in deployment location, service branch, periodic variability in level of exposure over time (see Sollinger, Fisher, & Metscher, 2008), rank, or other factors may reflect different levels of exposure to combat. Some have argued that less exposure to combat explains the lower prevalence rate of PTSD found in the study of UK service members (Hoge & Castro, 2006), a claim refuted by the original study authors.

This review highlights the variability in PTSD prevalence estimates among military personnel previously deployed to OIF, OEF, or corresponding non-U.S. operations. Studies using screening assessments indicate that between 5 to 12% of respondents meet screening criteria for PTSD. These estimates are comparable with the results of the only study designed to be representative of the deployed force, which produced an estimate of 14%. Estimates that fall far from a range of 5 to 20% may highlight certain groups that are at increased risk for PTSD, including previously deployed personnel seeking medical treatment. It is critical that researchers and policymakers consider the methods used to derive prevalence estimates, and the confidence intervals around those estimates. We recommend (a) that the method used to define PTSD be consistent across studies, (b) that the specific method used be well validated for estimating PTSD prevalence in this specific population, and

(c) that estimates control for differential exposure to combat across samples.

REFERENCES

- Abt Associates Inc. (2006). 2003-2004 Active Duty Health Study: Final report. Falls Church, VA: TRICARE Management Activity, Health Program Analysis and Evaluation Directorate.
- American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders (4th ed.). Washington, DC: Author.
- Bliese, P. D., Wright, K. M., Adler, A. B., Cabrera, O., Castro, C. A., & Hoge, C. W. (2008). Validating the Primary Care Posttraumatic Stress Disorder screen and the Posttraumatic Stress Disorder Checklist with soldiers returning from combat. *Journal of Consulting and Clinical Psychology, 76*, 272–281.
- Bliese, P. D., Wright, K. M., Adler, A. B., Thomas, J. L., & Hoge, C. W. (2007). Timing of postcombat mental health assessments. *Psychological Services, 4*, 141–148.
- Brewin, C. R. (2005). Systematic review of screening instruments for adults at risk of PTSD. *Journal of Traumatic Stress, 18*, 53–62.
- Dohrenwend, B. P., Turner, J. B., Turse, N. A., Adams, B. G., Koenen, K. C., & Marshall, R. (2007). Continuing controversy over the psychological risks of Vietnam for U.S. veterans. *Journal of Traumatic Stress, 20*, 449–465.
- Engelhard, I. M., van den Hout, M. A., Weerts, J., Arntz, A., Hox, J. J., & McNally, R. J. (2007). Deployment-related stress and trauma in Dutch soldiers returning from Iraq. Prospective study. *British Journal of Psychiatry, 191*, 140–145.
- Erbes, C., Westermeyer, J., Engdahl, B., & Johnsen, E. (2007). Post-traumatic stress disorder and service utilization in a sample of service members from Iraq and Afghanistan. *Military Medicine, 172*, 359–363.
- Foa, E. B., Riggs, D. S., Dancu, C. V., & Rothbaum, B. O. (1993). Reliability and validity of a brief instrument for assessing post-traumatic stress disorder. *Journal of Traumatic Stress, 6*, 459–473.
- Gaylord, K. M., Cooper, D. B., Mercado, J. M., Kennedy, J. E., Yoder, L. H., & Holcomb, J. B. (2008). Incidence of posttraumatic stress disorder and mild traumatic brain injury in burned service members: Preliminary report. *Journal of Trauma, 64*, S200–205.
- Grieger, T. A., Cozza, S. J., Ursano, R. J., Hoge, C., Martinez, P. E., Engel, C. C., et al. (2006). Posttraumatic stress disorder and depression in battle-injured soldiers. *American Journal of Psychiatry, 163*, 1777–1783.
- Helmer, D. A., Rossignol, M., Blatt, M., Agarwal, R., Teichman, R., & Lange, G. (2007). Health and exposure concerns of veterans deployed to Iraq and Afghanistan. *Journal of Occupational and Environmental Medicine, 49*, 475–480.
- Hoge, C. W. (2008). Re: "Psychiatric diagnoses in historic and contemporary military cohorts: Combat deployment and the healthy warrior effect." *American Journal of Epidemiology, 168*, 1095–1096; author reply 1096–1098.
- 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. *Journal of the American Medical Association, 295*, 1023–1032.
- Hoge, C. W., & Castro, C. A. (2006). Post-traumatic stress disorder in UK and US forces deployed to Iraq. *Lancet, 368*, 837; author reply 837.
- 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. *New England Journal of Medicine, 351*, 13–22.
- Hoge, C. W., McGurk, D., Thomas, J. L., Cox, A. L., Engel, C. C., & Castro, C. A. (2008). Mild traumatic brain injury in U.S. Soldiers returning from Iraq. *New England Journal of Medicine, 358*, 453–463.
- Hoge, C. W., Terhakopian, A., Castro, C. A., Messer, S. C., & Engel, C. C. (2007). Association of posttraumatic stress disorder with somatic symptoms, health care visits, and absenteeism among Iraq War veterans. *American Journal of Psychiatry, 164*, 150–153.
- Hotopf, M., Hull, L., Fear, N. T., Browne, T., Horn, O., Iversen, A., et al. (2006). The health of UK military personnel who deployed to the 2003 Iraq War: A cohort study. *Lancet, 367*, 1731–1741.
- Jakupcak, M., Luterek, J., Hunt, S., Conybeare, D., & McFall, M. (2008). Post-traumatic stress and its relationship to physical health functioning in a sample of Iraq and Afghanistan War veterans seeking postdeployment VA health care. *Journal of Nervous and Mental Disease, 196*, 425–428.
- Kolkow, T. T., Spira, J. L., Morse, J. S., & Grieger, T. A. (2007). Post-traumatic stress disorder and depression in health care providers returning from deployment to Iraq and Afghanistan. *Military Medicine, 172*, 451–455.
- Kulka, R. A. (1990). Trauma and the Vietnam War generation: Report of findings from the National Vietnam Veterans Readjustment Study. New York: Brunner/Mazel.
- Lapierre, C. B., Schwegler, A. F., & Labauve, B. J. (2007). Posttraumatic stress and depression symptoms in soldiers returning from combat operations in Iraq and Afghanistan. *Journal of Traumatic Stress, 20*, 933–943.
- Larson, G. E., Booth-Kewley, S., & Highfill-McRoy, R. M. (2006). Mental health after deployment to Iraq or Afghanistan. *Journal of the American Medical Association, 296*, 514–515; author reply 516.
- Larson, G. E., Highfill-McRoy, R. M., & Booth-Kewley, S. (2008). Psychiatric diagnoses in historic and contemporary military cohorts: Combat deployment and the healthy warrior effect. *American Journal of Epidemiology, 167*, 1269–1276.
- Martin, C. B. (2007). Routine screening and referrals for PTSD after returning from Operation Iraqi Freedom in 2005, U.S. Armed Forces. *MSMR: Medical Surveillance Monthly Report, 14*(6), 2–7.
- McGhee, L. L., Maani, C. V., Garza, T. H., Gaylord, K. M., & Black, I. H. (2008). The correlation between ketamine and posttraumatic stress disorder in burned service members. *Journal of Trauma, 64*, S195–198.
- McLay, R. N., Deal, W. E., Murphy, J. A., Center, K. B., Kolkow, T. T., & Grieger, T. A. (2008). On-the-record screenings versus anonymous surveys in reporting PTSD. *American Journal of Psychiatry, 165*, 775–776.
- 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*, 2141–2148.
- National Center for Health Statistics (NCHS) and the Centers for Medicare & Medicaid Services (CMS). (2008). The International Classification of Diseases, 9th Revision, Clinical Modification. Washington, DC: Author.
- Ouimette, P., Coolhart, D., Sugarman, D., Funderburk, J. S., Zelman, R. H., & Dornau, C. (2008). A pilot study of posttraumatic stress and associated functioning of Army National Guard following exposure to Iraq warzone trauma. *Traumatology, 14*(3), 51–56.
- Prins, A., Ouimette, P., Kimerling, R., Camerond, R. P., Hugelshofer, D. S., Shaw-Hegwer, J., et al. (2004). The Primary Care PTSD screen (PC-PTSD): Development and operating characteristics. *Primary Care Psychiatry, 9*(1), 9–14.
- Rundell, J. R. (2006). Demographics of and diagnoses in Operation Enduring Freedom and Operation Iraqi Freedom personnel who were psychiatrically evacuated from the theater of operations. *General Hospital Psychiatry, 28*, 352–356.
- Sayer, N. A., Chiros, C. E., Sigford, B., Scott, S., Clothier, B., Pickett, T., et al. (2008). Characteristics and rehabilitation outcomes among patients with blast and other injuries sustained during the Global War on Terror. *Archives of Physical Medicine and Rehabilitation, 89*, 163–170.

- Schell, T. L., & Marshall, G. N. (2008). Survey of individuals previously deployed for OEF/OIF. In T. L. Tanielian, L. Jaycox & Rand Corporation (Eds.), *Invisible wounds of war: Psychological and cognitive injuries, their consequences, and services to assist recovery* (pp. 87–115). Santa Monica, CA: RAND.
- Schneiderman, A. I., Braver, E. R., & Kang, H. K. (2008). Understanding sequelae of injury mechanisms and mild traumatic brain injury incurred during the conflicts in Iraq and Afghanistan: Persistent postconcussive symptoms and posttraumatic stress disorder. *American Journal of Epidemiology*, *167*, 1446–1452.
- Seal, K. H., Bertenthal, D., Maguen, S., Gima, K., Chu, A., & Marmar, C. R. (2008). Getting beyond “Don’t ask; don’t tell”: An evaluation of US Veterans Administration postdeployment mental health screening of veterans returning from Iraq and Afghanistan. *American Journal of Public Health*, *98*, 714–720.
- Seal, K. H., Bertenthal, D., Miner, C. R., Sen, S., & Marmar, C. (2007). Bringing the war back home: Mental health disorders among 103,788 US veterans returning from Iraq and Afghanistan seen at Department of Veterans Affairs facilities. *Archives of Internal Medicine*, *167*, 476–482.
- Smith, T. C., Ryan, M. A., Wingard, D. L., Slymen, D. J., Sallis, J. F., & Kritz-Silverstein, D. (2008). New onset and persistent symptoms of post-traumatic stress disorder self reported after deployment and combat exposures: Prospective population based US military cohort study. *British Medical Journal*, *336*, 366–371.
- Sollinger, J. M., Fisher, G., & Metscher, K. N. (2008). The wars in Afghanistan and Iraq—an overview. In T. L. Tanielian, L. Jaycox, & Rand Corporation (Eds.), *Invisible wounds of war: Psychological and cognitive injuries, their consequences, and services to assist recovery* (pp. 19–31). Santa Monica, CA: RAND.
- Stecker, T., Fortney, J. C., Hamilton, F., & Ajzen, I. (2007). An assessment of beliefs about mental health care among veterans who served in Iraq. *Psychiatric Services*, *58*, 1358–1361.
- U.S. Department of Veterans Affairs Veterans Health Administration Office of Public Health and Environmental Hazards. (2008). *Analysis of VA health care utilization among US Global War on Terrorism (GWOT) Veterans*. Unpublished quarterly report (cumulative through 3rd quarter FY2008). Washington, DC: Author.
- Vasterling, J. J., Proctor, S. P., Amoroso, P., Kane, R., Heeren, T., & White, R. F. (2006). Neuropsychological outcomes of army personnel following deployment to the Iraq War. *Journal of the American Medical Association*, *296*, 519–529.
- Waterhouse, M., O’Byrne, J., & Library of Congress. (2007). *National Guard personnel and deployments: Fact sheet*. Washington, DC: Congressional Research Service.
- Weathers, F., Litz, B., Herman, D., Huska, H., & Keane, T. (1993, October). The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility. Paper presented at the Annual Convention of the International Society for Traumatic Stress Studies, San Antonio, TX.
- Wessely, S., & Jones, E. (2004). Psychiatry and the lessons of Vietnam: What were they and are they still relevant? *War and Society*, *22*, 89–103.