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Traumatic brain injury and PTSD symptoms as a consequence of intimate partner violence

Katherine M. Iverson[a,b,*], Christina M. Dardis[a,b], Terri K. Pogoda[c,d]

[a]*Women's Health Sciences Division of the National Center for PTSD, VA Boston Healthcare System, 150 South Huntington Avenue (116B-3), Boston, MA, 02130, United States*

[b]*Department of Psychiatry, Boston University School of Medicine, 72 East Concord Street, Boston, MA, 02118, United States*

[c]*Center for Healthcare Organization and Implementation Research, VA Boston Healthcare System, 150 S. Huntington Avenue (Building 9), Boston, MA, 02130, United States*

[d]*Department of Health Law, Policy & Management, Boston University School of Public Health, 715 Albany Street, Boston, MA, 02118, United States*

Abstract

Objective: To effectively diagnose and treat women who have experienced intimate partner violence (IPV), it is important to identify the full range of physical and mental health consequences, including hidden wounds such as traumatic brain injury (TBI) and posttraumatic stress disorder (PTSD). We aimed to identify the occurrence of IPV-related TBI and associated PTSD symptoms among women veterans who experienced IPV.

Methods: A web-based survey was administered in 2014 to a national sample of U.S. women veterans. Among 411 respondents (75% participation rate), 55% reported IPV during their lives. These participants (N = 224) completed screening measures of IPV-related TBI, PTSD, and past-year IPV and comprised the current sample.

Results: A total of 28.1% (n = 63) met criteria for IPV-related TBI history, and 12.5% (n = 28) met criteria for IPV-related TBI with current symptoms. When adjusting for race, income, and past-year IPV, women with IPV-related TBI with current symptoms were 5.9 times more likely to have probable IPV-related PTSD than those with no IPV-related TBI history. Despite symptom overlap between TBI and PTSD, women with IPV-related TBI with current symptoms were significantly more likely to meet criteria for all four DSM-*5* PTSD symptom clusters compared to women with an IPV-related TBI history without current symptoms (Cramér's V′s = .34–.42).

Conclusion: Findings suggest there may be clinical utility in screening women who experience lifetime IPV for both TBI and PTSD symptoms in order to help clinicians better target their examinations, treatment, and referrals.

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* Corresponding author at: VA Boston Healthcare System, 150 S. Huntington Ave. (116B-3), Boston, MA 02130. Tel.: +1 857 364 2066; fax: +1 857 364 4515.

E-mail address: katherine.iverson@va.gov (K.M. Iverson).

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1. Introduction

Intimate partner violence (IPV) against women is a worldwide population health problem [1], and is associated with poor psychological and physical health, disability, and premature death [1,2]. It is a leading cause of injury to women in the United States (U.S.) [3], and women veterans are 1.6 times more likely to experience IPV during their lifetime than non-veteran women [4]. Although the field does not yet have a comprehensive understanding of why women who have served in the military are at heightened risk for IPV, several studies have found that a history of interpersonal violence, particularly military sexual trauma, increased risk for IPV among women Veterans [5–7]. Research suggests that much of the IPV that women veterans

experience occurs following their military service — when women are veterans [8]. It is therefore important to identify the health and healthcare needs of women veterans who have experienced IPV in order to inform a comprehensive healthcare agenda for the rapidly growing population of women veterans. Such research is needed because the Veterans Health Administration (VHA), the single largest provider of health care for more than 2.1 million women Veterans, is developing IPV screening programs that target women [9]. These efforts are consistent with the Institute of Medicine [10] and U.S. Preventive Services Task Force [11] recommendations to screen women and provide counseling as standard preventive care. To inform clinical practice, there is a need to identify the full range of physical and mental health consequences of IPV among women generally, and women veterans specifically, in order to improve screening, assessment, treatment, and ultimately clinical outcomes, among this at-risk population [12,13].

One of the most serious yet understudied consequences of IPV is traumatic brain injury (TBI) [14–16], defined as an alteration in brain function from an external force that disrupts the normal physiological functioning of the brain [17–19]. Not all external forces to the head, neck, or face will result in a TBI. The severity of a TBI can range from "mild," i.e., a brief change in mental status or consciousness to "severe," i.e., an extended period of unconsciousness or amnesia after the head injury [19]. Mild TBIs are more common than moderate and severe TBIs [20]. Health problems stemming from mild TBI usually resolve within hours or days; however, a significant portion of individuals continue to experience residual mental and physical health symptoms [15].

There has been substantial attention to TBI resulting from sports injuries and military service, [21] but scant research on TBI as an IPV after-effect [22–24]. IPV-related TBI can result from such events as being hit in the head or face with fists; having one's head or face pushed against a hard object; violent shaking; or attempted strangulation [24]. Estimates of TBI prevalence in female IPV survivors seeking emergency shelter or care in the emergency department range from 30% to 74% [24]. Unfortunately, many TBIs go undetected and thus untreated by health care providers [23,25], which could contribute to disparities in access to needed TBI treatment such as cognitive and neurological rehabilitation [26] and other mental health care for women. There are likely a number of factors that contribute to under-detection, including women's recovery from symptoms stemming from mild TBI, lack of provider inquiry regarding IPV and associated injuries, and women's reluctance for disclosure (e.g., fear for self or partner's safety). In order to enhance detection of IPV-related TBI among women, it is important to gain greater awareness of the occurrence of TBI among populations who may be most at risk. Given that women veterans are at high risk for IPV [4], they may also be at risk for IPV-related TBI and its attendant mental health consequences [12]. In the only published study examining this issue among women veterans, Iverson and Pogoda [27] found that 19% of female VHA patients experienced probable IPV-related TBI. The researchers only examined IPV-related TBI *history* and it is unknown whether women in their study experienced IPV-related TBI with *current* symptoms. That is, some women in the prior study likely experienced symptom resolution following mild TBI.

Although many individuals experience a full recovery following mild TBI, a significant proportion experience persistent physical and mental health symptoms that could benefit from clinical treatments [15]. Acute and/or chronic symptoms following TBI typically include physical problems (e.g., headaches), cognitive impairments (e.g., memory difficulties), and emotional difficulties (e.g., anxiety) [14,28]. In addition, posttraumatic stress disorder (PTSD) is a common condition among women who experience IPV. [29–32] It is important to consider that there is substantial overlap between PTSD and TBI symptomatology [28,33], especially for DSM-*5* [34] PTSD criterion E (i.e. arousal symptoms) [34]. As such, clinicians may assume that irritability or sleep problems are a manifestation of PTSD stemming from IPV [28]. However, if women with IPV-related TBI report greater symptoms across PTSD criteria, comorbidity may be more likely, and both conditions would warrant consideration. Understanding whether women who experience IPV-related TBI with current symptoms are more likely to meet specific PTSD criteria would have implications for mental health assessment and treatment [35].

The aims of this study were to: 1) identify the occurrence of IPV-related head events and IPV-related TBI history with and without current symptoms in a national sample of women veterans who experienced lifetime IPV; 2) examine the associations among IPV-related TBI with sociodemographic characteristics, IPV-related PTSD diagnosis, and past-year IPV; and 3) determine the associations between IPV-related TBI with current symptoms and likelihood of meeting specific DSM-*5* PTSD symptom criteria.

2. Material and methods

2.1. Sample

Data were drawn from a larger national study of women veterans' preferences for IPV-related counseling conducted between November and December 2014 [32]. Participants completed a 30-min anonymous web-based survey administered by GfK survey research firm. GfK maintains KnowledgePanel®, a probability-based, non-volunteer access survey panel of 55,000 U.S. adults that is representative of approximately 97% of U.S. households [36]. The study included an informed consent fact sheet and was approved by the local institutional review board.

As reported in detail elsewhere [32], all 548 women veterans in the KnowledgePanel® were invited to participate in the survey and 411 women participated (75.0% participation rate). Comparisons between responders and non-responders on demographic characteristics from GfK's roster file revealed that that responders were slightly older

(Cohen's $d = 0.30$) and slightly more likely to identify as White (Cramér's V = 0.22) than non-responders. As reported previously [32], approximately 55% ($n = 225$) of women reported lifetime IPV as measured by the Humiliate/Afraid/Rape/Kick (HARK) tool and stalking items modified from the National Violence Against Women Survey to capture stalking specifically from an intimate partner [37,38]. Among women who experienced lifetime IPV, one woman was missing data on the PTSD symptom measure and was excluded. The current sample therefore comprised 224 women.

2.2. Measures

Probable IPV-related TBI was assessed using a modified version of the VA TBI screening tool [39] (available from authors upon request). The modification was for item 1 of the measure in which we replaced the examples of deployment-related events that may increase risk for TBI with IPV-related heads events. Specifically, women were considered to have experienced an IPV-related head event if they reported experiencing at least 1 of 7 acts by an intimate partner (see Table 1). Consistent with the VA/Department of Defense clinical guidelines [17], women were then considered to meet screening criteria for possible IPV-related TBI history (hereafter referred to as IPV-related TBI history) if they reported that IPV-related head events were associated with loss of consciousness, altered consciousness (i.e., being dazed or confused), posttraumatic amnesia (i.e., not remembering events before or after the injury), concussion, or head injury. Women were then considered to meet criteria for IPV-related TBI with *current* symptoms (hereafter referred to as IPV-related TBI history with current symptoms) if they reported that one or more of the following symptoms began or got worse following the IPV-related head event *and* occurred within the past week: memory problems or lapses; balance problems or dizziness; sensitivity to bright light; irritability; headaches; sleep problems. Consistent with the VA/Department of Defense clinical guidelines [17], women who endorsed 1 or more IPV-related head events items without any TBI-related sequelae were categorized as having no IPV-related TBI history.

Past-year IPV was assessed using the four-item HARK tool [37]. As has been done in prior HARK research [6], we made slight modifications to items to remove emotionally-laden terms (i.e., "rape") and increase examples of emotional mistreatment. The modified HARK is a four-item screening measure of IPV from a partner or ex-partner, assessing emotional IPV, fear, sexual IPV, and physical IPV. Response options are dichotomous (yes/no). The number of positively endorsed items was summed [37]. The HARK has demonstrated high sensitivity and specificity in detecting IPV experiences [37].

We used the PTSD Checklist-5 (PCL-5) [40], a 20-item self-report measure of current DSM-5 PTSD symptoms that are rated on a 5-point scale. For this study items were anchored to IPV experiences by prompting participants to report how much they were bothered by each problem in the past month "*…due to an unsafe or unhealthy intimate relationship that you may have been in at any point in your life*". A cut-off score of 33 was used to determine probable PTSD diagnosis (yes/no) [41]. Cut-offs for the DSM-*5* PTSD criteria including B (Intrusion), C (Avoidance), D (Cognition/Mood) and E (Arousal) were created consistent with DSM-5 guidelines, such that participants met Criterion B or C if they endorsed at least one item, and met Criterion D or E if they endorsed at least 2 items (yes/no). The PCL-5 has demonstrated sound internal consistency ($\alpha = .96$), test–retest reliability ($r = .84$) and convergent and discriminant validity in samples of veterans [41]. The internal consistency in this study was excellent ($\alpha = .97$), with good to excellent internal consistency for DSM-*5* B, C, D, and E symptom (α's = .93, .88, .94, and .92, respectively).

Several sociodemographic items were assessed in the survey.

Table 1
Women who endorsed IPV-related head events and IPV-related TBI with and without current symptoms.

	Total Sample (n = 224)	Endorsed IPV-related Head Event(s) (n = 129)			$\chi 2$	*p*	Cramér's V
		No IPV-related TBI History	IPV-related TBI History Without Current Symptoms	IPV-related TBI History With Current Symptoms			
Endorsed ≥1 IPV-related Head Events	57.9% (n = 129)*	51.2% (n = 66)	27.1% (n = 35)	21.7% (n = 28)	–	–	–
Has a past or current intimate partner (for example, boyfriend, girlfriend, husband or wife) ever done any of the following to you?							
Hit you in the head with an object, hand or fist	35.3% (n = 79)	45.5%[a] (n = 30)	82.9%[b] (n = 29)	71.4%[ab] (n = 20)	**15.04**	**.001**	**.341**
Pushed or shoved your head into a wall, car, furniture, or other object	33.0% (n = 74)	45.5%[a] (n = 30)	65.7%[ab] (n = 23)	75.0%[b] (n = 21)	**8.39**	**.015**	**.255**
Broken your teeth or jaw	3.6% (n = 8)	3.0% (n = 2)	5.7% (n = 2)	14.3% (n = 4)	4.30	.116	.183
Caused eye or ear injuries	10.7% (n = 24)	10.6%[a] (n = 7)	22.9%[ab] (n = 8)	32.1%[b] (n = 9)	**6.60**	**.037**	**.226**
Shook you	28.6% (n = 64)	48.5% (n = 32)	48.6% (n = 17)	53.6% (n = 15)	0.22	.894	.042
Strangled/choked you	25.0% (n = 56)	30.3%[a] (n = 20)	54.3%[ab] (n = 19)	60.7%[b] (n = 17)	**9.71**	**.008**	**.274**
Threw you down the stairs	5.4% (n = 12)	3.0%[a] (n = 2)	11.4%[ab] (n = 4)	21.4%[b] (n = 6)	**8.15**	**.017**	**.251**
Caused other injury to your head, neck, or face	11.6% (n = 26)	7.6%[a] (n = 5)	25.7%[b] (n = 9)	42.9%[b] (n = 12)	**16.13**	**<.001**	**.354**

*n = 95 women who did not endorse experiencing any IPV-related head events. [ab]Superscripts that differ in each row represent significant group differences at $p < .05$.

2.3. Data analysis

Descriptive statistics were computed for IPV-related head events, IPV-related TBI history with and without current symptoms, sociodemographic variables, past-year IPV, and probable PTSD diagnosis. ANOVA and chi-square analyses (with Bonferroni corrections) were performed to examine differences in these variables among the three groups (i.e. those with no IPV-related TBI history, IPV-related TBI history without current symptoms, and IPV-related TBI with current symptoms). Effect size values are presented for these associations (Cohen's *f* for continuous and Cramér's V for categorical variables). For variables in which homogeneity of variance was violated, Brown–Forsythe robust test results are presented. Hierarchical logistic regression examined the impact of group differences in IPV-related TBI status on PTSD diagnosis when controlling for variables significantly associated with IPV-related TBI status. The contribution of IPV-related TBI status to the model was assessed via the significance of the change in the *F* value and the change in R^2, as well as the effect sizes for these variables (odds ratios [ORs] and 95% confidence intervals [CIs]). Chi-square tests assessed group differences in *DSM-5* PTSD symptom criteria across the three IPV-related TBI groups. Analyses were performed with SPSS, Version 22 [42].

3. Results

3.1. IPV-related head events and IPV-related TBI status

Overall, approximately 28% (n = 63) of the 224 women in this sample screened positive for IPV-related TBI. Table 1 presents the percentages of women who reported IPV-related head events, and for those who met screening criteria for IPV-related TBI history with and without current symptoms. Approximately 58% (n = 129) of women reported one or more IPV-related head events. Among women who experienced IPV-related head events, 51.2% did not report probable TBI symptoms, 27.1% reported IPV-related TBI history without current symptoms, and 21.7% reported IPV-related TBI history with current symptoms. Among these three groups, there were some significant differences in the types of IPV-related head events experienced (Table 1). In general, the pattern was such that compared to women with IPV-related TBI history with current symptoms, a lower rate of women with no probable TBI history reported IPV-related head events. Those who experienced IPV-related TBI history without current symptoms were intermediate to, and not significantly different from, either group.

From these results, three separate groups were created, those with: [1] IPV-related TBI history with current symptoms (n = 28), [2] IPV-related TBI history without current symptoms (n = 35), and [3] no history of IPV-related TBI (either no IPV-related head events or IPV-related head events with no TBI history; n = 161). These three groups were the focus of subsequent analyses.

3.2. Sociodemographic, PTSD diagnosis, and past-year IPV characteristics by IPV-related TBI status

Table 2 depicts sociodemographic characteristics, PTSD diagnosis, and sum of past-year IPV by IPV-related TBI status. There were a few sociodemographic differences among groups. Those with IPV-related TBI history with current symptoms were more likely to be non-White and more likely to report incomes of less than $25,000/year than were women with no IPV-related TBI history. Women with IPV-related TBI history without current symptoms did not differ sociodemographically from either group. The majority of those with IPV-related TBI history with current symptoms met screening criteria for PTSD (64%), representing a significantly greater percentage than those with IPV-related TBI history without current symptoms (29%) or no IPV-related TBI history (17%). Those with IPV-related TBI history with current symptoms also experienced more past-year IPV forms than did those with no IPV-related TBI history. These results held across each form of IPV, with medium effect sizes observed. Those with IPV-related TBI history without current symptoms did not differ significantly from the other groups on number of past-year IPV types experienced; the exception was for past-year sexual IPV, in which they reported significantly more types than those with no IPV-related TBI history.

3.3. Associations between IPV-related TBI and PTSD

Table 3 displays findings from a hierarchical logistic regression that examined the association between IPV-related TBI status and current PTSD status, when controlling for race, income, and sum of past-year IPV types. The full model (Table 3, Step 2) explained 22.4% of the variance in PTSD diagnosis, with IPV-related TBI status accounting for 7.7% of the variance. Women with IPV-related TBI history with current symptoms had a greater likelihood of having PTSD than did those with no IPV-related TBI history (OR =5.86; 95% CI = 2.22–15.48), controlling for race, income, and past-year IPV. Those with an IPV-related TBI history without current symptoms did not differ in the likelihood of having PTSD relative to women with no IPV-related TBI history.

3.4. Associations between IPV-related TBI status and PTSD symptom criteria

Table 4 presents findings from chi-square tests that assessed group differences in DSM-*5* PTSD symptom criteria across the three groups. Women with IPV-related TBI history with current symptoms were significantly more likely to meet each of the four PTSD symptom criteria than were those with IPV-related TBI history without current symptoms and women with no IPV-related TBI history. Medium effect sizes were observed for each symptom criterion, with Cramér's V ranging from .34 for intrusion symptoms to .42 for arousal symptoms.

Table 2
Sociodemographic, PTSD, and past-year IPV characteristics by IPV-related TBI status.

	IPV-related TBI With Current Symptoms (n = 28)	IPV-related TBI Without Current Symptoms (n = 35)	No IPV-related TBI History (n = 161)	$\chi 2$	p	Cohen's f/ Cramér's V
Age (M, SD)	45.29 (13.78)	51.69 (13.40)	50.38 (13.20)	2.10	.125	.019
Race (%)				**7.97**	**.019**	**.189**
Non-White	57.1%[a] (n = 16)	45.7%[a,b] (n = 16)	31.7%[b] (n = 51)			
Education (%)				1.66	.436	.086
College graduate or more	35.7% (n = 10)	37.1% (n = 13)	46.0% (n = 74)			
Income (%)				**16.01**	**<.001**	**.267**
Less than $25,000	39.3%[a] (n = 11)	22.9%[a,b] (n = 8)	10.6%[b] (n = 17)			
Marital Status (%)				1.36	.506	.078
Married/Partnered	50.0% (n = 14)	45.7% (n = 16)	55.9% (n = 90)			
Military Branch				3.97	.410	.134
Army	50.0% (n = 14)	48.5% (n = 16)	42.5% (n = 68)			
Navy	14.3% (n = 4)	30.3% (n = 10)	21.9% (n = 35)			
Air Force/Marines/Coast Guard	35.7% (n = 10)	21.2% (n = 7)	35.6% (n = 57)			
Probable PTSD Diagnosis (PCL-*5* ≥ 33)				**29.20**	**<.001**	**.363**
Yes	64.3%[a] (n = 18)	29.4%[b] (n = 10)	16.9%[b] (n = 27)			
# Past Year IPV Forms (0–4) (M, SD)[c]	2.32[a] (1.44)	1.57[ab] (1.63)	0.95[b] (1.19)	**11.20**	**<.001**	**.118**
Emotional Mistreatment				**13.93**	**.001**	**.249**
Yes	75.0%[a] (n = 21)	45.7%[a,b] (n = 16)	37.3%[b] (n = 60)			
Afraid				**12.95**	**.002**	**.241**
Yes	57.1%[a] (n = 16)	42.9%[a,b] (n = 15)	25.6%[b] (n = 41)			
Physical				**16.97**	**<.001**	**.275**
Yes	53.6%[a] (n = 15)	37.1%[a,b] (n = 13)	19.3%[b] (n = 31)			
Sexual				**19.88**	**<.001**	**.298**
Yes	46.4%[a] (n = 13)	31.4%[a] (n = 11)	13.0%[b] (n = 21)			

[a,b]Superscripts that differ in each row represent significant group differences at $p < .05$; [c] Levene's test for homogeneity of variances was significant, with Brown-Forsythe robust test results presented.

4. Discussion

This study identified the occurrence of self-reported IPV-related TBI and associated PTSD symptoms among a national sample of women veterans who had experienced lifetime IPV. More than 1 in 4 women (28%) in this study met screening criteria for IPV-related TBI history, with 1 in 8 women (12.5%) reporting IPV-related TBI history with current symptoms. These findings replicate prior research [27] documenting a high rate of IPV-related TBI history among female VHA patients and extend this research by demonstrating that a significant proportion of women veterans continue to experience symptoms following an IPV-related TBI.

Women who experienced IPV-related TBI with current symptoms had a high likelihood of meeting screening criteria for IPV-related PTSD. Overall, these findings are consistent with research demonstrating strong associations between deployment-related TBI and PTSD among samples of service members and veterans [43,44]. Iverson et al. found that 60% of women veterans with deployment-related TBI had a diagnosis of PTSD in their VHA medical records [45].

Table 3
Associations between IPV-related TBI status and IPV-related PTSD diagnosis status, controlling for race, income, and sum of past-year IPV types (0–4) (n = 222).

Variable	*B (SE)*	*Wald*	*df*	*p*	*OR (95% CI)*
Step 1	χ^2 [3] = 23.20, $p < .001$, Nagelkerke $R^2 = .147$				
Race[a]	−0.16 (0.36)	0.20	1	.654	0.85 [0.43–1.71]
Income[b]	−0.66 (0.43)	2.39	1	.122	0.52 [0.23–1.19]
Sum of PY IPV Types	0.49 (0.12)	17.62	1	<.001	1.63 [1.30–2.04]
Step 2	$\Delta\chi^2$ [2] = 13.10, $p = .001$ $\Delta R^2 = .077$				
Race	−0.32 (0.38)	0.71	1	.400	0.73 [0.35–1.53]
Income	−0.35 (0.47)	0.55	1	.459	0.71 [0.28–1.77]
Sum of PY IPV Types	0.37 (0.12)	9.25	1	.002	1.46 [1.14–1.86]
IPV-related TBI Status[c]		12.73	2	.002	
Probable TBI History	0.47 (0.46)	1.03	1	.310	1.60 [0.65–3.96]
Probable Current TBI	1.77 (0.50)	12.73	1	<.001	5.86 [2.22–15.48]

PY = Past-Year.
[a] Reference: White.
[b] Reference: Less than $25,000/year.
[c] Reference: No IPV-related TBI History.

Table 4
Differences in IPV-related PTSD symptom clusters by IPV-related TBI status.

Meets DSM-5 Criterion:	IPV-related TBI With Current Symptoms (n = 28)	IPV-related TBI Without Current Symptoms (n = 35)	No IPV-related TBI History (n = 161)	$\chi 2$	p	Cramér's V
B: Intrusion	78.6%[a] (n = 22)	37.1%[b] (n = 13)	29.2%[b] (n = 47)	**25.07**	**<.001**	**.335**
C: Avoidance	82.1%[a] (n = 23)	40.0%[b] (n = 14)	29.8%[b] (n = 48)	**27.81**	**<.001**	**.352**
D: Cognition/Mood	85.7%[a] (n = 24)	31.4%[b] (n = 11)	32.9%[b] (n = 53)	**28.95**	**<.001**	**.359**
E: Arousal	89.3%[a] (n = 25)	34.3%[b] (n = 12)	28.0%[b] (n = 45)	**38.76**	**<.001**	**.416**

[a,b]Superscripts that differ in each row represent significant group differences at $p < .05$.

In this study, approximately two-thirds of women with IPV-related TBI history with current symptoms experienced probable PTSD compared to 29% of those with IPV-related TBI history without current symptoms, and 17% of those with no IPV-related TBI. Even when adjusting for race, income, and past-year IPV, women with IPV-related TBI with current symptoms were 5.9 times more likely to meet screening criteria for IPV-related PTSD than were women with no IPV-related TBI history. This suggests that current PTSD is a significant issue for women experiencing IPV-related TBI with current symptoms. These findings are particularly informative given that all the women in this sample experienced one or more forms of IPV during their lifetime, and therefore suggest that having endured an IPV-related TBI and experiencing current symptoms contributes to a particularly complex presentation marked by both TBI and PTSD symptomatology. Clinical attention to both conditions is important in these cases, as their treatment modalities differ (i.e., cognitive rehabilitation for TBI, cognitive-behavioral therapy for PTSD) and may need to be integrated or delivered sequentially to help women achieve maximal clinical benefits.

Moreover, women with IPV-related TBI with current symptoms were more likely than the other groups to meet all four of the DSM-5 PTSD symptom clusters (i.e., intrusion, avoidance, negative alterations in cognition/mood, and alterations in reactivity/arousal). That the effect sizes for the differences among groups were medium further suggests that IPV-related TBI is contributing in a clinically significant manner to women's current health needs. If current symptoms were merely a reflection of the overlap among TBI and PTSD symptoms, we would have expected to see differences mainly in the arousal and intrusion clusters. Although not examined in this study, reports of somatosensory (e.g., pain and nausea) and vestibular (e.g., balance and coordination) symptoms may also be indicative of TBI-related distress [46] and assessment of these factors may assist clinicians with diagnoses and treatment planning.

A somewhat unexpected finding was the high proportions of women who endorsed various IPV-related head events. For example, 1 in 3 women in this study reported that a partner pushed or shoved their head into an object such as a wall, car, or furniture. In addition, 1 in 4 women in this sample reported being strangled, a form of violence that increases risk for intimate partner homicide [47,48]. Such events were particularly associated with IPV-related TBI history. These data provide evidence that such severe forms of physical aggression are all-too-common experiences among women veterans who report IPV and contribute to their mental and physical health needs.

Taken together, the findings highlighting the high rates of IPV-related TBI history with current symptoms along with the robust associations between IPV-related TBI and current PTSD suggest that clinicians should engage in careful screening and assessment for both TBI and PTSD symptoms among women who experience lifetime IPV. When IPV is detected, in addition to offering education, information, and safety planning [32,49], it may be clinically indicated to screen for IPV-related TBI, make referrals for more comprehensive evaluations of TBI, and measure the impact of TBI on women's current functioning. It is important to identify and treat PTSD among women who experience IPV as reductions in such symptoms not only can ameliorate distress but also may reduce risk for future IPV [50,51]. In the case of PTSD with co-occurring TBI, mental health clinicians may choose to first treat PTSD symptoms while monitoring the effects of the treatment on a broad array of health symptoms that are relevant to TBI using measures such as the Neurobehavioral Symptom Inventory [46]. Clinicians can then tailor their treatment and referrals to address remaining symptoms. Interventions to address TBI symptoms may include psychoeducation, cognitive remediation, neurological rehabilitation, and physical therapy.

This study was comprised of a general sample of women veterans who experienced lifetime IPV. Although the sample is similar to other representative samples of U.S. women veterans in terms of several demographic characteristics (e.g., age) [52,53], non-response bias based on unmeasured factors may still impact this study. As such, findings may not generalize to all women veterans. In addition, the sample was modest in size, resulting in some large confidence intervals for significant effects; replication among larger samples is needed. Moreover, findings should be replicated in samples of women in the community who experience IPV. Future studies should examine a range of physical and mental health needs to better inform clinical practice. In particular, such work should include a focus on depressive symptoms as this type of distress is common among women who experience IPV [30] and some depressive symptoms overlap with those of PTSD and TBI [28,33].

The reliance on cross-sectional data and self-report screening measures are additional limitations. The psychometric properties of the IPV-related TBI screener have not been evaluated. The screener is a modified version of the one

used by the VHA to screen patients for deployment-related TBI. It should be noted that the evidence regarding the psychometric properties of the original tool is somewhat mixed, especially in the context of PTSD. Notwithstanding, the measure used in this study is highly consistent with recent IPV-related TBI screening recommendations [26]. Given that women with current IPV-related TBI reported more past-year IPV, it is possible that women were in current relationships with the perpetrator of the TBI. Such information would be particularly important to assess in the context of clinical care. This study used a self-report measure of PTSD symptoms and therefore PTSD diagnosis is considered "probable"; however, the PTSD Checklist-5 [40] has high agreement with PTSD diagnoses determined by clinical interview [41]. Future research should also examine contextual variables, including the timing and number of IPV-related TBIs endured and healthcare utilization using longitudinal designs in order to advance this line of inquiry. It is important to remember that IPV is often chronic and can result in multiple TBIs [25], which can have a cumulative impact on health and functioning [24]. This may explain the strong associations observed in this study between IPV-related TBI history with current symptoms and current IPV-related PTSD symptoms. Moreover, women veterans can experience TBIs during their military service from a wide array of etiologies, including combat and blast exposure, training exercises, and motor vehicle accidents [54]. Future research should measure these additional potential forms of TBI as well as their relative contributions to women veterans' health. Similarly, this study focused specifically on IPV-related PTSD symptoms. Future work should account for symptoms stemming from other common traumas, such as combat and military sexual trauma.

IPV is a major cause of psychiatric distress and suffering. Findings demonstrate high rates of IPV-related TBI among a national sample of women veterans. Women who experience IPV-related TBI with current symptoms are particularly likely to experience probable PTSD and various forms of past-year IPV, making them an important population for interventions to promote recovery from the often invisible physical and mental injuries that are common consequences of IPV. It is hoped that the current findings will inform screening, assessment, and treatment for women who experience IPV by increasing clinician awareness and encouraging further research and clinical inquiry into this important yet understudied topic.

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